Estimating Realistic Activity Times: A Critical Pseudoscience Problem and Workaround Solution [1]

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ABSTRACT

This article highlights a flaw underlying the traditional "PERT" approach for estimating project activity durations and proposes a workaround solution.

THE PROBLEM

Estimating activity durations and scheduling project delivery and completion dates is particularly critical for both Contractors with Firm Fixed Price (FFP) contracts, as well as Clients/Donors awarding Cost Plus Fixed or Incentive Fee (CPFF & CPIF) -type contracts.

However, the difficulty of developing **realistic** time estimates has been pinpointed by participants in my project management seminars as one of their major concerns. Experienced project managers unanimously acknowledge that -- *for one, or more, reasons* – planned schedules were typically under-estimated. Even those using the standard "PERT" formulas to estimate activity & project duration said that in practice both the "**Most Likely**" and the subsequently-calculated "***Earliest Expected***" times were unrealistic; being significantly **over-optimistic**!

As a bit of background, the Program Evaluation & Review Technique (PERT) is a statistical probability-based time-estimating technique of the Critical Path Method (CPM) -- *introduced in the late 1950's* -- with which I became acquainted in the early 1960's when I was a management intern on the U.S. Navy's Polaris Project. Today, PERT is a standard tool, incorporated into some scheduling software for use when there is uncertainty with individual activity time duration estimates. [*Not incidentally, when visiting Pearl Harbor with some of my grandkids a few years ago, I was shocked to see a Polaris Missile on exhibit as a* ***museum piece*** *near the entrance to the visitors' center!*]

The PERT formula for estimating an activity duration is: te = (Opt + 4M + Pess) / 6

Where:

te = earliest expected time estimate, i.e. a weighted average or "mean" of the range of possibilities
Opt = optimistic time estimate
M = most likely time estimate
Pess = pessimistic time estimate
4 = a constant weight
6 = a constant divisor

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For example, where: **Opt** = 3; **M**= 7 and **Pess** = 23:

$$\textbf{te} = [3 + 4(7) + 23] / 6 = [(3 + 28 + 23)] / 6 = 54 / 6 = \textbf{9}$$

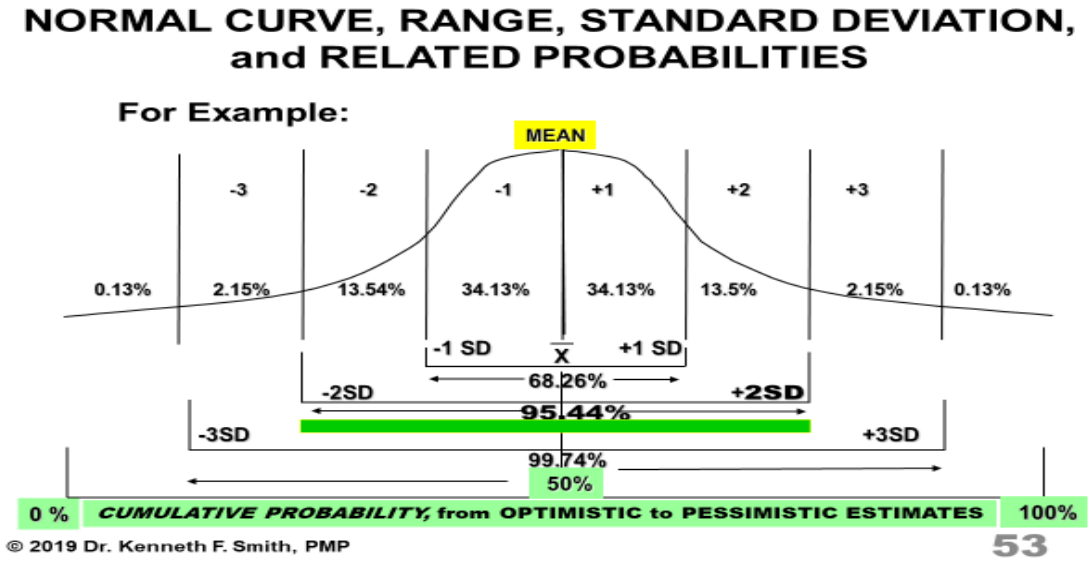
Although seemingly more statistically sophisticated than a simple 3 point 'average' estimate – *i.e. an arithmetic mean* -- the **fundamental flaw** in using this formula to estimate an Activity (*or activities, and the overall project schedule*) duration is that -- *by definition* -- the resultant te is merely a weighted average. Hence the probability for completing the Activity (activities, and/or project schedule) **by the expected time is still only 50%.** In other words, if/when applied to project activity scheduling, the calculated Project Activity **te** duration is under-estimated at least half of the time. Consequently, from the outset, the odds of the resultant activity milestones – *and, indeed, the overall project* – being completed as planned are just 50 / 50 -- a very high risk that the estimated schedule will be overrun. In essence -- despite giving more weight to the Most Likely estimate -- this pseudoscientific approach to take probability into account in estimating activity durations is still no better than tossing a coin!

