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ABSTRACTS

MONOGRAPH/REPORTS

MR-165-ACQ Developing Improved Deflators for Defense Research and Development. C. Wolf. 1993.

This report considers both the theory and practice of allowing for prospective inflation in multiyear defense research and development programs. It reviews and analyzes current and prior methods of deflating out-year R&D spending in the United States, and, more briefly, in the United Kingdom and Japan and in two high-technology firms in the U.S. private sector. As defense budget constraints become increasingly tight, the share of R&D in the budget is likely to remain constant or perhaps even increase. At the same time, the absolute size of defense R&D will decrease, and the defense share in total government R&D will continue to decline. The problem of estimating expected inflation in the out-year costs of defense R&D programs is important because most of these programs extend over several years. Consequently, if future inflation in R&D costs is misestimated, R&D budgets will either be squeezed, if actual costs exceed those allowed for in budget planning, or excessive, if actual costs fall short of R&D projected for future years.

MR-255-PA&E The Decisionmaking Context in the Department of the Navy: A Primer for Cost Analysts. E. V. Larson, A. R. Palmer. 1994.

This report provides the cost analyst with an introduction to the Department of the Navy and focuses on those characteristics that are most important to understanding the DON's two major resource-allocation processes: budgeting (reflected in its Planning, Programming, and Budgeting System (PPBS) process), and Research, Development and Acquisition (RDA). The report describes and identifies the most important elements of the DON's executive structure, operating forces, and shore establishment, including the administrative and operational organizations; identifies and describes force structure and major force building blocks and equipment; identifies the principal actors, fora, decisions, and activities within the PPBS and RDA processes; and discusses nomenclature, reporting mechanisms, and coding schemes that are critical to understanding resource allocation within the DON.

MR-291-AF An Analysis of Weapon System Cost Growth. J. A. Drezner, J. M. Jarvaise, R. W. Hess, P. G. Hough, D. Norton. 1993.

Cost growth (meaning the underrun or overrun of actual vs. estimated costs) is an enduring and prevalent problem

in weapon system development. In tight budgetary times, the problem is intensified because a systematic bias in cost estimates can undermine the basis of resource allocation decisions. This exploratory analysis attempts to quantify the magnitude of cost growth in weapon system programs, and identify factors affecting cost growth. The study revealed that cost estimates are systematically biased toward underestimation, resulting in an average program cost growth of 20%.

MR-317-DPRC Developing Price Series for Cocaine. J. P. Caulkins. 1994.

This report describes how to construct time series for the price of cocaine using data from the Drug Enforcement Administration's System to Retrieve Information from Drug Evidence, a database that includes records of prices paid by undercover agents for individual purchases. Central to this process is the task of standardizing data for transaction size and purity. Prior efforts in this area are reviewed and their treatment of purity found wanting. This report suggests that because quality control is difficult for illicit products, price is governed more by the expected purity than by the actual purity of the product. Using this concept, price series are constructed for the gram, ounce, and kilogram level in a variety of locations. Analysis of these series reveals that significant price differences exist between cities, even at the wholesale level; these differences do not necessarily dissipate over time; and the ratio of prices at different market levels has remained remarkably constant over time. This last result is consistent with the hypothesis that price increases at one level are passed through to lower levels on a percentage basis (i.e., according to a multiplicative model) rather than a dollar-for-dollar basis (i.e., according to an additive model).

MR-462-OSD Essays in the Economics of Procurement. A. Bower, J. N. Dertouzos. 1994.

"The separate essays in this volume summarize earlier RAND reports and reprint articles that have appeared in the professional literature"—Pref.

MR-465-OSD A Policy Analysis of Alternative Military Retirement Systems. B. J. Asch, J. T. Warner. 1994.

Summarizes the authors' previously developed theoretical model of compensation in a large, hierarchical organization like the military that permits an analysis of the issues surrounding the design of military compensation. Presents an empirical version of that model and uses it to evaluate the current and alternative military

retirement systems in terms of their implications for force structure, cost, and productivity (i.e., personnel effort and ability sorting); the implications for the current military compensation system, and the implications of several proposals (including several of the authors' own design) that change the structure of the military retirement system. The authors estimate that under certain circumstances the proposed systems would permit the Department of Defense to maintain forces at least as capable as today's at no higher cost.

MR-483-RC Star Wars: A Case Study of Marginal Cost Analysis and Weapon System Technology. G. L. Donohue. 1994.

This report presents a case study of how marginal-cost analysis can be used to influence investment decisions, not only in deciding whether to procure a major weapon system, but also how to invest R&D dollars for maximum potential leverage in the long run. The case involves the strategic defense system that the United States examined in the mid-1980s, following President Reagan's "Star Wars" speech of March 1983. The analysis presented here addresses the relative costs to the defender and the attacker in a race in which attackers added re-entry vehicles and defenders added interceptors. The initial results, based on the technology necessary for near-term deployments (by the year 2004), were very unfavorable. Subsequent analysis considered a variety of plausible technological breakthroughs and highlighted the potential value of what came to be called "brilliant pebbles," although great uncertainty remained about whether a favorable marginal cost ratio could be obtained. While not a complete policy analysis, the study is an important example of systems analysis: it affected policy at the time by tempering the claims of strategic defense enthusiasts and channeling R&D and architecture studies in fruitful directions.

MR-730-A Understanding and Reducing the Costs of FORSCOM Installations. J. G. Boltan, J. M. Halliday, E. G. Keating. 1996.

The Arroyo Center has been investigating alternative approaches to reducing the cost of base operations at FORSCOM installations. Researchers analyzed expenditure data from the eight major installations (Forts Bragg, Campbell, Carson, Drum, Hood, Lewis, Riley, and Stewart) and visited six of them to discuss with garrison personnel their reengineering efforts, contracting experience, the Installation XXI initiatives, and other aspects of base operations. The data indicate that for a variety of reasons, expenditures for base operations functions can differ widely across installations. Limitations of the Army financial accounting system make it difficult to draw specific conclusions about these expenditures without detailed analysis of data from each installation. Decentralized approaches to reengineering

seem to hold some promise for reducing future operating costs, but it may be difficult for the Army to realize all potential savings in the long term. Proposals to create a hub/satellite structure or centralize functions should be examined carefully before implementation. The civilian pay cap to be applied in FY96 and the implementation of Integrated Sustainment Maintenance have the potential to create some problems if unit and installation incentives are not aligned with overall Army policy. Finally, although increased use of contracting has been proposed as an alternative to civilian employees, this will not solve all current problems. Contracting has advantages, but the A-76 (Commercial Activities) process must be simplified, and installation experience with contracts should be more widely disseminated. Moreover, contracting functions does not necessarily save money, although installations with major contracts are generally satisfied with contractor performance.

MR-760-A A Policymaker's Guide to Accrual Funding of Military Retirement. W. M. Hix, W. W. Taylor. 1997.

Since 1985, military retirement has been funded prospectively on an accrual basis. Until that time, it was funded on a pay-as-you-go basis, leaving an unfunded liability of more than \$500 billion. That unfunded liability was assigned to the Treasury Department, which is amortizing the debt over a 60-year period. Treasury amortization is annually offset by recomputations of the liability that result from changes in assumptions or experience. Those recomputations result in actuarial gains or losses, which result in adjustments to the Treasury payments. The report argues that the Department of Defense (DoD) should share in gains or losses. DoD now funds accrual payments though aggregate estimates of normal cost, undifferentiated by the experience of the various military services. A recommended change to service-specific imputations of normal cost would result in lower funding by the Army, Navy, and Marine Corps, and increased funding by the Air Force.

MR-991-OSD Using the Force and Support Costing System: An Introductory Guide and Tutorial. J. H. Bigelow, M. J. Carrillo, H. G. Massey, A. R. Palmer. 1999.

The Force and Support Costing (FSC) System is a set of models and databases that helps analysts project the cost implications of proposed changes in defense forces, infrastructure, and assets. The user interface and many of the models are implemented in Excel; most of the database resides on a network. The illustrated study projects effects on defense costs arising from the deactivation of an Army division. The FSC system allows the user to view the force structure in the current Army program, select the division to be cut, and specify when the deactivation will occur.

The system then translates that deactivation into reductions in personnel and equipment assets, and costs out the implications. In addition to stepping through the specific procedures for the simulation, the authors show other ways the FSC System can be used to analyze the cost effects of various policy actions.

MR-1066-DFAS Defense Working Capital Fund Pricing Policies: Insights from the Defense Finance and Accounting Service. E. G. Keating, S. M. Gates. 1999.

The Defense Finance and Accounting Service (DFAS), created in 1991 through the consolidation of military service-specific accounting and finance operations, provides a variety of services to Department of Defense (DoD) customers, such as payroll, bill payment, and generation of accounting statements. Examining DFAS data on expenditures and workload to explore possibilities for improved operations, the authors argue that current linear pricing of DFAS services is inappropriate. In particular, DFAS expenditures neither increase nor decrease commensurate with workload. DFAS's pricing could be improved by a switch to a nonlinear approach, distributing fixed costs among customers using open-the-door transfer payments and charging only incremental costs to customers on a per work unit basis. Such a pricing reform would require changes to current Defense Working Capital Fund (DWCF) regulations.

MR-1261-DFAS Improving the Defense Finance and Accounting Service's Interactions with Its Customers. E. G. Keating, S. M. Gates, J. E. Pace, C. Paul, M. G. Alles. 2001.

The Defense Finance and Accounting Service (DFAS) provides a variety of finance and accounting services to military customers. Because DFAS received customer complaints, its leadership asked RAND to take a comprehensive look at all DFAS-customer interactions to identify problems and determine how those interactions might be improved. The methodology was to collect information from interviews and data analysis and then make recommendations for improving customer interactions. RAND interviewed personnel at DFAS headquarters, two regional centers, and two operating locations, selecting employees who have considerable experience in the organization. Then we interviewed knowledgeable command- and installation-level customers to identify the issues they felt were most important in their interactions with DFAS. Our research was complemented by analysis of DFAS data pertaining to costs, workload, and performance. Customers cited two shortcomings in DFAS finance services: unacceptably high interest penalty payments and untimely and inaccurate payments to military personnel. On the accounting side, customers suggested the Chief Financial Officers Act of 1990 was a compliance exercise of little direct benefit to them. We

determined that DFAS has problems, both in accounting and finance, with new systems acquisition and implementation. RAND made four recommendations to DFAS: (1) Develop the ability to respond to crises such as the FY00 change in military pay. (2) Continue its pricing reforms. (3) Acquire new software commercially. (4) Make greater use of the Web to make the accounting data customers receive more timely and to expedite efforts to fix errors.

MR-1369.0-NSF Assessing the Benefits and Costs of a Science Submarine. C. Meade, R. J. Lempert, F. S. Timson, J. B. Kadtke. 2001.

After the end of the Cold War, the U.S. Navy made SSN 637-class nuclear attack submarines available to the scientific community to conduct scientific research underneath the Arctic sea ice caps. Sponsored by the Navy and civilian science agencies, these missions provided a wealth of important scientific data. However, this class of submarine is now retiring from the Navy's active fleet, and it has been proposed that one of these vessels be converted into a dedicated research platform. The National Science Foundation asked RAND's Science and Technology Policy Institute to assess the costs and benefits of operating an SSN 637-class nuclear submarine for unclassified scientific research throughout the world's oceans. This report presents the results of RAND's study.

MR-1370-AF Military Airframe Costs: The Effects of Advanced Materials and Manufacturing Processes. O. Younossi, M. Kennedy, J. C. Graser. 2001.

In recent years, a number of attempts have been made to estimate the cost of future weapon systems toward the goal of optimizing acquisition policy. This report focuses specifically on the effects of material mix, manufacturing techniques, and geometric part complexity on the cost of military airframes. It begins by offering background information on those materials that are most critical to airframe manufacture and on the relative advantages of both traditional and evolving part fabrication techniques. It then proceeds to a quantitative analysis of the cost implications of various materials and manufacturing techniques on airframe production, drawing both from an industry survey and from analysis of industry data. The data thus derived are then integrated with those of a comprehensive historical database. The report concludes that composites, while offering a number of advantages over metals in airframe manufacture, are generally associated with higher costs across a range of categories. At the same time, it concludes that while new manufacturing technologies hold the potential to diminish airframe manufacturing costs, the increased airframe complexity of future fighter aircraft may well offset this advantage. The report recommends that cost analysts remain abreast of changes in industry practice so that they

may more accurately gauge the potential effects of such changes on future airframe costs.

MR-1596-AF Military Jet Engine Acquisition: Technology Basics and Cost-Estimating Methodology. O. Younossi, M. V. Arena, R. M. Moore, M. A. Lorell, J. Mason, J. C. Graser. 2002.

As manufacturing processes and materials used in aircraft engine production change and new information on aircraft engine technology becomes available, cost-estimation techniques must be updated. The authors present the results of a RAND research project to develop a new methodology for estimating military jet engine costs. They first discuss the technical parameters that drive the engine development schedule, development costs, and production costs, and then present a quantitative analysis of actual historical data on development schedules and costs. Their principal focus was on adding new observations to the cost-estimating database from earlier RAND studies and updating the parametric relationships for aircraft engine costs and development time. The authors present a series of parametric relationships for forecasting the development cost, development time, and production cost of future military engine programs. Their results indicate that rotor inlet temperature is a significant variable in most of the reported estimating relationships. Full-scale test hours and whether an engine is new or derivative were also found to be significant cost-estimating measures.

