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clusively by the district or project staff in their analyses of alternative projects within their district.

The structure of Fig. 1 roughly reflects the structure of this handbook. In Chapter II, before taking you into the detailed steps, however, we provide what we hope will be an illuminating glimpse at the nature of the resource approach to educational project cost analysis. A discussion of the rationale underlying the resource approach to educational project cost analysis is followed by an abbreviated discussion of the steps in the process of estimating different types of project cost.

We describe the nature of project-comparable cost and district-specific cost, delineating the differences between the two types of cost estimates. We also distinguish between an acquisition cost and an operational cost for each type of cost. We also explore what we mean when we talk about cost information. This discussion sets the stage for a look at the general use of appropriate cost information.

In Chapter III, we provide an illustrative sample of project cost estimation. Specifically, we lead you through the development of the types of cost information you need. The concluding two chapters are concerned with the use of

cost information in comparing projects from the perspectives of persons within a district (Chapter IV) and at the federal/state levels (Chapter V).

II. THE RESOURCE APPROACH TO COST ANALYSIS

The resource approach to cost analysis is designed to provide cost estimates that will permit equitable comparisons among projects, where cost or cost/effectiveness is the basis for comparison. A project is a combination of resources used in a specified manner to achieve stated objectives. We are using cost as a somewhat abstract, but common or universal, measure of the nature and quantities of the resources required for a project. We are mostly concerned with the cost as measured by using standard prices for the same resources. As an individual, you are concerned with your cost. (We will identify and discuss this distinction in later chapters.)

The process begins with determining the resources used in an instructional project. The cost of these resources--staff, facilities, equipment and materials--is then estimated, using standard prices for comparable resources. The resource approach is best explained by defining the elements of the approach that distinguish it from the more traditional cost analysis used in answering questions such as: "What does it cost to operate the media center?" and "How can we be more efficient?"

In this chapter, the discussion of the resource approach is followed by a brief exploration of the rationale underlying its development. The major steps in the process are then briefly described. The closing discussion of this chapter deals with the use of the appropriate cost information in comparing projects.

DEFINITION OF THE RESOURCE APPROACH

Key phrases in the opening sentences provide a handy organizational device for an efficient, brief definition of the resource approach. These phrases are: (1) the resources used in an instructional project, (2) cost estimates that will permit equitable comparisons, and (3) standard prices for comparable resources. Together, they capture the essence of the resource approach. Within each phrase, however, lie many nuances, all with their own impact not only on the procedures of estimating cost but also on the uses of those estimates.

Resources Used in an Instructional Project. All the resources used in instruction and in direct instructional services to the project should be included in defining the resource requirements for a particular instructional project.

(An instructional project may have any "size" dimension--one or many classrooms may be involved.) The objective is to identify the differences in resource quality, quantities and utilization that distinguish one project from another. Resources that are commonly accepted as being provided to all projects may be excluded. Classroom space and typical classroom furnishings can serve to make the point: if each of the projects occupies a conventional classroom, then including the cost of the space simply inflates the cost estimate for each project by the same amount. On the other hand, if one of the projects, by virtue of its design, uses an additional laboratory or resource room, then its resource requirements (and the resulting cost estimate) are higher by the incremental space and its cost.

Cost Estimates That Will Permit Equitable Comparisons

Again, the cost estimate to be used in comparing projects covers the cost of all resources used in the project as stated above. The cost of the resources directly used in providing instruction should be estimated regardless of the source of the dollars with which the resources were purchased or regardless of the fact that the resources were inherited, cost-free, from a previous project.

There is another way of looking at the resources to be included: only the costs of resources that change because of the existence of a project are included. If Project A results in a change in, say, the cost of operating the school media center and Project B does not, then the cost of Project A includes the additional media center cost and the cost of Project B does not. This aspect of the resource approach is particularly cogent in assessing the cost to "produce" educational results or in determining, in a research-like mode at the federal or state levels, what project (or combination of resources) works and with what cost.

Let's take two examples. First, you are trying to determine, as the first step in your search for a good project, which of several projects is more cost-effective. What you really want to be able to say is that the resources of Project A, B or C produced some level of achievement. In order to make comparative statements about Project A, B or C, you have to have information about all the resources needed by each project. The fact that Project A's resources were mostly paid for from last year's Title I funds is irrelevant; Project A needed those resources to make it work, and the

cost of those resources should be included in the cost estimate of Project A.

As another example, you are trying to decide whether you should select Project A, B or C for your district or school. (The cost and outcome for Project A, B and C are about the same.) You are not now concerned with cost in a strict external comparative sense. You want to know what Project A, B or C will cost in your district. Say, for example, Project C uses a well-equipped reading laboratory and you already have one available. Your cost for Project C will be less than the cost of Project C in another district that does not have a reading laboratory. In this case, the cost of Project C, in the resource-situation of your district, is also less than your cost of Projects A or B and you have tipped the cost/effectiveness scale in favor of Project C.

Standard Prices for Comparable Resources. In translating the project's resource requirements into an estimate of cost, standard prices should be used for comparable resources. The standard price should be the simple average price (across locations) for that resource. For example, a price of $15,000 would be used for each classroom teacher

with average qualifications, or $5,000 for a typical instructional aide. Remember, the purpose here is to estimate a cost that will allow comparisons of projects on an equal basis. The same "standard price" is used for resources with the same quality characteristics.

The use of standard prices is not necessary when you are estimating your cost to implement a project in your district. You have to pay your teachers according to your salary schedule and you will pay local prices for other resources. More will be said about this shortly.

By now, you should have gained the feeling that the resource approach to cost analysis we are discussing is tightly tied to resources or the analysis of resources. Resources--what they are and what you have to pay for them--do make the difference in the estimates of project cost, independent of the purpose of estimating the cost. You might also be asking, "What's new?"

RATIONALE UNDERLYING THE RESOURCE APPROACH

First, there really is nothing new about the resource approach. It is a relatively simple, common-sensical approach that was put together in response to the wide-

spread, indiscriminate practice of measuring a project's cost according to the expenditure per student. This dollars-per-student measure was rarely questioned. We are sure all of you can cite cases where decisions were, in fact, based on this one piece of information. In fact, it is the usual practice to give the cost per student for a project with no indication of what is included in the cost.

If, however, the instructional strategies of new projects in other districts are to be successfully utilized in your district, information about the resources used and their cost as well as the effectiveness of these projects must be available to you when assessing which project you can use. The development of the resource approach was undertaken because the state-of-the-art in costing educational projects did not then provide the desired equitable cost basis for comparing projects.

As mentioned earlier, the resource approach was originally designed to yield project cost estimates that could be equitably compared across projects or districts. At the time of its design we were faced with the following problem. Program X, a mixture of ten projects, was in operation in

various regions of the country and the question was, "How do these projects compare in terms of their cost-effectiveness?" We had the cost-per-student figure for each project. Now the question was, "What does this figure mean?" We also knew the number of students in each project and could multiply the per-student cost by that number to get some type of total cost for each project.

Again, we were faced with the problem of what the figures meant. We were confident that price differences could explain some of the higher, or lower, cost figures. A project of a certain nature will cost more in a district with a higher salary schedule and in a district that is in an area with higher prices for the other resources used in the project. Salary schedules and price differentials could, of course, be manipulated to give an adjusted cost for each project. But, the information on <u>what was included</u> in the cost figure was still missing. We had to determine, for each project, the resources used (by type, quality and quantity) and the nature of other cost-generating activities such as materials development and pre-service training of the project's teachers.

Armed with the information about the resources needed for the projects and by using a standard price for comparable resources, we were able to construct "a relative cost" for each of the projects. It was this cost that we related to the outcome of the project so that we could rank the projects in terms of their cost-effectiveness. As you will see later, this cost figure has some very specific, and somewhat limited, uses.

The series of events just described led indirectly to the resource approach to educational project cost analysis. We add the qualifier "indirectly" because at that time the approach was not identified as the resource approach or even as an approach. Only with use, and with the recognition of the crucial role the knowledge of resources played in estimating a project's cost, did the proposed considerations in estimating cost become tagged with its catchy moniker. In short, we have no definitive answer to the question, What's new? We simply packaged the conventional cost-estimating procedures in a manner that would give us the cost information we needed in our comparison of alternative projects.

