What is the Value of Value? [1, 2]

Kenneth F. Smith

Management Systems Specialist
PERT Orientation and Training Center

PERT-Cost is a relatively new management technique in the complex field of Research and Development management – an extension of the more familiar **PERT-Time**, Critical Path methodology which has gained wide acceptance in government and industry. Although PERT-Cost is *required* on many large-scale R&D projects within the Department of Defense, and can be extremely useful in managing others, many individuals hold PERT-Cost *sub judice*, hesitating and uncertain whether it is a major breakthrough in management or just another system, trading on a familiar name.

One of the most controversial aspects of PERT-Cost is an item called "**Value of Work Completed**," or more usually, just "**Value.**" Significantly, "Value" lies at the heart of PERT-Cost and a thorough understanding of it is essential to evaluating the entire system.

The term "Value" itself gives rise to much of the confusion due to a natural tendency to ascribe a familiar meaning to a familiar word. "Value," as used in PERT-Cost, is not too far removed from Webster's definition of "the worth of a thing in money . . . at a certain time," or even an estimated or appraised worth . . . in a scale of values." It ***is*** indeed an attempt to measure a project in terms of money at a particular point in time, and also to provide an estimated worth in a scale of values, but here the similarity ends. "Value" is meant to provide the manager with a ***measure of progress in monetary terms*** so that he may have a basis for taking corrective action, if necessary. It is ***not*** intended to be a measure to identify "**bargains**" *per se* in the sense of good value.

"Value" Defined

If "Value" is not meant to indicate bargains, what precisely is it meant to do? Perhaps under the circumstances it would be wisest to redefine it. Actually, "Value" is nothing more than an attempt to ***evaluate where you are in your project, expressed in dollars, in terms of your planned estimate***. By comparing where you are with where you should be, a basis is provided for taking necessary corrective action.

[1] Second Editions are previously published papers that have continued relevance in today's project management world, or which were originally published in conference proceedings or in a language other than English. Original publication acknowledged; authors retain copyright. This paper was originally published in the Navy Management Review in 1965. It is republished here with the author's permission to provide another historical look at the early days of project and earned value management.

[2] How to cite this paper: Smith, K. F. (1965). What is the Value of Value? republished in the *PM World Journal*, Vol. XI, Issue VI, November 2022. Originally published in Navy Management Review, NAVSO, P910, Vol X, No. 8, Office of Management Information, U.S. Navy, August, page 4.

"Value" promises much – but what did it replace? After all, managers have been faced with these kinds of questions for years.

In the early management days – B.P.C. (before PERT-Cost) – managers used Gantt Charts, Bar Charts, Milestone Charts in various forms, in planning their projects. Progress on these charts was usually indicated by a line and expressed in terms of "**Percentage of Completion**" with time as their basis. When managers became more cost conscious, they realized that they could also evaluate a project by the amount expended, compared to the total amount estimated for the whole project. Of course, the two did not always coincide – there is not necessarily a direct relationship between time and money. Later, as managers became even more sophisticated in project management, they predetermined a rate of spending, and then measured actual expenditures against original estimates during the time period. This resulted in a so-called "S" curve.

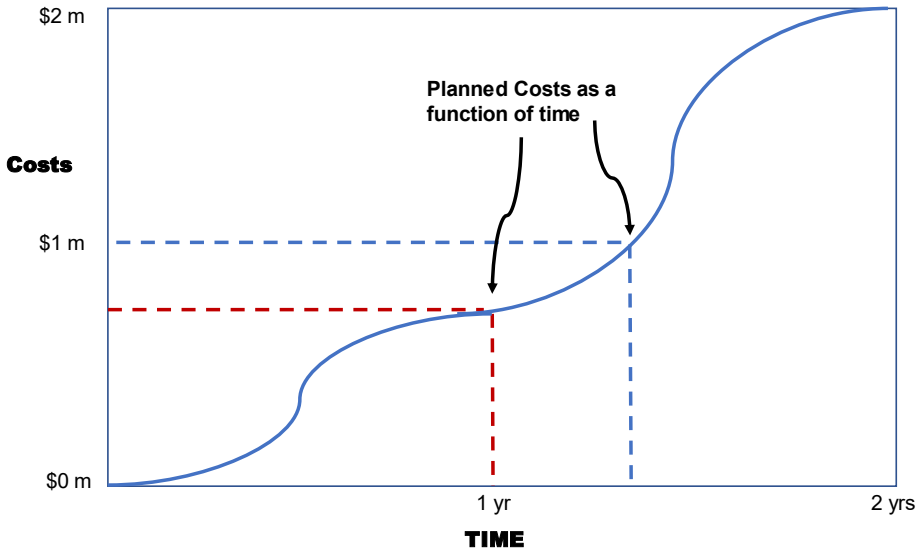


FIGURE 1

With this type of display, the manager could keep track of his project, knowing precisely where he should be at any time, and ready to take corrective action, should it become necessary. What a happy ending!

