# Using Technical Performance Measures to Inform Earned Value Performance

Glen B. Alleman
Wednesday 15th August 2018
10:45 AM – 11:30 AM

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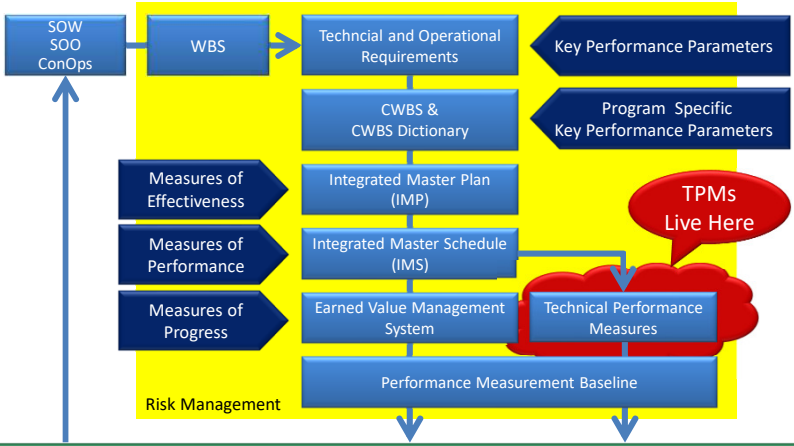
## Components we'll meet along the way to a credible PMB




Objective Status and Essential Views to support the proactive management processes needed to keep the program GREEN

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## Can Earned Value Alone Get Us To Our Destination?

- How do we increase visibility into program performance?
- How do we reduce cycle time to deliver the product?
- How do we foster accountability?
- How do we reduce risk?
- How do we start our journey to success?

Increasing the Probability of Success means …
*Connecting The Dots Between EVM and TPM to Reach Our Destination*

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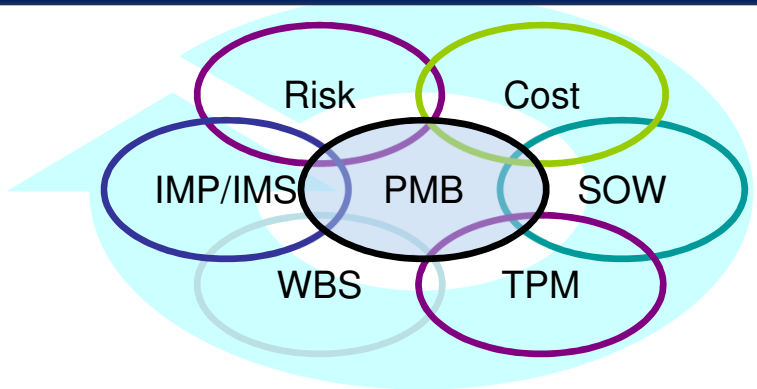
## Increasing the Probability of Program Success Means …

Building A Credible Performance Measurement Baseline




This is actually harder than it looks!

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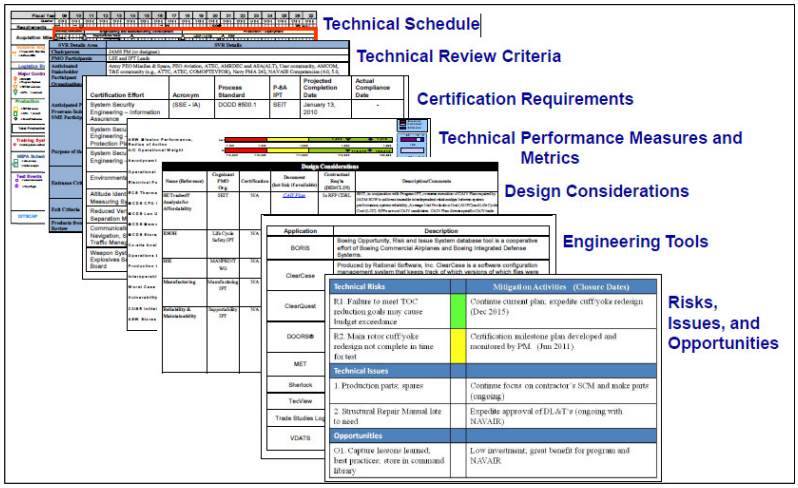
# Identifying the TPMs starts with good Systems Engineering

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# Some More Guidance

Systems engineering uses technical performance measurements to balance cost, schedule, and performance throughout the life cycle. Technical performance measurements compare actual versus planned technical development and design. They also report the degree to which system requirements are met in terms of performance, cost, schedule, and progress in implementing risk handling. Performance metrics are traceable to user–defined capabilities.

