Schedule Slippages, Root Causes & Recommended Remedies [1]

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Despite the mantra, charge, and challenge of every project manager to be "***On Time, On Budget and On Target***" – *and the ready availability of numerous "Best Practice" tools and techniques since the 20th Century surge promoted by the PMI, as well as other professional management entities* -- to this day **project schedule slippages continue to be endemic;** rather than rare, isolated, occurrences.

"WHY?" YOU ASK.

From my perspective[2] it is because *FROM THE OUTSET – albeit inadvertently* – so many projects are *PLANNED TO SLIP SCHEDULE!* Consequently, during implementation, hapless project managers are saddled with the inevitable -- *almost impossible* – task of trying to '*catch-up*'; but, *in most instances* falling short. **For those few project managers who do succeed, the kudos they earn are well deserved.**

IMO, the *'Root Causes'* of rampant schedule slippages are of two types, and are three-fold:

1. **Structural:**
    1. **Disconnect between project planners 'Visions & Missions' and project managers 'Realities'**
    2. **Decentralized Managerial Monitoring of input resources**

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[2] A *kaleidoscopic career as an itinerant project management systems specialist, project planner, advisor, project & portfolio manager, evaluator, and consultant/trainer for diverse sector projects -- at headquarters levels as well as in-the-field -- in many countries.*

2. Technical:

3. **Project planners inadequately address risks: -- they *erroneously, negligently* and *insufficiently factor probability* in implementation plans.**

ONE -- *OR MORE* -- MAY BE THE CAUSE OF YOUR PROJECTS SLIPPAGES.

Nevertheless, *readily-available approaches* exist, and coupled with two *properly-applied extant risk analysis techniques* could significantly improve -- *although not completely rectify* -- the situation.

1. RE: The Project Planner / Manager Disconnect

While not universal, my experiences -- and observation -- with numerous **National Governments and International Donor Organization-assisted organizations** was that their projects were predominantly **hybrid *"Owner-Planner - Contractor-Implementer"*** types. As such, initially they conceived, and **planned their projects *in-house; in stages, over a long period of time (months, or even years)*** with various combinations of executives, subject matter experts, consultants, NGOs (non-government community service-oriented organizations), and contractors -- *complete with a scope, schedule & tentative budget; based on their 'best estimates.'*[3]

Eventually, the ***in-house-planned projects*** were usually competitively **out-sourced** for an NGO contractor, or contractors **to implement. But *the contractors and their designated project managers were almost never involved in prior project planning*.**[4]

Then, following contract award**,** a considerable hiatus ensued, while the contractor's newly appointed project manager and team arrived on the scene and reviewed the project implementation plan with the organization's designated in-house project manager. They then reconciled and updated the plan to conform with current reality, plus any '*conditions precedent*' to be met before starting formal implementation. Subsequently, change orders were sought by the contractor, intermittently, to further modify the project's scope, budget and schedule – *all of which were usually approved* each time.

[3] An amalgam of assorted knowledge, experiences, and wishful thinking by those involved.

[4] Indeed -- *at least under US Government '**Level Playing Field**' rules* – participants in preliminary feasibility and design stages were often even ***precluded*** from bidding on the subsequent implementation contract because their prior knowledge, experience and familiarity with the project plan was considered by many agency contracting officers & legal counsel to constitute an 'unfair' advantage. Thus, paradoxically -- *as well as IMO ludicrous* -- contract award would be limited to *lesser-qualified* competitors! [**NOTE** for the skeptical; **This is not conjecture; *it was the norm*** which I often railed against, but to no avail. *However, I can't speak to current practices*.]

Such changes were almost always detrimental to the original pre-award duration, &/or initially-revised post-award duration and schedule.

No mystery here why project completion deadlines were/are missed!

Public & Private Sector 'Owner-type" and **"Outsourced" project plans** were **usually in much better shape** -- ***whenever the designated project manager was involved in the project's planning from the outset* – a *"Best Practice"* IMO.**

The Fix: *Unfortunately, the outlook for changing the long-entrenched government-related management 'modus operandi' of policies and practices for planning and implementing projects is bleak. However,* there is probably still room for some Owner-type projects to improve planning procedures by adopting ***Best Practice procedures*** and including their designated project manager in the project's planning team at an early stage.

