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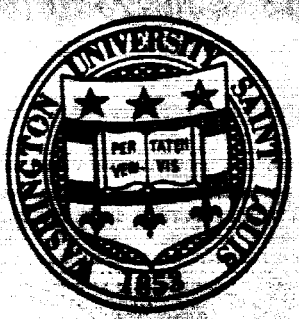

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PROGRAM BUDGETING AND THE SPACE PROGRAM

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PROGRAM BUDGETING AND THE SPACE PROGRAM

The implementation of the Planning-Programming-Budgeting System (PPBS) by all major Federal Government agencies presents both important opportunities and major problems to the Nation's space program. The first part of this paper describes the main features of the PPBS effort. The second part analyzes possible applications to and impacts on space activities.

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The Planning-Programming-Budgeting System [1]

Economists have long been interested in identifying policies that would promote economic welfare by improving the efficiency with which a society uses its resources, particularly in the public sector. For many years, the Corps of Engineers and the Bureau of Reclamation have applied benefit/cost analysis to evaluate prospective projects. Despite important difficulties, such as choosing an appropriate discount rate which would correspond to a realistic estimate of the social cost of capital, the use of benefit/cost analysis has improved the allocation of government resources. It has served as a partial screening device to eliminate obviously uneconomical projects--those whose prospective gains are less than estimated costs. Perhaps the overriding value has been to demonstrate the possibility of making objective analyses of essentially political actions, thus narrowing the area in which political forces operate.

A related development has been the application of cost/effectiveness analysis to military budget decision-making. For military programs, ordinarily the benefits or results cannot be expressed in dollars terms.

However, the end objective, such as the capability to destroy X number of enemy targets under stipulated conditions, can be expressed in quantitative terms. Hence, the alternative ways of achieving the objective--Y bombers versus Z missiles or some combination--can be priced out and a least cost solution arrived at.

This latter approach has been at the heart of the Planning-Programming-Budgeting System introduced in the Pentagon. It clearly has been the success of the Pentagon approach which has led to adoption of a government-wide PPBS effort. A fundamental shift has occurred in military resource allocation methods. Previously, each service competed for a larger share of the defense budget and, within the service totals, strategic weapons such as ICBM'S competed for funds with tactical programs. Under the new system, close substitutes for performing the same or similar missions are compared with each other, although different services may be involved.

On August 1965, President Lyndon Johnson required each large Federal agency to set up a PPBS activity. Through this combination of planning and budgeting, it was hoped that broad national goals would be identified, specific government programs related to them, and the most economical method of carrying them out arrived at. Four major steps are being taken to accomplish this rather tall order.

Identifying national goals. The specific goals which are deemed appropriate for the Federal Government to be seeking will be selected, in the light of a comprehensive evaluation of national needs and objectives.

Relating broad goals to specific programs. Specific alternative programs which may help to achieve the broad national goals and objectives will then be examined. The ones that appear to be most promising, given the various constraints under which the government operates, will have to be selected. Many government agencies have little discretion in selecting the optimum combination of programs which can assist in achieving broad national goals in its area of operations. They often find vague or conflicting congressional guidance on goals but clear and precise legislative directive as to which specific programs--and in what amounts--are to be conducted. The task here may be to infer the goals from the specific programs and then develop new or improved means of achieving these goals.

Relating programs to resource requirements. Specific costs of alternative programs will then need to be estimated, in order to compare their efficiency in achieving the goals. To those acquainted with benefit/cost or cost/effectiveness analysis, this will be no minor achievement in many illusive program areas.

Relating the resource inputs to budget dollars. Finally, the manpower, facilities, and other resource requirements will need to be translated into budget dollars, so that decisions can be made to implement the PPBS plan through the budget process.

The main product of PPBS is designed to be a comprehensive multi-year Program and Financial Plan for each government agency, which will be updated periodically and systematically. This Plan will show projected outlays for each major program area of an agency or department. Hence, determining the output-oriented categories is an important step.

Many difficulties are involved in measuring the output of a government program. Conceptually, only the end-product should be measured rather than intermediate outputs. For example, in the post office, the end product might be the number of letters delivered, and not the number of times these letters were handled at the various post offices.

Similarly, in the case of hospital programs it might be possible to look at output in terms of patient-days. However, the mission of a hospital might be described better as proper treatement of patients. Within a broader framework, the mission of a health program might be viewed as maintenance of good health and the output measure might reflect days of good health rather than incidents of illness.