Unfortunately, this did not always reflect the reality of the situation. Sometimes the money would be expended in a timely manner, or even "ahead of schedule," but ultimately when the day of reckoning came – either the time ran out, or the money was all gone – but the project was not completed! Schedule slippages and cost overruns were incurred. Actually, management would usually be aware of the impending trouble, usually about the 87% completion point of either time or money, but by then, there would be little time remaining to plan ahead!

The trap that most managers fell into in using this type of assessment was that little or no consideration was given to ***what remained to be done***, and what it would entail in terms of time and money. Rarely does a project run to completion without changes being incorporated by one or other parties to the contract.

When PERT-Cost was developed, it was recognized that the traditional measures of project progress were inadequate. A search for a new yardstick resulted in "**Value of Work Performed**," or simply "Value."

"Value" utilizes the same factors as before – planned costs over a period of time, but ***as a function of work accomplished***, not as a function of time. Now, instead of ***two*** measurements to indicate progress, there is ***one***, which embraces time, cost and accomplishment. Progress is expressed as a dollar value, derived from an assessment of what was actually spent compared to what was originally planned to be spent to achieve a particular objective. Furthermore, if the basis for the cost estimate changes, the changes can be incorporated without distorting the measurement process. The PERT-Cost manager also takes into consideration what remains ahead. "Value" is an estimate of progress geared to what remains to be done, rather than to how much has been expended to date. The total project is not assessed as one entity, however.

"Work Package" is Basic Unit

In PERT-Cost, the total project is broken down into a number of "**Work Packages**" – i.e. definable units of work required to complete a specific job or process. The Work Package is the basic unit for assigning schedule and cost responsibility. Each Work Package has a "Value" and the sum of these separate "Values" represents the "Value" for the entire project.

Formula for Value

The formula used to determine "Value" is:

$$V = \frac{a}{R} \times P$$ where:

V = **Value of work completed to date** (the unknown)

a = actual costs incurred to date

R = Revised estimate to complete the Work Package (including the actuals already incurred, and based upon the manager's judgements of what remains to be done

P = Original Planned Cost (Contract Cost) of the Work Package

This is a very simple shift in emphasis, but as an analytical tool it provides the manager with a great deal of insight into his project. Depending upon his situation, the manager can either estimate his project's current status by identifying the "Value," or, in certain circumstances where he knows the "Value," he can use the process to estimate probable future costs.

Obviously, everything hinges upon the original planned estimate. Not only is it the original contract price for the contract, it is also the yardstick by which progress will be subsequently measured, so it should be established with some care.

The contractor, in the early stages of PERT-Cost planning, establishes a Work Breakdown Structure and PERT networks, to determine WHAT has to be done, HOW he plans to do it, and WHEN. Having thus identified the scope of his project, he should be in a position to prepare cost estimates to accomplish these tasks, drawing upon his experience. It is important to prepare this this original cost estimate carefully because subsequent performance will be matched against it, and regardless of the actual costs incurred and regardless of WHY, the ultimate "Value" will remain the same. (The exception of course is when changes to the contract are authorized via contract change notices.)

Referring back to **Figure 1**, at any intermediate point in time, a planned cost has been estimated. This may be precise for every point on the curve, or it may be purely guesswork between major checkpoints. If it is the latter, a linear relationship may be used to simplify the analysis. It should be borne in mind, however, that with PERT-Cost the determinant function in this expression is ***Cost as a function of Work Accomplishment***, and not merely Cost as a function of Time.

Having established these planned cost relationships, it is then necessary to track the actual costs incurred to compare them with the original plan. However, we are not concerned with the rate of expenditure, so merely noting deviations from the plan during the reporting period will not suffice. It is necessary to examine whether the work planned during this time period has been accomplished satisfactorily.

For the purpose of illustration, let us consider one of the several Work Packages necessary to complete a phase of the project. From this standpoint, at least six situations are possible:

1. The money planned was adequate and the Work Package was completed on time – the actuals and the plan meshed perfectly.

