Keynote Address

Strategies to Detect, Prevent, and Correct the Causes of Complex Program Stress and Failure

Glen B. Alleman
Niwot, Colorado, USA

PGCS PROJECT AND PROGRAM MANAGEMENT SYMPOSIUM
Better Management Better Projects

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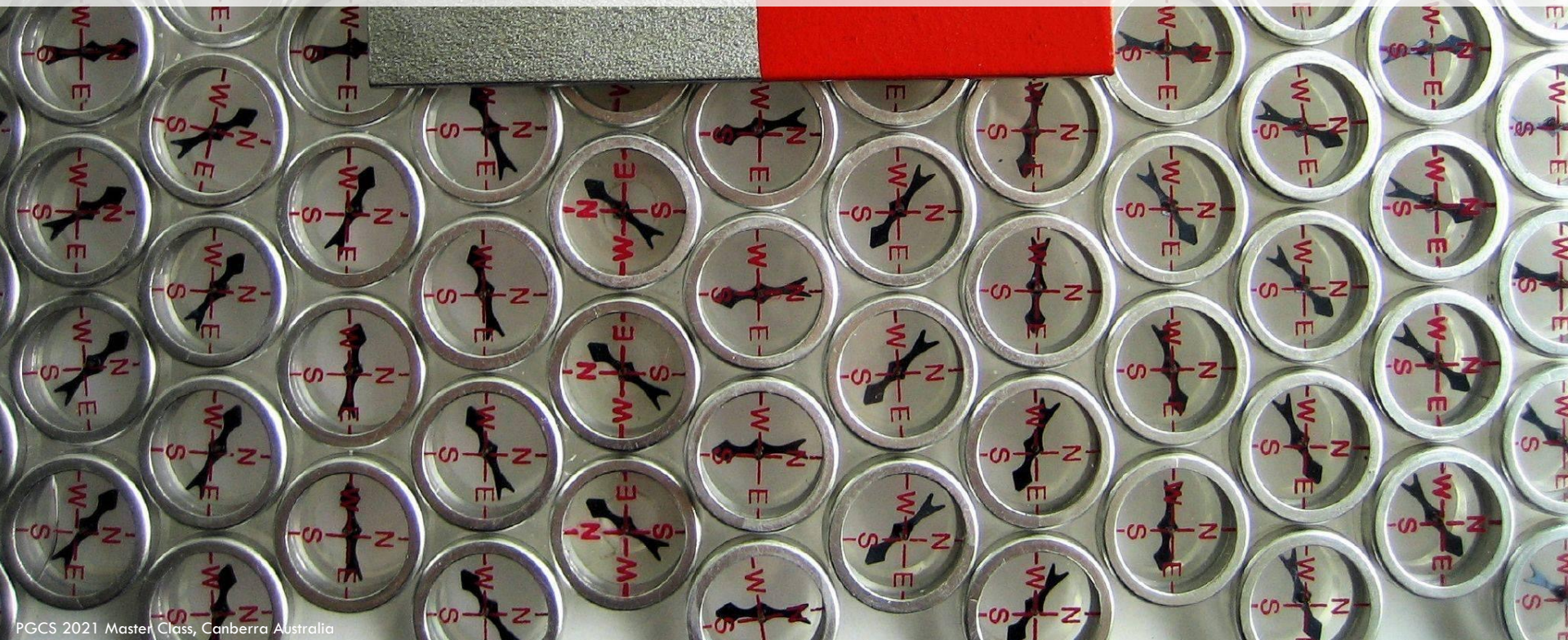
"Why do so many projects overspend and overrun?

Because they're managed as if they were merely *Complicated* when in fact, they are *Complex*.

They're planned as if everything is known at the start when in fact, they involve high levels of uncertainty that create cost, schedule, and technical risk."

Architecting Systems: Concepts, Principles and Practice,
Hillary Sillitto, College Publications, 2014.

The goal of all successful program management processes is to align the measures of Effectiveness and Performance into a cohesive process to Increase Probability of Success



Causes of Program Failure

Four Primary Causes of Project and Program Failure and their contributions that impact the probability of success (POPS) are driven by the failure of Systems Engineering and Program Management principles, processes, and practices to address the root causes of these four primary causes.	Systems Engineering Causes					Program Management Causes				
	Inadequate understanding of technical, operational and programmatic requirements	Lack of system engineering, discipline, and authority	Lack of cost, schedule, and technical planning and oversight	Stovepiped development, with late integration of deliverables	Lack of Subject Matter Expertise	Incomplete, obsolete, inflexible system and programmatic architectures	Low visibility to Risk and missing handling plans	Overestimating technology maturity of deliverables and systems	Failure to Measure Physical Percent Complete for all performance metrics	Failure to identify Uncertainties creating risks and their handling strategies
1. **Unrealistic** Performance Expectations, with missing Measures of Effectiveness and Measures of Performance	X	X		X	X	X	X	X		X
2. **Unrealistic** Cost and Schedule Estimates, based on inadequate risk adjusted growth models	X	X	X		X	X	X	X	X	X
3. **Inadequate** assessment of risk and unmitigated exposure to these risk without proper handling plans	X	X	X		X	X	X		X	X
4. **Unanticipated** technical issues without plans and solutions to maintain effectiveness and performance of product or service	X	X	X	X	X	X	X	X	X	X

Adapted with permission, from Mr. Gary Bliss, Director PARCA, Office of Assistant Secretary for Acquisition Technology and Logistics, US Department of Defense

Root Causes of Cost & Schedule Growth start with …

- Not adequately specifying what ***Done*** looks like, in Measures of Effectiveness (MOE) and Measures of Performance (MOP) for outcomes prior to starting work,
- Not quantifying the Reducible and Irreducible uncertainties that will create risks to the probability of success of the program, and
- Failing to manage these risks, created by uncertainties to the MOP which each MOE during execution of the program.

Corrective and Preventive Actions for keeping the Program on Plan, answer 5 questions … †

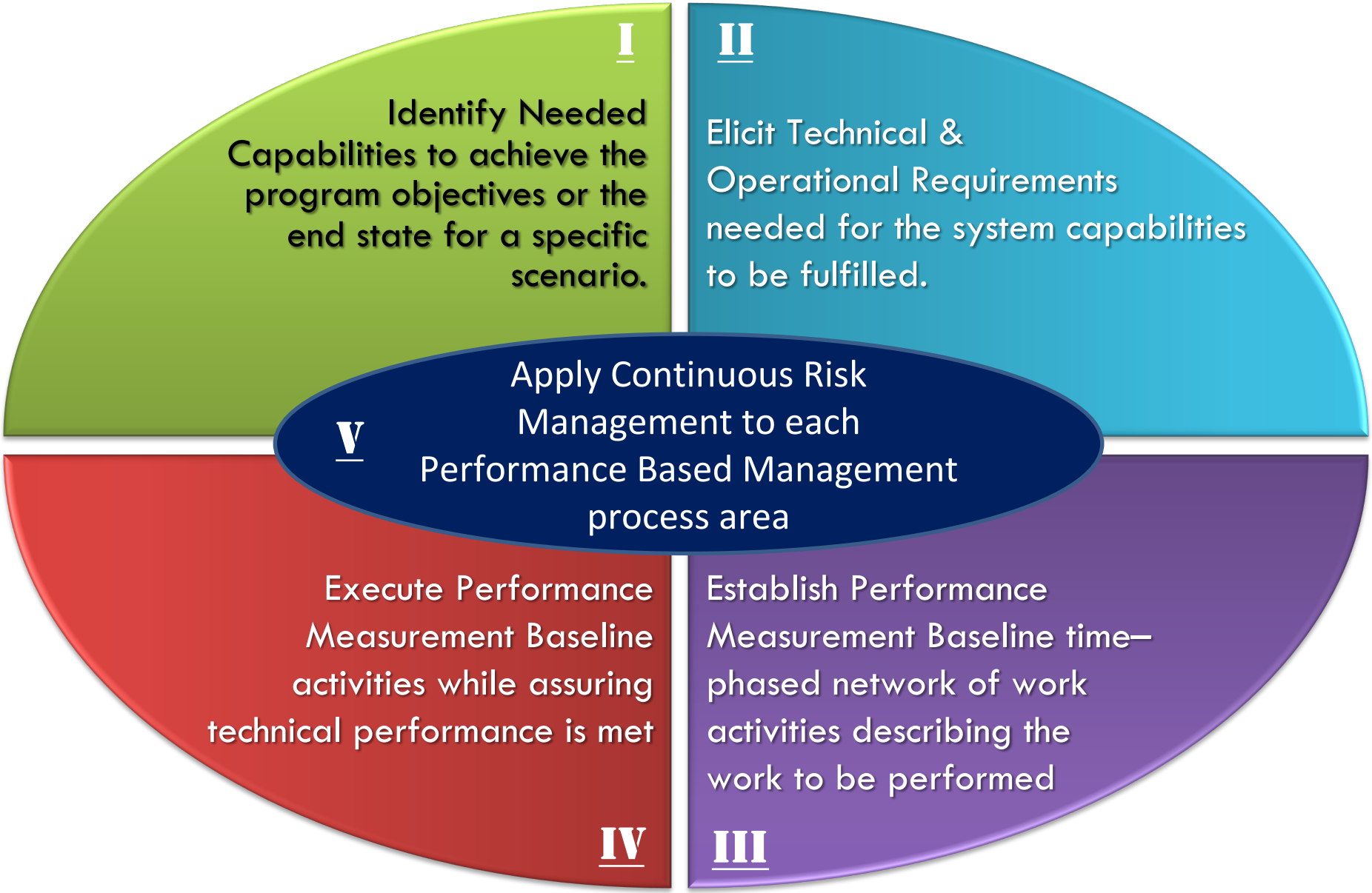
1. What does ***Done*** look like in units of measure meaningful to the decision maker?
2. What is the ***Plan*** and ***Schedule*** to reach ***Done*** with needed ***Capabilities***, at needed time, for needed cost?
3. What ***time***, ***money***, and ***resources*** are needed to reach ***Done*** and in what period are they needed?
4. What ***impediments*** must to be discovered on the way to ***Done*** and with their corrective or preventive actions?
5. What ***Units Of Measure*** are needed to credibly assess progress toward ***Done***?