There is a parallel in our daily life. In 1969, the Federal Truth-In-Lending Act provided consumers with a guide, the Annual Percentage Rate (APR) which enables them to compare the interest charges of different lenders. The APR, as you know, is a uniformly stated cost of credit, calculated in simple interest terms. Regardless of how the lender calculates the finance charge, all lenders must now express the cost of a loan in the same way. The APR serves the same purpose as the project cost figure estimated using the resource approach. Just as you can compare the cost of lenders by using the APR, you can compare the cost of projects as producers of educational outcomes, using the project cost figures as index-like measures.

We have been using the terms "project cost figure" and "project cost information" in a rather vague manner. This was intentional. We wanted to delay introducing any more precise terminology until our brief discussion of the steps in the process of estimating project cost.

STEPS IN THE PROCESS

In the resource approach to cost analysis you are concerned with determining the physical resource requirements

for the project and with calculating the dollar cost. Your first step is to determine the facilities, staff, equipment, materials and services needed to conduct the educational project. You then translate these resource requirements into an estimated project cost. Following this sequence forces you to explicitly consider the varying resource requirements for different projects.

When you are estimating the cost of projects you want to compare, you should include the cost of all resources, even the free ones already available within the district or inherited from some of your discontinued projects. As discussed earlier, a standard price (or more simply, the same price) for comparable resources is used to estimate the cost. The resulting estimated cost is identified as the project-comparable cost (PCC). It is, in essence, a fictitious cost that puts all projects on an equal basis. It is a cost you can use in comparing projects, in relating project costs to outcome or in an initial screening process.

In estimating the project cost to be used in deciding whether or not you should implement a particular project in your district, the resources available (those you do not have

to buy) within the district must be determined. You will not be paying for them again. You will, however, have to include the cost of using the resources you have already paid for. District-specific prices--the prices you have to pay for each resource--are used to estimate the cost. The resulting estimated project cost in this case is the district-specific cost (DSC) in your district. This is your cost--what you probably would have to spend for the project as defined.

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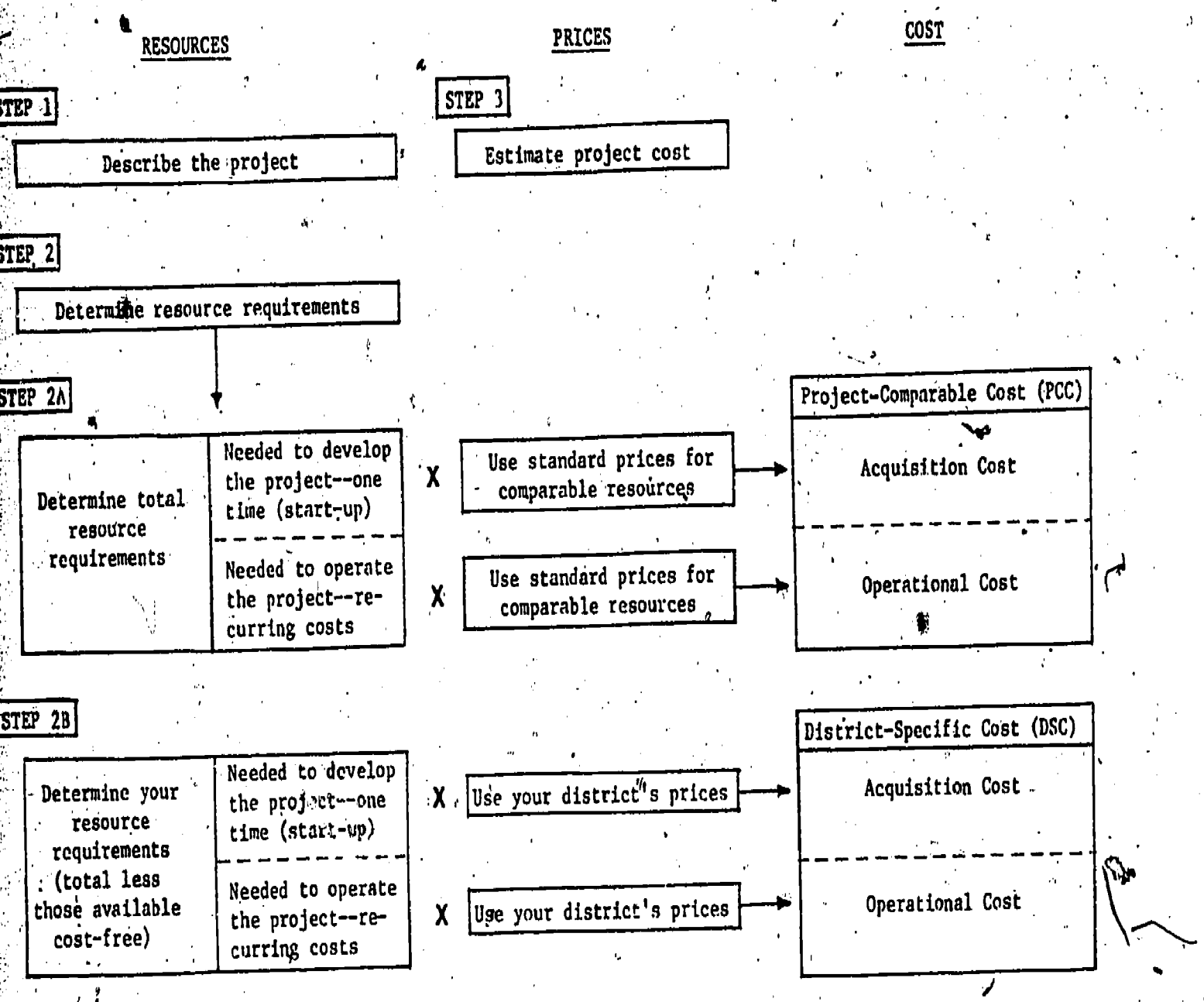

Fig. 2--The process of estimating project cost

resources and the way in which the resources are used to produce the educational outcome. The quality of the estimate of the cost depends on the completeness with which the resource requirements are determined. This determination, in turn, depends on the description of the project. In defining the project, the types and magnitude of support activities (project planning) or services (evaluation or pre-service training) also need to be identified.

Determination of Resource Requirements

The definition of the project is followed by the determination of its resource requirements. Most resources are direct counts of the type, quality and amount of staff, equipment and materials. Others are "functional packages," such as evaluation or pre-service training, which are costed as combinations of resource items or as a price-per-unit of service.

If you are estimating a project's cost so that you can compare it to other projects on a cost basis, then you will be concerned with all the resources needed. If you are estimating your cost to implement the project in your district, or comparing the cost of implementing one project or another

in your district, then you will be concerned with the net resources needed. The net resources are the resources you will have to pay for after you "subtract" your cost-free resources.

There is another small twist that we briefly mentioned earlier and that showed up in Fig. 2. This is the type of cost estimate. We used the term "type" in an attempt to avoid jargon but now we have to be more precise. When you buy something, you often have to pay a one-time cost and then a recurring cost to use it or operate it. The same distinction occurs in buying an educational project. In this discussion, we have chosen to use the term "acquisition cost" to identify the initial cost of those resources you have to acquire in order to implement the project. It is, essentially, the start-up cost. The term "operational cost" covers the recurring cost of operating the project--the cost of maintaining the project over some period of time. In a fiduciary sense, you could amortize the purchase price of most resources and develop an "annualized cost"--a reasonable measure for project comparisons if all resources are included, and the estimates are made using the same factors.

In making comparisons of projects with the purpose of deciding which project you can afford, information about both the acquisiton cost and the operational cost is important. It may be that you can afford to acquire the project but not to operate it. You have the facilities you need for the project and most of the equipment is available from a discontinued project but you cannot afford to pay the staff salaries. If you have information about the acquisition cost and the operational cost, you are in a position to make a more realistic decision.

We have stressed the need to determine what resources are required and to estimate the cost based on those resources. Knowledge of the specific resources is important for another reason--resource availability. Suppose that you have determined the resources needed and that the estimated operational cost of the project is within your budget, but the project, as designed and operated in another district, requires ten special reading teachers, each with five years of experience. If you cannot find ten reading teachers at the price you planned to spend, your cost of the project may be beyond your budget (due to the higher salaries you

would have to pay). It may be that you cannot find ten reading teachers at any price; in this case, the project is infeasible from the point of view of resource availability, not cost.