— *Defense Acquisition Guide*
(https://dag.dau.mil/Pages/Default.aspx)

In The End — It's Always About Systems Engineering

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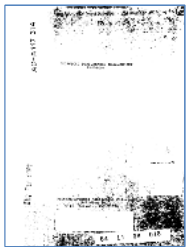
# This Has All Been Said Before

*… the basic tenets of the process are the need for seamless management tools, that support an integrated approach … and "proactive identification and management of risk" for critical cost, schedule, and technical performance parameters.*
— Secretary of Defense, Perry memo, May 1995



TPM Handbook 1984

**Why Is This Hard To Understand?**

- We seem to be focused on EV reporting, not the use of EV to manage the program.
- We think getting the IPMR out the door is the end of Program Planning and Control's efforts, not the beginning.



# A Final Reminder …

**TPMs are one source of Risk Management processes**

- Program management control efforts include the linkage between the Integrated Master Plan (IMP), Integrated Master Schedule (IMS), Technical Performance Measures, risk management, and earned value management.

***3.1 What is Technical Measurement?***

Technical measurement is the set of measurement activities used to provide the supplier and/or acquirer insight into progress in the definition and development of the technical solution and the associated risks and issues. This insight helps project management make better decisions throughout the life cycle to increase the probability of delivering a technical solution that meets both the specified requirements and the mission needs. The insight is also used in trade-off decisions when performance exceeds the threshold. Technical measurement is planned early in the life cycle and then performed with increasing levels of fidelity as the technical solution is developed.

- *Risk Management Guide to DOD Acquisition*, Seventh Edition, December 2014
- INCOSE Technical Measurement, INCOSE-TP-2003-020-01

## We see TPMs starting with the Integrated Baseline Review (IBR)

- Confirms that the Performance Measurement Baseline (PMB) captures the entire techncial scope of work, which is schedule to meet program objectives, identifies risks, assigns resources to meet requirements, and implements management control processes.

*Currently reported Earned Value data contains invaluable planning and budgeting information … for program management, however, shortcomings of the system are it emphasis on retrospection and lack of integration with techncial achievement.*
– Cmdr. Nicholas Pisano

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## *Back To Our Technical Performance Measures*

Technical Performance Measures do what they say,

***Measure the Technical Performance***

of the product or service produced by the program.

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## To develop TPMs we first need to define some other measures

- Measures of Effectiveness (MoE)
- Measures of Performance (MoP)
- Key Performance Parameters (KPP)
- Than we can define the Technical Performance Measures (TPM)



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## Measure of Effectiveness (MoE)

Operational measures of success that are closely related to the achievements of the mission or operational objectives evaluated in the operational environment, under a specific set of conditions.

Measures of Effectiveness …

- Are stated in units meaningful to the buyer,
- Focus on capabilities independent of any technical implementation,
- Are connected to the mission success.

MoE's Belong to the End User

"Technical Measurement," INCOSE–TP–2003–020–01



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## Measure of Performance (MoP)

Measures that characterize physical or functional attributes relating to the system operation, measured or estimated under specific conditions.

Measures of Performance are …

- Attributes that assure the system has the capability and capacity to perform,
- Assessment of the system to assure it meets design requirements to satisfy the MoE.

MoP's belong to the Program – Developed by the Systems Engineer, Measured By CAMs, and Analyzed by PP&C

"Technical Measurement," INCOSE–TP–2003–020–01



## Key Performance Parameters (KPP)

Measures that Represent the capabilities and characteristics so significant that failure to meet them can be cause for reevaluation, reassessing, or termination of the program

Key Performance Parameters …

- Have a threshold or objective value,
- Characterize the major drivers of performance,
- Are considered Critical to Customer (CTC).

