

Management Services: A Magazine of Planning, Systems, and Controls

Volume 3 | Number 5

Article 6

9-1966

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Recommended Citation

Ross, W. R. (1966) "Evaluating the Cost of PERT/Cost," *Management Services: A Magazine of Planning, Systems, and Controls*: Vol. 3: No. 5, Article 6.

Available at: <https://egrove.olemiss.edu/mgmtservices/vol3/iss5/6>

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PERT/Cost is probably the most effective project control system yet devised — but it's also one of the most expensive. Here are some of the criteria to be followed in deciding when to use it —

EVALUATING THE COST OF PERT/COST

by *W. R. Ross*

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PERT/Cost, one of the newest techniques for the management of large and complex work programs, is also one of the costliest to carry out. Many managers might be inclined to reject its use on this ground alone. Such a view is shortsighted. Like any other business cost, the cost of PERT/Cost should be viewed in its proper perspective.

As has been previously explained in *MANAGEMENT SERVICES*,¹ PERT

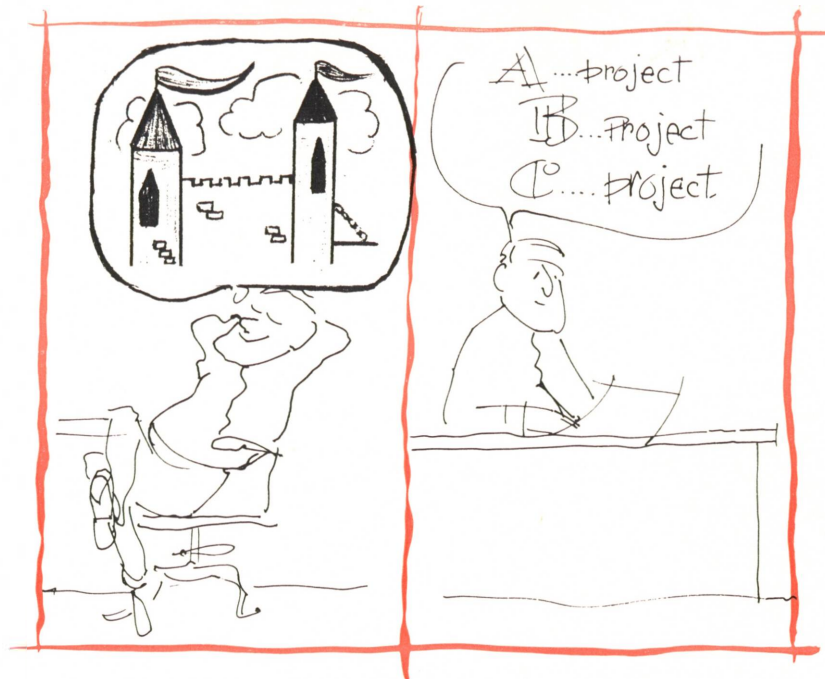
(also known as PERT/Time) is a method of planning, monitoring, and controlling time progress on a complex project by depicting the steps in the project in the form of a network showing the relationships among them. PERT/Cost is an extension of the original PERT method to the control of costs as well as time schedules.²

PERT/Time, now widely used,

has proved itself more effective in ensuring on-time completion of extremely complex projects than such conventional scheduling techniques as Gantt charts, flow process charts, and milestone charts. The newer PERT/Cost is less well established but seems, potentially at least, to offer even greater management benefits. There is no denying, however, that both PERT/Time and (particularly) PERT/Cost require more time, effort, and expense to install and operate than older, more traditional management control techniques.

¹ See "What PERT Is" and "What PERT/Cost Is," *M/S*, January-February, 1966, p. 30.

² For a more detailed explanation of PERT/Cost see Don T. DeCoster, "PERT/Cost — the Challenge," *M/S*, May-June, 1964, pp. 13-18.



Besides being expensive, PERT/Cost demands more of managers than traditional control systems. Developing the work breakdown structure, networks, and work packages—with time and cost estimates—requires intensive management participation.

