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DEPARTMENT OF ECONOMICS
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PLANNING-PROGRAMMING-BUDGETING SYSTEMS:

Selected Case Materials

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Preface

Most of the following materials on Planning-Programming-Budgeting Systems (PPBS) were originally prepared for the author's Graduate Seminar in Public Expenditures. They are being made available in this form in the hope that they will be useful to those engaged in applying economic analysis to the allocation of resources in space and related public sector programs.

The economic foundations of PPBS were analyzed in an earlier working paper, "Program Budgeting: Applying Economic Analysis to Government Expenditure Decisions." Applications to NASA were presented in a working paper on "Program Budgeting and the Space Program." The views expressed are personal.

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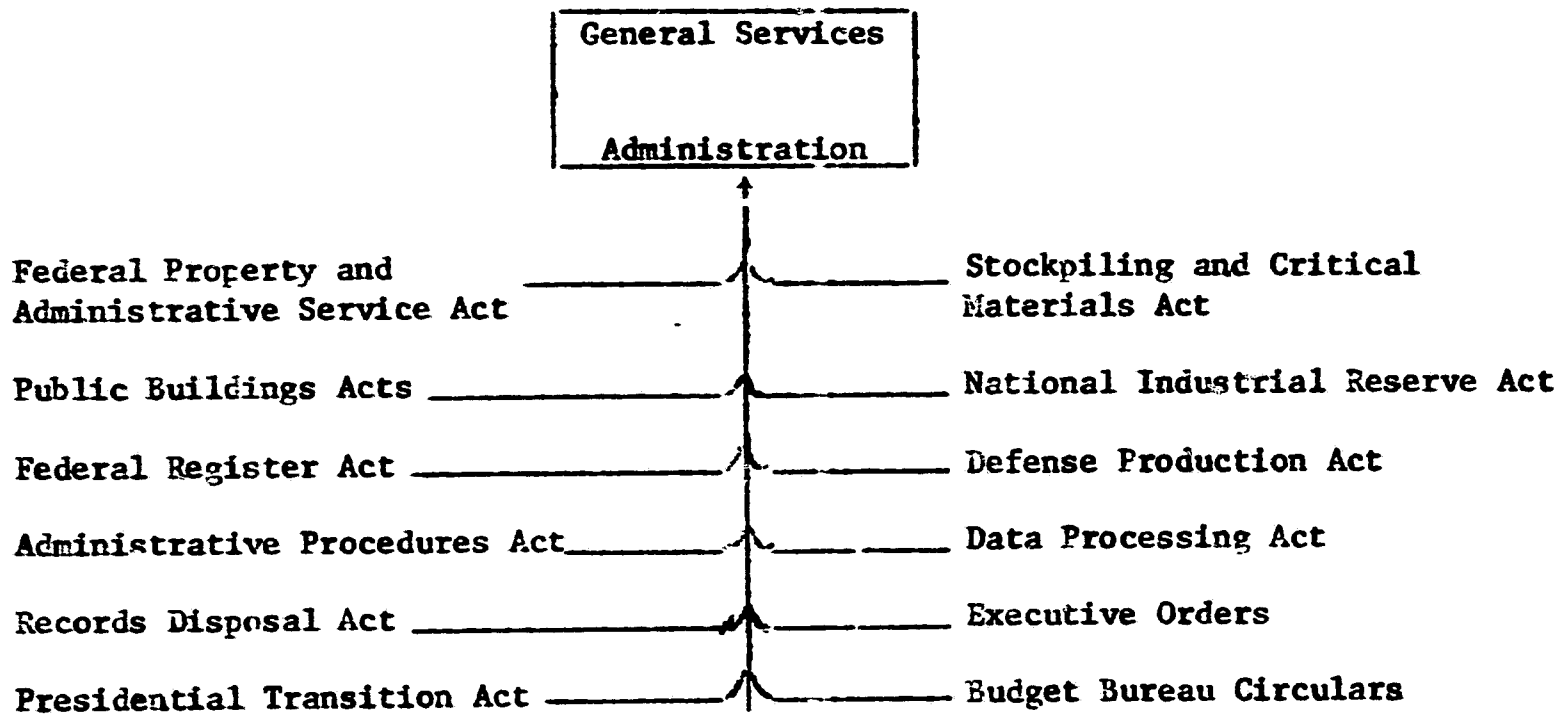
Part A - Program Budget Statements

Table 1

THE PROBLEM OF IDENTIFYING AGENCY GOALS
(Example of Agency with Many Mandates)



Source: General Services Administration

Table 2

ILLUSTRATIVE OUTLINE OF A NATIONAL TRANSPORTATION PROGRAM

Elements	Fiscal Years
GENERAL INTER-CITY TRANSPORT	1967, 1968, 1969, 1970, 1971, 1972
Interstate Highways	
Interstate Highway Program	
Primary System Highways	
Domestic Water Transport	
Inland Waterways Facilities	
Maritime Programs	
Aviation	
CAB Subsidies to Airlines	
FAA and NASA Aircraft Technology	
URBAN COMMUTER TRANSPORTATION	
Urban Highway Systems	
Urban Transit Systems	
RURAL ACCESS	
Secondary System-Roads	
Forest, Public Lands, National Parks Roads	
Aid to Local Service Aviation	
MILITARY STANDBY TRANSPORTATION	

Source: U.S. Bureau of the Budget

Table 3

ELEMENTS OF A TRANSPORTATION PROGRAM CATEGORY:
URBAN COMMUTER TRANSPORTATION

Urban highways

Passenger-miles carried
Ton-miles of freight carried
Number of miles of way completed
Number of miles of way placed under construction

Urban transit systems

Passenger-miles carried
Ton miles of freight carried
Number of miles of way completed
Number of miles of way placed under construction

From the above information, some comparisons might be made between urban highways and urban transit systems in terms of:

1. Capital cost per mile of way.
2. Operating cost per mile of way.
3. Average commuter travel time per mile of way.

Source: U.S. Bureau of the Budget

Table 4

RUDIMENTARY PROGRAM BUDGET FOR NASA IN FISCAL YEAR 1967
(in millions)

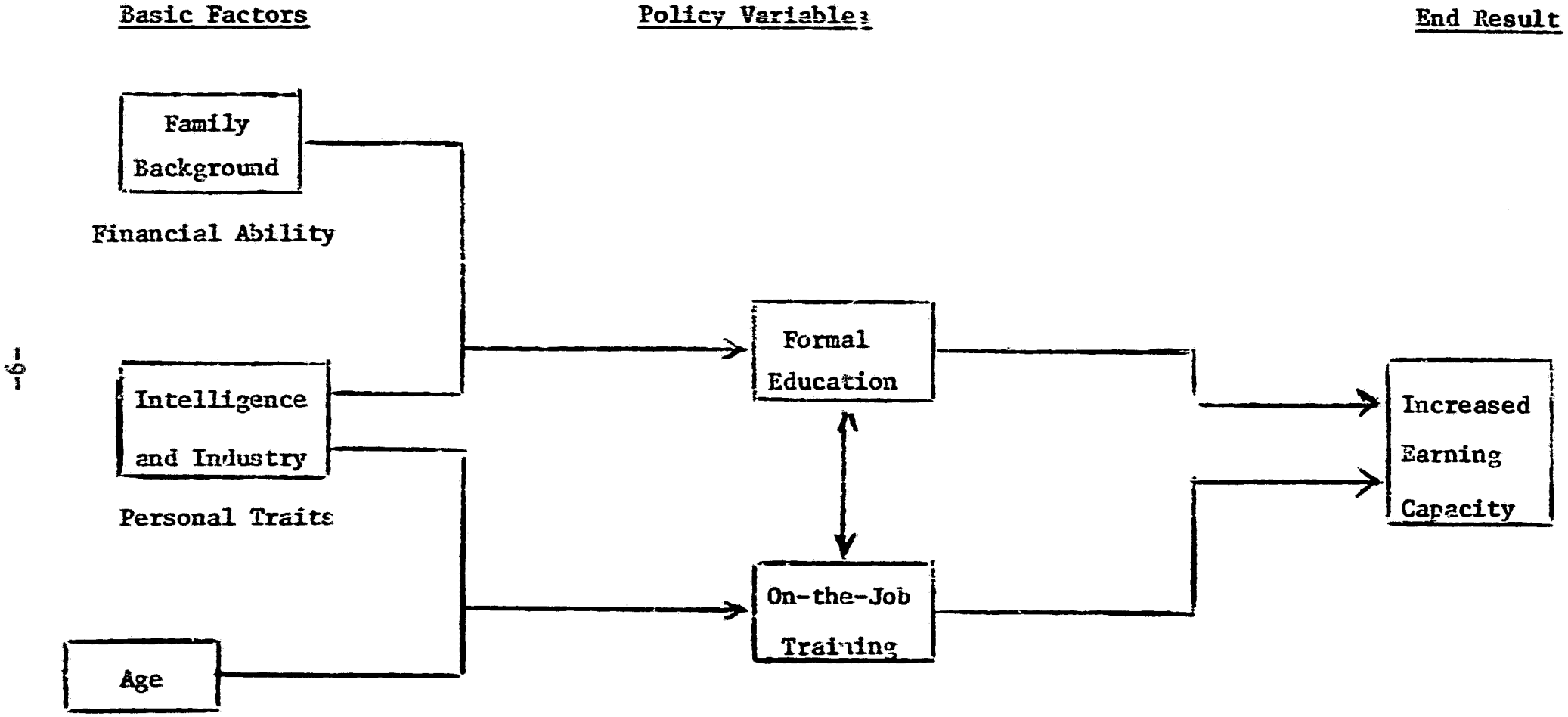
Activity (Budget Plan)	Appropriation Categories: Research and Development	Construction of Facilities	Administrative Operations	Total
Manned space flight	$3,024	$54	$310	$3,387
Scientific investigations in space	530	6	69	605
Space applications	88	-	13	101
Space technology	248	11	192	451
Aircraft technology	33	21	50	104
Supporting activities	325	9	30	
TOTAL	$4,248	$101	$664	

Source: M. L. Weidenbaum, "Program Budgeting and the Space Program", The Management of Aerospace Programs, American Astronautical Society, 1967.

Table 5

A HYPOTHETICAL PROGRAM MODEL

(Education Versus Training)



Source: M. L. Weidenbaum, Washington University

Table 6

PORTION OF ILLUSTRATIVE PROGRAM MEMORANDUM FOR U.S.I.A. ACTIVITIES IN COUNTRY X

Media	Outputs	Annual Cost (Thousands of Dollars)	Unit Cost (Dollars)	Cost Per User
Direct Radio Broadcasting	63 Hours/Week	113	34.00	
Local Radio Placement	5,400 Hours/Week	100	.37	
Television	14 Hours/Week	56	79.00	
Magazine	20,000 Copies Bi-Monthly	6	.05	To be determined through benefit-cost analysis
Pamphlets	15,000 Copies/Week	59	.08	
Press Placement	6,000 Column-Inches/Week	120	.40	
Motion Pictures	60 Hours/Week	127	41.00	
Books	7,000 Copies/Week	121	.32	

Source: U.S. Bureau of the Budget

Table 7

TYPICAL STUDENT TRAINING PROGRAM FOR PPBS

First Term

Micro-economic Analysis--The analysis of the economic behavior of households, firms and markets focusing on the determination of prices, output, and income distribution.

Introduction to Quantitative Methods--A review of calculus, an introduction to linear algebra and related maximization techniques. Introduction to probability theory and statistics.

Introduction to Computer Applications--A study of information handling, computer systems, and computer programming.

Public Expenditure Economics--A study of economic criteria to be used in the analysis of public problems.

