Rand 1976-77

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. . . a nonprofit corporation formed to further and promote scientific, educational, and charitable purposes, all for the public welfare and security of the United States of America.

—Articles of Incorporation

Foreword

This annual report covers the fiscal year ending October 2, 1977. It contains excerpts from a sampling of Rand research publications issued during the year, to demonstrate by example what Rand does. These excerpts are supplemented by a listing of research areas in which we are active and of reports and books published during the year.

Our purpose at Rand is to do what we can to help advance the national security and the general welfare. We believe that the world would be a better one if, among other things, the rational element in policy choices were somewhat stronger. We try to nourish that element through a number of research activities known collectively as "policy analysis."

Focused on problems of choice in the public sector, policy analysis aims at assuring that the problem is understood, that the right questions are asked, that relevant and reliable data are available (or acquired), that all appropriate choices are recognized and included in the analysis, that the consequences of alternative courses of action are foreseen as far as possible, and that the degree of our ignorance about an uncertain future is spelled out clearly. The consequences of alternative choices include the likely costs, in dollars and in other impacts on society, the benefits, and the distribution of both costs and benefits—who pays which costs, who gets which benefits.

Policy analysis seeks to improve the basis on which policymakers, including the public, can exercise their judgment—can make, that is, a more informed judgment. This means that the assumptions of analysis and the criteria of evaluation are stated explicitly and clearly. It means that the results of analysis are communicated in such a way that the role of assumptions and value preferences are made clear and that policymakers are enabled to assign their own values and use their own judgment in weighing outcomes.

The crucial point is that policy analysis should be carried out so clearly, so openly, so explicitly that the reader of the analyst's report

can retrace the analysis. That is, the analysis must make apparent the connections between knowledge and conclusion and between theory and conclusion. This enables the decisionmaker to understand the analysis and to re-create it on the basis of his own assumptions, knowledge, and values.

At the same time, the public should have access to this information, using it not only to judge the wisdom of decisions made in its behalf, but also to distinguish the *reasoning* from the *reasons* underlying those decisions. So informed, the public is better able to separate the rhetoric from reality in the policymaking process. Such issues, then, as "the crime problem," "the urban crisis," or "the energy problem" that cast long shadows over our society are understood to be not problem statements but rhetorical representations at a level of aggregation so high as to confound public official and policy analyst alike. As agents of the public interest, officials and the analysts who aid them must be required to define the elements of such agglomerates and to deal with them systematically to the extent that human talents and techniques will allow. We hope that the excerpts contained in Part 1 of this volume will illustrate Rand's role in that process.

* * *

For the second consecutive year, Rand's total effort was about evenly divided between national security and domestic programs. Revenues from contracts and grants totaled $34.4 million, which supported 532 professional-years of effort devoted directly to research. An additional $8.8 million was subcontracted to other organizations for support of Rand projects. Estimated revenues for the coming year are $36.4 million, plus $7.0 million of subcontracts. Project AIR FORCE, Rand's research contract with the U.S. Air Force, continues to be our largest single contract, amounting to $10 million in the past fiscal year and projected at $9.5 million for the coming year.

A number of changes in program and organization were set in motion this year. Their purpose is to strengthen research capabilities in certain discipline and program areas, increase opportunities for the application of research talent, and provide a better basis for long-range research planning. Both dimensions of our matrix

organization were affected: research departments, which hire, house, and develop staff according to professional specialty, and research programs, where most of the sponsored research is managed, with staff drawn from the departments to get the research done.

We have merged two departments, Engineering Sciences and Physical Sciences, to form the Engineering and Applied Sciences Department. This change sets the stage for a renewed and broadened emphasis on advanced technology, in such fields as fluid dynamics, structures, materials, communications, optics, and radar.

The National Security Research Division manages our work on national defense issues for sponsors other than the Air Force. Research in that division has been restructured under six programs: Applied Science and Technology; Manpower, Mobilization, and Readiness; Information Processing Systems; Ground Warfare; Strategic Assessment; and International Security Policy. Sponsors of research in this division include agencies within and outside the Department of Defense. (See the list of research sponsors in Part 5 of this volume.)

The Project AIR FORCE Division will also operate with a new program structure in the coming year: Technology Applications; Strategic Systems; Theater Conflict; Operations and Readiness Improvements; Manpower, Personnel, and Training; and Systems Acquisition Management.

The basic structure of the Domestic Programs Division remains unchanged, with major programs ongoing in Criminal Justice, Education and Human Resources, Energy Policy, Health Sciences, Housing, Labor and Population, and Urban Policy. One program, Communications Policy, having fulfilled its substantive objectives, has been phased out. About a third of the division's work continues to be focused on two long-term social experiments, in which new policies in health care and housing are being pretested experimentally using representative populations in representative locales. Another long-term study effort, begun last year for the Energy Research and Development Administration, supports policy formulation in the new Department of Energy.

The results of Rand research are conveyed to our sponsors and the research community in formal reports, papers, briefings and seminars,

and articles in professional journals. Most of our publications are made available also to the general public, through government documentation centers, direct-mail purchases at nominal cost, and depository collections in some 350 university, public, and research libraries worldwide. This year we augmented that reporting with *Rand Research Review,* a selective digest of current Rand research. Written for the general reader, the *Review* is issued three times yearly (spring, summer, fall), and is available from Rand on request. Also published this year, and likewise available, is a comprehensive survey of the work of Rand's Domestic Programs Division, entitled *Domestic Research at Rand.*

The Rand Graduate Institute and Duke University's Institute of Policy Sciences and Public Affairs received two joint grants this year: one for $250,000 from the Alfred P. Sloan Foundation to be used to support development of case materials in technology and public policy for graduate courses in public policy analysis, and another for $100,000 from The Ford Foundation for developing materials relating to defense and arms control. These grants supplement an earlier one for curricular development in the amount of $150,000, awarded the two institutions by The Ford Foundation. The Rand Graduate Institute is now in its eighth year. It has 42 graduate fellows in its program. Accredited by the Western Association of Schools and Colleges, the Institute provides a combination of practical research experience and advanced graduate training leading to a doctoral degree in policy analysis.

The past year brought a major change in corporate management. Stephen J. Lukasik has succeeded John P. White as Senior Vice President for National Security Programs. Dr. White left Rand at midyear to become Assistant Secretary of Defense for Manpower, Reserve Affairs, and Logistics. Dr. Lukasik, a physicist and former vice president of Xerox Corporation, was director of the Defense Advanced Research Projects Agency from 1971 through 1974.

We are pleased to report that William T. Coleman, Jr., and Edwin E. Huddleson, Jr., have rejoined Rand's Board of Trustees. Mr. Coleman had resigned from the Board in 1975 to become U.S. Secretary of Transportation. Mr. Huddleson had completed his previous term as Trustee in the spring of 1976. These elections offset two departures

from the Board in 1977: Thomas P. Pike and John White, whose counsel and support we shall miss. Finally, we take pleasure in welcoming to our membership a new Trustee, former Secretary of Defense Donald H. Rumsfeld.

J. Paul Austin
Chairman of the Board

Donald B. Rice
President

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Sampler 1

Excerpts from Rand publications that suggest the scope and character of current work . . .

DEFENSE WITHOUT THE DRAFT

For the approximately 2 million young American males who come of military age each year, there is probably no single public policy decision in the past 25 years more important than the termination of the draft in 1973. The importance of this decision, however, goes far beyond the implications for those most immediately affected by the draft's removal. Whether viewed as an instrument of economic and social policy or in terms of its effects on the maintenance of the U.S. defense effort, the draft was a key element of public policy and touched on nearly every aspect of defense management.

The advent of the All-Volunteer Force (AVF) accordingly marks the beginning of one of the largest and most important experiments of its type ever conducted. Never before in modern history has a nation with such global military responsibilities or such an emphasis on defense been without the authority to conscript young men into military service.

Together with the skyrocketing manpower costs and tight defense budgets that have characterized the 1970s, the removal of the draft has served to make military manpower one of the key concerns in the Pentagon and on Capitol Hill.

Despite its importance as a public policy issue, remarkably little has been published about the AVF and its implications for defense and nondefense national objectives. This report therefore offers the first comprehensive analysis of the AVF, including the factors that led to the removal of the draft, the experience from the first few years without conscription, and the longer-run prospects for the volunteer force.

Two themes underlie this analysis. The first concerns the narrower effects of the draft's removal on the maintenance of a viable national defense, while the second concerns some of the broader social implications of the method of manpower procurement. . . . [We come to four basic conclusions:]

1. *The time was right for the AVF.* . . . [The] volunteer force offered one of the very few viable alternatives to the growing inequities created by the selective service draft . . .

[in that] smaller and smaller proportions of military-age youth would have to bear the burdens of the draft.

2. *The volunteer force has worked.* In spite of initial management difficulties, the military services have succeeded in attracting a socially representative mix of the desired numbers and types of personnel without the pressure of the draft and at a cost substantially less than generally assumed.
3. *The removal of the draft has raised genuine questions about the ways in which the DOD uses and manages its human resources.* The legacy of the draft means that fundamental changes in manpower management and utilization are needed, not only to ensure the long-run success of the volunteer force, but more important, to halt spiraling manpower costs and make better use of defense resources.
4. *There has been a failure, not with the volunteer force, but rather with the AVF policy debate.* Whether due to misinformation, a lack of information, or a misunderstanding about the basic issues, the AVF debate has not come to grips with the important policy issues of the 1970s and 1980s. . . .

The removal of the draft presents an opportunity to make better use of defense resources—an opportunity that was not always present under or encouraged by the draft. The importance of this point is dramatically underlined by the fact that the relatively modest changes that have been suggested here could yield long-run cost savings of from $5 to $10 billion per year.

To summarize, the AVF can be made to fail. But it can also be made to work—and perhaps much better than its draft-dependent predecessor. Whether or not the potential of the AVF is realized will depend critically on the policies that the DOD and the Congress adopt during the next ten years, for the true test will occur in the 1980s. If this potential is not realized, society may not be willing to pay the escalating costs emanating from the current approach and, as a consequence, may simply cut forces.

Richard V. L. Cooper, Military Manpower and the All-Volunteer Force, *Rand Report R-1450-ARPA, September 1977.*

THE CRIMINAL INVESTIGATION PROCESS

This book provides an in-depth look at the criminal investigation process, an aspect of police work that is of increasing public concern given the rapidly rising crime rate. . . . When this study began, very little was known about the pattern of investigative activities followed across police departments, or the effect of these activities on solving crimes. Because reported crime and arrest data do not distinguish between the results of patrol activity and those of investigative efforts, little was known about investigative outputs. Also, the nature of investigative activity was thought to have changed as a result of court decisions severely limiting the interrogation of suspects and warrantless searches. These changes have created a demand for more objective or scientific investigation techniques that do not infringe on the constitutionally protected rights of suspects. These were the factors that led us to undertake the research reported here. . . .

[The study's] objectives were

- To describe, on a national scale, current investigative organization and practices.
- To assess the contribution that police investigation makes to the achievement of criminal justice goals.
- To ascertain the effectiveness of new technology and systems being adopted to enhance investigative performance.
- To reveal how investigative effectiveness is related to differences in organizational form, staffing, procedures, etc. . . .

[Our findings include the following:]

Department-wide arrest and clearance rates are unreliable measures of the effectiveness of investigative operations. The vast majority of clearances are produced by activities of patrol officers, by the availability of identification of the perpetrator at the scene of the crime, or by routine police procedures. . . .

Although serious crimes are invariably investigated, many reported felonies receive no more than superficial attention from investigators. Most minor crimes are not investigated. . . . [For] homicides, rape,

other felony sex crimes, kidnapping, aggravated assault, robbery, burglary, auto theft, and larceny *together*, 64.8 percent did not receive as much as a half-hour's attention from an investigator. . . .

An investigator's time spent on casework is preponderantly consumed in reviewing reports, documenting files, and attempting to locate and interview victims. For cases that are solved (i.e., a suspect has been identified), an investigator's average time in post-clearance processing is longer than the time spent in identifying the perpetrator. A substantial fraction of time is spent on noncasework activities. . . . [Investigators] spend about 93 percent of their time on activities that do not lead directly to solving previously reported crimes. . . . The time they spend on cases after they have been cleared serves the important purpose of preparing cases for court. . . . The time they spend on noncasework activities serves a general support function for casework activities and therefore may be useful in ways that are difficult to quantify. The time they spend on crimes that are never solved can only be judged in terms of its public relations value and a possible deterrent value, because most of these crimes can be easily recognized at the start. . . .

Many police departments collect more physical evidence than can be productively processed. Allocating more resources to increasing the processing capabilities of the department is likely to lead to more identifications than some other investigative actions. . . .

In many large departments, investigators do not consistently and thoroughly document the key evidentiary facts that reasonably assure that the prosecutor can obtain a conviction on the most serious applicable charges. . . .

Our study does not in any way suggest that total police resources should be reduced. . . . If, after appropriate test and evaluation, the suggestions we have made for improving the investigative function prove to be effective, the ultimate implication of our work would be a substantial shift of police resources from investigative units to other units.

Peter W. Greenwood, Jan M. Chaiken, and Joan Petersilia, with contributions from Linda Prusoff, Robert Castro, Konrad Kellen, and Sorrel Wildhorn, The Criminal Investigation Process, *D. C. Heath and Company, Lexington, Mass., 1977, a Rand book.*

AIR FORCE ENERGY PROBLEMS

The "energy issue" has assumed a prominent position in both short- and long-term Air Force planning. Uncertainties in the future availability and economics of crude-oil-based jet fuels pose a particular challenge to the Air Force, the largest DOD consumer of jet fuel. . . .

As a consequence, the Air Force will need to consider ways to reduce its consumption of crude-oil-based jet fuels in existing and in new equipment and might possibly have to develop propulsion systems capable of operating on jet fuels derived from energy resource alternatives to crude oil. . . .

[The] overall objective of this report is to identify and assess the possible benefits of R&D programs that might provide (1) a short-term reduction in Air Force jet fuel consumption through selected aerodynamic and propulsion modifications to the existing fleet . . . and (2) a long-term option to use noncrude-oil-based jet fuel in future aircraft. . . .

Most Air Force airplanes have engines developed in the late 1950s and early 1960s. Retrofit of newer, more efficient engines could result in a 20 to 30 percent reduction in fuel consumption, which would more than offset the energy required to manufacture and install the engines.

However, the reductions in expenditures for jet fuel would not be sufficient to recover the costs of the retrofit because of three major factors: (1) the high procurement costs for the new engines; (2) the low level of peacetime flying hours for military aircraft; and (3) the advanced age of the average aircraft by the time the retrofit program was completed (average fleet ages would be about 15 years or more). . . .

[Modest] aerodynamic changes . . . have been proposed for some transport-class Air Force aircraft—the C-141 and the C-130—to reduce drag and hence reduce fuel consumption. Analysis of [these options] indicates that . . . [prospects] for reducing energy use by modifying aerodynamic characteristics and offsetting the modification costs through savings in jet fuel expenditures do not appear to be

particularly attractive for aircraft currently in the fleet (with the possible exception of a C-141 modification). Nevertheless . . . the option may be viable for future aircraft if modifications are accomplished early enough in the aircraft life cycle to allow cost recovery. . . .

The Air Force . . . must be acutely attuned today to the possibility that in the future it may have to resort to an alternative fuel that may require either the modification of existing engine hardware or even the introduction of a new generation of aircraft engines. . . .

Analysis of the alternative fuels option indicates that . . . [a] synthetic jet fuel, or synthetic JP, similar to conventional hydrocarbon jet fuels in use today, is the most attractive military fuel form derivable from U.S. oil shale or coal resources, given the energy conversion technology that is expected to be available in the future.

An analysis of the cost and energy efficiency of the production and distribution of jet fuels from coal revealed that a synthetic JP fuel would require lower energy expenditures and would result in a less costly fuel product than the other two major alternatives—the cryogenic fuels liquid hydrogen and liquid methane.

Synthetic JP also has the advantage of being far more similar to jet fuels in use today than the two cryogenic alternatives, which should ease transitional problems for military users and promote its assimilation into a domestic fuels market now dominated by crude-oil-based fuels. . . .

Significant R&D is needed to develop the synthetic jet fuel option for the future . . . to assure a suitable fuel product for military use. . . . The R&D should focus on developing a full understanding of the physical, chemical, and economic influences of synthetic jet fuels on refinery operations and on military jet engines . . . [to] reveal the proper technology balance between emphasis on energy conversion (e.g., the refinery) and on energy use (e.g., the military jet engine).

J. R. Gebman and W. L. Stanley, with J. P. Weyant and W. T. Mikolowsky, The Potential Role of Technological Modifications and Alternative Fuels in Alleviating Air Force Energy Problems, *Rand Report R-1829-PR, December 1976.*

THE COMPUTER SIMULATION OF LEUKEMIA THERAPY

Rand . . . is seeking to improve the biological precision of chemotherapy in the treatment of cancer, leukemia, and the lymphomas. The rationale is that mathematical models and computer simulations based on the biology of disease and its treatment can assist in the development of a clinically useful predictive approach to chemotherapy. They can also be used to organize, in a useful way, the burgeoning quantities of data arising from new assays, new diagnostic procedures, new technology, and new protocols. . . .

The chemotherapy of cancer and leukemia in laboratory test animals is known to be sensitive to details of the treatment plan. Both humans and laboratory test animals have been shown to exhibit such sensitivity, but only in the case of animal tumors have investigators been able to take advantage of this sensitivity to achieve extremely long-lasting remissions or cures.

Such factors as drug composition and structure; drug dosage and schedule; the manner in which the drug is administered (i.e., oral versus intravenous . . .); type, sensitivity, and resistance of malignant and normal cells; and the status of the immune system all contribute to the balance between undertreatment (dominated by the toxic effect of disease) and overtreatment (dominated by the toxic effect of treatment on normal tissue function).

Ideally, treatment decisions should, and in a few cases already have started to, reflect the importance of these factors for an individual patient. Currently, the effect of only some factors on treatment outcome is quantifiable. As a means of extending this quantification to the treatment of acute leukemia, we have been exploring the feasibility of developing a leukemia-therapy simulator.

This report describes our progress in the development of such a computer-based simulator for the treatment of a commonly studied animal leukemia. The extension to the human clinical situation is much more complex, but the present study helps to point out those critical factors for individual patients that must be measured and quantified before a realistic attempt at a comprehensive predictive simulation of the therapy of human leukemia can be attempted. . . .

Different animals, organs, and cell types have highly specific physical and biochemical properties that alter their response to therapy. One aspect of these differences, the growth characteristics of cells both untreated and treated, is the theme of cell kinetics. Another aspect, the altered disposition and time history in critical body organs of the active forms of a drug, constitutes the subject of pharmacology and pharmacokinetics. A third aspect involves interactions among intracellular pharmacology and cell growth and kinetics, at the ultimate site of action. And a fourth aspect of this range of biological variability, less completely understood and much less quantifiable at present, involves the interplay among the immune system, the host, tumor growth, and the treatment plan. . . .

Our approach is a modular one: Individual computer-based mathematical models of cell growth, drug distribution, intracellular biochemistry, and cellular lethality are developed and individually tested based on relevant biological measurement and similitude. Once the component models have been verified, they are then integrated into a comprehensive model of treatment. In this way, measurements and data obtained from *in vitro, in vivo,* and even clinical tests have been organized to define quantitative interactions and to enhance predictability.

This report describes an integrated mathematical computer-based model of the pharmacokinetics, intracellular enzyme kinetics, and cell kinetics of the treatment of L-1210 mouse leukemia by cytosine arabinoside (ara-C). . . .

This integrative approach poses the following questions: Do we understand these components well enough to model them individually? And do we understand them well enough to integrate them?

At present, we would answer these questions with a cautious yes.

T. L. Lincoln, P. F. Morrison, J. Aroesty, and G. M. Carter, The Computer Simulation of Leukemia Therapy: Combined Pharmacokinetics, Intracellular Enzyme Kinetics, and Cell Kinetics of the Treatment of L1210 Leukemia by Ara-C, *Rand Report R-2001-HEW, December 1976.*

BASIC LIMITS IN MAKING MICROCIRCUITS

Today's microcircuit fabrication industry is operating against two fundamental limits: the wavelength of visible light and the number of elements that can be reproduced with a single alignment. . . .

In size, the technology is rapidly approaching the limitations imposed by the wavelength of visible light. Five-micron circuit dimensions are used in routine production; masks for such circuits contain features only 10 wavelengths of light in size. . . . The use of electron beams, ultraviolet light, and X-rays makes fabrication of submicron geometry devices possible. . . .

In precision, the technology is rapidly approaching or possibly exceeding the dimensional stability of the silicon substrate. Precision mask alignments on the order of 1-micron accuracy are being used over 4-in. (10-cm) wafers, a precision of one part in 10^5. . . . [Because] no significant improvements in the number of devices reproduced per alignment are anticipated, substantial changes in the patterning processes are likely.

In spite of the revolutionary nature of the changes in fabrication and design methods imposed by submicron geometries, U.S. industry appears to be treating these changes as further incremental progress. There seems to be little evidence of work aimed at quickly reaching the fundamental limits to device size imposed by physical theory. More effort needs to be devoted to improving the organization of circuitry to provide the most computation per unit area of circuit.

Unless positive steps are taken, the existing U.S. investment in today's fabrication methods may be made obsolete by the new fabrication technologies, producing less vigorous competition domestically, and placing the United States in a disadvantageous position in defense and international trade. . . .

The microcircuit industry is now at a turning point. New methods will be implemented to obtain smaller dimensions. New pattern generation and pattern replication equipment will be put into service. Basic choices currently being made will affect the entire industry for the next 20 years, and some of the relatively inexpensive research

objectives undertaken now may have considerable future leverage. . . . This report outlines the fundamental principles that should guide the choice of such research topics. . . .

The following four important activities, not now covered by private funds, should be considered for future funding:

1. *Efforts aimed at making very small devices.* Such efforts would set aside for the time being the push toward more complicated devices and focus instead on making quite simple circuits with the smallest possible feature sizes. Such efforts would not only serve to verify the limits to transistor size predicted theoretically, but also serve as a test bed for the fabrication and electronic design techniques required for these small dimensions.

2. *Efforts aimed at measuring the limits of dimensional stability of silicon substrates and mask materials. . . .*

3. *Efforts aimed at predicting the optimum feature size, die size, and wafer size, given the constraints of the newly evolving technology. . . .*

4. *Efforts aimed at understanding the system design implications of very-large-scale integrated circuits.* Indications are that great benefits may be obtained by improving the arrangement of memory and processing power implemented in the more complex circuits that will be available in the near future. Questions that need to be answered are: How should computations be organized so as to obtain maximum performance with minimum silicon area? What advantages can be gained by making "smart" memories that can compute as well as store? How can complex machines be configured to minimize the software burden on their users? . . .

Relatively modest investments in these four areas can be expected to give good payoff.

Ivan E. Sutherland, Carver A. Mead, and Thomas E. Everhart, Basic Limitations in Microcircuit Fabrication Technology, *Rand Report R-1956-ARPA, November 1976.*

UNDERSTANDING WELFARE DEPENDENCY IN NEW YORK CITY

New York City's welfare caseload grew from 130,000 cases in January of 1962 to 503,000 cases in the same month of 1972.... During the same period the number of people receiving public assistance in the City grew from 341,000 to 1.3 million. In 1972, nearly 17 percent of the City's 7.9 million residents were receiving public assistance. This unrelenting increase in welfare dependency [was] found in most large urban centers during the 1960s....

As the management reforms [in welfare, begun in 1971 by federal and New York State and City governments,] began to get off the ground, it became clear ... that [these] ... reflected ... assumptions about welfare dependency for which there was little or, in some cases, conflicting empirical support. Major policy changes were being implemented without adequate descriptions of the experiences of welfare recipients in the existing programs and without knowledge of which categories of recipients might benefit most from the changes....

In late 1971 [the City asked] The New York City–Rand Institute to assist in the design and implementation of ... a series of policy studies on the characteristics of [welfare] clients, their patterns of dependency, and the effectiveness of programs in meeting [their] income maintenance, shelter, and employment needs....

There were a number of reasons for undertaking a major welfare research effort for the City. First, there was no source of periodic reliable statistics on the characteristics of welfare recipients.... Other than a Monthly Statistical Report on the aggregate flow of cases on and off the rolls, the City ... had no regular source of comprehensive data on such critical characteristics as the age and sex of welfare recipients, the average grant received, the number receiving food stamps, the size of shelter allowances, the source of nonwelfare income, or the distribution of cases by size and composition.

Second, little was known about the dynamics of welfare dependency in New York City. It was a widely held view that most welfare recipients stay on the rolls for such long periods of time that dependency seriously threatens their productivity.... [But] there was no

longitudinal study of dependency based upon [case records] . . . over a time period as long as five or six years. . . . [Further], little was known about the relationship between changes in the local economy and the decision of the poor to turn to welfare. The accepted notion that welfare rolls increase during periods of economic recession and decline during expansions did not explain the massive growth of the rolls during the 1960s when the national economy was healthy. . . .

Third, there was considerable debate over the size of the population in New York City eligible for but not receiving welfare . . . [an] important [factor] because of the consequences for the City's budget if members of that population choose to turn to welfare during a recession. . . .

Fourth, there were no reliable statistics on the number and characteristics of the employable welfare population. Nor were there such statistics to indicate whether job training and employment programs had been successful in moving more employable recipients into jobs than would have been the case without the programs. . . .