The Federal agencies are encouraged to consider comparisons and possible trade-offs among program elements which are close substitutes, even though the activities may be conducted in different agencies. This is an attempt to introduce some competition among programs and hopefully to achieve greater effectiveness from budgetary outlays.

Table 1 is a hypothetical sketch of this new approach. Transportation is a good example of a major program category which consists of a variety of activities in different departments, with little attention to gaps or overlapping functions or conflicting objectives.

The major agencies involved are the Department of Commerce (Bureau of Public Roads and the Maritime Administration), the Federal Aviation Agency, the Department of the Army (Corps of Engineers, civil functions), the Department of Agriculture (Forest Service), The Department of the Interior (National Park Service), the Treasury Department (the Coast Guard), the Department of Housing and Urban Development (mass transit assistance program),

Table 1

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	

and regulatory agencies, such as the ICC, CAB, and Federal Maritime Board. Significantly, only a few of these agencies are scheduled to be absorbed by the proposed Federal Department of Transportation.

Table 2 illustrates the possible specific elements which might comprise one of the transportation subcategories, urban commuter transportation. These elements may vary from the number of miles of way placed under construction (a measure of capital investment) to the number of passenger-miles carried (a measure of output). Tables 1 and 2 are indicative of the broader horizons of the new breed of governmental budgeteers and represent an initial step along a relatively new path in governmental resource allocation.

Impacts of PPBS on the Space Program

The formal transition to PPBS should be relatively straightforward for the major space agencies. Both the Department of Defense and NASA already develop their budget proposals around programs and specific systems. Certainly the task would seem to be less formidable than for agencies in such elusive areas as justice, social welfare, and beautification. For example, a basic program breakdown of NASA outlays already is contained in the Budget document and can be developed into a rudimentary program budget (see Table 3).

Identifying national space goals. Nevertheless, the complete adaptation of the PPBS mechanism and concepts might create or highlight important policy problems for the space program. It might be helpful to return to each of the four major steps of PPBS described earlier. The first step is "identifying national goals." Two basic and quite different approaches have been suggested for identifying the goals relevent to the space program.

Table 2

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
Number of passenger miles 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.

Table 3

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	364
TOTAL	$4,248	$101	$664	$5,012

Source: Derived from materials in Budget of the United States Government for the Fiscal Year Ending June 30, 1967, Washington, U.S. Government Printing Office, 1966, pp. 867, 870, and 872.

The first approach is that of the recent report of the Senate Committee on Aeronautical and Space Sciences [2] which, although dealing with aeronautics, may be almost equally relevant. The Committee states that "national aeronautical goals [for our purposes, we may substitute 'astronautical goals'] support, and interact with, a group of more general goals." Four so-called more general goals are identified: national transportation goals, national defense goals, social and economic development goals, and international relations and prestige goals. From this point of view, space exploration would be considered essentially as an intermediate good, a step toward achieving other, more fundamental goals.

The second approach to identifying national space goals is that of the National Planning Association contained in a recent study by Leonard Lecht. [3] In identifying the major American goals and objectives, Lecht lists space research along with national defense, consumer living standards, and other fundamental needs of our society. He states that, 'There is general agreement in the United States that a sustained space research program is an important and continuing national objective" (p. 277).

That these are two different approaches to space goal-setting may be seen by reference to some of the fundamental questions involved in budgeting for space programs. For example, are Project Apollo and the development of a supersonic transport alternative means of achieving a similar goal--successful scientific competition with the communist nations? According to the Senate approach, it would appear that this would be a sensible tradeoff, and that the two programs are to some degree substitutes. Under the NPA approach, this would not be the case. A manned lunar landing would be

considered basic to space research while the SST would be treated together with other transportation programs.

However somewhat different results may be obtained in attempting to answer the question: on what basis should space funds be allocated to DoD or NASA? Under our variant of the Senate approach these would not be viewed as substitutable items. Military space programs would be considered to be part of a national defense goal while NASA programs would be related to one or more civilian national goals. Conversely, under the NPA approach both DoD and NASA could be viewed as, at least in some cases, alternative instruments for performing space research and development.