† These Five Principles are from *Performance-Based Project Management: Increasing the Probability of Project Success*, Glen Alleman, American Management Association, 2014

One Critical Success Factor for Increasing Probability of Program Success is …

- Integrating the data and processes used by the program controls and engineering staff to track, and manage technical and programmatic performance, along with the technical and programmatic risks to that performance.
- By integrating Systems Engineering, Technical and Operational Engineering, and Programmatic and Technical Performance Management processes into an *Integrated Program Performance Management System* (IPPMS), the program can be put on the road to success.

5 *Practices* for Increasing Probability of Success



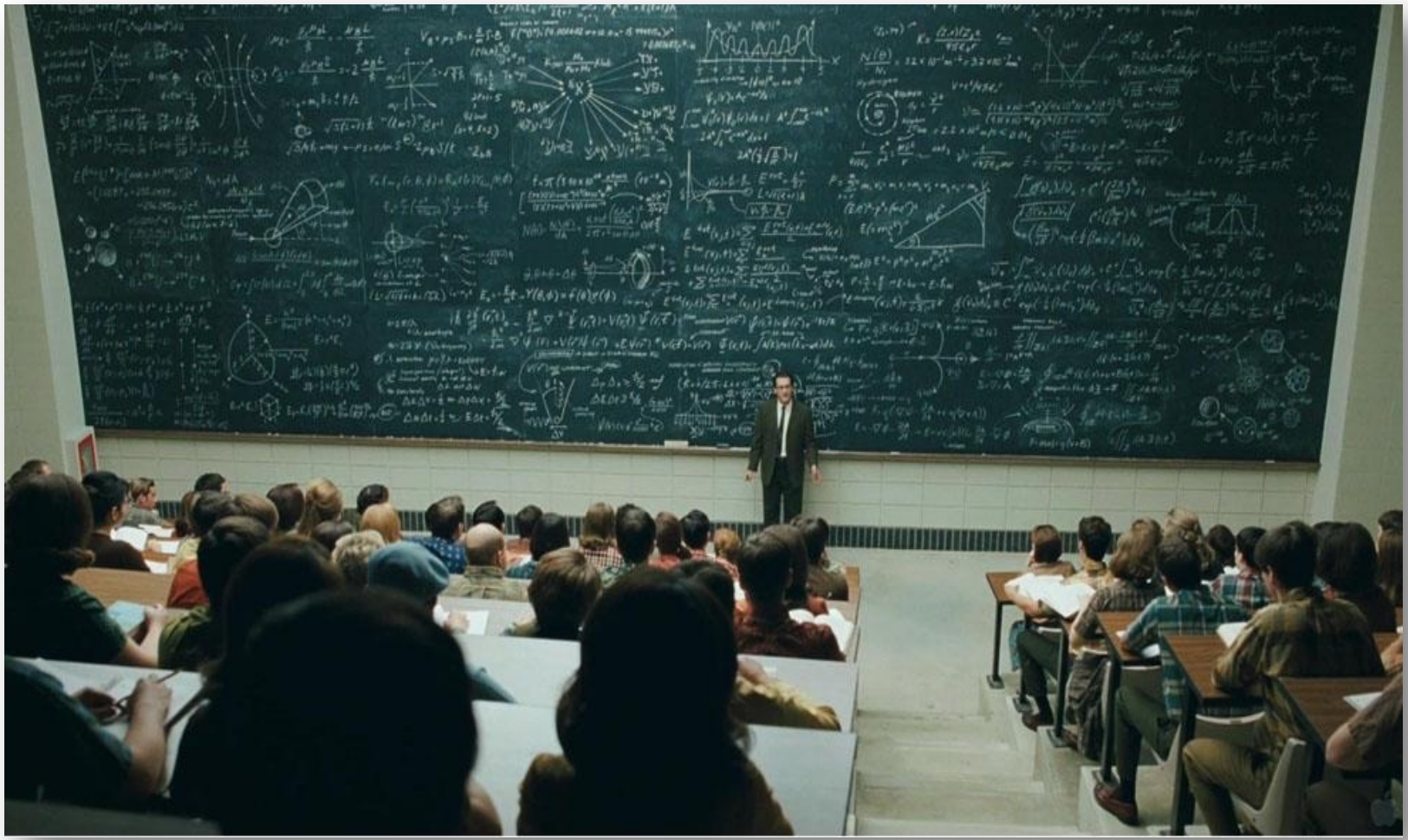
The Concept of an Essential View

Essential Views increase the probability of program success through the data provided to the Integrated Program Management Processes through Leading and Lagging Indicators, and other elements of the Performance Measurement Baseline.

"Lagging Indicators" are data contained in the IPMR. This data must be verified for its credibility before any "leading indicators" can be used.

"Leading Indicators," provide credible forecasts of cost and schedule, using the "Lagging Indicators" and other measures of effectiveness and performance.

Essential Views Are About The Risk Adjusted Actionable Information Needed To Keep The Program **GREEN**



Data is necessary, but not sufficient to take corrective actions for Program Success

What is an Essential View?

Essential Views mean they are essential to the success of program.

There are many views of the program's performance.

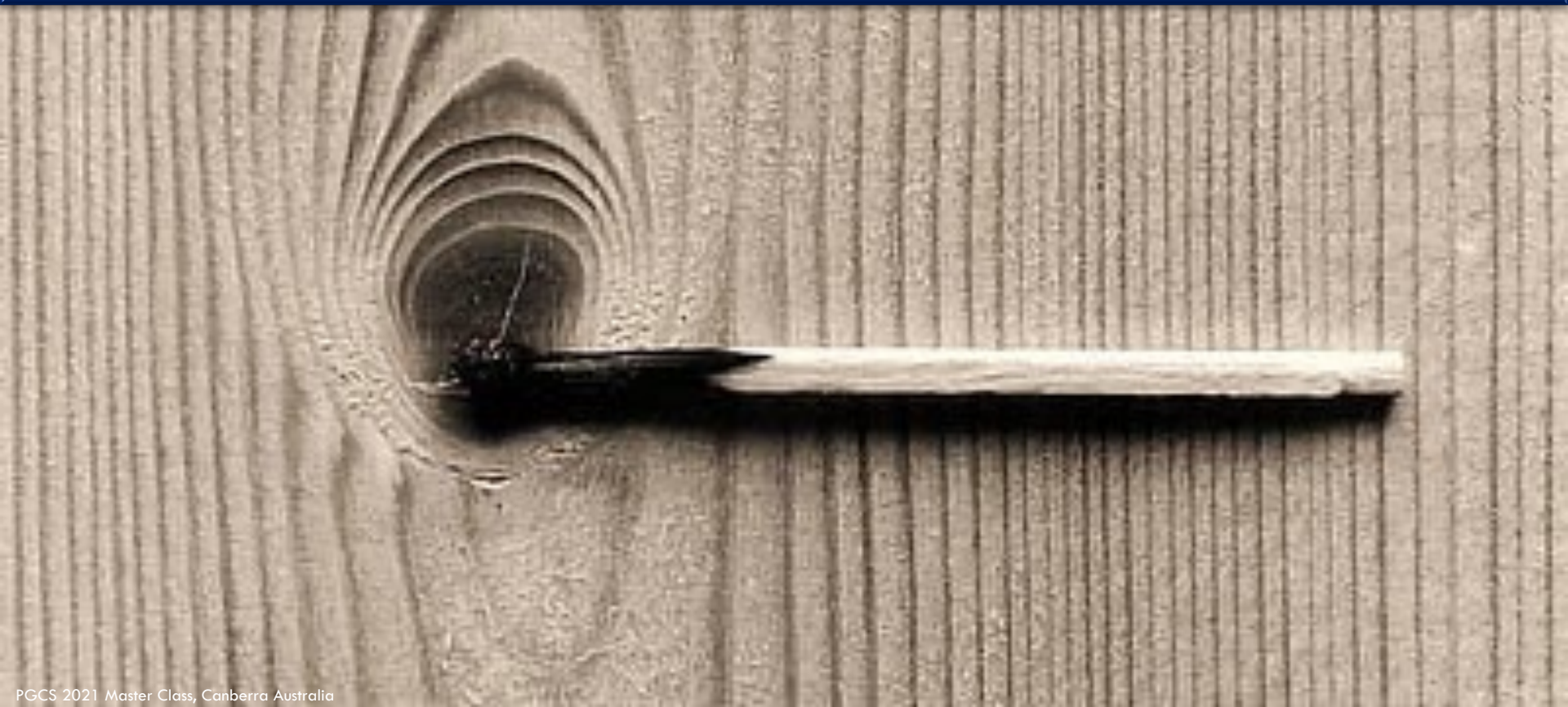
Many are required by acquisition directives; they report past performance.

But these views may or may not be *Essential*.

Let's define what it means to be *Essential* and what are the elements of these views.

An Essential Views Turns on the Lights …

…to provide a program performance forecast for *In Progress* activities.
Don't wait until the Milestone has passed.
It's too late then to take corrective actions.
PUT OUT THE FIRES BEFORE THEY START



Critical Success Factors (CSF) for Essential Views

The Metrics and Key Performance Indicators (KPI) that are the basis of the *Essential Views*, must be established for those critical activities that can have a direct impact on the success or failure of the project. This includes the tracking of assumptions and value.†

† Project Management Metrics, KPIs, and Dashboards, A Guide to Measuring and Monitoring Project Performance, Harold Kerzner, Ph.D., John Wiley & Sons, 2011

Five Immutable Elements of Program Success with the Needed Evidence for Success

Principle	Evidence the Principle is put into Practice
Where are we going?	▪ Integrated Master Plan (IMP) ▪ SOW, WBS, ConOps, KPP, CBP
How do we get there?	▪ Integrated Master Schedule (IMS)
Do we have enough resources?	▪ Resources and need dates in IMS (RLS)
What impediments will we encounter?	▪ Risk Management Plan (RMP) ▪ Risk adjusted IMS (RR)
What are the measures progress?	▪ Earned Value Measures (EV) ▪ Technical Performance Measures (TPM) ▪ Measures of Effectiveness (MoE) ▪ Measures of Performance (MoP) ▪ Key Performance Parameters (KPP)

Increasingly Credible Performance Indicators

Increasing visibility using credible information of actual program performance, in units of measure meaningful to the decision makers

Increasing fidelity of program performance

	Operational definition of Credible, means …	Units	Docs
6	Compliance with Planned Key Performance Parameters at each stage of program maturity in units measures of mission effectiveness	KPP	CBP
5	Compliance with Planned Program Key Performance Parameters (KPP) for each deliverable at each stage of program maturity	KPP	SOW
4	Compliance with Planned Measures of Effectiveness (MoE) for each deliverable at each stage of program maturity	MOE	IMP
3	Compliance with Planned Measures of Performance (MoP) for each deliverable at each stage of program maturity	MOP	IMP
2	Probabilistic Estimate at Completion (EAC) using EV Data, Technical Performance Measures (TPM), Risks, and probabilistic forecasting models	EAC, TPM, RR	PMB
1	Earned Value Data derived from risk adjusted past performance	EV	PMB

Both Leading and Lagging Indicators are Needed For The Essential Views

The information provided by the program performance measurements in the past Contract Performance Reports describes cost and schedule measures from past periods and the current period.

