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A SYSTEMS APPROACH TO ANALYSIS OF URBAN SERVICES

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The creation of the Programming-Planning-Budgeting System (PPBS) in the U.S. Department of Defense and its subsequent extension to other agencies of the Federal Government has stimulated interest among urban planners. PPB holds the promise of being a viable means for carrying rational calculation into many realms of public effort and expenditure. The ideas and techniques upon which it rests are seductive both for their power and generality and for their demonstrated applicability in attacking the incredibly complex problems in designing and building a modern defense capability. In addition, it seems clear that the adoption of PPB concepts by the Federal Government has gone beyond federal agencies, as indeed might be expected if those concepts have the merits claimed by their proponents. The Demonstration Cities Act of 1966 calls for the creation of what amounts to a PPB capability in cities selected to participate. The U.S. Senate Subcommittee on Intergovernmental Relations [15] has issued material on PPB applications in local government. Around the country several State and local governments have begun to institute PPB procedures, while research groups, notably the State-Local Finances Project at George Washington University [12], display considerable interest in the resulting research opportunities.

How PPB is being introduced into the Federal system was described by Page [7] in a recent issue of this Journal.¹ So far, no comparable description for a local government has appeared, although several governments seem to have made considerable progress towards instituting PPB systems. A number of authors have examined problems likely to occur in the process of transferring PPB to the local level in hypothetical terms.² In the coming years, this literature within planning will surely expand and multiply. The purpose of the present paper is neither to assess nor to describe such PPB efforts.

Rather, it will emphasize some points of substance involved in the analysis that must underpin a successful PPB effort.

THE DIFFUSION OF PPB

New methods often fail to make the difficult transition between levels of government. For some there is good reason. Many methods are technically inappropriate at widely differing levels. Political style differences make others unacceptable. But it might be argued that a good part of the failures stem from these very facts of diffusion and transition, with their accompanying coarsening of understanding, formalization and routinization of procedures, and implied dependence upon weaker technical staff. The result, too often, is adoption of form but not of substance, and the outputs are poor. With deference to successful exceptions, one might argue that the 701 program offers examples of this process within city planning.

As PPB is diffused into local governments, these influences will threaten its adoption, as they would any other innovation. Similarly, difficulties will exist within governments in the process of diffusion across departments. Counter-measures are possible. In the Federal Government, the diffusion of PPB methods has been accompanied by a parallel migration of analysts from the Defense Department into many other agencies. Presumably, they are to carry the gospel in its pure form, establish congregations, and maintain contact with the mother church, now moved from its birthplace in an important outlying province to an enclave within the capital of empire, namely, the Bureau of the Budget. Given the skill required to carry out PPB analyses, this appears to be a good strategy. But where are the skills for local government to come from? For the next few years the prospects are bleak.

Such problems are endemic to innovation, but PPB has some additional ones of its own. It involves tampering with the budgetary process. Following

Wildavsky [16, 17], it might be argued that this fact alone is sufficient to ensure that efforts will be made to mould the process of innovation so as to disturb as little as possible the structure of political and organizational power within and between departments. Strategies and tactics for achieving this end are available and well understood by their users. Furthermore, the power shift is likely to involve not only the executive branch but also the legislative. Successful adoption of PPB potentially strengthens the executive in budget bargaining by replacing the piecemeal structure of the line budget with integrated budgetary requests that are demonstrably interlocking. While legislators may resist any attempt to replace the line budget with some other form, the compromise adopted by the Defense Department--namely, an internal budget based on the adopted program structure--still is likely to tip the balance of information towards the executive. Legislators are aware of this aspect of PPB and might be expected to respond appropriately.

PPB AND SYSTEMS ANALYSIS

Finally, there is the problem which gives rise to the main body of this paper. The budgetary and analytic roots of PPB go back at least fifty years,³ but the actual realization of effective integration of planning and budgeting took place in the Department of Defense during the period beginning in the late 1950's and culminating in the tenure of Robert McNamara as Secretary of Defense. Even there, PPB did not spring forth full blown. It grew from the soil of twenty years of increasingly sophisticated analysis of weapons systems that had to be created almost from scratch. The high cost and complexity of modern weapons systems, and the penalties of failure, placed an evident premium upon rational and economically feasible choice. The result was the emergence of an analytical design procedure that combined technology and economics in the general approach now known as systems analysis.⁴ PPB,

at least in the Department of Defense, may be looked at as the logical outcome of a steady expansion of the scope of systems analyses. Its components --program structure, program elements, analytical comparison of alternatives in terms of cost and effectiveness--all presuppose both a sophisticated understanding of the technical nature of systems with which it deals, and methods for their manipulation and analysis. Such understanding and capability were achieved before PPB.