Clearly, the proper identification of the national goals which each Federal gency's programs are designed to serve is fundamental to the effective application of PPBS. Without doing so, the process can readily degenerate into routine filling out of tedious forms. Although the matter of goal-setting is essentially subjective, the present writer opts for the NPA approach to the space program, that it has become an important national objective. On that basis, it may be useful to proceed to the next PPBS steps.

Relating broad space goals to specific space programs. As Margolis and Barro have pointed out, a set of mission categories that is useful in practice must be based on well-defined characteristics of projects at a lower level of abstraction than "ultimate objectives" or "national goals." They call for an "end-product" rather than "end-objective" set of categories, having the following characteristics:

1. They should group projects that are functionally related in an operationally well-defined sense. This might be according to type of payload or region of space in which they operate.
2. They should separate projects that serve distinct concrete objectives. For example, projects that provide economic benefits or military capabilities should be separated from purely scientific efforts.
3. They should reflect the space program as currently constituted and projected but should be flexible enough to allow for growth in program scope and variety of subjects. /4

It should be recognized that there may be fundamental limitations to as well as advantages of the Margolis-Barro approach. Their "end-product" categories do provide a method of budget allocations on a program basis which is rather operationally simple and clear cut. However, it hardly is a format for making the key decisions about the scope and structure of the space program. Rather, it requires that these broad "political" decisions already have been made, so that the PPBS technicians can go about their job of precisely costing out launching schedules and tracking facilities requirements.

Indeed, they state that "the whole question of 'space program goals' has been discussed at too vague and abstract a level to be relevant to the program budgeting process, and it has been obscured by public controversies over the wisdom of undertaking particular space missions" (p. 133). In view of the pioneering nature of the Margolis-Barro effort to develop a

space program budget, we should be charitable in belaboring their shortcomings. However, it is somewhat disappointing to see the technician lamenting that his chore of choosing between 80% and 85% learning curves is obscured because the nation has not clearly determined that the overall mission is worth undertaking at all.

On a technical basis, the space program may appear to be readily adaptable to PPBS. Witness the ease with which the standard budget materials were able to be converted into at least a rudimentary space program budget (Table 3). However, on a substantive basis, it appears that such program budget materials do not throw up the basic policy alternatives for the space program which is at the heart of the PPBS approach--the choice among alternative programs for achieving a given mission. It is only on the basis of alternative choices, that benefit/cost or cost/effectiveness analyses can be made to assist the policy makers in their decision-making.

It may be recalled that for the transportation area, the hypothetical program analysis presented choices among modes--air, water, and land--and between systems--highways and mass transit for the urban commuter function (see Tables 1 and 2). Despite greater sophistication in the important area of cost methodology, available program analyses for space activities do not present such basic choices, but assume that they already have been made. It is the contention of the present writer that following this less ambitious route will result in PPBS degenerating into a low-level accounting operation. Indeed, the desire to fill out the formats neatly should not take priority over the fundamental need to improve the allocation of government resources among alternative uses. Although any first attempts inevitably will be crude, it is suggested that program budgeting for space activities throw up alternatives such as the following:

1. Continuation of the current effort at a manned lunar landing by 1970.

2. A slow-down in the manned lunar program and an expansion in unmanned planetary exploration, both within the same budget total as (1).

3. A slow-down in the manned lunar landing and an expansion in efforts to utilize the fruits of space technology on earth, both within the same budget total as (1).

4. Continuation of the current effort at a manned lunar landing by 1970 and beginning a major effort at exploring Mars, thus raising the space budget substantially above (1), particularly in later years.

5. Continuation of the current manned lunar landing program and a substantial expansion of NASA's aeronautical R&D with the aim of expanding the use of commercial aircraft in short-haul markets and by personal rather than primarily business travelers. This alternative might require levels of budgetary support at various ranges between (1) and (4).

Undoubtedly the above questions require more precise formulation and in some cases detailed development of missions which have been stated too broadly. However, they are designed to indicate the types of basic choices which should not be ignored in the Planning-Programming-Budgeting System but which are the fundamental reason for establishing the detailed budgetary procedures and forms.

Relating space programs to resource requirements. Given the identification of the specific programs which could help to achieve broad national space goals, the problem of estimating resource requirements would seem to be a less formidable one. Here, the path-breaking work of the Rand Cost Analysis Department [15] reduces this formidable task to relatively manageable proportions. However, important technical problems do arise.

