# How to IMPLEMENT a COMPETENCY DEVELOPMENT/CAPACITY BUILDING Program for Earned Value Management that has been TESTED and PROVEN to WORK [1]

## Dr. Paul D. Giammalvo

This is a follow-up to the paper published in the April PMWJ authored by Mr. Rizkia Zain, "Developing Parametric Modelling for Class 4 Estimate of Pier and Jetty Construction by Analyzing Historical Databases using AI Tools & EVM Techniques"; PM World Journal, Vol. XIII, Issue IV, April. Available online at https://pmworldlibrary.net/wp-content/uploads/2024/04/pmwj140-Apr2024-Zain-Parametric-Modelling-for-Class-4-Estimate-of-Pier-and-Jetty-Construction.pdf

Due to the word count limit set by AACE, for anyone interested in the topic of using data from Earned Value Calculations as the basis to validate and analyze cost and productivity databases applied to repetitive projects, we wanted to expand on the explanation of the template we set up in more detail than was able to be covered in Mr. Zain's paper.

### BACKGROUND INFORMATION

As some of you know, for 10+ years, our PTMC Team and I worked closely and proactively with the GAO as an INDEPENDENT PRACTITIONER (not representing PMI, AACE, IPMA, or the Guild of Project Controls) contributing to the GAO's "Green" and "Pink" versions of their " Cost Estimating and Assessment Guides" and "GAO Schedule Assessment Guide."

During those 10+ years, we have been "test driving" what the GAO (and more recently, what NASA advocated in their Cost Estimating Handbook, Version 4.0) with our paying clients to see if there were any measurable improvements, at least as practiced in the oil, gas, and mining businesses. The AACE CCP or PMP (ALL our students taking our program are required to publish papers, including those preparing for the PMP) produced by the graduates of our 6-month-long, graduate-level competency development/capacity building courses have been published by David Pells in his PM World Journal, but these papers NORMALLY covered only SINGLE

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PROJECTS, and up until this point, we did not have a sufficient number of COMPARABLE projects to test against the NASA STANDARDIZED multi-dimensional Appendix B- Work Breakdown Structure, Appendix G, Cost Modeling and Technical Input Risk, Figure G-6, and Appendix J, Joint Cost and Schedule Confidence Level Analysis, Figure J-6 and J-13, Scatterplot. As our client is a "for-profit" publicly traded Indonesian oil and gas company, we had to modify the analysis approach, understanding that the data from our clients is confidential and proprietary.

## Guiding Standards and Research-Based Principles

The two researchers most closely advocate the same philosophies that we advocate in our roles as "for-profit" property owners/developers and contractors who "flip" houses for a profit and have been developing and providing competency development and capacity building consulting services on a "for-profit" basis for 30+ years now.

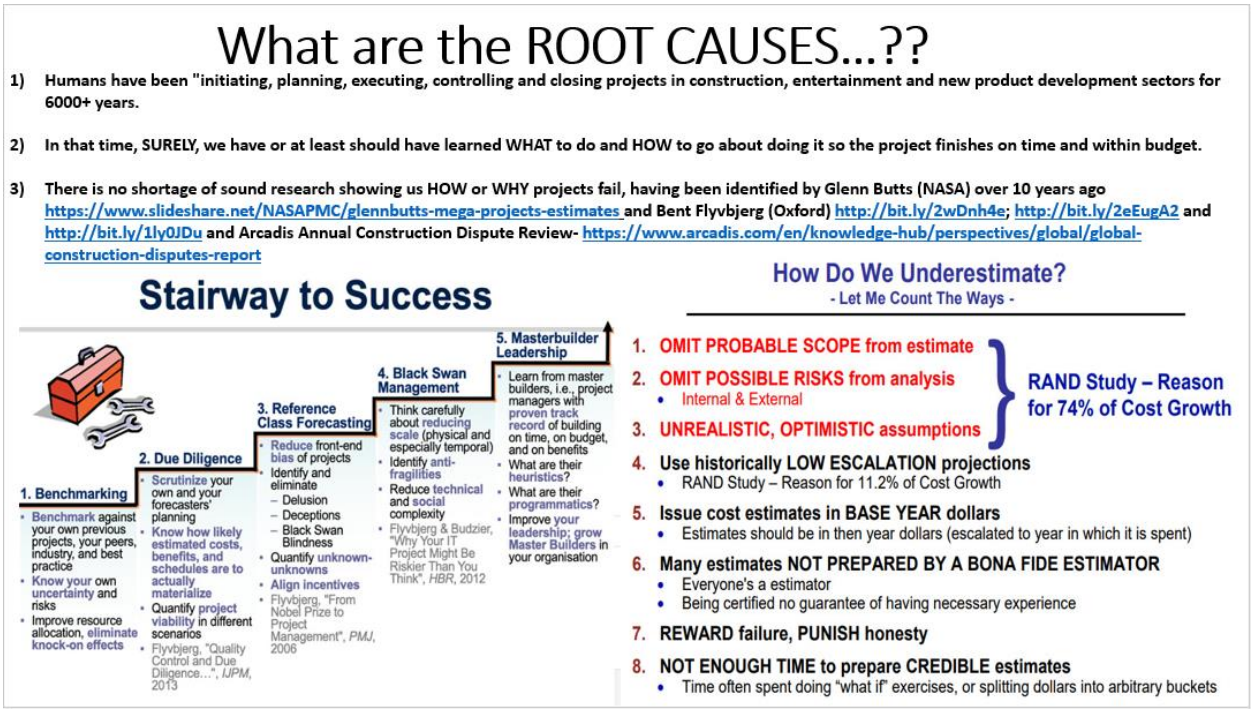
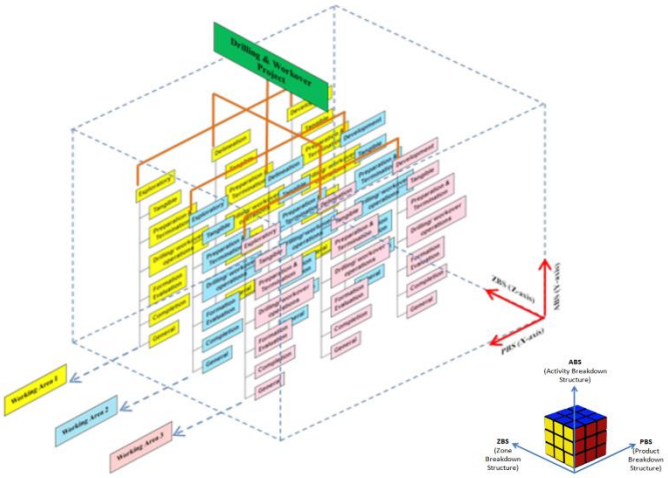