It is certainly not true that followers must repeat the experience of innovators in every respect, but if they fail to perceive the critical elements of that experience, then the advantages of being followers may all be vitiated. Clearly, the PPB followers in both the Federal and local governments have a very different point of departure from the innovators. PPB is being instituted from above by executive fiat.

Although cost-benefit analysis of projects has been carried out in Federal and State agencies for a considerable time, it would be hard to argue that most agencies, especially in local government, have analytical and systems design capabilities comparable in relative terms to those in the Department of Defense at the inception of PPB. Perhaps more importantly, rapidly changing technology and demands upon national defense capability since 1945 forced a posture of inventiveness upon the defense agencies. Systems such as Polaris had to be evaluated and brought into existence without precedents. Thus, comparison of alternatives came to imply also the creation of genuinely new alternatives. In this process, systems analysis was critical. Comparable achievements in other agencies are not common. They have had less money, faced less rapid change, and were less able to evaluate the results of new programs. In addition, at lower levels of government, budgets are small and operations hedged about with fences of legal mandate and organizational custom.

If the discussion above is accurate, the conclusion to be drawn is that even if good analysts are found to put PPB into local government, there will remain an "information gap." Without a good deal of basic work on the technology and economics of public services, PPB could turn into a formal ritual for manipulating categories of activity without achieving much significant improvement in response to urban problems. Unless PPB results in significant advances in the way in which urban governments perform their basic housekeeping functions, including social services, it will be hardly worth the effort. Identification of such changes will call for systematic analysis of governmental operations and an inventive attitude. Systems analysis may be a useful tool in bringing this about. However, the same transfer problems arise in the case of systems analysis as with PPB. The remainder of this paper surveys the problems of urban systems analysis.

Systems analysis has evolved during the past twenty years as a response to the need to solve complex military design and decision problems. It is eclectic in its selection of technical methods for problem solving, finding its unifying theme in a style of attack upon the problems themselves. The core of a systems analytic approach lies in the attempt to describe any problem in relation to the structure of objectives in which the problem appears, and the pattern of total costs and benefits implied by alternative technical and distributional solutions. Several very difficult tasks are involved in this apparently simple statement. We will examine them briefly.

OBJECTIVES

The systems analyst typically looks at his system not as an end in itself but as a means toward the achievement of certain objectives of some broader entity in which he is operating. In order to do this he must be able to specify those objectives operationally and relate the outputs of

alternative systems to the achievement of objectives. The requirement of operability is crucial. It is not enough to say, for example, that a particular configuration of activities promotes education. We must define what we mean by educational achievement, specify how it is observed and measured, show how the outputs of the activities are related to it, and demonstrate that those activities will, in fact, have the effects attributed to them.

The process of definition and specification of objectives is difficult and painful. We cannot expect in general to be able to achieve a satisfactory outcome by abstract thought. Rather, the process of formulating alternative approaches itself suggests modifications of objectives and their operational definitions. A good systems analysis may contribute as much to the clarification of what its sponsors are really trying to do as it does to the achievement of those ends.

In the provision of public services, the specification of objectives is rarely adequate. Typically, two kinds of weakness occur. Objectives may be specified, but in terms so broad and vague that it is impossible to tell how well the system is doing towards their achievement. In themselves, such objectives as health, safety, education, fuller citizenship, and so forth are certainly unexceptionable. But without operational definitions for measuring the effectiveness of alternative systems for their achievement, they tend to become irrelevant to the real operations of government departments.

In such a situation, the second kind of weakness appears. This is the establishment of objectives in terms of criteria defined on the inputs to the system rather than its outputs. Public services are particularly prone to such formulations since they commonly have great difficulty in the specification and measurement of output. Objectives tend to be set up as systems of standards for the provision of certain classes of inputs, and the quality of the system's performance then comes to be measured in input terms. Such

measures as pupil-teacher ratios, doctor-patient ratios, professional librarians per capita, and so on do not measure the performance of the system as a means to wider social ends. They measure what is being put in, not what is coming out.