As Margolis and Barro point out, the interdependence among space activities makes it difficult to compute the true incremental cost of carrying out an individual project. It follows from the principle of the learning curve that the cost of hardware items procured for a particular project depends not only on the number of units required by that project but also on the number required by all projects using those particular items. If a project is eliminated and, hence, the demand for a particular hardware item reduced, then the unit cost of the item increases to all other projects that require it concurrently or at a later date. [16]

To further complicate estimating the resource requirements of space programs, it should be noted that major space vehicle systems and ground installations are often used in many different flight projects. Items that are most likely to have multiple uses--boosters, propulsion systems, launch facilities, tracking networks--have tended to be expensive relative to items that are peculiar to individual projects. [17] No single method among the many suggested for dealing with this problem is really satisfactory. The present procedure whereby such items are segregated into separate categories appears to be as reasonable as any.

The fundamental problem to be encountered at this step of the process perhaps is the fact that, as in the case of defense activities, so much of the results of the space program cannot be expressed in dollar terms. Hence, benefit/cost analyses cannot be made. To some degree, we must be content with relying on Leonard Lecht's conclusion that, "The space effort involves the incurring of large expenditures in the present or near future for benefits at a more remote future date which, at best, can be very imperfectly foreseen...the unanticipated consequences are likely to exceed in importance those which can be anticipated in advance." /8

Again relying on the experience of military analysts, cost/effectiveness studies can be utilized at this step of the space PPBS process to identify the least cost alternatives to achieving already-identified space goals.

Relating the space resource inputs to budget dollars. In a sense, this last step may seem to be a backward taking one. After identifying the total system resource inputs, PPBS now requires that they be reduced to the common and crude denominator of budget dollars. Upon reflection, it can be seen that this is an essential step of the entire process. Supposedly or hopefully the basic program decisions have been made in the context of a complete analysis of the entire system being considered, including its costs and benefits to the nation as a whole as well as to the Federal Treasury. /9 However, for the results of the PPBS analysis to become operationally useful in terms of government budget-making and expenditure allocation, they must be incorporated into the formal budget submissions in the customary manner.

Indeed, this may be the fundamental double contribution of PPBS: to make possible the implementation of long-range planning through the budget process, thus giving practical application to the planning and analysis effort and improving the intellectual content of budget-making.

Conclusion

By raising fundamental questions concerning the alternative uses of the Federal Government's funds and resources and by providing some concepts and methodology for answering them, the Planning-Programming-Budgeting System is an important attempt both to sharpen the government's budgetary preparation and review process. Perhaps more fundamental, it ultimately--if carried out in spirit as well as in letter--will increase the benefits achieved by the Nation from its public investments and outlays.

Footnotes

/1 For a more detailed treatment, see M. L. Weidenbaum, "Program Budgeting: Applying Economic Analysis to Government Expenditure Decisions", University of Missouri Business and Government Review, Vol. VII, No. 4, July-August 1966, pp. 22-31.

/2 U.S. Senate, Committee on Aeronautical and Space Sciences, Policy Planning for Aeronautical Research and Development, Washington, U.S. Government Printing Office, 1966.

/3 Leonard A. Lecht, Goals, Priorities, and Dollars, New York, Free Press, 1966.

/4 Milton A. Margolis and Stephen M. Barro, "The Space Program" in David Novick, editor, Program Budgeting, Program Analysis and the Federal Budget, Cambridge, Harvard University Press, 1965, pp. 133-135.

/5 Cf. Harold Asher, Cost-Quantity Relationships in the Airframe Industry, Santa Monica, Rand Corporation, July 1956; David Novick, Weapon-System Cost Methodology, Santa Monica, Rand Corporation, February 1956; David Novick, System and Total Force Cost Analysis, Santa Monica, Rand Corporation, April 1961.

/6 Margolis and Barro, op. cit., pp. 128-129. The procedure described by Margolis-Barro raises the question of marginal versus average cost pricing. If the canceled project were the marginal recipient and marginal cost pricing were used, there would be no effect on the projects that were higher up on the curve (to the left on a negative sloping improvement curve). However, under an average cost pricing system, the effects would be as they indicate.

/7 Ibid. p. 129.

/8 Lecht, op. cit., p. 285.

/9 Such externalities are dealt with at length in the pertinent economic literature. See the sources cited in (1).