

Keynote – 2
Integrating
Systems Engineering (SE)
and
Program Performance Management (PPM)
to create ...

A Match Made in Heaven

Glen B. Alleman
Tuesday 20 August 2019
9:35AM – 10:35AM

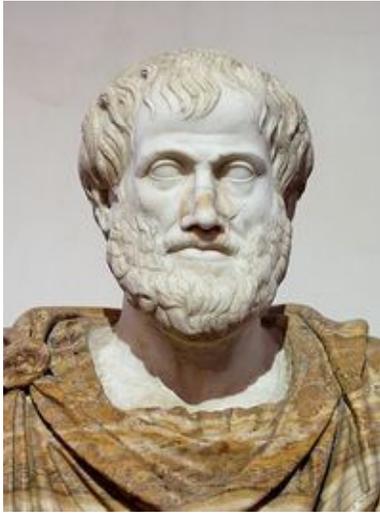
PGCS PROJECT AND PROGRAM MANAGEMENT SYMPOSIUM
• Better Management • Better Projects

 UNSW
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August 21–22, 2019

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Timeless Advice



The way to success is ...

First, have a definite, clear, practical idea – *a goal, an objective.*

Second, have the necessary means to achieve your ends – *wisdom, materials, and methods.*

Third, adjust your means to that end.

– *Aristotle*

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More Timeless Advice

*Du siehst den Wald vor lauter
Baument nicht*



*You don't see the forest for all
the trees*

When we start with requirements – **The Trees** – we loose sight of what **Done** looks like – **The Forest** – since we have no **Measures of Effectiveness (MOE)** and **Measures of Performance (MOP)** for the needed **Capabilities** produced by the Project.

Systems Engineering starts by identifying the MOEs and MOPs for each **Capability**.

Only when those **Capabilities** are defined, in those units of measure, can we start developing the **Technical Performance Measures (TPM)** and Operational requirements that are the basis of all project success.

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Let's Put This Advice to Work

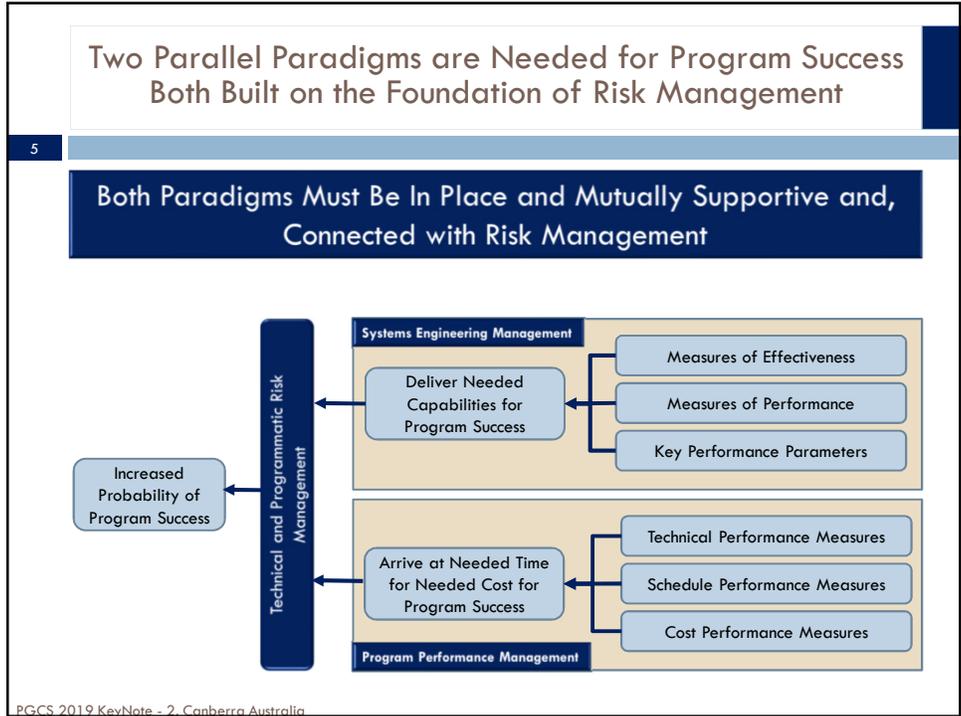
For project success we must know what **Done** looks like in units of measure meaningful to the Decision Maker

These Measures of Effectiveness and Measures of Performance
Start with Systems Engineering



- Define the System Capabilities first,
- Only then define Requirements, Plans, Risk and Performance Management targets and goals.
- Then adjust each of these for risk created by Reducible and Irreducible Uncertainty.