Measures of this type are particularly attractive in situations where the systems outputs are diffuse and the global objectives imprecise. Because these things are hard to pin down, the attraction of the easily measurable input components becomes overwhelming for the hard pressed administrator who must run his agency and secure a budget for his operations. If there were a unique and simple relationship between inputs, outputs, and goals, the difficulty would not be serious. But such relationships rarely exist. Inputs may be used in widely varying proportions. Similar inputs may imply very different configurations of distribution of services to the population. In this situation, the use of input measures as objectives leads easily to the distortion of real agency goals away from the social ends for which the agency was established, towards internal organizational and administrative ends. Empire building within organizations is a familiar example of such a distortion. In the absence of global measures of performance, who is to say what such developments contribute to or detract from an agency's performance?

SYSTEM STRUCTURE

A systems analysis aims both to analyze existing ways of realizing objectives and to invent new ones for comparison. In order to do so, an understanding of the internal characteristics of the system and of the environment in which it operates is invaluable. Here we may make a distinction between limited range analyses and broader investigations of overall strategy and performance. In limited range analyses, the organizational environment may be taken as given. The analyst seeks to evaluate new ways of accomplishing

limited ends within it. Examples of such analyses might include the question of introducing electronic data processing equipment into circulation function of a library, or proposals to increase the hours during which a clinic is open. In broad system analyses, the organizational and goal structure of the system is itself called into question. An example of such analysis might deal with the role of a library system as a provider of study space for high school and college students. The distinction made here cannot be hard and fast. Rather, we might think of it as a continuum from the very specific to the most general problems, carrying with it an increasing concern with re-specification of overall system objectives. However, it should also be borne in mind that limited questions can lead to very general answers. One of the most famous systems analyses [18] ever carried out began with the question of where to locate bomber bases and ended with major alterations in U.S. strategic posture.

In all cases, however, certain common elements of concern appear. The focus upon performance with respect to broader objectives means looking at any system as a means for transformation of resource inputs into system outputs. This implies a simplified model of the system similar to that shown in Figure 1. Although crude, Figure 1 contains a quite general description of our view of an appropriate structure for the analysis of provision of existing local public services. It postulates a production system for certain classes of public outputs. The existing system takes quantities of resources of different types (I) and transforms them into quantities of outputs (O) that are distributed in varying amounts among groups (R) across the population of the area over which supply jurisdiction exists. The nature of the transformation is determined by the technical state of the process of production, the relative costs of inputs that may be substituted for one another, and the organizational, institutional, and functional subsystem structure within the producing system.