Fifth . . . [little] was known about who received the benefits of . . . the shelter allowance program, the Medicaid program, and the social services programs . . . how much was received, or whether alternative lower-cost options could be devised. . . . [Were] recipients of equal need receiving similar benefits, and was the money spent to help the poor actually achieving the stated objectives of each program?

Lastly . . . most of the decisions affecting welfare policy are imposed on the City by Washington or Albany without any evaluation by the City of the consequence of these decisions. . . . A set of procedures for estimating the economic impact of welfare policy changes on the City (while they are still at the proposal stage) was felt to be a valuable aid to City administrators in assessing current and future proposals for welfare reform. . . .

This report is a compilation of the objectives, progress reports, and accomplishments of [our] five-year research project on welfare dependency in New York City.

David W. Lyon, Welfare Policy Research for New York City: The Record of a Five-Year Project, *Rand Report R-2119-RC, December 1976.*

LONG-RANGE DEVELOPMENT PLANNING IN THE AIR FORCE

This report presents the final results of Rand's Long-Range Development Planning study, undertaken at the request of the Air Force. In particular, the Air Force asked that we focus on finding better ways to determine what technologies should be pursued to develop the capabilities that will be needed in the future. Accordingly, the report analyzes current planning procedures in both the Air Staff and Air Force Systems Command and suggests ways for improving their contribution to effective technology development. . . .

To develop capabilities that will be used in the distant future requires projections of user needs, estimates of operational conditions, and specifications of expected performance that are inherently uncertain.

Decisions about what kinds of capabilities to develop are based on a number of highly uncertain considerations: What will be our national strategy and how will our resources constrain its implementation? Who will be our opponents? Under what circumstances are we likely to confront them? What capabilities will they have?

Decisions about the kinds of intermediate technology development to undertake—about the kinds of technical building blocks that will need to be constructed en route to a useful capability—involve still more uncertainties. What kinds of options can technology make available now? In the near future? How predictable is the technical success of a particular option? Which options are being pursued by other developers? What new alternatives might success make available? . . .

[An] important element in long-range development planning is to give visibility to the possible technology and resource-allocation consequences of current program alternatives. Where possible it is also important that their impacts on the attainment of future capabilities be assessed. This function affords an opportunity to determine appropriate hedges for the uncertainties characteristic of each type of development activity so that these hedges may be integrated into the periodic near-term development program decisions. . . .

[Despite] all the attention given to the management and planning of R&D activities by other military services and industrial firms that compete on the basis of technical advancement, the search for better planning procedures continues. . . .

This study examines how the U.S. Air Force currently conducts its technology planning and how Air Force procedures may be made more effective. It focuses exclusively on the procedures and mechanisms used in planning—on the *making* of planning decisions, not their content. Rather than addressing the question of whether the right kind of capabilities and technologies are being provided for the future, the study considers whether or not an effective planning process exists and what kind of improvements may be called for. . . . [Generally,] the study is concerned with technology development efforts that will take at least six, perhaps twelve or fifteen, years to yield results in terms of a new operational capability. . . .

Our observations of industrial planning practices enabled us to identify the following common elements that seem worthy of emulation by the Air Force:

- R&D planning, programming, and budgeting is separated from other corporate programming and budgeting activities.
- A small staff carries out corporate strategic planning for the organization's chief executive directly; a similar R&D planning staff serves the senior R&D executive.
- The organization's long-range goals are assessed frequently.
- R&D planning is structured, but quantitative methods are not widely used. . . .

Our recommended improvements include establishing a systematic strategic planning effort by a small corporate planning staff located within the Chief of Staff's personal staff. This office would be charged with exploring goals and alternatives suitable for the uncertainties of the future, with particular concern for resource constraints likely to be encountered.

W. E. Simons, G. K. Smith, E. S. Ojdana, Jr., R. Y. Pei, S. W. Purnell, and E. S. Wainstein, Long-Range Development Planning in the Air Force, *Rand Report R-1989-PR, September 1976.*

NUCLEAR POWER: 1946 TO 1963

This report concerns the research, development, and demonstration of nuclear power reactors in the United States from 1946 to 1963. It analyzes (1) Atomic Energy Commission (AEC) strategies for reactor development and commercialization, (2) how these strategies influenced the choice of reactor designs . . . in the Power Reactor Demonstration Program (1955-1963), and (3) how the . . . various demonstration projects affected the selection of commercial-scale reactors by reactor manufacturers and electrical utilities during the early 1960s. . . .

[Some] general observations may be drawn from U.S. experience in developing nuclear reactors for electricity generation:

- The early development of reactor technology for electricity generation was made to serve the interests of national prestige, which allowed the more prosaic goal of long-term commercial success to be confounded.
- In developing reactor technology, solving the exciting technical problems that appealed to engineers was a necessary but insufficient condition for achieving operational reliability, which required attention to the comparatively pedestrian activities of the whole system. . . .
- Maintaining the distinction between R&D and demonstration at the project level appears to have been crucial to the successful management of government-funded nuclear reactor development. . . .
- The use of multiple approaches combined with a staged, sequential strategy separating R&D from near-commercial demonstration helped to ensure that government-funded projects to develop reactor technology yielded the most useful information for a given cost.
- That the AEC pursued multiple options during the 1950s and early 1960s helped to ensure that even the "most preferred" approach proceeded better, and helped to protect against wrong choices amid technological, commercial, and institutional uncertainties.

Wendy Allen, Nuclear Reactors for Generating Electricity: U.S. Development from 1946 to 1963, *Rand Report R-2116-NSF, June 1977.*

PETROLEUM REGULATION: THE FALSE DILEMMA OF DECONTROL

The petroleum industry in the United States remains bound by price controls originated in 1971 and recently extended until 1979 by the Energy Policy and Conservation Act (EPCA) of 1975. . . . Extending the controls was viewed as a way to combat higher prices for refined products, at the expense of increased U.S. dependence on foreign oil. . . .

Existing analyses, with which we agree, conclude that the . . . price ceilings must . . . reduce U.S. crude oil production, and hence increase U.S. dependence on foreign oil sources. Prevailing analyses also conclude that decontrol would increase the price of refined products by as much as 5¢ to 6¢ per gallon. That conclusion . . . [is] incorrect. . . .

Although the price controls on crude oil did not influence product prices, they did transfer profits within the petroleum industry. In 1975, the crude oil price controls and allocation program transferred about $8 billion from crude oil producers to refiners. . . . [Much] of this was a transfer between production and refining subsidiaries. However, at least $3 to $4 billion was transferred from crude oil producers to nonaffiliated refiners. Decontrol would eliminate these transfers. . . . The product price ceilings attempted to force refiners to pass on these profit transfers to consumers, but the price ceilings are not binding. Market forces in fact impose a greater discipline on refined product prices than do the Federal Energy Administration controls.

The results of our inquiry imply that the policy debate about decontrol has been erroneously concerned with increases in refined product prices. . . . [The] controls have had substantial impact, but on redistribution of profits in the crude oil and refining industries, rather than on product prices. . . . [The] opportunities for decontrol written into the EPCA present a political challenge to the new Administration. The choice is reduced dependence on foreign oil or continuation of the current multi-billion-dollar transfers within the industry.

Charles E. Phelps and Rodney T. Smith, Petroleum Regulation: The False Dilemma of Decontrol, *Rand Report R-1951-RC, January 1977.*

ARMS CONTROL: THE NEW GENERATION OF CONVENTIONAL ARMS

[The] attention of governments and analysts in the arms control community has, in recent years, been centered on nuclear armaments. . . . This is, of course, as it should be, because controlling the risks of general nuclear war must remain our highest priority.

On the other hand, it has been widely noted that the emerging nuclear parity between the United States and the Soviet Union has greatly reduced the credibility of a nuclear retaliatory threat to deter aggression. In the past, in any really serious crisis, there was the implicit threat that the United States might use its overwhelmingly superior arsenal of nuclear weapons. . . . That time has passed. It is unlikely that the United States will manage anything greater than nuclear parity with the Soviet Union in the foreseeable future. Thus, the role of conventional forces has become more central, and they can be expected to play an increasingly important part in establishing and maintaining an effective deterrent posture, especially in Europe. . . .

In the past, conventional forces have been studied primarily from the relatively simpler viewpoint of possible quantitative limitations (as in the General and Complete Disarmament proposals of the 1962-1964 period and in most aspects of Mutual and Balanced Force Reduction). Little attention has been given, however, to possible limitations on qualitative improvements in conventional arms. . . .

This report is concerned with the question of whether or not qualitative constraints on conventional armaments are desirable, feasible, and acceptable ways of promoting U.S. national security objectives in the long run. The discussion is centered around possible U.S.-SU agreements and emphasizes the arms control implications of the new generation of conventional arms, which includes precision-guided munitions (PGMs) and remotely piloted vehicles (RPVs). . . .

In the context of the arms competition between the United States and the Soviet Union, there are several incentives for attempting constraints on conventional weapons. These include:

- The enhancement of the security of the two parties and their allies.
- The prospects for economies....
- The elimination of catastrophic instabilities....

Major changes are taking place in the capabilities of a number of classes of nonnuclear weapons. Some observers believe that these changes will transform the nature of conventional warfare, and that, a dozen or more years from now, many of the systems that have been mainstays since the beginning of World War II will be obsolescent. In particular, there have been developments in PGMs, in RPVs that can be launched from a variety of platforms, and in mobile air defense systems. New designs of efficient and hard-to-track cruise missiles can function as either PGMs or RPVs....

[The] essential statement about ... the new precision weapons ... is [that accuracy] is no longer a strong function of range; if a target can be acquired and followed during the required aiming process, it can usually be hit. For many targets hitting is equivalent to destroying....

[The] arms control specialist must learn how to deal with [these] small and efficient modern weapons, a class that includes many weapons that will defy present detection techniques, that may exist in great numbers, and that can be employed with great effect....

Limitations founded only on shallow understandings of these weapons, or that turn out to provide one-sided advantages, can have only a transitory effect, and the process of recovery could lead to even more dangerous instabilities....

Our theme is that a better understanding of how the new generation of arms works, what sorts of postures are likely to be efficient, and how these postures relate to the needs of the two sides can help us to identify aspects of the competition where curbs on arms growth will be *mutually* beneficial.

S. J. Dudzinsky, Jr., and James Digby, Qualitative Constraints on Conventional Armaments: An Emerging Issue, *Rand Report R-1957-ACDA, July 1976.*

HEALTH CARE AND HEALTH

One of the most vexing questions in health services research is the relationship between resources devoted to personal health services and the outputs of those services. The prevailing view in the United States suggests that additional personal health services do little, if anything, for mortality and/or morbidity. They probably provide relief of anxiety, symptomatic relief, or prognostic information.

What the patient does for or to himself (by smoking, drinking, exercise, sleep, and the like) [in this view] has much more to do with explaining variation in conventional measures of health status outcomes than additional personal health services. . . .

The evidence supporting this view typically comes from [the lack of association between] mortality or morbidity rates [and] medical care resources across regions (for the most part, regions of the United States). . . . Several [such] studies . . . have concluded that the effect of additional medical care resources on mortality and morbidity was small, if it existed at all. However, this conclusion was suspect because mortality appears to be a relatively insensitive measure of outcome; in other words, the power of statistical tests when mortality is used as a dependent variable might not be great. . . .

In this report, we illustrate a different approach to the problem of assessing the effect of medical care resources on health status. Rather than look at mortality or morbidity directly, we look at physiological measurements taken in the United States Health Examination Survey. This approach has potentially greater power than existing approaches for isolating the contribution that medical care services or other factors can make to health status, because one can focus on diseases or conditions for which medical care may make a difference.

If, as many believe, most diseases that are currently not treated are either self-limiting or irreversible, the set of diseases for which additional medical services can affect mortality may be small. In this case, if mortality from all causes is aggregated and [studied as a function of] medical care resources and environmental factors, as has been done in the literature to date, the observed effect of medical care will be both small and hard to detect.

By contrast, there may be some diseases, such as hypertension or periodontal disease, where additional medical care resources can make a difference. If so, it should be much easier to measure the contribution of medical care by focusing on the variation in the prevalence of such problems rather than on the variation in mortality or morbidity rates from all causes. Effects of health habits may also emerge more clearly with this approach. . . .

We have analyzed data from the United States Health Examination Survey, Cycle I . . . [which] gave screening examinations to a random sample of the U.S. population from 1959 to 1962. In this report, we analyze the results for diastolic blood pressure, serum cholesterol concentration, electrocardiogram evaluation, chest X-ray evaluation, varicose veins, and a periodontal index. . . . Our procedure is to [study the statistical correlation between] the physiological indices [and] measures of quantity of medical resources in an area, as well as demographic and socioeconomic characteristics of the person sampled such as age, sex, race, family income, and education. Our interest is in the association, if any, between variation in an area's medical resources and variation in the physiological measures examined, other factors constant. . . .

It is possible that [our conclusions] would need to be modified if data from more recent years were used; data from a similar survey conducted roughly a decade later . . . will be available in the future and will permit testing for the effects of technological change in medicine (e.g., antihypertensive drugs). . . .

While additional education and income were found to have an effect in reducing the prevalence of abnormal chest X-rays and periodontal disease, the physiological measures were affected little by additional medical resources. The results thus support the view that what an individual does (or does not) do for himself has a greater effect on his health than the consumption of additional medical care services.

Joseph P. Newhouse and Lindy J. Friedlander, The Relationship between Medical Resources and Measures of Health: Some Additional Evidence, *Rand Report R-2066-HEW, May 1977.*

VIETNAM AND INDONESIA: CONFLICT OR COOPERATION

[Among] the countries of Southeast Asia only Indonesia and Vietnam could be expected to become regional powers with hegemonial aspirations, claiming a dominant position in their respective part of the world by virtue of their human and natural resources and of their self-confidence and sense of destiny. . . .

For different reasons, these two countries overshadow the rest, Indonesia due to its size, natural resources, and strategic location; Vietnam because of its exceptional political will and military capability. . . . Both countries have a militant tradition going back to their respective armed struggle for independence, in the 1940s, which sets them apart from all the other countries in the region, which obtained or maintained their independence by political and diplomatic maneuvers. . . .

At least since the fall of Saigon in April 1975, the question has been frequently asked whether these two countries will ultimately clash, contending for a hegemonial role in Southeast Asia. . . .

The present regimes in Vietnam and Indonesia are ideological adversaries who have each won a decisive victory against their internal enemies. Although neither government has voiced explicit claims to spheres of influence, they may have overlapping but antagonistic interests in the political evolution of Thailand and Malaysia. Were the Indonesian Armed Forces to have the capability to come to the support of Thailand in case of Vietnamese military intervention in a Thai civil war, open warfare between Vietnam and Indonesia would not be inconceivable.

But as long as Vietnam and Indonesia devote their energy and resources to their respective national development, ideological antagonism does not have to lead to armed confrontation. A generation ago Walter Lippmann compared the United States as a sea power to a whale and the Soviet Union as a land power to an elephant and concluded that if each stayed in its natural element they would not clash but that if they decided to fight, the aggressor would be at a disadvantage by leaving his natural element.

Within the Southeast Asian region the allegory is applicable to Vietnam and Indonesia. Its defense requirements will oblige Indonesia to become gradually a regional maritime power, but it is not likely to increase substantially its land forces. Vietnam, however, is a major military force on the mainland of Southeast Asia but does not have the capability to project its forces across the South China Sea into the Indonesian archipelago.

Therefore, even if relations between Vietnam and the Association of Southeast Asian Nations [ASEAN] countries remain hostile, armed conflict between Vietnam and Indonesia is not likely unless one or both countries assert hegemonial aspirations for the whole region and proceed to acquire the military capability to implement their political goals.

It is also not inconceivable that within the next two decades Vietnam and Indonesia as regional powers, supported by their respective associates, will decide that despite their ideological cleavage, common interests dictate the closing of ranks in order to protect Southeast Asia from interference in its affairs by the global powers. Memories of the colonial experience are still sufficiently strong on both sides of the Southeast Asia Iron Curtain to make such an event plausible. . . .

If the two hostile camps in Southeast Asia decide to seek a regional *détente* and to cooperate in establishing a "zone of peace, freedom, and neutrality," as advocated by ASEAN, it is conceivable that Vietnam could become the protector of Southeast Asia against military pressure from its giant continental neighbors, China and India, while Indonesia could in the future play a complementary role by securing the region from unwanted interference by the global maritime powers, the Soviet Union and the United States, by asserting its control over the straits between the Pacific and the Indian Ocean.

Guy J. Pauker, New Centers of Power in the Pacific Basin 1985-1995, *Rand Paper P-5849, March 1977.*

PUBLIC WORKS AND ECONOMIC RECESSIONS

Since late 1974, when the present severe recession began, debate has been continual over the effectiveness of using public works investments to cushion the increase in cyclical unemployment. This debate culminated in the Public Works Employment Act of 1976, which authorizes $2 billion to be allocated to state and local governments for "construction . . . renovation, repair, and other improvements of local public works projects." . . . While countercyclical public works investments are being used as one component, albeit small, of national stabilization policy, the debate continues over their contribution to economic stabilization. Three major questions stand out.

The first question concerns effectiveness: Are these investments any more or less cost-effective than tax rebates, corporate income tax credits, public service employment, or other stabilization instruments? . . . The second question is institutional: How feasible is it, politically and administratively, to allocate countercyclical public works funds at the beginning of a recession, and to withdraw them rapidly in the recovery period? . . . The third question is operational: . . . [How] should public works funds be allocated across states and cities, when and for how long should they be carried out, and what types of projects should be selected? . . .

This study investigates two basic issues in order to provide both information for the design of the present countercyclical public works program, and a foundation for future research on countercyclical policy:

- The relationship between business-cycle characteristics as they are experienced by the nation, states, and labor market areas.
- The direct, indirect, and induced employment effects of alternative types of public works projects. . . .

[and] deals with two additional issues:

- Potential bottlenecks in industries that are major suppliers to public works projects.

- The ability of countercyclical public works investments to target the cyclically unemployed....

[The study shows that the] employment cycles of states and labor market areas vary widely in response to fluctuations in levels of national employment [and that there have] been great variations in the duration, amplitude, and severity of local employment cycles.... There are also wide variations in the cyclical behavior of each state and labor market area from one cycle to another. Given present predictive capabilities, planning the timing of countercyclical public works investments in specific areas—so as to maximize effectiveness of these projects and minimize the probability of excess demand in the local labor and materials markets—is a difficult task....

Although current findings must be viewed tentatively, the report sheds some light on the effectiveness of countercyclical public works investments in dealing with three important countercyclical policy issues:

First, because a small share of the total jobs resulting from a public works project will be generated in the labor market area in which the project is implemented, the ability of public works investments to serve local cyclical needs may be limited, and may be inferior to that of a public service employment program.

Second, provided that there is appropriate consideration of the mix of projects, it is unlikely that a countercyclical public works program of the magnitude typically discussed in Congress will impose excess labor demand on major supplying industries or on the construction industry, and thus add to inflationary pressures....

A third preliminary finding is that countercyclical public works investments can generally be effective in creating employment in those industries and labor force categories most affected by cyclical unemployment. However, to provide employment opportunities to the young, who are more affected by cyclical unemployment than older workers, some other countercyclical program is likely to be more effective.

Georges Vernez, Roger Vaughan, Burke Burright, and Sinclair Coleman, Regional Cycles and Employment Effects of Public Works Investments, *Rand Report R-2052-EDA, January 1977.*

AIR FORCE MANPOWER, PERSONNEL, AND TRAINING

Working closely with the Air Staff, we are concerned with both long-term solutions to fundamental problems and short-term actions to improve the operational effectiveness and the cost-effectiveness of the Air Force. . . .

The advent of the All-Volunteer Force (AVF) was a major and fundamental change that affected all aspects of the way the Air Force procures, trains, and utilizes personnel. Although the transition from the draft-oriented procurement system has generally gone well, problems persist in several areas.

A major problem, pointed up in earlier Rand research, is the inability of the Air National Guard and the Air Force Reserve to attract enough non-prior-service personnel to maintain . . . personnel structures. . . . [We] sought solutions to this problem by way of three studies:

First, we designed and analyzed a controlled experiment in which a small number of selected reserve units were allowed to offer shorter terms of enlistment. We proved that adoption of such a policy would be counterproductive. Implementing shorter terms of enlistment would have little effect on recruiting in the short term and would lead to aggregate man-year losses and more serious manning problems in the future. As a result of our work, the Air Force rejected shorter terms of enlistment as a viable recruiting option.

Second, we carried out a detailed statistical analysis of the effects of the new Air National Guard recruiter program. We found the program to be highly cost-effective, especially when compared with the likely cost and effectiveness of a bonus program. We estimated that . . . the bonus would be only 11 percent as effective as an equal-cost recruiter program.

And third, in anticipation of future shortages of non-prior-service personnel, we analyzed the effects of such shortages on the combat capability of the Air Reserve Forces. Our research indicates that restructuring reserve units and increasing the use of airmen who had

previously served on active duty would provide a more cost-effective posture in the reserve....

Recently the Air Force Reserve altered its objective force structure to reflect a 68% prior service/32% non-prior-service mix. It explicitly noted that this new mix was preferable because of "training cost, retirement costs, pay and allowances, and productivity" measures as developed by the Rand study.

The AVF continues to cause problems for the Air Force's health delivery system. After World War II, the draft and related programs ensured an adequate supply of physicians, enabling the Air Force to offer a wide range of services to active-duty personnel and retirees, and their dependents. The ending of the draft raised fundamental questions about the future course and structure of the Air Force medical service....

Our research to date indicates that, even with the physician bonus and scholarship program, the Air Force will remain below the level of physician manning considered necessary to fully staff all medical facilities. This points up the importance of alternative delivery techniques and ways to conserve the scarce physician resource.

To examine this issue, we collected data on out-patient clinics at nine Air Force hospitals. Our analysis suggests that alternative clinic organizations that stress the use of physician "extenders" might be cost-effective ... without compromising the high quality of care at Air Force facilities. With the approval of the Surgeon General, we have designed and are helping to implement a test of this concept at four Air Force bases....

Improved planning promises large payoffs in the efficient and cost-effective use of personnel.

Bernard D. Rostker, The Project RAND Manpower, Personnel, and Training Program in Retrospect, *Rand Paper P-5839, April 1977.*

CABLE TELEVISION AND THE COPYRIGHT LAW

One of the purposes of law is to promote an efficient allocation of resources. The goal of the copyright laws, in particular, is to provide a financial incentive to authors to produce original works by granting them control over the use of their products. . . .

For almost seventy years, protection to authors was provided by the Copyright Act of 1909. With time, the parts of the Act that failed to deal directly with changes in the methods of distributing copyrighted materials became obsolete. Cable television, with its ability to carry television signals from distant markets and redisplay them to its subscribers, was one such development that could not have been anticipated in 1909. In 1974 the Supreme Court ruled that cable systems were not engaged in a "performance" when they retransmitted distant signals and thus were not liable for copyright infringement. . . .

In 1976 the General Revision of the Copyright Act took place, providing a compulsory license for cable systems to carry those signals currently authorized for retransmission by the Federal Communications Commission (FCC) upon payment of a specified percentage of revenues. . . . The copyright fees thus collected are to be distributed among the owners of the copyrighted programs used. . . .

The congressional review of the 1909 Copyright Act provided an unusual opportunity to reorder the structure of the cable and broadcast television markets by removing the constraints on the cable industry and by creating a mechanism that could register more directly consumers' preferences to program suppliers. The basic thesis of this report is that the congressional choice of a compulsory license, instead of full copyright liability (i.e., requiring the users of copyrighted material to negotiate with the owner to acquire the right to use that material) for distant signals will, for [the following] several reasons, aggravate the problems associated with distant signal importation. . . .

1. Fees fixed by law need bear no relationship to prices negotiated in a free market. In particular, the fee schedule

in the General Revision will provide program suppliers too little revenue.

2. The formula contained in the law is likely to prove inflexible as economic conditions change. Although the General Revision allows a royalty tribunal to reassess fees, it provides no guidance for altering the schedule.
3. The compulsory license will be less efficient in providing authors with the financial incentives to produce original work than would fees negotiated in the marketplace if cable systems were required to purchase the right to retransmit a distant signal (i.e., full liability), because the payments to suppliers will be at most indirectly related to consumer willingness to pay for the programming viewed. Under the General Revision, the division of the fees is by mutual agreement of suppliers. An efficient allocation requires that the individual supplier receive a payment that reflects the marginal value of the programming to consumers.
4. The most significant problem is the detrimental long-run effect of compulsory licensing on program suppliers. With fees too low and the stations' ability to pay for programs reduced by the diversion of audiences to distant signals, program suppliers will earn less as cable systems and distant signal importation spread. Some programs will not be produced because of inadequate compensation, even when consumers value such programs more than the costs of producing and distributing them. . . .

We expect renewed controversy over both distant signal importation and copyright liability for cable, despite the fact that the General Revision is supposed to settle the matter. Resolution of this controversy might take the form of either a revision of the 1976 General Revision to impose full liability or further FCC restrictions on distant signal importation. Because FCC regulation appears the more likely outcome, the ultimate effect of the General Revision may be to increase the amount of regulation that restricts consumers' ability to view programs of their choice.