MR-1597-DFAS Challenges in Defense Working Capital Fund Pricing: Analysis of the Defense Finance and Accounting Service. E. G. Keating, S. M. Gates, C. Paul, A. Bower, L. Brooks, J. E. Pace. 2003.

The Defense Finance and Accounting Service (DFAS) provides finance and accounting services to customers within the Department of Defense. The authors examine the DFAS's pricing structure and its impact on customer demand for DFAS services, the agency's workload, and equity in pricing. The authors found that the one-price-for-all finance output pricing, which does not vary with the workload burden that customers place on the DFAS, creates cross-customer subsidization, suggesting a need for nonlinear, customer-specific pricing. In addition, the authors examine whether any negative effects have arisen from the switch in October 1999 from unit billing to hourly billing for DFAS accounting work. They found no significant evidence that DFAS altered its behavior after the switch to take advantage of the hourly billing structure.

MR-1693-RC A Preliminary Benefit/Cost Framework for Counterterrorism Public Expenditures. B. Zycher. 2003.

The author develops a range of rough estimates of the benefits and costs of a U.S. counterterrorism effort in the

context of moderate (based on Northern Ireland in 1999), severe (recent Israeli experience), and nuclear terrorist attacks against the United States. The direct adverse economic effects of terrorist attacks include deaths and injuries, property damage, and reduced economic output. For the moderate, severe, and nuclear cases, these costs are estimated at approximately \$11 billion, \$183 billion, and \$465 billion per year, respectively. Real annual resource costs of U.S. counterterrorism efforts in the three cases are found to be \$10 billion, \$200 billion, and \$300 billion, respectively. The analysis suggests that the marginal benefit may exceed the marginal cost, and thus that spending may in fact be little. Another important facet of the problem is who is to finance the counterterrorism efforts—the federal government or state or local agencies. The author's approach should provide a framework for benefit/cost analysis of particular policies, and thus for construction of a rough but reasonable ranking among the myriad potential actions decisionmakers might consider. Finally, the preservation of national pride, although difficult to measure, can be considered a collective good benefiting all.

REPORTS

R-2425-DWP Seasonal Electricity Demand and Pricing Analysis with a Variable Response Model. L. A. Lillard, J. P. Acton. 1980.

The Los Angeles Electricity Rate Study is designed to yield information on the effects of alternative pricing structures for residential consumers. This report gives the results of the behavior of 624 households in the Los Angeles area over a 23-month period under seasonal and time-invariant experimental plans. The econometric model used emphasizes differences by households in permanent consumption level and in responsiveness to weather variation. The significant variation among households' responsiveness to both hot and cold weather, as well as their permanent consumption levels, are related to household characteristics (appliances, house and family characteristics). Thus, important differences can be expected across households from introducing seasonal pricing. It is concluded that welfare gains under seasonal pricing would be quite small, and that seasonal pricing of electricity has little to offer in comparison with present rates or with time-of-day rates.

R-2455-MRAL Resource Allocation in the Department of Defense: A Case Study of Army Aviation Maintenance. F. A. Camm, J. N. Davidson, G. A. Walter, C. Worthing. 1982.

Using the planning and management processes in Army aviation maintenance, the authors examine how the Department of Defense (DOD) adjusts resource requirements in response to input price changes. The report is based on an extensive literature survey and several hundred interviews conducted during 1977–1979. Because defense activities are dynamic, many of the specific problems of Army aviation maintenance have changed since the period of this report. The study does not seek to solve specific problems in Army aviation maintenance, however, or even to focus exclusively on Army aviation maintenance itself. It addresses a problem that has persisted over the entire period since World War II—DOD's reluctance to recognize changing input prices and respond accordingly. The report offers no specific policy recommendations; rather it aims to provide a better understanding of how DOD's planning and management processes work, to provide a foundation upon which future work can build to define policy options that improve these processes.

R-2525-1-HCFA Economic Factors in the Use of Laboratory Tests by Office-Based Physicians. P. M. Danzon. 1982.

This report analyzes the effect of economic factors on the frequency, charges, and location of laboratory tests by office-based physicians. Section II develops a formal model of the economic factors affecting physician behavior in prescribing and charging for tests. Section III describes supply conditions in the independent clinical laboratory industry and the effects of regulation. Section IV analyzes the decision to do tests in-house and to adopt semiautomated techniques. The data are described in Sec. V. Section VI presents empirical estimates of determinants of the frequency of tests, the decision to do tests in-house and acquire an autoanalyzer, and the physician's fee for a complete blood count. The findings and policy implications are summarized in Sec. VII. The appendix presents an alternative model in which the office visit fee is proportional to the amount of time spent by the physician.

R-2565-AF A Method for Estimating the Cost of Aircraft Structural Modification. J. L. Birkler, J. P. Large. 1981.

Describes research into the cost of aircraft structural modifications. Detailed cost and man-hour data supplied by the airframe industry permitted derivation of estimating tools for major aircraft components. Separate equations were derived for engineering, tooling, manufacturing, and material cost. The major explanatory variable was always weight. It was hypothesized that structural modification cost could be estimated on the basis of the weight of material added. Estimates of the cost of modification for the B-52, C-141, C-5, and EF-111 were compared with

cost data from industry. Considerable informed judgment is required as is a knowledge of such program-specific facts as whether the original production tooling still exists. Rather than a mathematical model, the study describes the kinds of information needed, suggests guidelines, and presents estimating equations for airframe systems and subassemblies. These contribute to an understanding of the estimating problem but do not constitute a general solution.

R-2582-HCFA Profits in Hospital Laboratories: The Effects of Reimbursement Policies on Hospital Costs and Charges. P. M. Danzon. 1980.

Provides a theoretical and empirical analysis of the effects of cost-based reimbursement (CBR) by Medicare for hospital services. With cost-based reimbursement, accounting costs become a price charged to cost-paying patients and are subject to optimization. The theoretical analysis shows how the CBR formula creates incentives for hospitals to raise charges to charge-paying (private) patients and to manipulate accounting costs to maximize revenue. Data from California hospitals tend to support these conclusions. Accounting "profits," which reflect relative prices to charge and cost-paying patients, show charges in excess of costs in the laboratory but not for the hospital as a whole. Laboratory costs are lower in for-profit than in voluntary hospitals, but there is no difference in total operating costs. The data support the hypothesis that laboratory charges are constrained by competition and nonzero demand elasticity, but day service charges are not.

R-2595-DOE A Quantitative Evaluation of Closed-Cycle Ocean Thermal Energy Conversion (OTEC) Technology in Central Station Applications. E. C. Gritton, R. Y. Pei, J. Aroesty, M. M. Balaban, C. Gazley, R. W. Hess, W. H. Krase. 1980.

A quantitative evaluation methodology to study the cost sensitivities and engineering uncertainties of advanced energy conversion systems. Results of the application of the methodology to evaluate the ocean thermal energy conversion (OTEC) technology are reported. Capital cost and bus-bar cost of electricity are estimated for optimal complete systems. Sensitivities of these cost estimates to perturbations in various significant design parameters are derived. The effect of major variations in design concepts on the total system cost is also discussed.

R-2601-AF A New Approach to Modeling the Cost of Ownership for Aircraft Systems. K. E. Marks, H. G. Massey, B. D. Bradley, J. Y. Lu. 1981. 0NCLASSIFIED

Illustrates estimation of support investment costs and recurring operations and support costs through a Model for estimating Aircraft Cost of Ownership (MACO), which also provides a framework for future research. MACO is

an outgrowth of an earlier evaluation of the strengths and weaknesses of the most widely used aircraft life cycle cost models. It combines new algorithms for major, maintenance-related costs with formulas drawn from existing models for other cost elements. MACO relates a full set of ownership cost elements to component level reliability and maintainability characteristics and to aircraft design, operations, logistics, and deployment parameters, although the MACO equations would have to be reorganized before they could be used to estimate costs according to the cost structure of the latest Cost Analysis Improvement Group guide. MACO computes resource quantities in units that can be related directly to Air Force programming categories, including base maintenance manning (by work center), depot manning, and recoverable spares inventory levels. Output and input parameters accommodate annual changes in system parameters and operating conditions such as component reliability and aircraft inventory size and activity rates.

R-2619-RC Standard Spacecraft Procurement Analysis: A Case Study in NASA-DOD Coordination in Space Programs. E. D. Harris. 1980.

Examines organizational and procurement issues surrounding NASA-DOD cooperation for a specific case study—DOD use of NASA standard spacecraft. Space shuttle operation, as the U.S. standard launch vehicle for both NASA and DOD payloads, refocuses attention on NASA-DOD cooperation. Use of standard spacecraft designs offers reduced operational costs, but intensifies the difficulty of determining agency needs and responsibilities while retaining mission responsiveness. A modified system-impact-assessment approach compares total costs of alternative procurement options and applies both sensitivity and a fortiori analyses to manage uncertainty. Principal conclusions are: use of a new standard spacecraft design, rather than any original NASA or DOD designs, provides the basis for minimizing the cost of the Air Force Test Program; factors essential to NASA-DOD cooperation are a common subset of missions, a common organization responsibility, and an extensive period of time to develop the organizational mechanics; and the successful NASA-DOD cooperation model is not easily transferred to other situations.

R-2641-DOE Quantitative Evaluation of Ocean Thermal Energy Conversion (OTEC): Executive Briefing. E. C. Gritton, R. Y. Pei, R. W. Hess. 1980.

Documentation of a briefing summarizing the results of an independent quantitative evaluation by The RAND Corporation of ocean thermal energy conversion (OTEC) for central station applications. OTEC uses the temperature difference between the warm surface waters of the ocean and the cold water from the depths to drive a power system which generates electricity. The electrical

power is transmitted to shore by an ocean cable system. The authors' evaluation of OTEC is based on resource availability, technical feasibility, and cost. They find that the thermal resources in the Gulf of Mexico may yield tens of GWe in generation capacity, that OTEC appears most competitive in regions highly dependent on imported oil, that no one component drives system cost and thus it is unlikely that a single component breakthrough will result in a dramatic cost reduction, and that the cold water pipe and cable systems require increased R&D to establish feasibility.

R-2665-AF The Economics of Military Capital. G. G. Hildebrandt. 1980.

Military capital is an aggregate measure of all durable assets of the defense establishment. The report investigates two related measures of military capital: the instantaneous productive capacity of military capital, which equals the total monetary value of the benefits provided by the assets at some point in time; and the long-run productive capacity of military capital, which equals the monetary value of the benefits provided by the assets over the remainder of their service lives. These two measures can be determined by utilizing information that is likely to be available to the analyst. Both deterioration and changes in asset quality are properly accounted for in the determination.

R-2731-PA&E Estimating Aircraft Depot Maintenance Costs. K. E. Marks, R. W. Hess. 1981.

Describes a series of parametric equations for use in estimating the depot maintenance cost of new Air Force aircraft, particularly for the five major maintenance categories: airframe rework, engine overhaul, airframe component repair, engine component and accessory repair, and avionics component repair. The equations are intended to provide cost estimates for Defense Systems Acquisition Review Council Milestone II, at which point some design details of major aircraft subsystems (airframe, engine, avionics) are available. The report presents a single set of equations that are the most representative and applicable to the widest range of estimating situations, but presents alternative equations and supporting data and analyses for use by the interested reader.

R-2857-NYO Costs of Closing the Indian Point Nuclear Power Plant. J. P. Stucker, C. L. Batten, K. A. Solomon, W. Z. Hirsch. 1981.

This report estimates the monetary costs that would result from closing the nuclear power generating facilities at Indian Point, New York. The report estimates the total magnitude of the costs, the major components of costs, and the sensitivity of those components to major

underlying assumptions. Both the direct costs of closure and the secondary costs induced by those direct costs are considered. Section II on incremental generating costs and Sec. III on one-time costs and savings cover the direct costs resulting from closing the Indian Point facilities. Section IV on what is called business costs and Sec. V on the importance and size of secondary costs cover the less direct costs that would probably be associated with closure. Section VI then states the major conclusions and indicates those areas where the currently available information is deficient. The appendix contains the computer program of the cost model, the input datasets, and the more important output files.

R-2882-ICJ Cost-Benefit Analysis and Voluntary Safety Standards for Consumer Products. L. L. Johnson. 1982.

The purpose of this study is to explore the opportunities for expanding the use of cost-benefit analysis, to discuss the problems standing in the way, and to suggest experiments with it that can serve as benchmarks for further application. The study also recommends the collection of better product-hazard information; such information would be a valuable input if cost-benefit analysis is adopted, and if it is not, it could still serve as a partial substitute for such analysis in the formulation of future standards. Section II treats several topics as a foundation for the subsequent analysis. Section III discusses the relationships among costs, benefits, and the optimal level of product safety, and the difficulties of pursuing cost-benefit analysis. Section IV explores the very limited past use of cost-benefit analysis in developing voluntary standards. Section V addresses a particularly important problem in improving the quality of cost-benefit analysis—that of obtaining better hazard information. The concluding Section VI touches briefly on tradeoffs between devoting resources to cost-benefit analysis and devoting them to other approaches to help ensure the appropriate level of product safety.