Estimation of Project Cost

The estimation of project cost involves, in simple terms, multiplying the resources required by their appropriate prices. When you are estimating the project-comparable cost (PCC), use standard prices for comparable resources or for cost-generating activities. When you are estimating the district-specific cost (DSC)--the cost you have to pay in your district--use your local prices. Naturally, the use of the different types of prices applies whether you are estimating the acquisition cost or the operational cost. The details of the process are discussed in the following chapter.

USE OF APPROPRIATE COST INFORMATION

We recognize that cost is not the most important consideration in many of your decisions. But our contention is that better cost information can be helpful in making

more informed decisions. The resource approach, which involves systematically estimating cost from the resources needed and developing cost estimates relevant to the decisions you are making, provides you with more useful cost information that a simple "accounting" cost per student.

It is often difficult to realize there is anything out of the ordinary about what something might cost. If we are economically rational, we all ask questions about cost. When buying a house we are concerned with, at a minimum, the down payment and the monthly payments; we might also investigate the impact on the monthly payment of a higher down payment, a longer-term mortgage, or a different interest rate. We also add in the property taxes and the monthly expenses of maintaining the house in determining whether or not we can afford to buy. Roughly the same types of cost are considered when buying a car--the initial cash outlay and the recurring operating expense. You might be able to afford a Cadillac in 1978 with a small down payment but not be able to afford the yearly expenses of interest and maintenance in subsequent years.

The types of project cost information we defined

earlier have similar uses in comparing projects. The acquisition cost is your one-time payment; the operational cost is your recurring expense for each time period of operation. Both these cost estimates are incremental cost to your district and would be calculated using your statement of resources needed and your prices. In effect, the estimates, tailored to the specific environment of your district, are still only planning cost figures--estimates of likely dollar cost impact to help you in making a first selection among alternatives. As estimates, they are not intended to meet the demands of financial accountability in expending public funds.

The DSC estimates are, however, closer to reality than the PCC estimates, which are calculated using standard prices for the same type and quality of resource. The PCC is, for your use, an index-like cost--an estimate of what Project A might cost. You should use the PCC estimate (estimated by you or others) as an initial screening mechanism.

If you hear of a super project in a far-away district and if you have a statement of its resource requirements and an estimate of its project-comparable cost, then you

have at least some idea of whether the project is gold-plated or silver-plated. If, on the other hand, the far-away project is touted as having a low per-student cost, and if you do not have a statement of its resource requirements or if you do not know the number of students served, then you have almost no real feeling for the total cost of the project.

At the district level use the PCC estimates--both the acquisition cost and operational cost--as a screening mechanism to identify projects you might be able to afford or projects that are more cost-effective. Use both categories of the DSC estimates in your district planning when comparing projects you might want to implement.

The real power of the PCC estimates lies in its comparability and in its usefulness for identifying the more cost-effective uses of resources by different educational projects. As discussed in Chapter V, the PCC estimates are useful in across-site comparisons of project cost.

In using cost information to your best advantage, you have to have a basis for understanding either the limits on the use of the cost information or the adjustments needed

to make the cost information useful to you. If you use the steps discussed in the following chapter to make the estimates for either the PCC or the DSC, you will have the basis for understanding the cost information. You will have a good idea of what costs are included in the estimates. And perhaps you also will know the limits on the uses of a specific set of estimates.

III. ESTIMATION OF PROJECT COST

It is common practice to give the cost per student for a project but to provide little or no indication of what is included in the cost. As was just discussed, in comparing several projects there is a need to know more than the cost per student for the projects. You have to know what the cost figure means--what the projects are, what resources are required, what prices were used. In short, the usually provided cost-per-student figure is inadequate information; it does not provide you with a sufficient basis for assessing the cost of a project as high or low or for determining whether or not you might be able to afford all or part of a project. You typically do not know what resources are needed.

The resource approach was designed to counter these problems by placing the emphasis on resources. Standard prices for comparable resources gives you a first-cut estimate of a project's cost. The identification of what kinds of resources are needed lets you determine if you have the necessary resources. It is conceivable that your district might not have, or be able to buy, the resources needed.

In estimating the cost to be used in comparing projects,* all resources needed for the implementation and operation of the project are included. Resources that do not change in quantity because you have reading Project A rather than Project B are excluded. The resources already available within a specific district or assets inherited from discontinued projects are included in calculating resources used by the project. The resources used for maintaining the building for example, are not included unless the cost of maintaining the building is increased due to the existence of the project.

A standard price for comparable resources, such as teachers with certain characteristics, is used. The resulting estimated cost is identified as the project-comparable cost (PCC). It is an "index cost" that permits you to make comparisons of projects on an equitable basis.

In estimating the cost to be used in deciding whether or not you might be able to afford a particular project in your district, the resources you have available and your

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*Here we are concerned about comparing the cost consequences of projects operating in different environments--e.g., different school districts.

district-specific prices for all resources must both be determined. The resulting estimated cost in this case is the incremental cost to your district--identified as the district-specific cost (DSC).

The process of estimating the project-comparable cost (PCC) or the district-specific cost (DSC) of a project begins with a definition of the project in terms of its resource requirements, as was shown in Fig. 1. These resource requirements are then translated into the type of cost estimate useful to you. This sequence forces explicit consideration of the varying resource requirements for different projects. Chapter II's skeletal discussion of the process is fleshed out with some more detailed thoughts in this chapter. In Chapter IV, a "number" illustration will be provided in discussing a district's use of cost information.

DESCRIPTION OF THE PROJECT

The first step in analyzing the resource requirements and estimating the cost of a project is the description of the project. The quality of the estimate of the cost of an educational project depends on the completeness with which the resource requirements are determined. This determina-

tion, in turn, depends on the description of the project. The sequence of events therefore begins with a description of what the project is and how the project works. Included as information should be the characteristics of the project's students, the number of students, the length of the instructional time, the class size and the type of staff. In defining the project, the types and magnitude of support activities or services must also be identified.

DETERMINATION OF RESOURCE REQUIREMENTS

The project description is followed by the determination of the resource requirements. The general types of information required are shown in Table 1. The goal is to identify a "shopping list" of all the resources needed and to then specify the types and quantities of each resource. (For those readers who find waiting difficult, examples of the resource requirements list for three projects are given in Chapter IV, Table 5, page 49.) Some of the information categories pertain to quantities of resources directly.

Others are "functional packages" for support activities such as pre-service training. The cost of these functional

packages, which are combinations of resource items, is usually estimated separately. For example, although pre-service training involves many resources, the cost of an hour of pre-service training can be estimated; the cost of the training can then be estimated by multiplying the number

Table 1

PROJECT DESCRIPTIVE INFORMATION NEEDED
(Illustrative example)

Students Characteristics Number	Equipment Project-related Student-related
Instructional data Class time Class size	Materials Project-related Student-related
Facilities Space Student/classroom/day Utilization Furnishings	Pre-service Training In-service training Support from other activities
Staffing Teachers Special teachers Paraprofessionals Other personnel	

of hours by the cost per hour. Additional data describing the resources needed for the support activities should be provided as appropriate for specific projects.

The length of instructional periods should be stated. Other information that contributes to determining the time the teacher spends with groups of students or individual students should be identified. At the very least, the number of students per teacher should be stated. The same information is needed for teaching assistants, instructional aides, or other staff.

In describing the facilities needed, the project's unique space requirements--including mobile or portable classrooms, laboratories--should be carefully identified. Any special furniture needs are to be specified, identifying any special per-student requirements.

Staffing for the project should be described in terms of the qualifications needed as well as in terms of quantity. For example, the number of certain types of teachers, of specialists, and of other staff involved in the project should be determined. If a staff member works less than full time on the project, you should use the percentage of

time involved. You should also determine the staff requirements for field trips directly related to the project's operation.