In some cases the cost of PERT/Cost may not be a consideration. If the project will fail without it, management has no real choice. When a work program is of long duration, complex, and very costly, PERT/Cost may be the only system that is capable of doing an adequate job of management planning and control. If undetected major schedule slippages and cost overruns seem inevitable, the question that management must ask itself is not, "How much does PERT/Cost cost?" but rather, "Where older methods are inadequate, can we afford not to use PERT/Cost now that it is available?"

More often, however, the decision is less clear-cut. Then management must decide whether the benefits to be derived from the system outweigh the expected costs of implementing and maintaining it. Admittedly, neither costs nor benefits are easy to determine.

Costs

From the point of view of a management that is thinking of installing a PERT/Cost system, the

"cost" of PERT/Cost means the incremental cost of using PERT/Cost over the cost of the management system it is to replace. This increment includes the following components: (1) salaries of individuals whose job descriptions list PERT/Cost implementation and maintenance duties (with salaries prorated in the case of individuals who spend only part of their time on PERT/Cost); (2) computer time where applicable; (3) supplies and incidental expenses; and (4) a reasonable amount of overhead.

It is probably true that the use of PERT/Cost also generally requires the expenditure of considerable time and effort by persons other than those directly associated with the primary PERT/Cost team. PERT/Cost demands a more precise definition of the work to be done and the objectives to be attained than is required by traditional management systems. Developing the work breakdown structure, networks, and time and cost estimates for the various work packages calls for more intensive participation by many operating

managers than is the case with older approaches to project management. However, even though it is recognized that operating managers will probably spend more time in planning, updating, and the like with PERT/Cost than with other systems, this somewhat indirect cost is difficult to determine and is excluded from the ensuing discussion of the cost of PERT/Cost.

Experience to date with PERT/Cost is somewhat limited. The cost of operating a PERT/Cost system is thought to be in the range of one to five per cent of total project cost.³

During recent visits to companies using PERT/Cost the author had an opportunity to investigate the question of cost. In addition, other companies furnished cost data from their experience with PERT and PERT/Cost. Their feasibility studies and their reports of the actual costs of maintaining a system gen-

³ Robert W. Miller, *Schedule, Cost, and Profit Control with PERT*, McGraw-Hill Book Company, Inc., New York, 1963, p. 121.

erally support the one to five per cent estimate previously mentioned.

Basis of calculation

A review of these studies showed four principal ways in which the cost of operating a PERT/Cost system was determined:

One company, which had had actual experience with PERT/Time only, estimated the cost of PERT/Time to be 1.1 per cent of the total project cost. This estimate was arrived at by accumulating the estimated cost of the following: (1) salary and wage costs for time spent by employees performing PERT functions; (2) computer programing and computer time; (3) materials, supplies, and reproductions; and (4) allocated overhead. The company's management felt that PERT/Cost would be four to five times as complex and expensive to operate as PERT/Time only; on this basis the cost of PERT/Cost was estimated to be about five per cent of total project cost.

A second company, for a PERT/Cost feasibility study, estimated the gross man-years that would be required to perform the PERT/Cost functions and added a flat amount for computer programing and computer time for three projects on which PERT/Cost was thought to be applicable. The cost of applying PERT/Cost to these three projects was estimated to be about three to four per cent of total project cost.

A third company was attempting to accumulate the actual costs of using PERT/Cost on a project to which the technique had already

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been applied. The study had not yet been completed, but management expressed the opinion that the cost of PERT/Cost would be no more than five per cent of the total project cost, perhaps only two to four per cent.

Another company and various individuals interviewed offered estimates of costs, generally in the one to five per cent range. None of these estimates was based on a specific study, however. Apparently they stemmed from one or more of the following sources: (1) what is in the literature, (2) figures overheard or reported at industry-government conferences or similar meetings, and (3) in more than one instance, pure guesswork.

The limited experience to date with PERT/Cost is certainly a hindrance to determination of its cost. Measurement of the benefits derived from its use is equally difficult, if not more so.

The literature on the subject and the persons interviewed by the author generally agreed on certain basic advantages that the PERT/Cost system has over other available management techniques — assuming, of course, that the project is of a nature suited to PERT/Cost application and of sufficient duration to permit the benefits to be derived.

