Chapter 2: Concepts of Cost Analysis

The title of this book refers to cost-effectiveness. Planners use cost-effectiveness analysis to distinguish projects which are merely cheap from ones which give good value. The term has been used in the title because it is common in everyday vocabulary. Planners may also use a related tool called cost-utility analysis. This term was not included in the title because it is less common and requires special explanation. Such explanation is among the tasks of this chapter.

Detailed examination of cost analysis techniques reveals complexities which may not be apparent at first sight. Readers who wish to study the subject in depth are recommended to begin with the publications by Levin and by Windham noted in the 'further reading' section (pp. 103, 105).

In the context of this book, however, detailed discussion is neither necessary nor possible. Accordingly this chapter is restricted to an outline of the concepts and procedures of cost analysis. It begins by highlighting three main types.

1. Three Types of Cost Analysis

Planners commonly use three different types of cost analysis.

a) *Cost-benefit analysis* is used when both costs and benefits can be expressed in monetary form. It is particularly useful in industry and commerce. For example, planners may match the costs of running a proposed factory with the expected value of its produce. After making a similar calculation for a different proposed factory, the planners can compare the proposals to see which is better.

   In education, however, it is rarely possible to use cost-benefit analysis. This is because it is difficult to determine the monetary value of literacy, mathematics achievement, sporting skills, etc.. It is fairly easy for planners to calculate the costs of two schools, but it is difficult to make a monetary estimate of the products of schools.

b) *Cost-effectiveness analysis* only requires the costs to be calculated in monetary terms. Effectiveness still has to be quantified, but it can be in any unit. In education, examination scores are a common measure of effectiveness.

c) *Cost-utility analysis* provides a way to deal with subjective factors. The tool is especially useful in education because different people place different values on the products of education. The word 'utility' means 'usefulness'. Planners may conduct surveys to find out the utility people place on academic achievements (i.e. the extent to which those people think that academic achievement is useful or valuable). The figures for utility of academic achievement may then be contrasted with the figures for sporting and other types of achievement. Cost-utility analysis allows planners to see how well an education system is producing the sorts of products that societies want.

Because cost-benefit analysis is rarely used in education, it will not be discussed further. However, the meaning of cost-effectiveness and cost-utility analysis deserves elaboration.

2. Cost-Effectiveness Analysis: A Simple Example

The nature of cost-effectiveness analysis may best be explained through a simple example. This one is concerned with achievement: educational administrators want to raise the mathematics scores of a group of pupils. The example is fictitious, but illustrates the basic principles. In this example, the administrators assess cost-effectiveness in six steps.

Step 1: Identify Alternative Ways to Achieve the Goal

Suppose that the administrators identify four alternatives:

i) split mathematics classes in half, so that pupils gain more individual attention;
ii) introduce computers on which students can practise problem-solving;

iii) provide a special in-service training course for teachers; and
iv) prepare new and better textbooks;

Step 2: Check on the Feasibility of the Alternatives
It is useless to proceed further if the options are not actually feasible. Therefore, the policy-makers must check:

* that schools have sufficient land to build extra classrooms if they are needed to accommodate split classes, and that sufficient extra teachers are available;
* that computers can be purchased and operated as necessary;
* that appropriate instructors can be found for in-service training, and that teachers can be released to attend the courses; and
* that well-qualified authors are available to prepare new textbooks, and that facilities can be found to print and distribute the books.

It is decided in this case that all options are feasible, so none is discarded.

Step 3: Calculate the Costs of Each Strategy

i) The first method would have a high cost. Some schools would require extra classrooms, and the authorities would have to employ more teachers. The cost is estimated at $200 per student.
ii) The second method would require special rooms, computers and some special materials, and would cost $100 per student.
iii) The third method requires teacher-trainers, facilities for training, and travelling expenses for the teachers. It would cost $60 per pupil.
iv) The fourth method would require specialist authors and printing and distribution facilities. However, unit costs would be much lower. At $30 per pupil, this method is the cheapest.

Step 4: Estimate the Effectiveness of Each Strategy

The effectiveness of each strategy can be determined by comparing the test scores of students who will gain help with those of similar students who will receive no help. On the basis of research studies and their own experience, the authorities estimate that:

i) the first method is expected to improve each pupil's score by 8 points,
ii) the second method is expected to improve each pupil's score by 20 points,
iii) the third method is expected to improve each pupil's score by 6 points, and
iv) the fourth method is expected to improve each pupil's score by 5 points.

Step 5: Combine the Information in a Table

	Cost per Student (a)	Effectiveness (test score) (b)	Cost-Effectiveness (a) ÷ (b)
Split Classes	$200	8 points	$25 per point
Computers	$100	20 points	$ 5 per point
Teacher-Training	$ 60	6 points	$10 per point
Textbooks	$ 30	5 points	$ 6 per point

Step 6: Analyse the Results

From the table, two main points emerge:

i) In this example, computers are the most cost-effective innovation. It is estimated that they will cost only $5 to increase a pupil's score by one point, compared with $6 for textbooks, $10 for teacher-training, and $25 for split classes.
ii) The most cost-effective strategy is not the cheapest. Textbooks would have been the cheapest, but they were only expected to raise achievement by 5 points per pupil, compared with 20 points for computers. As it happens, the most expensive strategy (split classes) was also the least cost-effective.