Second Term

Intermediate Quantitative Methods--An analysis of analytical techniques such as simulation, queuing theory, game theory, linear programming, and dynamic programming.

Workshop in Public Management--A study of management techniques as applied to public problems. Utilization of program budgeting and systems analysis in decision-making.

Structure of the American Economy--Examination of relative roles of public and private sectors. Macroeconomic theory including fiscal and monetary policy.

Analytic Workshops on Public Policy Issues--Analysis of public programs, e.g., poverty, education, water resources, transportation, economic development. Individual programs will be arranged according to the areas of interest of the student and of his sponsoring agency.

Seminar on Applications of Systems Analysis--A weekly seminar of speakers from government agencies that deals with applications of systems analysis to government problems.

Source: National Institute of Public Affairs

Part B. Case Materials on Benefit/Cost Analysis

Table 8

TYPICAL BENEFIT/COST ANALYSIS
WATER RESOURCE DEVELOPMENT PROJECT

	Amortization Period	
	50 years	100 years
Total Investment	$3,100,000	$3,100,000
Annual costs		
Interest & amortization	$123,400	$101,600
Operation, maintenance, etc.	25,400	25,900
Total Annual Costs	$148,800	$127,500
Annual benefits		
Flood damage reduction	$168,000	$206,000
Fish, wildlife, & recreation	32,800	35,500
Total Annual Benefits	$200,800	$241,500
Benefit - cost ratio	1.4	1.9

Source: James River and Tributaries, Jamestown, North Dakota, Letter from the Secretary of the Army Transmitting a Letter from the Chief of Engineers, 89th Congress, 1st session, House Document No. 266, August 17, 1965, p. 119.

Table 9

RETURN ON INVESTMENT IN EDUCATION

	Costs	Benefits
Social	Teachers and other current expenses	Improvements in general social welfare: Faster economic growth Greater literacy Greater political participation More research Nicer neighborhoods
	School construction and land acquisition	
	Debt service (all of above paid through taxes, gifts, fees)	Tangible benefits: Reduction in law enforcement costs and crime losses Trained work force for employers Reduction in unemployment (intergeneration benefits)
	Employment of students foregone (Discount by unemployment rate)	
Private	Fees and charges	As a consumer expense--"the full life"
	Income foregone (opportunity cost)	As an investment: Increased earnings Lower unemployment Financial option Free child care service Fruits of literacy (income tax return)

Table 10

CANCER CONTROL PROGRAMS, 1968-72

(Millions of Dollars)

	UTERINE CERVIX	BREAST	HEAD AND NECK	COLON-RECTUM
PROGRAM COST	118.7	10.1	7.8	7.3
Grants	68.1	7.4	7.4	7.0
Early Treatment	50.6	2.7	.4	.3
BENEFITS	1,071.4	43.8	9.0	3.8
Earnings Saved	998.3	39.0	8.2	3.2
Late Treatment Averted	73.0	4.8	.8	.6
BENEFIT/COST RATIO	9.0	4.3	1.1	.5

Source: Office of Economic Opportunity

Part C. Case Materials on Cost/Effectiveness Analysis

Table 11. Hypothetical Strategic Mission Force Structure

Table 12. Shift in Military Resource Allocation

Table 11

HYPOTHETICAL STRATEGIC MISSION FORCE STRUCTURE

Alternative Systems	Unrefueled	1 Refuel	2 Refuels
	Cost Per Unit (Millions of dollars)		
B-50	1.0	1.5	2.0
B-60	5.0	8.0	10.0
ICBM	4.0	---	----
	Radius (nautical miles)		
B-50	4,000	5,000	6,000
B-60	4,000	5,000	6,000
ICBM	6,000	-----	-----
	First Strike Survival Capability		
B-50	.7	.6	.5
B-60	.8	.7	.6
ICBM	.5	--	--
	Mission Survival Capability		
B-50	.4	.2	.1
B-60	.7	.6	.5
ICBM	.8	--	--
	Required Bombs per Target		
B-50	2	2	2
B-60	1	1	1
ICBM	3	-	-
	Total Cost per Target (millions of dollars)		
B-50	7.14	25.00	80.00
B-60	8.93	19.05	33.33
ICBM	30.00	-----	-----

Enemy Targets

Distance from Z1	No. of Targets
0-3000	11
3-4000	14
4-5000	35
5-6000	40
	100

Source: M. L. Weidenbaum, Washington University

Table 12

SHIFT IN MILITARY RESOURCE ALLOCATION

Old Budget System	New Planning-Budgeting System
Navy:	Strategic forces:
Polaris	Polaris
Marine Corps	ICBM'S
Carrier task forces	Long range bombers
Air Force:	General purpose forces:
ICBM'S	Marine Corps
Tactical aircraft	Armored divisions
Air defense aircraft	Tactical aircraft
Long range bombers	Carrier task forces
Army:	Continental defense forces:
Air defense missiles	Air defense aircraft
Armored divisions	Air defense missiles

Source: M. L. Weidenbaum, "Program Budgeting: Application of Economic Analysis to Government Expenditure Decisions", Planning-Programming Budgeting, Markham Publishing Company, 1968.

Part D. A Government-Wide Program Budget

Table 13. A Rudimentary Program Budget for the U. S. Government

A GOVERNMENT-WIDE PROGRAM BUDGET

Under the Planning-Programming-Budgeting Systems (PPBS) being established by the major Federal Government departments, program analysis is conducted primarily at departmental and bureau levels.[1] On the basis of existing budget materials and some previous work by the author, it is believed that a hypothetical program budget can be developed for the United States Government as a whole.[2]

Such a government-wide program analysis would permit comparing alternative programs of different agencies for fulfilling broad national goals, rather than merely examining the alternatives available to a single federal agency. Also, such an aggregate approach may be useful to the various state and local governments that currently are attempting to set up program budgeting systems.[3]

A rudimentary program budget for the entire Federal Government can be developed by basing it on the fundamental end purposes for which the various government programs are carried on.