Stanley M. Besen, Willard G. Manning, Jr., and Bridger M. Mitchell, Copyright Liability for Cable Television: Is Compulsory Licensing the Solution?, *Rand Report R-2023-MF, February 1977.*

LIFE-CYCLE ANALYSIS OF AIRCRAFT TURBINE ENGINES

Over the past decade, the Department of Defense has placed increasing emphasis on understanding and assessing acquisition strategies and cost considerations in the development and procurement of new weapon systems. In the present era of budget constraints, and with an increasing share of the DOD budget devoted to operating and supporting forces in being . . . attention has recently focused on attempts to understand and predict [the total costs, not merely the cost of procurement, but] total life-cycle costs for new weapon systems and important subsystems, including aircraft turbine engines.

[These costs] include not only the costs of acquisition (development and procurement) of a new weapon system, but also all the costs of operating and supporting the system in the field during its inventory lifetime. The latter costs for both existing and proposed weapon systems must be more clearly understood . . . so that the planner has flexibility in trading off quality, schedule, and cost in the selection of new engines [in order to maximize the operational capability of a system for a given total life-cycle cost]. . . .

Aircraft turbine engines are a particularly promising subject for study because: (1) they are extremely important in weapon-system applications; (2) they are felt to be the pacing subsystem in aircraft weapon-system development; (3) they represent a large inventory and budgetary expense; (4) their 30-year history of continuing technological improvement furnishes a sizable (though fragmentary) data base for analysis; and (5) they could provide insights, from a subsystem viewpoint across the life-cycle spectrum, that may be readily applicable to the weapon-system level.

The subject also has an immediate practical urgency: Engines are a topic of . . . interest today because of problems arising in the operational inventory with aircraft grounded owing to engine-related problems. . . .

The central question is, How much does it cost to acquire and own a military engine over its life cycle? No previous study has been able to answer this question fully. . . .

The problem addressed [here] is the weapon-system planner's lack of detailed information and a methodology to enable him to make early decisions concerning the selection of a new engine within a life-cycle context. . . .

This study examines the magnitudes, proportions, and trends of costs for acquiring and owning a new aircraft turbine engine and highlights the parameters driving these costs for the benefits sought. It provides an overall life-cycle methodology that incorporates the effect of state-of-the-art advances required for new engines. . . .

For a new engine program that will have an operational lifespan of 15 years, the findings indicate that:

- The magnitude and proportion of costs associated with an engine are significantly larger than and different from those found in previously published studies. For instance, engine depot and base maintenance costs, not including fuel and attrition, will exceed engine acquisition costs.
- Depot costs alone will exceed procurement costs.
- As much money can be spent on engine component improvement during its operational use as was spent to develop the engine to its initial model qualification.
- If component improvement and whole spare engine procurement are considered ownership costs, then ownership currently constitutes at least two-thirds of total engine life-cycle cost.
- Application of the models obtained in the study indicates that there is a continuing trend in the direction of higher ownership cost, measured both in absolute dollars and as a percentage of total life-cycle costs. Increasing depot cost is the reason for this trend. To break it, the Air Force will have to depart significantly from its current ownership practices at both depots and bases. . . . The study identifies operational and support policies and procedures that should be strongly supported in attempting to break the trend. Recent [Air Force] efforts . . . are directed toward counteracting the trend and merit vigorous support.

J. R. Nelson, Life-Cycle Analysis of Aircraft Turbine Engines: Executive Summary, *Rand Report R-2103/1-AF, March 1977.*

CRIMINAL CAREERS OF HABITUAL FELONS

Treatment and rehabilitation of offenders were until recently a dominant goal of the criminal justice system. Transforming criminals into law-respecting, productive citizens was thought to be a primary way of reducing crime. . . .

In recent years, however . . . at least for the handling of the serious habitual offender, [the] emphasis in sentencing and correctional programs has been moving from rehabilitation to punishment and incapacitation of offenders through imprisonment. The latter "hard-line" position seeks to enhance public safety by separating the chronic offender from the community and to enhance deterrence through the use of harsher punishment. . . . The Rand study of habitual offenders, of which this report is a part, seeks to illuminate the implications of this approach. . . .

With present knowledge, it is difficult to accurately classify an offender in terms of the future threat he poses to the community. . . . In particular, relatively little is known about how habitual offenders differ in the rate of committing crimes and in their skill at avoiding arrest. These factors are critical, for . . . the effect of longer sentences on overall crime will depend greatly on who is incarcerated for how long. . . .

The study focuses on the criminal careers of 49 inmates of a medium-security prison in California. All are serving time for armed robbery, and all have served at least one prior prison term. . . .

[Approximately] 80 percent of the sample had an intelligence level of normal or bright-normal. The average age at which these offenders committed their first serious juvenile offense was 14. . . . The average time of first arrest was about one year later. . . . Broken homes, lower economic status, and sibling criminal records were characteristic of many but not most in the sample; nor did such factors explain differences in later criminal behavior. . . . [The] average respondent committed about 20 crimes per year of street time. . . . [Only] a small percentage of crimes resulted in recorded arrest: 3 percent of the nondrug felonies in the juvenile period; 6 percent in the young adult

period; and 20 percent in the adult period.... Contrary to the assumption that an offender's illicit profits grow with his experience, these offenders, even in the later phases of their careers, averaged only a few thousand dollars per year....

In order to decide whether crime could be significantly reduced by incarcerating a greater percentage of habitual offenders for longer terms, policymakers need estimates of the amount of crime such offenders actually commit and their probability of arrest and conviction.

A unique contribution of this study is that it provides such estimates, by crime type and period in the criminal career, based on offenders' own reports. Besides incapacitation, the study results have implications for other criminal justice strategies: rehabilitation, deterrence, and prevention.... [For example, the] data gave us no reason to believe that the length of a prison term affects deterrence; those who served longer sentences did not have longer periods of street time after release until the next incarceration....

The preliminary evidence from this study suggests that incapacitation, by imprisonment, may be the most direct alternative for reducing the societal toll at the hands of habitual offenders, provided the most serious of them can be identified before their criminality has declined. If crime is to be reduced through incapacitation policies, the following procedural changes should be considered:

- Police and presentence investigators should provide prosecutors and judges with more thorough information—including multiple crime-clearance and juvenile offense data—to help identify the intensive offenders for whom incapacitation may be justified.
- Extended prison sentences should be imposed on offenders whose prior record and current charges reflect serious and sustained criminal activity. These sentences should be imposed at the earliest time such offenders have been identified with reasonable confidence.

Joan Petersilia, Peter W. Greenwood, and Marvin Lavin, Criminal Careers of Habitual Felons, *Rand Report R-2144-DOJ, August 1977.*

THE MILLION-POUND AIRPLANE

Between October 13 and November 14, 1973, aircraft of the Military Airlift Command delivered 22,497 tons of equipment and supplies to Lod Airport, Tel Aviv, Israel.... Although it accomplished its primary objectives, this exercise revealed several potentially dangerous shortcomings in U.S. strategic airlift capability—particularly for long-range missions. Specifically, it revealed that we might be denied overseas bases or overflight rights and that fuel for the return flight at the aerial port of debarkation might be unavailable or of very limited availability.

To a great extent, overseas bases and overflight rights were both denied to us during the 1973 airlift.... [The] only en route base available for refueling was Lajes Field in the Azores.... In recent months, however, [Portugal's] leaders have indicated that the use of Lajes as an en route base for aircraft participating in operations in the Middle East may also be forbidden....

The situation described above (i.e., denial of basing rights) could be greatly aggravated if fuel is either unavailable or in limited supply at the destination....

[This example and other possible ones suggest why it is important to explore the characteristics and usefulness of very large airplanes. An] airplane suitable for use in the airlift role could also be employed in a variety of other missions ... airborne missile launchers, tanker support for strategic bombers ... airborne command posts ... the tactical battle platform for launching either manned fighters or remotely piloted vehicles, various maritime missions such as antisubmarine warfare or sea-lane control, and ... a platform for Airborne Warning and Control Systems....

The research described in this report explores the military utility of very large airplanes (VLAs, over 1 million pounds gross weight) and examines several alternative fuels that could be used by such airplanes. The research was conducted jointly by Rand and the Aeronautical Systems Division of the Air Force Systems Command....

Our results indicate that very large airplanes may not be substantially more cost-effective than contemporary airplanes for certain airlift mission applications. Indeed, for some mission scenarios (e.g., NATO reinforcement—assuming fuel is available for the return leg), the C-5B displayed a somewhat better cost-effectiveness.

On the other hand, the very large airplanes clearly enhance the capability to perform missions not routinely performed at present. They could provide an essentially worldwide airlift deployment capability that does not rely on overseas bases—at least, on overseas bases not owned by the United States.

For the station-keeping missions [e.g., missile launcher, tactical battle platform, maritime air cruiser, and platform for command, control, and communications], the VLAs provide much greater flexibility than existing equipment. In all these applications, the VLA-JP [the very large airplane, burning conventional jet fuel (JP)] will be both more cost-effective and energy-effective than any contemporary airplane. . . .

[R]ecommendations . . . [regarding] advanced-technology large airplanes [include the following:]

- The Air Force should maintain a strong and active interest in advanced-technology large airplanes.
- Further study is needed to identify the optimum design constraints for military applications.
- The possibility of a compromise aircraft—one that would meet the requirements of commercial air cargo operations as well as military requirements (particularly for strategic airlift)—should be explored.
- Areas of research that may benefit advanced-technology large airplanes include propulsion (turbine engine technology, propfans), aerodynamics (laminar flow control, thick supercritical wings), [and] structures (composites, aeroelastic effects of high aspect ratio wings).

W. T. Mikolowsky and L. W. Noggle, with contributions by W. F. Hederman and R. E. Horvath, An Evaluation of Very Large Airplanes and Alternative Fuels, *Rand Report R-1889-AF, December 1976.*

COAL DEVELOPMENT AND GOVERNMENT REGULATION IN THE NORTHERN GREAT PLAINS

Every major energy supply development initiated in the past decade has generated considerable political controversy. These controversies and the policies that have emerged from them have in turn substantially affected the timing and extent of development. This report examines one such undertaking: coal development in the Northern Great Plains. . . .

[There] will be substantial changes in the physical forms, geographic sources, and means of production of U.S. energy supplies by the year 2000. This will be true particularly if major efforts are made to retard the growth in the proportion of national energy consumption provided by oil imports. The composition of energy supplies by form will change, with petroleum liquids and natural gas becoming less important, coal becoming more important, and nuclear power and possibly geothermal power, solar power, and oil shale emerging as significant forms of national energy supplies.

The sources and means of production will change noticeably as well. The Rocky Mountain and Northern Great Plains states—Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming—will become major sources of coal production. Most domestic coal will be produced by surface mining. . . .

Most of the new developments will occur in areas where significant energy production has not occurred to date. Political experience in coping with large-scale energy developments is thus lacking. This lack of experience is a problem because large-scale energy supply developments generally produce significant adverse effects. Many of these costs of development are borne by individuals and regions that have little or no influence on decisions about development.

Regulation is created to reduce or prevent such adverse impacts. However, the circumstances in which regulation emerges are such that regulation may produce adverse effects of its own. Because this pattern has become so familiar, learning to develop energy production efficiently while protecting individual interests and maintaining a

more desirable natural environment is an important policy challenge in the years ahead. . . .

The question "Who should regulate?" is an important question in the Northern Great Plains because the division of regulatory roles between the national government and the state governments has not been settled. Moreover, current or potential developments could result in conflict between the two levels of government. Conflict is possible between the two in at least four areas: (a) coal conversion plant siting, (b) approval of coal slurry pipelines, (c) taxation of coal production and conversion, and (d) coping with failure to meet state reclamation standards for strip-mined lands. . . .

Three broad patterns of regulatory policy for Northern Great Plains coal development, each embodying a distinct and consistent approach to these four problem areas, are outlined. In the first pattern, denoted as *centralization,* federal authority preempts state authority wherever the latter proves to be a significant constraint on coal development. In the second, denoted as one of *dual responsibility,* authority is divided among federal and state governments, creating a pattern of mutual restraint. In the third, *state control,* state authority predominates in all areas.

Three types of considerations are suggested as guidelines in evaluating these policy patterns. Basic social objectives, specifically considerations of efficiency and equity, are the first. The second includes various situational considerations: the extensive coal leasing that has already occurred, uncertainty about the success of surface reclamation efforts and large groundwater withdrawals, and the asymmetry between regions of the effects of conversion plant siting. General political principles governing the division of power to encourage responsible decisionmaking and restrain the exercise of power constitute the third.

The policy pattern of dual responsibility, with its approximate balance of interests, appears to incorporate these considerations best. As such, it is recommended for further analysis and evaluation.

Richard Nehring and Benjamin Zycher, with contributions from Joseph Wharton, Coal Development and Government Regulation in the Northern Great Plains: A Preliminary Report, *Rand Report R-1981-NSF/RC, August 1976.*

LIMITED STRATEGIC WAR

Nuclear policy in the United States has recently been undergoing perhaps its most radical transformation since the early days of the Kennedy-McNamara era.... At its core is an effort to depart from total reliance on the threat of "assured destruction" retaliation that dominated U.S. deterrence efforts throughout the past decade and to create a variegated menu of targeting options (some massive and others carefully measured and discriminatory) to provide the U.S. National Command Authority with a range of alternatives for varying crisis situations and nuclear deterrence breakdowns....

Although the "assured destruction" option is perfectly acceptable and rational as a peacetime deterrent *threat*, it could be suicidal as a wartime military *strategy*... [for] U.S. deterrence could fail at many levels below the massive attack threshold. Short of the classic annihilating attempt against U.S. retaliatory forces and sociopolitical cohesion, the Soviet leaders in certain scenarios could (a) preempt massively with nuclear weapons throughout the European theater and leave the U.S. homeland untouched, (b) couple that option with a major attack against selected military targets in the continental U.S. relevant to the immediate European theater engagement, and (c) reinforce their [less than all-out] nuclear initiatives with credible threats that U.S. escalation to the ... "assured destruction" level would expose U.S. society to unrestrained reprisal by fully alerted and undegraded Soviet strategic forces.

Finally, deterrence at the strategic level could fail in a whole assortment of unpredictable ways ranging from accident, inadvertence, and unintended collapse of Soviet command and control to misestimation of U.S. responses or outright madness....

The current effort to increase the breadth and flexibility of U.S. nuclear targeting options is the cutting edge of a broader attempt ... to infuse U.S. nuclear planning with an explicit and systematic ingredient of *strategy*.... Although commonly called a "strategy," "assured destruction" was by itself an antithesis of strategy.... [It] ceased to be useful precisely where military strategy is supposed to come into effect: at the edge of war....

Rather than deal in a considered way with the particular attack at hand so as to minimize further damage to the United States and maximize the possibility of an early settlement on reasonably acceptable terms, ["assured destruction"] had the simple goal of inflicting punishment for the Soviet transgression. Not only did this reflect an implicit repudiation of political responsibility, it also risked provoking just the sort of counterreprisal against the United States that a rational wartime strategy should attempt to prevent. . . . [As] President Nixon's 1970 Foreign Policy statement [read] . . . "Should a President, in the event of nuclear attack, be left with the single option of ordering the mass destruction of enemy civilians, in the face of the certainty that it would be followed by the mass slaughter of Americans?" . . .

Given the possibility of Soviet limited nuclear operations against which the "assured destruction" option would be inappropriate, current U.S. policy additionally calls for a force that "could implement a variety of limited preplanned options and react rapidly to retargeting orders so as to deter any range of additional attacks" that the Soviets might contemplate. Far from *supplanting* the "assured destruction" option, current U.S. policy simply seeks to *supplement* it with additional options of lesser magnitude against possible contingencies in which a massive U.S. reprisal would be counterproductive. . . .

Deterrence continues to be the policy's overwhelmingly dominant objective. But, unlike its predecessors, the policy seeks to be able (a) to deter not only massive attacks but more selective ones as well; (b) that unavailing, to meet a limited attack with a measured response designed to maintain U.S. involvement in the defense of its interests without having to cut off its nose to spite its face; (c) to exact a price for the Soviet transgression while deterring the Soviets from further escalation by the coercive threat of inflicting even greater damage with withheld forces; and (d) *only with all of this failing,* to impose the ultimate sanction of ["assured destruction."]

Benjamin S. Lambeth, Selected Nuclear Options in American and Soviet Strategic Policy, *Rand Report R-2034-DDRE, December 1976.*

MEDICAL MALPRACTICE: THE RESPONSE OF PHYSICIANS TO PREMIUM INCREASES IN CALIFORNIA

Between 1960 and 1974, per doctor malpractice insurance premiums in California increased 550 percent, from $400 to $2600—an annual increase of 14 percent. During the 1975-76 period, rates went up dramatically. On May 1, 1975, a 320 percent premium increase by the Argonaut Insurance Company sparked a physician slowdown centered in the San Francisco Bay Area. On November 1, 1975, Travelers Insurance jumped its rates for the rest of Northern California by 341 percent. . . .

How have physicians responded to professional liability cost increases in California? This is the central question addressed in this study. . . .

Available evidence suggests that malpractice rate increases *have not yet* caused either a reduction in California's physician supply or a serious statewide curtailment of medical services, but they *have* spurred important changes in practice patterns affecting the availability, cost, and quality of care. . . .

In general, we find that

- Most physicians have passed at least part of the costs of rate increases on to the public in the form of fee increases.
- Many physicians, perhaps between 8 and 18 percent, are going without insurance.
- Many physicians, probably around 7 percent of those insured, have made procedural changes to reduce their insurance premiums.

The malpractice insurance situation throughout the United States is also volatile: Rates are changing, state legislatures have passed new laws, new insurance companies are forming while others are retreating from the market. Thus, a physician considering relocation faces many uncertainties about the overall benefits of location change. . . .

Data . . . show that relatively *few physicians have decided to leave California*. . . .

Since California has traditionally been heavily dependent for its physician supply on physicians educated in other states, any downturn in migration of physicians to California would have important implications. In general, we find that *California continues to attract new physicians*. . . .

Physician practice changes can have a number of effects both positive and negative. For example, if increases in insurance rates either discourage unnecessary surgery or encourage the performance of surgery by more competent physicians, the result is an improvement in the quality of care. But if practice changes reduce certain types of care in particular geographic areas so that it is less available to those who may need it, then the quality of care is impaired.

We find that changes have, for the most part, been made by *family physicians* who are primarily interested in *reducing their practice of surgery and obstetrics*. Other important changes have been made by obstetrician-gynecologists who want to reduce their obstetrics caseloads. . . . Because obstetrical care is being reduced by both family physicians and obstetricians, it appears that the availability of this type of care may be affected in important ways.

Physicians may also respond to insurance rate increases by reducing the number of Medi-Cal patients they will accept, because reimbursement for this type of care has not kept pace with cost increases. . . . *We have examined Medi-Cal program data and have found neither a measurable decrease in the number of physicians treating Medi-Cal patients nor a decline in physician services or visits*. . . .

[We] suggest that insurance companies and the state consider the possibility of making rate structures more flexible so as not to discourage (a) rural and part-time practice by competent physicians; (b) family physicians and specialists from performing medical procedures they are trained and technically competent to perform; (c) new physicians from locating in California; and (d) physicians from obtaining insurance.

Albert J. Lipson, Medical Malpractice: The Response of Physicians to Premium Increases in California, *Rand Report R-2026-PSEC, November 1976.*

ALLIES AND COALITION WARS

NATO has always been the contingency that largely dictates the Army's overall size, configuration, doctrine, tactics, and equipment.... Yet there remains one enormous gap in this process of optimizing our forces for the NATO mission—*we still are not taking adequately into account the special requirements of coalition war.*

These requirements entail far more than combined command arrangements and adequate provision for liaison—important as these are. They mean more than overcoming the language barrier. They involve harmonization of doctrine, tactics, and procedures; compatibility of forces and logistics; interoperability if not standardization of equipment, munitions, and communications; even training and operating together—in short, all the interfaces indispensable to fighting effectively alongside allies.

Military history is replete with examples of the high costs of failing to take these obvious factors into account. One classic (and quite relevant) case is the Axis victory of 1940, when French, British, Dutch, and Belgian failure to operate effectively together contributed to their disastrous defeat....

Surprisingly, despite all [our] wartime experience, we never spent much effort in peacetime preparing explicitly for coalition warfare again next time around. Instead, our services retreated into their institutional shells and postured as though we and the enemy would be the only ones on the battlefield....

Despite a few bright spots, the proliferation of widely varying systems among the NATO allies approaches scandal. This results from largely duplicatory and overlapping research and development programs, and failure to reap the production economies of scale. Of course, the maintenance and resupply complications are horrendous too.... We can't even talk with each other over most of the tactical communications currently in use and, worse yet, under development by ourselves and others....

Paradoxically, it is the United States that has been at the same time the strongest voice in NATO and the worst offender in terms of "going

it alone." We are cast in the ambivalent role of leading NATO, yet insisting on full freedom of action in posturing our own forces. . . .

But can we afford such expensive practices any longer in the face of a growing threat and continued fiscal constraints? Tailoring a large fraction of the U.S. force posture more explicitly for the NATO coalition mission could: (1) free substantial resources for tradeoff; (2) materially improve the effectiveness of our NATO contribution; and (3) last but not least, actually improve Army capabilities for responding to other contingencies as well. I have in mind such measures as faster reinforcement, a more relevant reserve structure, and the economies and efficiencies inherent in both greater reliance on host nation support and more compatible or common R&D and defense production. . . .

Let me hasten to add that we Americans are hardly the only ones at fault. Our European allies, with infinitely more experience at coalition war than we, are if anything more culpable. They too neglect peacetime preparation for coalition war. . . .

Regrettably, the only ones who seem to be systematically preparing for coalition operations are the Soviets. Not only do the Soviets dominate the Warsaw Pact command structure, but they insist that their allies march to their tune, they provide most of their allies' equipment, and they enforce common (Soviet) doctrine and tactics. . . .

I don't want to overstate the problem. Notwithstanding their sad previous record, both NATO itself and most national commands are belatedly starting to come to grips with it, driven by the escalating costs of modern forces and the evolving threat.

Nor do I wish to underestimate the difficulty of achieving practical solutions. The problems involved are enormously complex. . . . At a conservative estimate, it could take 20 years to create an optimal coalition posture from the present mess. But it won't be achieved at all unless all the problems outlined here are addressed seriously and consistently.

R. W. Komer, Needed: Preparation for Coalition War, *Rand Paper P-5707, August 1976.*

ELECTRICITY PRICING AND LOAD MANAGEMENT

In the aftermath of the [1973/74] oil embargo, public attention in the United States has been focusing increasingly on the performance of the electricity sector throughout the country. The prices of most sources of energy have been continuously and dramatically rising since the early 1970s; concurrently, the traditional methods of pricing electricity have been under attack by a diverse group of critics who call for fundamental revisions in the structure of electricity rates. . . .

Proposals for fundamental changes in the tariffs under which electricity is sold in the United States have attracted the widespread attention of consumer groups, environmental advocates, energy policymakers, utilities, and regulatory commissions. . . . Peak-load pricing—charging higher rates during hours and seasons of highest demand—is increasingly being advocated as a method of harmonizing the interests of consumers, utilities, and the environment. Charging higher rates at peak periods encourages the conservation of energy at the times when the greatest fuel and capital resources are required to produce it; lower off-peak rates encourage energy uses to be shifted to periods when excess capacity is available and fuel costs are lower. The potential benefits of peak-load pricing are lower overall social costs of energy and a reduced need for new generating capacity. . . .

European utilities have historically sold electricity at rates that reflect these daily and seasonal differences in supply costs. Until very recently such time-related peak-load methods of pricing have not usually been a part of American practice. . . . In addition to their peak-load tariff policy, European utilities also frequently use more active approaches to modify the load patterns of their customers, such as by promoting appliances that use electricity predominantly during off-peak hours and by installing equipment that permits the utility to interrupt power supplied to selected end-uses. . . .

To examine the experience accumulated in six European countries, the authors have interviewed engineers, economists, and managers in utilities, private industry, and government in Finland, France, West Germany, Norway, Sweden, and the United Kingdom. . . .

Comparisons of industry-specific load curves for French firms in 18 industrial groups with their California counterparts in the same industries . . . [show that if] California utilities were to sell power to customers in these 18 industries under peak-load tariffs, backed by economic incentives for off-peak consumption similar to the incentives offered by French high-voltage tariffs, the amount of electricity used during a 4-hour peak period could be reduced by 54 million to 76 million kilowatt-hours per month, or by 33 to 46 percent of the present statewide peak-hour industrial demand. Load shifts of this magnitude would result in more efficient uses of fuel and achieve savings of as much as $1.3 million per month. If all types of industries in California were to respond to peak-load tariffs in a similar fashion, the load shifts and fuel savings would be some 80 percent larger. . . .

[Rand's work] in electricity pricing and demand . . . [also includes] an experiment in peak-load pricing for . . . a representative sample of . . . residential customers served by the Los Angeles Department of Water and Power (DWP). . . . The first experimental tariffs in the study were put into effect in June 1976 for 30 months—a test period long enough to record household behavior during three summers, the period of DWP's system peak . . . [and to give] consumers . . . some time to learn how their new rate plan works and to understand what opportunities they have for taking advantage of off-peak prices. . . .