The past periods are Cumulative, meaning the variances that make up that cumulative measure are *hidden* in the value of the numbers. †

The current period is the *actual* measure. There can be other measures that make use of past performance, but those are typically cumulative or averaged in some way.

For a credible *leading indicator,* we need all the past data in its raw form.

† *How to Lie With Statistics*, Darrell Huff, Norton, 1954. Chapter 2 tells how to *Lie* by selecting a well–chosen average

Essential Views must have both …

Lagging Indicators

- Cumulative and current period
  - Cost performance to date
  - Schedule performance to date
  - Risk retirement to date
  - Technical performance to date
- Heat matrix of variance
- Scheduled delivered against planned delivery

Leading Indicators

- Probability of Success (PoPS)
- Current execution index (CEI)
- Baseline Execution Index
- TPM forecast range
- Risk retirement range
- Probabilistic EAC
- Probabilistic ECD

Common gaps found in data, produce less than credible results†

Attribute	Impact for the data on the IPMR
Completeness	Missing or unusable
Conformity	Stored in non–standard format
Consistency	Values give conflicting information
Accuracy	Incorrect or out of date
Duplicates	Records or attributes repeated
Integrity	Missing or not referenced

† David G. Ahern, Director Portfolio Systems Acquisition, Deputy Assistant Secretary of Defense

A Final Reminder

Facts do not cease to exist because they are ignored.

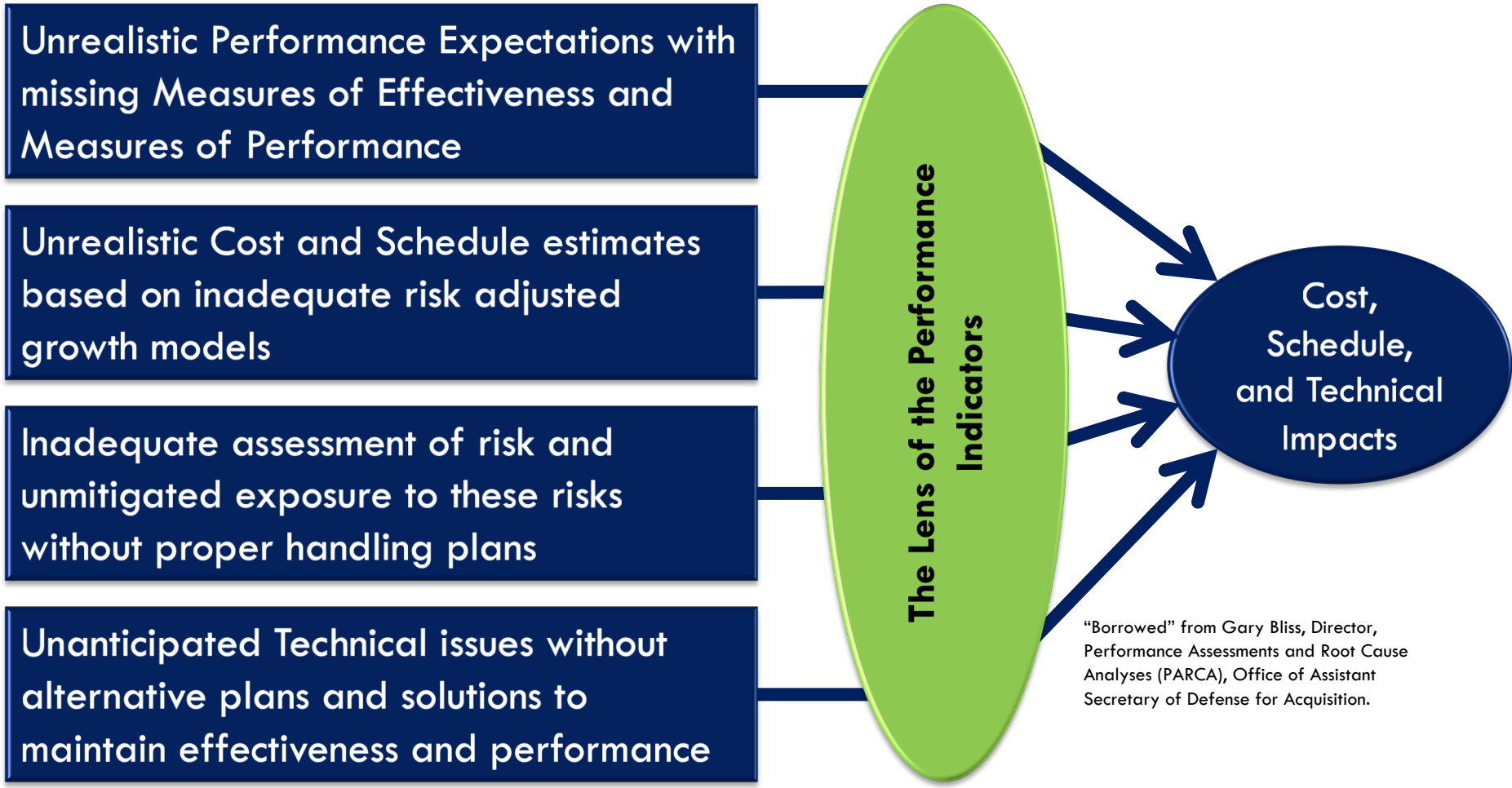
– Aldous Huxley

1894 – 1963

Failure Modes of All Programs

- Four Primary Causes of Program Failure
- Systems Engineering Source of Failure
- Program Management Sources of Failure

Four Primary Root Causes of Project Failure



"Borrowed" from Gary Bliss, Director, Performance Assessments and Root Cause Analyses (PARCA), Office of Assistant Secretary of Defense for Acquisition.

Systems Engineering Sources of Program Failure

Major Contributors to Poor Program Performance

- Inadequate understanding of requirements
- Lack of systems engineering discipline, authority, and resources
- Lack of technical planning and oversight
- Stovepipe developments with late integration
- Lack of subject matter expertise at the integration level
- Availability of systems integration facilities
- Incomplete, obsolete, or inflexible architectures
- Low visibility of software risk
- Technology maturity overestimated

Five Immutable Principles of Program Success

All successful projects adhere to five immutable principles during their lifecycle. These principles are independent of any project or program domain or context in that domain.

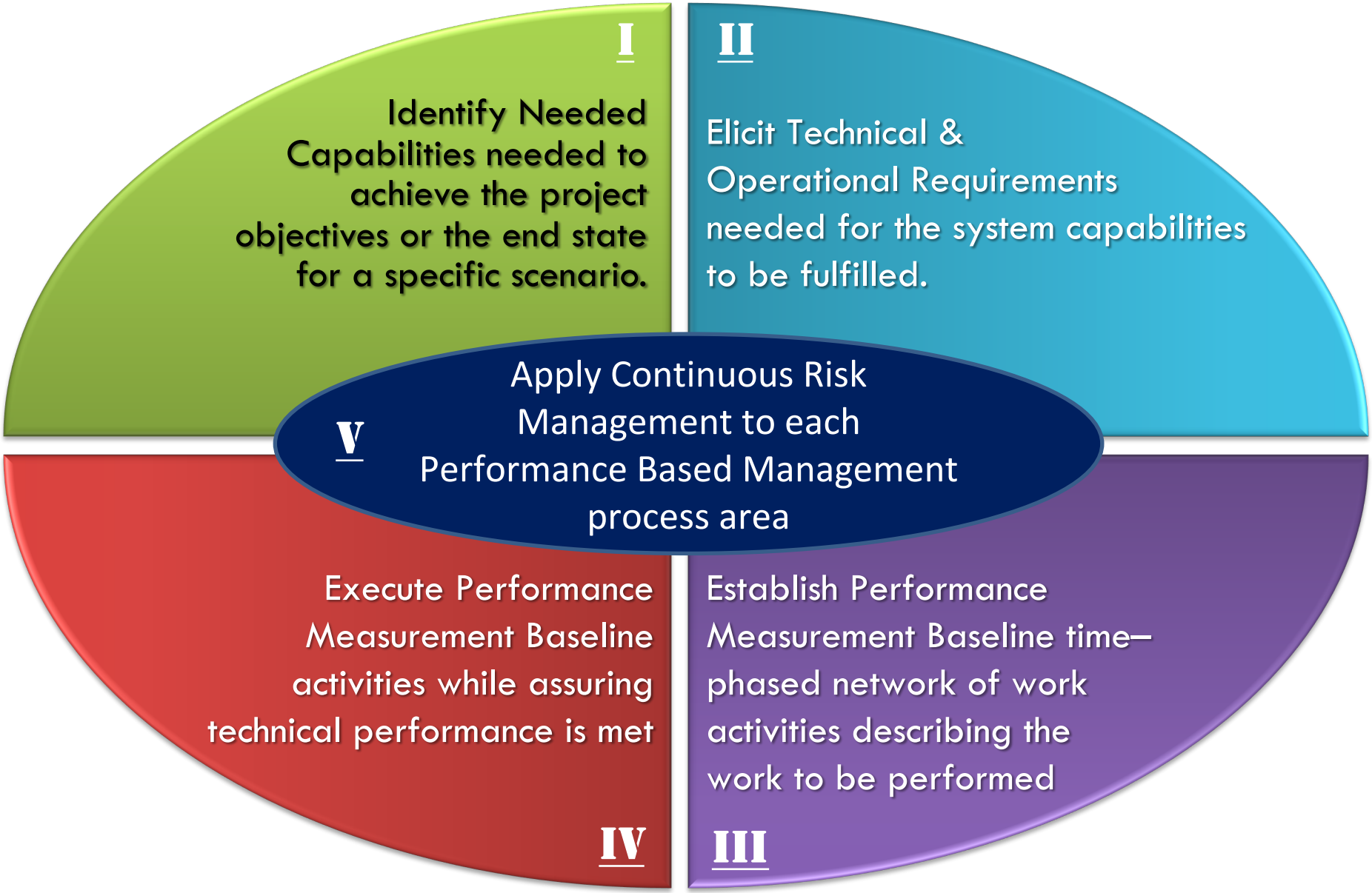
They are also independent of any project management or product development method as well, including Agile.