Equipment and materials should be identified as project-related or student-related. Project-related equipment or material is that which will be used by several classes of students during the day or during some time period of the project. Most often, project-related equipment and materials will vary with the number of classrooms. Student-related equipment and materials, on the other hand, will vary with the number of students. In calculating the operational cost, you should make additional distinctions about the consumable nature of the materials and about the lifetime of equipment. Materials consumed each year are replaced each year of the project's life. Tape recorders, likely to last five or more years, should have only an annual cost to maintain them and to provide an allowance for replacement.

The amount of time involved in pre-service and in-service training should be specified. The materials or equipment required should be described. It should be noted if the training time is included as part of the regular time

of the staff or if it is incremental to the regular working hours. If in-service training time is a substantial part of the individual teacher's time, additional teachers (or substitute teachers) may be required for the instruction load of the project.

The requirement for project-related services such as evaluation or other management activities should be specified. It is preferable if the actual time or the numbers of consultants can be specified. In either case, the purpose is to provide some estimate of the magnitude of these services so that the decision can be made between buying the service or developing, if possible, an in-house capability.

Support from other activities means the support the project requires from such service functions as tranportation. A particular project, for example, might require bus transportation for field trips. The cost of this instructionally required transportation would be over and above the cost of home-to-school transportation.

The project-descriptive items identified in Table 1 are meant to be suggestive only. If other data are available, you should include them in your listing of resource

requirements, since your purpose is to define as completely as possible those resources and cost-generating activities needed to carry out the project.

ESTIMATING THE PROJECT COST

The resource requirements are then translated into the dollar estimates of project cost--either the project-comparable cost or the district-specific cost. Basic to cost analysis is a list of cost categories. However, it is important to realize that not every element of cost is always included in the estimate for a specific project. Only those costs of district or school operation affected by the existence of the project are included in the estimated cost of the project. That is, if the cost of some activity will change if you implement a particular project, then you have to include the project's share of the activity's cost in the project cost estimate. An example will serve to clarify this point.

The district cost category, transportation, covers the transportation of students to and from school. Students in the project will, if they need it, continue to receive this

transportation. This regular transportation cost is not included in the cost of an individual project. But, if the instructional method of the project calls for field trips or other special activities requiring transportation, the cost of this transportation is included in the cost of the project.

The items, services, people, and activities required by a project can be brought together in the format shown in Table 2. The format provides a listing of the resources and cost-generating activities that are included in estimating a project's cost. The resources and cost-generating activities can be grouped into two broad categories: acquisition cost and operational cost. The costs of projects fall into either of these two categories. Acquisition cost is the one-time cost of acquiring an instructional project. Operational cost is the continuing cost of maintaining the project over a period of time.

The acquisition, or one-time, cost of acquiring a project is also referred to as initial investment, or capital cost. It covers the cost of all resources needed to implement the project. The cost of the effort devoted to

research, development, or design of components of the project or alternatives should be included as part of this cost. The cost of designing a different mathematics curriculum, for example, is a development cost. In estimating the district-specific cost, the need for development activities would be identified when the resources were being determined.

Table 2

RESOURCES OR COST-GENERATING ACTIVITIES INCLUDED IN PROJECT COST

Acquisition Cost	Operational Cost
Design of project*	Project direction*
Development of materials*	Evaluation*
Evaluation design*	Management support*
Project implementation*	Salaries
Equipment purchase	Teachers
Project-related	Paraprofessionals
Student-related	Specialists
Materials and supplies	Other
Project-related	In-service training
Student-related	Materials and supplies
Pre-service training	Project-related
Facilities (space)	Student-related
Installation of equipment	Equipment
	Replacement
	Maintenance
	Facilities operation and maintenance
	Contracted services
	Media services
	Transportation

*In an operational project where only the scope of the project is changed, there might be no cost associated with these activities.

Even in estimating the project-comparable cost, you might treat some overall development costs as "sunk" costs. That is, the first project to develop and use the curriculum would incur this expense; if subsequent projects could use the curricular materials, the projects would inherit the curriculum at no additional cost. On the other hand, if the curriculum had to be redesigned, this would be a development cost for that project.

The operational cost is also referred to as the recurring or continuing cost of maintaining the project. The cost of personnel, facilities, maintenance, equipment replacement, supplies, and the cost of in-service training of teachers are examples of the costs included as operational costs.

Some of the costs cover the cost of activities rather than the cost of items purchased. In many instances, the items purchased quite clearly underlie the cost of activities, but the activity cost may be used directly in estimating the project cost. For example, the evaluation cost might be estimated by using a factor such as cost per student. Or, the cost per project might be used if the evaluation is done by an outside contractor or evaluator. If

appropriate, these would be the factors used to estimate the operational cost of evaluation. The acquisition cost of evaluation--the nonrecurring cost--might reflect the amount of district staff time needed to design the evaluation. The cost basis would be per project for an acquisition cost and per student or project for the operational cost.

For each category, the cost basis is either per-student, per-project, per-unit, or direct service charge. The per-student and per-project distinction is rather obvious; the per-unit basis refers to units such as classrooms, resource centers, and language laboratories. The direct service charge is used when the service performed is measured in terms of, say, the number of hours of in-service training provided, the number of tests given or the number of square feet of buildings maintained. A direct service charge might also cover such items as the contracted transportation for the instructional part of a project or the provision of so many hours of instructional television.

In some cases, the cost basis might be a combination of project and unit (classroom), of student and service, or of project and service. No rigidity is implied. The intent

is to provide an understanding of how costs are categorized. Such categorization is basic to estimating the cost of a project. At this time, it is necessary only to emphasize that some cost is generated as a result of the number of students, and other cost because of the number of classrooms or instructional centers. In some cases, such as the development of instructional materials, there is a project cost that is independent of the number of students or centers.

Estimating the Project-Comparable Cost (PCC)

The cost categories provide a convenient way to identify the data needed about the project and its operation in order to estimate its cost. The data requirements for the cost categories for the acquisition and operational cost are shown in Tables 3 and 4, respectively. The quality of the estimate of the PCC depends on both the quality of the resource information and the way in which the information is used to develop the estimate.

In estimating the PCC, standard prices for comparable resources are used. The term "standard" is used to describe a price used across all projects.

Table 3

PROJECT DATA: ACQUISITION COST CATEGORIES

Cost Category	Data Requirements
Design of project Development of material Evaluation design Project implementation Pre-service training Installation	If these activities are required for the project, the number and the type of personnel involved, the time spent, and salary of those providing the activity are needed.
Equipment	The equipment list is determined for each student, for each classroom, and, if applicable, for the project. The classroom's equipment is used by several classes of students. The number of students that can use the equipment is specified.
Facilities	The space required is that over and above that needed for the regular program--both for each student and for special resource centers.
Materials	The initial stock of materials is determined for each student, for each classroom, and, if applicable, for the project.

Table 4

PROJECT DATA: OPERATIONAL COST CATEGORIES

Cost Category	Data Requirements
Project direction Evaluation Management support In-service training	The number and type of staff, the time spent for each activity, and salary of those providing the activity are needed.
Salaries (with fringe benefits)	All instructional staff and direct support classes of staff are identified by broad category; i.e., general teachers, specialists, and aides are used rather than a teacher with a specific salary. Fringe benefits are included as a district percentage factor.
Materials and supplies	The type and quantity of materials used are specified on a student and project basis.
Equipment	The equipment maintenance factor and the equipment replacement factor (based on the estimated lifetime of the equipment) are applied to the equipment used in the project.
Facilities operations and maintenance	The project requirements for each of the categories are specified in terms of square feet maintained, services purchased, number of hours of audio-visual instruction, and bus trip mileage.

For example, a price of $15,000 per year for teachers with certain educational and experience qualities is used in estimating the PCC. This includes a percentage for fringe benefits. This price would be obviously out of line for districts with either a much lower or higher salaries. But because the same price is used for comparable teachers in all projects, the cost difference for the salary expense of the project cost actually reflects the difference in the numbers and types of teachers needed for the project. This same argument applies to the use of standard prices for all types of resources in estimating the cost.

The acquisition cost includes the cost to remodel and furnish instructional centers, the cost of the equipment and the materials needed for all instructional centers, and the pre-service training cost of the project staff. The operational cost includes the salaries of the staff, the cost of materials consumed or lost, the cost of replacing and maintaining the equipment, the cost of in-service training, and other support activities.