2. RE: Decentralized Management & Monitoring of Input Resources

Ensuring timely acquisition and delivery of input resources is essential, as delays can constrain commencement of pre-scheduled project activities. However, throughout my career I encountered and observed ***widespread deficiencies in this respect, in both government-oriented and private sector project implementation.***

Logistical support procedures are complex, and highly-specialized subject matter experts (SMEs) working in an organization's contract's office or procurement department usually manage -- *i.e. negotiate, schedule and track* -- them, ***separately from the project and the project manager*. [**However, the in-house project managers of the US Agency for International Development (USAID) were formally designated "**COTRs**" (*pronounced '**cotars**'*) – i.e. **the Contracting Officer's Technical Representatives** – ***leaving no doubt as to who was in charge!*]**

Although project activities were initially planned and scheduled in consultation with in-house resource providers and *contract & procurement specialists* – it was almost taken for granted the requisite budget, related critical personnel and equipment inputs – *whether provided in-house, or outsourced* -- would then be made available to the project manager as/when needed**.** However, ***after actual contracts were awarded*, delivery dates were often changed** during implementation by the Contract &/or Procurement Officer ***without the Project Manager's participation or awareness*** -- and **crucial items were delivered much later than originally planned and anticipated.**

Furthermore, **personnel, incremental funding and equipment resources --** *previously promised by organizational department heads in a matrix-structured project support setup during planning; as well as other entities* **– also frequently arrived late &/or in**

diminished quantities, despite follow-up and desperate last-minute appeals by the Project Manager; and sometimes even not honored at all! Instead of devoting his/her energies to *directing and managing* the project's implementation activities, ***all too often the project manager was handicapped; powerlessly 'coordinating' activities controlled by others. A classic situation of the tail wagging the dog!***

The *Process* for monitoring – *if not the responsibility for managing* -- project resource inputs is thus ripe for rectification.

The Fix: Even though beyond the Project Manager's immediate control, IMO ***incremental procurements and pre-planned delivery schedules*** of key outsourced supplies, equipment, personnel resources ***should also be included* in the Critical Path network implementation plan for monitoring under the project manager's direct control.** They should be diagrammed ***as additional Milestones and concurrent external merge Activities immediately prior to the work for which needed,* highlighting their lead-times.**

Then, instead of having to rely on intermittent *ad hoc* feedback from the other organizational entities -- *which usually entailed frantic follow-up when delivery was scheduled to be imminent, or failed to show up as promised* -- **these resource input activities and milestones can be much more closely monitored by the Project Manager *as leading indicators*,** and their lead-times checked during regular recurrent project status review meetings.

While not a panacea, closer coordination with providers, systematic monitoring under the Project Manager's control, & early warning about input resources should help improve the situation.

3. RE: Erroneous, Negligent & Insufficient Risk Analysis

Error: Misuse of the PERT Formula

With the advent of the ***Critical Path Method (CPM)*** in the late-1950's, an attempt was made to address **uncertainty in estimating activity durations** -- by creation of the **Program Evaluation & Review Technique** (**PERT**) **formula:**

$$\text{Earliest Expected Time} = \frac{\text{Optimistic Time} + 4 \times (\text{Most Likely Time}) + \text{Pessimistic Time}}{6}$$

To be able to usefully apply this formula obviously requires some knowledge of what exactly constitutes the most likely duration for accomplishing the activities under 'normal' circumstances; what risks they could confront, and what opportunities might exist to

accelerate performance. However, while it may be feasible to estimate times for familiar activities in technical sectors where similar projects have previously been undertaken elsewhere, **in most situations it is simply a 'ceiling' estimate,**[5] with little or no basis for ascribing a meaningful time period to an activity.

Even in those instances where realistic estimating is possible, **a common error is to consider only the 'touch' time** – *i.e. based on the level of effort to be expended on the job* – rather than duration between activity commencement and completion milestones. Unfortunately – *particularly in **Owner**-type projects where the project's resources are scattered throughout the matrix* – **equipment and personnel resources are shared and individuals are often assigned as 'team' members to *concurrently* support multiple projects.** Consequently, instead of working full-time on any one project, people come and go; leaving tasks unfinished, and returning intermittently.[6] Therefore, **when estimating activity durations, *'waiting' time should also be factored in to the 'Most-likely' and 'Pessimistic' time estimates.***

Furthermore; in most instances I encountered on-the-job, **planners then missed &/or misused the probabilistic implications** of the weighted formula. Despite the fact that the ***'Earliest Expected time'* only had a 50% probability of success** – ***they routinely applied the resultant duration*** to activities to determine the project schedule. That was like using a coin toss, or playing 'Russian Roulette' with ***three* bullets!**

Even worse, given that there was an **Optimistic** time in the equation, **executives &/or customers often subsequently raised the performance bar** and pushed the planners to aim for that tightened target.