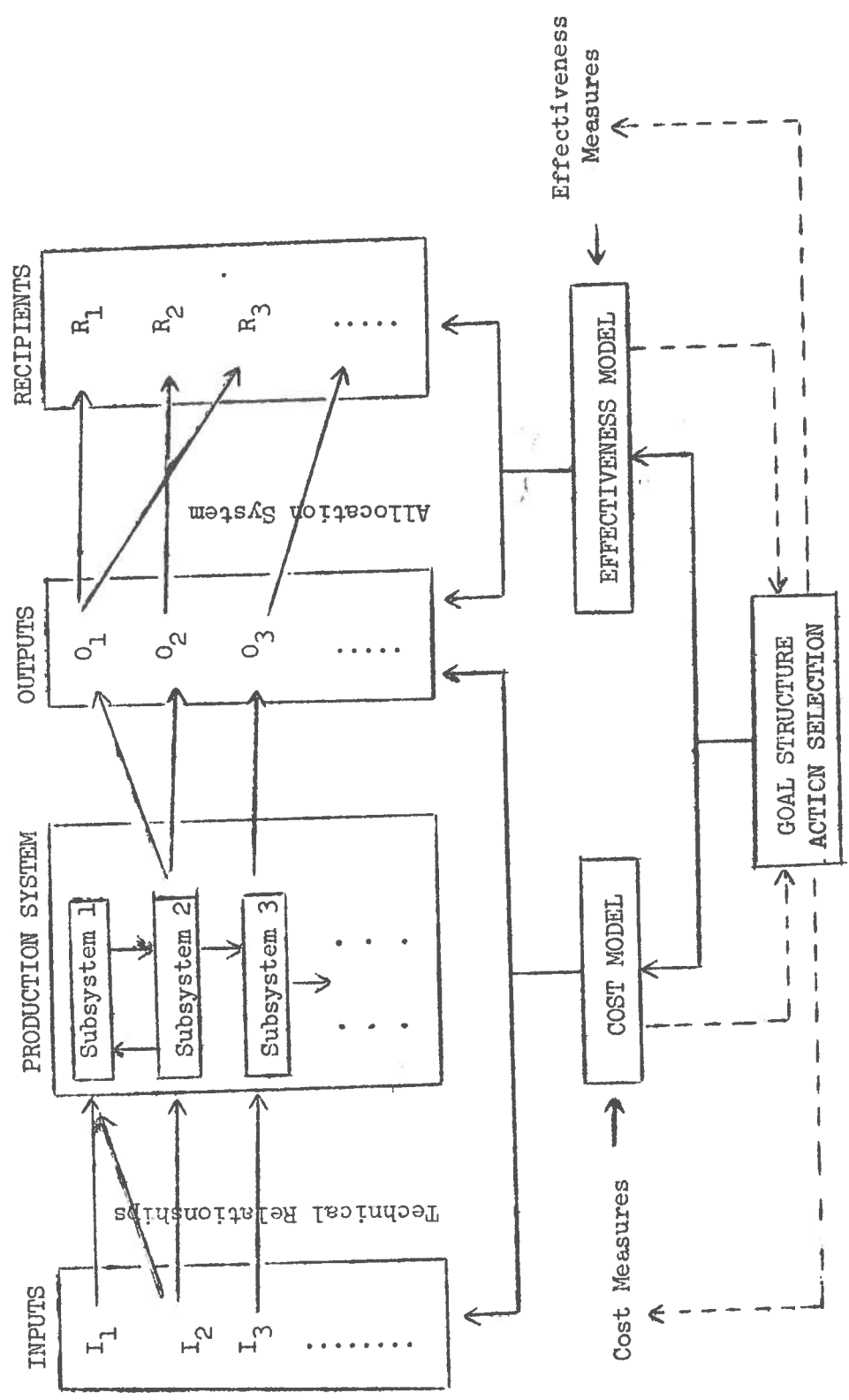


FIGURE 1. Schematic Model of a Systems Analysis Structure for Urban Public Services

The relative quantities of different outputs produced and their distribution among competing recipient groups depends upon the form of allocation procedure adopted. For commercial enterprises and some public and quasi-public products, for example, telephone service, the price system allocates output among consumers on the basis of their own preferences and the distribution of income.⁵ For some public products, there is virtually no differential allocation. If one consumes, all do. Defense or clean air are examples at national and local levels. But many public products lie between these poles. Library services are an example. All taxpayers contribute to the cost of the system and all are free to use it. However, whether they do or not depends greatly on the mix of outputs produced and especially on its spatial distribution. A decision on the part of the system to produce some particular set of outputs actually influences the distribution of benefits significantly. Without a price system and consumer response to signal the performance of a system under such conditions, how should decisions about allocation of resources be made? Again, the existence of higher level operationally defined objectives is crucial. If these objectives can be defined and outputs related to them in cost terms, then decision makers will have an improved basis on which to exercise judgment about alternative output mixes.

Figure 1 contains two major components. The upper half describes schematically the elements involved in the production and distribution of a particular configuration of outputs. The production system is seen as a complex of subsystems that may be defined functionally, organizationally, or in a number of other ways. These subsystems interact to transform inputs into urban services and other system outputs which are distributed to different groups in the population. The task of the systems analyst is to evaluate alternative patterns of resource allocation within the constraints imposed by the system or systems devoted to some objective or cluster of objectives,

and, if he can, find improved means for achieving them. Evidently, this is a fundamental aspect of program definition and evaluation within a PPB structure.

Several simplifications are involved in the model of Figure 1. We assume that a single overall system for production of the outputs can be defined, and there is a tendency to see it as one agency. This does not reflect the reality of many producers of similar products. Both libraries and school systems commonly claim contributions to education; police, welfare, and public health agencies attack many identical problems from alternative points of view; city planning, public works, and urban renewal agencies overlap strongly. The problem pervades any integrated analysis of the provision of local public services. We must acknowledge its existence and attempt to take account of it where it appears to be significant.