Estimating the District-Specific Cost (DSC)

The project-comparable cost serves as an "index" cost

for use in the comparative analysis of different projects. It does not answer the question of what a project might cost if implemented in your school district. The incremental cost to your district is necessary in making decisions about whether or not the district can afford a project similar to a successful project in another district. The DSC estimates are necessary when deciding the scope and the design of the project that can be accommodated within the resource constraints of the district.

The process of estimating the district-specific cost (DSC) is essentially the same as the process of estimating the PCC. The emphasis, again, is on estimating the resource requirements and on translating those requirements into an estimate of dollar cost. The difference, and the increased difficulty, lies in the need to determine the incremental resource requirements of having the project in your district. In some districts, the unavailability of certain resources might be an obstacle to the implementation of a project even though the district, in an accounting sense, has the funds to afford the project. This possibility makes it all the more important to estimate the physical resources needed to implement and operate a project.

In estimating the incremental resource requirements, the resources available within the district at no additional cost are taken into account as free goods. These resources could be, say, assets inherited from discontinued projects, physical resources provided cost-free by the community, or volunteer services. After the net, or incremental, resource requirements are determined, district-specific resource prices and cost factors are used to develop the estimated district-specific cost (DSC).

In this chapter, the discussion has intentionally emphasized an early step in the process of estimating cost--the need to determine the resource requirements as completely as possible. Much less attention has been paid to the mechanics of going from resource requirements to cost. We hope to correct the imbalance in the following chapter.

Before going to Chapter IV it would be helpful if you would look again at Fig. 2--The Process of Estimating Project Cost (Chapter II, page 20).

IV. USE OF PROJECT COST INFORMATION--DISTRICT

When you are estimating either the project-comparable cost (PCC) or the district-specific cost (DSC) for a project, you are developing cost information to be used in making decisions about the dollar consequences of having a particular project. The PCC might seem to you to have little direct impact on your decisions. This is really not true for two reasons. The PCC provides you with an index by which you can roughly determine whether you are thinking of a project in the Lincoln Continental or Honda Civic class. The estimation of the PCC is based on the total of the resources needed for the project; if you have the PCC and the resource requirements and the standard price for each resource, you can develop the information you must have for estimating your district-specific cost (DSC) for the project.

Our main purpose is to take you through the steps in estimating the district-specific cost of a project in your district. Most of your decisions about project cost impact in your district have to be based, quite logically, on the resource picture and prices in your district.

Because the difference between the PCC and the DSC is sharpened when you contrast the resource statements and prices used in estimating each, and because you need the project's resource description for estimating either the PCC or the DSC, we include the steps in estimating the PCC in the discussion of estimating the DSC.

The steps in estimating cost are (1) describe the project or projects, (2) determine the total resource requirements and the incremental or net resource requirements for the project in your district and (3) estimate the PCC, using standard prices for comparable resources, and the DSC, using the prices you have to pay in your district.

THE PROJECT-COMPARABLE COST ESTIMATE

In the real world you would have a complete description of each of the projects we identify as Projects A, B and C. Here we just tell you that the projects are instructional projects at the elementary level, and all deal with reading instruction. The resource requirements for the three projects are summarized in Table 5. These are estimates of the resources needed to make the instructional stategy of each project work.

Table 5

PROJECT RESOURCE REQUIREMENTS

Item	Project A	Project B	Project C
Number of Students: Reading	300	500	100
Instructional Time: Reading	1	1	1.25
Facilities			
Space	4 trailers 1 classroom	2 sgl centers(S) 1 dbl center (D) 1 activity area	1 classroom 1 activity area
Total square feet	4600	8000	2000
Air conditioned	x	x	—
Carpeted	x	x	x
Special wiring	x	x	x
Carrels	x	x	x
Tables	x	x	x
Utilization			
Time in use	3 (2-hr) shifts	7 periods	5 periods
Students/instructional unit	20	40-S; 65-D	50
Area/student (sq ft)	50	50	40
Staffing			
Teachers/center or unit	1	1	1
Aides/unit	1	1	3
Students/teacher	20	40;65	50
Teachers/project	5	4	1
Aides/project	5	5	3
Other direct	--	—	—
Equipment			
Major items	EDL AUD-X Controlled readers Tach-X Flash-X	Hoffman readers Tape recorders Flashcard rdrs Borg-Warner 80 (backup)	Telex Cassette recorders Tape recorders Language master
Materials			
Project-related	Filmstrips Discs EDL matls	Materials: Hoffman EDL Borg-Warner High variety	BRL matls Cassettes Medium variety other matls
Consumables (student-related)	x	x	x
Pre-service Training			
Teachers	1 week	2 weeks	1 week
Aides	1 week	—	1 week
Other staff	--	--	--
In-service Training	--	2 hrs/week	3 days
Other Support			
Remote diagnostic services	--	--	x
Project evaluation	x	x	x
Consultants	8 days	8 days	8 days

The PCC is then estimated, using appropriate data from the standard resource prices shown in Table 6. The price may be either a unit price for a resource or the price of an activity's unit of output. For example, the cost for evalu-

Table 6

STANDARD RESOURCE PRICES

Facilities	
Remodeling (project-related changes)	$ 3,000/unit
Furnishings (including carrels)	$ 2,000/unit
Equipment	
Replacement	10%
Maintenance (depends on estimate of reliability based on complexity)	10% or 20%
Materials	
Attrition from use, theft	10%
Consumables	$10/student
Salaries (including fringe benefits)	
Classroom teachers	$12,000/year
Paraprofessionals	$ 5,000/year
Consultants	$100/day
Pre- and In-service Training (including salaries, materials, training)	$200/day
Project Evaluation	$10/student

*Illustrative standard prices used in this handbook are not to be assumed as official prices in any other context.

ation of a project is estimated as $10 per student where the $10 per student is the price of a unit of output and the number of students is the number of units.

Some of the results of multiplying the standard resource prices by the quantities shown as the resource requirements are shown in Table 7, Project Cost Information. It is not

Table 7

PROJECT COST INFORMATION
(Costs in dollars)

Item	Project A	Project B	Project C
Equipment Cost			
Total	15,000	36,000	3,000
Cost per instructional area	3,000	9,000	2,000
Number of instructional areas	5	4	1.5*
Students per instructional area	20	40/65**	50
Replacement--10 percent	1,500	3,600	300
Maintenance--10 or 20 percent	3,000	7,200	300
Materials Cost			
Total	20,000	45,000	9,000
Cost per instructional area	4,000	11,250	6,000
Number of instructional areas	5	4	1.5*
Consumables ($ per student)	10	10	10
Pre-service Training			
Number of staff-days (all staff)	50	90	20
Cost per day to provide	200	200	200
Total cost	10,000	18,000	4,000
In-service Training			
Number of staff-days (all staff)	--	32	12
Cost per day	--	200	200
Total cost	--	6,400	2,400
Other Support			
Student diagnosis ($/student)	--	--	50
Student evaluation ($/student)	10	10	10
Consultants ($100/day)	800	800	800

*Classroom area plus activity area equals one instructional unit.

**Forty students per single center, sixty-five per double center.

necessary to do this particular step for all resources. Note, for example, the project cost information does include the project's salary cost; that is, the number of teachers is not multiplied by the salary for a classroom teacher until you are estimating the project's cost. The reason is simple. If you can go directly from the quantity of a resource and its price to the project cost, then skip the step. In some cases, your cost-estimating life can be made easier by excluding the intermediate step. That is, you can, for example, estimate the cost of in-service training ($200 per day) or project evaluation ($10 per student) separately from your main costing activities.

The project cost information is an intermediate group of data about the resource and cost dimensions of the various resources used for each project. These data are then categorized by whether they are one-time expenses in order to estimate the acquisition cost, or recurring expenses in order to estimate the operational cost. The results of this step--estimating the acquisition and operational cost--are shown in Table 8, Project-Comparable Cost for the Illustrative Projects.