The acquirer defines the KPPs during the operational concept development – KPPs say what DONE looks like

"Technical Measurement," INCOSE–TP–2003–020–01

# Technical Performance Measures (TPM)

Attributes that determine how well a system or system element is satisfying or expected to satisfy a technical requirement or goal

Technical Performance Measures …

- Assess design progress,
- Define compliance to performance requirements,
- Identify technical risk,
- Are limited to critical thresholds,
- Include projected performance.

"Technical Measurement," INCOSE–TP–2003–020–01



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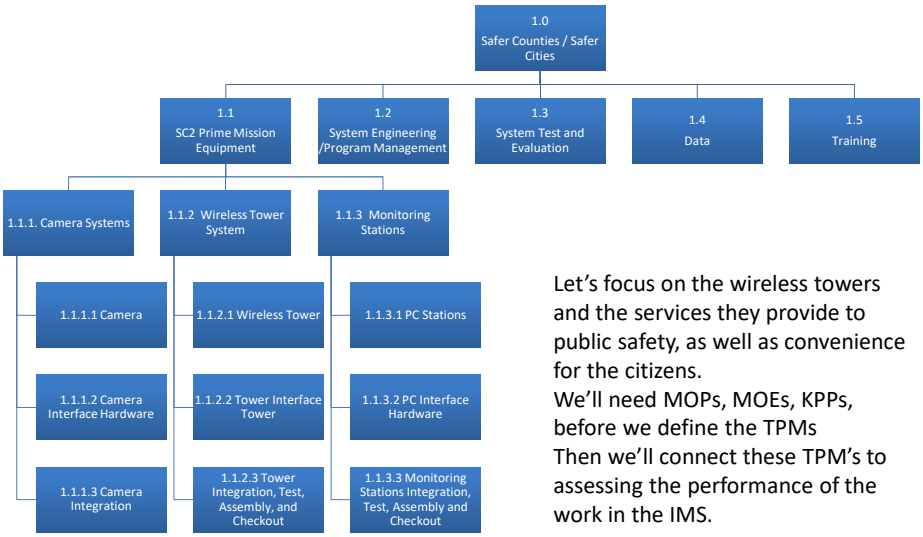
# TPMs start with the WBS




Let's focus on the wireless towers and the services they provide to public safety, as well as convenience for the citizens.
We'll need MOPs, MOEs, KPPs, before we define the TPMs
Then we'll connect these TPM's to assessing the performance of the work in the IMS.