Figure 1- Flyvbjerg's Capability Maturity Model (CMM) and NASA's Butt's Truths

In his paper, Zain was able to address many of the legitimate complaints raised by Glenn Butts, NASA, and Prof Bent Flyvbjerg that they have been raising for close to 15 years and continue to be avoided or ignored by PMI and AACE. In Zain's paper, he ADDRESSED the following complaints or issues:

-Zain developed a STANDARDIZED, multi-dimensional WBS using OBJECT ORIENTED or RELATIONAL DATABASE CODING rather than a "Flat File" or Hierarchical WBS coding structure, being incorporated into all their engineering, procurement, pricing, bidding, and payment documents based on CSI Omniclass. This is set up for eventual integration with Building Information Modelling (BIM Apps), and by using multi-dimensional WBS as a CHECKLIST, the probability of "missing" or "forgetting" scope is reduced.

Figure 2- Multi-Dimensional WBS



- Adopted "purchasing power parity" by using the price of gold as the basis for the databases and for forecasting future costs. (Gold price at the time of APPROVAL adjusted for the inflation to the mid-term of the actual execution of the project) (By converting to Gold Equivalency, the company did not feel he was disclosing any confidential or proprietary data) This addresses Butt's #4 and #5) (Authors Note: With the BRICS+ countries challenging the US Dollar as the "World's Reserve Currency" is likely to have a major negative impact on the purchasing power of the USD and the fair market price of gold.)

- Using the EFFICIENCY FACTORS (SPI and CPI) generated by the Earned Value Data, he could generate not only the AVERAGE percentage that the Front-End Loading (FEL) model was producing in terms of both TIME (SPI) and COST (CPI) but he is able to show the RANGE of errors/discrepancies in terms of time and cost of the estimating. (See Flyvbjerg CMM #2 and #3 and Butt's #3, #4 and #5) By using SPI and CPI, he can also apply the use of 3 Sigma Statistical Process Control Charts (SPC) to monitor if the workflows are IN or OUT of Statistical Control and whether the workflow processes can deliver within the target specifications.