R-2970-RC Health Care Costs: The Consequences of Increased Cost Sharing. C. E. Phelps. 1982.

This report analyzes the possible distributional consequences of several government policies for controlling health care costs. Drawing on the results of RAND's Health Insurance Study, it evaluates the potential savings from policies designed to increase cost sharing—deductibles and copayments—in both government and employer financed health insurance programs. It then examines how the cost of realizing these savings is distributed among major actors in the health care system—patients, doctors, hospitals, suppliers, insurers, and state and federal governments. The study assesses consequences of specific proposals to increase

income taxation of employer financed insurance programs and to increase copayments in Medicaid.

R-2985-ICJ Costs of the Civil Justice System: Court Expenditures for Various Types of Civil Cases. J. S. Kakalik, R. L. Ross. 1983.

This report analyzes the cost of processing domestic relations, mental health, probate and guardianship, property rights and condemnation, torts contracts and other civil complaints, and other civil petitions cases. Section II details the procedures for estimating and analyzing government expenditures for processing civil cases. Section III describes how the study derived the government expenditure per judge for each of the courts in the study—a necessary element in the cost-estimation procedure. Section IV reports the estimates of government expenditure and judge-time per civil case filed for various types of civil cases in state and federal courts. Finally, Sec. V provides estimates of the total nationwide government expenditure for processing civil cases.

R-3013-ICJ New Tools for Reducing Civil Litigation Expenses. M. A. Peterson. 1983.

The resolution of civil liability claims is an expensive and uncertain process. Frequent parties to civil litigation face growing costs, but they might reduce the expense and uncertainty of litigation through new methods for using computers. Organizations that have experience in handling a large volume of civil litigation can use these methods to manage groups of cases and to organize single, complex cases. Four new methods for using computers—open claim analysis, closed claim analysis, decision analysis, and rule-based modeling—may reduce the direct costs of litigation and the indirect costs of uncertainty in evaluating civil claims. All four methods have been used to analyze and support decisions about litigation, but most have not been widely applied. This report describes the development, uses, and limitations of each method, so that insurance company claim departments, law firms, corporations, and other frequent parties to litigation can consider whether those methods might be of help.

R-3210-RA Unit Cost Analysis: Annual Recurring Operating and Support Cost Methodology. J. Schank, S. J. Bodilly, R. Y. Pei. 1986.

This report presents a consistent and complete methodology for comparing annual operating and support costs of active and reserve units within and across all components of the force. Existing service models and data were modified or manipulated to create active and reserve annual cost models and cost factors. The report describes the general approach and uses service-specific case studies to demonstrate methods and cost factor derivations. Case

studies include: Air Force F-4D and C-130E squadrons; Army mechanized infantry, tank, field artillery, and combat engineering battalions; and Navy F-4S squadrons and FF1052 frigates. Results, given in FY 1983 dollars, show wide variances in annual active and reserve unit costs across units and services, emphasizing the need for a case-by-case approach to unit costing. Technical appendixes present the detailed descriptions of cost factor derivations and data sources. A companion document, R-3210/1-RA, provides a summary of this report in executive briefing format.

R-3210/1-RA Unit Cost Analysis: Executive Briefing. J. Schank, S. J. Bodilly, R. Y. Pei. 1986.

This report documents an executive briefing of a methodology for estimating the annual operating and support costs for similar units in the Active and Reserve components of the military services, and the results of case studies to which the methodology was applied. The methodology was developed to acquire an initial understanding of the potential budget implications of force mix decisions. It estimates the annual recurring incremental costs of unit personnel, peacetime equipment operations and peacetime base support. The accuracy of the cost estimates depends on the quality of the available data, which varies across the services and the different categories of cost factors. While the costing methodology developed under this research provides the necessary tools to estimate the annual recurring costs of specific types of units, further analysis in the areas of non-recurring transition costs and the difference between average and marginal personnel and equipment costs for force mix changes will be needed to understand the full budget impact of force mix decisions.

R-3212 The Capital Valuation of Military Equipment: Conceptual and Measurement Issues. G. G. Hildebrandt. 1985.

This report develops a methodology for measuring the capital value of military assets, and discusses two military capital measures. One measure, called the value of military capital (assessment), summarizes the value of defense assets during a particular year, and is useful for comparing the size of U.S. and Soviet military inputs. A second measure, called the value of military capital (wealth), summarizes the military benefits obtained from defense assets over the remainder of their service lives. The second measure is useful for comparing military wealth with other types of wealth in the economy.

R-3255-AF Aircraft Airframe Cost Estimating Relationships: Study Approach and Conclusions. R. W. Hess, H. P. Romanoff. 1987.

This report presents generalized equations for estimating the development and production costs of aircraft airframes. It provides separate cost estimating relationships (CERs) for engineering, tooling, manufacturing labor, and quality-control hours; manufacturing material, development support, and flight-test cost; and total program cost. The CERs, expressed in the form of exponential equations, were derived from a database consisting of 34 military aircraft with first flight dates ranging from 1948 to 1978. In addition to the basic objective of developing an updated set of airframe CERs, the study also examined three specific possibilities for improving CER accuracy: (1) stratifying the full estimating sample into subsamples representing major differences in aircraft type; (2) incorporating variables describing program structure and airframe construction characteristics; and (3) for the fighter aircraft only, incorporating an objective technology index into the equations.

R-3276-AF Assessing the Benefits and Costs of Motion for C-17 Flight Simulators. J. R. Gebman, W. L. Stanley, A. A. Barbour, R. Berg, J. L. Birkler, M. G. Chaloupka, B. F. Goeller, L. Jamison, R. J. Kaplan, T. F. Kirkwood, C. L. Batten. 1986.

This study examines the benefits and costs of incorporating a motion system in the C-17 flight training simulator, and it suggests a standard framework for assessing simulator fidelity requirements in general, and motion cueing alternatives in particular. Using a framework detailed in this report, the research assesses three simulator alternatives: a system having no motion, a system using hydraulic/pneumatic g-seats, and a system using a six-degree-of-freedom (dof) motion platform. If the Air force devises an adequate training syllabus for C-17 simulators and if the program plan ensures that adequate performance data are collected during development, the incremental costs of simulators using six-dof motion platforms appear to be warranted when measured against the likely benefits from their use. Simulators with no motion systems, or those using g-seats, do not appear to be cost-effective for the C-17 training application.

R-3376-COF Indirect Costs: A Guide for Foundations and Nonprofit Organizations. R. Eden, D. W. Lyon, J. E. Payne, A. Brink. 1986.

Indirect costs are costs for activities that benefit more than one project and for which it is difficult to determine how much each project should pay. When a nonprofit organization applies to a foundation for support, misunderstandings concerning indirect cost policies can arise between grantmaker and grantseeker. This report is intended to help parties on both sides of the grantmaking process to better understand the policy issues associated

with indirect costs. It examines the range of foundation and nonprofit concerns, practices, and policies regarding indirect costs; develops a common perceptual framework for understanding indirect costs; and provides guidelines for presenting and reviewing indirect costs in proposal budgets. The report is based on interviews with representatives of community, corporate, and private foundations and with representatives of various grant recipients, including service organizations, teaching colleges, research institutions and universities, and arts and performance groups.

R-3464-PA&E The Choice of Discount Rate Applicable to Government Resource Use: Theory and Limitations. J. P. Quirk, K. Terasawa. 1987.

This report presents a review of theories of the social discount rate, identifying the sources of divergent views and limitations of the theories in actual application. The question of the optimal discount rate to use in evaluating government projects has been debated in the economic literature since the late 1950s. The authors suggest that the discount rate be used as a filter rather than a device to achieve the desired level of government spending. Adopting this approach implies the choice of a discount rate that is in principle computable from existing data, with government budget limits acting as an effective constraint on government investment spending. Risk, flexibility, and data manipulability are considered. The approach is based purely on efficiency grounds and thus does not require information on the social rate of time preference. It does not address important equity issues, which the authors believe can be better resolved outside the framework of cost-benefit analysis.

R-3492-RA Cost Analysis of Reserve Force Change: Non-Recurring Costs and Secondary Cost Effects. J. Schank, S. J. Bodilly, A. A. Barbour. 1987.

This report describes a methodology for estimating the nonrecurring costs of Reserve component changes in the U.S. Air Force and the U.S. Navy and draws inferences about the factors that affect nonrecurring unit costs. The report also addresses other cost effects associated with unit charges, including changes in annual recurring costs and indirect or force-wide costs. Construction, support equipment, and aircrew training costs account for the majority of the nonrecurring costs in the various case studies. The findings suggest that nonrecurring costs can be reduced if (1) the basing location has existing facilities; (2) prior-service aircrew personnel with experience in the new weapon system can be recruited; and (3) the Reserve unit is located on an Active base that has excess capacity and can share in various logistic-support assets.

R-3557-EPA/JMO Age, Time, and the Measurement of Mortality Benefits. J. A. K. Cave. 1988.

Several analytical procedures can be used to place dollar values on the benefits of policies that reduce mortality. This report examines the sensitivity of such measures to age, time, and information effects. It derives benefits measures from a formal model of individual lifetime consumption decisions and applies them to several cases of policy interest. The author derives a number of policy recommendations from the research reported here: (1) base benefits assessments on full lifetable comparisons; (2) reexamine clinical and laboratory data in a way that permits economically meaningful risk assessment; (3) undertake ancillary studies of individual risk preference and time consistency; (4) avoid the use of human-capital or value-of-life measures whenever possible; and (5) take careful account of the timing and distribution of information when choosing policy options and measuring benefits.

R-3560-PSSP Understanding the Outcomes of Mega-Projects: A Quantitative Analysis of Very Large Civilian Projects. E. W. Merrow, L. McDonnell, R. Y., Argueden. 1988.

This report analyzes the costs, problems, and operations of megaprojects (projects requiring huge physical and financial resources) by examining 52 civilian projects ranging in cost from \$500 million to over \$10 billion (in 1984 dollars). The authors consider whether megaprojects meet their cost, schedule, and performance goals; whether they typically display poorer outcomes than smaller projects; what factors contribute to good and bad outcomes; and what steps can be taken to minimize the cost, schedule, and performance risks associated with megaprojects. The authors recommend that the sponsors of megaprojects (1) broaden the scope of the project definition phase to rigorously and systematically include cultural, linguistic, legal, and especially political factors; (2) train project managers to be as aware of the project's institutional environment as of the internal project organization; and (3) question whether new technology, construction techniques, or design approaches are essential to the mission of the project.

R-3723-ICTF Incremental Costs and Efficient Prices with Lumpy Capacity: The Single-Product Case. R. E. Park. 1989.

This report discusses the relationship between incremental costs and efficient prices when capacity must be added in costly "lumps," as much of it must be in the telephone business and other capital-intensive industries. It emphasizes comparison of various pricing rules, using numerical results from an abstract computer simulation model. The author provides some quantitative comparisons of prices and their effects on aggregate economic welfare and consumer surplus under the three pricing rules. He uses computer simulation models to

determine the relationship between capacity costs and optimal prices; how the lumpiness of capacity affects prices, welfare, and consumer surplus, and how the effects differ for smaller or larger lump sizes; and what is gained by using more elaborate pricing rules when capacity is lumpy. The findings indicate that more complex variable prices offer large efficiency gains over simpler pricing schemes.

R-3748-PA&E/FMP/JCS Estimating the Costs of Changes in the Active/Reserve Balance. G. A. Gotz, M. G. Shanley, R. A. Butler, B. Fishman. 1990.

Management of the total military force requires a determination of the proper role of the Selected Reserve. Both the executive and legislative branches of the government have increasingly looked to an expansion of the reserves as a potentially cost-effective way of maintaining the capability requirements of the total force. This trend has created the need for a cost methodology capable of supporting active/reserve force-mix decisions. This report presents a methodology for assessing the cost consequences of changing the mix of active and reserve units in the total force. The authors argue that the key to the usefulness of active/reserve force structure cost studies lies in a proper specification of the problem. Toward that end, they developed a structured accounting methodology for identifying and costing the resource, activity, and mission consequences of force structure change.

R-3748/1-PA&E/FMP/JCS Cost Element Handbook for Estimating Active and Reserve Costs. J. Schank, S. J. Bodilly, M. G. Shanley. 1990.

This report provides a reference handbook for cost analysts interested in estimating the various elements of costs associated with changes to the active and reserve force structure. It supports R-3748, which provides a methodology for assessing the cost consequences of changes in the active/reserve force mix.

R-3764-ICTF Incremental Capital Costs of Telephone Access and Local Use. B. M. Mitchell. 1989.

This report develops a methodology for assessing the incremental costs of local telephone services and provides initial estimates of those costs for conditions that are typical of California markets served by the two major local exchange carriers—Pacific Bell and GTE. The author constructs a small engineering-economic model of the three functional divisions of a local exchange: the local loop (the cables connecting subscribers to the switching point), the central office switch, and the interoffice transport facilities that link switches together. The local exchange network as a whole has average incremental capital costs for network access of some \$41 to \$114 per line annually across the three hypothetical communities

examined—larger urban areas, approximately average communities, and small urban communities. At approximately average levels of telephone use, the combined incremental capital costs of additional residential lines (access plus average usage) range from \$53 annually in larger urban areas to \$113 in small urban communities. Incremental capital costs of additional average business lines in the same communities range from \$54 to \$103 annually.