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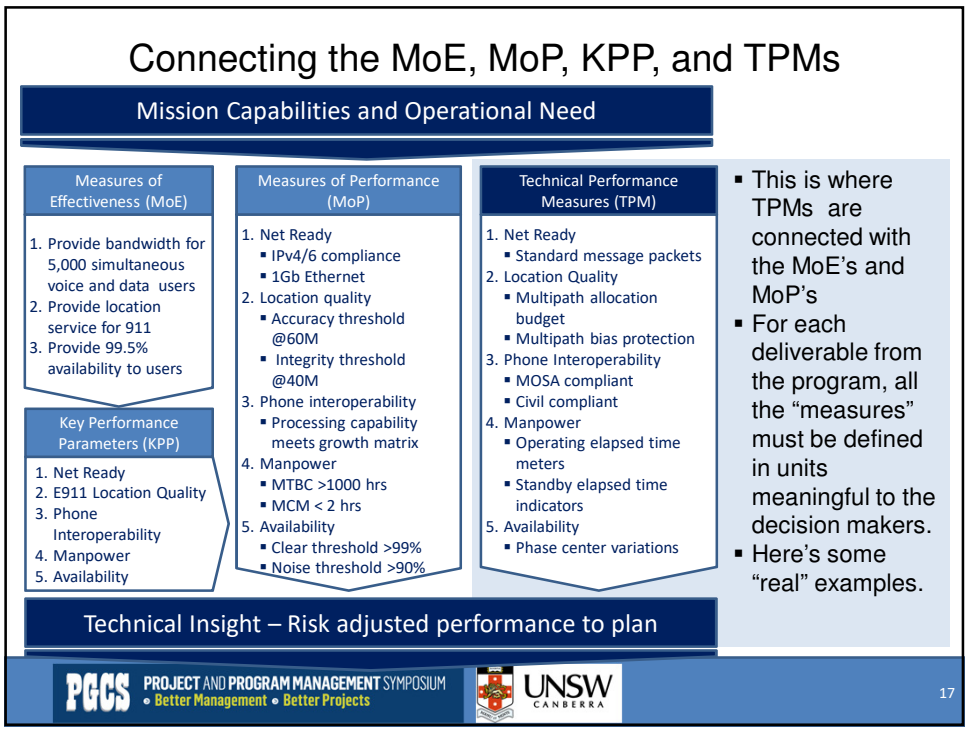
Connecting the MoE, MoP, KPP, and TPMs
Mission Capabilities and Operational Need
Measures of Effectiveness (MoE)
1. Provide bandwidth for 5,000 simultaneous voice and data users
2. Provide location service for 911
3. Provide 99.5% availability to users
Key Performance Parameters (KPP)
1. Net Ready
2. E911 Location Quality
3. Phone Interoperability
4. Manpower
5. Availability
Measures of Performance (MoP)
1. Net Ready
▪ IPv4/6 compliance
▪ 1Gb Ethernet
2. Location quality
▪ Accuracy threshold @60M
▪ Integrity threshold @40M
3. Phone interoperability
▪ Processing capability meets growth matrix
4. Manpower
▪ MTBC >1000 hrs
▪ MCM < 2 hrs
5. Availability
▪ Clear threshold >99%
▪ Noise threshold >90%
Technical Performance Measures (TPM)
1. Net Ready
▪ Standard message packets
2. Location Quality
▪ Multipath allocation budget
▪ Multipath bias protection
3. Phone Interoperability
▪ MOSA compliant
▪ Civil compliant
4. Manpower
▪ Operating elapsed time meters
▪ Standby elapsed time indicators
5. Availability
▪ Phase center variations
▪ This is where TPMs are connected with the MoE's and MoP's
▪ For each deliverable from the program, all the "measures" must be defined in units meaningful to the decision makers.
▪ Here's some "real" examples.
Technical Insight – Risk adjusted performance to plan
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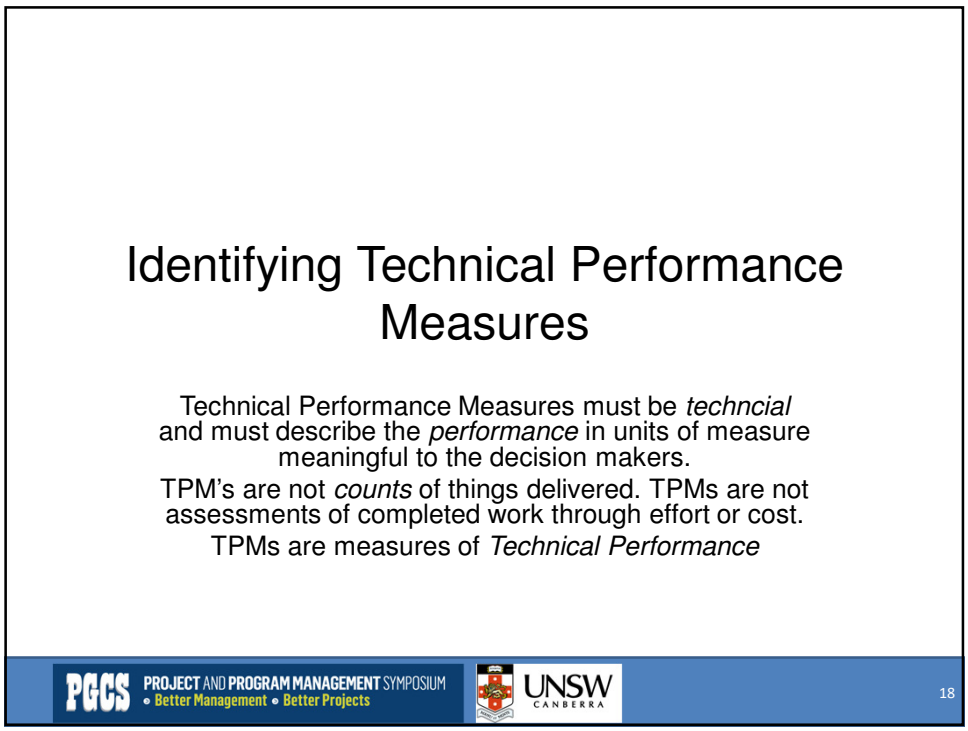
Identifying Technical Performance Measures
Technical Performance Measures must be *techncial* and must describe the *performance* in units of measure meaningful to the decision makers.
TPM's are not *counts* of things delivered. TPMs are not assessments of completed work through effort or cost.
TPMs are measures of *Technical Performance*
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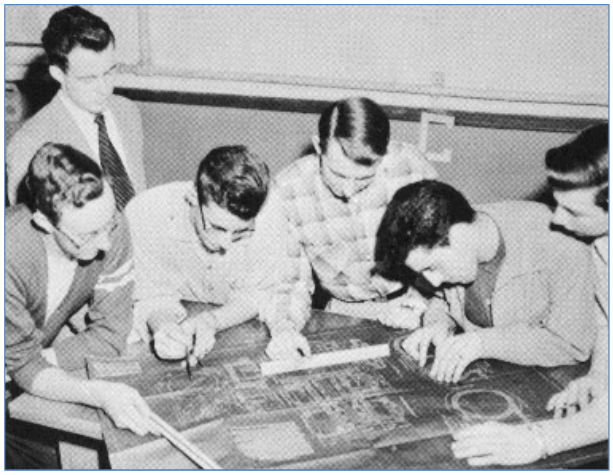
How can we possibly know we're on schedule or on budget without knowing if we're technically compliant?