Another simplification occurs in the relative treatment of inputs and outputs. Most urban public services contain a very large component of labor costs. Thus, a distribution of jobs is implied as part of any particular output mix. This may be a significant factor, especially in a situation where the socio-economic composition of the population of a city is changing and discrimination exists, in that it provides one path toward the achievement of full integration of minorities into the life of the community. A similar argument applies to other aspects of purchase of inputs, especially where capital expenditures are considerable.

A third simplification concerns the structure of the production system itself. Even if it is a single agency, the picture of clearly distinguishable subsystems is bound to be a distortion. Agencies are organizations as well as functional units. They are subject to the forces that shape organizational development from within. Not all subdivisions are likely to be functionally based; considerations of stability, personality, and institutional inertia

probably influence the organizational subsystem. Responsibilities may overlap or be incompletely specified. An organization is made up of people, not boxes on a chart. Informal patterns of relationships and behavior may differ greatly from those implied by the formal organization structure. Consequently, the subsystem structure that the systems analyst chooses to recognize may vary widely depending upon his orientation towards organization and administration, processes of production, or social and political behavior. While the analyst may desire to combine these viewpoints to a reasonable degree, it remains likely that in practice present departmental divisions will be taken as the point of departure because suggestions for change must be made from the existing formally recognized pattern.

A fourth simplification deals with the process of production itself. Implicitly, Figure 1 suggests a single pattern of input requirements for a given output configuration, with alternative output patterns to be compared. Under most circumstances, such a picture would be false. One of the most important problems, commonly, is to find that pattern of production which is most efficient, that is, lowest cost for a given set of outputs. We shall deal with this question in the next section.

COST AND EFFECTIVENESS

In the absence of a price mechanism to allocate output among recipients, some other procedure must be adopted. Traditionally, this process has been a mixture of political, administrative, and professional judgment. During recent years many attempts have been made to increase the amount and quality of information upon which such decisions may be based. Foremost among them have been efforts to quantify both the costs and the benefits stemming from alternative governmental actions. In cost-benefit analysis both sides are quantified in dollars and every effort is made to include not just the direct immediate costs and benefits to the agency and its clients, but also indirect

or spillover costs and benefits accruing to others not directly related to the action in question.

Systems analysis did not develop in this context, but rather in the realm of military decisions where the monetary quantification of benefits is largely impossible. Even so, it remains possible to quantify the objectives toward which military actions are directed and to devise measures of the effectiveness of alternative actions or systems with respect to those objectives. If such measures are available, it should be possible to form a good idea of the relative costs of achieving a marginal gain in one direction as opposed to another. For activities in which quantification of value of direct and indirect benefits is excessively difficult, this procedure seems to offer a useful if rocky path towards improvement of information for decisions.⁶

COST ANALYSIS

The lower portion of Figure 1 suggests the structure of a cost-effectiveness approach to urban services. The cost model appears to be relatively straightforward. For any configuration of outputs, it should tell us the total cost of producing them under the assumed system structure and production relationships. This bald statement covers a multitude of difficulties. Perhaps most pressing in the case of urban services are the specification of outputs and the understanding of technical relationships.

Defining outputs for any service or bureaucratic activity constitutes a major problem both of general understanding and of specific measurement. Systems analyses of governmental functions run directly into confusion between objectives and activities. It is usually easy enough to find some measure of activity going on. The trick is to find a measure appropriate to the objectives for which the agency was created. This is the problem of relating output and effectiveness to which we shall return. Its appearance here emphasizes that cost measurement is intertwined with what the system is supposed to achieve.

The second difficulty mentioned above dealt with the understanding of technical relationships. A cost model should provide costs, both total and by output category, of alternative output configurations. In order to produce this information, it must contain the important technical relations that determine what can be produced by any given set of inputs. Furthermore, it should allow for variations in input proportions in order to take advantage of substitution of inputs whose prices and productivity differ. The latter implies that we would like the cost model to be able to produce a minimum cost input solution for any output set. Its criterion might be called efficiency.

This is not a trivial task. Even if we know how outputs are to be defined, the processes of production of public services usually involve complex organizational structures. How alteration in the proportional weights of different parts of such organizations affects output is rarely known. Studying an existing organization may not reveal cost/output relationships that allow a determination of whether it is producing its current output at minimum cost. Furthermore, for many services the demand for outputs is affected by the input allocations themselves. Projecting costs and input requirements for outputs at new levels, particularly if they involve major changes in output proportions, may prove yet more uncertain.