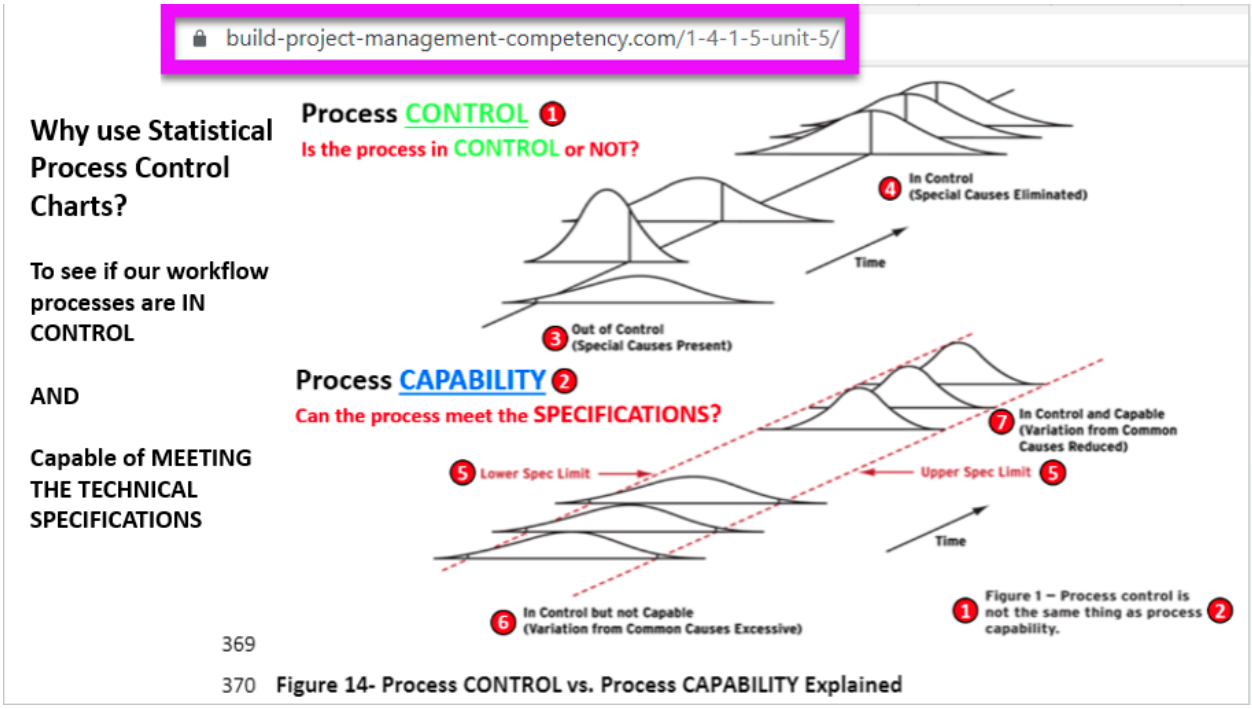


Figure 3- Process CONTROL and Process CAPABILITY

As project management is PROCESS-based, wouldn't it make the most logical sense if we went back to the teachings of Shewhart and Deming if we wanted to improve the EFFICIENCY of our workflow processes? Earned Value Management has long been advocating the measurement of the EFFICIENCY, documenting how we are using our people and physical assets by measuring the Schedule Performance Index (BCWP/BCWS = SPI) and how EFFICIENTLY we are using the financial assets by measuring the Cost Performance Index. (BCWP/ACWP = CPI) (For more on how we learned and implemented Earned Value Management that DIFFERS from what the US DAU advocates in ANSI 748.)

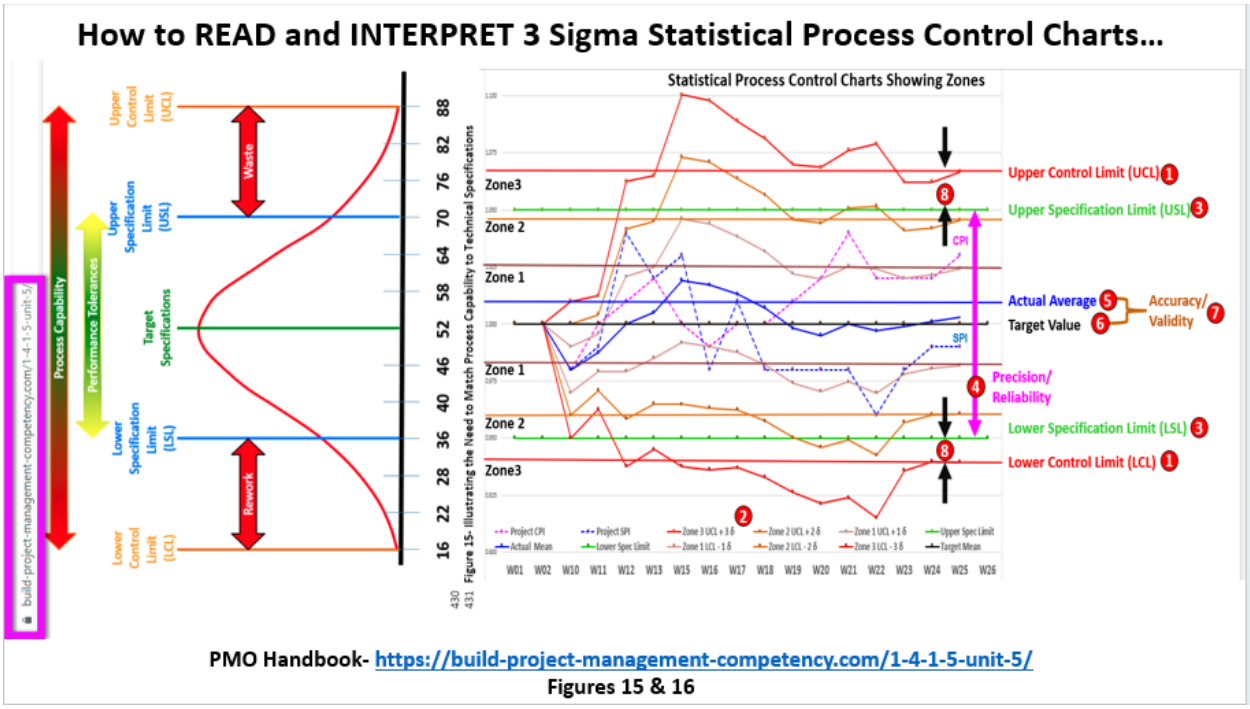


Figure 4- How to Measure the COST IMPACT between SPECIFICATIONS and PROCESS CAPABILITY

The closer together the Upper and Lower CONTROL LIMITS (UCL/LCL) to the Upper and Lower SPECIFICATIONS, the lower the costs, either through rejected deliverables OR process capability that delivers value the client does not need but is paying for. (For those who hold the PMP, this is known as “Gold-plating”.)