In a world of critical international tensions, the initial purpose is to protect the Nation against external aggressors, to maintain the national security. A variety of programs help to achieve this objective, some directly

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[1] Cf. M.L. Weidenbaum, "Economic Analysis and Government Expenditure Decisions," Finanzarchiv, Vol. 25, No. 3, November 1966, pp. 463-475.

[2] M.L. Weidenbaum, Federal Budgeting: The Choice of Government Programs, Washington, American Enterprise Institute, 1964 and "WHich Resources for What Goals? Another Look at the Budget," Challenge, July 1964, pp. 4-8.

[3] Cf. State-Local Finances Project, George Washington University, Planning-Programming-Budgeting for City, State, County Objectives, January 1967.

and others more indirectly. These programs range from equipping and maintaining the U.S. military establishment and bolstering the armed forces of other nations regarded as potential allies, to various types of international non-military competition and to negotiating arms control agreements.

A second basic national purpose, one also going back to the Constitution, is the promotion of the public welfare. Here, under the public welfare interpretation that has prevailed, the Federal Government has been operating in the fields of health, pensions, unemployment compensation, relief, and many similar activities.

A third major purpose of government programs has received an increasing amount of attention in recent years -- the promotion of the economic development of the United States. This category covers the various programs to develop the Nation's natural resources, the construction of transportation facilities, the support of education and research, and other attempts to enhance the growth rate of the American economy.

Finally, there are the routine day-to-day operations of the Federal Government. These include the functioning of the Congress and the Federal courts, the collection of revenues, and the payment of interest on the national debt.

A large portion of the Federal Budget, but less than half, is devoted to the national security (see accompanying table). In contrast, the fact that the great bulk of all non-military Federal Government spending is devoted to the various welfare programs may not be as widely known. A comparatively small portion of governmental funds is devoted to economic development.

An examination of the Federal Budgets and Congressional appropriation hearings over the years reveals little systematic attempt to appraise the wisdom or desirability of the over-all choice implicitly made in the allocation

of government resources among the major alternative uses. To date, the agency PPBS efforts seem to be aimed at a far lower level of abstraction. Hopefully, future refinements of the relatively rough analytical framework presented here will encourage Federal agencies to make more ambitious efforts along these lines.

National Security

The bulk of the national security budget is devoted to U.S. military forces. However, almost one-fifth of the total consists of programs that promote the national security through more indirect means, such as space competition or military foreign aid.

The data in the table indicate the types of "strategic" choices which can be made --- or are currently being made by default or accident in the allocation of funds for national security. Bringing these individual programs together in a single category, which is not now done anywhere in the budget process, could permit first raising and then answering questions such as the following:

Would national security be improved by shifting some or all of the $10 billion for foreign aid and nonmilitary competition to the U.S. military establishment itself?

Conversely, would the national security be strengthened by moving a proportionately small share of the direct military budget, say $500 million, to USIA or the arms control effort and thereby obtaining proportionately large increases in these latter programs?

Are we putting too much into foreign economic aid and not enough into the Voice of America (USIA)? Or vice versa?

Would we be better off if we shifted the funds now going to passive (civil) defense to the U.S. Arms Control and Disarmament Agency? Or vice versa?

The very existence of the type of information presented here may lead not only to attempts to answer questions such as these, but, more fundamentally, to widen the horizons of budget reviewers.

Public Welfare

The various quasi-life insurance and retirement programs receive the bulk of the funds for public welfare. However, this is hardly a conscious decision. The level of expenditure for these programs-such as the Old-Age and Survivors Insurance system-is predetermined by basic, continuing statutes; they are financed by permanent, indefinite appropriations which are not subject to review during the budget process because they do not even appear in the annual appropriation bills.[4] Hence, it may not be surprising that these programs have grown to dominate the nondefense budget, exceeding by far the total estimated expenditures for the various economic development programs.

Likewise, the expenditures under the various agricultural price support programs (in the category of "Assistance to Farmers and Rural Areas") exceed all of the outlays for the programs of urban housing and development. Again, the farm subsidy program is generally set by the substantive laws on price supports and farm aid, rather than through annual appropriations.

Also, this level of detail permits some cross-comparisons of government programs between the National Security and Public Welfare categories, comparisons which are not now made. For example, aid to farmers is roughly equal to the amount allocated for civilian space exploration. Would a revised trade-off between these two program areas result in a net advantage to the Nation? This type of analysis is trying basically to answer the question, "Would an extra dollar (a billion, in the case of the Government) be more wisely spent for Program A or for Program B?[5]

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[4]M.L. Weidenbaum, "On the Effectiveness of Congressional Control of the Public Purse," National Tax Journal, Vol. XVIII, No. 4, December 1965, pp. 370-374.

[5]For the classical formulation of this question, see V.O. Key, "The Lack of a Budgetary Theory," American Political Science Review, XXXIV, December 1940, pp. 1137-1144.

This, it is contended, is the fundamental question implicit in the allocation of government budgetary resources. The literally thousands of pages of budget justifications and Congressional hearings which are published each year fail to show even any awareness of the problem, much less any attempt at an answer.

Economic Development

In the exploratory categorization of government programs presented here, a number of activities are listed under the heading "Economic Development." A good share of them, such as for the development of needed natural resources or the improvement of necessary transportation facilities, may contribute to the more rapid growth and development of the American economy. Others, such as various subsidies, may be more questionable. Of course, it is inevitable that any classification will contain some borderline cases.

A brief examination of the composition of the Economic Development category may be revealing. Transportation facilities account for the largest single share and, when combined with natural resource programs, account for two-thirds of the total.

A further breakdown also indicates another level of choice which is possible. The amount shown for transportation facilities consists of three types of programs, land, air, and water facilities and vehicles. The dominance of land transportation--primarily Federal highway grants to the states--is striking. Would a revised choice between land and air transport expenditures be advisable? Between land transportation and another category if approximately equal size, such as education, training, and research? Raising these questions should not be taken as expressing value judgments, but rather as indicating a pattern for decision making.