These benefits are as follows: (1) improvement in planning, (2) improvement in business orientation, (3) improvement in the bases for evaluating alternatives, (4) improvement in management control and progress reporting, (5) identification of problem areas, (6) improvement in communications, (7) improvement in management of resources, (8) improvement in decision making, and (9) saving of time.⁴

Clearly, the cost alone of implementing and operating the system is not a sufficient criterion for



Measuring the cost of implementing and operating the system without considering the benefits derived therefrom is an unfair criterion for determining whether or not to use the system.



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⁴ For an elaboration on each of these benefits see Booz, Allen & Hamilton, Inc., *New Uses and Management Implications of PERT*, Chicago, 1964, pp. 8-17.

deciding whether or not to use it, the value of the benefits accruing to the company as a result must be balanced against the added costs. Unfortunately, many of these benefits, while real enough, are relatively intangible and not easy to quantify.

Determining the differential cost of operating PERT/Cost rather than another system and quantifying the benefits derived from the use of the newer technique both present problems. It is unlikely, therefore, that return on investment or some similar ratio is a valid criterion for deciding whether to install a PERT/Cost system. Some sort of weight must be given to the less tangible benefits in making the decision.

Multiple applications

There are also additional factors to be taken into account in evaluating the cost of PERT/Cost. One is whether the system is applicable only to one current project or whether it seems likely to be suitable for a number of future ones.

The initial cost of PERT/Cost is relatively high. All levels of management and other affected personnel must be extensively indoctrinated in the proper use of the system, and this is an expensive undertaking. Qualified instructors and adequate teaching materials are required for the training program. The recipients of instruction must be excused from their regular duties to participate.

Furthermore, computer facilities and programs must be evaluated. The content and design of system input and output requirements must be determined. Staffing the PERT/Cost team may require either an extensive search for qualified personnel or extensive training of company personnel to assume these responsibilities.

The costs involved in these and other aspects of PERT/Cost installation can be fairly substantial. It may be economically unsound to incur them to provide for a system that is to be used only once and then forgotten.

If PERT/Cost is likely to be of continuing use to the company in managing projects, then there is more justification for incurring the nonrecurring costs of its initial installation. Once management has been trained in the use of PERT/Cost, additional formal instruction will be needed only for incoming personnel. Problems of computer use will be fewer in subsequent applications, after experience has been gained. Later PERT/Cost team staffing should require only routine replacements or additions. The feedback of managers' experience with the application of PERT/Cost will provide the information needed for continued improvement of the system within the company. As managers become more accustomed to PERT/Cost, it will become more helpful to them in carrying out their responsibilities. Thus, system operating costs decrease and managerial benefits in-

crease after the initial application of PERT/Cost.

One-time use

Sometimes, of course, the use of the technique can be justified on a one-time basis. PERT/Cost would pay off for a single application, for example, if that project were very long in duration or so important that the company could not afford the risk of failure with a less effective system of planning and control.

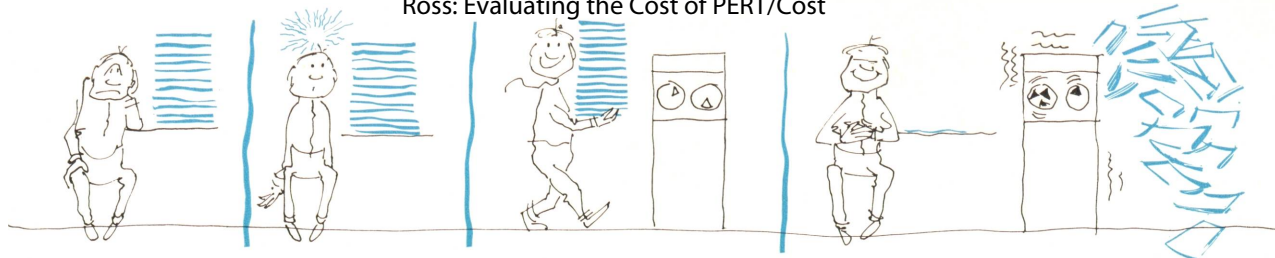
Even in questionable cases, it may be possible to recoup most if not all of the nonrecurring implementation costs of PERT/Cost with the initial application. Often the duration of a project can be reduced because of the improved planning and control provided by the system—and time saved means costs saved. Because essential work tasks are less likely to be overlooked with PERT/Cost, there are fewer costly delays. More precision in the planning stages of the project should lessen duplications of work effort. Pretesting of plans through simulation and use of such optional features of PERT/Cost as the Time-Cost-Risk Option and Resource Allocation Procedure⁵ can give assurance that project objectives are being met at a cost and within a time period that approach the optimal for the project.