2. The money planned for the task was insufficient; the Work Package was not completed on schedule. A "Revised Estimate to Complete the Work Package" should anticipate increases in both time and cost. This will also have an impact on the total program.

3. The money planned for the Work Package was insufficient but additional funds were obtained and expended to complete the Work Package on schedule. Consideration should be given to adjusting the total cost of the project upward.

4. The money planned was adequate. The Work Package was completed earlier than scheduled. Consideration may therefore be given to reducing the total time estimate for the project's completion.

5. The money planned for the Work Package was insufficient, but not all has been expended. Neither was the Work Package completed as anticipated. In preparing a "Revised Estimate to Complete the Work Package," consideration should also be given to extending the entire program in terms of time.

6. The money planned for the Work Package was more than sufficient. The work was completed without expending all the funds. The total estimated cost for the project may be reduced.

In all these situations except the first, the manager has an indication of variance from the expected plan. If the change in time does not have a monetary factor associated with it, it will not affect the "Value" calculation. It is in the analysis of ***cost variance*** that "Value" becomes meaningful to the manager.

Let us examine the second situation in detail and see how such an analysis may be performed. **Figure 2** illustrates a hypothetical Work Package.

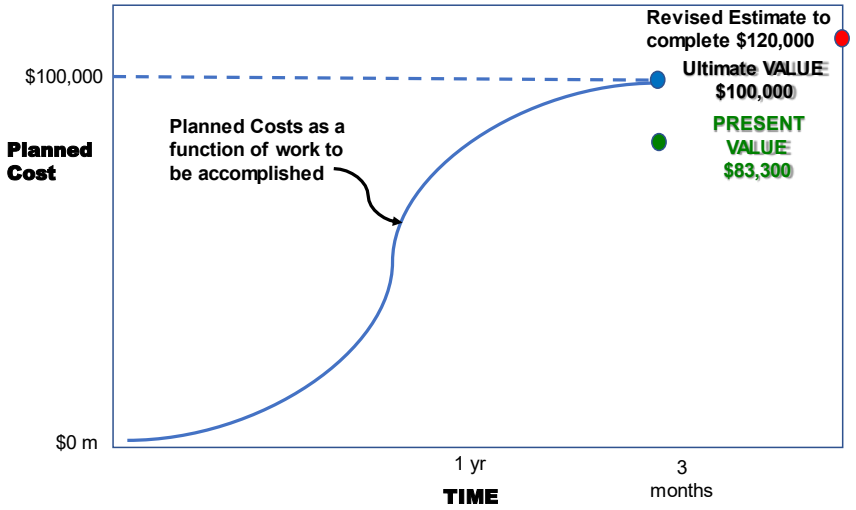


FIGURE 2

After three months have gone by, and $100,000 expended, the department responsible for this Work Package indicated that several major problems had arisen during this period. As a result of a reevaluation of the work remaining to be done in the Work Package, they now estimate that it will require a further $20,000 before the Work Package will be completed.

Now, although $100,000 is the ultimate "Value" of the Work Package in Figure 2, since it is not completed as of yet, the money spent to date does not represent "Value." The "**Value of Work Performed to Date**" is somewhat less than the $100,000 expended.

To determine the **Value**, we use the formula:

$$V = \frac{a}{R} \times P$$

In this case:

a = $100,000 (actual costs incurred to date on the Work Package)