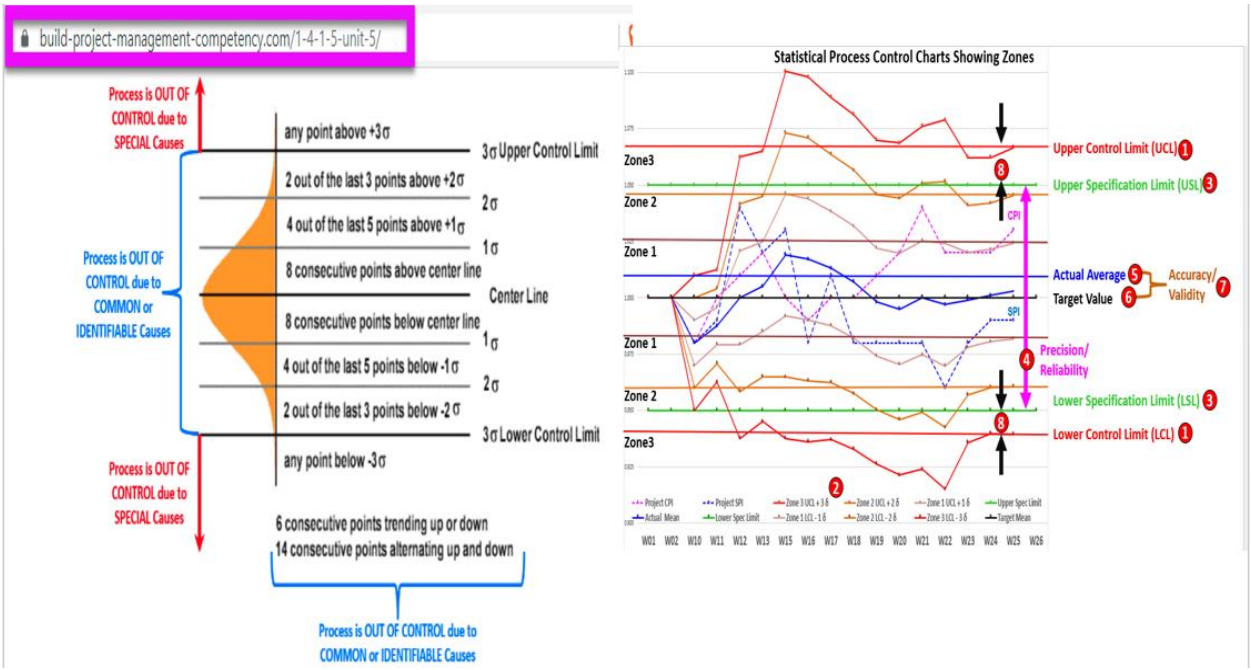


Figure 5- Statistical Process Control Zone Analysis

**So, How Do You Create this for YOUR Database?**

When the SPI and CPI values are plotted on a database of comparable or similar projects (Figure 5), we can see that we can plot the MEAN SPI **(1)** and CPI **(2)** vs the TARGET ("Bullseye") of 1.00 **(3)**. As a "for-profit" company, we have established the Upper and Lower SPECIFICATION limits of +/- 5%. (SPI and CPI between 0.95 and 1.05) This range is user-defined. **(4)**

But there is MORE!!! We can also see the RANGES, noting that the range for SPI **(5)** is much more widely dispersed than the range for CPI **(6)**. Flyvbjerg calls this "Reference Class Forecasting," and the NASA Cost Estimating Handbook calls it "Range Estimates," as shown in Figure G-6. Cost Modeling and Technical Input Risk and Figure J-19. Annual Cost Uncertainty Result Example Displays Cost Risk Statistics Over Time in Comparison to Available Annual Resources

For any hunters or target shooters, we can use this data to "adjust" our aiming point if we want to use the mean or median values to modify our cost estimate and completion date if we want to make the adjustments if we don't want to take the time to run a simulation using Monte Carlo software. **(7)**