R-3843-AF VHSIC Electronics and the Cost of Air Force Avionics in the 1990s. P. S. Killingsworth, J. M. Jarvaise. 1990.

Very High Speed Integrated Circuits (VHSICs) is the name of a Department of Defense technology program to develop the next generation of solid-state electronic technology for military systems. While VHSIC electronics has great potential, there is uncertainty about how VHSIC will affect system costs in almost every phase of the weapon system life cycle. This report is a thorough discussion of the cost issues associated with the use of VHSIC electronics in military systems. It is also a primer for cost analysts on how integrated circuits are designed and fabricated. Finally, it suggests methodologies, including cost estimating relationships, to develop cost estimates for systems that incorporate VHSIC technology.

R-3996-RC Issues Associated with Second-Source Procurement Decisions. J. L. Birkler, E. Dews, J. P. Large. 1990.

The basic argument for competition in Department of Defense (DoD) procurement is that it is believed to reduce the government's cost of purchasing goods and services. Nonetheless, in some cases it may be actually less costly for the government to forgo competition and rely on a single supplier. The DoD's program manager must determine whether competition is likely to result in savings or losses for the government; if competition is indicated, he must then decide on what specific form it should take. This report focuses on one of the DOD's strategies for establishing competitive production sources—"second-source" procurement, in which two firms produce a single design. Such an arrangement does not meet the requirements of traditional economic theory for the forces of competition to operate with full effectiveness. Only one buyer and only two sellers exist; demand is inelastic but uncertain. The authors describe five methods of estimating single-source cost, analyze the effect of competition, and discuss the breakeven method, which deduces the magnitude of pure savings needed to compensate for the cost to the government of introducing a second source. Finally, they analyze the Tomahawk project as an example of second-source procurement, and consider the quality of the resulting product.

R-4061-PA&E/FMP Guidelines for Planning the Cost Analysis of Active/Reserve Force Structure Change. M. G. Shanley. 1992.

This report presents a set of guidelines for fully defining force structure changes and for planning the execution of cost analyses involving force structure change. The guidelines are presented in the form of a "generic" question list designed to extract the critical information missing from a vaguely worded force structure alternative. The report explains the rationale for each question, suggests procedures for determining answers, and provides examples to illustrate how those answers can affect cost. The full question list is divided into three subject areas. First, a series of questions has been designed to extract the exact force structure change. A second set of questions addresses the transition tasks associated with the implementation of a proposed change. The third set of questions identifies those changes in resource and activity levels that drive cost. With even qualitative answers to the questions contained in this report, the analyst can identify the full scope of a force structure change and the major cost-driving factors that are likely to influence the final results. With that information, the analyst can either plan the detailed work of a longer cost analysis or properly qualify (by the highlighting of critical assumptions) the results of an immediately required cost estimate.

R-4078/1-PA&E Cost Factors in the Army. Vol. 1, The Decisionmaking Context. A. R. Palmer. 1992.

R-4078/2-PA&E Cost Factors in the Army. Vol. 2, Factors, Methods, and Models. A. R. Palmer, E. V. Larson. 1992.

NOTES

N-1005-NSF/FEA Evaluating Fuel Economy Mandates: An Exploratory Cost-Benefit Analysis. J. P. Stucker, B. K. Burright, W. E. Mooz. 1980.

The first study of the welfare costs expected from the government's current fuel-economy mandate program for new cars. A simulation model of the domestic auto makers' joint-profit-maximizing response to the mandates and to postulated conditions of consumer demand predicts the 1985 equilibrium market outcomes, including: new-car sales, prices, costs, and fuel economy; average annual miles driven and gasoline consumption by car class; and measures of consumers' surplus, industry profits, and changes in the federal budget. Lack of verified information on costs of increasing fuel economy prevents definitive welfare cost estimates, but best currently available information suggests national costs will be about \$25 (in

1976 dollars) for each barrel of gasoline conserved when the 27.5 mpg mandate for 1985 is achieved.

N-1561-ED State Allocation and Management of P.L. 94-142 Funds. M. A. Thomas. 1980.

Reports the findings from one of the studies conducted through The RAND Corporation's Education Policy Development Center. The Center is sponsored by the Office of the Assistant Secretary for Planning and Budget, and in response to requests from the U.S. Department of Education conducts research on the education of disadvantaged children. This study deals with the implementation of the Education for All Handicapped Children Act, P.L. 94-142. In particular, the study describes how State Departments of Education allocate and manage their P.L. 94-142 funds, and draws implications for federal management of the P.L. 94-142 program from the study's findings.

N-1591-NSF Equalization and Equity in General Revenue Sharing: An Analysis of Alternative Distribution Formulas. S. M. Barro. 1980.

In the mid-1970s, RAND undertook a study of alternatives to the existing method of distributing general revenue sharing (GRS) funds among states and localities. The objective of the study was to develop formulas that would produce more fiscal equalization and greater distributional equity. This Note covers distribution of funds among states. Circulated to the sponsor in 1975 in working paper form, it is being published at this time to reach a wider audience.

N-1685-AF An Analysis of Combat Aircraft Avionics Production Costs. J. A. Dryden, T. P. Britt, S. Binnings-DePriester. 1981.

Describes research directed toward developing parametric estimating relationships for the production costs of avionics suites and systems. The research sample comprised 17 combat aircraft and their avionics equipment. Potential explanatory variables were selected based on interviews with manufacturers about factors affecting avionics costs and the appropriateness of the variables for use in planning studies early in system acquisition. Multivariate regression analysis techniques were used to determine the statistical properties of candidate estimating relationships for whole suites and individual systems. The estimating equations derived for suites were generally satisfactory but not always as statistically efficient as desirable. Attempts to derive estimating relationships for avionics systems were much less satisfactory but offer improvements over the simple cost-per-pound metrics often used. The authors conclude that objective means for expressing technology change and

its importance for avionics cost estimation remain a concern for future research.

N-1732-RWJF The Costs, Effects, and Benefits of Preventive Dental Care: A Literature Review. C. B. Foch. 1981.

This Note presents a review of the literature on preventive dental care in line with the objectives of the National Preventive Dentistry Demonstration Program to provide realistic estimates of the costs and effects of such care among varying populations and local conditions. Examination of five recent studies of preventive dental care discloses widely varying estimates of its costs, effects, and benefits. In general, reported cost results do not account for all resources employed in the provision of care and do not fully document costs that are included. Benefit calculations are usually avoided as too difficult. Cost-benefit and cost-effectiveness analysis is discussed in Sec. II, while measures of costs, effects, and benefits of preventive care are covered in Secs. III, IV, and V, respectively. The several important roles of time are discussed in Sec. VI, and the Note concludes with a brief summary of the literature review's more important lessons.

N-1861-AF The Impact of Tanker Support on Selection of Long-Range Combat Aircraft Size. R. D. Shaver, H. G. Massey, A. A. Barbour, J. L. Birkler. 1982.

This Note addresses the problem of long-range combat aircraft (LRCA) size selection and the impact of tanker support. It examines two possible LRCA missions (the canonical SIOP requirement and the use of LRCAs for worldwide force employment (WWFE) with nonnuclear ordnance) and airframe designs. Section II discusses the range/payload equations (with and without tankers) appropriate for SIOP-like missions. Section III describes the range shortfalls for the SIOP mission given specific airframe designs and mission-specific payload weights. Section IV translates these designs into total life-cycle costs, still concentrating on the SIOP-like mission requirements. That section presents the observations about preferred sizes for LRCA if the SIOP were the only mission to be considered. Finally, Sec. V discusses the impact of the WWFE mission on the above observations. The appendix presents details of the cost estimates upon which the cost estimating relationships used for the analysis were based.

N-1862-DOE An Analysis of High-BTU Coal Gasification Cost Estimates. R. W. Hess, G. F. Mills. 1982.

Presents the results of an analysis of the projected capital costs of coal gasification subsystems and of high-BTU coal gasification plants. Section II reviews high-BTU coal gasification processes, selects the most appropriate for

analysis, indicates the current status of development, and identifies major technical uncertainties. Section III describes the method of analysis, data collection, and evaluation criteria. Section IV presents the results of the analysis of gasification subsystem and whole plant cost estimates. Appendix A compares a system using a standard dry-ash Lurgi gasifier with a system using a higher temperature slagging Lurgi gasifier. Appendix B describes an integrated gasification/combined cycle power plant using the Texaco entrained flow gasifier. Appendix C contains explanatory variable definitions.

N-1875-HHS Discounting of Nonmonetary Effects. E. B. Keeler, S. Cretin. 1982.

Cost-effectiveness analysts generally assume that preferences over time are such that streams of monetary and nonmonetary program effects can be reduced to one discounted sum of monetary costs and another of effects. It is known that if the nonmonetary effects can be cashed out in a way that does not vary with time, then the rates of discount for monetary and nonmonetary effects have to be equal. This Note presents a more compelling argument for the equality of those rates when hard-to-monetize benefits such as life-saving are involved. The Note shows that if the ability to produce the nonmonetary effect does not diminish too quickly over time, failure to discount benefits implies that programs are always improved by delay. In general, discounting benefits and costs at different rates can lead to peculiar results.

N-1882-AF Development and Production Cost Estimating Relationships for Aircraft Turbine Engines. J. L. Birkler, J. B. Garfinkle, K. E. Marks. 1982.

This Note describes RAND's latest study of cost estimating relationships for new military aircraft turbine engine development and production programs. It presents equations for estimating development and production costs and time of arrival for U.S. military turbojet and turbofan engines. The study derives new cost estimating relationships from an expanded database and uses new diagnostic statistics to screen the relationships and to evaluate the characteristics of the preferred set. Section II of this Note identifies the data used, explains the criteria and rationale for selecting explanatory variables, and describes recently developed regression diagnostics. Section III presents the preferred set of relationships. Comments on these results, a comparison with DAPCA equations, suggestions for the use of the cost estimating relationships, and directions for possible future research are discussed in Sec. IV. Supporting statistics for the predictive models are available in the appendix.

N-1952-DOE An Analysis of the Cost, Schedule, and Performance of the Baseline SRC-I Commercial Demonstration Plant. R. W. Hess, T. Hayashi, M.

Kamionski, R. Y. Pei, C. W. Myers, W. H. Kruse, R. E. Horvath. 1983.

This Note documents an analysis of the cost, schedule, and performance of the proposed SRC-I Commercial Demonstration Plant. Section II contains an annotated version of the RAND briefing given on May 5, 1982 to the Director of the Office of Coal Processing. Appendix A contains back-up charts utilized in the briefing. Appendix B is the technical assessment undertaken in support of the determination of the PPS equation input values. Variable definitions, input values, and the basis for the input values are provided in App. C. A recapitulation of the ICRC cost, schedule, and performance estimates is contained in App. D. Appendix E summarizes the assumptions made in the calculation of SRC-I unit product costs. Appendix F lists the attendees at the May 5 briefing and includes the Program Office summary. Finally, App. G contains ICRC comments on the RAND analysis.

N-2179-RC The Costs of Closing Nuclear Power Plants. J. P. Stucker. 1985.

This paper presents methods for estimating the full costs of closing nuclear power plants. It (1) reviews recent studies of the economic costs of closing the Indian Point and Zion nuclear generating facilities, (2) offers methods for synthesizing the total costs of such closures, and (3) identifies and discusses the uncertainties associated with the major cost drivers. Scenarios describing the distribution of costs among ratepayers, stockholders, bondholders, and taxpayers are then used to illustrate alternative viewpoints on net and total closure costs. A matrix framework for conceptualizing and displaying closure costs is developed and used to illustrate the inadequacies of the cost estimates developed for recent public-policy debates.

N-2196-SFC How Management Practices Can Affect Project Outcomes: An Exploration of the PPS Database. C. W. Myers, M. R. Devey. 1984.

This Note documents the results of a study that evaluates data characterizing certain aspects of the management of process plant developments contained in RAND's Pioneer Plants Study (PPS) database. Various management approaches and attributes are analyzed as they relate to project cost, schedule, and performance. The analysis is exploratory, relying on a limited amount of management data. The results suggest that statistical analysis can serve as a useful supplemental tool in research on project management.

N-2252-AF Cost Implications of Transferring Strategic Airlift C-141s to the Air Reserve Forces. A. A. Barbour. 1985.

The Military Airlift Command's C-141 fleet presently is operated under an arrangement whereby each squadron is manned by both active duty and reserve personnel on an approximately 55 percent active to 45 percent reservist basis. This Note compares the cost of operating these C-141 squadrons under the present arrangement with the cost of a wholly reservist operation. It was found that when the costs of the present combined operation are calculated with the usual cost factors for C-141 squadrons there appears to be a potential to save one-third of the annual cost per squadron by transferring the C-141s to the Air Reserve Forces (ARF). However, the relatively high cost of the present C-141 operation stems largely from peacetime airlift requirements which would not be reduced by a transfer of C-141s to the ARF. As a result, the potential savings of a transfer become negligible when the cost of providing this peacetime airlift service by other means is added back in. The author emphasizes that when another cargo aircraft is acquired that can adopt the peacetime missions of the C-141s at comparable cost, these side-effects of the C-141 active/ARF comparison will disappear.