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# Measures of Technical Parameters†

| Attribute | Description |
|---|---|
| Achieved to Date | ▪ Measured technical progress or estimate of progress in units of performance |
| Current Estimate | ▪ Value of a technical parameter that is predicted to be achieved now or in the future |
| Milestone | ▪ Point in time when an evaluation of the technical measure is accomplished |
| Planned Value | ▪ Predicted value of the technical parameter |
| Planned Performance Profile | ▪ Profile representing the project time phased demonstration of a technical parameter |
| Tolerance Band | ▪ Management alert limits |
| Threshold | ▪ Limiting acceptable value of a technical parameter |
| Variances | ▪ Demonstrated technical variance<br>▪ Predicted technical variance |



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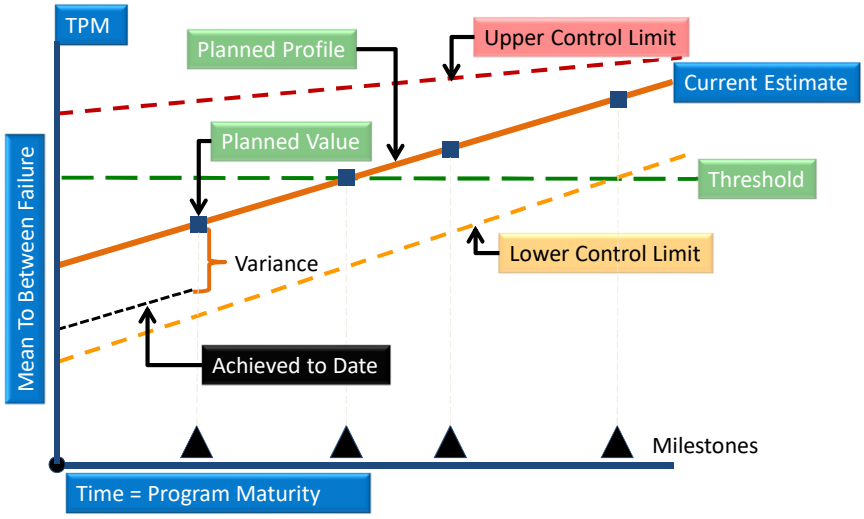
## A Familiar Graphic for TPMs

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## What Do We Need To Know About This Program Through The TPMs?