However, before proceeding further, policy-makers would have to check several points:

* Although the third column of the table appears to indicate the number of dollars required for a one-point improvement in test score, it assumes that monetary investment and educational improvement are proportional. In practice, policy-makers might be faced by an 'all or none' situation. Thus, logistic factors might require them invest a full $100 per student in computers, thereby gaining a 20 point increase in effectiveness. The computers could not be broken into pieces in order to invest only $5 per student and gain a single point increase.
* In turn this implies that the authorities would need to consider the amount of money that they have available. Sometimes the budget is restricted, and expensive strategies cannot be adopted even if they are highly cost-effective.
* The example assumes that only a small group of pupils is involved. If the policy-makers wanted more widespread change, they would have to decide whether the most cost-effective option would always have the same impact, or whether the impact would diminish with scale. On the question of feasibility, the policy-makers would also have to check resource availability for large-scale implementation. If they foresaw diminishing returns and/or feasibility constraints, they might decide on a different option or on a combination of strategies.
* Most important of all, the policy-makers would have to check both that their original estimates of cost and effectiveness were reasonably accurate, and that the future would not bring major changes. A change in costs, for example, could radically change the conclusions about the most desirable investment strategy.

Cost-Effectiveness and Cheapness

Cost-effectiveness is not necessarily the same as cheapness: some strategies may be cheap but ineffective. Sometimes it is worth investing more *money on a project, choosing a higher-cost strategy because it also has higher effectiveness.*

3. Cost-Utility Analysis: A Simple Example

Further complications arise when policy-makers have to consider subjective judgements on the value of outcomes. The example given above was fairly simple because it restricted analysis to a single objective: achievement scores in mathematics. However, in reality the policy-makers might have the choice e.g. of investing in (i) mathematics instruction, (ii) reading, or (iii) a combination of mathematics and reading. In this case they would have to decide which option is most desirable; and to do this, they would have to use personal judgements.

For this type of decision, policy-makers would have to use cost-utility analysis. At least in theory, it is possible to conduct surveys to determine the utility (value) that different people place on different outcomes. If necessary, researchers can introduce weightings if they consider the opinions of some people to be more important than the opinions of others. The researchers can then determine an 'average utility' for the item in question. The table below shows an example of the ways that utility and cost could be combined.

A Hypothetical Illustration of Cost-Utility Analysis

	— Instructional Strategy —	
	A	B
Probability of raising mathematics performance by grade-level equivalent	.5	.3
Probability of raising reading performance by grade-level equivalent	.5	.8
Utility of raising mathematics performance by grade-level equivalent	6	6
Utility of raising reading performance by grade-level equivalent	9	9
Expected utility	[(.5)(6)]+[(.5)(9)]=7.5	[(.3)(6)]+[(.8)(9)]=9
Cost	$375	$400
Cost-utility ratio	$50	$44

In reality, of course, it is very difficult to make such calculations. They require a lot of data and expertise, and rest on many controversial assumptions. Sometimes, moreover, the surveys would be so expensive that the authorities would have no money left for the innovation! In practice, therefore, it is very rare for policy-makers to make precise mathematical calculations as envisaged by the theory.

Nevertheless, the basic concept remains very important. For the present context it stresses that some educational outcomes may be valued by society more highly than others, and that policy-making should take this into account. Even if they cannot draw up numerical equations, policy-makers can at least list the various factors and make a general assessment of their implications and importance.

4. Cost Analysis and Multiple-Shift Schooling

It is now necessary to turn from general principles to the specific context of multiple-shift schooling. This section considers first cost-effectiveness analysis and then cost-utility analysis.

If restricting the focus to cost-effectiveness, policy-makers concerned with multiple-shift schooling would begin by identifying an objective. Suppose, for example, that the authorities want to increase school enrolments. The options might include:

i) expand existing schools by opening more classes at each level,
ii) expand existing schools by increasing class size,
iii) expand existing schools by introducing double shifts, and
iv) build new schools.

The authorities would assess the feasibility, costs and effectiveness of each option, and would draw up policies to stress either a single strategy or a combination of strategies.

Alternatively, policy-makers might have already decided that they wished to introduce multiple shifts, but might be uncertain which model would be most appropriate. In this case they would perform the same type of analysis to compare:

i) end-on double-session schooling,
ii) end-on triple-session schooling,

iii) overlapping double-session schooling,
iv) overlapping triple-session schooling, etc..

By itself, however, this type of analysis would probably be inadequate. In practice, decision-making often requires choice between different 'baskets' of outcomes. Thus, one strategy might have a good impact on enrolments but a bad impact on quality and on equity, while another strategy might have a less impressive impact on enrolments but cause fewer problems of quality and equity. In this case, decision-making would require some form of cost-utility analysis, assessing the importance of each outcome in a multi-dimensional way.

This, of course, is easier said than done. As noted above, in the real world, policy-makers are short of information, time and technical expertise. It is unrealistic even in advanced countries to expect this type of sophisticated analysis except in very unusual circumstances.

However, even in poor countries policy-makers can still apply the principles of cost-effectiveness and cost-utility analysis in a general way. The most important point is that policies should be based on balanced and systematic assessment of:

— costs,
— effects, and
— utilities.

Policy-makers can start by listing the factors in each category, quantifying them where possible, and noting which ones are of particular importance. In the absence of full mathematical guides and research evidence, the final decision will rest on the judgement of the decision-makers. At least, however, one should aim for such careful judgement, to reduce the arbitrariness of much existing policy-making. The economic, educational and social ingredients for decision-making on multiple-shift schooling are discussed in Part II of this book.