N-2273-SFC Review of Cost Improvement Literature with Emphasis on Synthetic Fuel Facilities and the Petroleum and Chemical Process Industries. R. W. Hess. 1985.

In order to provide a firmer basis for making realistic assessments of potential synthetic fuel process cost reductions, this Note documents a review of the publicly available literature on cost improvement, defined as the reduction in a technology's unit product cost that typically occurs as experience with the technology is gained. The review encompasses both theoretical and applied works and emphasizes the practical observations and empirical data from the few synthetic fuel facilities actually in existence as well as the analogous petroleum refining and chemical process industries. Among its conclusions, the study found that (1) with respect to overall unit product cost/price, the effective range of improvement rates appears to be between 5 percent and 40 percent with a norm between 20 percent and 30 percent; and (2) it typically takes four or five years to iron out basic performance problems in innovative process plants.

N-2274-SFC Potential Production Cost Benefit of Constructing and Operating First-of-a-Kind Synthetic Fuel Plants. R. W. Hess. 1985.

This Note documents an analysis of the extent to which the "learning" associated with pioneer (first-of-a-kind) synthetic fuel plants can be applied to possible future production expansions. It develops approximations of the magnitude of cost improvement that might reasonably be expected to result from the construction and operation of pioneer synthetic fuel facilities. The results show that,

subject to a number of important qualifications, the potential cost improvement attributable to the construction and operation of a pioneer synthetic fuel plant can be substantial (in some instances, up to 30 percent). A companion document, *Review of Cost Improvement Literature with Emphasis on Synthetic Fuel Facilities and the Petroleum and Chemical Process Industries*, N-2273-SFC, documents a review of the publicly available literature on cost improvement.

N-2283/1-AF Aircraft Airframe Cost Estimating Relationships: All Mission Types. R. W. Hess, H. P. Romanoff. 1987.

This Note is part of a series that derives a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design and manufacturing information. A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For all mission types, the equation set uses empty weight and speed as the basic size-performance variable combination.

N-2283/2-AF Aircraft Airframe Cost Estimating Relationships: Fighters. R. W. Hess, H. P. Romanoff. 1987.

This Note is part of a series that derives a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design and manufacturing information. A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For fighters, the equation set uses airframe unit weight as the variable.

N-2283/3-AF Aircraft Airframe Cost Estimating Relationships: Bombers and Transports. R. W. Hess, H. P. Romanoff. 1987.

This Note is part of a series that derives a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design and manufacturing information. A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For bombers and transports, no single acceptable estimating relationship could be identified. Estimates for these aircraft should be developed by analogy or by using the equation set developed for all mission types.

N-2283/4-AF Aircraft Airframe Cost Estimating Relationships: Attack Aircraft. R. W. Hess, H. P. Romanoff. 1987.

This Note is part of a series that derives a set of equations suitable for estimating the acquisition costs of various types of aircraft airframes in the absence of detailed design

and manufacturing information. A single set of equations was selected as being the most representative and applicable to the widest range of estimating situations. For attack aircraft, no single acceptable estimating relationship could be identified because sample sizes were small and not homogeneous. Estimates for these aircraft should be developed by analogy or by using the equation set developed for all mission types.

N-2301-AF Assessing the Benefits and Costs of Motion for C-17 Flight Simulators: Technical Appendixes. W. L. Stanley, C. L. Batten, T. F. Kirkwood, R. J. Kaplan, L. Jamison, B. F. Goeller, M. G. Chaloupka, J. L. Birkler, R. Berg, A. A. Barbour, J. R. Gebman. 1986.

This document provides technical support for R-3276. Appendixes describe (1) experiments to determine the value of motion in training simulators; (2) aircraft features that will influence the motion of the C-17; (3) possible effects on motion cues of the C-17's stability and control augmentation system; (4) the fidelity of different simulator motion cueing alternatives; (5) a suggested methodology for assessing the training capability of simulators; (6) the effects of simulator motion on simulator training capability, safety, and avoidance of simulator sickness; and (7) the costs of providing motion in simulators.

N-2368-DOE An Application of the Pioneer Plants Study Methodology to a First-of-a-Kind MHD Central Station. R. W. Hess, E. W. Merrow, R. Y. Pei. 1987.

This Note examines the feasibility, reasonableness, and credibility of applying a set of models based on chemical processing technology, as developed in the Pioneer Plants Study (PPS), to a related, but distinctly different, set of projects—advanced electric power generation facilities, specifically a first-of-a-kind central power station that uses magnetohydrodynamics (MHD) as its primary power production technology. The findings suggest that applying the PPS methodology is feasible, and its results reasonable. The application was not without difficulty, however. The authors conclude that in order to increase the applicability of the PPS models to advanced power plants, data would have to be collected on four to six carefully selected power plant projects, and additional statistical analysis would have to be performed.

N-2386-PSSP Process Industry Contingency Estimation: A Study of the Ability to Account for Unforeseen Costs. J. J. Milanese. 1987.

Contingency ratio calculation is one of the least understood and most neglected areas of cost estimation. This Note describes the result of a limited study of the nature of the contingency estimation process. Its goal was to determine the adequacy (the ability to project unforeseen costs) of contingency estimation in the

chemical process industries. The findings suggest that various parameters associated with novelty and complexity appear to be overlooked by estimators. The primary importance of the estimate type was established, as was the importance of the type of company. The job position of the estimator, the preparer and the type of contract under which design and construction were performed were not statistically significant in the calculation of the contingency amount.

N-2389-PSSP Comparing Project Investment Costs: A Methodology and Baseline for the Refining Industry. J. L. Birkler, W. Micklish. 1986.

This Note describes a method for comparing refinery project costs and attempts to establish an industry baseline against which investment costs for such projects can be compared. The parametric methods it describes can be used to obtain rough cost estimates in the absence of detailed descriptive information (e.g., project characteristics) and engineering designs. These estimates can then be used to assess whether a proposed project's costs will be competitive with the industry standard.

N-2420-PA&E Accounting for the Cost of Tactical Aircraft. G. G. Hildebrandt, Man-B. Sze. 1986.

The rising cost of weapon systems has been a serious concern to defense policymakers. It has been unclear, however, whether costs are rising faster or slower than the quality of the equipment. This Note develops a methodology for estimating the relationship between the cost of tactical aircraft and military quality. The authors apply the methodology to aircraft produced since 1950. Their analysis suggests that most of the cost growth derives from the increase in aircraft quality that has occurred over time. Furthermore, the cost increase has been reduced by improvements in the technology of aircraft production.

N-2426-FMP/RA Notes on the Gramm-Rudman-Hollings Deficit Reduction Plan. G. A. Gotz. 1986.

The Department of Defense (DOD) may be significantly affected by the Gramm-Rudman-Hollings deficit reduction plan (GRH), formally called the Balanced Budget and Emergency Deficit Control Act of 1985, Public Law 99-177. Although the broad outlines of GRH are widely known, the details are not well understood, and there is still disagreement as to how it is to be implemented and whether it is constitutional in whole or in part. This Note describes and comments on aspects of GRH which have not received much attention in the press, but which may have important effects on the DOD budget and on spending incentives within the Department of Defense.

N-2629/1-AF ALEC: A Model for Analyzing the Cost-Effectiveness of Air Force Enlisted Personnel Policies (Theory and Results). C. P. Rydell. 1987.

The Aggregate Lifecycle Effectiveness and Cost (ALEC) model enables managers of Air Force enlisted personnel to compare the cost-effectiveness of alternative management actions for a part of the force selected for analysis. Example actions are limits on the numbers of various types of enlistments, reenlistment bonuses designed to increase the number of persons making the Air Force a career, retraining programs that transfer personnel from one specialty to another, and the early-release program. This volume gives the theory and behavioral relationships used to build the model and gives cost-effectiveness results.

N-2629/2-AF ALEC: A Model for Analyzing the Cost-Effectiveness of Air Force Enlisted Personnel Policies (Documentation and User's Guide). C. P. Rydell. 1987.

The Aggregate Lifecycle Effectiveness and Cost (ALEC) model enables managers of Air Force enlisted personnel to compare the cost effectiveness of alternative management actions for a part of the force selected for analysis. Example actions are limits on the numbers of various types of enlistments, reenlistment bonuses designed to increase the number of persons making the Air Force a career, retraining programs that transfer personnel from one specialty to another, and the early-release program. This volume presents the microcomputer model that estimates the cost effectiveness of management actions for a given part of the enlisted force. Model users can evaluate complex combinations of actions and examine specific parts of the enlisted force.

N-2677-FMP Incremental Costs of Military and Civilian Manpower in the Military Services. A. R. Palmer, D. J. Osbaldeston. 1988.

This Note updates a series of reports by the Department of Defense (DoD) Comptroller's Office that contained cost estimates for military and civil service personnel, per man-year and by pay grade. The Note presents basic estimates of how the DoD budget would be affected by manning changes, then adjusts the estimates for differences between the DoD's budget effects and effects on the federal government's requirements for financing from the civilian sector. Cost effects associated with the use of individual man-years of military or civilian labor are distinguished from effects associated with changing personnel inventory flow patterns that support the change in use. The Note provides data for fiscal year 1986 and also describes estimation procedures that could be used to update the data on a regular basis.

N-3047-PCT A Generalized Approach for Analysis of Alliance Burden-Sharing. B. Zycher. 1990.

This Note discusses alliance burden-sharing in the context of multinational provision of a group of goods, including three the author uses to illustrate his discussion—military services, security and economic assistance, and defense and science/technology research. The author formulates a simple and straightforward methodology with which the distribution of alliance burdens can be estimated, given that members of the alliance, both individually and collectively, produce several goods furthering their broad objectives. These goods vary in terms of publicness and exclusion cost. The author includes a brief conceptual discussion of differences in marginal valuations, outlines the numerous components of the three prototypical alliance outputs, and evaluates subjectively the degrees of publicness characterizing the components.

N-3062-ACQ An Estimation of USAF Aircraft Operating and Support Cost Relations. G. G. Hildebrandt, Man-B. Sze. 1990.

To understand the availability of data to identify operating and support (O&S) costs, this Note develops aggregative cost estimating relationships to explain O&S costs. A database called VAMOSC is used in conjunction with other information on aircraft characteristics to relate O&S costs per aircraft to flying hours per aircraft, flyaway cost, number of aircraft, and design age. At the total O&S cost level, flyaway cost is an acceptable proxy for aircraft type and the mission design series year of initial operational capability. These cost estimating relationships give impressive explanatory results; whether they have equal predictive power remains to be seen. They may be helpful for assessing Air Force trade-offs between modernization and operating tempo and eventually for understanding the cost of achieving alternative readiness levels.

N-3136-AF Pitfalls in Calculating Cost Growth from Selected Acquisition Reports. P. G. Hough. 1992.

Cost growth is a highly visible phenomenon in the procurement of major weapon systems. In general, cost growth is the ratio of a weapon system's current estimate of cost to that of some earlier estimate. Thus, even given the same current estimate, different measures of cost growth are possible, depending on which prior estimate is selected as the baseline. Most studies of cost growth, however, select the cost estimate made at the time of program entry into full-scale development (the development estimate) as the baseline. Both the current estimate and the development estimate are normally taken from the Selected Acquisition Report (SAR), a legally mandated summary report on the status of major acquisition programs. This Note identifies and explains the type of cost data found in the SAR and reviews the history

of the SAR with respect to cost reporting. In spite of changes that have improved the quality and comprehensiveness of the data in the SAR, it still presents difficulties for measuring cost growth. Among the most notable problems are failure of some programs to use a consistent baseline cost estimate, exclusion of some significant elements of cost, exclusion of certain classes of major programs, and constantly changing preparation guidelines. Nevertheless, the author concludes that SAR data are suitable for identifying broad-based trends and temporal patterns across a range of programs.

ISSUE PAPER

IP-216-DFAS RAND Research Suggests Changes in Department of Defense Internal Pricing. E. G. Keating. 2001.

RGS DISSERTATION

RGSD-105 The Gemfibrozil Cost-Benefit Model: Analysis of Data from the Helsinki Heart Study, Model Development and Extension to the California Medicaid Population. S. Sarma. 1993.

In this research the author develops a logistic regression model based on data from the Helsinki Heart Study (HHS) to estimate the five-year probability of coronary heart disease (CHD) events in persons with various risk factors. When coupled with information on the prevalence of those risk factors in a population and the costs of CHD therapy, the model can be used to estimate the five-year health and economic outcomes of different drug treatment strategies. Real time analysis can allow the decisionmaker to use the model to immediately evaluate the effects of changing model assumptions or input values such as the costs and the effectiveness of drug therapy and program demographics. Using Gemfibrozil for this exemplary case study, the author applies the National Cholesterol Education Program (NCEP) guidelines to a publicly funded state level program. Approximately 11 percent of the total population between the ages of 40 and 80 years would be treated with the drugs; approximately 8600 CHD events (representing approximately 9 percent of the events expected) would be prevented during the five-year treatment period, and the net cost to the program of following the NCEP guidelines would be about \$116 million. By targeting patients using the risk model, and selecting only persons for whom the savings incurred by preventing CHD events offset the costs of drug treatment, we can devise alternate strategies that both provide

equivalent health benefit and reduce program net expenditures. One such strategy would result in treating a differently selected group of approximately 11 percent of the total population with the drugs, preventing approximately 14,500 CHD events at a net cost of approximately \$37 million. Another strategy that optimizes targeting of the population at risk for CHD achieves health benefits that are similar to the NCEP and demonstrates net program savings of approximately \$8 million. These results reflect a five-year drug treatment horizon analogous to the HHS and are denominated in 1988 U.S. dollars. The model supports similar analyses of the consequences of therapy with the other pharmaceutical products currently available for dislipidemia therapy and can be readily expanded to include new pharmacologic treatments introduced in the future.