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- All Project Success Starts with
Capabilities-Based Planning
- 6
- Describing What Done Looks Like in Units of Measure
Meaningful to the Decision Makers
- What **Capabilities** do we need possess to accomplish our Mission or fulfill our Business Strategy?
 - What are the **Measures of Effectiveness (MOE)** and **Measures of Performance (MOP)** for these Capabilities?
 - What **Technical Performance Measures (TPM)** are needed for each deliverable to fulfill each MOE and MOP of each **Capability**?
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The Two 1/2's (SE and PPM) Needed to Make a Whole

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Systems Engineering is an interdisciplinary field of engineering and engineering management, focused on the design and management of complex systems throughout their life cycles.
At its core, systems engineering utilizes systems thinking principles to organize this body of knowledge.

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Program Performance Management is the Principles, Processes, and Practices for identifying and managing the work needed deliver the outcomes meeting the Measures of Effectiveness and Performance and their Key Parameters.

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With the Measures of **Physical Percent Complete** from the Principles, Processes, and Practices we can answer...

- What is our progress to plan?
- Are we ahead or behind schedule?
- Are the deliverables compliant with the requirements?

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A Few Challenges Faced During the Integration of SE and PPM to Increase the Probability of Program Success

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Systems Engineering and Project Management are tightly intertwined domains.