The acquisition cost includes the cost to remodel and furnish the instructional centers, the cost of the equipment and materials needed for the instructional centers, and the pre-service training cost of the project staff. The opera-

Table 8

PROJECT-COMPARABLE COST FOR THE ILLUSTRATIVE PROJECTS
(In dollars)

Item	Project A	Project B	Project C
ACQUISITION COST			
Facilities (remodel., furnish.)			
Total project cost	$25,000	$ 20,000	$ 7,500
(Cost/instructional area)	(5,000)	(5,000)	(5,000)
Equipment			
Total project cost	15,000	36,000	3,000
(Cost/instructional area)	(3,000)	(9,000)	(2,000)
Materials			
Total project cost	20,000	45,000	9,000
(Cost/instructional area)	(4,000)	(11,250)	(6,000)
Pre-service Training	10,000	18,000	4,000
Total Acquisition Cost	70,000	119,000	23,500
OPERATIONAL COST			
Salaries (incl. fringe benefits)			
Teachers ($12,000/year)	60,000	48,000	12,000
Paraprofessionals ($5,000/year)	25,000	25,000	15,000
Other (variable)	--	--	--
Materials			
Program-related (10%)	2,000	4,500	900
Consumables (student)	3,000	5,000	1,000
Equipment			
Replacement (10%)	1,500	3,600	300
Maintenance (10 or 20%)	3,000	7,200	300
In-service Training	--	6,400	2,400
Other Support			
Remote diagnostic services	--	--	5,000
Student evaluation (testing)	3,000	5,000	1,000
Consultants ($100/day)	800	800	800
Total Operational Cost	$98,300	$105,500	$38,700

tional cost includes the salaries of the staff, the cost of materials consumed or lost through attrition or theft, the cost of replacing and maintaining the equipment and the cost of in-service training activities. Also included in the operational cost are the costs of support activities such as project evaluation on a per-student basis per year and the cost for the consultant services required by the projects.

The PCC for each project, along with some project information, is summarized in Table 9. Remember, the PCC has been adjusted for variations in resource prices due to different salary schedules or regional prices. If we compare the operational cost per student, we have a quick and dirty measure of the relative expensiveness of Projects A, B and C. We

Table 9

PROJECT COMPARABLE COST
(Costs in dollars)

Item	Project A	Project B	Project C
Number of students	300	500	100
Students/instructional center	20	40/65	50
Acquisition cost	$70,000	$119,000	$23,500
Number of instructional centers	5	4	1.5
Operational cost	$98,300	$105,500	$38,700
Operational cost/student	$ 328	$ 211	$ 387

can also, it seems, divide the acquisition cost by the number of students. This comparative measure is more quick and dirty than the operational cost per student. The problem lies in determining the number of students to use as the divisor.

If the total number of students in all the instructional periods (or some such time division) is used, the acquisition cost per student reflects an implicit utilization rate for the instructional center. A case in point is Project B. From the information in Table 5, we note that the instructional centers are used seven periods a day. In current educational practice, that is really maximum utilization rate for facilities in any one day. If the facility could only be used five periods a day, more instructional centers would be needed to accommodate the students of the project. If the number of students per instructional center is assumed to be "best" for the instructional strategy of the project, then the acquisition cost on a per-student basis for each instructional center can be obtained but should be identified as the cost for the designed utilization rate of the instructional center.

THE DISTRICT-SPECIFIC COST ESTIMATE

Now, because your salary schedule is lower, let's say, than the standard prices shown in Table 6, you feel you might be able to afford one of the projects. You decide to investigate the dollar impact of Project C in your district because its objectives and instructional strategies match your needs and your way of operating. You need to know the incremental cost--your cost or the DSC--in deciding whether or not you can afford Project C in a dollar sense. In order to estimate the DSC, you have to determine if you have, or can purchase, the resources needed for the project.

In estimating the DSC you follow the same steps discussed earlier. There are two differences: you use (1) the net resource requirements and (2) your own district's prices in estimating your DSC. From the statement of total resource requirements, you determine the resources you have on hand or available and the resources you have to purchase. You now have the net resource requirements for the project in your district. After these have been determined, you estimate the cost to your district by using district-specific prices rather than the standard prices shown earlier in Table 6.

To illustrate the process and considerations in estimating the DSC of a project, the data for Project C are used. These basic data, extracted from the Project C column of the earlier tables, are shown again for your convenience in Tables 10, 11 and 12. In examining the cost information about Project C, you notice that the standard teacher salary for the classroom teacher is $12,000 per year. In your district the current salary schedule sets the classroom teacher at $9,000 per year. Also, let's assume, you pay your instructional aides or paraprofessionals $4,000, while the standard price used in the PCC estimate is $5,000 per year. That means you will be using these prices (along with the others shown in Table 11) instead of the standard prices shown in the earlier Table 6.

You already have on hand a major portion of the equipment and materials needed for the project. This means your acquisition cost will be less, but you will incur the replacement and maintenance operational cost for all the equipment. Because you have adequately remodeled space available for one of the one-and-a-half required instructional centers, you do not have to make the one-time expenditure for remodeling.

Table 10

PROJECT AND RESOURCE INFORMATION FOR PROJECT C

An Elementary Level Reading Program

Descriptors	Resource Information
Students Served	Grades 2-4 Title I; low SES Underachievers
Instruction Class time Number of students Students/instructional area Number of sections Utilization	 1.25 hours - Reading 100 50± 2 5 hours/day
Facilities Space Furnishings	 2000 square feet 1 instructional area 1 activity area 6 carrels Carpeting Tables and chairs
Staffing Certified teachers Special teachers Paraprofessionals	 1 per instructional area None 2 per instructional area 1 per activity area
Equipment	Telex (remote diagnostic) Tape recorders Cassette players Headsets
Materials	Books, games, incentives
Pre-service Training	5 days per staff member
In-service Training	3 days per staff member
Other Support	Remote diagnostic-prescriptive services

Table 11

DISTRICT RESOURCE PRICES

FOR ESTIMATING COST OF PROJECT C

Item	Cost
Facilities Cost	
Total project cost	$7,500
Cost per instructional area	5,000
Equipment Cost	
Total	3,000
Cost per instructional area	2,000
Number of instructional areas	(1.5)
Students per instructional area	(50)
Replacement factor 10%	300
Maintenance factor 10%	300
Materials Cost	
Total	9,000
Cost per instructional area	6,000
Number of instructional areas	(1.5)
Consumables ($ per student)	10
Salaries (including fringe benefits)	
Classroom teachers ($ per year)	9,000
Paraprofessionals ($ per year)	4,000
Consultants ($/day)	100
Pre-service Training	
Number of staff days	(20)
Cost per day (time and materials)	200
Total cost	4,000
In-Service Training	
Number of staff days	(12)
Cost per day	200
Total cost	2,400
Other Support	
Remote diagnostic services ($ per student)	50
Project evaluation ($ per student)	10
Consultants ($ per day)	100

Table 12

PROJECT COMPARABLE COST FOR PROJECT C
(In dollars)

Item	Cost
ACQUISITION COST	
Facilities (remodel/furnish	
Total project cost	$ 7,500
(Cost per instructional area--$5,000)	
Equipment	
Total project cost	3,000
(Cost per instructional area--$2,000)	
Materials	
Total project cost	9,000
(Cost per instructional area--$6,000)	
Pre-service Training	4,000
Total acquisition cost	$23,500
OPERATIONAL COST	
Salaries (including fringe benefits)	
Teachers ($12,000/year)	$12,000
Paraprofessionals ($5,000/year)	15,000
Other (variable)	--
Materials	
Project-related (10%)	900
Consumables ($10 per student)	1,000
Equipment	
Replacement (10%)	300
Maintenance (10%)	300
In-service Training	2,400
Other Support	
Remote diagnostic services ($50 x 100)	5,000
Project evaluation ($10/student x 100)	1,000
Consultants (8 x $100/day)	800
Total operational cost	$38,700

Along the way, you also decide to estimate the district-specific cost of two alternatives of Project C. (The changes result in only slightly different projects--if you make substantive changes you no longer have Project C.) In one you design the project for twice the number of students. In the other you increase the students served by fifty percent but you want to consider developing an in-house capability for the diagnostic-prescriptive services. These services were contracted services in Project C as originally designed. This change has an impact on both your acquisitional cost and your operational cost. You have to increase the pre-service training for the project staff (acquisitional cost impact) and assign additional staff to provide the service (operational cost impact).