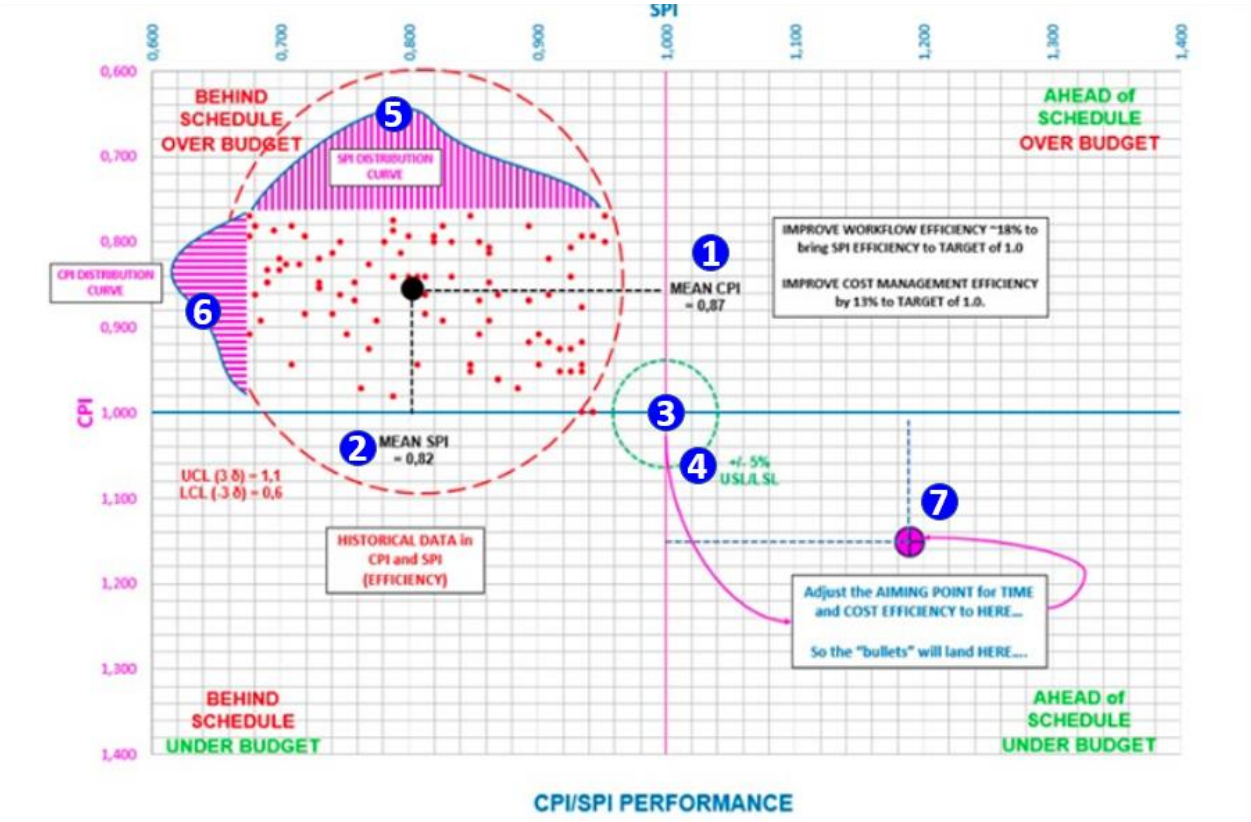


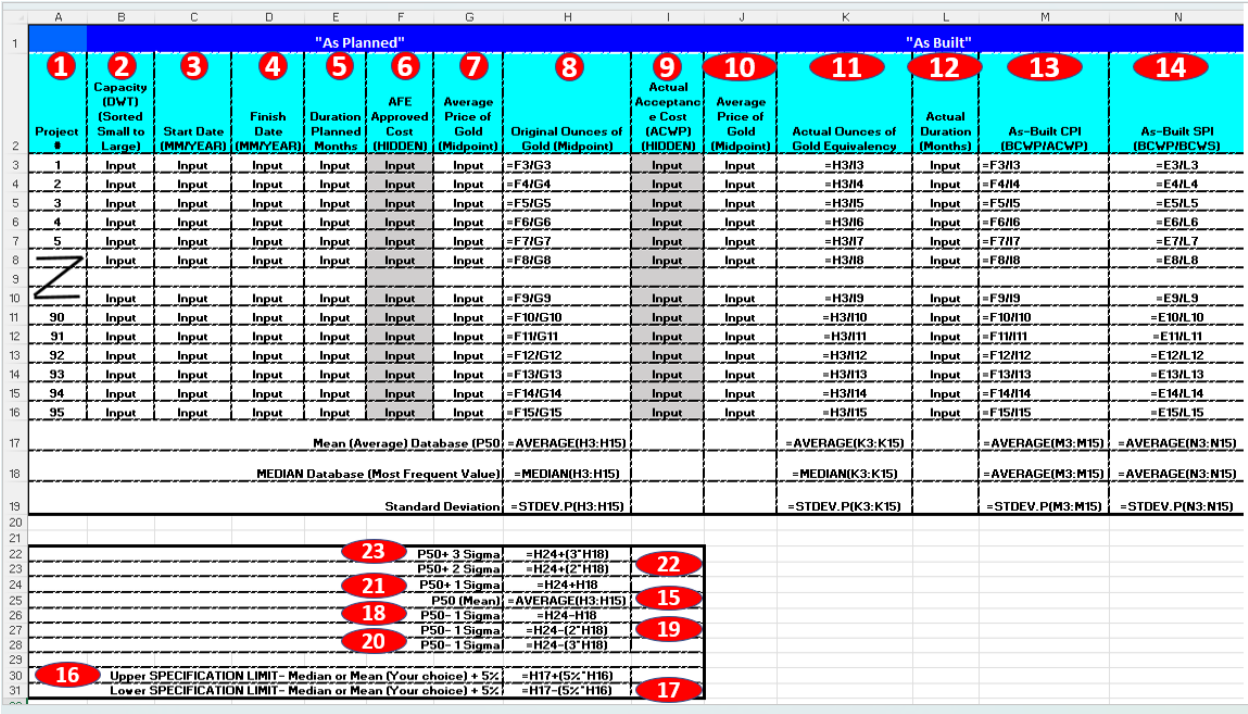

Figure 6- CPI and SPI Matrix Scatterplot's

Mr. Zain MODIFIED the NASA Appendix G, Figure G-6, in his paper. Cost Modeling and Technical Input Risk, and Appendix J, Figure J-6 and J-13, Scatterplot to make more sense to his stakeholders from the perspective of a publicly traded "for profit" business. This is what he generated, which shows the database showing the SPI and CPI values indicating that 100% of all the projects finished LATE and 98% (93/95) finished OVER BUDGET. We knew this was true, but we had no good way to MEASURE it QUANTITAVILY to BENCHMARK against the Database.

He also shows that SPI (measuring how efficiently they use their people, equipment, and time) has an AVERAGE efficiency of 0.82 with a RANGE between 0.67 and 0.96. To measure how efficiently they use MONEY, on AVERAGE, they are 0.87 EFFICIENT, but with a RANGE of 1.00 (bullseye) to 0.76. But keep in mind that of 95 projects, only 2 hit the "Bullseye" in terms of COST, and none hit the bullseye in terms of TIME.

Now, is this information your management needs or wants? Ready to get STARTED?

**So, How Do You COLLECT YOUR Data?**



| | A | B | C | D | E | F | G | H | I | J | K | L | M | N |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | "As Planned" | | | | | | | | | "As Built" | | | |
| 2 | 1 Project # | 2 Capacity (DWT) (Sorted Small to Large) | 3 Start Date (MM/YEAR) | 4 Finish Date (MM/YEAR) | 5 Duration Planned Months | 6 AFE Approved Cost (HIDDEN) | 7 Average Price of Gold (Midpoint) | 8 Original Ounces of Gold (Midpoint) | 9 Actual Acceptance Cost (ACWP) (HIDDEN) | 10 Average Price of Gold (Midpoint) | 11 Actual Ounces of Gold Equivalency | 12 Actual Duration (Months) | 13 As-Built CPI (BCWP/ACWP) | 14 As-Built SPI (BCWP/BCWS) |
| 3 | 1 | Input | Input | Input | Input | Input | Input | =F3/G3 | Input | Input | =H3/I3 | Input | =F3/I3 | =E3/L3 |
| 4 | 2 | Input | Input | Input | Input | Input | Input | =F4/G4 | Input | Input | =H3/I4 | Input | =F4/I4 | =E4/L4 |
| 5 | 3 | Input | Input | Input | Input | Input | Input | =F5/G5 | Input | Input | =H3/I5 | Input | =F5/I5 | =E5/L5 |
| 6 | 4 | Input | Input | Input | Input | Input | Input | =F6/G6 | Input | Input | =H3/I6 | Input | =F6/I6 | =E6/L6 |