REPRINT

RP-671 Is Crack Cheaper Than (Powder) Cocaine? J. P. Caulkins. 1998.

Retail prices for crack and powder cocaine are compared for 14 U.S. cities between 1986 and 1991 using regression analysis and t-tests. Prices are estimated from the United States Drug Enforcement Administration's System to Retrieve Information from Drug Evidence (STRIDE) database. On average, crack is neither more nor less expensive per pure unit than powder cocaine. Prices are not equal in every city in every year, but crack is equally likely to be more or less expensive, and the differences are not large relative to variation in prices of both forms of cocaine between cities and over time. Crack has been widely believed to be cheaper than powder cocaine, and this "fact" has been used to explain why U.S. drug problems worsened in the 1980s. However, this study concludes that crack is not, in fact, cheaper per pure unit than powder cocaine. Other explanations must be sought for why crack spread so rapidly relative to powder cocaine. Originally published in *Addiction*, v. 92, no. 11, 1997.

PAPERS

P-6463 Ethics and Policy Analysis. C. Wolf. 1980.

Policy analysis usually defines its objectives and constraints too narrowly. It rarely includes consideration of social justice, and more seldom such values as beauty, honor, and dignity. Because these broader considerations are so difficult to introduce, we tend instead to rely on the

wisdom and sensitivity of decisionmakers, as well as analysts who may be only modestly endowed with these characteristics. Yet the limitations in our ability to acquire or impart wisdom are severe. Hence, the scope of costs and benefits policy studies should be widened to include these broader considerations. Any value can be included provided we have the ingenuity to specify its importance relative to other values. There are tradeoffs among social values just as there are tradeoffs among private values. The tools and concepts of economic price theory are potentially applicable to the analysis of ethical issues. The opportunity costs associated with any single ethical value must be identified and evaluated when one chooses among alternative courses.

P-6495 Alternative Measured-Service Rate Structures for Local Telephone Service. B. M. Mitchell. 1980.

An examination of several types of measured-service rate structures that could eventually supplant the flat rate and an analysis of the effects of offering consumers a choice between a flat and a measured rate. The paper concentrates on the long-term welfare effects, of alternative rates implicitly measured by consumers' plus producer's surplus. Simple assumptions are made: costs vary only with the number of subscribers and calls, and the detailed effects of consumer demand elasticities ("repression") are omitted.

P-6530 Economic Issues in Usage-Sensitive Pricing. B. M. Mitchell. 1980.

Two central economic considerations confront regulators and telephone companies considering usage-sensitive (measured-service) pricing of local telephone service: determining when measured rates are desirable and establishing principles for designing them. Measured rates will be desirable on allocative grounds when they increase the net efficiency of the economic resources used to produce telephone service. The principles for designing them must apply to structure and level, and whether the rate will be mandatory or offered as an option to a conventional flat rate. The paper examines issues of allocative efficiency and rate design for local measured service.

P-6537 Cost Analysis of Light Water Reactor Power Plants. W. E. Mooz. 1980.

A statistical cost analysis of the licensing time, construction time, and capital cost of light water reactor (LWR) power plants. Use of econometric techniques allows the major cost-driving variables to be identified through multivariate analysis of time series data on over 50 U.S. nuclear power plants. The analysis provides a clearer picture than does engineering cost estimates of the dynamic changes that have occurred in the cost of power

plants. A tool is described that can be used to project LWR costs.

P-6600 Risk-Spreading Properties of Common Tax and Contract Instruments. J. K. Sebenius, P. J. E. Stan. 1981.

Many tax systems and private contractual arrangements require payments by means of fixed fees (lump sum taxes), percentages of gross revenues (royalties or ad valorem taxes), or percentages of net income (profit-sharing or income taxes). Even where payments due under such instruments have the same expected value, their risk-spreading implications for the parties involved may differ. For equal expected levies, profit-sharing is often ranked as the most effective means of risk-sharing, followed by royalty payments, and, finally, by fixed fees, which supposedly fail completely in spreading risk. We demonstrate that this common assessment does not hold in general. Using both mean-variance and expected utility frameworks, we derive necessary and sufficient conditions for a welfare ranking of these traditional financial instruments.

P-6604 Development of Parametric Cost Models for Weapon Systems. J. P. Large. 1981.

Statistical cost models are widely used in the Department of Defense for estimating the cost of next-generation weapon systems. This paper presents a brief survey of the evolution of such models from the post-World War II period to the present time. The emphasis is on aircraft cost models of the type that require only physical and performance parameters as inputs. The utility of such models has been demonstrated, and they are now being used in a variety of other fields. In a simple exploratory analysis, time use data are examined to compare the work of rural Guatemalan children attending primary school with the work of children not attending. Only about 58 percent of Guatemalan children of primary school age (7–14) were attending school at the time of the study; some children work as much as seven hours or more per day. The results show that although for some children—especially older boys—income-earning and housekeeping activities may reduce school attendance, they fail to fully explain nonattendance. The study suggests a need for programs (1) to reduce work constraints by making school schedules more compatible with work schedules, and (2) to increase the motivation to send children to school.

P-6617 Local Telephone Costs and the Design of Rate Structures. B. M. Mitchell. 1981.

Most of the variable costs of local telephone service are due to providing capacity sufficient to meet the maximum volume of calling which occurs during a small number of

busy hours. As a result, a uniform average-cost price at all hours may be less efficient than a flat-rate tariff which charges nothing per call, even if metering were costless. Because capacity is distributed throughout the network and used jointly by different calls, optimal peak-load prices may be positive when demand is below the maximum level, and the highest rate need not occur at the hour of peak demand. Realistic rate structure can have only a limited number of separate prices. An efficient rate structure will combine hours and routes that have similar marginal costs and demand elasticities.

P-6736 Uncertainty in Estimating Power-Plant Closure Costs: A Review of "Economic Impact of Closing Zion Nuclear Facility," a Report by the Comptroller General of the United States. J. P. Stucker. 1982.

Comparing the Government Accounting Office's estimates of the costs that could result from the closure of Zion and Indian Point reveals the large range of uncertainty currently associated with such estimates and suggests a number of areas requiring further study. Better and more detailed information on alternative generating costs, decommissioning costs, incremental financing costs, and secondary costs in general needs to be developed and documented. And the groups or institutions who will ultimately bear these costs need to be identified. Uncertainties in all these areas must be reduced, and common costing methods and assumptions adopted, before intelligent decisions can be made regarding the future of any of the nuclear generating facilities (either operational or under construction) that are currently being questioned.

P-6781 Can Implementation of Computers Be Justified on Cost-Effectiveness Grounds? R. J. Shavelson, J. D. Winkler. 1982.

Examines claims that technology can decrease educational costs, primarily by replacing teachers and other staff, thereby increasing educational productivity. The authors conclude that such claims are unwarranted. First, most cost analyses focus on hardware costs, but these costs are not the major factor driving the cost of computers used in instruction. Second, technology is more likely to change the skill mix of labor in education than to decrease the intensity of labor. Third, research on the effectiveness of computer-assisted instruction (CAI) indicates that drill and practice as an adjunct to or alternative to some regular instruction is effective. Therefore, a policy of integrating the computer with the teacher, rather than replacing the teacher, is more likely to lead to improved achievement in less time. Finally, the cost of replacing a significant portion of teacher time with CAI is currently prohibitive.

P-6782 Vertical Integration, Contestable Markets, and the Misfortunes of the Misshaped U. 1982.

This paper models the vertical integration of an upstream monopolist who sells an intermediate good to firms in a contestable downstream market. The downstream firms combine that good with other inputs, according to a production function with U-shaped average costs, to produce a final good which is sold to consumers at minimum average cost. One theme of the paper is to compare the incentives for and results of vertical integration when the upstream market is protected from entry with those when the upstream market is contestable. The results suggest that vertical mergers should be encouraged in the latter case but tolerated in the former only under specific guidelines. The second theme is to explore the effects on the scale of firms in the downstream industry of the monopolization of the upstream market and of vertical integration. Monopolization upstream may cause distortions in the scale of downstream firms, and such scale distortions create incentives for integration. The use of a nonconstant return downstream technology also helps to explain partial forward integration.

P-6822 Total Cost Estimates for Closing Indian Point. J. P. Stucker, K. A. Solomon. 1982.

Based on a review of existing studies, the authors advance a method for estimating the total costs associated with the premature closure of a nuclear power plant facility. The methodology is described in terms of the planned closure of an operational plant but can easily be generalized to cover the forced, immediate closure of a nuclear facility following, say, a severe accident. Illustrating the procedures and the state of current costing information by analyzing the postulated voluntary closure of Indian Point Units 2 and 3, the authors find the differential cost of closure over keeping the units open at between \$7 billion and \$17 billion. Cost uncertainty of this magnitude seriously degrades the decisionmaking ability of both private and public authorities.

P-6837 Government Shortcomings and the Conditions of Demand. C. Wolf. 1982.

The author considers the inadequacies of governmental activities from a particular point of view: inefficiencies and inequities that result from the conditions of demand for government activities in Western democracies, especially the United States. Criteria for evaluating the conditions of demand for government activities are identified. The author concludes that profound distortions can result from politically effective demands for government action or inaction. As a result, government programs may be initiated or expanded even though they are inefficient in a static sense, as well as inequitable in conferring special gains and privileges on politically effective groups, while imposing greater costs on politically less effective ones. Other programs may be expanded to a level where they become inefficient in a

dynamic sense by undermining the incentives on which the economy's longer-term growth depends.

P-6839 Cost Reduction in Vertically Related Industries: Integration Versus Nonlinear Pricing. H. Quirnbach. 1983.

This paper examines the incentives of the monopoly producer of an intermediate good either to integrate into a contestable industry it serves or to impose either a royalty scheme or a two-part tariff. The paper focuses on cost reduction rather than profit maximization incentives. With free entry downstream, independent downstream firms earn zero profit. Thus, the monopolist's profit is the industry profit, and any move which lowers industry costs while (for comparison) yielding the same final good demand must thereby improve the monopolist's profit. It is further shown that cost reduction is not just sufficient but also locally necessary for profits to increase under any of the three alternatives.

P-6869 Cost Growth in New Process Facilities. E. W. Merrow. 1983.

This paper describes the causes of cost misestimation for major process plants and speculates about why the estimation problem has been so resistant to resolution. The discussion is based on a substantial body of RAND work that developed methods for evaluating the cost, schedule, and performance of process plant projects. The paper details the approach to the analysis and how the model for analyzing the problem was developed. The last part of the paper discusses why the cost estimation problem has persisted, including difficulties in the estimating process and managerial obstacles to estimation accuracy.

P-6881 The Meaning of Cost Analysis. D. Novick. 1983.

Transcript of a talk given to the Los Angeles Chapter of the Institute of Cost Analysis on May 18, 1983. The talk traces the history of the term cost analysis and defines it, in particular with reference to systems analysis.

P-6896 Regression Diagnostics in Practice: Experiences from Modeling Jet Engine Costs. J. B. Garfinkle, J. L. Birkler. 1983.

This paper describes how regression diagnostics were used to help develop revised cost-estimating relationships for jet engines. The goal was to derive meaningful, yet easy-to-use models based on an updated collection of few observations and many variables. First, specific criteria were established for selecting explanatory variables. A variety of numerical and graphical techniques were then used to critique candidate models by examining residuals and evaluating the influence of individual engines. The final models are not only intuitively satisfying, but

generally provide better predictions and are easier to use than earlier models. Additionally, the user is provided with a greater understanding of the design and sensitivity of the models, and therefore a better understanding of the actual estimates.

P-6998 Cost and Schedule Implications of Multinational Coproduction. M. D. Rich, W. L. Stanley, J. L. Birkler, M. E. Vaiana. 1984.

This paper examines the cost, schedule, and program management implications of multinational coproduction—international collaboration during weapon system production. It assesses the positive and negative aspects of multinational coproduction, spotlights differences in U.S. and European approaches to systems acquisition, and offers guidelines for ensuring the success of future collaborative efforts based on analysis of numerous U.S. and European national and multinational programs, including F-16 fighter aircraft coproduction. Although they are delicate and complex undertakings, properly structured coproduction programs can offer a spectrum of advantages to participating countries.

P-7078 Treasury Proposal Will Increase, Not Decrease, Investment. D. P. Henry, W. B. Trautman. 1985.

This paper considers the impact on capital investment of the Treasury tax reform proposal that would eliminate the investment tax credit, lengthen the write-off periods for capital goods, and index the write-offs to inflation. The authors argue that the assertion by business groups that the proposal would reduce investment is erroneous because it only considers the impact of the cost of capital, and therefore ignores an important factor: the higher after-tax cost of capital must be balanced against the higher after-tax revenue from capital. They find that the Treasury proposal would actually increase the incentives for most categories of capital investment when compared to the present tax law.