In practice, cost estimation turns out to be a formidable problem even if many of the indirect costs are ignored. Budget data commonly takes the wrong form or does not exist. Where significant innovation is required, uncertainty is likely to be especially great. For example, an investigation of the costs of implementation, as against hardware, of electronic data processing would probably show considerable costs in areas either not considered in the initial decisions to install them or seriously underestimated, for example, set-up times.

In contrast to these problems, some features of cost and programming analysis suggest that the prospects are not all bad. The theory and practice of optimization has developed swiftly during the past twenty years. Techniques for allocation of resources, such as linear programming, have been widely adopted in private industry but have hardly penetrated into the local government service sector. Partly, the failure to use them has been due to their initial cost and the necessity for skilled personnel. But inability to recognize their potential value has probably been equally important. In areas where skills and such recognition have coincided, as in transportation analysis, the results have been promising. One virtue of a systems approach is its implicit search for new methods that can encourage the adoption of techniques developed elsewhere once they have been refined to the point of practical utility. There are grounds for believing that significant improvement in the production processes of local government could be achieved with their aid.

Even if new techniques are not easily adopted, careful cost analysis of current operations can be very useful. The main reason for this is the output orientation of systems analysis. A systems analyst tries to tie costs explicitly to the outputs for which they are incurred. This is not easy, for most financial data in government is not directed to this end. A typical municipal budget consists of expenditures and appropriations by agencies, and within each by objects of expenditure. The objects are descriptive categories of purchases and are therefore directed towards inputs rather than outputs. Formulation of budgets in this way supports two major financial purposes in local government, control of expenditure by the legislature and comptroller and intermediate management of labor force and resources to achieve internal efficiency. Unfortunately, the relationship of expenditures to objectives is clouded. One cannot tell from looking at a typical departmental budget statement anything about the purpose of many expenditures. In addition, since the

proportion of labor cost in the provision of public services is so high, the inclusion of this component as a single entity swamps all the rest, many of which turn out to be of trivial size.

A cost analysis that goes beyond object-of-expenditure categories, relating them to outputs, may be very revealing of the actual, as opposed to the announced, behavior of any organization. Certainly, it would seem more useful than information on expenditures on minor supply items. To carry out such an analysis requires a careful apportionment of expenditures by object to the outputs for which they are utilized. This, in turn, depends on an understanding of the organizational and functional structure of the agency. Where outputs are imperfectly defined, judgments about their nature and the form of categorization to be employed are necessary. Naturally, these too are subject to error. Not only direct costs but also indirect and support costs must be estimated and allocated. In the process, new understanding of the total cost of operating programs or activities may be gained, and misconceptions about the relative size of program components removed. For example, the Air Force discovered that it cost as much to support a bomber wing for three years as to equip it in the first place. Similar relationships between capital and operating costs exist elsewhere. Furthermore, expenditures in one direction often give rise to costs in others. Thorough comprehension of the ramifications of cost relationships should allow more accurate projection of the cost impact of new proposals even if it cannot provide the optimal resource pattern for their achievement.

Cost analysis is especially germane if the organization's output structure encompasses programs directed towards specific ends. However, there are always some components in any agency that are extremely difficult to allocate to outputs related to final objectives. Typical of these is the overall management function. Who is to say what part of the cost of management goes

to any particular output or objective? To recognize this fact is not to despair. Cost analysis aims not at perfection but at sufficiency. If a large proportion of expenditures can be covered, then the remainder cannot significantly change the general pattern revealed. Major difficulties arise chiefly in agencies where a very large part of expenditures is unallocable. The cause may lie either in the nature of the work performed or the organization and attitude of the agency to its own activity. Any agency that looks at itself primarily through inputs and internal arrangements rather than outputs will be difficult to analyze. Such attitudes are not rare in local government. Furthermore, the output categorization used by the analyst for such agencies probably will contain a larger element of arbitrariness than otherwise.