The district-specific cost estimates for the alternative configurations of Project C are shown in Table 13. The DSC estimates are shown for only the three configurations you selected. The cost information also provides insights about the likely impact of other changes you might want to make. At the very least, you know the dollar impact of having Project C, as originally designed, in your district.

A LIMITED USE OF COST-PER-STUDENT DATA

Earlier, in Table 9, we provided some of the project information and the PCC estimates for Projects A, B and C. The same project information, along with the estimates of the DSC (the estimated cost in your district) for three

Table 13

DISTRICT SPECIFIC COST ESTIMATES FOR ALTERNATIVE CONFIGURATIONS OF PROJECT C

Project Cost Category	C_1 (100 students)	C_2 (200 students)	C_3 (150 students)
Acquisition Cost			
Facilities (remodel/furnish) (only 1 activity area has to be remodeled)	$ 3,500	3,500	3,500
Equipment (unit cost/instructional area for 50 students is $2,000)	3,000	3,000	3,000
Materials (unit cost for instructional area for 50 students is $6,000)	9,000	18,000	9,000
Pre-service Training (5 days per staff member and training of 40 days for diagnostic services in C_3)	4,000	8,000	12,000
Total acquisition cost	$19,500	$32,500	$27,500
Operational Cost			
Salaries Teachers ($9,000) Paraprofessionals ($4,000)	(1) $ 9,000 (3) 12,000	(2) $18,000 (6) 24,000	(2) $18,000 (4) 16,000
Materials			
Project-related Consumables	900 1,000	1,800 2,000	900 1,500
Equipment			
Replacement Maintenance	300 300	500 500	400 400
In-service Training	3,200	6,400	3,200
Other Support			
Student diagnostic services Project evaluation Consultants	5,000 1,000 800	10,000 2,000 800	-- 1,500 800
Total operational cost	$33,500	$66,000	$42,700

configurations of Project C are shown in Table 14. We also stated, in our illustration, that one reason for your investigating the dollar impact of Project C in your district was because your salary schedule was lower and because a major portion of the equipment needed was already available in the district. You were thinking (we said) that your operational cost per student would be less than the cost per student using the PCC estimates. You are right. Your operational cost per student for Project C_1, C_2 or C_3 ranges from $195 to $330. The operational cost per student, using the PCC estimate, was $387 for the students served by Project C.

Let's look at the acquisition cost estimates. For

Table 14

DISTRICT SPECIFIC COST ESTIMATES
(Costs in dollars)

Item	Project C_1	Project C_2	Project C_3
Number of students	100	200	150
Students/instructional center	50	50	50
Acquisition cost	$19,500	$32,500	$27,500
Number of instructional centers	1.5	2.0	1.5
Operational cost	$33,500	$66,000	$42,700
Operational cost/student	$ 195	$ 330	$ 285

Project C, the acquisition cost using the PCC estimates is $23,500 for one and one-half instructional centers serving 100 students. (Don't divide yet.) Your estimated acquisition cost is $19,500 for the 100 students in Project C_1; $32,500 for the 200 students of Project C_2; and $27,500 for the 150 students of Project C_3. (Now divide.) You find the following:

Acquisition cost/student--Project C = $235 (PCC)

Acquisition cost/student--Project C_1 = $195 (DSC)

Acquisition cost/student--Project C_2 = $163 (DSC)

Acquisition cost/student--Project C_3 = $183 (DSC)

Why the drop from the PCC's $235/student to the $195 figure for the DSC estimated cost per student for the same number of students? Remember, the PCC estimates are based on the cost of all the resources required. All your DSC estimates are developed from your net resources--resources you have to pay for now to implement the project. You had available an adequately remodeled instructional center and some of the equipment. So your net resources required for the instructional centers were lower.

It is recommended that you never seriously consider the acquisition cost per student alone as a reliable input to your decision. You are interested in the "size" of the acquisition cost, in the resources needed and the number of students who can be served by the project as designed. But think about these pieces of information separately. If you feel lost without an acquisition cost per student, at least find out what resources are included in the cost estimate. Or, use the operational cost per student; it is less hazardous, less likely to be misused. The chances are that you have more reliable information about the resources used and the number of students served.

As a cautionary note, two points should be made clear. First, the cost estimates we have been developing are planning cost estimates. Much greater detail and accuracy are required to meet the needs of actual implementation and financial accountability. Second, we are sure that you realize your analysis of the dollar-cost alone does not provide you with adequate information for your final decisions. The resource approach, by emphasizing the analysis of resources as well as cost, does add a modicum of information about the

non-dollar resource implications of your decisions. The decision about which project to implement depends primarily on the outcome you expect to achieve through the project and only secondarily on its cost.

You can compare the cost and the outcome for several projects. The procedures are discussed in the following chapter. In your intra-district project comparisons, you could use the PCC estimates for a first-cut planning exercise, but you should use your DSC estimates in assessing, more realistically, the impact of projects in your district. The equitable comparison of projects across districts, however, demands the use of PCC estimates. The use of PCC estimates rather than DSC estimates in the following chapter makes no difference in the procedures for comparing projects.

V. USE OF PROJECT COST INFORMATION--FEDERAL/STATE

Appropriate analysis can be a powerful factor in the search for more effective educational projects. The joint consideration of project cost and outcome, through the use of cost-effectiveness analysis, contributes to a greater understanding of the project itself, its impact on cost and its effectiveness. Information about the cost and outcome of different projects should aid the search.

The objective of this discussion is to explore a practical approach to using the results of cost-effectiveness analysis in comparing projects. The illustration uses data about the cost and outcome of several projects operating in different districts. Specifically, the project-comparable cost (PCC) is used as the measure of project cost; the outcomes are presented in the metric of Normal Curve Equivalents (NCE). "An NCE is a normalized standard score that has been linearly transformed to match the national percentile distribution at values of 1, 50, and 99. The scale has a mean of 50 and a standard deviation of 21.06."*

*User's Guide, ESEA Title I Evaluation and Reporting System. Tallmadge, G. Kasten and Christine T. Wood. RMC Research Corporation, Mountain View, California, 1977, p.2. Copies available from the Office of Planning, Budgeting, and Evaluation, U.S. Office of Education, Washington, D.C., 20202.

We are concerned with comparing the cost and outcomes of alternative projects, and with making these comparisons in a simple, straightforward manner. The primary analytical tool is cost-effectiveness analysis, and the decision-making arena includes both the state and the district levels. (The data used in the following analyses are reasonably close to what you might expect in an actual study; they were not, however, obtained from any particular study.)

GENERAL STRUCTURE FOR COMPARING PROJECTS

You can compare projects without using the analytically risky cost-effectiveness ratio alone. Three alternative approaches are available. All can be used with pencil, paper and calculator. The equal-effectiveness approach groups projects by their outcome and then ranks projects within each outcome group by the cost to achieve that level of outcome. Conversely, the equal-cost approach examines the different levels of outcome achieved by each project with equal, or nearly equal, cost. That is, projects can be ranked by the outcome achieved for a given cost. A third approach is pair-wise comparison. In this

procedure, the cost and outcome of two alternative projects are compared, and your value judgment comes into play in deciding whether or not the better outcome is worth the additional cost.

You obviously would not, however, rely solely on cost-effectiveness numbers in making your comparisons. This is, of course, true in any decision-making context, but it is especially important in education. The measurement of achievement is imprecise enough so that decisions should not be based on relatively small differences in outcome. Just what degree of difference warrants a change is a matter for each individual to determine in the light of other information.

In the structuring of the analysis, the purpose and approach of the state-level planner differs from that of the district-level planner. The state planner is concerned with

- assessing the effectiveness of the dollars spent in support of many projects comprising a program such as ESEA Title I; and
- identifying the more promising projects for dissemination; or
- making recommendations to other districts seeking remedies.

The district planner, on the other hand, is more concerned with the analysis of a particular project in terms of its impact on the ongoing projects of the district. At the district level, the project-comparable cost would be used as a first-screening value. Next, the cost of alternative configurations of the project that can be afforded within the resource limits would be examined. (The project incremental cost for each configuration is developed using district-specific resource prices.)

COMPARING COST AND OUTCOME

In this illustration, the major emphasis is on state-level comparison of projects, or, more specifically, on comparing the costs and the outcomes of several projects operating in different districts. Brief examples will illustrate the use of the equal-effectiveness, equal-cost, and pair-wise comparisons of demonstration programs.