P-7246 Reserve Force Cost Research. J. Schank. 1986.

This paper was originally presented at a workshop on Naval Reserve Manpower, Personnel, and Training Research at the Naval Postgraduate School, Monterey, California, June 25–27, 1986. It summarizes the results of a previous RAND analysis of the annual operating costs of both Active and Reserve units, describes current work on non-recurring costs associated with changes to the Reserve Force structure, and outlines possible areas for future cost research.

P-7256 Assessing Benefits and Costs of Alternative Aircrew Training Simulators for the C-17 Military Transport. W. L. Stanley. 1986.

At the request of the U.S. Air Force, The RAND Corporation examined the benefits and costs of incorporating motion systems in C-17 flight simulators and suggested a general framework for assessing simulator motion requirements. The analysis screened alternatives to identify potentially attractive motion devices, constructed alternative simulator cases with only the motion devices varying from one case to another, assessed important benefits and costs, and used a "scorecard" method to compare benefits and costs. The cases ranged from a simulator using a six-degree-of-freedom motion platform to one with no motion. The costs of motion platforms appear warranted when measured against likely benefits. The study results are assisting in the development of simulator motion requirements for the C-17 and other new systems. The analysis framework permitted the multidisciplinary study team to effectively integrate and present a mix of qualitative and quantitative results.

P-7307 The Relative Cost Factor: A Method of Comparing Petroleum Refinery Investment. J. L. Birkler, W. Micklish, E. W. Merrow. 1987.

Major refinery projects are complex endeavors that span many years and require the integration of many activities and groups. A simple model could not capture all these facets. The Relative Cost Factor model does not demand more specialized or detailed knowledge than would be readily available during the concept formulation phase. It is accurate enough to permit comparison of many refinery projects. Relationships are provided for only the major refining processes, but equations for other processes may be easily derived. Any project to be evaluated by the techniques developed must be consistent with the basic assumptions under which these relationships were developed. Development and pricing policies must be similar to those of the 1970s and early 1980s.

P-7361 Military Spending in Czechoslovakia, Hungary, and Poland. K. Crane. 1987.

Western researchers who analyze Warsaw Pact military spending have concentrated on the Soviet Union; the non-Soviet Warsaw Pact (NSWP) has been relatively neglected. Yet the forces funded by the NSWP military budgets would be an essential component in most plausible scenarios for a Warsaw Pact attack on Western Europe. Using East European statistics, this paper aims to remove some of our present ignorance concerning the size and composition of NSWP military expenditures. The author constructs military expenditures estimates for personnel, procurement of military durables, operations and maintenance, and research and development costs. He

concludes that the reported budgets of Czechoslovakia, Hungary, and Poland probably contain most of their military expenditures, although they omit military research and development expenditures, some personnel expenditures, and some direct subsidies for military producers.

P-7425 Beginning of Military Cost Analysis, 1950-1961. D. Novick. 1988.

The traditional way of looking at military procurement at the end of World War II was in terms of hardware. Fairly early, however, it seemed to some RAND researchers that other things—such as real estate, people, supply, and maintenance—were involved. This realization led to the concept now called weapon systems analysis, which includes the political, economic and social, and technical and military considerations that make up a total system. All of these elements have to be taken into account when pricing futuristic hardware proposals. This paper, which was originally presented as a talk at Science Applications, Inc., in Los Angeles in January 1979, traces the major steps in the evolution of the process that developed, by 1961, into program budgeting, which is still in place in the Department of Defense.

P-7515 The Cost and Benefits of Reliability in Military Equipment. A. J. Alexander. 1988.

The rising demand for more reliable military equipment has generated questions on the net benefits and appropriate strategies for obtaining reliability. This paper examines the costs of achieving greater reliability, the benefits of improved reliability in reduced support costs and increased availability, and strategies for attaining reliability goals. The author considers several kinds of evidence: reliability improvement programs, new product developments, statistical analyses of reliability costs and outcomes in new programs, and a review of a broad range of cases analyzed in other studies. He also examines seven systems in detail: F-18 aircraft, CH-47D helicopter modernization, F100 turbine engines, the Phalanx Mk15 close-in weapon system, the LAMPS MKIII helicopter antisubmarine warfare system, the Minuteman I inertial navigation system, and the Carousel inertial guidance system. Based on the data, the author concludes that reliability improvements are possible, that the greater the improvement the more costly the necessary investment, and that the improvement probably rises proportionally faster than the investment.

P-7539 Birth of a Profession: Four Decades of Military Cost Analysis. P. G. Hough. 1989.

The ability to accurately assess military resource requirements has become more important as defense budgets are strained by increased interservice competition

and by political pressures. This paper chronicles the evolution of cost analysis as it has affected the process of weapon procurement. The art of cost analysis has gone through various permutations marked by the personalities involved over the past 40 years. RAND personnel figured prominently in the early days, and RAND's David Novick is considered "the father of cost analysis." The author stresses that, though cost analysis is crucial in the decisionmaking process, it is only part of the equation and must not be viewed as a panacea in solving procurement problems.

P-7543 Impacts of Advanced Manufacturing Technology on Parametric Estimating. P. G. Hough. 1989.

The introduction of advanced manufacturing technology in the aerospace industry poses serious challenges for government cost analysts. Traditionally, these analysts have relied on parametric estimating techniques for both planning and budgeting. Despite its problems, this approach has proven to be a remarkably useful and robust tool for estimating new weapon system costs. However, rapid improvements in both product and process technology could exacerbate current difficulties and diminish the utility of the parametric approach. This paper reviews some weaknesses associated with parametrics, then examines how specific aspects of the factory of the future may further affect parametric estimating. Finally, it suggests avenues of research.

P-7732 Estimating the Cost of Advanced Technology. R. W. Hess, J. R. Nelson, P. S. Killingsworth, S. A. Resetar. 1992.

This paper contains the four presentations that made up the "Estimating the Cost of Advanced Technology" session of the 30th Annual Joint National Meeting of the Operations Research Society of America and the Institute of Management Sciences, held October 29–31, 1990, in Philadelphia, Pennsylvania.

DOCUMENTED BRIEFINGS

DB-191-OSD Cancellations and Delays in Completion of Department of Defense A-76 Cost Comparisons. E. G. Keating. 1997.

The Department of Defense (DoD) has recently increased its use of A-76 public/private cost comparisons. This documented briefing examines the history of A-76 public/private cost comparisons in the DoD using data covering fiscal years 1978–1994. A-76 refers to the Office of Management and Budget (OMB) circular A-76, which

mandates the process for competition for work between government employees and contractors. A fuller understanding of this history may provide insights as to how future cost comparisons might progress as well as suggest possible policy changes to improve future outcomes. It is thought that cost comparisons might reduce infrastructure costs and/or increase military effectiveness. As a note of caution, however, this study finds that since 1978 there have been approximately five A-76 cost comparisons cancelled for every eight completed. Further, those completed have often taken two years or longer to complete. The briefing considers DoD cost comparison background, patterns of cost comparison cancellations, and durations of completed comparisons.

DB-240-AF Incentives to Undertake Sourcing Studies in the Air Force. L. H. Baldwin, F. A. Camm, E. G. Keating, E. M. Pint. 1998.

This annotated briefing examines the incentives of participants in the Air Force's sourcing process (encompassing both A-76 competitions and direct conversions). The goal of this research is to suggest how process participants can best be induced to start and complete cost-effective sourcing studies that will help the Air Force realize its goal of reducing the cost of support activities without inappropriately reducing military capability or quality of life. Personnel at the Air Staff, major commands, and installations play important roles in identifying activities to be studied and conducting sourcing studies. Although the Air Staff has strong fiscal incentives to start and complete sourcing studies, it relies on command and installation personnel actually to carry out sourcing activities. Major command leadership, due to informational asymmetries, is largely dependent on its functional and installation personnel to identify prospective studies and complete them successfully. Unfortunately, functional and installation personnel have strong incentives to work against sourcing studies, and installation commanders' tenures are often too short to affect the process adequately. The Air Staff has passed down operations and maintenance budget cuts to the major commands, providing them with fiscal incentives to perform sourcing studies as well as pursue other cost-saving activities. However, the Air Staff faces a difficult challenge associated with appropriate allocation of budget cuts, and these cuts do not address the challenges that major commands face in motivating their functional and installation personnel.

DB-398-AF The Effects of Advanced Materials on Airframe Operating and Support Costs. R. Raman, J. C. Graser, O. Younossi. 2003.

Advanced materials-particularly polymer composites and titanium-are increasingly being used instead of aluminum in military airframe structures because of their superior

strength and lighter weight. As such, the authors concentrate on answering a fundamental question: Do airframe parts made of advanced materials cost more to maintain than parts made of aluminum? Because very little is known about the operating and support costs of airframe parts after an aircraft is fielded and operational, the research team produced a methodology for forecasting these costs. The authors analyzed part-level maintenance data from the F/A-18 A/B/C/D and survey-based data from airframe contractors and the B-2 Program Office. In their F/A-18 part-level analysis, the authors concluded that maintenance is a function of part type and material type, with access doors being the most expensive parts to maintain. Their findings also indicate that composite materials require more maintenance than aluminum, with composite parts containing aluminum honeycomb substructures requiring the most maintenance. Titanium parts, by comparison, need the least maintenance. Survey-based data showed similar results, with the exception of the airframe contractor's survey data, which had mixed results for titanium parts, the maintenance of which varied with material form relative to aluminum sheet as a baseline.

JOURNAL ARTICLES AND BOOK CHAPTERS (Not Available from RAND)

LRP-200009-13 The Relationship Between Modifiable Health Risks and Group-Level Health Care Expenditures. D. R. Anderson, W. Whitmer, R. Z. Goetzel, R. J. Ozminkowski, J. Wasserman, S. Serxner, S. T. Kennedy.

PURPOSE: To assess the relationship between modifiable health risks and total health care expenditures for a large employee group. **DESIGN:** Risk data were collected through voluntary participation in health risk assessment (HRA) and worksite biometric screenings and were linked at the individual level to health care plan enrollment and expenditure data from employers' fee-for-service plans over the 6-year study period. **SETTING:** The setting was worksite health promotion programs sponsored by six large private-sector and public-sector employers. **SUBJECTS:** Of the 50% of employees who completed the HRA, 46,026 (74.7%) met all inclusion criteria for the analysis. **MEASURES:** Eleven risk factors (exercise, alcohol use, eating, current and former tobacco use, depression, stress, blood pressure, cholesterol, weight and blood glucose) were dichotomized into high-risk and lower-risk levels. The association between risks and expenditures was estimated using a two-part regression model, controlling for demographics and other confounders. Risk prevalence data were used to estimate

group-level impact of risks on expenditures. **RESULTS:** Risk factors were associated with 25% of total expenditures. Stress was the most costly factor with tobacco use, overweight, and lack of exercise also being linked to substantial expenditures. **CONCLUSION:** Modifiable risk factors contribute substantially to overall health care expenditures. Health promotion programs that reduce these risks may be beneficial for employers in controlling health care costs. Published in *American Journal of Health Promotion*, v. 15, no. 1, Sept./Oct. 2000, p. 45–52.

LRP-200012-16 Costs and Cost-Effectiveness of a Church-Based Intervention to Promote Mammography Screening. S. E. Stockdale, E. B. Keeler, N. Duan, K. P. Derose, S. A. Fox.

OBJECTIVES: To evaluate the costs of implementing a church-based, telephone-counseling program for increasing mammography use, and to identify the components of costs and the likely cost-effectiveness in hypothetical communities with varying characteristics. **DATA SOURCES/STUDY SETTING:** An ethnically and socioeconomically diverse sample of 1,443 women recruited from 45 churches participating in the Los Angeles Mammography Promotion (LAMP) program were followed from 1995 to 1997. **STUDY DESIGN:** Churches were stratified into blocks and randomized into three intervention arms—telephone counseling, mail counseling, and control. The authors surveyed participants before and after the intervention to collect data on mammography use and demographic characteristics. **DATA COLLECTION/EXTRACTION METHODS:** The authors used call records, activity reports, and interviews to collect data on the time and materials needed to organize and carry out the intervention. The authors constructed a standard model of costs and cost-effectiveness based on these data and the Year One results of the LAMP program. **PRINCIPAL FINDINGS:** The cost in materials and overhead to the church site was \$10.89 per participant and \$188 per additional screening. However, when the estimated cost for church volunteers' time was included, the cost of the intervention increased substantially. **CONCLUSIONS:** A church-based program to promote the use of mammography would be feasible for many churches with the use of volunteer labor and resources. Published in *HSR, Health Services Research*, v. 35, no. 5 pt. 1, Dec. 2000, p. 1037–1057.

LRP-200100-42 Important Influences on Effectiveness and Costs to Be Considered in the Evaluation of Cancer Screening. R. Boer, H. de Koning, M. van Ballegooijen, P. J. van der Maas.