[The experiment includes] 980 customers on 17 *time-of-day* tariffs . . . 360 customers on 4 *seasonal* tariffs . . . 460 customers on two *flat-rate* tariffs . . . [and] 400 customers on a *conventional* declining-block tariff (this is the *control group* for the experiment).

Bridger M. Mitchell, Willard G. Manning, Jr., and Jan Paul Acton, Electricity Pricing and Load Management: Foreign Experience and California Opportunities, *Rand Report R-2106-CERCDC, March 1977; and Manning, Mitchell, and Acton,* Design of the Los Angeles Peak-Load Pricing Experiment for Electricity, *Rand Report R-1955-DWP, November 1976.*

MILITARY TANK DEVELOPMENT IN THE SOVIET UNION AND THE UNITED STATES

Soldiers are fond of speaking of the fog of battle, but the fog of peace is even more impenetrable. Potential enemies, weapons, and geographical conditions can be observed only hazily and are continually shifting.

An appropriate research and development policy is one that recognizes the uncertainty and fluidity of the situation. However, it is not always possible to achieve this ideal.... We must therefore better understand the reasons for past behavior and the barriers to implementation of new policy. The lack of such an understanding remains the main practical obstacle to improving the way we develop technologically advanced systems....

This report presents a comparative study of tank ("armor") development in the Soviet Union and the United States. A principal goal of the study was to improve the understanding of the weapons acquisition process in these two countries. A secondary, but broader, goal was to learn more generally about the development of technologically advanced systems. Examination of armor development in two dissimilar countries over many years should allow the constancies of the process to be observed through shifting institutions and environments....

From 50 years of armor development, an R&D strategy can be abstracted that appears to have been effective in both the United States and the Soviet Union, in wartime and peacetime, during rapid technological change and periods of consolidation, and with large budgets and small. This long-run R&D strategy consists of (1) product improvement of existing designs; (2) independent development of components and technology; and (3) construction and testing of experimental prototypes.... Although evolutionary change cannot be the answer to every demand for increased performance, there is often the potential for extensive improvement through cumulative incremental changes.

The improved elements for incremental change must come from efforts devoted to component and technology development.... Product

improvement, however, may eventually reach the point of diminishing returns. . . .

The experimental prototype is the appropriate technique for determining whether an older product is no longer worth improving and whether a new development ought to be undertaken. But it is important that such programs be planned in a "question mark" mode rather than in an "exclamation point" style. They should be explicitly and consciously used to ask questions, not to make assertions. . . .

For many American weapon systems of the post-World War II period, an alternative development strategy was adopted [the weapons system concept]. It was believed that uncertainties could be adequately managed through analytical studies and thorough engineering. In general, this belief turned out to be unfounded. Systems were too complex, and desired technological advance was too great to be treated by the scientific and engineering knowledge and techniques that were available. . . .

Some of the most successful programs of the past quarter-century were outstanding examples of the efficacy of the weapons system concept. The Manhattan Project and B-29 development of World War II, the Atlas and Minuteman I ballistic missile program, and the Polaris submarine and missile developments were exceptional programs that transformed the services—their budgets, roles, and missions. The success of these programs brought forth a succession of imitative efforts whose unsuccessful outcomes suggest that it is not possible to standardize the exceptional. . . .

A development program of a technologically advanced system that does not recognize the inherent uncertainty of technological change and that does not structure the process in a sequential, flexible way designed to resolve the technological uncertainties will inevitably face serious difficulties of cost, schedule, and performance when unexpected problems arise.

Arthur J. Alexander, Armor Development in the Soviet Union and the United States, *Rand Report R-1860-NA, September 1976.*

IMPROVING THE READING ACHIEVEMENT OF INNER-CITY CHILDREN

Increasing students' reading achievement, particularly among minority students, has long been a central concern of the Los Angeles Unified School District. To further that goal, the District instituted its School Preferred Reading Program in 1972.... The program concentrated on elementary students who were scoring at the 25th percentile or lower on standardized reading tests, it featured determination of goals and approaches by individual schools, and it set minimum quantitative objectives for reading gains at the 3d and 6th grade levels....

In 1975 [the District asked Rand] to conduct the present study, whose purpose is to identify the school and classroom policies and other factors that have been most successful in raising the reading scores of inner-city children....

In general, our findings confirm the appropriateness of the current district reading program policies of school-level goal setting, teacher involvement in program planning, and the allocation of important decisionmaking authority to schools and teachers. We found that for ... Black ... students, school and classroom inputs were directly responsible for significant changes in students' reading achievement.

In other words, school and classroom decisions matter for the education of the minority students we studied, over and above the importance of student background characteristics such as socioeconomic status and prior reading knowledge....

[We] conclude that three broad categories of factors produce improved reading achievement for Black children: program content, implementation strategies, and classroom atmosphere....

We found that [Black student] reading achievement improved when the reading program used varied materials for different students at the same time. Other more novel approaches to instruction, such as open classrooms and team teaching, were not consistently related to measured gains on standardized reading tests....

[Reading] curricula do not, by themselves, determine the success or failure of a school's reading program. In fact, there is wide variation in average student progress among classrooms that have very similar curricula and reading strategies. This may imply that any of the reading programs we studied *can* be effective depending on how well it is implemented and taught....

The implementation strategies chosen by a school to support its reading program are crucial.... Successful implementation strategies in our sample included adequate teacher training (especially with respect to the use of varied materials), a high level of informal consultation among staff, and freedom on the part of teachers to make modifications in the reading program that increase its pertinence to the practical situations they encounter in their classrooms....

Classroom atmosphere factors that affected [Black student] reading included an absence of disruption, frequent contact between teachers and parents, and a feeling of efficacy on the part of teachers.... Moreover, we found that teachers matter for reading: Their sense of being able to "get through" to students, their commitment and morale, help to determine how much children learn. We were surprised to find little or no association between teachers' background attributes and reading progress in their classrooms. Years of experience, ethnicity, college major, or place where the undergraduate degree was obtained appeared to have little influence....

As an illustration of the quantitative importance of the various specific factors that we have identified as important, we estimate that exposing the average [Black] student in our sample to all of the approaches found to be effective would have resulted in a 10 to 20 point percentile gain for that student over the course of the 6th grade, instead of the decline of 3 percentile points that actually occurred.

David Armor, Patricia Conry-Oseguera, Millicent Cox, Nicelma King, Lorraine McDonnell, Anthony Pascal, Edward Pauly, and Gail Zellman, with contributions by Gerald Sumner and Velma Montoya Thompson, Analysis of the School Preferred Reading Program in Selected Los Angeles Minority Schools, *Rand Report R-2007-LAUSD, August 1976.*

FINDING THE TARGET BY MAP-MATCHING

If . . . air supremacy is not available over enemy territory . . . then air-launched weapons may have to be delivered from standoff . . . fired . . . from a point beyond visual line of sight to the target. . . .

Automatic tracking following acquisition or "lock-on" is a well-developed technology. . . . Not as much can be said for the acquisition function, however. To date, human intervention, in one form or another, must be involved to identify and acquire ground targets in a cluttered terrain background. There are, nevertheless, two generic approaches to realizing the required self-contained target acquisition on air-delivered weapons. . . .

The most common approach ["data-link"] to in-flight acquisition is to acquire the target in "real time" with direct human assistance, using radio links between the weapon and its launch aircraft (or via relays to some other control point). Radio links enable a human observer to find, identify, and "acquire" the target, and incidentally also to monitor the subsequent tracking operation and refine it as needed. . . . [However, the links] may be subjected to enemy jamming or may serve as sources to be tracked by the enemy for the purpose of physical destruction. . . .

Alternatively, if prior reconnaissance imagery of the target area is available, an observer can study it, find the target, and mark it. If this marked imagery (in some appropriate form) is then placed on board the weapon, together with the sensor for obtaining "live" imagery, all that is required in real time is to bring these two images into coincidence. . . . At that point, the weapon will "know" where it is with respect to the target and will be able to steer itself to impact. . . . So the technical problem reduces to one of [map-matching—mechanically] comparing two pieces of terrain imagery that are similar, but certainly not identical. . . .

Despite all these potential advantages, there are no operational systems of this sort in existence today, and for two very good reasons. The most obvious difficulty is the need for prior reconnaissance. . . . [Also] differences between the recce picture and the "live" sensor image will degrade the map-matching performance, so that a good

deal of effort must be expended in adapting the raw recce picture to correspond to the predicted strike conditions.

The second difficulty with image correlation systems is more subtle but probably even more important. The problem is that, under the degraded conditions just mentioned, the system may [produce] . . . a "false" match with some similar but incorrect portion of the target area. . . . This problem, although not encountered frequently, has still been the nemesis of most of the experimental systems in the past that have been brought up to a flight test. . . .

The principal conclusion is that by using the methods illustrated in this report, an approximate lower bound on the . . . probability of correct . . . target acquisition . . . can be calculated, so that one can, at least in principle, design systems to an acquisition specification. . . .

The second major conclusion of this study is that . . . there ought to be better [mathematical methods for comparing the sensor map with the reference reconnaissance map] than those that have usually been used in the past. . . . Rather than to simply refine [methods] that still compare every [picture element] in the sensor and reference scenes, one should search for powerful preprocessing schemes to extract the "most unique" features. One would perhaps apply several feature-selecting algorithms to a reference scene until "good" or efficient features were found for each specific scene; then not only would the reference map be modified, but the on-board preprocessor would be instructed to look for the same chosen features in the sensor map. As a consequence, the chances for a false lock should be reduced, and at the same time the amount of real-time processing should also be reduced.

H. H. Bailey, F. W. Blackwell, C. L. Lowery, and J. A. Ratkovic, Image Correlation: Part I, Simulation and Analysis, *Rand Report R-2057/1-PR, November 1976; and H. H. Bailey,* Remote Acquisition of Ground Targets through Image Correlation (Map-Matching), *Rand Paper P-5814, March 1977. This work has been extended and new techniques developed, by the same authors, in R-2211-AF,* Estimation Techniques and Other Work on Image Correlation, *September 1977.*

THE HOUSING ASSISTANCE SUPPLY EXPERIMENT: THE THIRD YEAR

The Housing Assistance Supply Experiment is one among several elements of the Experimental Housing Allowance Program undertaken by the Office of Policy Development and Research, U.S. Department of Housing and Urban Development (HUD). The program is designed to help HUD and the Congress decide whether a national program of direct cash assistance to low-income households is a feasible and desirable way to help them secure decent housing in a suitable living environment; and if so, to help determine the best terms and conditions for such assistance and the most efficient and appropriate methods for administering a nationwide program.

As part of this program, the Supply Experiment addresses issues of market and community response to housing allowances. It entails operating a full-scale allowance program in each of two metropolitan areas, chosen for strong contrasts in their housing markets, for ten years; and monitoring both program operations and market responses for about five years. The communities selected for the experiment are Brown County, Wisconsin (whose central city is Green Bay), and St. Joseph County, Indiana (whose central city is South Bend). . . .

The Supply Experiment introduced a full-scale housing allowance program into two very different housing markets. One market has a low vacancy rate and high property values, while the other has a high vacancy rate and low property values. One market appears to divide into submarkets only in terms of types of housing, while the other is racially segregated with strong distinctions between neighborhoods. One community is racially and culturally homogenous, and has strong civic spirit; the other is divided politically and socially into groups that vigorously promote their narrower interests.

The most important conclusion at this stage of the experiment is that neither market was noticeably disrupted by the introduction of the allowance program and the enrollment of several thousand low-income families in the course of the first year of program operations. . . .

We see no evidence of program-caused inflation in rents or home prices, no evidence of real estate speculation or home repair fraud, no

evidence of neighborhood turnover as program participants seek acceptable housing, and no evidence of widespread hostility toward participants or toward the program itself.

The other side of the coin is that the program so far has not dramatically affected housing expenditures; the amount of housing construction and home repair; neighborhood quality; the policies of landlords, mortgage lenders, or realtors; the degree of residential segregation; or tenure arrangements. . . .

The participants have benefited in two ways. First, their financial burdens have been eased by allowance payments. When they enrolled, nearly all were spending more than a fourth of their income for housing; many spent as much as 40 or 50 percent. Now, only the poorest participants spend much more than a fourth of nonallowance income for housing. Second, about a third are occupying better housing, sometimes acquired by moving . . . but more often by repairing their homes to meet program standards. . . . A few renters have bought homes with the aid of the allowance. . . .

Over time, program participants should gain confidence in the reliability of allowance payments and may venture on more housing improvements that are desirable but not mandatory. And as enrollment grows, so will the program effects. We note various indications of supportive community change—city-sponsored housing rehabilitation and home repair programs, landlords advertising that their vacant units meet Housing Allowance Office standards, lenders and realtors taking note of participants' new resources. But we cannot yet say how these trends will work out.

In short, we think the program has so far been modestly successful in meeting its main objectives: enabling participants to afford decent, safe, and sanitary housing without unreasonably scrimping on other forms of consumption. Community benefits—visible neighborhood improvement, residential integration of minorities—are more elusive. The program may or may not have these effects. If so, they will come slowly.

Third Annual Report of the Housing Assistance Supply Experiment, *Rand Report R-2151-HUD, February 1977.*

CITIZEN PARTICIPATION IN BROADCAST LICENSING BY THE FCC

The Communications Act of 1934 directs the Federal Communications Commission to regulate broadcast services so that the "public interest, convenience, and necessity" are served....

To make use of the public's perspective on the public interest, the Commission has established a wide variety of procedures to facilitate public participation in the management and regulation of broadcasting. These procedures range in complexity from the most informal suggestion or complaint to the intricate, time-consuming, and extraordinarily expensive license challenge wherein a party seeks to oust a broadcaster from his channel and to take his place on the dial....

On one hand, the Federal Communications Commission is directed to regulate broadcast services so that the "public interest, convenience, and necessity" are served. In this decisionmaking process the public has a right to be heard. On the other hand, the potential problem arises of citizen groups using petitioning power in an irresponsible and abusive fashion, impairing the broadcaster's ability to serve the public interest as best he sees it.

With this dilemma as its central point of focus, this report has several components: (1) It describes some of the avenues open to citizens seeking to influence FCC policies; (2) it describes the history of citizen participation, through petition and settlement, in broadcast licensing; (3) it traces the evolution of an FCC policy statement regarding citizen agreements and analyzes it, especially in the light of four recent cases before the FCC; and (4) it makes recommendations for future Commission policy which suggest that considerable leeway remains for Commission approval of citizen settlements, without infringing on the rights and obligations of broadcasters....

There is much that can be done by the FCC to promote effective citizen participation while still protecting the rights of broadcasters....

[Although] citizen groups can exert great leverage against broadcasters, the two are hardly evenly matched opponents in Commission proceedings. Broadcasters are frequently better financed and are more likely to be represented by large amounts of legal

talent. . . . [Allowing] voluntary payment of legitimate and prudent expenses could prove extraordinarily valuable in helping to right the balance.

A more imaginative approach for the Commission to follow would be to request legislation either allowing the Commission to award costs, including attorney's fees, to citizen groups that have contributed significantly to the resolution of a matter in the public interest, or to request that a "citizen's legal fund" be set up, from which the Commission itself could fund citizen group efforts designed to promote the public interest. The Commission has in the past exhibited at least some interest in proposals to help defray the legal expenses of parties involved in Commission proceedings.

Changes in internal Commission procedures could also provide for more effective citizen participation. . . . [In] many cases a petitioning citizen group is caught in a Catch-22: It cannot get a license designated for hearing until it makes a sufficient evidentiary showing, but it cannot make a sufficient evidentiary showing until it gains the rights of discovery, which come only after a license has been designated. . . .

The Court noted that "providing challengers with the power to take depositions" might be one means of avoiding this procedure, in which it finds that a petition raises sufficient questions about the licensee's capacity or operations so as to warrant a further investigation but not so strong as to require a designation for hearing. In such a case, the Commission could grant the citizen group various powers of discovery and once the discovery process is complete, determine whether the license should be set for hearing.

Lest it be thought that these measures promote irresponsible behavior on the part of citizen groups, it should be emphasized that they could all be made subject to strict Commission control. . . .

This could well be a propitious time for the Commission to turn its back on its history of denying citizen participation and of acting in an indecisive and dilatory fashion and instead to affirmatively promote responsible, effective citizen participation fully respectful of broadcasters' legitimate rights.

Joseph A. Grundfest, Citizen Participation in Broadcast Licensing before the FCC, *Rand Report R-1896-MF, March 1976.*

THE IMPLICATIONS OF SMART WEAPONS

For several centuries, men have been using weapons that were usually quite unlikely to hit.... We are entering a time when weapons will be very likely to hit, and to hit at unusually long range. We should understand that this is a big change from the experience out of which present forces and concepts evolved. We should be prepared to find that drastic changes will be forced upon us....

Today's forces will find it hard to hide from smart threats.... It is doubtful that one could hide any vehicle that carries enough firepower to deserve the enemy's attention. Nevertheless, [we] must figure out how to hide yet retain capability. That is a major implication of the advent of high technology devices in the battle area....

Our present force, indeed our entire "style," involves large numbers of vehicles at all echelons and an immense flow of consumables—none of which can be protected. We don't know how to do otherwise, but we had better learn because we will be vulnerable. Accommodation certainly will involve changes so radical as to seem outlandish by present standards. Reluctance to adopt radical goals toward which to direct our evolution will extend the lead time and increase our danger; it should not be thought that this future is remote....

For the present, until we know we can do without them, the ground force must contain men. They are needed for their target-finding ability and for very little else. Fortunately, modern technology makes it possible to put a man in control of immense standoff firepower—as much as we are accustomed to attributing to a whole division. Thus, it is not necessary for the men to carry the munitions. That is just as well, because a man can't carry enough on his shoulders, and we wouldn't be able to resupply him. The proper role for the man is to carry electro-optical equipment, to find and identify targets, to call for standoff fire, and perhaps to participate in terminal guidance. Having no heavy burden to carry, he can walk; in the concept presented here there is no need for him to move very far or very fast. Afoot, he can hide behind a bush. That ability is important because it diminishes the enemy's ability to diagnose his location from a map study.

For numerous reasons the man should not be alone, but there is no need for many men at one location. Thus, we are led to the idea of a small team of men. There doesn't appear to be need for as many as five, but two seems too few; a team probably should contain three or four men. . . . Thus, we arrive at a ground force consisting of a number of teams of men dispersed throughout the region and concealed. It is quite appropriate to think of them as guerrillas—albeit perhaps trained uniformed professionals—in command of heavy firepower delivered to them [very quickly,] on call, by standoff missiles. . . .

In war they must remain in place except for local movement to enhance their concealment or their effectiveness. They should seek to attack targets as opportunity affords, except on occasions when attack would put them in undue jeopardy. . . . They should be capable of operating indefinitely, waging an ongoing attrition war. . . .

It is commonly thought, on intuitive grounds, that such a dispersed force would need unreasonably dense deployment, or unobtainable radius of effect about each site, and unattainable deadly weapons at their disposal, to be effective. To a considerable extent these are technical questions amenable to estimation by analysis.

A preliminary analysis [shows] . . . that a force [of the order of 10,000 men] dispersed throughout West Germany, with modest terrain visibility, and calling in low kill probability fire, could nevertheless impose quite substantial and continuing attrition. . . . [Further,] a similar force, numbering about 16,000 men, deployed at higher density along the West German frontier, and calling in antitank mines as well as other munitions, could slow and then chew up a heavy invasion even across a wide front. The attrition force dispersed throughout the country would await the invaders who broke through the frontier force.

The particular numbers cited . . . were chosen as plausible but illustrative. Their purpose is to show that the usual intuitive estimates are seriously erroneous and that the whole problem warrants careful study.

T. Finley Burke, The Implications of the PGM Era, *Rand Paper P-5815, March 1977.*

CLINFO: A COMPUTER SYSTEM FOR MEDICAL RESEARCHERS

CLINFO . . . is a computing system for the storage, retrieval, and analysis of . . . clinical study data . . . pertaining to medical research on human subjects . . . in the environment of General Clinical Research Centers (GCRCs). . . .

GCRCs are small inpatient/outpatient research units, generally with fewer than 20 beds, and usually located within a university-affiliated hospital, that serve as institutional research resources for improving the quality of care that physicians offer. They provide patient care, special prescribed dietary services, biological sample collection, and specialized laboratory facilities. . . .

Generally clinical investigators collect time-oriented, but sparse, data about individual patients; they explore them by looking at sets of data values for groups of patients; they examine changes over time for individual patients or patient groups; they create subsets of patients who have common characteristics; and, once they have organized the interesting data, they analyze them using fairly simple . . . techniques. . . .

[We interviewed] 90 investigators at 23 GCRCs. We asked each investigator about his background and research interests; how much data of what types he collected; how he organized, explored, and analyzed his data; what difficulties he had doing this; what experiences he had had in using or attempting to use programmable calculators and computers; and how computer-based assistance with his data management and analysis activities might benefit his research.

The interviewed investigators told us that, aside from obtaining financial support, their greatest difficulties were in organizing and analyzing their data. . . . [They] claimed that if they had a readily accessible, well-designed data management and analysis computer system, together with specially trained support personnel, this would reduce their nonproductive time, provide greater insight into their research, reduce the duration of their research studies, and increase their publishable results. . . .

[Although] nearly everyone we talked with had nominal access to a computer center, very few . . . used it. They often lacked appreciation for what computers could do for them (partly because the computer center generally showed little interest in them and provided little in the way of user services), and when they attempted to use computers they encountered many administrative, sociological, and technical difficulties. On the other hand, many investigators were making extensive, effective, and comfortable use of programmable calculators . . . [which] are useful for data analysis but not data organization and often require the data to be reentered each time they are analyzed. . . .

The CLINFO project is being conducted by clinical investigators at the Baylor College of Medicine, the University of Washington, Vanderbilt University, and the University of Oklahoma; by information scientists at The Rand Corporation; and by staff members of the [National Institutes of Health]. . . . To date the project (1) has determined that the most critical needs which can be met effectively using state-of-the-art computer technology lie in the areas of managing and analyzing clinical-research data collected by individual investigators, (2) has developed prototype minicomputer-based systems designed to satisfy these needs in the GCRC setting, and (3) has installed, and is successfully operating, two prototype systems in GCRCs where they are being evaluated. . . .

The first [two CLINFO prototypes have] been operating at the Baylor College of Medicine . . . since January 1976 . . . [and] the University of Washington School of Medicine . . . since September 1976. . . . The third site will be the Vanderbilt University School of Medicine. . . .

The CLINFO prototype is based on the premise that clinical research data are a precious commodity representing considerable intellectual, organizational, and financial investment. They are derived from tests and measurements made on human subjects, and they hold the promise of new knowledge in the treatment or prevention of human disease.

G. F. Groner, W. R. Baker, Jr., T. G. Christopher, M. D. Hopwood, N. A. Palley, W. L. Sibley, and H. K. Thompson, Jr., The Design and Evaluation of a Prototype Data Management and Analysis System for Clinical Investigators, *Rand Paper P-5746, November 1976; and Palley, Groner, Hopwood, and Sibley*, CLINFO User's Guide: Release Two, *Rand Report R-1543-2-NIH, October 1976.*

SOVIET PROPOSALS FOR INTERNATIONAL REDUCTION OF MILITARY BUDGETS

In the three-quarters of a century since the first effort in modern times, at the Hague Peace Conference in 1899, reduction of military budgets has been proposed numerous times, by many countries, in a variety of international forums. . . . The USSR has been particularly active in promoting this route to disarmament. Beginning in 1948 and over the next two decades, the Soviet Union made more than 20 proposals for reduction of military budgets. . . .

After some eight years of Soviet inactivity on this subject, Foreign Minister Gromyko proposed at the 28th General Assembly in September 1973 that the five permanent members of the Security Council reduce their military budgets by 10 percent from the 1973 level during the following financial year; that 10 percent of the savings be allotted in assistance to developing countries; and that other states, particularly those with a "major economic and military potential," should follow suit.

Although generally welcomed by representatives of developing countries, the Soviet initiative was greeted with skepticism by the Western states and uncompromising hostility by the People's Republic of China. To rescue a difficult situation, the representative of Mexico suggested an expert study of the problem . . . [which led to] a report that covered not only the problems of reducing military budgets by the major spenders but also those of using the savings for development assistance.

The USSR participated in that group and the group report was adopted unanimously by the members. However, subsequent efforts by the Assembly to build on that report, including the appointment of a second expert group in 1976 to study in greater depth the problems of measurement and reporting of military expenditure did not receive Soviet support. . . .

With extraordinary frequency [over the past 30 years,] the Soviet Union has . . . [proposed] moderate-size reduction of military budgets of the great powers. However, with no provision for comparing military

budgets of different states or for verifying compliance with the reductions, the Soviet proposals have never been regarded by Western states as serious disarmament measures. "Who will take us seriously," asked Britain's Sir Donald Maitland at the 28th General Assembly, "if our suggested starting point is arbitrary and unverifiable deductions from an unknown quantity?"

There are three criteria of utility and viability for any disarmament agreement—equity (with respect to the degree of sacrifice imposed on the participants), stability (the contribution made to regulating arms competitions and to defusing international crises), and verifiability. The satisfaction of these criteria requires information.... Military expenditure limitation is no different in these respects than strategic arms limitation or other kinds of arms control arrangements. If anything, the information requirements of expenditure limitation are greater, inasmuch as the type of information required cannot, for the most part, be obtained by "national technical means."