| 7 | 5 | Input | Input | Input | Input | Input | Input | =F7/G7 | Input | Input | =H3/I7 | Input | =F7/I7 | =E7/L7 |
| 8 | Z | Input | Input | Input | Input | Input | Input | =F8/G8 | Input | Input | =H3/I8 | Input | =F8/I8 | =E8/L8 |
| 9 | | | | | | | | | | | | | | |
| 10 | | Input | Input | Input | Input | Input | Input | =F9/G9 | Input | Input | =H3/I9 | Input | =F9/I9 | =E9/L9 |
| 11 | 90 | Input | Input | Input | Input | Input | Input | =F10/G10 | Input | Input | =H3/I10 | Input | =F10/I10 | =E10/L10 |
| 12 | 91 | Input | Input | Input | Input | Input | Input | =F11/G11 | Input | Input | =H3/I11 | Input | =F11/I11 | =E11/L11 |
| 13 | 92 | Input | Input | Input | Input | Input | Input | =F12/G12 | Input | Input | =H3/I12 | Input | =F12/I12 | =E12/L12 |
| 14 | 93 | Input | Input | Input | Input | Input | Input | =F13/G13 | Input | Input | =H3/I13 | Input | =F13/I13 | =E13/L13 |
| 15 | 94 | Input | Input | Input | Input | Input | Input | =F14/G14 | Input | Input | =H3/I14 | Input | =F14/I14 | =E14/L14 |
| 16 | 95 | Input | Input | Input | Input | Input | Input | =F15/G15 | Input | Input | =H3/I15 | Input | =F15/I15 | =E15/L15 |
| 17 | | | | | | | Mean (Average) Database (P50 | =AVERAGE(H3:H15) | | | =AVERAGE(K3:K15) | | =AVERAGE(M3:M15) | =AVERAGE(N3:N15) |
| 18 | | | | | | | MEDIAN Database (Most Frequent Value) | =MEDIAN(H3:H15) | | | =MEDIAN(K3:K15) | | =AVERAGE(M3:M15) | =AVERAGE(N3:N15) |
| 19 | | | | | | | Standard Deviation | =STDEV.P(H3:H15) | | | =STDEV.P(K3:K15) | | =STDEV.P(M3:M15) | =STDEV.P(N3:N15) |
| 20 | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | |
| 22 | | | | | | 23 | P50+ 3 Sigma | =H24+(3*H18) | 22 | | | | | |
| 23 | | | | | | | P50+ 2 Sigma | =H24+(2*H18) | | | | | | |
| 24 | | | | | | 21 | P50+ 1 Sigma | =H24+H18 | | | | | | |
| 25 | | | | | | | P50 (Mean) | =AVERAGE(H3:H15) | 15 | | | | | |
| 26 | | | | | | 18 | P50- 1 Sigma | =H24-H18 | | | | | | |
| 27 | | | | | | | P50- 1 Sigma | =H24-(2*H18) | 19 | | | | | |
| 28 | | | | | | 20 | P50- 1 Sigma | =H24-(3*H18) | | | | | | |
| 29 | | | | | | | | | | | | | | |
| 30 | | | | | | 16 | Upper SPECIFICATION LIMIT- Median or Mean (Your choice) + 5% | =H17+(5%*H16) | | | | | | |
| 31 | | | | | | | Lower SPECIFICATION LIMIT- Median or Mean (Your choice) + 5% | =H17-(5%*H16) | 17 | | | | | |