They ask five questions that must have credible answers that establish the foundation for success. Without credible answers to these 5 questions, the project has little hope of success.

5 Immutable Principles of Program Success

1. Where Are We Going?
2. How Do We Get There?
3. Do We Have Enough Time, Resources, And Money To Get There?
4. What Impediments Will We Encounter Along The Way?
5. How Do We Know We Are Making Progress?

5 *Practices* for Increasing Probability of Success



5 Practices of Performance-Based Project Management®

5 Immutable Principles	I Identify Needed Capabilities	II Establish Requirements Baseline	III Performance Measurement Baseline (PMB)	IV Execute the PMB	V Continuous Risk Management
Where are we going?	ConOps, SOO, SOW	Technical and Operational Based Plan	Incremental Maturity Measures	Physical Percent Complete	Risk Identification
How are we going to get there?	Integrated Master Plan (IMP)	Work Breakdown Structure	Integrated Master Schedule (IMS)	Iterative and Incremental Delivery	Risk Analysis
What do we need along the way?		Resource Management Plan		Future Performance Forecasting	Risk Handling Plans
What impediments will we encounter along the way?	4 Levels of Uncertainty: 1) Variance 2) Foreseen 3) Unforeseen 4) Chaos	Technical and Programmatic Risk handling assigned to all WBS deliverables	Risk adjustments to cost and schedule measures	Risk adjusted Performance Measurement Baseline	Risk Tracking and Reporting
How do we measure progress?	Measures of Effectiveness (MoE)	Measures of Performance (MoP)	Technical Performance Measures (TPM)	Earned Value Management (EVM)	Risk Control

I – Identify Needed Capabilities

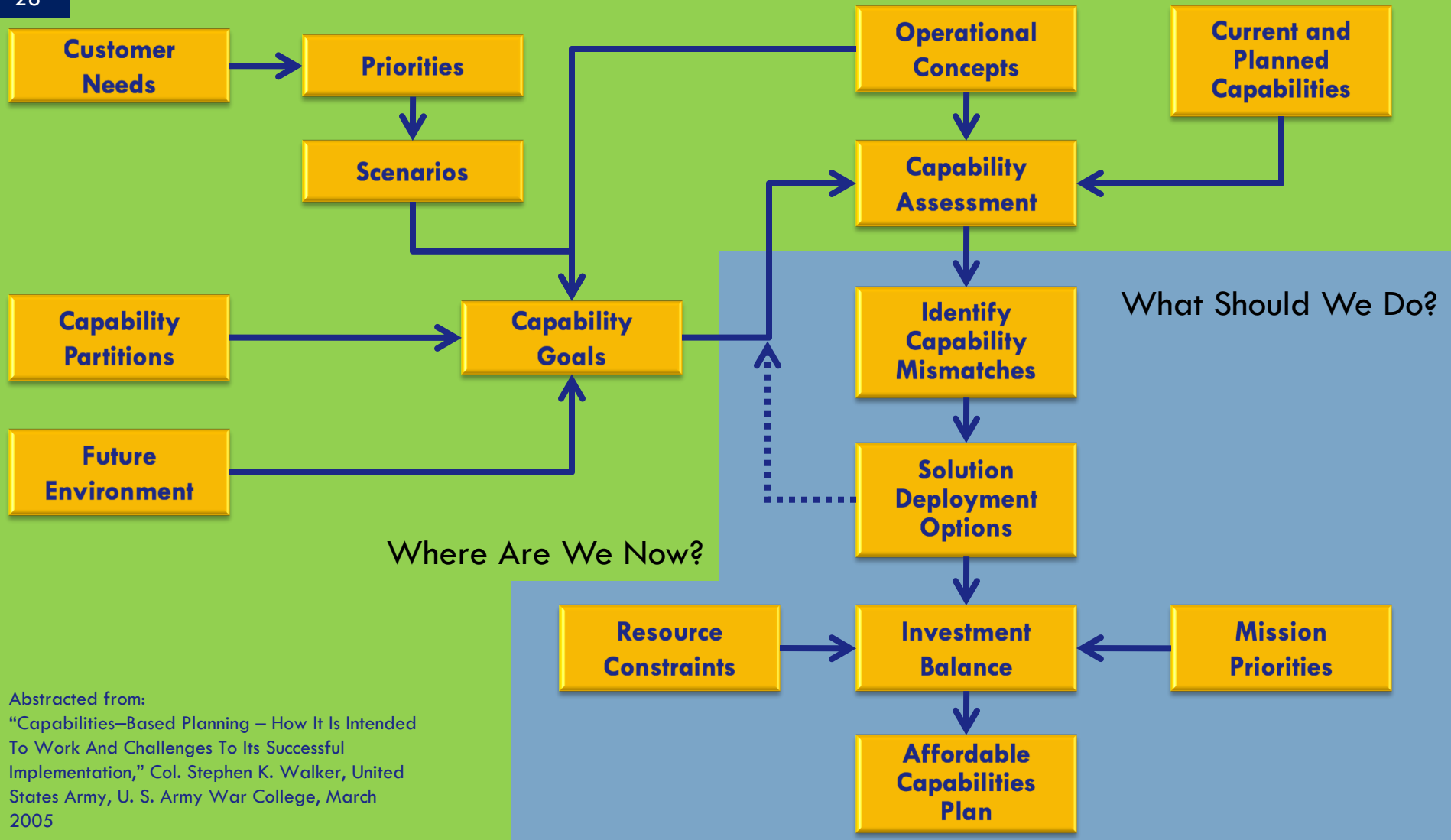
"Planning, under uncertainty, to provide capabilities suitable for a wide range of modern-day challenges and circumstances while working within an economic framework that necessitates choice."

By Identifying system capabilities, the elicited technical and operational requirements can be traced from the Measures of Effectiveness (MOE) to each deliverable in the Integrated Master Plan and Schedule.

Capabilities state the "why" of the system.

† Analytic Architecture for Capabilities-Based Planning, Mission-System Analysis, and Transformation, Paul Davis, RAND, 2002

Identifying Needed System Capabilities



Abstracted from:
"Capabilities–Based Planning – How It Is Intended To Work And Challenges To Its Successful Implementation," Col. Stephen K. Walker, United States Army, U. S. Army War College, March 2005

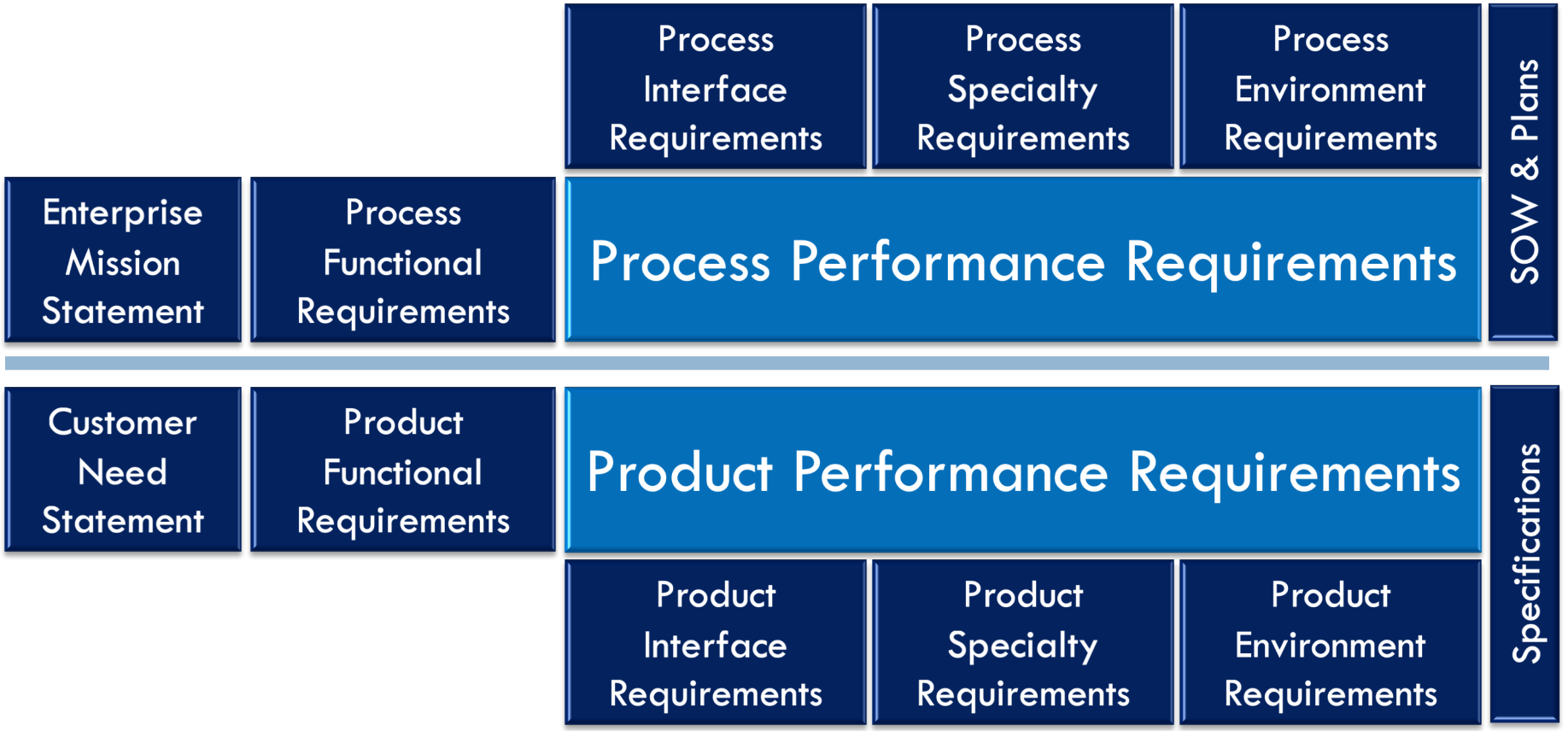
II – Establish the Technical and Operational Requirements

Technical and Operational requirements are the basis of Work Packages and Planning Packages and the work efforts needed to produce the deliverables from these Packages.

These deliverables fulfill the technical and operational requirements needed to deliver the system Capabilities.

Tracing Capabilities to Requirements and back again, assures each requirement has a “home” in the system.