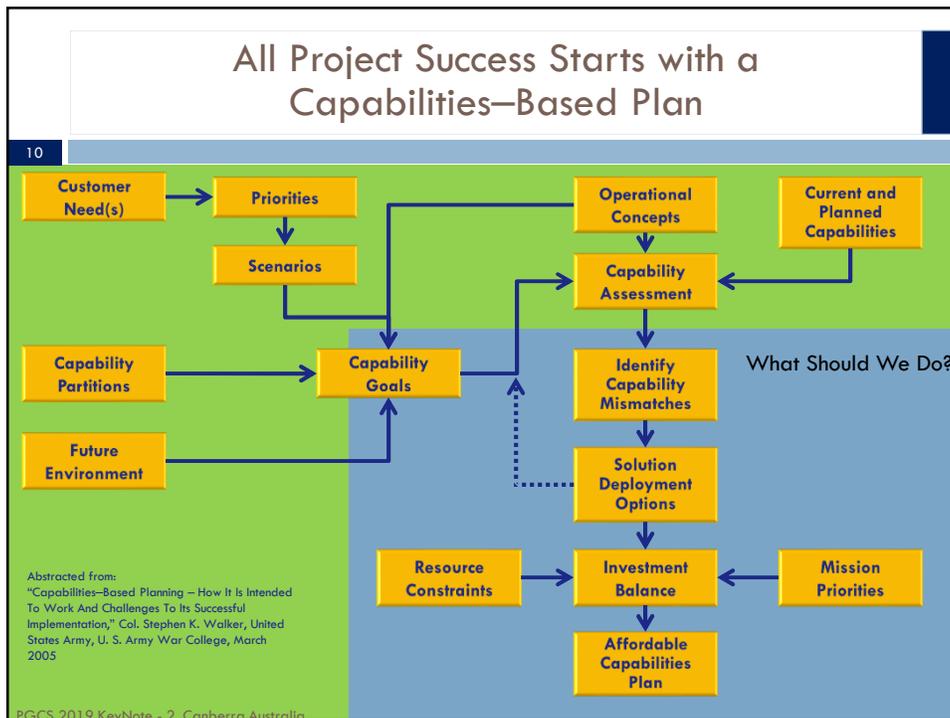
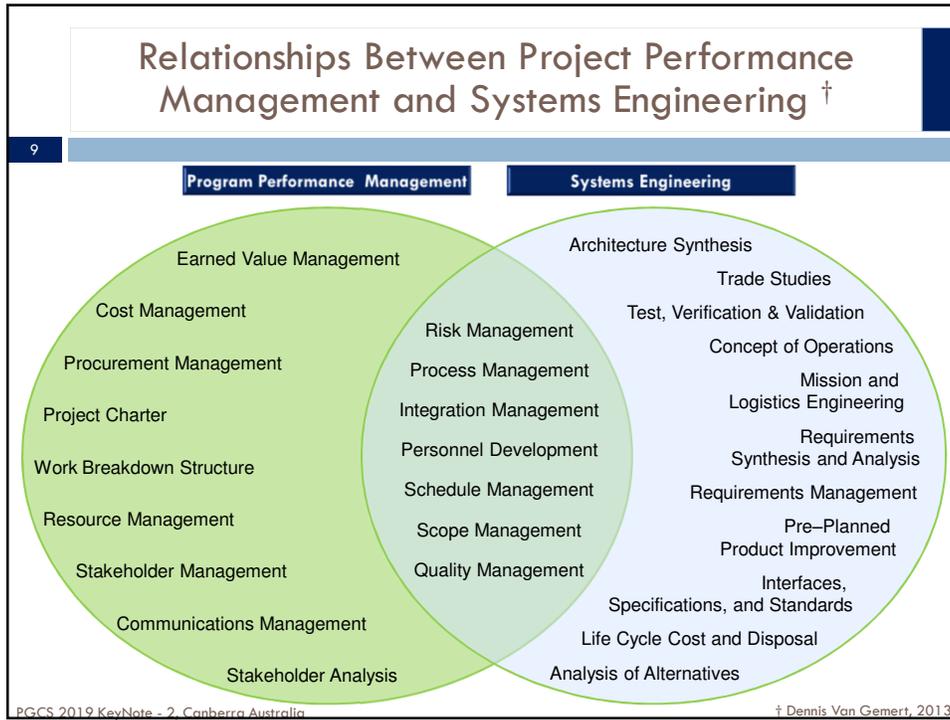
– *Handbook of Systems Engineering and Management*, Sage and Rouse, Wiley–Interscience, 2nd Edition, 2009.