To review for a moment, we have available the description of the program (including the number of students), the estimates of the project-comparable cost, and the outcome (achievement gain).

To achieve our goal of showing the use of cost-effec-

Table 15

SUMMARY OF PROJECT COST AND OUTCOME INFORMATION

Project Comparable Cost* ($ thousands)				Outcome Data**				
				Pre-test		Post-test		
Project	Acquisition	Operational	Total	Percentile	NCE	Percentile	NCE	NCE Gain
A	2	41	43	10.5	23.6	27.2	37.2	13.6
B	6	34	40	15.2	28.4	35.2	42.0	13.6
C	3	13	16	26.0	36.5	51.2	50.6	14.1
D	2	13	15	10.5	23.6	20.0	32.3	8.7
E	4	38	42	26.2	36.6	50.0	50.0	13.4
F	2	22	24	15.4	28.5	27.1	37.2	8.7
G	3	14	17	15.4	28.5	23.4	34.7	6.2
H	6	16	22	33.1	40.8	60.9	55.8	15.0
I	2	12	14	26.3	36.6	38.8	44.0	7.4
J	2	23	25	33.2	40.9	50.0	50.0	9.1
K	9	35	44	33.2	40.9	50.4	50.2	9.3

*Actual programs were for varying numbers of students. The project-comparable cost was estimated for the same number of students.

**Achievement gain over a two-year period. All outcomes expressed in the metric of Normal Curve Equivalents (NCE).

tiveness analysis in comparing projects, we use the illustrative summary information shown in Table 15. In a real situation, the details of each project's achievement data and supporting cost analysis would be available. The resource requirements for staff, equipment, special facilities, materials and training would be defined as part of the project description and as the basis for estimating cost.

The acquisition cost, the annual operating cost and the total cost for one year's operation are given for remedial reading projects, which are all scaled for 120 students. All costs would be estimated as project-comparable costs. The acquisition cost varies from a low of $2,000 to a high of $9,000, reflecting differences in resources required for each project. For example, one project might use a heavily equipped resource center, while another project would emphasize pre-service teacher training or student materials. The operating cost also varies from a low of $11,000 to a high of $41,000. The trade-off of lower acquisition cost

*For more information, refer to Sumner's discussion in R-955/2, A Guide to Education Performance Contracting--Technical Appendix, S. A. Haggart, G. C. Sumner, and J. Richard Harsh, The Rand Corporation, Santa Monica, California, March 1972.

versus higher operating cost might be a deciding factor in a district's capability to implement a project. That is, you might not be able to afford a project that demands a large outlay of funds for equipment or training in the near future, but you could continue to pay the operational salaries already budgeted.

The important characteristic of these cost measures is their comparability. The user is fully aware not only of what is included in each estimate, but also of the fact that standard prices were used to estimate the cost for the resources required. Moreover, because these illustrative projects are scaled to be alternatives (alternative remedial reading projects for 120 students), the cost-effectiveness ratios can have some limited meaning in an initial ranking of the projects.

Using the cost and outcome information of Table 15 results in the cost-effectiveness ranking of projects shown in Table 16. Projects C, H, D and I, with the lower costs per unit of achievement, rank in the top four, while projects B, E, A and K have the higher costs per unit of achievement. The composition of the "better" four projects changes somewhat if outcome is the sole basis of ranking (Table 17).

Table 16

RANKING OF PROJECTS BY THEIR COST-EFFECTIVENESS RATIOS

Project	Project Comparable Cost ($ thousands)	NCE Gain	Cost/ Effectiveness Ratio	Project Ranking
A	43	13.6	3.2	10
B	40	13.6	2.9	8
C	16	14.1	1.1	1
D	15	8.7	1.7	3
E	42	13.4	3.1	9
F	24	8.7	2.8	7
G	17	6.2	2.7	5
H	22	15.0	1.5	2
I	14	7.4	1.9	4
J	25	9.1	2.7	6
K	44	9.3	4.7	11

Table 17

COMPARISON OF PROJECTS RANKED ON OUTCOME ONLY

Ranked by NCE Gain			Ranked by Cost/ Effectiveness
1	H	15.0	C
2	C	14.1	H
3	A	13.6	D
4	B	13.6	I
5	E	13.4	G
6	K	9.3	F
7	J	9.1	J
8	D	8.7	B
9	F	8.7	E
10	I	7.4	A
11	G	5.2	K

As shown in Table 17, consideration of outcome alone puts Projects H, C, A and B in the top four; Projects A and B are added to the top grouping, and Projects I and D move considerably lower--to the "bottom" four projects. Project G is consistently low in the rankings, regardless of the basis of the ranking.

What happens if we group projects by nearly equivalent outcomes and select the lowest cost project within that group? Conversely, what projects are identified as the most effective within a group whose costs are equal or nearly equal? These results are shown in the following two tables. In the equal-effectiveness case (Table 18), Project J is much more cost-effective than Project K in achieving almost the same outcome; Project D is more cost-effective than Project F in achieving the same outcome.

When projects are ranked by outcome within nearly equal cost groups (Table 19), Projects A, B and E of the highest cost grouping all are about equally effective for a given cost. Project K really comes off poorly; it is more costly than any other and yet ranks sixth out of the eleven projects in terms of outcome. In the middle-cost groups, Project H

Table 18

PROJECTS RANKED BY COST WITHIN GROUPS OF NEARLY EQUAL EFFECTIVENESS

Project	NCE Gain	Cost	Cost/ Effectiveness
H	15.0	$22,000	1.5
C	14.1	16,000	1.1
B	13.6	40,000	2.9
A	13.6	43,000	3.2
E	13.4	42,000	3.1
K	9.3	44,000	4.7
J	9.1	25,000	2.7
D	8.7	15,000	1.7
F	8.7	24,000	2.8
I	7.4	14,000	1.9
G	6.2	17,000	2.7

Table 19

PROJECTS RANKED BY OUTCOME WITHIN GROUPS OF NEARLY EQUAL COST

Project	Cost	NCE Gain	Cost/ Effectiveness
K	$44,000	9.3	4.7
A	43,000	13.6	3.2
E	42,000	13.4	3.1
B	40,000	13.6	2.9
J	25,000	9.1	2.7
F	24,000	8.7	2.8
H	22,000	15.0	1.5
G	17,000	6.2	2.7
C	16,000	14.1	1.1
D	15,000	8.7	1.7
I	14,000	7.4	1.9

achieves the greatest outcome, and in the lowest-cost group, Project C far outstrips the other projects in the grouping.

A useful and revealing technique is pair-wise comparison of two alternatives. Briefly, in pair-wise comparison, the outcome and cost are examined in relation to each other, and your value judgment is exercised in deciding if the additional outcome is worth the additional cost.

In our example, Projects B and F address the same target population (the same pre-test status). Project B has a cost of $40,000 and an achievement gain of 13.6, while Project F, on the other hand, with a gain of 8.7, has a cost of $24,000:

	Cost	NCE Gain	Cost/ Effectiveness
Project B	$40,000	13.6	2.9
Project F	$24,000	8.7	2.8

In this case, you must ask yourself if the additional 4.9 in achievement gain is worth $16,000.

The pair-wise comparison is particularly enlightening in view of roughly the same cost-to-effectiveness ratio for both projects. This illustrates how the cost-effectiveness

ratio, by itself, can be misleading; an indifference (due to the same ratio) on the part of the decisionmaker is implied--an indifference not at all evident when the dimensions of project cost and outcome are examined.

IMPACT OF ANALYSIS

These brief examples illustrate a simple, analytically sound way to make the most of cost and outcome data. It is possible to effectively rank projects matched to both educational needs and available resources.

The simple process of estimating project-comparable cost (PCC) and district-specific cost (DSC) discussed in this handbook yields a substantially improved informational base for the decisions that are made at all levels of the educational system. The district gains additional insights for project modification; a state department of education has an equitable means for comparing projects in different districts; and a district can more readily and systematically assess the merit of a project operating in another district. Because information about the various dimensions of cost is known and can be manipulated in an easy fashion, reliance on the enigmatic cost per student can be avoided.

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