Figure 7- Excel Template to Calculate the Data for the SPI and CPI Analysis

7.1 While we used only project numbers in the corporate version of this database, we included DEMOGRAPHICS, including the physical location, the project manager, engineers, and contractors. In the event this client has a proposed new project, he/she can sort the location, size (DWT), and even the project manager, engineers, and contractors; then, using Monte Carlo Simulation, they can run a simulation using different PM, Engineers and Contractors based on the historic information updated for today and tomorrow's cost. (Using current gold costs)

7.2 This is self-explanatory; however, when running any simulations, we will match the proposed project's size and location against comparable sizes and locations.

7.3 The start date is determined when the project is authorized to proceed, and funding has been authorized. (This is often called "Approved for Expenditure" or AFE.

7.4 In the SIMULATED completion date, a P70 or P80 is usually used based on the size and location of the project in a similar location. Possibly even comparing project managers and contractors.

7.5 The AFE start date to the simulated completion date = Duration. Once completed, the actual data is used to update the actual costs and duration vs. the planned costs and planned duration.

7.6 As this version of the template, the actual costs are considered confidential and proprietary; we need them, but they are displayed only for those approved to view this data.

7.7 The beauty of using Gold Equivalency is that as gold is sold in almost every country worldwide, it is easy to convert a project in Indonesia to a similar project in Malaysia, Australia, or any other country, regardless of how remote it is. Using a publicly traded commodity makes it easy to update a project from prior years to sometime in the future or from one country to a different country. It is also easy to forecast the future price of Gold using readily found future growth rates. (Authors Note: With the BRICS+ countries challenging the US Dollar as the "World's Reserve Currency" is likely to have a major negative impact on the purchasing power of the USD and the fair market price of gold.)

7.8 Divide the midterm average price of gold when the AFE is approved into the simulated cost (whatever P-level management wants to apply), resulting in the project BCWS Early Date. Using a different P level will give us the Late Date BCWS.

7.9 Like #6, this version of the template's estimated costs are considered confidential and proprietary. We need them, but they are displayed only for those who are approved to view this data.

7.10 Again, using simulation, we calculate the price of gold at the midpoint of the project's duration and divide the hidden cost estimate determined by whatever P-level management decided to yield the planned BCWS at either the ED or LD curve.

7.11 Instead of tracking the cost in terms of money, we track the cost in terms of actual ounces of gold at the current fair market costs. This method does not require updating our cost databases each year to reflect inflation or risk premiums. Because gold's "purchasing power parity" is very stable over time, it simplifies the maintenance and updating of our cost and productivity databases.

7.12 is calculated by deducting the Notice to Proceed (NTP) start date from the current date. This yields the Duration to Data Date or the NTP—Acceptance Date (the asset was commissioned and put in service), which gives us the actual duration to update our database.

7.13 yields the CPI as of any interim date or at the end of the project using the standard formula from the DAU Gold Card, PMI, AACE, or any credible published formula for CPI.

7.14 yields the SPI as of any interim date or at the end of the project using the standard formula from the DAU Gold Card, PMI, AACE, or any credible published formula for SPI.