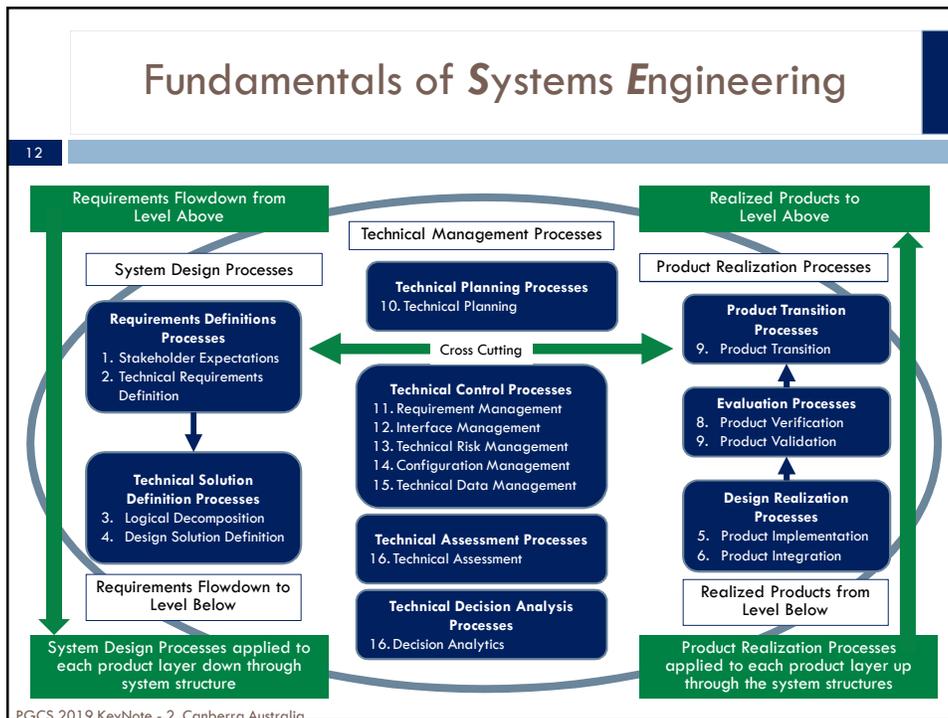
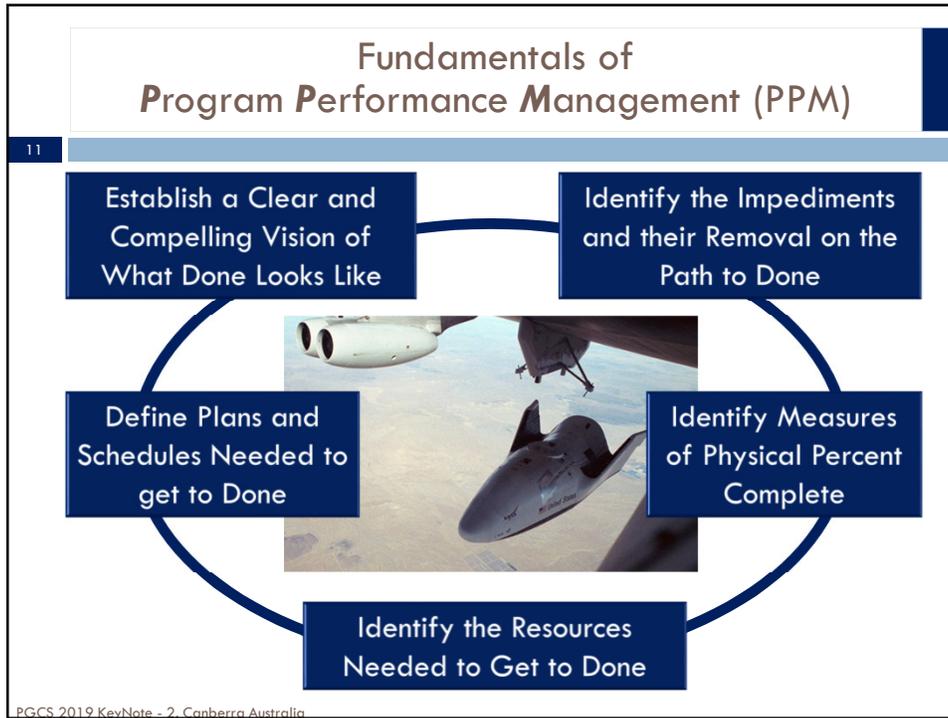
While Program Management has accountability for cost and schedule performance and Systems Engineering has accountability for technical and systems elements of the program – these activities are not separate.

Both Program Performance Management and Systems Engineering are part of an integrated framework for increasing the Probability of Program Success.

– *Toward a New Mindset: Bridging the Gap Between Program Management and Systems Engineering*, PMI® Global Congress 2011

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Measures of Success in the Systems Engineering Paradigm

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Measures 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.

Measures 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.

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Increasing Probability of Program Success starts with ...

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Connecting the Dots Between Systems Engineering and PPM

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- Program Performance Management (PPM) and Systems Engineering (SE) share common ...
 - Characteristics
 - Goals
- Integration of the two disciplines creates opportunities to ...
 - Improve quality, schedule, and cost management
 - Reduce risk
 - Increase returns on long term investment

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Barriers to Successfully Making These Connections, Starts with ...

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- Cultural differences occur between Program Managers and Systems Engineers and their different views of Stakeholder needs, through the lens of:
- Managing, planning, and implementation processes.
 - Defining system components and the interaction of those components.
 - Building system components in the presence of cost, schedule, and technical performance uncertainty.
 - Integrating system components to deliver the needed Capabilities for the needed cost on the needed Date.