Regrettably, the USSR has remained unmoved by this argument. Neither does it show any sign of interest in easing its virtual total ban on the release of military information. The near-term prospects for agreement by the major powers on significant military expenditure reductions are, consequently, not promising.

In the meantime, a related though separate effort is proceeding in the United Nations to develop a system of standardized reporting of military expenditure. Evidently, it is not likely that the USSR will be interested in encouraging this effort either. However, the idea has broad international support at present and it may be hoped that its adoption and operation will not be long delayed. Given the continuation of such support, the creation of a standardized United Nations reporting system offers a framework in which gradual alteration of Soviet policy on the disclosure of its military expenditure could take place. If there is any basis for optimism with respect to improvement generally in relations among the major powers, perhaps there are also grounds for hope on this particular issue.

Abraham S. Becker, Soviet Proposals for International Reduction of Military Budgets, *Rand Paper P-5837, March 1977.*

WHY FAMILIES MOVE

Many policies under recent consideration for the development of human resources potentially affect the migration of labor. Some, such as the application of relocation assistance bonuses, are designed to do so directly by enabling people to move to available jobs. Others, such as negative income taxes, wage subsidies, unemployment insurance, public employment programs, minimum wage laws, and the Equal Rights Amendment, might do so unintentionally by altering the costs and benefits of migrating. It is essential to anticipate both the direct and the indirect effects of a particular policy if its overall impact is to be assessed and unintended influences are to be avoided.

Existing migration studies offer policymakers little clear guidance on how national or regional human resource development policies might affect population redistribution. . . . This report attempts . . . to bridge the gap between previous research, with its limitations, and the current concerns of policymakers. . . . The study is restricted to married couples so that family interactions . . . overlooked in most migration studies but having important implications for policy, can be fully analyzed. . . .

Some of the findings of the research help to explain paradoxes found in previous studies (e.g., the seeming absence of "push" of economic conditions at the place of origin), whereas others confirm relationships found before (e.g., the effect of previous migration on subsequent geographic mobility) but shed new light on the causes of the underlying behavior. Certain results disagree with the conclusions of some recent studies (e.g., those that find a working wife always inhibits family migration), and others illuminate policy-relevant issues (such as how a negative income tax might affect migration) not investigated before because the appropriate data were not available.

The main findings of this study [include]:

- Household-level unemployment or dissatisfaction with a job does "push" a family to move. . . .
- Local . . . unemployment rates *do* affect out-migration, but only within the subset of people most seriously affected—the unemployed.
- Unemployed persons and others looking for work are more

responsive to such economic determinants as family income, origin wage rates, and expected earnings increases than persons apparently satisfied with their jobs.

- Families are much more likely to move in a given period if they moved in the recent past, primarily because of a strong tendency for people to return to places they have recently left....
- Families who have moved several times previously are more likely to move again than are families who made one or no recent moves *if* those multiple moves were nonreturn moves....
- Wives are not passive, secondary migrants, but rather appear to have a significant influence on the family's decision whether to move and where.... Also, families that move tend to select destinations where both the husbands' *and wives'* earnings are highest...

Several of the findings... have important policy implications:

- Because unemployed persons, especially those living in depressed labor markets, are already more likely to move than are those who are not looking for work, it may not be necessary to instigate policies facilitating migration for a group already induced to leave. Such policies may merely provide a costly duplication of the already effective influence of private market forces.
- Because unemployed persons appear to respond to local unemployment rates in deciding whether to leave an area, policies of investment to expand economic opportunities in depressed areas are likely to help prevent economically forced out-migration.
- An increase in family income is estimated to reduce the probability that a family whose head is unemployed will migrate.... Thus, unless the receipt of an income bonus is conditional on its being used to help defray costs of moving, income supplements given to the unemployed may be used to subsidize their staying in their current location rather than to finance job search in other labor markets.

Julie DaVanzo, Why Families Move: A Model of the Geographic Mobility of Married Couples, *Rand Report R-1972-DOL, September 1976.*

SOVIET POLICY DILEMMAS IN ASIA

Spurred at the end of the last decade by the outbreak of armed conflict along the Sino-Soviet border and by the new U.S. Administration's first steps to disengage from Vietnam, the Soviet Union embarked on a course of intensified diplomatic activity in Asia, coupled with highly visible displays of Soviet naval power in Pacific and Indian Ocean waters, that quickly captured world attention. Measured by almost any conventional standard . . . the USSR is now engaged in the affairs of Asia on a considerably wider front than ever before.

Yet all of this activity has brought few tangible rewards to the Soviet Union. Moscow has not emerged as a conspicuous beneficiary of the post-Vietnam regroupment of Asian political forces, as many Western observers had earlier feared, and the USSR does not appear to be well-positioned to make major political gains soon in Asia. . . .

Early Cold War predictions that the USSR would enjoy a potentially decisive advantage in the Third World over the alien West, discredited by its imperialist and colonialist past, have turned out to be grossly exaggerated. . . .

The Soviet leadership's preoccupation with efforts to contain China, discredit its leaders, and discourage other Asian states from collaborating with the People's Republic of China appears to be based on the expectation that as long as control of China remains in hostile hands, the inevitable growth of Chinese power and influence will sooner or later convert what Moscow probably still regards as a potential threat to Soviet security into a real and critical menace. To position itself to deal with this potential, the USSR since 1965 has conducted a massive military buildup along the Sino-Soviet border, where a substantial fraction of its aggregate conventional and peripheral nuclear strike forces are now concentrated, facing Chinese forces that are vastly inferior by almost every measure of strength. . . .

Many Western analysts (and, in private conversations, some Soviet specialists as well) have regarded this as a characteristic Soviet overreaction, which has had no demonstrable current utility, but has

served to convert the most pessimistic Soviet expectations about China into a virtually self-fulfilling prophecy.

The longer-run Soviet interest, and almost certainly the preference of the present Soviet leadership, is to achieve a reconciliation or, at least, a reduction of tensions and accommodation with the PRC. . . . [But] even if future Soviet and Chinese leaderships could agree on a resolution of China's territorial claims against the USSR and to a partial withdrawal or thinning out of mobile military forces stationed along the border, the vast military infrastructure . . . installed by the USSR (and, in response, to a much lesser extent by the PRC) has locked the two sides into a confrontation posture from which it would be extraordinarily difficult for them to extricate themselves. . . .

"Normalization" rather than "détente"—not to speak of alliance—is likely to characterize Soviet relations with most Asian states in the near future; and the inclination of Asian political elites to take out comparatively low-cost, low-profile insurance against an uncertain future by opening a political dialogue with Moscow appears to be growing. For those concerned with stable and orderly development of international relations in Asia, this trend need not be a cause for great anxiety, and might even have salutary effects, particularly if broadened and deepened Soviet diplomatic involvement leads the USSR to assume a greater share of responsibility for providing economic and technical assistance to the developing countries of the region. . . .

Where the USSR has been successful in planting its presence and expanding its influence abroad, it has done so by massive transfers of military resources and by flexing its muscles internationally on behalf of clients engaged in regional conflicts with their neighbors. . . . Soviet willingness to play such a role, however, is unlikely to be consequential if invitations are not forthcoming.

As never before in modern Asian history, the probability of external military intervention depends above all on the play of indigenous political forces which neither the USSR nor any other outside power can reliably control.

Arnold Horelick, Soviet Policy Dilemmas in Asia, *Rand Paper P-5774, December 1976.*

NEW MEXICO TRIES TO IMPROVE HEALTH CARE AND CONTROL MEDICAID PROGRAM COSTS

By 1970 the need to examine what increments in health were being obtained for additional investments in medical care was critical.... [In] 1965, $40.5 billion (5.9 percent of the gross national product) was being directed to medical care.... 1973 figures were estimated at $99 billion or 7.7 percent of the gross national product....

About the same time that concerns over the cost of medical care were surfacing, health services researchers and physicians were studying an age-old issue, the quality of services rendered. Although efforts to assess the quality of care must be traced back to Florence Nightingale's work in the 19th century, by the 1960s a critical mass of data had been accumulated that demonstrated the following:

- Serious deficiencies existed in most areas of medical care, regardless of the method by which care was assessed.
- These deficiencies involved in many instances the omission of simple tasks, such as recognition by the physician of an abnormal laboratory result and follow-up action.
- Deficiencies in the quality of care received were not confined to disadvantaged groups but appeared to be almost equally distributed between nondisadvantaged and disadvantaged groups.
- Deficiencies in care varied remarkably by physician and by the condition that required care in the first place; attempts at predicting the quality of care given by a physician by means of a series of physician characteristics such as age, medical school of graduation, or board certification status were unproductive....

On September 1, 1971, a peer review system designed both to improve the quality of care given to Medicaid patients and to control the cost of such care became operational in New Mexico. [Our] purpose ... is to evaluate the first two years of operation of that system....

The principal conclusions and implications regarding the effect of peer review on costs and quality of care [include]...

- Physician involvement in peer review had a major effect

on quality of care regarding one ambulatory service, but virtually no effect on costs of care.

- Almost all savings to the Medicaid program were brought about by the administrative activities of the fiscal intermediary working in tandem with the peer review organization. Without these administrative savings (which did not require professional review), the peer review system would not have produced any net savings.
- Peer review of ambulatory care from a computerized data bank based on Medicaid claims was shown to be feasible.
- Peer review of ambulatory care, except in the case of injections and perhaps prescriptions, will almost inevitably lead to greater use of most services and thus increase costs. It is hoped that the increase in the use of services fostered by peer review will also improve health status. . . .
- The Medicaid program saved money on nursing home care through the efforts of the peer review system to reclassify nursing home patients to lower levels of care. The longer run outcomes of this approach are unknown; they should be evaluated to ensure that the cost savings were not realized through sacrificing quality and humaneness of care.
- The length-of-stay approach (precertification and recertification) to controlling hospital costs . . . was ineffective. . . .

The principal conclusions and implications regarding physicians and quality of care include . . .

- It was comparatively easy to identify . . . physicians who had the most basic problems with delivering appropriate medical care.
- Both educational efforts and direct sanctions had positive effects in improving quality of care (as measured by the one criterion of lower numbers of injections billed, especially for drugs with potentially potent side effects). . . .
- Certification by a specialty board was very highly correlated with better quality of care; younger age was not.

Robert H. Brook and Kathleen N. Williams, Evaluation of the New Mexico Peer Review System, 1971 to 1973, *Rand Report R-2110-HEW/RC, February 1977.*

NUMBERED LIVES: SOME STATISTICAL OBSERVATIONS FROM INTERNATIONAL HOSTAGE EPISODES

Approximately one-fifth of all incidents of international terrorism involve taking hostages—by taking over embassies or other public buildings or kidnapping individuals. Terrorists seize hostages—diplomats, corporate executives, tourists, sometimes just anybody handy—to deliberately heighten the drama of the episode guaranteeing widespread publicity and increasing their leverage by placing human life in the balance. . . .

[We have studied] 77 international hostage incidents that took place between August 1968 and June 1975 . . . in which foreign government officials were kidnapped or kidnappers' demands were made on governments. . . . The main findings may be summarized as follows. . . .

- Standard kidnapping tactics are more likely in countries where the terrorists are operating on home terrain and have an underground organization. Barricade and hostage incidents are more likely when the terrorists are operating abroad, or at home in countries where they lack the local capability for sustaining underground operations.
- American diplomats and other American representatives abroad have been the most popular targets of kidnappers, figuring in more than a third of all international hostage incidents during the past six years. However, kidnappers have *explicitly* targeted the U.S. government with their demands in only three incidents.
- In two-thirds of the cases in which explicit demands were made, they were directed at the local government. The release of prisoners was the principal demand in two-thirds of the cases in which demands were made.
- Firm no-concession policies toward individual kidnappings have not clearly served as deterrents to future kidnapping tactics. The demise of such tactics appears to result mainly from effective antiterrorist campaigns that destroy the organization and apprehend its members regardless of specific ransom policies. . . .

- Except in possibly one case, no local government changed its no-ransom policy during an episode because of presumed U.S. influence.
- The decision by governments to meet or reject the demands of kidnappers does not appear to have been much affected by the rank or by the number of hostages held.
- More hostages have died during an assault by security forces than from cold execution by the terrorists. . . .

Terrorists probably do not engage in formal cost-benefit analysis while preparing an operation. Yet solely on the basis of the history of the 77 cases in the chronology, a potential kidnapper could conclude that, on a global scale, he had the following probabilities of success and risk:

- 90 percent probability of actually seizing hostages.
- 77 percent chance that *all* members of the kidnapping team would escape punishment or death, whether or not they successfully seized hostages.
- 40 percent chance that all or some demands would be met in operations where something more than merely safe passage or exit permission was demanded.
- 36 percent chance of full compliance with such demands.
- 86 percent chance of success where safe passage or exit, for themselves or others, was the sole demand.
- 60 percent chance that, if concessions to the principal demands were rejected, all or nearly all of the kidnappers could still escape alive by going underground, accepting safe passage in lieu of their original demands, or surrendering to a sympathetic government.
- Almost a 100 percent probability of gaining major publicity whenever this is one of the terrorist goals.

In sum, the record suggests that the tactic of seizing hostages for bargaining or publicity is far from being irrational, mindless, ineffective, or necessarily perilous.

Brian Jenkins, Janera Johnson, and David Ronfeldt, Numbered Lives: Some Statistical Observations from 77 International Hostage Episodes, *Rand Paper P-5905, July 1977.*

APPOINT A COMMISSION: SOCIETY'S REACTION TO SERIOUS PROBLEMS

The study presented in this report was commissioned by the . . . Department of Health, Education, and Welfare in response to the publication of three independent reports on youth and schooling: *Youth: Transition to Adulthood,* by the President's Science Advisory Committee (James Coleman, Chairman); *The Education of Adolescents,* by the National Panel on High Schools and Adolescent Education (John Henry Martin, Chairman); and *The Reform of Secondary Education,* by the National Commission on the Reform of Secondary Education (B. Frank Brown, Chairman).

The study team was charged with reviewing these three reports critically to assess: the completeness and accuracy of their evidence; their success in identifying important and persistent phenomena in this nation's education and socialization of youth; their judgments about the extent to and manner in which these phenomena have caused unnecessary social, economic, and educational problems; and the likely efficacy of policies they propose to ameliorate these problems. The study team consisted of an educator, a social psychologist, an economist, and an educational policy analyst with experience in federal and local educational policymaking. . . . [In addition to making a critical review of these commission reports, the authors provide some insights, illustrated by the excerpts below, into the social and political functions of such commissions.]

This undertaking has proved to be hazardous. Each of the three reports represents a bundle of theories, beliefs, and evidence—in varying proportions—developed by a distinguished group of knowledgeable, often expert, persons.

Commission studies such as these have become, in the United States and in other democratic nations, important parts of the societal reaction to immediate, serious problems. They are intended to be efficient devices to bridge the gaps in knowledge and perception that exist between policymakers and the best-informed or -advised segment of the public.

Commission members are chosen for their practical or intellectual expertise, but not necessarily for their objectivity or methodological prowess. They do not always accept uncritically the research evidence presented to them, but rather assess it in the light of their years of prior experience and values, and do not perform new research. [Their] intellectual processes are inherently obscure and are made more so by the political processes by which commissions usually accommodate differing views in building consensus among the members.

Commission reports are thus easy to criticize, but hard to refute. Critics, ourselves included, risk taking "cheap shots" that attack the credibility of the reports without appreciating the fullness of their understanding or, most significantly for policy purposes, without suggesting either alternative or additional interpretations of the situation or policy implications. We have tried to make the value assumptions of the commissions' reports explicit and to show where their lines of argument are or are not compelling. [Two of the] questions we tried to answer were:

- How complete and accurate are the reports in their presentation of evidence? . . .
- To the extent that sources of the problem lie in the social institution, how can institutional performance be improved?

For policymakers especially, we have also tried to assess both the continuing relevance of information and suggestions (already three to four years old) and the feasibility of specific proposed reforms. . . .

Finally, we hope that our report will not contribute to a view that youth and adolescence in America are best described as a series of pathological episodes, with the arguments centered on how much worse adolescents are becoming. We would like to emphasize that, in our study, we found the differences between youth and adults to be both less extensive and less significant for the future than the reports suggest—and that, in our lives, we have found among the vast majority of young people (as among adults) much alienation and uncertainty, but little that is pathological.

Michael Timpane, Susan Abramowitz, Sue Berryman Bobrow, and Anthony Pascal, Youth Policy in Transition, *Rand Report R-2006-HEW, June 1976.*

PRIVACY AND THE COMPUTER

Surrounded by record-keeping systems that contain extensive personal information about him, the citizen finds that he is increasingly in a position of significant disadvantage in the balance of power between himself and the totality of data systems....

A pivotal aspect of the privacy issue is the present one-sided control that the "data owner" has over the use of personal information.... Except in isolated categories of data, an individual has nothing to say about the use of information that he has given about himself or that has been collected about him.... Although recourse is now available to the individual in such sectors as the credit industry, federally controlled record-keeping systems, some educational institutions, and in some state and local governments, generally the private sector is not legislatively constrained....

The privacy issue ... achieved significant impetus from a committee chartered by Secretary Elliot Richardson, then of the Department of Health, Education, and Welfare (HEW), who pointed the group toward an examination of the record-keeping practices of his agency. The ensuing report, published in July of 1973, has had a profound effect on the privacy issue in this country and to some extent in the world.... "Records, Computers and the Rights of Citizens" has set the tone, concepts, and even the language for most legislative attempts to treat privacy in an omnibus fashion. The report made several very important contributions.

First, it did define privacy in terms of mutuality of interest between record-keeper and data subject. Second, it introduced the notion of "fair information practice" as a basis for improving the balance between record-keeper and data subject and as a means of assuring mutuality of interest and joint control. It set forth five general principles that are regarded as the foundation for privacy safeguards. Finally, it suggested features that a code of fair information practice might contain.

Language and concepts were lifted from the report with minimal change and became the basis for omnibus legislative attempts in the country. For example, the Federal Privacy Act is based on the

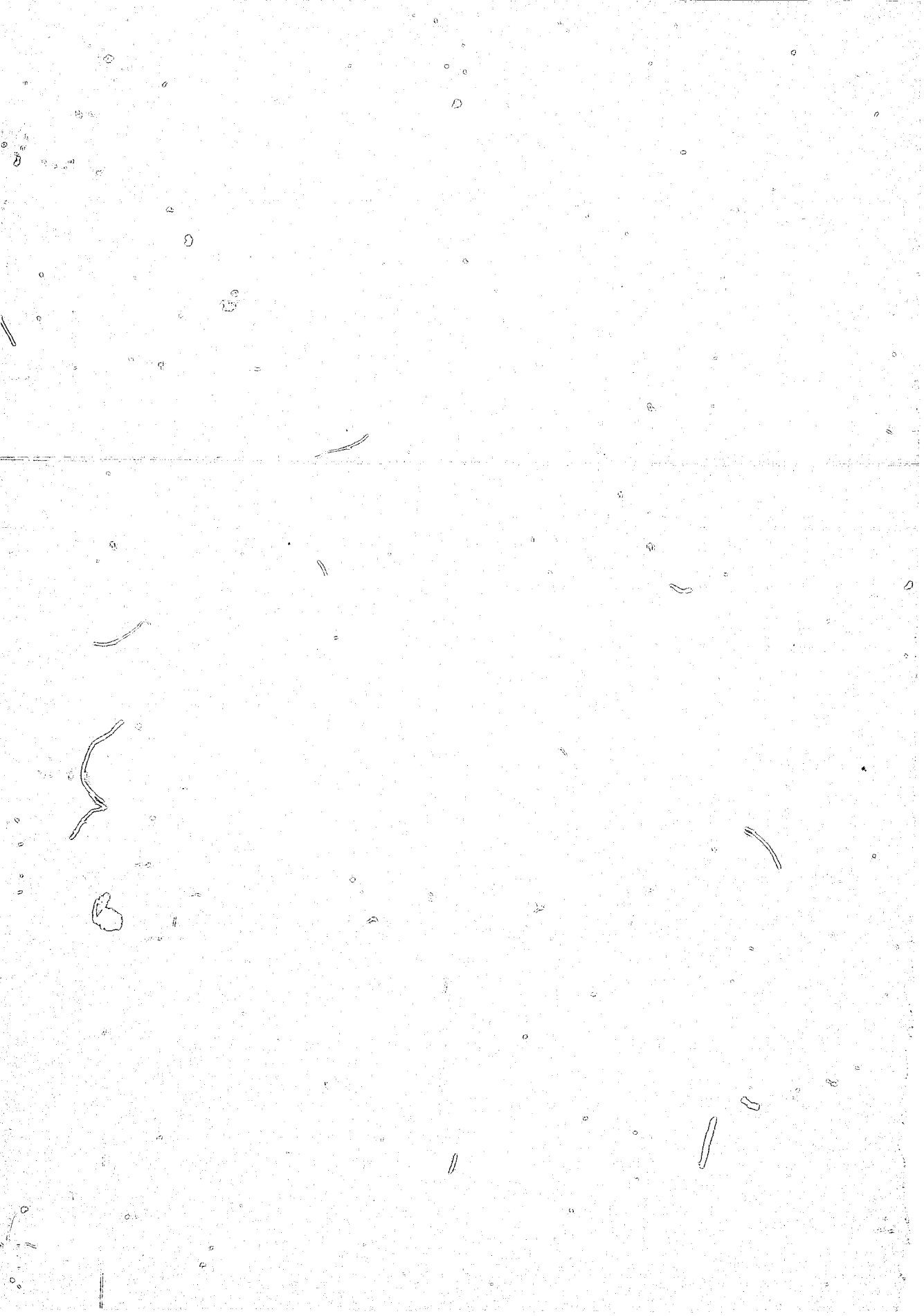
concepts, principles, and even language introduced by the HEW report; many state efforts also are. . . .

Both the concept of a Code and its details are now widely used as the foundation of privacy legislation in the United States, and its applicability is being studied in other countries. The five basic principles of the Code are equally applicable to personal information record-keeping systems in the government and in the private sector:

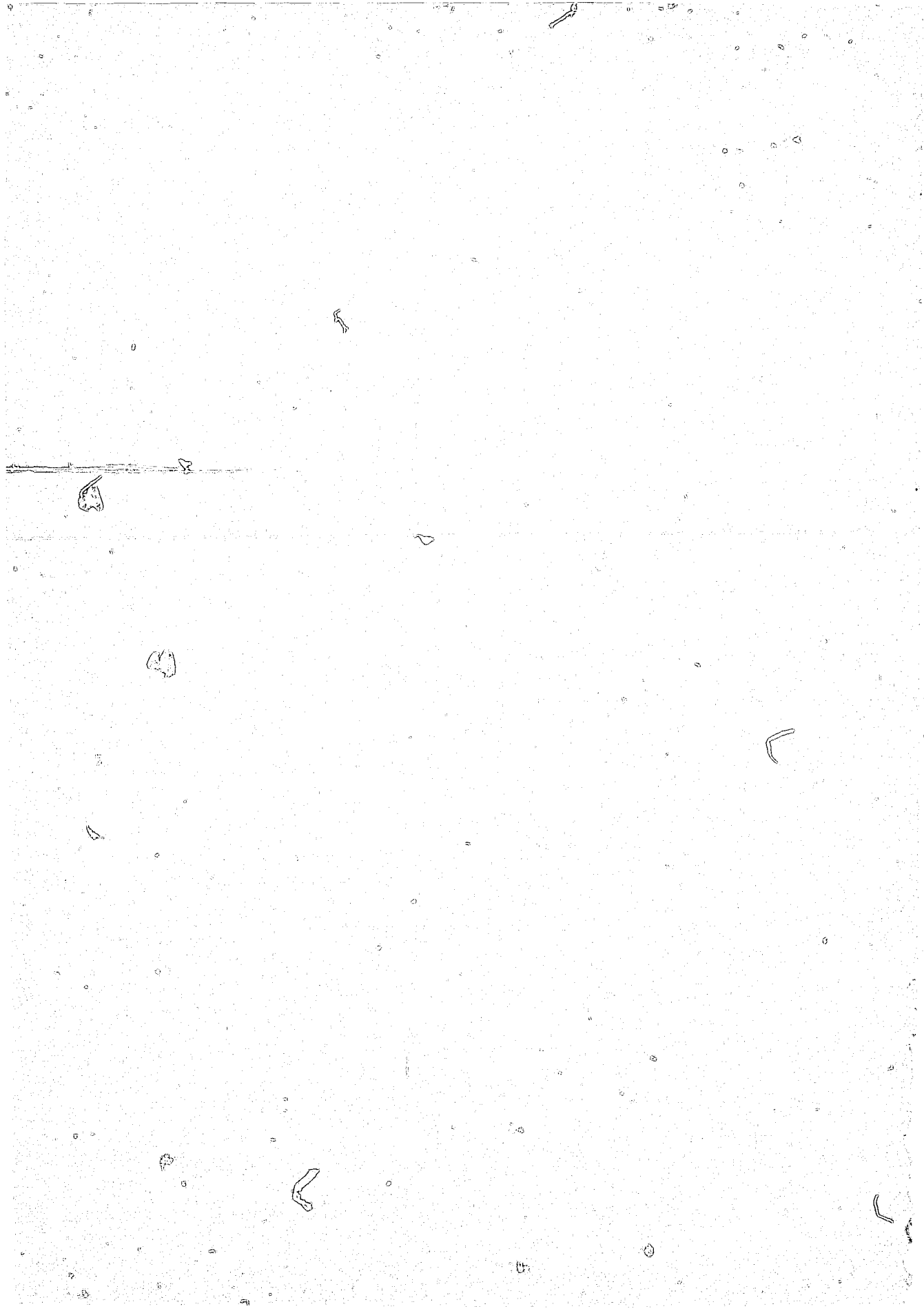
1. There must be no personal data record-keeping systems whose very existence is secret.
2. There must be a way for an individual to find out what information about him is on record and how it is used.
3. There must be a way for an individual to correct or amend a record of identifiable information about him.
4. There must be a way for an individual to prevent information about him that was obtained for one purpose from being used or made available for other purposes without his consent.
5. Any organization creating, maintaining, using, or disseminating records of identifiable personal data must guarantee the reliability of the data for their intended use and must take precautions to prevent misuse of the data. . . .