The Fix: When estimating activity durations, **factor 'waiting' time in to 'Most-likely' and 'Pessimistic' time estimates.**

Then **rectify the egregious 50% probability error** assignments, and **estimate *Realistic durations*** *for the activities.* I explained how to do this -- *in two earlier PMWJ articles*[7] -- by adding 2 standard deviations to the computed activity PERT 'Earliest Expected Time.'[8]

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[5] AKA a '**SWAG**' – a Scientific Wild-Ass Guess!

[6] I have heard that **waiting time** can constitute ***as much as ten times the activity touch time***, casting an asymmetrical dispersion for the PERT 'Pessimistic' time estimate.

[7] Estimating Realistic Activity Times: A Critical Pseudoscience Problem and Workaround Solution, *PM World Journal*, Vol. VIII, Issue IX, October 2019; and Realistic Time Estimates Revisited, *PM World Journal*, Vol. IX, Issue VIII, August 2020.

[8] For the statistically-challenged, a 2 standard deviation boost increases the probability of timely project activity completions *from a hazardous **50%,** to a much safer – i.e. less-risky **-- 95%.***

I also developed a related tool -- a template; – *readily available on request* – for users to crunch the numbers and highlight the probabilities for ***any*** selected activity durations.

Negligence: Disregarding Probability

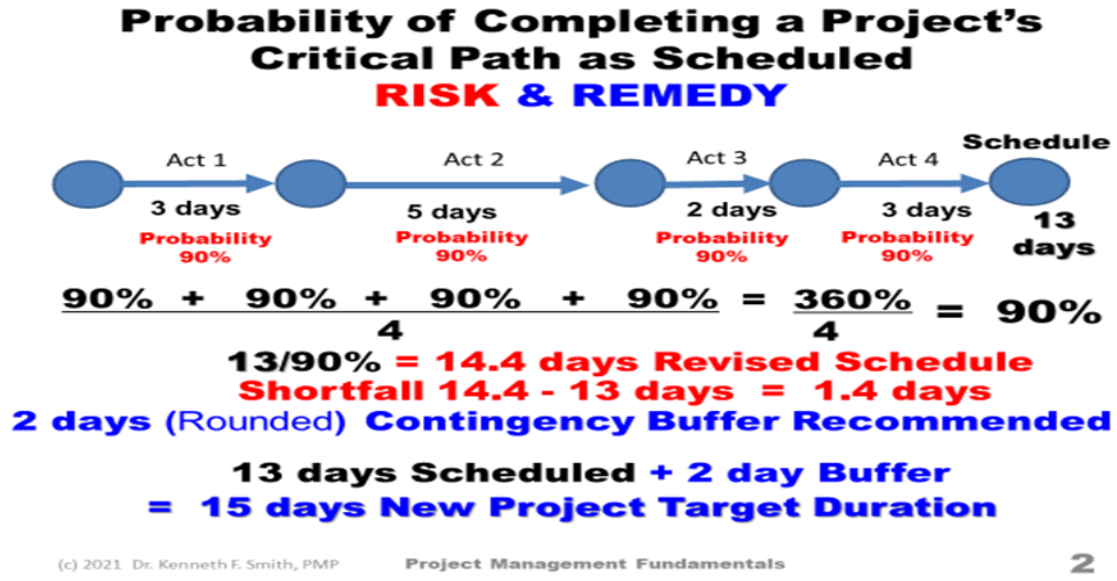
Subsequently, all activity durations in the project implementation plan were treated as deterministic, and any probabilistic aspects were promptly forgotten and discarded.

To assuage project implementation managers, occasionally the planners added a **lump sum duration** to the critical path as a **project buffer,** with estimates -- *usually in the 5% to 10% range* – but based on nothing more than a 'ceiling estimate'.