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Common Causes of Dis-Integration Between Program Performance Management and Systems Engineering

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- Cost and Schedule performance measures are not integrated with System Engineering performance measures.
- Work effort is duplicated, with program members receiving potentially conflicting views of the same technical and programmatic work activities.
- Requirements tracked and managed separately, resulting in different views of customer needs.

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The New Mindset Starts with of an IPPMS with a Shared Problem and Solution Space

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- The shared space between Program Management and Systems Engineering is based on ...
 - Leadership
 - Negotiation
 - Communications
 - Collaboration and teamwork
 - Sustained focus on mission
 - Risk management
 - Configuration management

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This Shared Space is Necessary, but not Sufficient, to Increase Probability of Program Success

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Other Integrations must be in place, including:

- Data integration
- Process integration
- Shared, risk informed, Performance Management measures to inform cost and schedule forecasts and technical performance, using
 - Measures of Effectiveness (MOE)
 - Measures of Performance (MOP)
 - Technical Performance Measures (TPM)
 - Key Performance Parameters (KPP)

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Management Approaches for Successful Integration of SE and PM

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- Clear Vision, Goals, and Benefits
- Governance
- Management Approach
- Integrated Planning and Risk Management
- Customer and Stakeholder Management
- Scope and Requirements Control

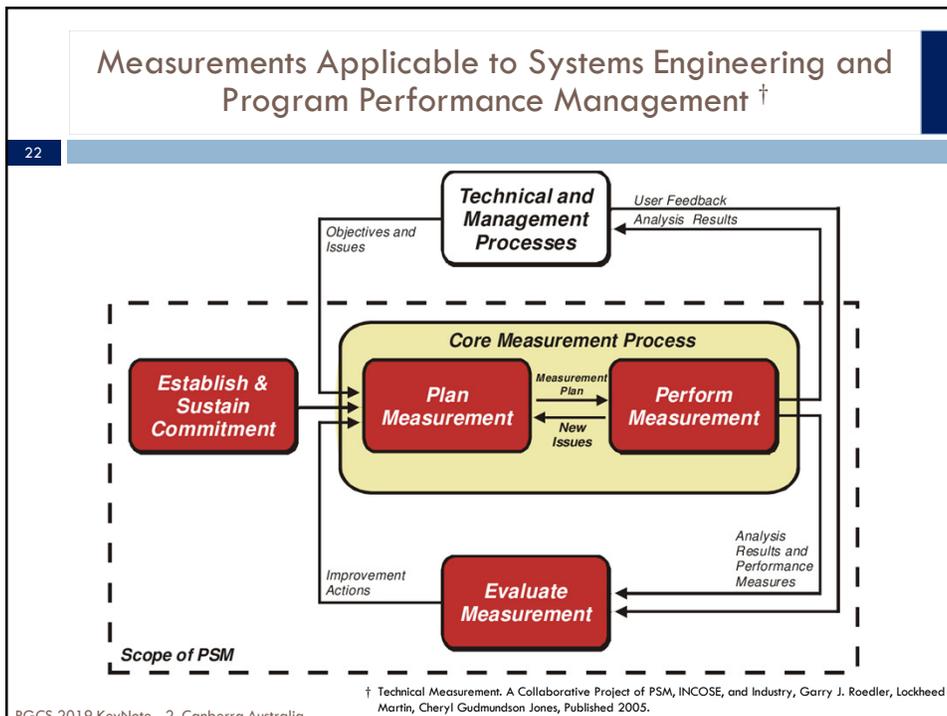
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Connecting SE and PM Starts with ...

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Program Management Plan(s)	Systems Engineering Plan(s)
<ul style="list-style-type: none"> □ Program Overview □ Project Scope □ Strategic / Organizational Alignment □ Constraints □ Organizational Structure and Responsibilities □ Communications management □ Performance Management □ Risk and Opportunities □ Quality Management □ Resource Management □ Budget and Cost Estimates □ Change Management □ Risk Management 	<ul style="list-style-type: none"> □ Program Requirements □ Technical Staffing and Organizational Structure □ Technical Baseline Management □ Integration of overall management of the program

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Connecting the Dots

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Program Management	Shared Performance Measures	Systems Engineering
IMP Narrative	Measures of Effectiveness (MOE)	ConOps Capabilities
IMP Narrative	Measures of Performance (MOP)	
WBS Dictionary	Technical Performance Measures (TPM)	System Requirements
WBS Dictionary	Key Performance Measures (KPM)	
WBS Dictionary Risk Register	Risk Management	Risk Dependency Model
Risk Register	Schedule Margin	Technical Performance Margin
Contract Budget Baseline	Management Reserve and Contingency	

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The Integration of Program Management and Systems Engineering IS Risk Management

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Continuous Risk Management means ...