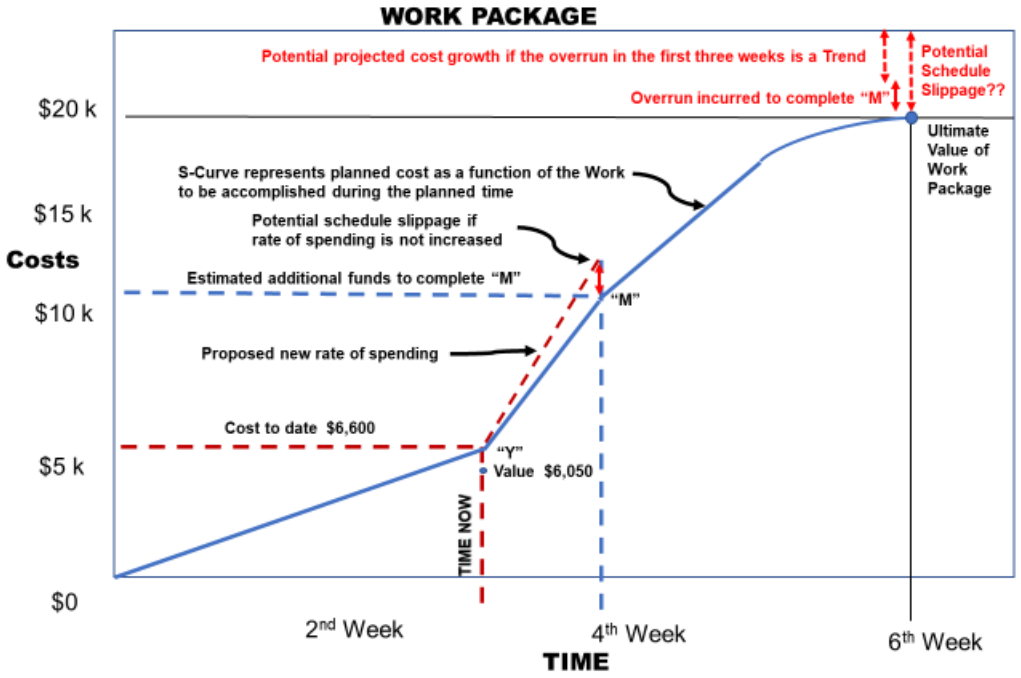
P = $100,000 (Planned Costs for the Work Package)

R = $120,000 (Revised Estimate to Complete the Work Package, including actual costs plus additional estimate to complete)

What has occurred here is that instead of looking back to the start of the Work Package and reckoning up to "time now" that $100,000 of the $100,000 budgeted has been spent, the manager has taken into account how much more remains to be done, and has used this as a basis for his estimating. Expressed as a percentage of the Work Package completion, we could say that instead of being 100% complete (a/P) x 100 (which the manager intuitively knows is not so, since some work still remains); the Work Package is only 83.3% complete: V/P x 100.

As far as time is concerned, of course, it depends upon the rate at which the job can be increased to accommodate the already slipped schedule, as to how long it will take to complete the Work Package.

Estimates of "Value" are not made only upon the planned completion date of the Work Package, as illustrated here. They can be made at any point in time that the manager and his staff are prepared to "look ahead" and assess what remains to be done. Upon completion of a "Value" estimate, it is then possible to determine where you are in terms of Work Package accomplishment, and what corrective action is required. Figure 3 (*below*) illustrates an interim estimate of "Value" for another hypothetical Work Package.



In this example, the Work Package is a $20,000 job (planned) of six weeks duration (planned). Within the Work Package is a major Milestone "M" at the fourth week for $11,000 planned cost. At the *third* week management wants an indication of how the Work Package is progressing. Since there is only another week to go before the scheduled completion of milestone "M," it may be more convenient to look ahead only to this completion point, rather than the completion for the entire Work Package. Thus, by applying the latest "Shop" estimates for the milestone completion, an interim measure of progress can be obtained. Let us assume that $12,000 is the new estimate to complete the Milestone, and that expenditure is currently at $6,600. By application of the formula: $V = (a/R) \times P$ we obtain a "Value" of $6,050 for the work completed to date, where a = $6,600; R = $12,000; and P = $11,000.

Again, this estimated overrun for the Milestone M of $1,000 may be an isolated case, or it may be indicative of a general trend for the whole Work Package. If the subsequent work can be completed within the budgetary limitations planned for that portion, there will be an overrun of $1,000 due to the estimate already made. If it is indicative of a general trend, the formula can be turned around to project a "Revised Estimate to Complete the Work Package" thus: $R = (a/V) \times P$ where a = $6,600, V = $6,050; and P = $20,000. Naturally, this "prediction" is only an estimate, but until he incurs "actuals" it is a very useful approximation for the manager to work with. By establishing and tracking probable trends the manager may be able to forestall disaster by taking timely corrective action – reducing the scope of the project, or using the time to muster additional resources that he is anticipating he will require.

Insofar as the total project is concerned, the overrun on one Work Package may be an isolated case that will not be repeated. Nevertheless, an "overrun" has already been in our hypothetical Work Package, and even if management action is taken immediately, this cannot be recovered. Furthermore, management is estimating a total overrun for the Work Package of almost $2,000.