The inclusion of some of these programs under the Economic Development category may be questionable. In the case of natural resource programs, the bulk of the funds is devoted to the dams, power and related multi-purpose projects of the Corps of Engineers and the Bureau of Reclamation. Yet many authorities question the merits of individual projects.

Professor Otto Eckstein of Harvard University concluded in a study published by the Congressional Joint Economic Committee as follows:

> "In the case of at least half of all the projects that are being built, it is unlikely that their effect on national income will be positive... The return on many projects is so low that their net effect will be to reduce the rate of growth of the economy."[6]

Professor Eckstein pointed out that the techniques used by federal agencies to measure benefits from water resource projects "considerably overstate the additions to national income," in good measure by inflating the indirect or secondary benefits which might accrue from the expenditure. However, a more basic shortcoming of these projects may be their contribution to the large farm surpluses by adding to the amount of land on which farm products, not needed to meet consumer demands at current prices, are being grown.

The agricultural-resource trade-off, or choice, may be a rather odd, but not unique, one. To some extent, a reduction in funds for natural resources would permit a reduction in farm subsidy outlays. Here we have another aspect of broadening the vista of budgetary review. Not only can we examine choices among programs, but we can also examine the consistency of the various programs in relation to each other.

The final category of government programs represents, as best as can be estimated, the general costs of operating the government, the relatively day-to-day functions. Table 1 shows that more than 70 percent of the funds in

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[6]Otto Eckstein, "Evaluation of Federal Expenditures for Water Resource Projects," in Joint Economic Committee, U.S. Congress, Federal Expenditures for Economic Growth and Stability, 1957, p. 667.

this category cover the payment of interest on the public debt. The bulk of the remaining outlays for government operations is devoted to collecting internal revenue and the housekeeping functions of the General Services Administration, such as the Public Buildings Service and the Federal Supply Service.

Summary

The budgetary preparation process itself could benefit by making use of a program or purpose appraoch to decision making. During the last few years, there has been one very good example of Congressional interest and concern with a functional or purpose approach to budgeting. In the case of the Department of Defense, the executive branch has made the basic budget decisions via such an end-purpose approach.

Although military appropriation requests are still made for operations and maintenance, personnel, etc., the underlying decisions are made on program grounds. Here, it is a question of strategic versus limited war capability, offensive versus defensive forces, etc. Within these overall categories, the alternative weapons systems which could fulfill the same end mission are compared with each other. One case would be the Navy's Polaris missile system competing with the Air Force's Minuteman ICBM for strategic funds despite the different services involved. (In earlier years it was more a case of the Navy's strategic missiles competing with Marine Corps ordnance-two relatively unrelated items-within the Naval procurement budget.)

The advantage of this new method of budget presentation is that it permits the direct comparison of the various programs of the different services which are close substitutes for each other or which contribute to a common mission or purpose. Clearly, this is a general methodology which has application in budgeting for nonmilitary programs.

The incorporation in the budget message and the budget document of the approach here suggested might result in growing Congressional and public concern and awareness of the problems of choosing among alternative uses of government funds. An alternative would be for a Congressional committee staff to rework the existing budget submissions within this framework for review, say, by the entire appropriations committees prior to their detailed examination of individual appropriation requests. This might permit the parent appropriation committees to set general guidelines and ground rules for detailed budgetary review. This would be quite different from the present situation where the overall allocation of budgetary funds among the major functions of government is more nearly the accidental result of a myriad of individual budget decisions.

In getting into the details of budget statements, we should not forget that the essential question to be considered is: "Would an extra dollar be more wisely spent for Program A or for Program B?" This forgotten question in the federal budgeting process, however, is no more novel than a family's decision to use the Christmas bonus for a new car or a vacation, or a company's decision to use an increase in earnings to raise the dividend rate or to embark upon a new research program.

Table 13

A RUDIMENTARY PROGRAM BUDGET FOR THE U.S. GOVERNMENT
(FISCAL YEAR 1967, Billions of Dollars)

Basic Goals	Interior	Health Education & Welfare	Housing and Urban Development	VA	AEC
National Security:					
U.S. Military Forces					1.13
U.S. Passive Defense					
Foreign Military Forces					
Foreign Non-Military Activities					
Scientific Competition					
Arms Control & Disarmament					
Total-National Security					
Public Welfare:					
Life Insurance & Retirement		28.05		.72	
Unemployment Insurance		2.90			
Health		2.45		1.27	
Public Assistance		3.75		1.98	
Veterans Compensation				2.31	
Assistance to Farmers & Rural Areas	.08				
Urban Housing & Facilities			1.57		
Specialized Welfare Programs	.35	.02		.50	
Total-Public Welfare	.43	37.17	1.57	6.78	
Economic Development:					
Natural Resources	.99				1.13
Transportation Facilities	.02		*		
Education & General Research		3.51			
Economic Regulation	*				
Aids & Subsidies to Business					
Total-Economic Development	1.01	3.51	*		1.13
Government Operations:					
Interest Payments					
Legislature Functions					
Judicial & Law Enforcement					
Housekeeping Functions					
Conducting Foreign Relations	.40				
Total-Government Operations	.40				
Grand Total	1.84	40.68	1.57	6.78	2.26

Table 13 (cont.)
A RUDIMENTARY PROGRAM BUDGET FOR THE U.S. GOVERNMENT (continued)
(FISCAL YEAR 1967, Billions of Dollars)