Identify Requirements That Deliver Capabilities †



† *Systems Requirements Practices*, Jeffery O. Grady, McGraw Hill, 1993

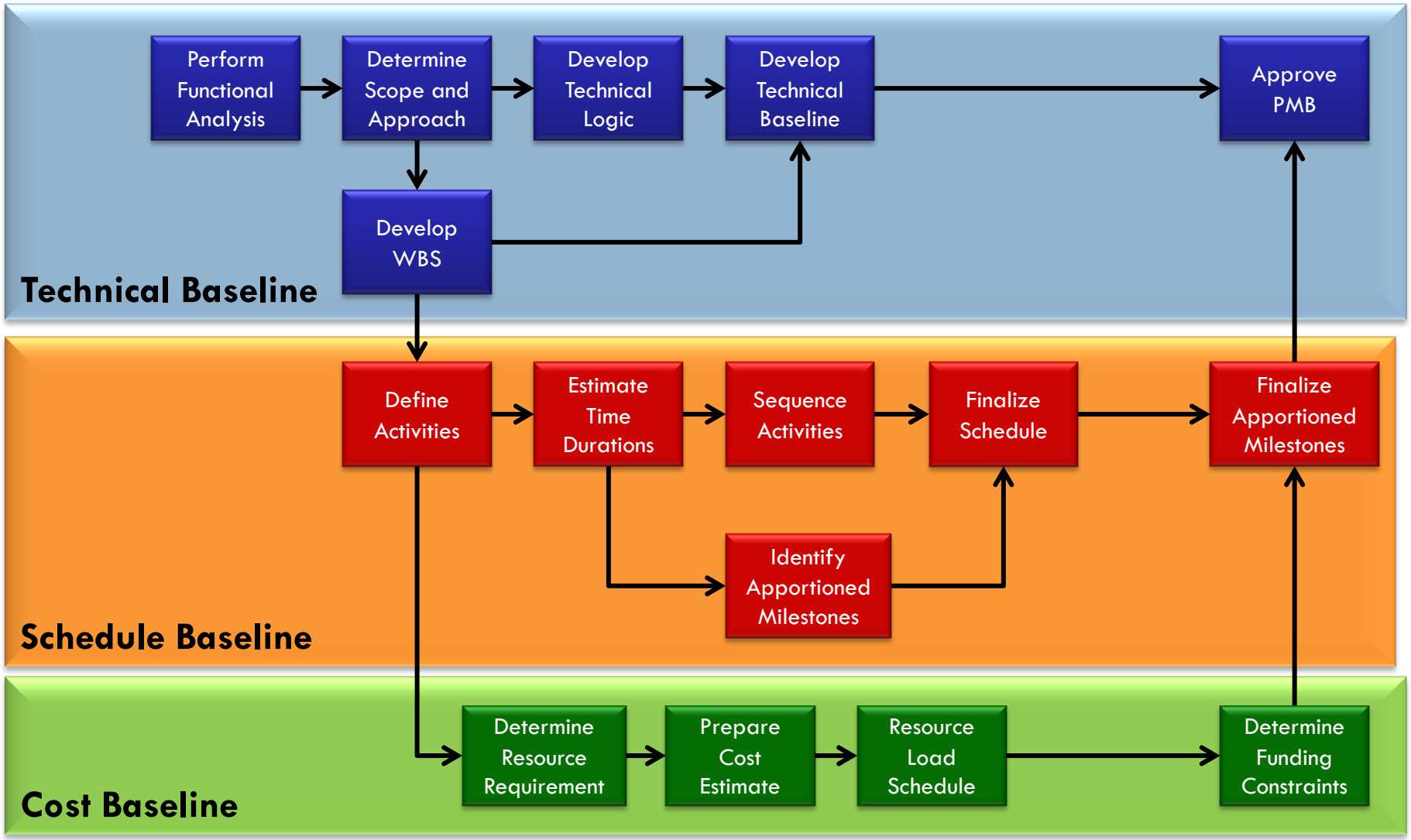
III – Establish the Performance Measurement Baseline

The Performance Measurement Baseline (PMB) is the integrated scope, schedule, host used to assess progress to plan using measures of physical percent complete.

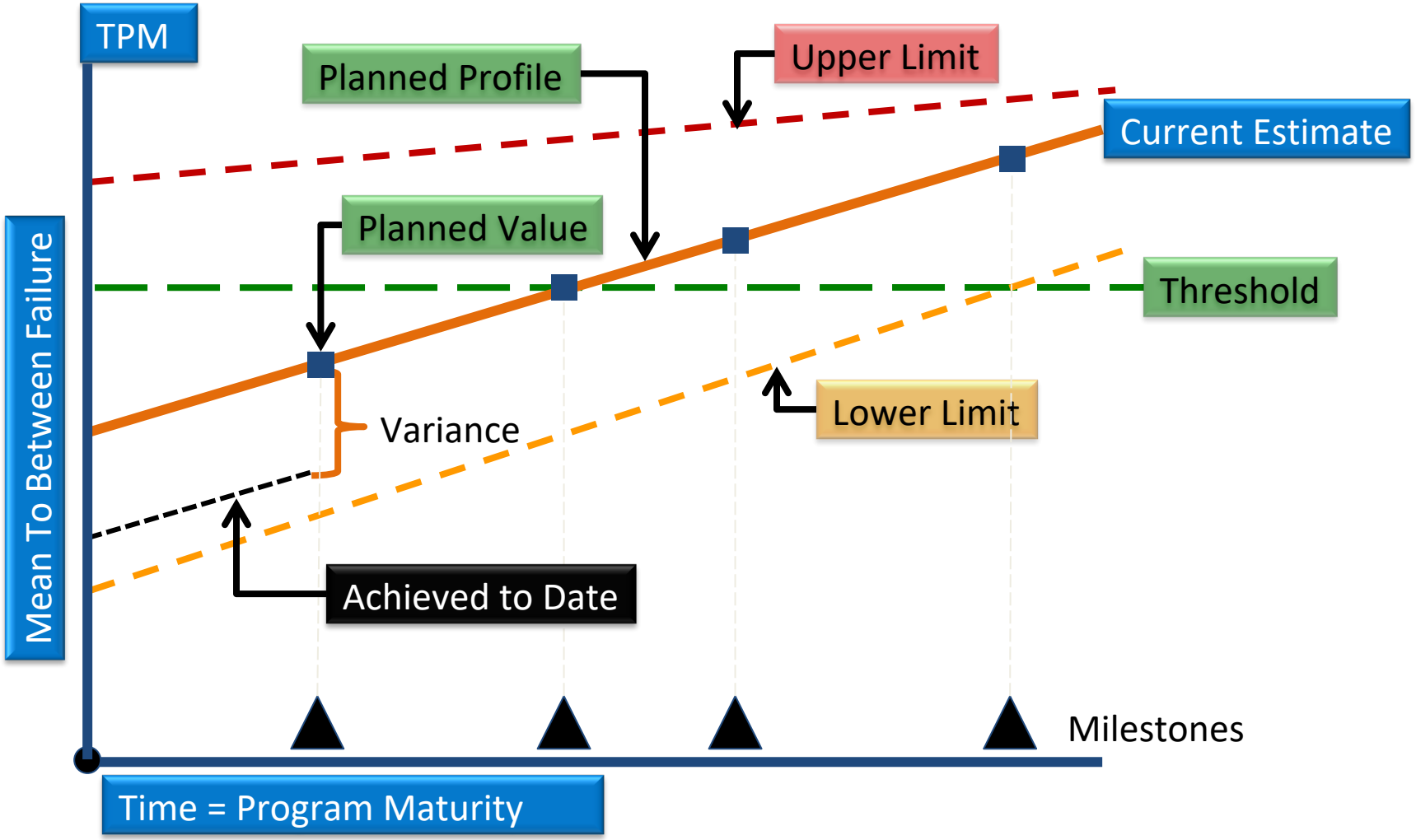
Starting at the Work Package level, a pre–defined performance measure is established.

During the performance period assessment of "progress to plan" produce measures of Physical Percent Complete.

Establish the Three Elements of the Performance Measurement Baseline



Technical Performance Measures (TPM)



IV – Execute the Performance Measurement Baseline

Using the Performance Measurement Baseline (PMB), each Work Package must start as planned, complete on or near the planned date, and produce the planned technical performance.

This is the key to success for any credible Performance Based Management plan.

In the absence of this, the program is behind schedule, over budget, and non–compliant with the technical goals.

V – Perform Continuous Risk Management

This section is extracted from the Software Engineering Institute's Continuous Risk Management (CRM) Guidebook.

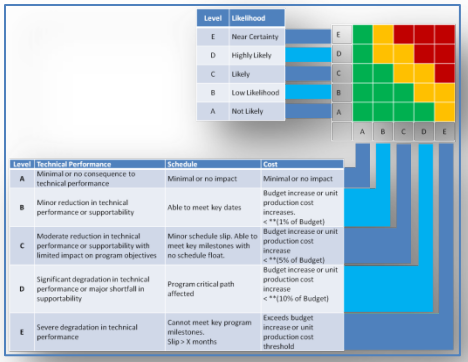
CRM describes the underlying principles, concepts, and functions of risk management and provides guidance on how to implement it as a continuous practice in projects and organizations.

Perform Continuous Risk Management

Uncertainty Creates Risk

Irreducible (Aleatory)

Reducible (Epistemic)



Natural Variability

Ambiguity

Periods of Exposure to Natural Variance

Ontological Uncertainty (UNK UNK)

Probabilistic Events

Probabilistic Impacts

Periods of Exposure to Events

One Last Reminder

Risk Management is Project Management for Adults

Tim Lister

Waltzing with Bears: Managing Risk on Software Projects,
Tom de Marco and Timothy Lister, Dorset House Publishing (2003)

25 Essential Views for Increasing the Probability of Project Success

Using the TSAS example program, let's see how the 25 Essential Views can inform the Program Management Process to assure we are Increasing the Probability of Success

An Essential View (Metric) Must Provide

- Evidence of an executable plan with information showing the plan is based on meeting the required technical objectives, resourced with personnel with the requisite skills, and risk tolerant
- Monthly cost and schedule status progress tightly coupled with achieving the technical objectives and management of risks
- Insight to key problem areas (both WBS elements and key activities within the IMS)
- Predictive information about the effort remaining (and remaining risks) so corrective and preventive actions can be taken before those aspects become an issue.