Extension of privacy protection to record-keeping systems maintained by criminal justice and law enforcement agencies of state and local governments and by private industry and institutions is the next order of business.

Rein Turn and Willis H. Ware, Privacy and Security Issues in Information Systems, *Rand Paper P-5684, July 1976; and Willis H. Ware,* Privacy Issues and the Private Sector, *Rand Paper P-5685, July 1976. Willis Ware was Chairman of the 1973 HEW Committee and Vice-Chairman of the Privacy Protection Study Commission, created by the Privacy Act of 1974. The final report of the Commission was presented to the President and Congress on July 12, 1977.*



Research Areas 2



APPLIED SCIENCE AND TECHNOLOGY

Advanced propulsion technology
Atmospheric sciences
Cruise missile technology
High accuracy technology
Hydrodynamics
Laser applications
Microcircuit technology
New technologies: military uses and implications
Planetary mapping
Strategic and space systems for the 1980s
Synthetic fuels

COMMUNICATIONS

Cable television systems
Social effects of TV viewing
Telephone pricing
Worldwide military communications network

CRIMINAL JUSTICE

The criminal investigation process
Dangerous habitual offenders
Juvenile delinquency
Performance measures in the prosecution process
The sentencing process

DEFENSE STRATEGY, FORCES, AND SUPPORT SYSTEMS

Advanced concepts and systems for ground warfare
Airbase vulnerability and defense
Air Force operations and support: alternative policies and structures
Alternative NATO postures and concepts
Arms control: cruise missiles
Command and control
Cost analysis methods for Air Force systems
Crisis operations
Force readiness
Future strategic aerospace force requirements

Hypervelocity impact weapon systems
ICBM options
Implications of precision-guided weapon systems
Improving the reliability of avionic systems
Major forces shaping the 1980s
Military options and operations in space
Missile accuracy
Mobility
Posturing NATO to cope with unexpected attack
Remotely manned systems
Satellite survivability
Space-based strategic support systems
The strategic arms competition
Survivability of U.S. and allied forces
Tactical war: conventional and nuclear

EDUCATION

Aids for the partially sighted
Air Force education and training
Educational finance and governance
Evaluation of federal programs for educational innovation
Evaluation of multiple educational options
Implementing innovations in public schools
Reforms in state finance of education
School desegregation

ENERGY, ENVIRONMENT, AND NATURAL RESOURCES

Atmospheric effects of power plants
California water policy: long-range implications
Computer simulation of bays and estuaries
Energy and air quality in California
Energy policy and technology issues
An experiment in alternative electric rate structures
Future energy demand and conservation
Military energy availability and use
The nuclear fuel cycle and nuclear proliferation
Nuclear power reactors
Water pollution
World oil reserves

HEALTH

- Air Force health delivery systems
- Alcoholism and treatment
- Assessing the quality of health care
- Federal biomedical research policy
- Health care demand, operations, and service
- Health Insurance Study
  - Field operations in Dayton, Ohio; Fitchburg, Massachusetts; Charleston, South Carolina; and Seattle, Washington
  - Analysis and evaluation
- Hospital costs and service
- The information processing needs of clinical researchers
- Leukemia chemotherapy
- Medical malpractice

HOUSING

- Housing Assistance Supply Experiment
  - Field operations in St. Joseph County, Indiana, and Brown County, Wisconsin
  - Data collection and processing
  - Analysis and evaluation
    - Supply responsiveness
    - Behavior of market intermediaries
    - Residential mobility and neighborhood change
    - Effects on nonparticipants

HUMAN RESOURCES

- Aid to families with dependent children
- Air Force medical organization and personnel
- The All-Volunteer Force
- Alternative military personnel policies
- Black/white earnings and employment patterns
- DOD training and manpower management
- Late adolescent childbearing
- Migration and return migration
- Military manpower requirements and compensation
- Needs of the low income and minority aged
- Nonmetropolitan growth

Personnel and training support for advanced avionics systems of the 1980s
Supply and retention of Air Force officers

INFORMATION SYSTEMS

Advanced computer science and defense problems
Machine-aided knowledge acquisition
Management of military computer resources
Privacy and security of computer data

INTERNATIONAL STUDIES: ECONOMICS, POLITICS, TECHNOLOGY

Changing political and economic conditions in Europe
Economic and demographic family behavior in Malaysia
Economic development, human resources, and income distribution in lesser developed countries
Flood prevention in the Netherlands
Future European defense issues
Implications of Soviet and Chinese military policy and strategy
International terrorism
Japan's energy program
Research and development: U.S. and Soviet
Soviet arms control policies
Soviet involvement in the Third World
Soviet strategic posture and decisionmaking
Technology exchange: international security issues
U.S.-Chinese relations

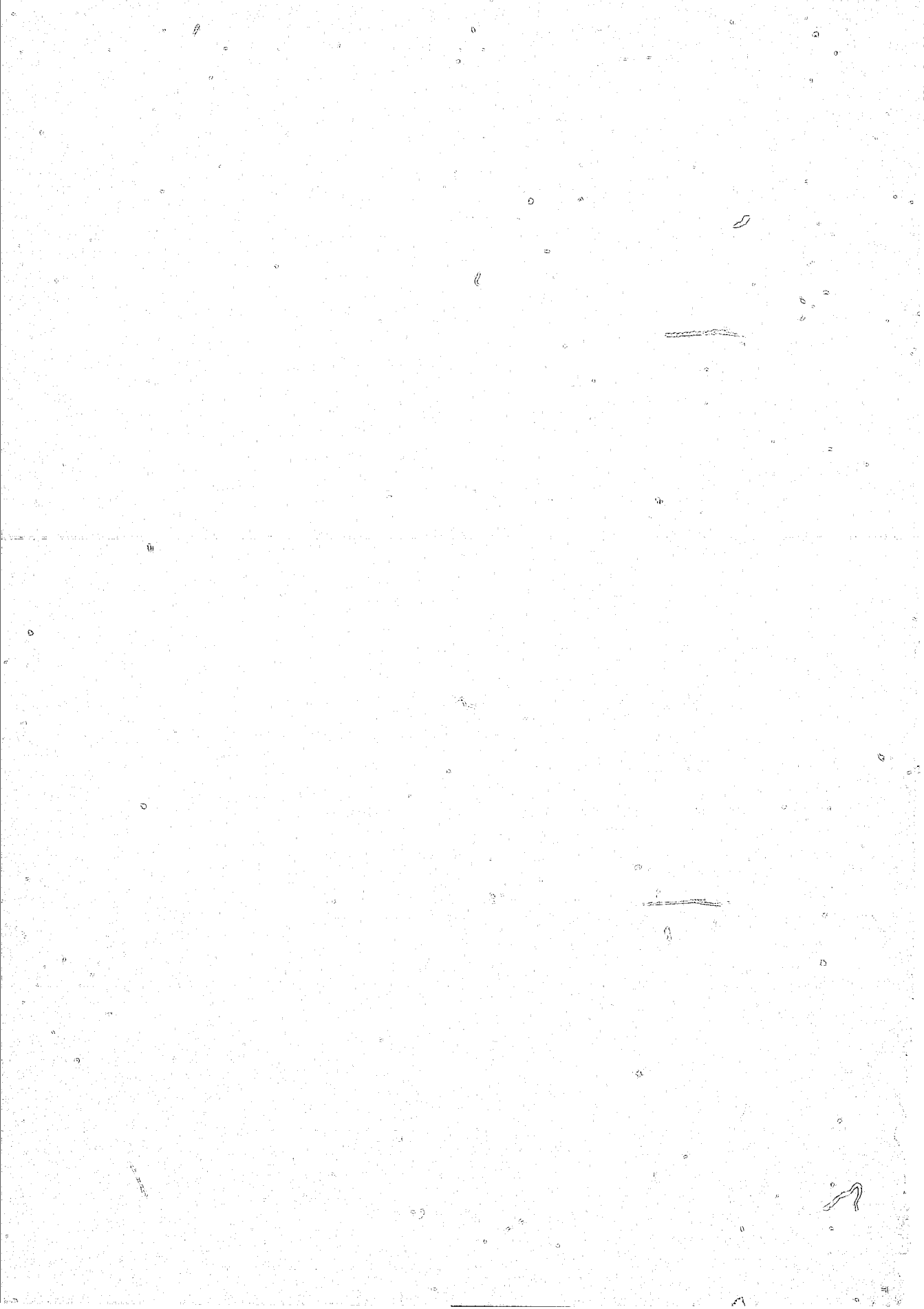
REGIONAL AND URBAN PROBLEMS

Economic conditions of metropolitan areas
Policies affecting residential location, delivery of public services, etc.
Urban impacts of federal policies

RESEARCH, DEVELOPMENT, AND ACQUISITION OF SYSTEMS

Acquisition strategies and institutions
The adequacy of the defense industrial base

Air Force acquisition policy
Alternative processes for spacecraft acquisition
Federal demonstration projects
Impact of R&D strategy on cost and performance of energy systems
International R&D trends
Long-range development planning



Research Reports and Books 3

The titles listed in this section represent Rand reports issued for general distribution for the twelve months ending September 30, 1977. Also listed are books published during this period. Excluded from the listing are some 200 professional papers produced by the staff and intended primarily for journal publication. Papers are listed in Rand's indexes and in a variety of subject bibliographies, described in the last section of this report. Also excluded from the listing are classified reports on research in our national security programs, and working documents designed for reporting provisional research results to our clients and sponsors.

CONTINUED

1 OF 2

APPLIED SCIENCE AND TECHNOLOGY

R-1898-ARPA. *"e^9": Stability Theory and Boundary-Layer Transition.* S. A. Berger, J. Aroesty.

R-1949-AF. *Geometric Performance of Pseudoranging Navigation Satellite Systems: A Computer Program.* J. V. Lamar, L. N. Rowell, J. J. Mate, Jr.

R-1956-ARPA. *Basic Limitations in Microcircuit Fabrication Technology.* I. E. Sutherland, C. A. Mead, T. E. Everhart.

R-1966-ARPA. *The Buoyancy and Variable Viscosity Effects on a Water Laminar Boundary Layer along a Heated Longitudinal Horizontal Cylinder.* L. S. Yao, I. Catton.

R-1970-ARPA. *Strategic Defense Materials: A Case Study of High Temperature Engines.* R. G. Salter, C. Dzitzer, E. D. Harris, W. E. Mooz, K. Wolf.

R-1979-AF. *Advanced Composites: Electromagnetic Properties, Vulnerabilities, and Protective Measures.* A. L. Hiebert.

R-2015-ARPA. *Rand/ARPA Climate Dynamics Research: Executive Summary and Final Report.* W. L. Gates.

R-2056-ARPA. *Molecular and Metallic Hydrogen.* M. Ross, C. Shishkevish.

R-2057/1-PR. *Image Correlation: Part I. Simulation and Analysis.* H. H. Bailey, F. W. Blackwell, C. L. Lowery, J. A. Ratkovic.

R-2057/2-PR. *Image Correlation: Part II. Theoretical Basis.* H. W. Wessely.

R-2089-NASA. *The Control Net of Mercury: November 1976.* M. E. Davies, F. Y. Katayama.

R-2090-NASA. *Control Point Measurements on Mariner 10 Pictures of Mercury.* M. E. Davies, F. Y. Katayama, J. A. Roth.

R-2091-NASA. *Identification of Control Points on Mercury.* M. E. Davies, J. A. Roth.

R-2099/1-NASA. *Standard Spacecraft Economic Analysis, Volume 1: Executive Summary.* E. D. Harris, J. P. Large.

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R-2111-ARPA. *Entry Flow in a Heated Tube.* L. S. Yao.

COMMUNICATIONS

R-1936-RC. *A New Approach to Millimeter-Wave Communications.* N. E. Feldman, S. J. Dudzinsky, Jr.

R-1962-MF. *Optimal Pricing of Local Telephone Service.* B. M. Mitchell.

R-2023-MF. *Copyright Liability for Cable Television: Is Compulsory Licensing the Solution?* S. M. Besen, W. G. Manning, B. M. Mitchell.

CRIMINAL JUSTICE

The Criminal Investigation Process. P. W. Greenwood, J. Chaiken, J. R. Petersilia. D. C. Heath and Company, Lexington, Mass.

Indicators of Justice: Measuring the Performance of Prosecution, Defense, and Court Agencies Involved in Felony Proceedings. S. Wildhorn, M. M. Lavin, A. H. Pascal. D. C. Heath and Company, Lexington, Mass.

R-1803-NYC. *Guidelines for Scheduling Police Patrol Cars.* P. Kolesar, K. L. Rider, T. B. Crabill.

R-1912/1-DOJ. *Patrolling the Neighborhood Beat: Residents and Residential Security. Executive Summary.* R. K. Yin, M. E. Vogel, J. Chaiken, D. Both.

R-1930-DOJ. *Intervening with Convicted Serious Juvenile Offenders.* D. Mann.

R-2018-DOJ. *Research on Criminal Justice Organizations: The Sentencing Process.* B. Cohen, S. H. Leinen.

R-2144-DOJ. *Criminal Careers of Habitual Felons.* J. R. Petersilia, P. W. Greenwood, M. M. Lavin.

DEFENSE STRATEGY, FORCES, AND SUPPORT SYSTEMS

R-1450-ARPA. *Military Manpower and the All-Volunteer Force.* R. V. L. Cooper.

R-1700-AF. *MODIA: Vol. 1, Overview of a Tool for Planning the Use of Air Force Training Resources.* M. B. Carpenter-Huffman.

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R-1703-AF. *MODIA: Vol. 4, The Resource Utilization Model.* M. Gallegos.

R-1860-NA. *Armor Development in the Soviet Union and the United States.* A. J. Alexander.

R-1865-PR. *Costs of the Next Due Base-Level Inspection during a Depot Visit.* T. H. Browning, I. K. Cohen, J. Y. Lu.

R-1872-PR. *AIDA: An Airbase Damage Assessment Model.* D. E. Emerson.

R-1889-AF. *An Evaluation of Very Large Airplanes and Alternative Fuels.* W. T. Mikolowsky, L. W. Noggle, W. F. Hederman, R. E. Horvath.

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R-1893-PR. *The Army Deployment Simulator with a Data Base of Army Units and Equipment.* J. H. Hayes, L. Cutler.

R-1923-PR. *The Consolidated Support Model (CSM): A Three-Echelon, Multi-Item Model for Recoverable Items.* J. A. Muckstadt.

R-1940-ARPA. *A Dynamic Model for Optimum Bonus Management.* P. Munch.

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R-2016-PR. *Atmospheric Visual and Infrared Transmission Deduced from Surface Weather Observations: Weather and Warplanes VI.* R. E. Huschke.

R-2034-DDRE. *Selective Nuclear Options in American and Soviet Strategic Policy.* B. S. Lambeth.

R-2070-PR. *The Peacetime Evaluation of the Pilot Skill Factor in Air-to-Air Combat.* P. deLeon.

R-2098-AF. *Introduction to the USAF Total Force Cost Model.* H. G. Massey.

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R-1821-NSF. *The Role of Education in Facilitating Adaptation to Technological Change: An Analytical Framework and Review of the Literature.* D. Bell, T. K. Bikson, P. J. Rich, J. M. Wuchitech.

R-1901/1-HEW. *Title IV of the Civil Rights Act of 1964: A Review of Program Operations: Executive Summary.* S. Crocker, R. Crain, M. H. Graubard, J. M. Kimbrough, N. King, M. Thomas, F. M. Wirt.

R-1901/2-HEW. *Title IV of the Civil Rights Act of 1964: A Review of Program Operations.* S. Crocker, R. Crain, M. H. Graubard, J. M. Kimbrough, N. King, M. Thomas, F. M. Wirt, L. P. Oliver.

R-2007-LAUSD. *Analysis of the School Preferred Reading Program in Selected Los Angeles Minority Schools.* D. J. Armor, P. Conry-Oseguera, M. A. Cox, N. King, L. M. McDonnell, A. H. Pascal, E. Pauly, G. Zellman, G. C. Sumner, V. M. Thompson.

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R-2192-HEW/LE. *The Enrollment Effects of Federal Student Aid Policies.* S. J. Carroll, B. M. Mori, D. A. Relles, D. Weinschrott.

R-2224-HEW. *The Courts as Educational Policymakers and Their Impact on Federal Programs.* B. Levin.

ENERGY, ENVIRONMENT, AND NATURAL RESOURCES

R-1561-NSF/FEA. *Econometric Models of the Demand for Motor Fuel.* B. K. Burright, J. H. Enns.

R-1623-NSF. *Energy Conservation in Nonresidential Buildings.* R. G. Salter, R. L. Petruschell, K. Wolf.

R-1829-PR. *The Potential Role of Technological Modifications and Alternative Fuels in Alleviating Air Force Energy Problems.* J. R. Gebman, W. L. Stanley, J. P. Weyant, W. T. Mikolowsky.

R-1842-NSF/FEA. *The Economic Impact of Automobile Travel Cost Increases on Households.* J. P. Stucker, T. F. Kirkwood.

R-1861-CIEP. *The Economics of United States Grain Stockpiling.* J. P. Stein, R. T. Smith.

R-1899-NSF. *Residential Demand for Electricity in Los Angeles: An Econometric Study of Disaggregated Data.* J. P. Acton, B. M. Mitchell, R. S. Mowill.

R-1951-RC. *Petroleum Regulation: The False Dilemma of Decontrol.* C. E. Phelps, R. T. Smith.

R-1955-DWP. *Design of the Los Angeles Peak-Load Pricing Experiment for Electricity.* W. G. Manning, B. M. Mitchell, J. P. Acton.

R-1978-EPRI. *Prediction of Thermal-Hydraulic Performance of Gas-Cooled Fast Breeder Reactors.* C. Gazley, Jr., G. M. Harpole, L. S. Yao, W. H. Krase, I. Catton, J. A. Grzesik, W. W. Matyskiela.

R-1981-NSF/RC. *Coal Development and Government Regulation in the Northern Great Plains: A Preliminary Report.* R. D. Nehring, B. Zycher, J. Wharton.

R-2069-NSF. *Alternative Institutional Arrangements for Developing and Commercializing Breeder Reactor Technology.* L. L. Johnson, E. Merrow, W. S. Baer, A. J. Alexander.

R-2087-RC. *U.S. Grain Reserves Policy: Objectives, Costs, and Distribution of Benefits.* J. P. Stein, E. B. Keeler, R. T. Smith.

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R-2116-NSF. *Nuclear Reactors for Generating Electricity: U.S. Development from 1946 to 1963.* W. Allen.

R-2127-ERDA. *Proceedings of The Rand Corporation Conference on MHD Power Generation, June 29-July 1, 1976.* R. Y. Pei, S. Purnell.

R-2128-ERDA. *The Noble-Gas Closed-Cycle System of Magnetohydrodynamic Power Generation.* R. Y. Pei, R. W. Hess.

HEALTH

R-1543-2-NIH. *CLINFO User's Guide: Release Two.* N. A. Palley, G. F. Groner, M. D. Hopwood, W. L. Sibley.

R-1602-HEW. *Rules of Operation for the Rand Health Insurance Study.* L. Clasquin, M. E. Brown.

R-1943-PBRP. *The Effect of Federal Biomedical Research Programs on Academic Medical Centers.* A. P. Williams, Jr., G. M. Carter, D. S. Chu, S. B. Coleman, A. P. Massell, C. R. Neu, R. L. Rasmussen, W. H. Rogers.

R-1944-PBRP. *The Effects of Federal Funds upon Selected Health-Related Disciplines.* D. E. Drew, J. G. Wirt, F. W. Finnegan, M. C. Fujisaki, A. L. Laniear.

R-1952-HEW. *Hematological Compensation during Treatment of Sickle-Cell Anemia: A Simple Mathematical Model.* J. Aroesty, T. L. Lincoln, W. S. King, P. F. Morrison.

R-2001-HEW. *The Computer Simulation of Leukemia Therapy: Combined Pharmacokinetics, Intracellular Enzyme Kinetics, and Cell Kinetics of the Treatment of L1210 Leukemia by Ara-C.* T. L. Lincoln, P. F. Morrison, J. Aroesty, G. M. Carter.

R-2021/1-HEW. *Quality of Medical Care Assessment Using Outcome Measures: An Overview of the Method.* R. H. Brook, A. D. Avery, S. Greenfield, L. J. Harris, T. Lelah, N. E. Solomon, J. E. Ware, Jr.

R-2021/2-HEW. *Quality of Medical Care Assessment Using Outcome Measures: Eight Disease-Specific Applications.* A. D. Avery, T. Lelah, N. E. Solomon, L. J. Harris, R. H. Brook, S. Greenfield, J. E. Ware, Jr., C. H. Avery.

R-2021/3-HEW. *Quality of Medical Care Assessment Using Outcome Measures: Executive Summary.* R. H. Brook, A. D. Avery.

R-2026-PSEC. *Medical Malpractice: The Response of Physicians to Premium Increases in California.* A. J. Lipson.

R-2027-HEW. *Comparing Costs of Inpatient Care in Teaching and Non-Teaching Hospitals: Methodology and Data.* A. P. Massell, A. P. Williams, Jr.

R-2066-HEW. *The Relationship between Medical Resources and Measures of Health: Some Additional Evidence.* J. P. Newhouse, L. J. Friedlander.

R-2110-HEW/RC. *Evaluation of the New Mexico Peer Review System, 1971 to 1973.* R. H. Brook, K. N. Williams.

R-2126-HEW. *The Methodology Used to Measure Health Care Consumption during the First Year of the Health Insurance Experiment.* K. H. Marquis.

R-2141-HEW. *The Erosion of the Medical Marketplace.* J. P. Newhouse.

R-2215/1-HEW. *Algorithms for Health Planners: Vol. 1, An Overview.* L. J. Harris, E. Keeler, A. I. Kisch, M. E. Michnich, S. F. deSola, D. E. Drew.

R-2215/2-HEW. *Algorithms for Health Planners: Vol. 2, Infant Mortality.* L. J. Harris, E. Keeler, M. E. Michnich.

R-2215/3-HEW. *Algorithms for Health Planners: Vol. 3, Breast Cancer Mortality.* A. I. Kisch, E. Keeler.

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R-2215/5-HEW. *Algorithms for Health Planners: Vol. 5, Preventable Death and Disease.* A. I. Kisch, S. F. deSola.

R-2215/6-HEW. *Algorithms for Health Planners: Vol. 6, Hypertension.* D. E. Drew, E. Keeler.

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R-2151-HUD. *Third Annual Report of the Housing Assistance Supply Experiment.* Housing Assistance Supply Experiment Staff.

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R-1849-HEW/DOL. *The Census Occupational Taxonomy: How Much Information Does It Contain?* F. R. Welch, I. Maclennan.

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R-2052-EDA. *Regional Cycles and Employment Effects of Public Works Investments.* G. Vernez, R. J. Vaughan, B. K. Burright, S. B. Coleman.

R-2115-CDOBP. *AFDC Caseload and the Job Market in California: Selected Issues.* A. F. Abrahamse, D. M. de Ferranti, P. D. Fleischauer, A. J. Lipson.

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R-1909-1-ARPA. *International Terrorism: A Chronology (1974 Supplement).* B. Jenkins, J. Johnson.

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R-2106-CERCDC. *Electricity Pricing and Load Management: Foreign Experience and California Opportunities.* B. M. Mitchell, W. G. Manning, J. P. Acton.

R-2172-AF. *Emergent Nationality Problems in the USSR.* J. Azrael.

R-2202-CIEP. *International Capital Markets in the 1970s.* R. T. Smith, H. Soesastro.

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R-2088-HEW. *Survey Measurement Design and Evaluation Using Reliability Theory.* M. S. Marquis, K. H. Marquis.

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REGIONAL AND URBAN PROBLEMS

Tinkering with the System: Technological Innovations in State and Local Services. R. K. Yin, K. A. Heald, M. E. Vogel. D. C. Heath and Company, Lexington, Mass.

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RESEARCH, DEVELOPMENT, AND ACQUISITION OF SYSTEMS

R-1753-1-PR. *CURVES: A Cost Analysis Curve-Fitting Program.* H. E. Boren, Jr., G. W. Corwin.

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R-1855/1-PR. *The Computer Resources Management Study.* S. M. Drezner, H. L. Shulman, W. H. Ware, G. K. Smith, M. Davis, R. N. Reinstedt, R. Turn.

R-1989-PR. *Long-Range Development Planning in the Air Force.* W. E. Simons, G. K. Smith, E. S. Ojdana, Jr., R. Y. Pei, S. Purnell, E. S. Wainstein.