Basic Goals	Defense	State	Treasury	Post Office	Commerce	Labor	Agriculture
National Security:							
U.S. Military Forces	56.50						
U.S. Passive Defense	.13						
Foreign Military Forces							
Foreign Non-Military Activities	.05						
Scientific Competition							
Political & Psychological Competition							
Arms Control & Disarmament							
Total-National Security	56.68						
Public Welfare:							
Life Insurance & Retirement	1.78	.01					
Unemployment Insurance			*			4.02	
Health							
Public Assistance							
Veterans Compensation							
Assistance to Farmers & Rural Areas							5.96
Urban Housing & Facilities	.52						
Specialized Welfare Programs	.02		.05			.45	
Total-Public Welfare	2.32	.01	.05			4.47	5.96
Economic Development:							
Natural Resources	1.29						.63
Transportation Facilities			.49		4.20		
Education & General Research					.49	.02	
Economic Regulation						.03	*
Aids & Subsidies to Business				.84	.30		.03
Total-Economic Development	1.29		.49	.84	4.99	.05	.66
Government Operations:							
Interest Payments			12.75				
Legislature Functions							
Judicial & Law Enforcement							
Housekeeping Functions			1.01				
Conducting Foreign Relations		.40					
Total-Government Operations		.40	13.76				
Grand Total	60.29	.41	14.30	.84	4.99	4.52	6.62

Table 13 (cont.)

A RUDIMENTARY PROGRAM BUDGET FOR THE U.S. GOVERNMENT (continued)
(FISCAL YEAR 1967, Billions of Dollars)

Basic Goals	NASA	Federal Aviation Agency	Civil Service Commission	Other	Total
National Security:					
U.S. Military Forces				.05	57.68
U.S. Passive Defense				.01	.14
Foreign Military Forces				2.05	2.05
Foreign Non-Military Activities				2.96	3.01
Scientific Competition	5.01				5.01
Political & Psychological Competition				.19	.19
Arms Control & Disarmament				.01	.01
Total-National Security	5.01			5.27	68.09
Public Welfare:					
Life Insurance and Retirement			2.85	1.60	35.01
Unemployment Insurance					6.92
Health					3.72
Public Assistance					5.73
Veterans Compensation					2.31
Assistance to Farmers and Rural Areas					6.04
Urban Housing and Facilities				.01	2.10
Specialized Welfare Programs				.02	1.41
Anti-Poverty Programs				1.75	1.75
Total-Public Welfare			2.85	3.38	64.99
Economic Development:					
Natural Resources				.06	4.10
Transportation Facilities		.76		.02	5.49
Education and General Research				.53	4.55
Economic Regulation					.03
Aids and Subsidies to Business				.15	1.32
Total-Economic Development		.76		.76	15.49
Government Operations:					
Interest Payments					12.75
Legislature Functions				.16	.16
Judicial and Law Enforcement				.42	.42
Housekeeping Functions			.13	.45	1.59
Conducting Foreign Relations					.80
Total-Government Operations			.13	1.03	15.72
Grand Total	5.01	.76	2.98	10.44	164.29

Source of Data: Federal Budget for the fiscal year ending June 30, 1967.

Part E. Application to Government Programs

A very personalized comparison of benefit/cost analysis and existing forms of justification of new governmental undertakings.

Science and Government in a Democratic Society

by Murray L. Weidenbaum
Professor of Economics
Washington University
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A Presentation to the Symposium on Science and Politics in a Democratic Society, University of Illinois, Urbana, Illinois, March 7, 1968.

I must confess at the outset that I find the great bulk of the public discussions dealing with the impact of science and technology on the United States both discouraging and unproductive. On reflection, I think that this is so because the dialogue generally is limited to two polar alternatives.

The first polar alternative I would label the "view with alarm". It has become fashionable in many quarters, particularly in the humanities, to view with alarm the extent to which uncontrolled science and technology are destroying our society. Almost any issue of the Saturday Review, for example, contains another denunciation of these twentieth century Phillistines and of their deleterious influence.

The second polar alternative is somewhat harder to define. It might be said that it looks upon science and technology as almost sacred cows (cows that can be milked however). Perhaps that is not fair, the holders of this position may not really view science and technology as being beyond criticism, but perhaps worse yet, as ends instead of means.

Hence, attempts by laymen to involve themselves in science policy often engender cries of interference, shortsightedness, and worse. However, when I examine the actual justifications for undertaking new major scientific projects (e.g., development of a supersonic transport, construction of a linear accelerator,

or penetrating below the earth's surface), I am always so struck by the absence of that objectivity and hard, factual, quantitative analysis that I associate with the core of the scientific method.

I cannot cease being amazed when I am told by scientists that we must embark upon a major technological project on faith -- faith that through serendipity (the invention of this all-purpose justification must rank as an important technological innovation in and by itself) it will turn out to be worthwhile after all.

Let me cite a case in point. During the past month, I had occasion to attend an important meeting of a national scientific and engineering association; the audience was assured by one distinguished speaker that a specific current major technological undertaking would produce great benefits, of which by far the most important benefits would be those that we cannot presently conceive of. That scientific forecaster saved his greatest contempt for what he termed the present-day doubters of the benefit of such technological undertakings. He contended that in future periods we all will look back upon these people with disdain as men of little faith.

To those who are neither scientific theologians nor wistful yearners for a simpler society, I offer a third alternative. In a crude way, it may be considered the agnostic view of the social scientist, and perhaps more particularly of the economist. To clear the air, I assume that we will not try to stifle scientific inquiry nor inhibit technological innovation. Also -- and this may be the hooker -- I assume that the determination of the uses to which public resources (particularly money) are put is a matter for the public to decide.

Hence, if a professor of engineering wants to devote his leisure time to designing a supersonic transport or planning a linear accelerator, fine, he will have our blessing, and will be entirely free to do so. However, the very first time that he asks for a mere $100 million of our taxpayers' money to start building the gadget, he will have to justify it -- and not in the soft, theological terms of the natural scientist but in the hard, objective manner of the social scientist.

He will have to answer questions such as the following: Are the expected benefits worth the cost? How well can he measure the benefits? Has he omitted important elements of cost to society, such as polluting the environment? Finally, and most crucial, are the returns from this expenditure of public funds likely to be greater than from alternative uses of the public's money?