Thus, despite the high initial implementation costs, PERT/Cost in

⁵ See DeCoster, *op. cit.*



In the initial use of PERT/Cost extensive indoctrination of all levels of management in the proper use of the system is a relatively expensive undertaking.



The large masses of data, combined with the need for timely accumulation and reporting, make the use of a computer mandatory on some applications.

some cases may be more economical for use on a single project than the current planning and control system.

Options

As was noted previously, there are certain optional features that may be used in or omitted from the application of PERT/Time and PERT/Cost. Generally speaking, the more of these supplemental procedures used the greater the cost (in time and expenses for personnel, processing, supplies, and overhead). For example, the use of the Resource Allocation Procedure supplement in refining the plans and the use of simulation undoubtedly increase the cost of implementing and operating a PERT/Cost system — although they also presumably increase its benefits.

Perhaps the most controversial option in PERT/Time and PERT/Cost is the preparation of three time estimates for the completion of a project activity. These three time estimates are then used to compute expected times, measures of dispersion, and the probabilities that certain phenomena will or will not occur. The cost of implementing a PERT system can often be reduced by omitting these mathematical calculations without loss of effectiveness; a system with single time estimates is frequently quite satisfactory in practice.

Other details of the system also affect the cost. These include the number of levels in the work breakdown structure, the stipulated dollar size of work packages, the degree of detail desired in the net-

works, the frequency of reporting and updating, and the number of levels of management involved. In making decisions on these factors, the designer of the PERT/Cost system again must balance benefits against costs.

Manual vs machine processing

For projects consisting of more than a relatively small number of activities, successful application of the PERT/Cost technique requires automatic data processing. Large masses of data combined with the necessity for timely accumulation and reporting of such data make the use of a digital computer mandatory. The speed and flexibility of the computer also permit managers to determine, through simulations, the effects of various proposed approaches to performing the work or of alternative assignments of available resources.

Sometimes computations can be made and data can be collected and processed by manual methods. If the network has relatively few events and activities and the reviews and updates are made infrequently, manual methods of calculation and report preparation may be both cheaper and faster. However, the point at which the use of a computer becomes desirable is reached quite rapidly as the size of the project increases. Beyond a certain size of network it becomes impractical and perhaps impossible to operate the system completely by hand.

There is no simple rule that can be applied to determine the break point between the use of manual

methods and the use of a computer. The size of the networks, the frequency of computations, and the types of output reports are among the factors that must be balanced in making the decision. Other considerations include the availability of computer facilities and the availability of suitable programs for these facilities.

Unfortunately, there is no clear-cut formula for determining when PERT/Cost is the appropriate management system to use. Many factors need to be considered in determining its feasibility as a planning and control tool.

PERT/Cost is costlier to implement and operate than traditional systems. However, it is also capable of giving more assistance in managing the types of projects to which it is suited. If the increased benefits outweigh the differential costs involved, then the system should be considered seriously.

Perhaps the best summary of the problem can be drawn from the statement of one PERT/Cost manager who was interviewed: "Sure, putting in and maintaining a PERT/Cost system is expensive. But this is true of any extensive management system. It's not nearly as costly as the schedule delays and substantial cost overruns that are traditional in the types of work for which PERT/Cost is intended. Taking all things into consideration, if PERT/Cost is applied to a substantial program of work—say, one costing 25 million dollars—and if PERT/Cost is the only management system that can get the job done — then I say PERT/Cost doesn't cost; it pays."