R-2058-PR. *Competition in the Acquisition of Major Weapon Systems: Legislative Perspectives.* M. D. Rich.

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4 The Rand Graduate Institute

THE INSTITUTE

The Rand Graduate Institute provides advanced graduate training leading to a doctoral degree in policy analysis. An integral part of The Rand Corporation, the Institute offers an innovative program that combines formal academic training with participation in Rand research on real issues of public policy. Policy analysis is defined as the application of systematic methods to problems of public policy and choice in domestic, international, and national security affairs.

Now entering its eighth year, the Institute is accredited by the Accrediting Commission for Senior Colleges and Universities of the Western Association of Schools and Colleges, an action that was completed at the Commission's meeting of June 1975.

Admission requirements include a master's degree or equivalent training in a field of physical or biological science, social science, or mathematics. For applicants from countries where master's degrees are not usually awarded, careful consideration is given to equivalent academic preparation. Applicants who are admitted become graduate fellows in the program, and pay annual tuition of $3000.

GRADUATE FELLOWS

The Institute accepted eleven new graduate fellows in academic year 1976-1977, and eight in the current year. Nearly all of them came from outside Rand. With the new students admitted for the fall of 1977, there are 42 graduate fellows in the program. They include eight women and six foreign students.

Of the eight graduate fellows who passed their written and oral qualifying examinations in 1973, three finished their dissertations and received the Institute's first doctoral degrees at graduation exercises held in October 1974. Twenty-two more graduate fellows passed the written and oral qualifying examinations between 1974 and 1977.

Three additional dissertations have been completed since 1975, and five or six others are in an advanced stage of preparation. Dissertation topics include both national security and domestic policy issues.

Institute graduates and former students hold positions in the Office of Management and Budget, the Congressional Budget Office, the Air

Force's Space and Missile Systems Organization, the Nomura Research Institute in Japan, and The Rand Corporation.

CURRICULUM

The Institute's three-year curriculum includes nine academic quarters, each of ten weeks' duration. The program comprises three categories of study. The first is a set of core courses intended to provide a fundamental understanding of concepts and theory, together with the tools and techniques needed for policy analysis. The second is a series of workshop seminars based on completed policy studies. The third is on-the-job training. In this program category, graduate fellows participate in Rand research projects, initially as apprentices and later in roles of increasing responsibility, with the object of producing a publishable dissertation in the third year.

Courses and workshops in the academic year 1976-1977 included the following:

Microeconomics
Statistics and data analysis
Organizational behavior and analysis
Technology and public policy
Econometrics
Politics and methodology of public resource allocation
Psychological aspects of decisionmaking
Philosophical and ethical aspects of policy analysis
Alternative approaches to modeling
Strategic studies
Criminal justice studies

In their applied research, graduate fellows are working in a variety of program areas: human resources and housing, strategic studies, energy studies, national health insurance, education, international economics, military manpower, maintenance management, acquisitions policy studies, and water resources.

FACULTY

The Institute's faculty is drawn principally from the doctoral staff of Rand's professional departments. In addition, the Institute has

benefited from a three-year grant of $150,000 awarded by The Ford Foundation in 1973, supplemented by a two-year grant of $100,000 awarded by The Ford Foundation in 1976, for general support of curriculum development, visiting faculty, and visiting lecturers. In the fall quarter of 1976, Dr. John Dawson, Professor at the Naval Postgraduate School in Monterey, California, taught "Politics and Methodology of Public Resource Allocation," and in the summer of 1977, Professor Abraham Kaplan, Dean of the Faculty of Social Sciences at the University of Haifa in Israel, taught "Philosophical and Ethical Aspects of Policy Analysis."

As part of a continuing series of visits and seminars by members of the Academic Advisory Board, Dr. William P. Gerberding and Professor Robert M. Solow conducted seminars attended by graduate fellows, faculty, and the Rand Advisory Board during the 1976-1977 academic year. Other seminars were conducted by Dr. Harold Smith, Chairman of the Defense Science Board Task Force on Vulnerability, and Dr. John E. Koehler, Assistant Director for National Security and International Affairs in the Congressional Budget Office.

ADVISORY BOARDS

The Institute's Director, Dr. Charles Wolf, Jr., is assisted by two advisory boards in formulating policies on curriculum, faculty, admissions, qualifying examinations, and funding. One is an internal Rand Advisory Board, which meets monthly and consists of faculty members, other senior Rand staff members, and five graduate fellows. The other is the Institute's Academic Advisory Board, which meets twice each year and helps to foster interaction between the academic community and the Rand Graduate Institute. Members of the Academic Advisory Board are:

Kenneth J. Arrow (Chairman), *University Professor of Economics, Harvard University*

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SUPPORT FUNDS

Student fellowship funds provided by The Ford Foundation grant enable the Institute to aid particularly promising candidates who could not otherwise come to the Institute; to provide partial support in a few other cases when on-the-job training opportunities are temporarily unavailable because of project timing problems; to provide partial support when dissertations cannot be entirely funded by a Rand project; and to further the Institute's affirmative action efforts.

CURRICULAR MATERIALS DEVELOPMENT PROGRAM

In 1975, the Rand Graduate Institute and Duke University's Institute of Policy Sciences and Public Affairs began a jointly administered Public Policy Curricular Materials Development Program (PPCMDP) funded by a $150,000 grant from The Ford Foundation. The purpose of this program is to develop teaching materials for graduate courses in public policy. The program recently received two additional grants: $250,000 from The Sloan Foundation for development of curricular materials relating to technology and public policy, and $100,000 from The Ford Foundation for development of materials relating to defense and arms control. The PPCMDP Editorial Advisory Committee, which meets semiannually, has granted awards totaling $108,500 in response to proposals to develop cases and other curricular materials in the field of policy analysis.

Administration 5

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THE RAND GRADUATE INSTITUTE

Charles Wolf, Jr., *Director*

October 1977

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*Contracts and grants of more than $50,000 for the twelve months ending September 30, 1977.

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ACCOUNTANTS' REPORT

COOPERS & LYBRAND

CERTIFIED PUBLIC ACCOUNTANTS

IN PRINCIPAL AREAS
OF THE WORLD

To the Board of Trustees
The Rand Corporation

We have examined the statement of financial position of The Rand Corporation as of October 2, 1977, and October 3, 1976, and the related statements of changes in capital, operations and capital from operations, and changes in financial position for the 52-week and 66-week periods then ended. Our examinations were made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the financial statements referred to above present fairly the financial position of The Rand Corporation at October 2, 1977, and October 3, 1976, and the results of its operations and changes in financial position for the periods then ended, in conformity with generally accepted accounting principles applied on a consistent basis.

Coopers & Lybrand

Los Angeles, California
November 2, 1977

THE RAND CORPORATION

STATEMENT OF FINANCIAL POSITION

	October 2, 1977	October 3, 1976
Current assets:		
Cash	$1,712,137	$ 870,329
Billed and unbilled contract costs and fees (Note 2)	5,372,285	5,556,809
Amounts due from The New York City–Rand Institute, Inc., less $320,000 allowance for uncollectible amounts (Note 3)	—	79,659
Other receivables	96,321	133,578
Prepayments, travel advances, and deposits	212,172	282,923
Total Current Assets	7,392,915	6,923,298
Current liabilities:		
Current maturity of note payable (Note 4)	256,581	222,222
Accounts payable	1,344,322	965,177
Employee payroll deductions	420,899	393,803
Accrued compensation and retirement plan contributions (Note 5)	671,297	647,034
Accrued vacation pay	2,191,023	2,093,455
Accrued property tax	111,427	101,150
Unexpended portion of research grants received	171,067	217,579
Total Current Liabilities	5,166,616	4,640,420
Working Capital	2,226,299	2,282,878
Noncurrent assets:		
Property, plant, and equipment, net of accumulated depreciation and amortization (Notes 6 and 7)	6,659,782	5,227,185
Software development costs, net of accumulated amortization, $496,067 (1977) and $341,135 (1976) (Note 8)	277,610	432,542
Facility rearrangement costs, net of accumulated amortization, $492,120 (1977) and $387,677 (1976) (Note 8)	26,129	130,572
Endowment Fund assets (Note 9)	481,109	425,320
Other assets	71,826	68,274
Total Noncurrent Assets	7,516,456	6,283,893
Notes payable, less current maturities (Note 4)	260,954	267,498
Net Assets	$9,481,801	$8,299,273
Commitments and contingencies (Notes 10 and 11)		
Capital:		
Ford Foundation Grant	$1,000,000	$1,000,000
Endowment Fund (Note 9)	481,109	425,320
From operations, as restated (Note 7)	8,000,692	6,873,953
Total Capital	$9,481,801	$8,299,273

The accompanying notes are an integral part of this financial statement.

THE RAND CORPORATION

STATEMENT OF CHANGES IN CAPITAL
For the 52 weeks ended October 2, 1977,
and the 66 weeks ended October 3, 1976

	Ford Foundation Grant	Endowment Fund	Capital from Operations	Total Capital
Balance, June 29, 1975, as previously reported	$1,000,000	$314,489	$7,114,711	$8,429,200
Adjustment to restate prior years (Note 7)			(864,392)	(864,392)
Balance, June 29, 1975, as restated	1,000,000	314,489	6,250,319	7,564,808
Contributions received		98,024		98,024
Interest earned		12,807		12,807
Contract operations			1,036,661	1,036,661
The Rand Corporation-Supported Projects			(413,027)	(413,027)
Balance, October 3, 1976	1,000,000	425,320	6,873,953	8,299,273
Contributions received		6,062		6,062
Interest earned		10,227		10,227
Contract operations			1,425,779	1,425,779
The Rand Corporation-Supported Projects			(299,040)	(299,040)
Profit on sale of System Development Corporation common stock (Note 9)		39,500		39,500
Balance, October 2, 1977	$1,000,000	$481,109	$8,000,692	$9,481,801

The accompanying notes are an integral part of this financial statement.

THE RAND CORPORATION

STATEMENT OF OPERATIONS AND CAPITAL FROM OPERATIONS

	For the 52 Weeks Ended October 2, 1977	For the 66 Weeks Ended October 3, 1976
Revenues:		
Reimbursable direct and indirect contract costs	$41,559,988	$48,879,144
Contract fees	1,619,703	1,743,305
Other	241,279	275,232
	43,420,970	50,897,681
Costs and expenses (Note 12):		
Reimbursable direct contract costs	29,970,332	35,063,054
Reimbursable indirect contract costs	11,589,656	13,816,090
Expenses not reimbursed under contracts	623,188	901,876
	42,183,176	49,781,020
	1,237,794	1,116,661
Provision for (recovery of) amounts related to the dissolution of The New York City–Rand Institute, Inc. (Note 3)	(187,985)	80,000
Added to Capital from Contract Operations	1,425,779	1,036,661
Expenditures for The Rand Corporation-Supported Projects:		
Research	318,100	413,088
Publications (net of $30,340 royalty income in 1977 and $36,447 royalty income in 1976)	(19,060)	(24,529)
Other	—	24,468
Expenditures for The Rand Corporation-Supported Projects	299,040	413,027
Excess of Additions to Capital from Contract Operations over Deductions from Capital for The Rand Corporation-Supported Projects	1,126,739	623,634
Capital from operations, beginning of year as restated (Note 7)	6,873,953	6,250,319
Capital from Operations, End of Year	$ 8,000,692	$ 6,873,953

The accompanying notes are an integral part of this financial statement.

THE RAND CORPORATION

STATEMENT OF CHANGES IN FINANCIAL POSITION

	For the 52 Weeks Ended October 2, 1977	For the 66 Weeks Ended October 3, 1976
Sources of working capital:		
Added to capital from contract operations	$1,425,779	$1,036,661
Additions not requiring working capital:		
Depreciation and amortization	1,110,778	1,343,332
Loss on disposition of property, plant, and equipment	23,909	17,498
Working Capital Provided from Contract Operations	2,560,466	2,397,491
Disposition of property, plant, and equipment	38,149	185,859
Mortgage on properties held for future use	248,500	—
	2,847,115	2,583,350
Applications of working capital:		
Additions to property, plant, and equipment	2,343,512	964,878
Current maturities of notes payable	255,054	1,258,666
Additions to deferred costs and other assets	6,088	80,618
To The Rand Corporation-Supported Projects	299,040	413,027
	2,903,694	2,717,189
Decrease in Working Capital	(56,579)	(133,839)
Changes in components of working capital:		
Increase (decrease) in current assets:		
Cash	841,808	491,636
Billed and unbilled contract costs and fees	(184,524)	21,649
Amounts due from The New York City–Rand Institute, Inc	(79,659)	(722,452)
Other receivables	(37,257)	(34,359)
Prepayments, travel advances, and deposits	(70,751)	69,864
	469,617	(173,662)
Decrease (increase) in current liabilities:		
Current maturity of note payable	(34,359)	28,668
Accounts payable	(379,145)	(139,262)
Employee payroll deductions	(27,096)	3,761
Accrued compensation and retirement plan contributions	(24,263)	37,465
Accrued vacation pay	(97,568)	(128,142)
Unexpended portion of research grants received	46,512	98,483
Accrued property tax	(10,277)	(101,150)
Estimated unsponsored dissolution costs of The New York–Rand Institute, Inc	—	240,000
	(526,196)	39,823
Decrease in Working Capital	($ 56,579)	($ 133,839)

The accompanying notes are an integral part of this financial statement.

THE RAND CORPORATION

NOTES TO FINANCIAL STATEMENT

1. Summary of Accounting Policies:

a. Corporate organization. The Rand Corporation (Rand) is a nonstock, nonprofit, tax-exempt corporation, performing research under contracts and grants from government agencies and private nonprofit institutions concerned with public problems. In addition, Rand conducts educational programs which provide graduate training leading to a doctoral degree in policy analysis.

b. Change in fiscal period. The Board of Trustees, in February 1976, changed the end of Rand's fiscal period from the Sunday nearest June 30 to the Sunday nearest September 30, in order to conform with the new fiscal period of the federal government. Accordingly, the financial statements for the period ended October 3, 1976, include operations for 66 weeks. Rand's usual fiscal period is 52 or 53 weeks.

c. Revenue recognition. Substantially all work performed under contracts is on a cost-plus-fixed-fee basis. Revenues are recorded as costs are incurred and include estimated earned fees in the proportion that costs incurred to date bear to total estimated costs. Reimbursable costs are limited to the maximum amount specified in the contract.

Other revenues are principally composed of interest income and sales (net of operating costs) of computer services. Revenues and related costs for the computer service sales activity are recognized as the services are performed.

d. Property, plant, and equipment. Property, plant, and equipment is stated at cost. Buildings, improvements, and equipment, as well as leasehold improvements, are depreciated over the period in which contract cost revenues are received for the use of such assets. This reimbursement period coincides with the estimated useful life of the asset or for leasehold improvements coincides with the lesser of the lease term or estimated useful life of the asset. Depreciation and amortization methods used are:

Buildings and improvements	Straight-line and double-declining balance
Leasehold improvements	Straight-line
Equipment	Straight-line and sum-of-the-years digits

When assets are retired or otherwise disposed of, the assets and related allowances for depreciation and amortization are eliminated from the accounts and any resulting gain or loss is reflected in operations.

e. Deferred costs. Software development costs represent costs incurred for the development of management information and accounting systems and are being amortized over five years, using the straight-line method. Facility rearrangement costs principally consist of certain building improvement costs and costs of rearranging equipment to improve efficiency. These costs are being amortized primarily over five years, using the straight-line method. Amortization of deferred costs is a reimbursable indirect cost.

f. Employee retirement plan. Rand has two employees' retirement plans, a Qualified Plan and a Voluntary Annuity Plan. The two retirement plans are insured with Teachers Insurance and Annuity Association of America and College Retirement Equities Fund (TIAA-CREF). The Qualified Plan is entirely Rand-financed while the Voluntary Annuity Plan requires employee contributions. All full-time permanent

employees are eligible to participate in either plan. Rand's contributions to the Qualified Plan vest at the earlier of retirement or four years of service; however, vesting begins after two years of service and increases weekly to 100% at the end of four years of service. Rand's contributions to the Annuity Plan vest immediately. All contributions made by Rand are charged to operations.

g. Expenditures for The Rand Corporation-Supported Projects. These expenditures are primarily for research projects in the public interest that are entirely sponsored by the Corporation and for certain supplemental research that complements work sponsored by others. These expenditures are incurred at the discretion of management.

Other expenditures included in this classification are the publishing of Rand books (less royalty income), fellowships for research, education and teaching leaves, and grant cost sharing.

2. Billed and Unbilled Contract Costs and Fees: The following tabulation shows the components of billed and unbilled contract costs and fees:

	1977	1976
U.S. Government agencies:		
Billed amounts	$1,255,260	$2,089,173
Unbilled amounts	2,820,075	2,567,648
Retainage	636,637	454,515
	4,711,972	5,111,336
State, local, and private sponsors:		
Billed amounts	306,624	172,923
Unbilled amounts	335,827	193,525
Retainage	17,862	79,025
	660,313	445,473
	$5,372,285	$5,556,809

Unbilled amounts principally represent recoverable cost and accrued fees billed in October 1977 and 1976, respectively.

Certain retainage amounts under contracts become due at the end of the contract period, while other retainage amounts become due when the Defense Contract Audit Agency has completed its audit of costs incurred during the period work was performed. Rand management believes such audits (Note 11) will be completed in fiscal 1978. Based on these arrangements, all of the retainage outstanding at October 2, 1977, are expected to be collected in fiscal 1978.

Three contracts and one grant from four agencies of the federal government account for 64% of Rand's revenues in fiscal 1977 and 65% in fiscal 1976.

Rand's operations are not subject to the Renegotiation Act of 1951. Contract terminations are not anticipated at present, and past contract terminations have not resulted in unreimbursed costs. Most general and administrative expenses are reimbursable costs under contract terms.

3. Amounts Due from The New York City-Rand Institute, Inc.: The Board of Trustees of Rand and The New York City-Rand Institute, Inc. (the Institute) in 1975 decided to dissolve the Institute on completion of its contracts. The Institute, a New

York nonprofit membership corporation formed in July 1969, had conducted programs of scientific research and study designed principally to benefit the City of New York. Agreements to perform work for New York City agencies were tripartite, including the Institute, Rand, and the City of New York. The Institute's contracts were completed in 1976; however, the Institute and Rand decided to delay its dissolution until after settlement of a claim of not less than $250,000 that the Institute had made against the City of New York.

During fiscal 1977 the parties agreed to settle the claim for $200,000; subsequently, in July 1977, the $200,000 was paid to the Institute and was turned over to Rand in partial settlement of the approximate $400,000 owed Rand at that time. (An allowance for $320,000 had been provided against this receivable by October 3, 1976.) This recovery, including accounts receivable collected by the Institute and paid to Rand, and net of accrued expenses estimated to effect the Institute's dissolution, has been reflected in the accompanying statement of operations.

The Board of Trustees of the Institute adopted a Plan of Dissolution and Disposition of Assets in May 1975, and management of the Institute filed a Petition for Dissolution in August 1975. Dissolution, which is expected in 1978, is awaiting the approval of the New York State Supreme Court. In the opinion of management, all costs to be incurred in the dissolution of the Institute have been provided for.

4. Notes Payable: Notes payable at October 2, 1977, and October 3, 1976, consisted of the following:

	1977	1976
Note payable to bank, principal payments of $18,518 monthly to 1978, plus interest at ½ of 1% above the prime interest rate; collateralized by computer equipment	$269,035	$489,720
Mortgage payable on properties held for future use (Note 6), 7% per annum, principal and interest of $2,886 payable monthly to 1987	248,500	—
Total	517,535	489,720
Less portion due within one year	256,581	222,222
Due after one year	$260,954	$267,498

5. Employee Retirement Plan: The corporate contributions to the retirement plans (described in Note 1f) range from 10% to 14% of salaries (less applicable Social Security taxes), depending on the age of the participating employee. Rand has reserved the right to terminate the plans at any time, but in such an event, the benefits already purchased by the participant and contributions by Rand would not be affected. Rand's contributions for the 52 weeks ended October 2, 1977, were $1,757,149 and for the 66 weeks ended October 3, 1976, were $1,834,364.

6. Fixed Assets: Fixed assets at October 2, 1977, and October 3, 1976, consist of:

	1977	1976
Land	$2,540,074	$1,365,744
Buildings and improvements	6,721,555	6,292,483
Leasehold improvements	158,397	154,309
Equipment	6,516,750	5,914,820
	15,936,776	13,727,356
Less accumulated depreciation and amortization	9,276,994	8,500,171
	$6,659,782	$5,227,185

Rand purchased real property for future use during the year ended October 2, 1977, in the amount of $1,530,000 (see Note 4).

Depreciation and amortization expense for the 52 weeks ended October 2, 1977, was $851,403 and for the 66 weeks ended October 3, 1976, was $1,027,673.

7. Restatement of Prior Years: As described in Note 1d, it is the Corporation's policy to depreciate its assets over the period in which contract cost revenues are received for the use of such assets. From 1953 through 1960, the Corporation was receiving reimbursement under its contracts on an accelerated basis for its building in use at the time but was only depreciating the asset on a straight-line basis. As a result, $864,392 of depreciation was not recognized during that period and resulted in an addition to capital from operations. Accordingly, a prior period adjustment has been made in the accompanying financial statements as of June 29, 1975, to charge capital from operations and credit accumulated depreciation for $864,392.

8. Deferred Costs: Amortization of software development costs and facility rearrangement costs for the 52 weeks ended October 2, 1977, was $259,375 and for the 66 weeks ended October 3, 1976, was $315,659.

9. Endowment Fund: The Board of Trustees in 1974 authorized the establishment of an Endowment Fund for the purposes of broadening Rand's work on international economics, security issues, and arms control; providing continuity for Rand's research on domestic social policy issues; performing certain research in the social and physical sciences; and teaching and training policy analysts. In addition to unrestricted contributions, the Fund may receive contributions for special purposes that are consistent with other goals of Rand. Rand management is authorized to expend Fund assets for purposes determined by the Board of Trustees. There have been no expenditures from the Fund since it was established.

During 1977, System Development Corporation repurchased under a tender offer 9,405 shares (of the 50,000 shares donated by System Development Foundation then held in the Fund) of its common stock for $9.20 per share. The remaining shares are valued at $5 per share. Rand's Board of Trustees valued these shares after considering financial data at the date of the donation. The shares, which are not publicly traded, represent approximately 2% of the outstanding common stock of System Development Corporation and are voted by the donor.

Endowment Fund assets in the accompanying Statement of Financial Position are represented by:

	1977	1976
Cash, certificate of deposit, and accrued interest receivable	$278,134	$175,320
System Development Corporation common stock	202,975	250,000
	$481,109	$425,320

10. Long-Term Lease Commitments: Rand rents property and equipment under leases that expire through 1981. Payments for property taxes and other expenses are required in addition to minimum rentals on certain leases. Also, certain leases have escalation clauses requiring rental increases commensurate with increases in property taxes and operating expenses. Such additional amounts have not been significant. Several of the equipment leases include purchase options. Minimum lease commitments are as follows:

	Property Leases Less Noncancelable Subleases	Peripheral Computer Equipment Leases	Total
1978	$283,965	$158,428	$442,393
1979	261,880	59,836	321,716
1980	4,365	10,805	15,170
1981	—	850	850
Total	$550,210	$229,919	$780,129

Rental expense for the 52 weeks ended October 2, 1977, and for the 66 weeks ended October 3, 1976, was $763,574 and $935,982, respectively, net of sublease income of $16,507 and $26,616, respectively.

See also Note 11 regarding a contingent lease obligation.

11. Contingencies and Commitments: Contract costs billed to sponsors are subject to audit by the Defense Contract Audit Agency (DCAA). Resulting indirect cost adjustments, if any, are prorated to all contracts. Contract costs billed prior to June 29, 1975, have been negotiated. Appropriate provision has been made in the accompanying financial statements.

The DCAA field report for the 15 months ended October 3, 1976, has been completed. Management has provided for any possible cost disallowances in the financial statements. In the opinion of management, further adjustments, if any, will not have a significant effect on Rand's financial statements. Management also believes adjustments, if any, to costs subsequent to October 3, 1976, will not have a material effect on Rand's financial statements.

On July 1, 1957, Rand assigned leases, expiring in 1986 and 1987, for certain land and buildings. The assignee (System Development Corporation) assumed obligations to pay $356,500 annually plus property taxes and insurance. Rand is contingently liable for a maximum of one year's lease payments should the assignee vacate the premises without giving one year's advance notice to the lessor.

12. Costs and Expenses: Costs and expenses in the accompanying Statement of Operations comprise:

	For the 52 Weeks Ended October 2, 1977	For the 66 Weeks Ended October 3, 1976
Reimbursable direct contract costs:		
Salaries, consulting, and travel	$15,124,207	$18,285,020
Employee benefits	4,696,353	5,315,460
Subcontracting	8,795,011	9,399,052
Other	1,354,761	2,063,522
	$29,970,332	$35,063,054
Reimbursable indirect contract costs:		
Salaries and travel	$ 5,695,475	$ 6,507,458
Employee benefits	2,207,187	2,390,090
Supplies, services, and rental	2,599,570	3,855,551
Other	1,087,424	1,062,991
	$11,589,656	$13,816,090
Expenses not reimbursed under contracts:		
Operating expenses absorbed by The Rand Corporation	$ 502,936	$ 607,949
Interest	39,807	114,026
Other	80,445	179,901
	$ 623,188	$ 901,876

Access to Publications 6

INDEXES AND BIBLIOGRAPHIES

During the period covered by this report, Rand published some 300 reports and professional papers. In addition, commercial publishers produced three new books written by members of the Rand staff. Most Rand publications are available to the public from a variety of sources. They include Rand itself, government documentation centers, and a worldwide network of about 350 libraries that maintain collections of our publications (see the listing at the end of this section). Indexes to Rand publications are available in several thousand public and university libraries.