We now expect such greatly maligned types as administrators of social welfare programs to make just such calculations to support their budget requests for new training, health, and anti-poverty programs. I see great charm in extending the use of the scientific method to public resource allocation in the area of science and, especially, technology.

Part F. Application to Business Planning

This section contains the author's views on existing shortcomings in company long-range planning and the pitfalls and potentials in applying PPBS techniques in the business firm.

PPBS AND THE BUSINESS FIRM

By Murray L. Weidenbaum

To those that have read the available literature, it appears at first blush that all that a company needs to do in order to bolster a lagging sales trend, or to counter a declining profit rate, or to increase its share of the market, or to retain creative executives, or to keep stockholders happy, is just to institute a planning, programming and budgeting system(PPBS) modeled after the Pentagon experience. This interest in the application of economic analysis to resource allocation questions is commendable.

However, I am duly chastened by the knowledge that the zeal of the newly converted is usually great and often excessive. Hence, I believe that it is useful first to, in a sense, step back, reflect, and reexamine some of the fundamental postulates of the new planning and programming and budgeting and then try to put the details of format and form filling out into some more substantive perspective.

The Rudiments of Business Planning.

I think that it may be helpful to examine the fundamentals of business planning and then see the contribution that PPBS can make to it. As anyone who has sat through at least one long-range planning session knows, all business firms are supposed to deliberately and systematically make their plans for the future. They establish goals and objectives for the enterprise. They then identify opportunities that are likely to exist in the foreseeable environment. They then proceed to choose from among the alternative opportunities that may help them achieve their objectives. And, finally, they evaluate the expected performance in a feedback or loop-closing fashion.

We also know that we need to develop operational plans as well as longer term plans, divisional plans as well as corporate plans, R & D plans as well as

business plans, and strategic plans as well as tactical plans. Why some of us have done all of that and still not gotten a hold of the keys to the kingdom of heaven, if there is any such restful place for the weary breed of planners, business or governmental.

Please do not misunderstand my intent. I have little quarrel with the need to conceptualize or to prepare an adequate framework for planning for an organization. This is clearly a necessary, but possibly not sufficient, condition for successful forward thinking by a business firm. Many of the shortcomings of business forward thinking -- under which may be subsumed planning and programming and budgeting -- are the result of faulty application rather than inadequate theorizing. I should like to present a few of the most frequent shortcomings, at least as I have found them in my own industrial experience, and then indicate how PPBS can contribute to eliminating them.

True Long-Range Plans are Rarities

I have found that most of the output of business long-range planning groups is far from true long-range business plans. Most of the specific reports prepared by these groups that I have examined are more in the nature of scheduling current programs with long lead times rather than the development of true long-range business plans which I take to be development of courses of action to deal with the future. My qualification for determining what is a business plan is no more rigorous than the dictionary definition that to plan is "to devise or project, as a method or course of action."

In practice, so-called planning documents usually seem to focus on analyzing future potentials and requirements of existing product lines and programs -- expected sales and profits, projected manpower and facilities and so forth. Some of these plans do cover the future potentials and requirements of new products but almost inevitably, these are limited to those products on which the company already

was currently working in either the preliminary design or prototype stage. There seem to be few business plans which attempt to bridge the inevitable gap between the future results of current programs and the requirements of long-term targets. Even fewer business planning efforts involve an explicit choice among the major alternative means of achieving the long-term targets and goals of the firm. This of course provides the basic opportunity for a system which integrates planning and programming and budgeting.

The Role of Top Management in Formal Planning

In discussing their long-range problems with chief executives of large manufacturing companies over a considerable period of time, I do not recall any important reference to the content of their long-range plans other than some vague mention of having that sort of activity going on -- somewhat akin to hiring a proper quota of engineers from a given minority group.

Some of the more thoughtful executives quickly point out that the basic statistical data in the formal planning documents are useful to them in their own planning. This divorce of the formalized planning process from the actual planning and, more important, from the decision-making is made even clearer when it is realized that many chief executives are supposedly charged with long-range planning as their primary responsibility and have delegated the operating activities to an executive vice president or some other subordinate. Even in such cases, one customarily finds the formal planning organization somewhere down in the bowels of the corporate staff, possessing a rather tenuous relationship to the supposedly planning-minded chief executive.

Again I note in passing the potential role of PPBS, to link planning as an intellectual exercise and budgeting as an expression of management decision-making -- programming of course being the mechanism for the link.

Planning and Trivia

The third basic shortcoming of business planning, at least as I have found it, is in the excessive amounts of trivia contained in typical company long-range business plans. This may, in more than a small way, help to explain why formal business plans are so seldomly used as decision-making tools. The usual business firm's long-range plan informs the reader in wearying detail of monthly delivery schedules, the recruiting budget, square footage of storage space by type, and so forth. I will consider this paper to be successful if just one of the readers takes to his company the conviction that, in preparing a business plan for 1974, it is not essential to compute overhead rates to four decimal places.

Long-Range Planning and Substantive Problems

Perhaps the basic shortcoming in the present practice of business planning is the failure to come to grips with the key problems facing the company and/or its industry. This may be the inevitable result of the fetish or dogma which maintains that the planning must be done by the line departments, and that the headquarters organization should mainly concern itself with aggregating divisional and departmental submissions. Hence, if a headquarters staff does do some developmental long-range planning, such as examining those new or potential areas which do not fall within the current jurisdiction of, or have been overlooked by, the operating divisions, it is generally careful not to intrude upon the formal business planning process with this sort of thing.

The headquarters staff often is looked upon merely to add some class or polish to the planning process, such as a broad brush evaluation of the external environment or providing an analysis of the public relations image of the corporation. As a result, the major substantive problems -- such as the declining space market for the aerospace industry or increasing government competition for many commercial

industries -- often simply fall between the cracks or are dealt with outside of the formal planning process.