The 25 Essential Views Needed to Increase the Probability of Program Success

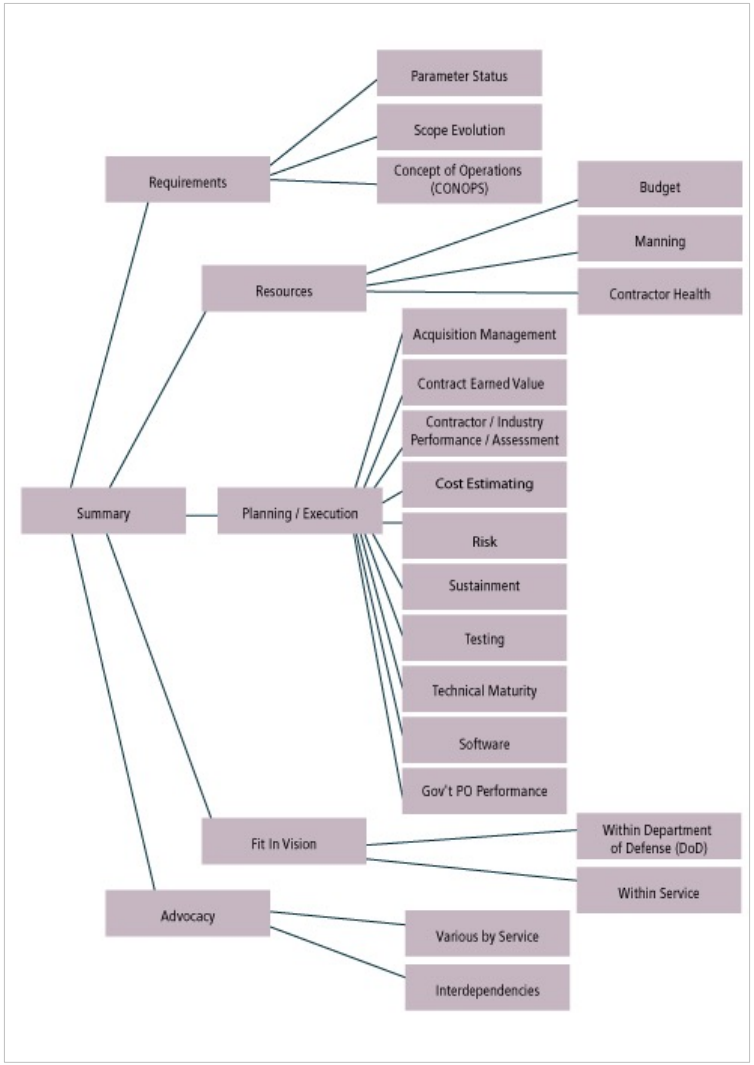
1. Key Technical Performance Measures plan(s)
2. Deliverables plan
3. Summary level of the Integrated Master Schedule (IMS) and proposed budgeted cost of work scheduled thru projected contract completion
4. Labor Full Time Equivalent (FTE) utilization plan
5. Schedule health and performance checks
6. Risk register and mitigation actions
7. Risk burn down plan
8. Computation of initial management reserves (MR) using the IMS and risk register
9. Computation of schedule margin (SM) using the IMS and the risk register
10. TPM plan vs estimated actuals vs cost and schedule performance metrics (CPI, SPI)
11. Deliverables plan vs actuals vs the CPI and the SPI
12. Labor plan vs actuals
13. Cumulative CPI, SPI, and SPIt against IBR spend plan, with percent spent, percent complete, and percent scheduled;
14. Risk Burn-Down Plan vs Actuals;
15. Cost and schedule performance informed by the Risk Burn Down Actuals for Select Risks;
16. Schedule heath and performance metrics
17. Composition of WBS Costs to Budget at Complete Total
18. Management Reserve and BAC Projection
19. Contract Modification Percent Change;
20. Baseline Revisions Index;
21. Forecast of Estimate At Completion (EAC) and Estimated Completion Date (ECD) using performance data;
22. Updated Risk Register;
23. Confidence level of EACs and ECDs; and
24. Schedule Sensitivity Indices.
25. Cost Sensitivity Indices.

Connecting the Dots to Increase Probability of Program Success

Determining the ability of a program to succeed in delivering systems or capabilities, the US Military services developed the Probability of Program Success (PoPS) approach.

PoPS standardizes the reporting of certain program factors and areas of risk. Each service measures a slightly different set of factors, but all the tools use a similar hierarchy of five factors at the top level. These factors are Requirements, Resources, Execution, Fit in Vision, and Advocacy.

Metrics to Assess Probability of Program Success†



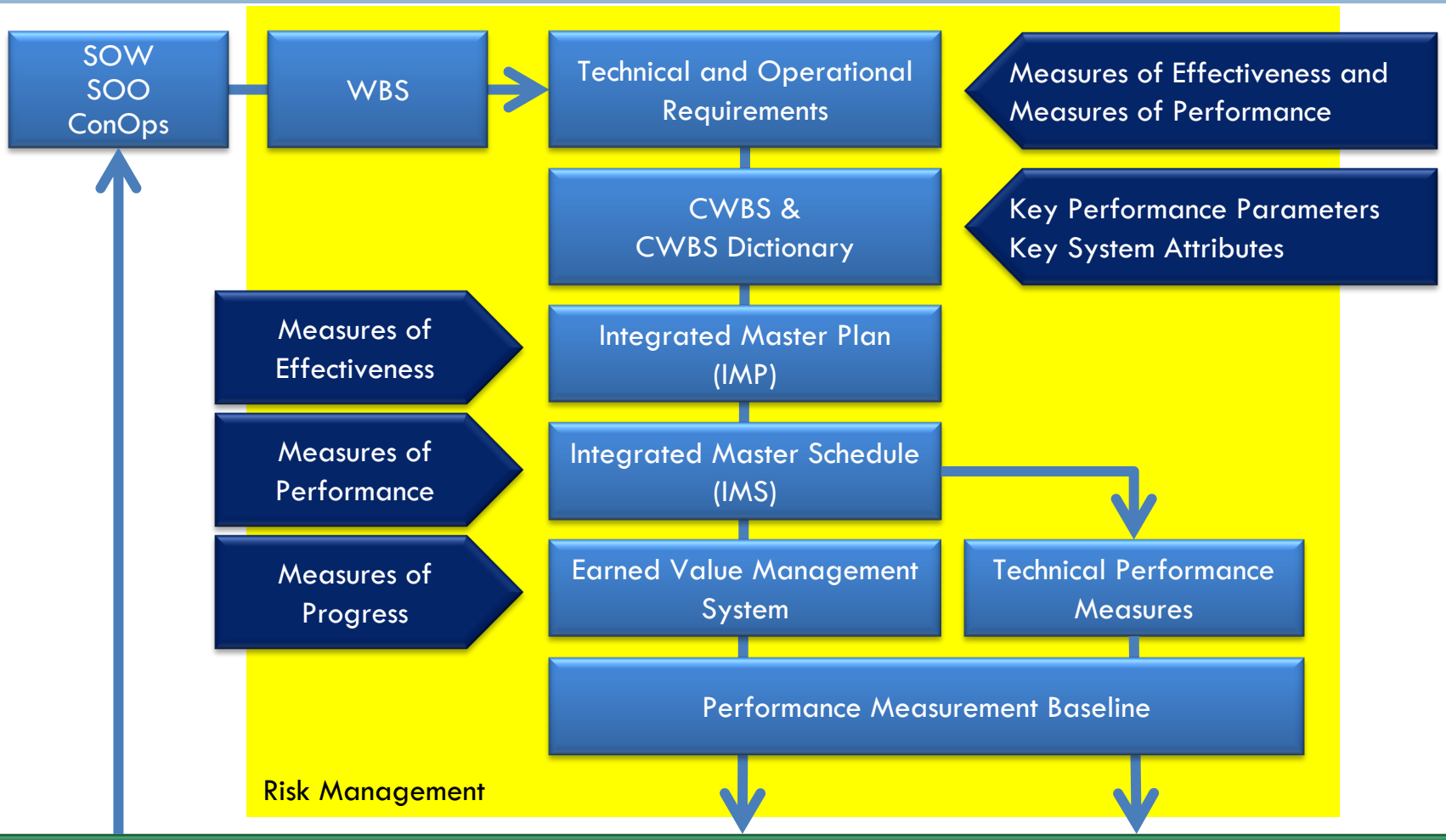
- Associated with each factor are metrics
- Determining the value of each metric is the responsibility of the acquisition program team. System engineering inputs are relevant to most of the reporting items; some are more obvious than others.
- The 25 Essential Views and MITRE's Leading Indicators are the foundation for assessing PoPS

† MITRE Systems Engineering Guide, Acquisition Management Metrics

Connecting the Managerial Dots

Connecting the Programmatic Dots

Connecting the Execution Dots



Objective Status and ***Essential Views*** supporting the proactive processes needed to keep program GREEN

The Description of DONE Starts with the Integrated Master Plan (IMP)

A primary failure mode of complex programs is not having a clear, concise, measurable definition of Done, in units of measure meaningful to the decision makers

This starts with the Integrated Master Plan †

† "Integrated Master Plan and Integrated Master Schedule Preparation and Use Guide," Version 0.9, October 21, 2005

The IMP tells us What Done Looks Like in Units of Measure Meaningful to the Decision Makers

The Integrated Master Plan (IMP) Is A Strategy For The Successful Completion Of The Project