EFFECTIVENESS ANALYSIS

The discussion above brings out the intimate relationship between the structure of output and the analysis of cost. Now we turn to the relationship between the structure of output and the achievement of broader objectives. This general topic may be called the study of effectiveness.⁷

The compilation of costs can be carried out for the most part under a single system of measurement, namely, dollars. While nobody denies the existence of intangible cost factors, for local government services usually they either can be treated as negative effectiveness variables or are relatively minor. Since the main concern centers on the use of resources in the production of public goods, it seems reasonable to measure those resources by their prices in the marketplace. The other side of the picture, outputs and benefits, is more resistant to monetary quantification. There are several reasons for this. In the absence of a market and price system for allocation of what is produced, no obvious valuation procedure based on people's subjective demands presents itself. Often public goods are produced by government simply

because any such price allocation is inconceivable or because the idea of valuation is meaningless. The value to a country of the ability to slaughter its enemies would be hard to calculate. To get people to purchase their portion of that ability voluntarily would be even harder, since each knows his contribution to be a miniscule part of the whole and that if he can evade payment he still will receive protection. These are classical arguments for governmental provision of such goods in the large. They do not answer the questions of how well the government is doing for its money in any specific purchase, or whether it should buy one product or another.

Systems analysts have attacked this question through the device of the measure of effectiveness, relating the output characteristics of any activity or system to the achievement of broader objectives. The notion of effectiveness, although imperfectly defined, is useful. In military systems it ties performance characteristics of alternative systems being evaluated to alternative ways of describing what they are supposed to do. A military example is illuminating. We might judge a missile by the probability that it will hit its target. This would be one measure of its effectiveness. On reflection we might see that this probability does not allow for the question of whether the missile, burdened with guidance systems, carries enough explosive to destroy the target. Judging alternatives on hit probability alone might give rise to choice of a missile insufficiently destructive. Similarly, we have not specified in the probability of hitting, whether we are talking just about directional accuracy or also the ability to overcome counter-missile measures likely to be taken. In a broader sense, we must also know the cost of the missile, for this determines the effective number that can be procured and consequently the overall number of targets that may be threatened with a given probability of success. The latter constitutes a broader system-effectiveness measure and illustrates that choices on the basis of narrower system

definitions, i.e., the individual missile, may be incompatible with broader objectives.

Clearly, the selection of effectiveness measures calls for skill, judgment, and a full understanding both of the alternatives being analyzed and the problem which they are designed to tackle.

Measures of effectiveness in the production of government services are rare. Typically, they are replaced by two kinds of devices, performance measures and standards. Performance measures relate to the problem of administrative control of operations where the output is poorly defined. Usually, they are specified on some sort of activity basis so as to give an estimate of work performed. Thus a welfare worker may be assessed by the number of case files he can process. Controversy persists over the form of these measures and the way in which they are, or are not, used, or in some cases whether they exist at all. Traffic ticket quotas are an example of the latter. Many questions arise from the doubtful relationship between the performance measure used and the ultimate output towards which the work is directed. The performance measure tends to be a management control device designed to allow management to detect variations in work levels and respond accordingly. It may in fact have little relation to final output, or conceivably result in effects opposite to what was intended.

The problem of standards is much broader. Government activity is honeycombed with sets of standards. We may distinguish among them two types, technical performance standards and generalized system standards. Considerable overlap exists and many problems are common to both, but the distinction is nevertheless convenient.

Technical performance standards exist throughout industry and give a vital measure of uniformity and interchangeability, together with confidence of performance. In government they perform a similar function with perhaps a higher

degree of overlap into socio-economic and political spheres. Detailed housing code standards, for example, may insure uniformity in wiring, but also have powerful implications of protection of certain occupational groups from innovation. In general, we cannot say much about technical performance standards. Certainly, they perform an important function, although there seems to be some likelihood that careful examination would be in order in many instances.

Generalized system standards are so labelled to distinguish them from technical performance standards. They tend to be specified for the entire system or some major part of it, and they are commonly couched in input terminology. System standards are very common whereas output and effectiveness measures are difficult to find. In local government, libraries are a very good example, many of the standards being promulgated by professional organizations such as the American Library Association. In other circumstances, standards may be established in various ways. A notable example is the role of the underwriters in establishing standards for local fire departments throughout the U.S. The relation between systems of standards and measures of effectiveness is complicated. Obviously, if the standards are established by knowledgeable people, they will reflect the technology of the system and aid in establishing some minimum levels of service. But their formulation in terms of input quantities rather than desirable output levels may lead to misallocation of resources in situations that are not average. More important, they may divert the attention of the agency from what it is supposed to be producing towards a concern for meeting input requirements, and from there lead naturally to the evaluation of performance in input terms. The danger in this attitude lies in cutting off an agency from its mission, a sort of loss of contact with reality. Concern with internal organizational aims becomes overriding to the eventual detriment of the agency itself and the

community at large. To the extent that the existence of effectiveness measures offsets this tendency alone, they may be well worthwhile.