Indeed, using the PERT formula is *even worse than playing Russian Roulette (RR)!* In RR, the probability of success (*surviving*) is 83%, while the probability of being killed is "only" 17% (i.e. 1 chance in 6).

So ***what can you do*** to increase your chances for successfully estimating activity durations?

MY WORKAROUND SOLUTION

Since the PERT formula is based on probability theory, we can augment it to determine the probability for a more successful (*i.e. less risky*) outcome, ***such as 95%;*** a 20 to 1 success rate. [*For those of you interested in the derivation of standard deviation and probability theory, the following diagram illustrates this concept. Otherwise skip the diagram and go to the discussion that follows.*]



My pragmatic approach and recommended workaround procedure to resolve this fatal flaw has been to **add two *estimated* standard deviations** to the PERT formula for a more **"Realistic" time (tr)**. **This *increases the probability of successful occurrence to 95%; a Significant Difference!***

Thus: **tr = [(opt + 4 M + pess)/ 6] + 2 ESD**

Where a "*quick and easy*" 'estimated' Standard Deviation (**ESD**) = (Pess – Opt) / 6

Or: $$tr = \frac{(Opt + 4M + Pess)}{6} + \frac{(Pess - Opt)}{3}$$

For example: In the previous situation,

where Opt = 3; M= 7 and Pess = 23; and the **te was calculated as 9**

the estimated Standard Deviation is: (23 – 3) 6 = 20 / 6 = 3.3

So **Two ESDs** = 3.3 x 2 or 20 / 3 = **6.6**

and the "Realistic Time" (with a 95% probability of attainment) is

tr = 9 + 6.6 = 15.67, or **16 rounded**

I also developed an Excel template to compute this new **realistic estimate (tr)** and facilitate comparison with the PERT **te** estimate.

ESTIMATING ACTIVITY DURATIONS FOR PLANNING & SCHEDULING
UNDER CONDITIONS OF UNCERTAINTY
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NOTE: The Probability of SURVIVING Russian Roulette is 83% !

	THE PERT FORMULA (0 + 4 ML + P) / 6	MURPHY'S LAW	 PERT is *ONLY* 50% PROBABILITY	Dr. Ken's REALISTIC FORMULA	Enter Your Trial & Error Probability % 75.00	Crispin Piney's Formula (Includes Buffer for "Unknown Unknowns")
Activity #	ENTER a Probability % in the WHITE Cell at the right to obtain the Wanted Times associated with the O ML & P Time Estimates in the WHITE Cells Below; Compared to PERT & other Probabilities			PERT + 2ESDs 95.44% PROBABILITY	Probability of meeting the SCHEDULE	PERT + 2((P-PERT)/3)
	OPTIMISTIC (BEST) TIME	MOST LIKELY (ML) TIME	*(PESSIMISTIC) WORST CASE*	EXPECTED TIME	REALISTIC TIME	YOU WANT IT *WHEN?!*	XPERT Time
1	3	7	23	9.00	15.67	12.83	18.33
2	2	10	21	10.50	16.83	14.14	17.50
3	4	8	24	10.00	16.67	13.83	19.33
4	4	18	80	26.00	51.33	40.57	62.00
5				0.00	0.00	0.00	0.00

The template is also useful to facilitate the 'negotiating' process by demonstrating the greater risk of failure for anything less than the computed realistic time – as well as the likelihood of attaining any other 'top down' desired or imposed deadlines for project activities.

Admittedly this "realistic" time of 16 is considerably higher than either the "most likely" time of 7, or PERT's "earliest expected" time of 9; and, at first, is likely to be resisted by the client – or your boss.

However, if "Top Management" (or the Client) still insist on their deadline or the PERT estimated **te**, ask them directly if they would play Russian Roulette with one bullet; to which they will most likely answer with a resounding "***No!***" Then rejoin by asking why they want to put their company's reputation at risk, and their project's planned schedule in jeopardy by ignoring the project manager's professional judgement and playing "*PERT Project Management*" -- the equivalent of Russian Roulette with three (or more) bullets?

CONCLUSION

By providing a much more reasonable basis for estimating activity time durations, this workaround to the PERT formula enhances project managers professional planning capabilities. Applied in tandem with the adjunct template, planning discussions can be facilitated to establish overall project implementation plans that should result in fewer schedule slippages. Realistic estimating and scheduling also provides organizational executives and program managers with a more rational basis for evaluating subsequent implementation performance of their project managers.

A "*Win-Win*" for all!

About the Author

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Dr. Kenneth F. Smith has been a project management consultant for ADB, the World Bank, and USAID for decades. He earned his DPA (Doctor of Public Administration) from the George Mason University (GMU) in Virginia and his MS from Massachusetts Institute of Technology (MIT Systems Analysis Fellow, Center for Advanced Engineering Study). A long-time member of the Project Management Institute (PMI) and IPMA-USA, Dr. Smith is a Certified Project Management Professional (PMP®) and a member of the PMI®-Honolulu Chapter.

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