7.15 – 7.23 provides us with the classic +/-3 Zone Statistical Process Control Charts

## Conclusions

We do not subscribe to what PMI or APM/APMG or even all of what AACE or the Asset Management Institute advocates. As we are both OWNERS and CONTRACTORS, the model we advocate is an "INTEGRATED Asset, Portfolio (Of Assets and Projects), Programs and Projects that originated with either Esso or Diamond Shamrock Oil around 1955 that combines the elements of ISO 55000 and ISO 21500 (the former "unwoke" version, not the current ISO 21500) that has been tested and proven for 65+ years, as evidence that this INTEGRATED model has been adopted by all the major International and most national or regional oil companies as well as most electrical, airports, water, utilities, as well as road and railroads.

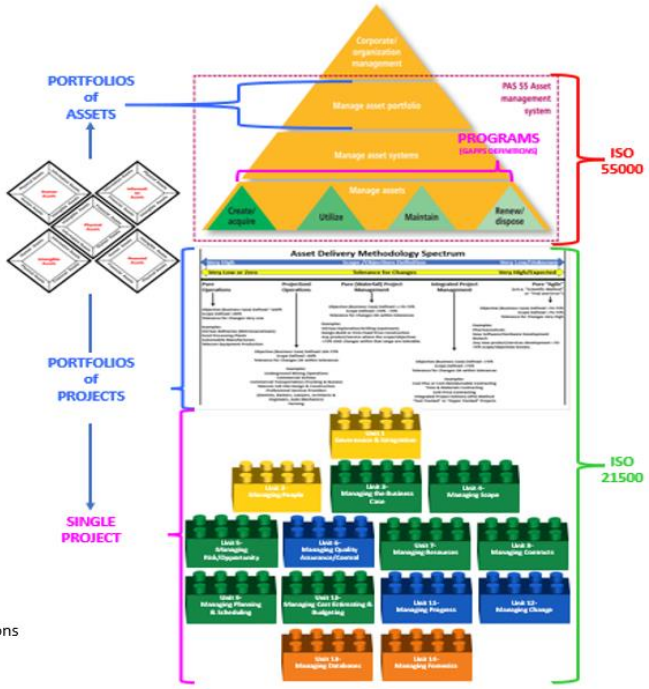
Any public or privately owned organization that requires physical assets. For PROOF, go to the members of The Institute of Asset Management and look at the members. For a quick overview, spend 10 minutes to watch the video that explains what our philosophy is, and if you go HERE, you can see what we teach in our 6-month-long, graduate-level COMPETENCY development/capacity building program where you will produce papers like the one produced by Mr. Zain or realize 65 millions of savings in 4 years as our client Freeport McMoran Indonesia documented implementing Earned Value Management to an Operating Gold Mine.

If you want to see HOW we do it, we will show you step by step and even provide you with the templates we developed so you can do it yourself at your company or university.

**The "Big Picture" Showing the Integrated Asset, Portfolios, Programs and Project Management Methodology.**

**ISO 55000**
**+**
**ISO 21500**

(Adapted from the Best Tested and PROVEN practices published by Esso or Diamond Shamrock Oil circa 1955.)





Grand Strategy


Strategy


Grand Tactics


Tactics

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Jakarta, Indonesia

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He is also active in the Global Project Management Community, by playing a "thought leadership" role for the Association for the Advancement of Cost Engineering International, (AACEI) http://www.aacei.org/ since 1991; He has also been active in two IPMA member organizations: The Green Project Management Association (GPM) http://www.greenprojectmanagement.org/ where he served on the Certification Board of Directors for two years and the American Society for the Advancement of Project Management http://www.asapm.org/ for which he served for four years on the BoD as Director of Marketing. He also sat on the Board of Directors of the Global Alliance for Project Performance Standards (GAPPS), www.globalpmstandards.org, Sydney, Australia and is active as a regional leader. Currently, he is a compensated consultant to the International Guild of Project Controls. http://www.planningplanet.com/guild as the primary author of their "Compendium and Reference" as well as the chief architect of their competency-based credentialing program. http://www.planningplanet.com/guild/certification

He has spent 35 of the last 50 years working on large, highly technical international projects, including such prestigious projects as the Alyeska Pipeline and the Distant Early Warning Site (DEW Line), upgrades in Alaska and the Negev Airbase Constructors, Ovda, Israel and the Minas

Oil Field in Rumbai, Sumatra. His current client list includes Fortune 500 major telecommunications, oil, gas and mining companies plus the UN Projects Office and many other multi-national companies, NGO organizations and Indonesian Government Agencies.

In addition to 45+ years of hands-on field experience, Dr. Giammalvo holds an undergraduate degree in Construction Management, his Master of Science in Project Management through the George Washington University and was awarded his PhD in Project and Program Management through the Institute Superieur De Gestion Industrielle (ISGI) and Ecole Superieure De Commerce De Lille (ESC-Lille) under the supervision of Professor Christophe Bredillet. "Dr. PDG" can be contacted at pauldgphd@gmail.com.

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