- What WBS elements represent the TPMs?
- What Work Packages produce these WBS elements?
- Where do these Work Packages live in the IMS?
- What are the Earned Value baseline values for these Work Packages?
- How are we going to measure all these variables?
- What does the curve look like for these measurements?

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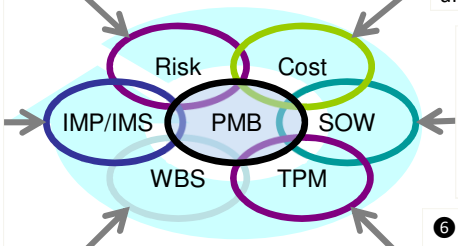
## Let's Connect Some More Dots

❸ Technical and Programmatic ***Risks*** Connected through the WBS, Risk Register, IMP and IMS

❹ Budget at the Work Package level, rolled to the Control Accounts showing cost spreads for all work in the IMS

❷ IMS contains all the Work Packages, BCWS, Risk mitigation plans, with traces to the IMP measuring increasing maturity through Measures of Effectiveness (MOE) and KPPs




❺ Deliverables defined in the SOW, traced to the WBS, with narratives and Measures of Performance (MoP)

❻ Measures of Performance (MOP) for each critical deliverable in the WBS and identified in each Work Package in the IMS, used to assess maturity in the IMP

❶ The Products and Processes in a "well structured" decomposition, traceable to the deliverables

The PMB is the Document of Record for the Program ***Performance is Measured through the PMB***

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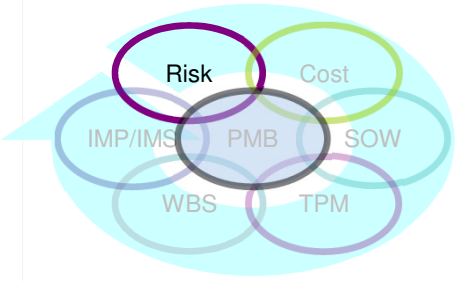
## *Raison d'etre for Technical Performance Measures*

The real purpose of Technical Performance Measures is to reduce Programmatic and Technical RISK

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## Key Elements of A Good TPM

- **Traceability** – Requirements to WBS to TPMs to EV control accounts.
- **Impact** – How much WBS work, & therefore EV money, is covered by the TPM(s)? What is effect?
- **TPM Banding/Sensitivity** – What banding (R/Y/G) and sensitivity (EV impact) should be used for each TPM?
- **Technical Readiness Level** – What's the state of the technology supporting the requirement(s) for which TPM is a metric?

Implementing Technical Performance Measurement , Mike Ferraro , General Engineer, PEO/SYSCOM Conference



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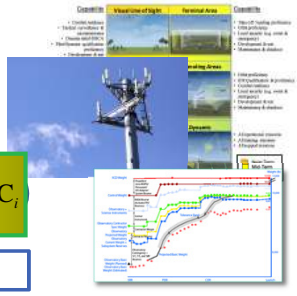
## Determination of Physical % Complete must be informed by both task completion and technical status

***Measuring progress of what people do***

$$\sum_{i=1}^{N} BCWP_i = \sum_{i=1}^{N} BCWS_i \times P\%C_i$$

**Physical % Complete P%C**

***Measuring progress of the Result of what people do***



- Progress of a set of tasks
  - Drawings Completed
  - Lines of Code Written
  - Work Products Produced
  - Reviews Completed
- Progress of the technical status
  - Critical TPM Achievement
  - System Capabilities Met
  - Quality of Work Products
  - System Under Review Acceptable