More Negligence: Ignoring Extant Buffering Techniques

In 1997, Dr. Eliyahu Goldratt[9] proffered a **systematic approach to address risk in scheduling**, with the **Critical Chain Project Management (CCPM) technique.** Goldratt advocated that the ***residual probabilities*** of critical path activities (*which he referred to as an '**Event Chain**'*) ***be combined after the original scheduled project completion date as a collective*** **Project Buffer** to establish a **revised target date** for project completion. This process is illustrated in Figure 1.

Figure 1



[9] An Israeli physicist and management guru

That was 25 years ago!

But – *to my knowledge* – the Project Management Institute (PMI) never indorsed CCPM, or included it in its PMBOKs.

Furthermore, feedback -- *from clients during my consultations, as well as from participants in my training activities* -- reveals **little or no awareness of CCPM for addressing risk issues with additional probability analysis;** and *merely continued misapplication of the PERT formula*, while bewailing untimely delivery **of outsourced** inputs as an endemic problem beyond their control.

The Fix: After I became aware of **Goldratt's critical chain concept** at the end of the 20th Century, I applied it on the job wherever appropriate; and also incorporated it in my training courses**. I recommend project planners do likewise.**

Insufficiency: Landau's Lacuna

After several applications of Critical Chain, I also recalled and resurrected an earlier concept by **Dr. Martin Landau**[10] -- of which I was aware -- ***to modify Goldratt's approach*** and **extend probability theory** to address a latent issue: the aforementioned ***integrated procurement and resource input scheduling*** aspect, as well as other activities in similar circumstances***.***[11] **The lacuna postulated by Landau** is essentially as follows:

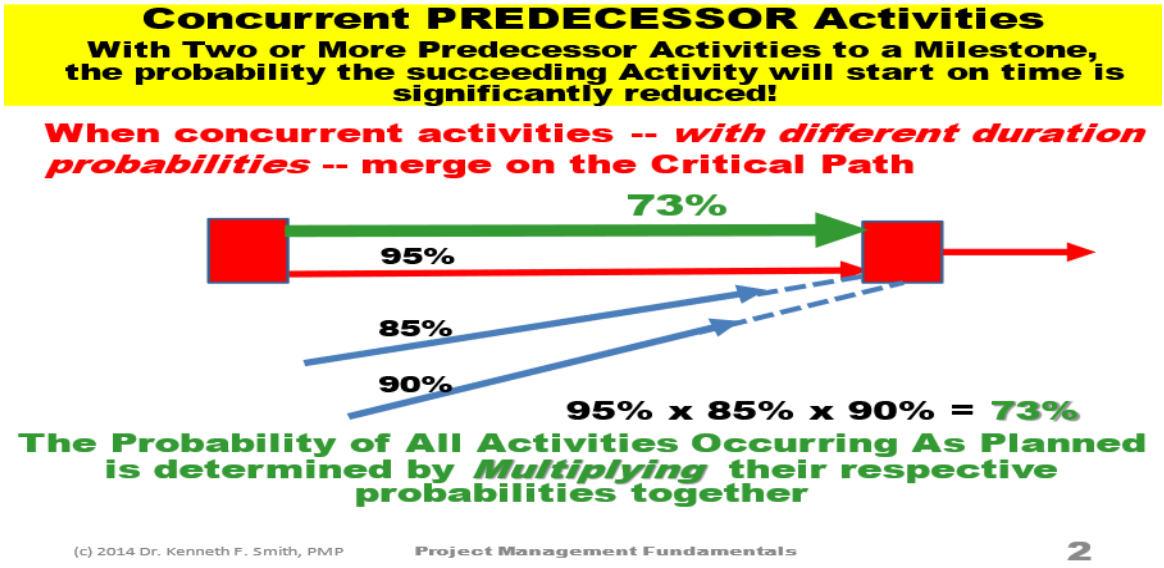
[10] Namely "**Redundancy Theory**," *first expounded in a July 1969 article "Redundancy, Rationality, and the Problem of Duplication and Overlap," Public Administration Review* by Martin (Marty) *Landau [1921-2004] Professor of Political Science, UCLA*. In essence -- ***in project terms*** – Redundancy theory asserts project success can be increased by undertaking several concurrent individually-independent activities towards the same objective. The probability of ***success by at least one of the activities*** increases exponentially with multiple concurrent attempts, calculated by $\mathbf{PS_1 = 1 - F^n}$ *w*here $\mathbf{PS_1}$ = the Probability of Success; **1** is a constant; **F** = probability of failure, and **n** = number of attempts. For example, given two concurrent activities, both with a typical PERT 50% Earliest Expected Time probability, the probability of *at least one of them succeeding* would be $\mathbf{1 - .50^2}$ = .75 or **75%**. [**Note:** *This is the same formula the Air Force used to plan the number of gravity-bomb strikes on a target. But I digress!*]