- ❑ Managing risks produced by uncertainty has shown positive correlations between risk management and increasing the probability of program success.
- ❑ Determining which risks are important to deal with in a prioritized model, their interactions, statistical interdependencies, propagation, and evolution.
- ❑ Implementing strategies to handle risk with mitigation, correction, prevention, and avoidance, derived from Root Cause Analysis, to remove and prevent the conditions and actions creating the risks.

Risk Management is Project Management for Adults – Tim Lister

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Continuous Risk Management Increases Probability of Program Success (PoPS)

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- **Preventing Problems** – before they occur with a *pre-mortem* to identify causes, take corrective and preventive action to remove the condition and activity of the root cause before the risk becomes an issue.
- **Improving Quality** – by focusing on program objectives and consciously looking for risk that effect cost, schedule, and technical performance throughout the program's lifecycle.
- **Enable Better use of Resources** – through early identification of problems and providing input to management decisions regarding allocation of resources.
- **Promoting Teamwork** – by involving personnel at all levels of the program and focusing their attention on a shared vision of the mission to provide the mechanism for achieving the MOE's and MOP's as planned.

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Earned Value (EV) and Earned Schedule (ES) Provide Objective Measures of Performance

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- Develop and Validate requirements, including trade studies and Analysis of Alternatives (AoA).
- Define and allocate Technical Performance Measures (TPMs).
- Achievement of the planned TPMs based on planned Functionality.
- Measure Physical Percent Complete (P%C) based on Quantitative Backup Data (QBD) for each TPM.

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Best Practices for Integrating Earned Value and Earned Schedule with Systems Engineering

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- Integrated Master Plan (IMP) communicates required technical accomplishment needed to increase project maturity as planned.
- Integrated Baseline Review (IBR) ensures contractor has integrated SE work products and technical performance into IMS at Work Package (WP) level.
- Verify Work Package interim progress and completion are traceable to status of requirements.
- Discretely plan and measure all rework.
- Account for deferred functionality by adjusting P%*C* to reduce progress to Plan.

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Engineering Challenges and their Impacts on Earned Value (EV) and Earned Schedule (ES) Management

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	Challenges to Engineering Programs	Impacts on Earned Value Management
1	Firefighting—Reactive Program Execution	EVM provides a system for disciplined management of complex projects
2	Unstable, unclear, and incomplete requirements	EVM, through the organizing, planning, and budgeting, including revisions and data management guidelines, provides for clarification of requirements
3	Insufficient alignment and coordination of the extended enterprise	EVM provides clear metrics that span the entire program and enables a program to improve organizational alignment and overall process optimization.
4	Processes are locally optimized not integrated for the entire enterprise	Same as Above
5	Unclear roles, responsibilities, and accountability	EVM, through the organizing guidelines, provides for a clear structure of the organizational breakdown and assigned program scope.

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In Our Thursday Workshop, We'll Use an Actual Program to Show How Integrated SE and PPM can Increase Probability of Program Success for our Cow Counting UAV Example

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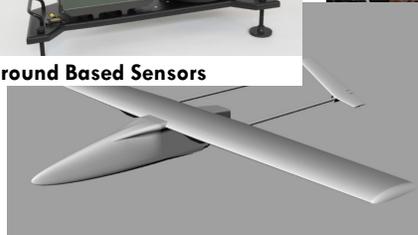
Tactical Situation Analysis System



Ground Based Sensors



Command and Data Center



UAV with Airborne Sensors



Mobile Sensors

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