Progress is measured by *effectiveness* of outcomes to the end user



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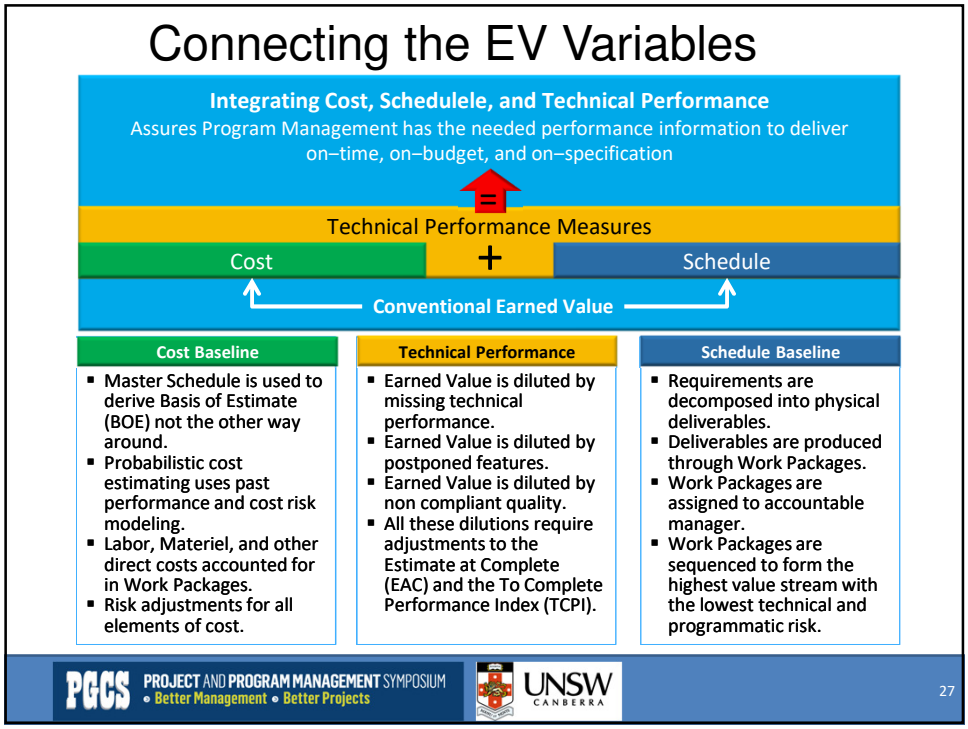
Connecting the EV Variables
Integrating Cost, Schedulele, and Technical Performance
Assures Program Management has the needed performance information to deliver on–time, on–budget, and on–specification
=
Technical Performance Measures
Cost
+
Schedule
Conventional Earned Value
Cost Baseline
Master Schedule is used to derive Basis of Estimate (BOE) not the other way around.
Probabilistic cost estimating uses past performance and cost risk modeling.
Labor, Materiel, and other direct costs accounted for in Work Packages.
Risk adjustments for all elements of cost.
Technical Performance
Earned Value is diluted by missing technical performance.
Earned Value is diluted by postponed features.
Earned Value is diluted by non compliant quality.
All these dilutions require adjustments to the Estimate at Complete (EAC) and the To Complete Performance Index (TCPI).
Schedule Baseline
Requirements are decomposed into physical deliverables.
Deliverables are produced through Work Packages.
Work Packages are assigned to accountable manager.
Work Packages are sequenced to form the highest value stream with the lowest technical and programmatic risk.
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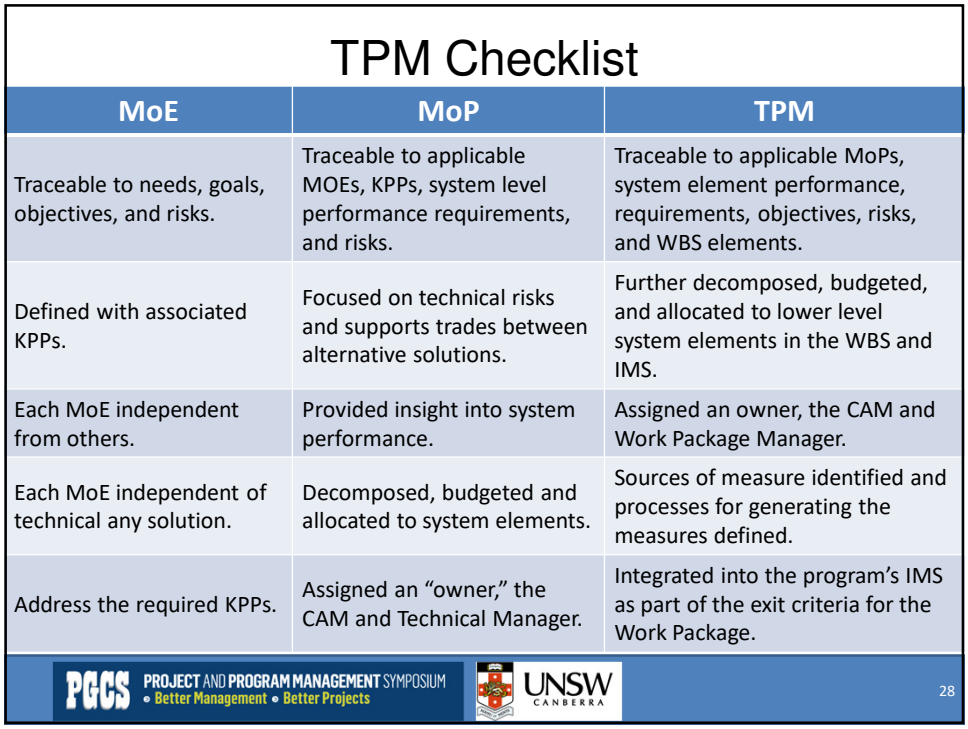
TPM Checklist
MoE
MoP
TPM
Traceable to needs, goals, objectives, and risks.
Traceable to applicable MOEs, KPPs, system level performance requirements, and risks.
Traceable to applicable MoPs, system element performance, requirements, objectives, risks, and WBS elements.
Defined with associated KPPs.
Focused on technical risks and supports trades between alternative solutions.
Further decomposed, budgeted, and allocated to lower level system elements in the WBS and IMS.
Each MoE independent from others.
Provided insight into system performance.
Assigned an owner, the CAM and Work Package Manager.
Each MoE independent of technical any solution.
Decomposed, budgeted and allocated to system elements.
Sources of measure identified and processes for generating the measures defined.
Address the required KPPs.
Assigned an “owner,” the CAM and Technical Manager.
Integrated into the program’s IMS as part of the exit criteria for the Work Package.
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## Summary of TPM Benefits