[11] I worked intermittently with Marty during 1981 & 1982 -- while he was a consultant to USAID – and he piqued my interest in possible applications of Redundancy Theory to project management. A related issue for project planning analysis was *"How many concurrent efforts should a project undertake?"* His answer: It depends on the priority of the project, the need for a successful outcome, the probability of success of each approach and the available budget. As a guide, bear in mind that **the probability of project success increases *geometrically* with merely *arithmetic* increases in *concurrent* activities**. In subsequent conversations with me, **Marty also postulated the *inverse* of redundancy theory for project analysis** – *i.e.* ***the diminished***

The *probability* of completing a critical path 'merge' milestone on time *is reduced* by the ***combined probabilities*** **of its preceding concurrent activities (***assuming they are scheduled 'just-in-time,' even if not on the critical path***).**

This concept is illustrated in Figure 2, below.

Figure 2



In this example, **the lacuna postulated by Landau reduces the probability of the critical path activity being completed on time by as much as 22% from the original 95%** to a **combined 73% probability for all merge activities being completed as scheduled.** This significantly impacts the start of the subsequent activity. By so doing, **the significant Impact** in terms of ***subsequent Milestone 'start' scheduling*** is shown in Figure 3.[12]

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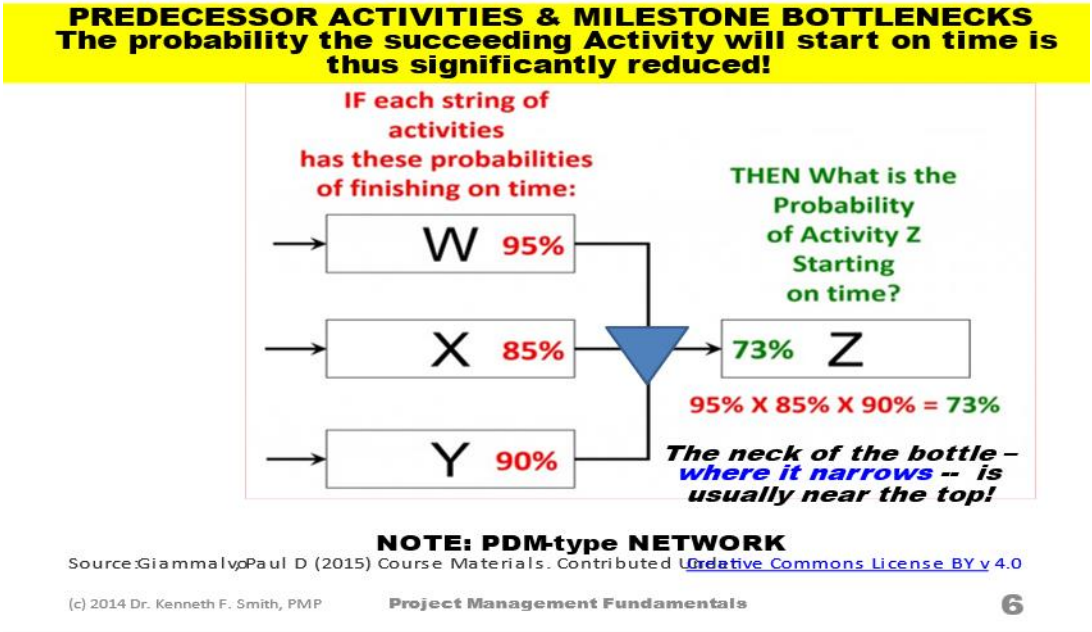
probability of all concurrent activities succeeding when needed. The probability of **all activities** succeeding on time is $\mathbf{PS_2 = S^n}$ *where* **S** = *probability of Success. Given the same probabilities as the example in the above footnote,* $\mathbf{.50^2}$ = .25 or ***only 25%*****; a concomitant reduction also of 25%! This lacuna *highlighted a hidden flaw in critical path analysis; with major implications for merge activities on the project critical path contributing to significant schedule slippage, especially when activities are scheduled as late as possible.** However, *to the best of my knowledge,* Dr. Landau never coined a term for his inverse analysis lacuna postulate, or formalized his insights regarding critical path analysis and schedule slippage.