In addition, Rand maintains selective bibliographies of its publications in a variety of subject fields, shown below. Copies of bibliographies are available from Rand without charge.

Aerodynamics
Africa
Arms Control
Asia
China
Civil Defense
Combinatorics
Communication Satellites
Communication Systems
Computer Simulation
Computing Technology
Cost Analysis
Criminal Justice
Decisionmaking
Delphi and Long-Range Forecasting
East-West Trade
Education
Energy
Europe
Foreign Aid
Foreign Policy
Game Theory
Gaming
Health-Related Research
Human Resources
Latin America
Linguistics
Maintenance
Management
Mathematical Programming: Applications
Mathematical Programming: Theory
Middle East
New Modes of Conflict: Urban Guerrilla Warfare and International Terrorism
New York City–Rand Institute
Operations Research Methods
Policy Sciences
Pollution
Population
Privacy in the Computer Age
Probability
Program Budgeting
Public Safety
R&D and Systems Acquisition

SIMSCRIPT and Its Applications
Space Technology and Planning
Statistics
Systems Analysis: Methods, Techniques, and Theory
Television
Transportation
Urban Problems
USSR
Water Resources
Weather and Climate Studies

SUBSCRIPTION LIBRARIES

Approximately 350 libraries in the United States and 37 other countries maintain collections of unclassified Rand publications, as shown below. Provided on an annual subscription basis, these collections are available to library patrons on the same basis as other holdings and are subject to the same rules and regulations. Individual publications can usually be obtained by other libraries through the Interlibrary Loan Service, and subscription libraries are authorized to reproduce materials from the Rand collection for their patrons.

The date in parentheses after each university or public library listing is the initial subscription date, to indicate the depth of holdings.

Subscription Libraries in the United States

ALABAMA	
Auburn 36830	Auburn University, Ralph Brown Draughon Library (1965)
Jacksonville 36265	Jacksonville State University, Cole Library (1973)
Montgomery 36109	Auburn University Library (1972)
University 35486	University of Alabama Library (1971)
ALASKA	
Fairbanks 99701	University of Alaska, Elmer E. Rasmuson Library (1968)
ARIZONA	
Tempe 85281	Arizona State University Library (1966)
Tucson 85721	University of Arizona Library (1965)
ARKANSAS	
Fayetteville 72701	University of Arkansas Library (1970)
CALIFORNIA	
Anaheim 92803	Rockwell International Corporation
Bakersfield 93309	California State College Library (1972)
Berkeley 94720	University of California, General Library (1953)
Burbank 91503	Lockheed California Company
Chico 95926	Chico State University Library (1963)
Davis 95616	University of California Library (1969)
Dominguez Hills 90246	California State College Library (1972)
Fullerton 92631	California State University Library (1968)
Irvine 92664	University of California Library (1965)

Long Beach 90802	Long Beach Public Library (1972)
Los Angeles 90009	Aerospace Corporation
Los Angeles 90032	California State University, John F. Kennedy Memorial Library (1974)
Los Angeles 90024	University of California, University Research Library (1953)
Los Angeles 90007	University of Southern California Library (1965)
Monterey 93940	Naval Postgraduate School Library (1972)
Pasadena 91109	California Institute of Technology, General Library (1953)
Pomona 91768	California State Polytechnic University Library (1968)
Redondo Beach 90278	TRW Systems Group, Technical Library (1974)
Riverside 92507	University of California Library (1967)
Rohnert Park 94928	California State College Library, Sonoma (1970)
Sacramento 95809	California State Library (1969)
Sacramento 95819	Sacramento State University Library (1972)
San Diego 92138	General Dynamics, Convair Division
San Diego 92182	San Diego State University, Malcolm A. Love Library (1973)
San Francisco 94105	Golden Gate University Library (1977)
San Luis Obispo 93401	California State Polytechnic University, Dexter Memorial Library (1970)
Santa Barbara 93106	University of California Library (1968)
Santa Clara 95053	University of Santa Clara, Orradre Library (1971)
Santa Cruz 95060	University of California Library (1969)
Stanford 94305	Stanford University Libraries (1953)

COLORADO

Boulder 80302	University of Colorado Libraries (1977)
Colorado Springs 80840	U.S. Air Force Academy, Academy Library (DFSLB) (1968)
Denver 80203	Denver Public Library (1953)
Denver 80217	Johns-Manville Corporation
Denver 80210	University of Denver Libraries (1973)
Fort Collins 80521	Colorado State University Libraries (1973)
Greeley 80631	University of Northern Colorado Library (1973)

CONNECTICUT

Fairfield 06431	General Electric Company, Data Center
Middletown 06457	Wesleyan University, Olin Library (1970)
New Haven 06520	Yale University Library (1953)
Storrs 06268	University of Connecticut, Wilbur Cross Library (1963)

DELAWARE

Newark 19711	University of Delaware Library (1972)

FLORIDA

Coral Gables 33124	University of Miami, Otto G. Richter Library (1967)
Gainesville 32603	University of Florida, Engineering and Physics Library (1953)
Miami 33144	Florida International University Library (1972)
Orlando 32816	Florida Technological University Library (1970)
Tallahassee 32306	Florida State University Library (1972)
Tampa 33620	University of South Florida Library (1970)

GEORGIA

Athens 30601	University of Georgia Libraries (1967)
Atlanta 30332	Georgia Institute of Technology, Price Gilbert Library (1953)
Atlanta 30303	Georgia State University Library (1972)
Statesboro 30458	Georgia Southern College Library (1974)

HAWAII

Honolulu 96822	University of Hawaii Library (1953)

IDAHO

Boise 83707	Boise State College (1971)

ILLINOIS

Cahokia 62206	Saint Louis University, Parks College of Aeronautical Technology Library (1966)
Carbondale 62901	Southern Illinois University, Morris Library (1975)
Charleston 61920	Eastern Illinois University, Booth Library (1963)
Chicago 60611	Chicago Public Library (1973)
Chicago 60637	University of Chicago Library (1953)
Chicago 60680	University of Illinois at Chicago Circle, Library (1974)
DeKalb 60115	Northern Illinois University, Swen Franklin Parson Library (1964)
Edwardsville 62025	Southern Illinois University, Lovejoy Library (1972)
Evanston 60201	Northwestern University Library (1969)
Macomb 61455	Western Illinois University Library (1974)
Normal 61761	Illinois State University Library (1970)
Springfield 62706	Illinois State Library (1972)
Springfield 62703	Sangamon State University Library (1966)
Urbana 61801	University of Illinois Library (1953)

INDIANA

Bloomington 47401	Indiana University Library (1966)
Indianapolis 46202	Indiana University-Purdue University, Downtown Campus Library (1971)
Lafayette 47907	Purdue University Library (1953)
Muncie 47306	Ball State University Library (1976)
Notre Dame 46556	University of Notre Dame, Memorial Library (1970)

IOWA

Ames 50010	Iowa State University Library (1953)
Des Moines 50319	State Library Commission of Iowa (1974)
Iowa City 52242	University of Iowa Libraries (1953)

KANSAS

Emporia 66801	Emporia Kansas State College, William Allen White Library (1975)
Hays 67601	Fort Hays Kansas State College, Forsyth Library (1971)
Lawrence 66044	University of Kansas Libraries (1970)
Manhattan 66504	Kansas State University Library (1965)
Wichita 67208	Wichita State University Library (1970)

KENTUCKY

Bowling Green 42101	Western Kentucky University, Helm-Cravens Library (1973)
Highland Heights 41076	Northern Kentucky State College Library (1973)
Lexington 40506	University of Kentucky Library (1953)

LOUISIANA

Baton Rouge 70813	Southern University Library (1972)
Lafayette 70501	University of Southwestern Louisiana Libraries (1974)
New Orleans 70122	Louisiana State University, Earl K. Long Library (1969)
New Orleans 70118	Tulane University, Science Library (1965)

MARYLAND

Baltimore 21218	Johns Hopkins University, Milton S. Eisenhower Library (1953)
Baltimore 21204	Towson State College, Albert S. Cook Library (1972)
Baltimore 21201	University of Baltimore Library (1975)
College Park 20742	University of Maryland, Engineering Library (1966)

MASSACHUSETTS

Amherst 01002	University of Massachusetts Library (1967)
Boston 02117	Boston Public Library (1963)
Cambridge 02138	Harvard University, Godfrey Lowell Cabot Science Library (1953)
Cambridge 02139	Massachusetts Institute of Technology Libraries (1953)
Chestnut Hill 02167	Boston College, Bapst Library (1965)

MICHIGAN

Ann Arbor 48104	University of Michigan, General Library (1953)
Detroit 48202	Detroit Public Library (1966)
East Lansing 48823	Michigan State University Library (1965)
Houghton 49931	Michigan Technological University Library (1973)
Kalamazoo 49001	Western Michigan University, Dwight B. Waldo Library (1965)
Lansing 48933	State of Michigan, Department of Education (1974)
Mt. Pleasant 48859	Central Michigan University Library (1974)
Warren 48090	General Motors Corporation
Ypsilanti 48197	Eastern Michigan University Library (1971)

MINNESOTA

Minneapolis 55401	Minneapolis Public Library (1971)
Minneapolis 55455	University of Minnesota Libraries (1953)

MISSISSIPPI

University 38677	University of Mississippi Library (1972)

MISSOURI

Columbia 65201	University of Missouri Library (1965)
Kirksville 63501	Northeast Missouri State University, Pickler Library (1970)

Maryville 64468	Northwest Missouri State University, Wells Library (1976)
St. Louis 63121	University of Missouri, Thomas Jefferson Library (1964)
St. Louis 63130	Washington University Libraries (1953)
St. Louis 63105	R. S. Weinberg and Associates

MONTANA

Missoula 59801	University of Montana Library (1973)

NEBRASKA

Lincoln 68588	University of Nebraska Libraries (1953)

NEVADA

Carson City 89701	Nevada State Library (1974)
Las Vegas 89109	University of Nevada Library (1966)
Reno 89507	University of Nevada Library (1967)

NEW HAMPSHIRE

Durham 03824	University of New Hampshire Library (1971)
Hanover 03755	Dartmouth College, Baker Library (1968)

NEW JERSEY

Newark 07101	Newark Public Library (1972)
Newark 07102	Rutgers-The State University, Dana Library (1972)
Princeton 08540	Princeton University Library (1953)
Trenton 08602	Rider College Library (1974)
Trenton 08625	Trenton State College, Roscoe L. West Library (1969)
Whippany 07981	Bell Telephone Labs, Inc., Library

NEW MEXICO

Albuquerque 87106	University of New Mexico, Zimmerman Library (1968)

NEW YORK

Albany 12224	New York State Library (1968)
Albany 12203	State University of New York Library (1970)
Bethpage 11714	Grumman Aerospace Corporation
Binghamton 13901	State University of New York Library (1971)
Brooklyn 11238	Brooklyn Public Library (1970)
Buffalo 14203	Buffalo & Erie County Public Library (1963)
Canton 13617	St. Lawrence University Library (1969)
Ithaca 14853	Cornell University Libraries (1953)
New Rochelle 10801	Iona College, Ryan Library (1973)
New York 10027	Columbia University, Engineering Library (1953)
New York 10022	General Electric Company
New York 10018	New York Public Library (1953)
New York 10022	Sumitomo Shoji America, Inc.
Niagara University 14109	Niagara University Library (1970)
Rochester 14627	University of Rochester Library (1969)
Stony Brook 11790	State University of New York Library (1965)
Suffern 10901	Rockland Community College Library (1975)

Syracuse 13210	Syracuse University Library (1965)
Utica 13502	State University of New York, Upper Division College Library (1970)

NORTH CAROLINA

Chapel Hill 27514	University of North Carolina, Wilson Library (1971)
Davidson 28036	Davidson College Library (1972)
Durham 27706	Duke University Library (1953)
Greensboro 27412	University of North Carolina Library (1972)
Raleigh 27607	North Carolina State University, D. H. Hill Library (1973)

OHIO

Akron 44304	University of Akron Library (1970)
Cincinnati 45202	Public Library of Cincinnati (1969)
Cincinnati 45221	University of Cincinnati Library (1969)
Cleveland 44106	Case Western Reserve University, Sears Library (1965)
Cleveland 44114	Cleveland Public Library (1953)
Cleveland 44115	Cleveland State University Library (1977)
Columbus 43210	Ohio State University Libraries (1953)
Columbus 43215	State Library Board (1969)
Dayton 45433	Air Force Institute of Technology Library (1967)
Kent 44242	Kent State University Library (1963)
Oxford 45056	Miami University Libraries (1971)
Toledo 43606	University of Toledo Library (1970)
Youngstown 44503	Youngstown State University Library (1973)

OKLAHOMA

Norman 73069	University of Oklahoma Library (1953)
Tahlequah 74464	Northeastern Oklahoma State University, John Vaughan Library (1972)
Tulsa 74104	University of Tulsa, McFarlin Library (1973)

OREGON

Ashland 97520	Southern Oregon College Library (1969)
Portland 97207	Portland State University Library (1970)
Salem 97310	Oregon State Library (1970)

PENNSYLVANIA

Philadelphia 19104	Drexel University Library (1971)
Philadelphia 19122	Temple University Library (1970)
Pittsburgh 15213	Carnegie Library of Pittsburgh (1953)
Pittsburgh 15260	University of Pittsburgh, Hillman Library (1968)
Slippery Rock 16057	Slippery Rock State College Library (1971)
Swarthmore 19081	Swarthmore College Library (1976)
University Park 16802	Pennsylvania State University, Pattee Library (1965)

RHODE ISLAND

Providence 02912	Brown University Library (1953)

SOUTH CAROLINA

Clemson 29631	Clemson University Library (1973)
Columbia 29208	University of South Carolina, McKissick Memorial Library (1969)

TENNESSEE

Chattanooga 37401	University of Tennessee Library (1974)
Cookeville 38501	Tennessee Technological University Library (1972)
Johnson City 37601	East Tennessee State University Library (1974)
Knoxville 37916	University of Tennessee Library (1972)
Memphis 38111	Memphis State University, John Brister Library (1964)
Nashville 37203	Joint University Libraries (1953)

TEXAS

Austin 78712	University of Texas Library (1953)
Canyon 79015	West Texas State University Library (1970)
College Station 77843	Texas A&M University Library (1965)
El Paso 79904	El Paso Community College, Learning Resources Center (1973)
Houston 77001	Rice University Library (1958)
Houston 77004	University of Houston Libraries (1969)
Lubbock 79409	Texas Tech University Library (1969)
San Antonio 78284	Trinity University Library (1974)
San Antonio 78284	University of Texas Library (1971)

UTAH

Provo 84601	Brigham Young University Library (1965)
Salt Lake City 84112	University of Utah Libraries (1953-71, 1973)

VIRGINIA

Blacksburg 24061	Virginia Polytechnic Institute and State University Library (1965)
Charlottesville 22901	University of Virginia, Alderman Library (1953)
Lexington 24450	Virginia Military Institute, Preston Library (1963)
Richmond 23173	University of Richmond, Boatwright Memorial Library (1974)
Richmond 23284	Virginia Commonwealth University, James Branch Cabell Library (1975)

WASHINGTON

Bellingham 98225	Western Washington State College, Wilson Library (1971)
Cheney 99004	Eastern Washington State College, John F. Kennedy Memorial Library (1972)
Olympia 98501	Washington State Library (1970)
Pullman 99163	Washington State University Library (1967)
Seattle 98124	The Boeing Company
Seattle 98105	University of Washington Library (1953)
Tacoma 98402	Tacoma Public Library (1976)

WEST VIRGINIA

Charleston 25305	West Virginia Library Commission, Technical Services (1973)

Glenville 26351	Glenville State College, Robert F. Kidd Library (1971)
Montgomery 25136	West Virginia Institute of Technology Library (1974)

WISCONSIN

Eau Claire 54701	University of Wisconsin-Eau Claire, William D. McIntyre Library (1972)
Green Bay 54305	University of Wisconsin Library (1967)
Madison 53706	University of Wisconsin, General Library (1953)
Menomonie 54751	University of Wisconsin-Stout, M.R.S. Pierce Library (1970)
Milwaukee 53233	Marquette University, Memorial Library (1972)
Milwaukee 53233	Milwaukee Public Library (1971)
Milwaukee 53201	University of Wisconsin-Milwaukee, Library (1972)
Superior 54880	University of Wisconsin, Hill Library (1971)

WYOMING

Laramie 82071	University of Wyoming Library (1971)

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DISTRICT OF COLUMBIA

Washington 20310	Army Library, Department of the Army (1970)
Washington 20006	George Washington University Library (1970)
Washington 20540	Library of Congress (1953)

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PUERTO RICO

Rio Piedras 00931	Universidad de Puerto Rico, Biblioteca General (1966)

Subscription Libraries in Other Countries

AUSTRALIA

Adelaide, S.A.	State Library of South Australia (1971)
Bathurst, N.S.W.	Mitchell College of Advanced Education Library (1975)
Brisbane, Queensland	M.I.M. Holdings Limited (1976)
Brisbane, Queensland	State Library of Queensland (1973)
Bundoora, Victoria	La Trobe University Library (1971)
Canberra, A.C.T.	Australian National University, Institute of Advanced Studies Library (1968)
Canberra, A.C.T.	National Library of Australia (1969)
Clayton, Victoria	Monash University Library (1972)
Duntroon, A.C.T.	Royal Military College, Bridges Library (1968)
Nedlands, W.A.	University of Western Australia Library (1973)
North Ryde, N.S.W.	Macquarie University Library (1966)
Sydney, N.S.W.	University of Sydney, Fisher Library (1958)

AUSTRIA

Laxenburg	International Institute for Applied Systems Analysis (IIASA) Library (1972)

BELGIUM	
Namur	Facultes Universitaires N.D. de la Paix, Service des Bibliotheques (1973)
St. Niklaas Waas	Biblioteek voor Hedendaagse Dokumentatie (1975)
BRAZIL	
Brasilia	Camara dos Deputados (1971)
Rio de Janeiro	Servico Federal de Processamento de Dados (SERPRO), Biblioteca (1971)
Sao Paulo	Cidade Universitaria, Instituto de Pesquisas Tecnologicas (1973)
CANADA	
Burnaby, B.C.	British Columbia Institute of Technology Library (1973)
Burnaby, B.C.	Simon Fraser University Library (1970)
Calgary, Alberta	University of Calgary Library (1973)
Downsview, Ontario	York University Libraries (1971)
Fredericton, N.B.	University of New Brunswick, Harriet Irving Library (1969)
Guelph, Ontario	University of Guelph Library (1968)
Halifax, N.S.	Dalhousie University Library (1968)
Hamilton, Ontario	McMaster University, Mills Memorial Library (1968)
London, Ontario	University of Western Ontario Library (1977)
Montreal, Quebec	McGill University Library (1968)
Montreal, Quebec	Sir George Williams University Library (1969)
Ottawa, Ontario	Carleton University Library (1968)
Ottawa, Ontario	National Defence Headquarters, DIR Scientific Information Services (1965)
Ottawa, Ontario	Department of Finance Library (1974)
Ottawa, Ontario	National Research Council Library (1958)
Quebec, Quebec	Les Presses de l'Universite Laval (1970)
Toronto, Ontario	University of Toronto Library (1968)
Vancouver, B.C.	University of British Columbia Library (1970)
Waterloo, Ontario	Wilfrid Laurier University Library (1972)
Windsor, Ontario	University of Windsor Library (1970)
Winnipeg, Manitoba	University of Manitoba, Elizabeth Dafoe Library (1973)
CANAL ZONE	
Balboa	Canal Zone College Library (1971)
CHILE	
Santiago	Biblioteca del Congreso Nacional (1977)
CHINA	
Taipei, Taiwan	Tamkang College of Arts and Sciences, Chueh Sheng Memorial Library (1970)
COLOMBIA	
Medellin	Universidad Pontificia Bolivariana, Biblioteca del Area de los Ingenierias (1974)

DENMARK	
Aarhus C	Statsbiblioteket, Universitetsparken (1972)
Fjerritslev	Per Gundersen's Hus, Library (1972)
ENGLAND	
Bailrigg, Lancaster	University of Lancaster Library (1967)
Boston Spa, Yorkshire	British Library, Lending Division (1958)
Keele, Staffordshire	University of Keele Library (1972)
London, SW1A 2EU	Ministry of Defense, Whitehall Library (1967)
Oxford	Institute of Economics and Statistics (1971)
FRANCE	
Paris 16	Association Francaise pour la Cybernetique Economique et Technique, Library (1958)
Paris 16	Organisation for Economic Co-operation and Development, Library (1968)
GERMANY (WEST)	
Berlin	Preussischer Kulturbesitz, Staatsbibliothek (1974)
Berlin-Charlottenburg	Universitatsbibliothek der Technischen Universitat Berlin (1969)
Bonn	Deutscher Bundestag Bibliothek (1973)
Ebenhausen-Isartel	Stiftung Wissenschaft und Politik, Library (1966)
Frankfurt a.M.	Stadt- und Universitats Bibliothek (1958)
Gottingen	Niedersachsische Staats- und Universitatsbibliothek Gottingen (1970)
Hamburg	Staats- und Universitatsbibliothek (1971)
Hannover, Welfengarten	Bibliothek der Technischen Hoschschule und Technische Informationsbibliothek (1968)
Kiel	Bibliothek des Instituts fur Weltwirtschaft und der Universitat Kiel (1973)
Koln	Universitats- und Stadtbibliothek Koln (1970)
Konstanz	Universitat Konstanz Bibliothek (1971)
Munich	Industrieverlagen-Betriebsgesellschaft (1966)
Saarbrucken	Universitatsbibliothek der Universitat des Saarlands (1969)
GREECE	
Athens	Hellenic Air Force Command, Branch C, Research Directorate (1973)
HONG KONG	
Hong Kong	Far East Book Company
INDIA	
Bombay	National Institute of Bank Management, Library (1970)
Delhi	Defence Scientific Information and Documentation Centre, Defence Science Library (1967)
New Delhi-1	Indian Council of World Affairs Library (1966)
New Delhi-1	Institute for Defence Studies and Analyses Library (1971)

INDONESIA	
Djakarta	Centre for Strategic and International Studies (1972)
IRAN	
Tehran	Tehran University, Central Library (1977)
ISRAEL	
Haifa	Israel Institute of Technology, Department of Industrial and Management Engineering (1965)
Haifa (Mt. Carmel)	University of Haifa Library (1974)
Tel-Aviv	Ministry of Defence (1971)
Tel-Aviv	Tel-Aviv University, Leon Recanati Graduate School of Business Administration, Library (1965)
ITALY	
Padova	Biblioteca Universitaria (1968)
Urbino	Sogesta S.P.A.
JAPAN	
Kamakura, Kanagawa	Nomura Research Institute (1967)
Niihari-gun Ibaragi-ken	Tsukuba University Library (1971 only)
Tokyo	Intercontinental Marketing Company
Tokyo	National Diet Library (1958)
Tokyo	Seisaku Kagaku Kenkyusho
Tokyo	Shiryo Center
Toyota-shi Aichi-ken	Gijutsu Shiryo Shitsu
JORDAN	
Amman	I. P. S. (1977)
Amman	Royal Society for Scientific Research (1966)
KOREA	
Seoul	Agency for Defense Development, Technical Library (1973)
Seoul	Asian Institute for Public Policy (1977)
KUWAIT	
Kuwait	Kuwait University Library (1975)
MALAYSIA	
Kuala Lumpur	National University of Malaysia Library (1971)
Kuala Lumpur	University of Malaya Library (1974)
MEXICO	
Puebla, Puebla	Universidad de las Americas, Learning Resources Center Library (1972)

THE NETHERLANDS	
Delft	Technological University Library (1972)
NEW ZEALAND	
Wellington	General Assembly Library (1971)
NIGERIA	
Ibadan	Ibadan University Library (1972)
Ile-Ife	University of Ife Library (1975)
Lagos	National Library of Nigeria (1971)
Lagos	University of Lagos, Yakubu Gowon Library (1974)
Nsukka	University of Nigeria, Nnamdi Azikiwe Library (1974)
NORWAY	
Trondheim	University of Trondheim, Norwegian Institute of Technology (1971)
SCOTLAND	
Aberdeen	Aberdeen University Library (1973)
SINGAPORE	
Singapore 10	Ministry of Defence (1971)
SOUTH AFRICA	
Pretoria, Transvaal	Universiteit van Pretoria, Merensky-Biblioteek (1971)
SPAIN	
Madrid-34	Universidad Autonoma, Catedra Teoria Economica (1970)
SWEDEN	
Nykoping 1	Aktiebolaget Atomenergi Library (1958)
SWITZERLAND	
Zurich	ETH - Bibliothek (1969)
WEST PAKISTAN	
Rawalpindi	Defence Science Organization, Documentation Centre (1970)

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