The Role of PPBS

The purpose in reviewing the mistakes of the past, and that is essentially what has been covered thus far, is quite simple. On the one hand, there is great danger of PPBS being so mechanically implemented by business firms that it falls into the same mold as what has come to be conventional business planning and hence, perpetuates the same mistakes. Or on the other hand, as I see it, the major contribution that PPBS can make is precisely to overcome the key shortcomings that have just been described.

At this point it would be extremely helpful to briefly review the basic concepts of PPBS. We can obtain the essence of the matter simply by going back to the fundamental definitions. I suggest that the reader note how different they may be from the way the same terms are used in the typical business firm.

Planning: the study of objectives, of alternative ways of achieving objectives, of future environments, and of contingencies and how to respond to them. The purpose of planning is to explore alternatives, to stimulate ideas about tradeoffs and management strategies, to identify problems, to formulate theories, and, of course, to generate data.

Programming: a method or system of describing activities according to objectives or "outputs" -- sales or profits, in this case -- and of relating these objectives to the costs or "inputs" needed to produce the outputs.

Budgeting: the activity through which funds are requested, appropriated, apportioned, and accounted for.

The contributions that can and should result from instituting such a broad-gauged PPBS approach in a modern corporation are threefold:

(1) Combining long term planning with short term budgeting, so that the annual budget is not something separate and apart from the planning exercise but really represents the first year of the long term planning effort.

(2) Presenting an array of alternative means of achieving the company's goals and objectives. This is what PPBS really is all about -- the choice among alternatives. It is not a means of justifying the already agreed upon intentions of the management: it is not a means of forecasting: it is not even a sophisticated internal information and communication system -- or at least it should not be just these things. If PPBS has any contribution to make to the business firm, it is to present to top management the major alternative means of achieving the company's objectives, together with -- and this is the differentiating characteristic -- an objective methodology for selecting among these alternatives.

(3) The third contribution, hence, is getting the line and staff managements aware of the potentialities of cost-effectiveness analysis, benefit-cost analysis, and similar applications of the general family of analytical techniques which we like to call systems analysis.

When then President Lyndon Johnson first announced the establishment of PPBS on a government-wide basis, he referred to it as a "very new and very revolutionary system." Some of the people who have utilized return on investment techniques for a number of years may be just a bit skeptical of the "revolutionary" character of PPBS. Of course, they are right. Companies that array alternative capital investments and compare them via a sophisticated return on investment analysis or discounted cash flow technique already are using the basic concepts of PPBS. There is an important proviso here -- providing that the results of these analyses directly determine the company's capital asset budget. That does not mean just serving as a screen for the routine items but constituting the primary evaluation mechanism for major investment decisions.

Moreover, it is the rare company that applies this same approach of choosing among alternatives in an objective and quantifiable fashion to other activities, such as research and development, marketing, manufacturing, advertising, and so forth.

Problems of Implementation

I believe that we should candidly acknowledge the very real difficulties that will be encountered in attempting to establish an effective PPBS program in a business firm or in any type of organization for that matter. Many of the obstacles will arise from the simple and almost inevitable fact that important changes will result in the "pecking order." Some organizations and individuals will view the potential changes as threats, others as opportunities.

Shifts in the location and flow of decision-making authority are likely to occur and these may well alter organizational structures. Perhaps the most important and far-reaching organizational shift will be the reduction or elimination of the traditional separation of business planning, financial analysis, and economic research staffs.

Additional changes in backgrounds and education of management will occur. Requirements for staffing the PPBS units themselves and recruiting line officials who understand and can effectively utilize the new managerial techniques, will impose additional duties on company personnel organizations. This will inevitably widen the array of managerial skills for which a company recruits.

Many companies may not wish to go the McNamara route of bringing in a group of [illegible] brilliant "whiz kids" who can implement PPBS in rather speedy fashion. They may prefer the slower route of developing the skill of their own management personnel. This second approach may have the compensating advantage of reducing internal objections to the changes to be made.

Those companies who wish to rely primarily on home-grown capabilities need to be aware of the training requirements for typical PPBS personnel. There are three key

aspects here. The first is grounding in quantitative analysis. I do not mean just college algebra, but calculus, computer programming, simultation techniques, probability theory, linear programming, and other advanced statistical methodology.

The second key facet of a PPBS education is modern economic analysis. The emphasis is on modern. The old-line, institutionally-oriented principles course or the diverting problems seminar just will not do. The training here includes microeconomic analysis covering the determination of prices, profits, and output by individual firms and industries and macroeconomic theory covering the behavior of the national economy.

The third and final aspect of PPBS training draws upon the mathematical and economic techniques in what we call systems analysis. This is the application stage, where the future PPBS users are trained in using the advanced methodology in preparing and reviewing plans and budgets.

Upon reflection, there may be two levels at which such training should be provided. Clearly, the most detailed instruction should be given to the personnel who will be carrying on the analysis. Perhaps a broader brush, but not too superficial, exposure would be sufficient for the more senior executives who assign and review these analyses. A certain minimum understanding may simply be necessary both to avoid being snowed by the fancy footwork and to find the holes which often occur in even the most sophisticated analyses.

Conclusion

It may be a great temptation for a company listening to a representative of another company tell how useful PPBS has been to their operations to then go back and quickly attempt to duplicate the formats and apply the procedures to their own company in the expectation that they can achieve the same useful results.

I doubt if I can emphasize too greatly the fundamental concern that the contribution of a comprehensive planning, programming, and budgeting system is not in

filling out forms and running endless computations, but in the conceptually simple yet operationally difficult task of 1) identifying the overriding objectives of the organization· 2) developing an array of feasible alternatives for achieving them· 3) systematically choosing from among the alternatives; and 4) converting the results into operational decisions.

In concluding this sermon, it might be appropriate to make proper mention of the patron saint of planning, whose spirit no doubt accompanies all pioneering efforts in this field. It may not be generally known, but he is the famout Scottish poet, the late Robert Burns. Of course, his claim to this position is based on a simple line of his poetry which can be translated into contemporary English as "the best laid plans of mice and men still can get fouled up."