[12] **NOTE:** I am aware my esteemed colleague Dr. Paul Giammalvo -- *an occasional contributor to PMWJ* -- also advocates and utilizes this analytical approach to scheduling, but not how and when he learned of it.

Figure 3



To facilitate this process, years later I developed a template to apply Goldratt's Critical Chain concept where the individual critical path activity *durations* and *probabilities* were entered to calculate a buffer; and still later updated it to *include Landau's postulated Lacuna* for the reduced probability of merged critical path activities, as in Figure 4.

Figure 4

EXTENDED 50 ACTIVITY CRITICAL PATH ANALYSIS

RISK & REMEDY with BUFFER

PROJECT TITLE: Ken's Demo

	Work Week Duration				Critical Path Activities	
	4 days	5 days	6 days	7 days	24	Scheduled Duration
Start Date:	21-Jun-21	21-Jun-21	21-Jun-21	21-Jun-21	3	Buffer
Scheduled Completion:	2-Aug-21	24-Jul-21	19-Jul-21	15-Jul-21	27	Recommended
Recommended TARGET:	6-Aug-21	28-Jul-21	22-Jul-21	17-Jul-21	11%	Buffer as % of Original Schedule

NOTE: Recommended # & % are rounded up

CP ACTIVITIES	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
CP ACTIVITY ID	0-1	1-3	3-4										
Duration: DAYS	13	7	4										
Probability %	90%	95%	90%										
Duration @ 100%=	14	7	4										

THREE-STEP PROBABILITY COMPUTATION FOR A CRITICAL PATH ACTIVITY THAT IS A MERGE ACTIVITY

FREEZE

1. ENTER BELOW CP ACTIVITY & PROBABILITY

CP ACTIVITY #	3rd	90%

2. ENTER BELOW THE PROBABILITIES OF UP TO 9 CONCURRENT ACTIVITIES THAT MERGE WITH CP

		MERGE PROBABILITY
1	90%	
2	85%	77%
3	95%	73%
4		0%
5		0%
6		0%
7		0%
8		0%
9		0%
10		0%

3. SUBSTITUTE THE APPROPRIATE PROBABILITY VALUE AT THE LEFT FOR THE MERGED CP ACTIVITY IN THE ABOVE TABLE

Given a project start date, a **Project Buffer** is then calculated and the schedule determined based on a 4, 5, 6 or 7 day work week.

The Fix: In addition to applying Goldratt's Critical Chain concept to address the long-neglected application of probability to the critical path, **I recommend project planners also rectify its shortcomings by incorporating Landau's Lacuna in their analysis,** as illustrated by the template in the foregoing Figure 4.

SUMMARY CONCLUSION

Proper use of PERT, and Goldratt's Critical Chain Method -- modified by **Landau's Lacuna --** to establish a **Project Buffer** based on **Activity Contingencies will enable practitioners to develop more realistic implementation plans.**

Renewed attention to *explicitly identifying and monitoring outsourced inputs* as constraining activities should facilitate project implementation.

In conjunction with a separate **Management Reserve Buffer** (*discussed in a previous PMWJ article*[13]), **these quick Fix approaches & templates[14] can reduce the incidence &/or magnitude of future project schedule slippages.**

Today, there is a critical need to pay even closer attention to realistic estimating, scheduling and monitoring of input deliveries, as timely project implementation is *exacerbated* by *contemporary supply chain disruption problems*. Hopefully, awareness of these root causes – *whether de novo, or a refresher* -- will stimulate the current generation of project practitioners to amend their currently defective PERT application planning and scheduling approaches, and inadequate procedures for procurement monitoring.

Then, perhaps, projects will even be completed

On or Ahead of Schedule!

PROPER PROJECT PLANNING PRECLUDES POOR PERFORMANCE!

[13] Risk Exposure, Murphy's Law & Management Reserve, *PM World Journal*, Vol. IX, Issue IX, September 2020

[14] Available from kenfsmith@aol.com -- *together with many more templates for other project management applications* -- on proof of purchase of my book **Project Management PRAXIS, (**available from Amazon).

About the Author

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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, Thailand, 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.

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