It is true that all the money allocated for the entire project has not yet been spent, but if the project is to be completed within the original funding limitations – whatever they may be – something will have to give way. This is where management must decide what course of action to follow – whether to charge on, regardless, and hope that things will "sort themselves out" and the problems will disappear if ignored studiously enough (or at least be compensated by "breakthroughs" later on[3]); whether to revise the scope of the project downward to stay within cost; or whether to start looking for more money now instead of waiting until present funds are expended. Here many managers are disappointed with PERT-Cost, for it doesn't tell managers WHAT to do, it only indicates where an apparent problem exists. This should be sufficient for managers worthy of the name.

To obtain an overall "Value of Work Completed to Date" for the entire project, it is necessary to calculate the "Value" of each Work Package completed or in progress, and add them up. By applying the formulae, any of the other situations may be analyzed in a similar manner.

A major advantage of expressing project status in monetary terms instead of percentages, is that it is far easier to obtain a meaningful summarization. By using "Value," all actuals are converted to the same base for reference purposes. Percentages can rarely be summarized in this manner because usually they are derived from different bases and any attempt to combine percentages distorts the result.

Other Relationships in Analysis of a Project

Apart from the basic "Value" formula, there are several other relationships that can be derived, all of which may be useful to the manager in analyzing his project. For convenience, these are summarized as follows:

V = (a/R) x P [To determine "Value" of work performed to date, if a "Revised Estimate to Complete can be determined for any phase or phases for which an original "Planned Estimate" was made.]

R = (a/V) x P [To determine the "Revised Estimate to Complete" any phase or phases of the Work Package, if a "Value" can be established for any pervious phase or phases.]

[3] Many managers who apply their own "optimistic" approach to their law of averages – that set-backs will be compensated by breakthroughs – are later confronted with Murphy's Law: Things that could be worse, eventually become worse.

(V/P) x 100 = % of work completed to date [Cost as a function of Work completed.]

(a/P) x 100 = Planned % of completion [Cost as a function of time.]

[(R/P) x 100] - 100 = % of projected overrun [Where R is greater than P.]

100 - [(R/P) x 100] = % of projected underrun [Where R is less than P.]

[(a/V) x 100] - 100 = % of overrun experienced to date [Where a is greater than V.]

100 - [(a/V) x 100] = % of overrun [Where a is less than V.]

(V/a) x 100 = % of work that can be completed within planned cost limitations.

100 - [(V/P) x 100] = % of work remaining on the Work Package.

R - a = Cost of the remaining work to be completed.

a - V = Overrun incurred to date (which is not recoverable**).**

V - a = Underrun to date (where **V** is greater than **a**).

Value of "Value"

In conclusion, the value of "Value" is that it is a fairly simple, practical tool which enables the manager to relate dollars spent, to progress achieved. It is only an estimating technique, and as such, does not guarantee 100% accuracy. When used wisely, however, it will provide the manager with a more accurate picture of his project's status at any time, and probable future trends, than any other technique in use today.

About the Author

Dr. Kenneth Smith

Honolulu, Hawaii
& Manila, The Philippines

Initially a US Civil Service Management Intern, then a management analyst & systems specialist with the US Defense Department, Ken subsequently had a career as a senior foreign service officer -- management & evaluation specialist, project manager, and in-house facilitator/trainer -- with the US Agency for International Development (USAID). Ken assisted host country governments in many countries to plan, monitor and evaluate projects in various technical sectors; working 'hands-on' with their officers as well as other USAID personnel, contractors and NGOs. Intermittently, he was also a team leader &/or team member to conduct project, program & and country-level portfolio analyses and evaluations.

Concurrently, Ken had an active dual career as Air Force ready-reservist in Asia (Japan, Korea, Vietnam, Indonesia, Philippines) as well as the Washington D.C. area; was Chairman of a Congressional Services Academy Advisory Board (SAAB); and had additional duties as an Air Force Academy Liaison Officer. He retired as a 'bird' colonel.

After retirement from USAID, Ken was a project management consultant for ADB, the World Bank, UNDP and USAID.

He earned his DPA (Doctor of Public Administration) from the George Mason University (GMU) in Virginia, his MS from Massachusetts Institute of Technology (MIT Systems Analysis Fellow, Center for Advanced Engineering Study), and BA & MA degrees in Government & International Relations from the University of Connecticut (UCONN). A long-time member of the Project Management Institute (PMI) and IPMA-USA, Ken is a Certified Project Management Professional (PMP®) and a member of the PMI®-Honolulu and Philippines Chapters.

Ken's book -- **Project Management PRAXIS** (available from Amazon) -- includes many innovative project management tools & techniques; and describes a "**Toolkit**" of related templates available directly from him at kenfsmith@aol.com on proof of purchase of PRAXIS.