The need for good measures of effectiveness in the provision of government services seems to be considerable. But the form of these measures cannot be entirely analogous to those used elsewhere. Governmental services are provided principally for the population which makes up the community, thus any pattern of production and distribution implies not only cost, efficiency, and effectiveness in response to declared objectives, but also a question of equity in the distribution of both costs and outputs. In one sense it might be argued that the equity question should be subsumed under effectiveness. Equity may well be incorporated as an objective. However, it merits separate treatment as a prime consideration in the politics of distribution of local government services. As with the other points discussed, we can do little more here than mention it as a special ramification of any effectiveness analysis for local government.

MEASUREMENT

To conclude this brief review of problems of cost and effectiveness, we should say something about the problem of measurement. Throughout, we have stressed the idea that the systems analyst searches constantly for operational definitions. The ability to measure becomes an important constraint on operationality in the analysis. But measurement is neither simple nor trivial.⁸ Very often, the way in which we decide to measure variables significantly influences our view of the variables themselves. Furthermore, the ability to measure some variables more easily than others may lead to a bias, often quite unsuspected by the analyst, in favor of those variables which he can measure and the objectives most closely associated with them.

On the cost side, the measurement problem is somewhat eased by the use of dollars as uniform units of measure. The principal problem is to ensure the accuracy of the measurements, both by elimination of error in the measurement of any specific cost and by the inclusion of all relevant costs under any specific heading. For systems already in existence, the achievement of accurate measurement of cost requires careful analysis of historic data. For projected systems, the problem of uncertainty of cost estimates arises. Experience in military systems analysis suggests that uncertainty with respect to projected costs rises as the time required for the development of the new system increases and as the degree of innovation from existing technology grows [12].

The measurement of effectiveness presents problems of a different order. Without any specific units of measure and, as we have seen, without any a priori reasons for selecting some measures of effectiveness over others, the choice of measures is bound to be a process of interaction between what we would like to be able to measure and what we feel we can measure with a reasonable degree of accuracy. The only real test of a measure of effectiveness is its ability to reflect the achievement of the agency's objectives. Thus we must constantly be on guard against the temptation to select measures of effectiveness because we have the ability to measure them even though we may not know their relationship to system-wide objectives. Without such a relationship, measures of effectiveness must be regarded as subject to criticisms as the performance standards discussed above.

Although the measurement of effectiveness is relatively new in local government, we might expect certain classes of measures to appear. One such distinction would be between absolute and ratio measures.⁹ The former are necessary in order to retain a perspective on the magnitude of operations and output implied by any particular system. The latter are likely to be

especially useful in analyzing distributive consequences of particular systems and as measures of efficiency in the use of inputs. Examples of the two kinds of measure might be total books circulated by a particular library system and books circulated per capita. Considerable evidence suggests that both kinds of measure should be used simultaneously in order to avoid biases in the measurement of effectiveness. The theory of measurement in cost-effectiveness analysis is still relatively undeveloped and awaits further work.

CONCLUSION

In this paper we have looked at some questions involved in the application of a systems approach to urban services. The prospect of diffusion of PPB into local government makes such application timely. It now remains to demonstrate that the approach is in fact applicable. Work towards this end is presently being carried out by the author for an urban public library system. Specific results and further general findings will be reported in a later paper.

NOTES

1. A brief but useful bibliography on PPB is given in Page [7].
2. Notably Hatry in [12, 15] and Steger [13]. See also papers in Novick [6].
3. The origins of PPB on the budgetary side are well treated by Schick [11].
4. The literature on systems analysis is now very large. Useful introductions may be found in Quade [9] and McKean [5].
5. The degree and control of monopoly, of course, influence the pattern of allocation in any particular case.
6. In this paper we emphasize the cost-effectiveness rather than cost-benefit approach. While the latter is theoretically preferable, it has received much more attention [1] and for a large class of urban services the quantification of benefits appears doubtful. General discussions of cost-effectiveness analysis appear in Quade [9, 10].
7. Besides the references given above, a more sophisticated view of cost-effectiveness may be found in Fox [2] and Heuston and Ogawa [3].
8. See Hodge [4].
9. These terms are used here in the ordinary algebraic sense rather than that of the theory of measurement.

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