Trials of cancer screening are designed to give an answer to the question of whether screening is effective, in particular in reducing cancer mortality. The main result of

such a design is presented as a relative risk of dying from cancer in the study group (invited to screening) as compared to the control group (not invited). This relative risk is often treated as a constant which does not depend on the particular screening situation (Elwood et al., 1993). But it has been shown that the cost-effectiveness ratio can differ strongly with economic context (Brown and Fintor, 1993). Besides the economic context, effectiveness and costs of screening also strongly depend on several other aspects of the screening situation. In this chapter we describe such aspects and give some examples of quantification of their influence as estimated with the aid of the MISCAN simulation package (Habbema et al., 1985; Loeve et al., 1999) with examples mainly from models of breast cancer screening (van Oortmarssen et al., 1990; de Koning et al., 1991; de Koning et al., 1995), because international interest has focused strongly on screening for cancer of this site. Other examples are mostly from models of cervical cancer screening (van Ballegooijen et al., 1990; Koopmanschap et al., 1990; van Ballegooijen et al., 1992a; van Ballegooijen et al., 1995; van Ballegooijen et al., 1997). The authors' models on prostate cancer screening (Boer et al., 1997) and colorectal cancer screening (Loeve et al., 1999) are not yet suitable for public health decision support because the evidence on efficacy is too preliminary for prostate cancer screening in general and for colorectal cancer screening if any screening modality other than faecal occult blood testing is to be considered. Results from trials are essential for sensible public health decisions on cancer screening. In this chapter it is shown that they cannot automatically be extrapolated to population screening situations without taking into account epidemiology, demography, screening quality, policy and history, clinical practice and costs. The role of these components of detailed evaluation of a screening programme are now described in more detail. Published in *Quantitative Methods for the Evaluation of Cancer Screening I* edited by S. Duffy, C. Hill, J. Esteve (Oxford; New York: Oxford University Press, 2001), p. 13–25.

LRP-200109-11 Cost-Effectiveness of Practice-Initiated Quality Improvement for Depression: Results of a Randomized Controlled Trial. M. Schoenbaum, J. Unützer, C. D. Sherbourne, N. Duan, L. V. Rubenstein, J. Miranda, L. S. Meredith, M. Carney, K. B. Wells.

CONTEXT: Depression is a leading cause of disability worldwide, but treatment rates in primary care are low. **OBJECTIVE:** To determine the cost-effectiveness from a societal perspective of 2 quality improvement (QI) interventions to improve treatment of depression in primary care and their effects on patient employment. **DESIGN:** Group-level randomized controlled trial conducted June 1996 to July 1999. **SETTING:** Forty-six primary care clinics in 6 community-based managed care

organizations. **PARTICIPANTS:** One hundred eighty-one primary care clinicians and 1356 patients with positive screening results for current depression. **INTERVENTIONS:** Matched practices were randomly assigned to provide usual care (n = 443 patients) or to 1 of 2 QI interventions offering training to practice leaders and nurses, enhanced educational and assessment resources, and either nurses for medication follow-up (QI-meds; n = 424 patients) or trained local psychotherapists (QI-therapy; n = 489). Practices could flexibly implement the interventions, which did not assign type of treatment. **MAIN OUTCOME MEASURES:** Total health care costs, costs per quality-adjusted life-year (QALY), days with depression burden, and employment over 24 months, compared between usual care and the 2 interventions. **RESULTS:** Relative to usual care, average health care costs increased \$419 (11%) in QI-meds (P = .35) and \$485 (13%) in QI-therapy (P = .28); estimated costs per QALY gained were between \$15 331 and \$36 467 for QI-meds and \$9478 and \$21 478 for QI-therapy; and patients had 25 (P = .19) and 47 (P = .01) fewer days with depression burden and were employed 17.9 (P = .07) and 20.9 (P = .03) more days during the study period. **CONCLUSIONS:** Societal cost-effectiveness of practice-initiated QI efforts for depression is comparable with that of accepted medical interventions. The intervention effects on employment may be of particular interest to employers and other stakeholders. Published in *Journal of the American Medical Association*, v. 286, no. 11, Sept. 19, 2001, p. 1325–1330.

LRP-200202-03 Cost-Effectiveness of Cervical Cancer Screening: Comparison of Screening Policies. M. E. van den Akker-van Marle, M. van Ballegooijen, G. J. van Oortmarssen, R. Boer, J. D. F. Habbema.

BACKGROUND: Recommended screening policies for cervical cancer differ widely among countries with respect to targeted age range, screening interval, and total number of scheduled screening examinations (i.e., Pap smears). The authors compared the efficiency of cervical cancer-screening programs by performing a cost-effectiveness analysis of cervical cancer-screening policies from high-income countries. **METHODS:** They used the microsimulation screening analysis (MISCAN) program to model and determine the costs and effects of almost 500 screening policies, some fictitious and some actual (i.e., recommended by national guidelines). The costs (in U.S. dollars) and effects (in years of life gained) were compared for each policy to identify the most efficient policies. **RESULTS:** There were 15 efficient screening policies (i.e., no alternative policy exists that results in more life-years gained for lower costs). For these policies, which considered two to 40 total scheduled examinations, the age range expanded gradually from 40–52 years to 20–80 years as the screening interval decreased from 12 to 1.5

years. For the efficient policies, the predicted gain in life expectancy ranged from 11.6 to 32.4 days, compared with a gain of 46 days if cervical cancer mortality were eliminated entirely. The average cost-effectiveness ratios increased from \$6700 (for the longest screening interval) to \$23 900 per life-year gained. For some countries, the recommended screening policies were close to efficient, but the cost-effectiveness could be improved by reducing the number of scheduled examinations, starting them at later ages, or lengthening the screening interval. **CONCLUSIONS:** The basis for the diversity in the screening policies among high-income countries does not appear to relate to the screening policies' cost-effectiveness ratios, which are highly sensitive to the number of Pap smears offered during a lifetime. Published in *Journal of the National Cancer Institute*, v. 94, no. 3, Feb. 2002, p. 193-204.

LRP-200212-17 An Economic Evaluation of a School-Based Sexually Transmitted Disease Screening Program. L. Y. Wang, G. R. Burstein, D. A. Cohen.

BACKGROUND: A school-based sexually transmitted disease (STD) screening program was implemented in eight New Orleans public high schools to detect chlamydia and gonorrhea. **GOAL:** The goal was to assess the incremental cost-effectiveness of replacing non-school-based screening with the school-based screening program. **STUDY DESIGN:** A decision-analysis model was constructed to compare costs and cases of expected pelvic inflammatory disease (PID) in the school-based screening scenario versus a non-school-based screening scenario. Cost-effectiveness was quantified and measured as cost per case of PID prevented. **RESULTS:** Under base-case assumptions, at an intervention cost of \$86,449, the school screening program prevented an estimated 38 cases of PID, as well as \$119,866 in treatment costs for PID and its sequelae, resulting in savings of \$1524 per case of PID prevented. Results remained cost-saving over a reasonable range of model parameter estimates. **CONCLUSIONS:** The New Orleans school-based chlamydia screening program was cost-effective and cost-saving and could be cost-effective in other settings. School-based screening programs of this type are likely to be a cost-effective use of public funds and can reduce the burden of STDs among adolescents. Published in *Sexually Transmitted Diseases*, v. 29, no. 12, Dec. 2002, p. 737–745.

LRP-200304-03 Postpartum Length of Stay and Newborn Health: A Cost-Effectiveness Analysis.

OBJECTIVE: To evaluate the cost-effectiveness of increasing lengths of brief postpartum hospitalizations. **METHODS:** A cost-effectiveness model extrapolating from secondary data was used. Social costs in 2000 US dollars were estimated using several sources, including a randomized controlled trial, a retrospective study, and

survey data. Life-years saved from reduced infant mortality were estimated from administrative data from Washington State. A total of 113,147 singleton newborns who were born in nonmilitary hospitals in Washington State in 1989 or 1990 and had postpartum stays short enough to be affected by length of stay legislation were studied. The cost-effectiveness of increases in postpartum lengths of stay similar to those that would occur if all mothers and singleton newborns used at least the time allotted to them under the federal length of stay legislation was measured. **RESULTS:** Estimated lower-bound cost per newborn life-year saved was 19,800 dollars (95% confidence interval: 11,600–61,300 dollars) when only neonatal deaths were considered. The corresponding upper-bound estimate was 94,800 dollars (95% confidence interval: 55,200–286,800 dollars). The results were very sensitive to assumptions about the discount rate for future life-years and the time from birth during which averted deaths are considered (neonatal deaths, postneonatal infant deaths, or all infant deaths). **CONCLUSIONS:** At hospitals that do not experience additional capacity costs as a result of increased lengths of stay, lengthening short postpartum stays seems to be more cost-effective than many common health interventions and well below cost-effectiveness thresholds suggested by the literature. Even at hospitals that experience additional capacity costs, the cost-effectiveness of lengthening short postpartum stays seems to be roughly equal to the benchmark of 100,000 dollars per quality-adjusted life-year suggested by the literature. Published in *Pediatrics*, v. 111, no. 4, Apr. 2003, p. e316-e322.

LRP-200306-03 A Review of the Evidence for the Effectiveness, Safety, and Cost of Acupuncture, Massage Therapy, and Spinal Manipulation for Back Pain. D. C. Cherkin, K. J. Sherman, R. A. Deyo, P. G. Shekelle.

BACKGROUND: Few treatments for back pain are supported by strong scientific evidence. Conventional treatments, although widely used, have had limited success. Dissatisfied patients have, therefore, turned to complementary and alternative medical therapies and providers for care for back pain. **PURPOSE:** To provide a rigorous and balanced summary of the best available evidence about the effectiveness, safety, and costs of the most popular complementary and alternative medical therapies used to treat back pain. **DATA SOURCES:** MEDLINE, EMBASE, and the Cochrane Controlled Trials Register. **STUDY SELECTION:** Systematic reviews of randomized, controlled trials (RCTs) that were published since 1995 and that evaluated acupuncture, massage therapy, or spinal manipulation for nonspecific back pain and RCTs published since the reviews were conducted. **DATA EXTRACTION:** Two authors independently extracted data from the reviews (including number of RCTs, type of back pain, quality assessment,

and conclusions) and original articles (including type of pain, comparison treatments, sample size, outcomes, follow-up intervals, loss to follow-up, and authors' conclusions). **DATA SYNTHESIS:** Because the quality of the 20 RCTs that evaluated acupuncture was generally poor, the effectiveness of acupuncture for treating acute or chronic back pain is unclear. The three RCTs that evaluated massage reported that this therapy is effective for subacute and chronic back pain. A meta-regression analysis of the results of 26 RCTs evaluating spinal manipulation for acute and chronic back pain reported that spinal manipulation was superior to sham therapies and therapies judged to have no evidence of a benefit but was not superior to effective conventional treatments. **CONCLUSIONS:** Initial studies have found massage to be effective for persistent back pain. Spinal manipulation has small clinical benefits that are equivalent to those of other commonly used therapies. The effectiveness of acupuncture remains unclear. All of these treatments seem to be relatively safe. Preliminary evidence suggests that massage, but not acupuncture or spinal manipulation, may reduce the costs of care after an initial course of therapy. Published in *Annals of Internal Medicine*, v. 138, no. 11, Jun. 2003, p. 898-E-907.

LRP-200401-02 The Changing Face of Pharmacy Benefit Design: A Small Group of Pharmacy Benefit Experts Suggests That Changes Could Be Coming for Tiered Copayment Designs. J. D. Malkin, D. P. Goldman, G. F. Joyce.

Employers, health plans, and pharmacy benefit managers seeking to reduce rapid growth in pharmacy spending have embraced multi-tier pharmacy benefit packages that use differential copayments to steer beneficiaries toward low-cost drugs. The consensus of fifteen pharmacy benefit design experts whom the authors interviewed is that such plans will become more prevalent and that the techniques these plans use to promote low-cost drugs will intensify. The effect on health outcomes depends on whether the high-cost drugs whose use is being discouraged have close, low-cost substitutes. Published in *Health Affairs*, v. 23, no. 1, Jan./Feb. 2004, p. 194–199.

LRP-200401-11 Employee Responses to Health Insurance Premium Increases. D. P. Goldman, A. A. Leibowitz, D. A. Robalino.

OBJECTIVE: To determine the sensitivity of employees' health insurance decisions—including the decision to not choose health maintenance organization or fee-for-service coverage—during periods of rapidly escalating healthcare costs. **STUDY DESIGN:** A retrospective cohort study of employee plan choices at a single large firm with a "cafeteria-style" benefits plan wherein employees paid all the additional cost of purchasing more generous insurance. **METHODS:** The authors modeled the probability that an

employee would drop coverage or switch plans in response to employee premium increases using data from a single large US company with employees across 47 states during the 3-year period of 1989 through 1991, a time of large premium increases within and across plans. RESULTS: Premium increases induced substantial plan switching. Single employees were more likely to respond to premium increases by dropping coverage, whereas families tended to switch to another plan. Premium increases of 10% induced 7% of single employees to drop or severely cut back on coverage; 13% to switch to another plan; and 80% to remain in their existing plan. Similar figures for those with family coverage were 11%, 12%, and 77%, respectively. Simulation results that control for known covariates show similar increases. When faced with a dramatic increase in premiums—on the order of 20%—nearly one fifth of the single employees dropped coverage compared with 10% of those with family coverage. CONCLUSIONS: Employee coverage decisions are sensitive to rapidly increasing premiums, and single employees may be likely to drop coverage. This finding suggests that sustained premium increases could induce substantial increases in the number of uninsured individuals. Published in *The American Journal of Managed Care*, v. 10, no. 1, Jan. 2004, p. 41–47.

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