- Measures of results based on technical achievement
- Integrated technical performance with budget and schedule – providing an integrated systems approach to performance measurement
- Establishes the linkage between engineering and cost/schedule considerations in program management decision making
- Measures the programmatic impact of technical variance in terms of risk
- Reduces subjectivity through the establishment of technical performance baseline



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## Past Issues with Earned Value Management and Scheduling

- Ability to take credit for all work accomplished
- How to defend what work was earned
- Identifying EV milestones in the schedule focused attention on those tasks so that maximum earned value could be taken
- IMS was too detailed to manage the program
- CAM's used other means to manage and assess progress related to their work; i.e. detailed schedules
- Detailed schedules did not reflect what was reported in IMS

Solution – Quantifiable Backup Data (QBD)



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## Quantifiable Backup Data (QBD)

- A QBD is a supplement to the IMS to help manage discrete work at a lower level than is maintained in the IMS
- The QBD measures the work objectively
  - 748-C calls out on Page 1
  - Objectively assess accomplishments at the work performance level
- QBD's are part of the PMB
- QBD's do not replace the EVMS Earned Value Techniques (EVT)



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## Quantifiable Backup Data (QBD)

- A detailed listing of tasks necessary to complete all scope in a work package during the defined period of performance.
- It is an approach used to objectively measure performance
  - Each task on the list is weighted – total weighting equals 100% of the work package BAC (weighting is important, should not be equal weighting on every task).
  - Upon completion of QBD development the QBD is placed under configuration control.
  - The CAM assesses physical percent complete of each QBD task.
  - The percent complete is calculated from the cumulative assessments.
- The purpose of the QBD is to:
  - Ensure and demonstrate that all contract work is accounted for;
  - Ensure the schedule and budget are realistic and achievable;
  - Mitigate schedule and budget risks; and,
  - Provide a basis for objectively assessing progress for discretely measured work packages.



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