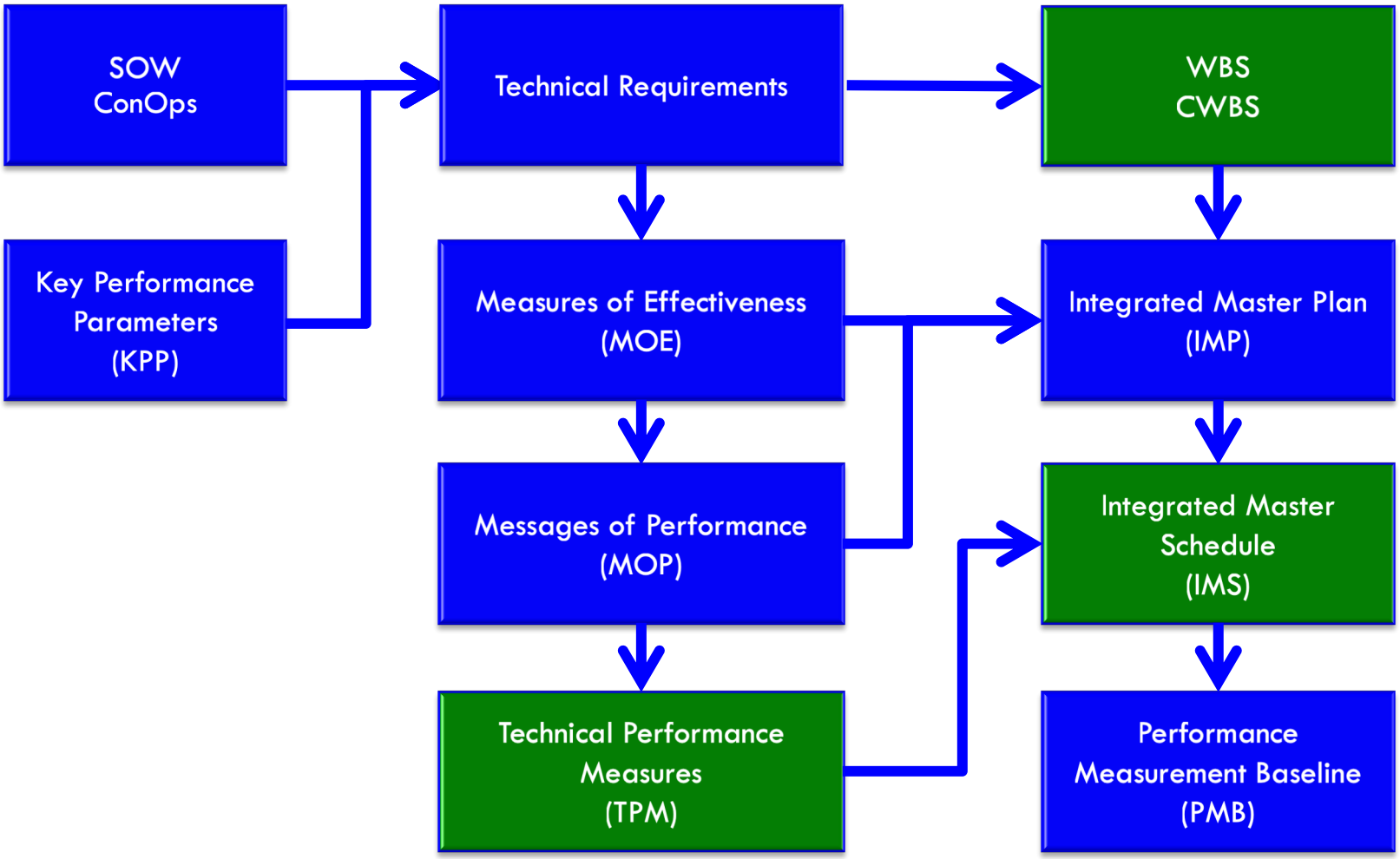
The Plan describes where we are going, the various paths we can take to reach our destination, and the progress or performance assessment points along the way to assure we are on the right path.

These assessment points measures the "maturity" of the product or service against the planned maturity. This is the only real measure of progress – not the passage of time or consumption of money.

The Importance of the IMP

- The IMP is the single most important document to a program's success
  - It clearly demonstrates the providers understanding of the program requirements and the soundness of the approach a represented by the plan
- The IMP/IMS provides:
  - Up Front Planning and Commitment for needed Capabilities from all participants
  - A balanced design discipline with risk mitigation activities
  - Integrated requirements including production and support
  - Management with an incremental verification for informed program decisions

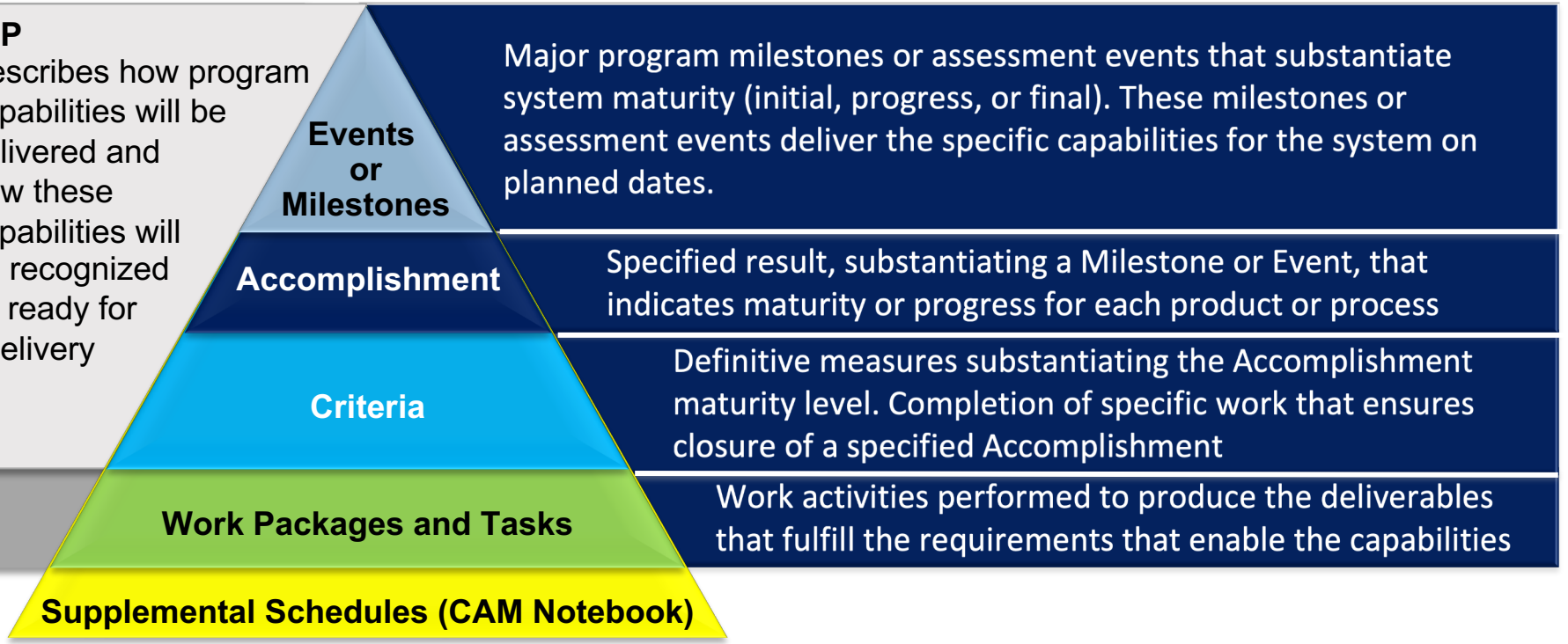
The IMP Captures System Requirements in MOEs, MOPs, KPPs, and TPMs



The IMP / IMS Structure

IMP
Describes how program capabilities will be delivered and how these capabilities will be recognized as ready for ddelivery

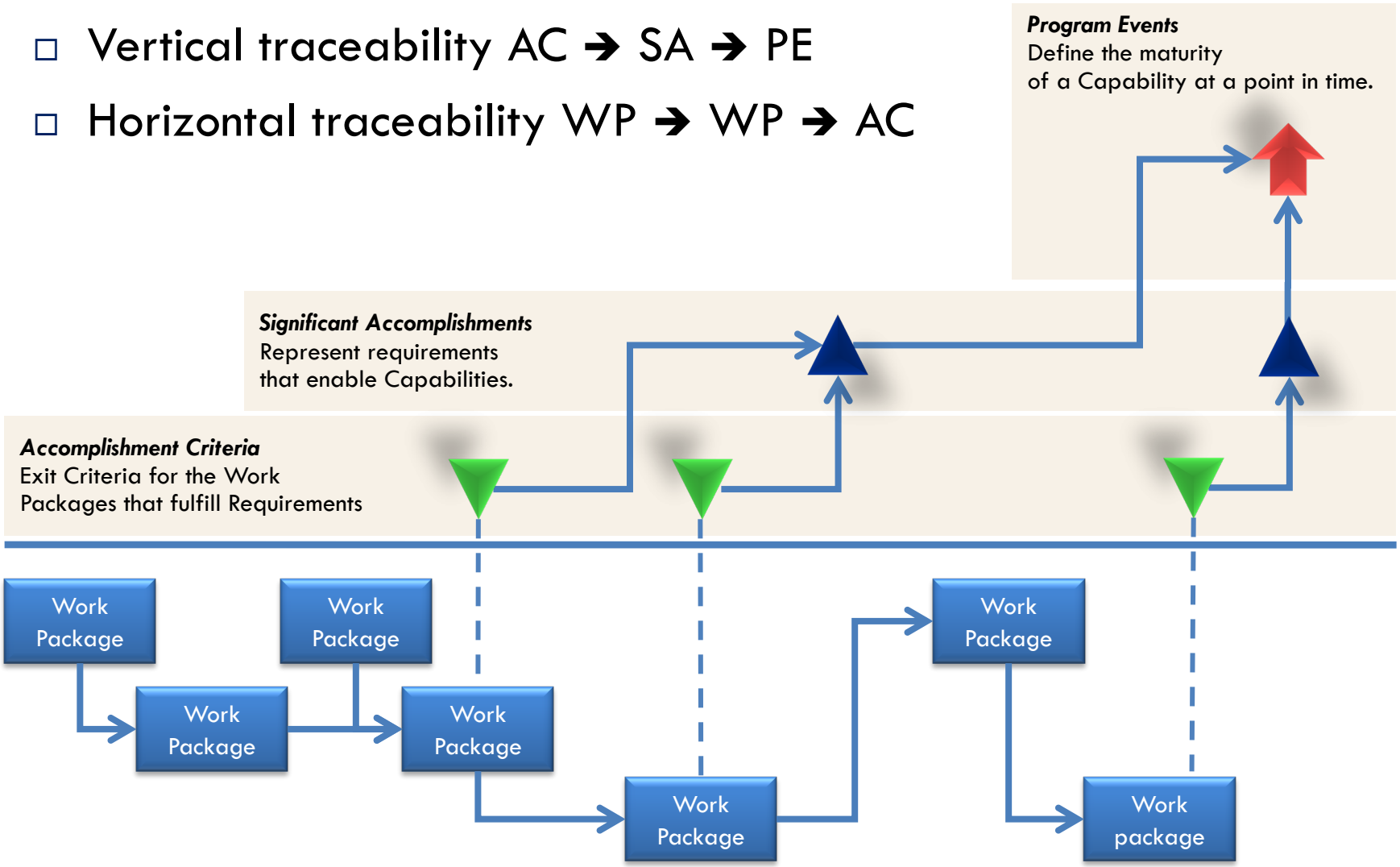
IMS



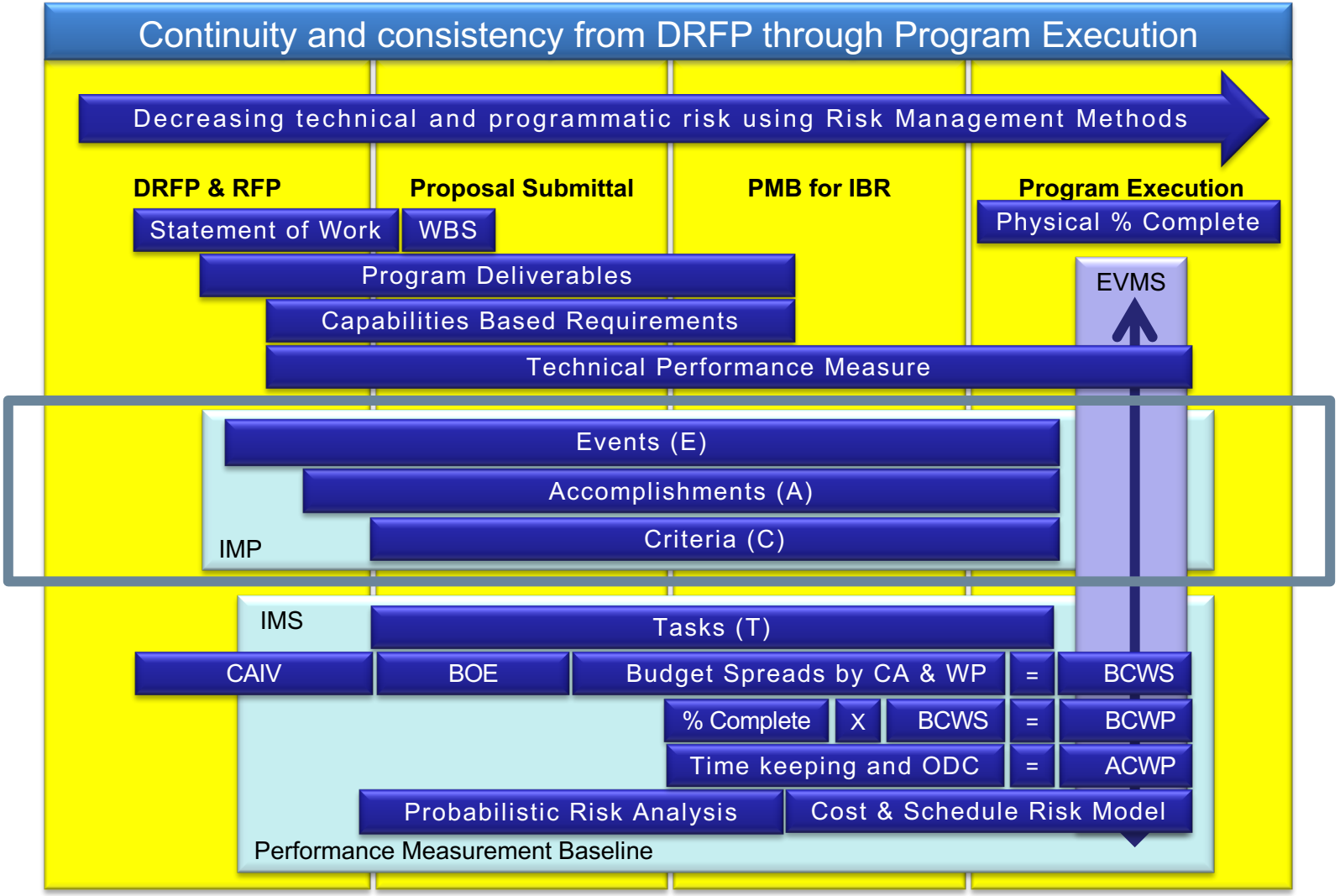
This decomposition is not unique to the IMP/IMS paradigm. Without some form of decomposition of what ***DONE*** looks like, it is difficult to connect the work of the project to the outcomes of the project. This decomposition – which is hierarchical – provides the mechanism to increase cohesion and decrease coupling of the work effort. This coupling and cohesion comes from the systems architecture world is has been shown to increase the robustness of systems. The project cost, schedule, and resulting deliverables are a system, subject to these coupling and cohesion.

Vertical and Horizontal Traceability

- Vertical traceability AC ➔ SA ➔ PE
- Horizontal traceability WP ➔ WP ➔ AC



The Integrated Master Plan's Role During Project Execution

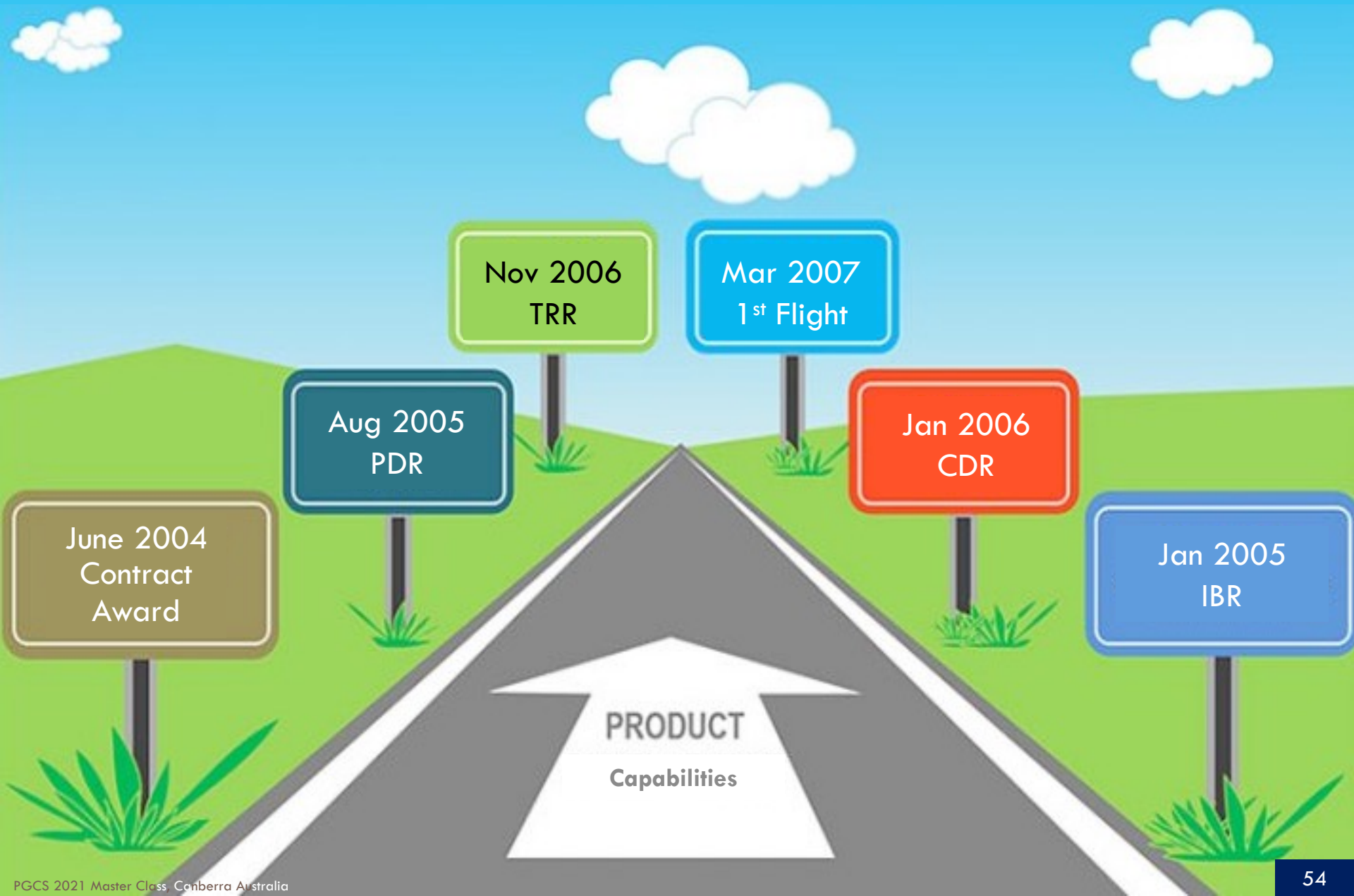


5+1 Steps to Building the IMP/IMS

The Integrated Master Plan (IMP) says what Done looks like in measures of increasing maturity of the Deliverables, through assessment of the Significant Accomplishments and Accomplishment Criteria †

† "Better Schedule Performance Assessments Derived from Integrated Master Plan-References Schedule Metrics," David C. Bachman.

The IMP Tells Us Where We Are Going
The IMS Tells Us When We Plan To Arrive



Program Events are the Assessment of the Evolving Maturity of the Program's Capabilities

- Program Events are maturity assessment points in the program
- They define what levels of maturity for the products and services are needed before proceeding to the next maturity assessment point
- The entry criteria for each Event defines the units of measure for the successful completion of the Event
- The example below is typical of the purpose of a Program Event

The Critical Design Review (CDR) is a multi-disciplined product and process assessment to ensure that the system under review can proceed into system fabrication, demonstration, and test, and can meet the stated performance requirements within cost (program budget), schedule (program schedule), risk, and other system constraints.

The SA's Define The Entry Criteria for Each Program Event

Preliminary Design Review Complete

AC's Are Higher Fidelity Models of the Program's Increasing Maturity Flow

Work is Done in "Packages" that Produce Outcomes Measured with TPM's

The 6 Steps Result In An IMP/IMS Showing What Done Looks Like

The ***Plan*** Tells Us "How" We are Going to Proceed Toward Done
The ***Schedule*** Tells Us "What" Work is Needed to Make Progress Toward Done

- The IMP is the "Outer Mold Line", the Framework, the "Going Forward" Strategy for the Program.
- The IMP describes the path to increasing maturity and the Events measuring that maturity.
- The IMP tells us "How" the program will flow with the least risk, the maximum value, and the clearest visibility to progress.
- The IMS tells us what work is needed to produce the product or service at the Work Package level.

Niwot Ridge, LLC
4347 Pebble Beach Drive
Longmont, Colorado 80503
+1 303 241 9633
glen.alleman@niwotridge.com

Performance-Based Project Management®

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Integrated Master Plan
Integrated Master Schedule
Earned Value Management
Risk Management
Proposal Support Services

Performance-Based Project Management® is a field proven, practical approach to increasing the Probability of Program Success by providing actionable information in units of measure meaningful to the decision maker.