# Revision Project for the INCOSE/PSM Technical Measurement Guide

## A Collaborative Project

17 September 2019


### Garry Roedler

President, International Council on Systems Engineering (INCOSE)

INCOSE Fellow, ESEP and Founder Award Recipient

Vice Chair, National Defense Industrial Association, Systems Engineering Division (NDIA SED)

Senior Fellow. Lockheed Martin Corporate Engineering

### Cheryl Jones

Project Manager, Practical Software and Systems Measurement (PSM)

Technical Lead, Army Software Sustainment Cost Estimation

US Army AFC - CCDC Armaments Center

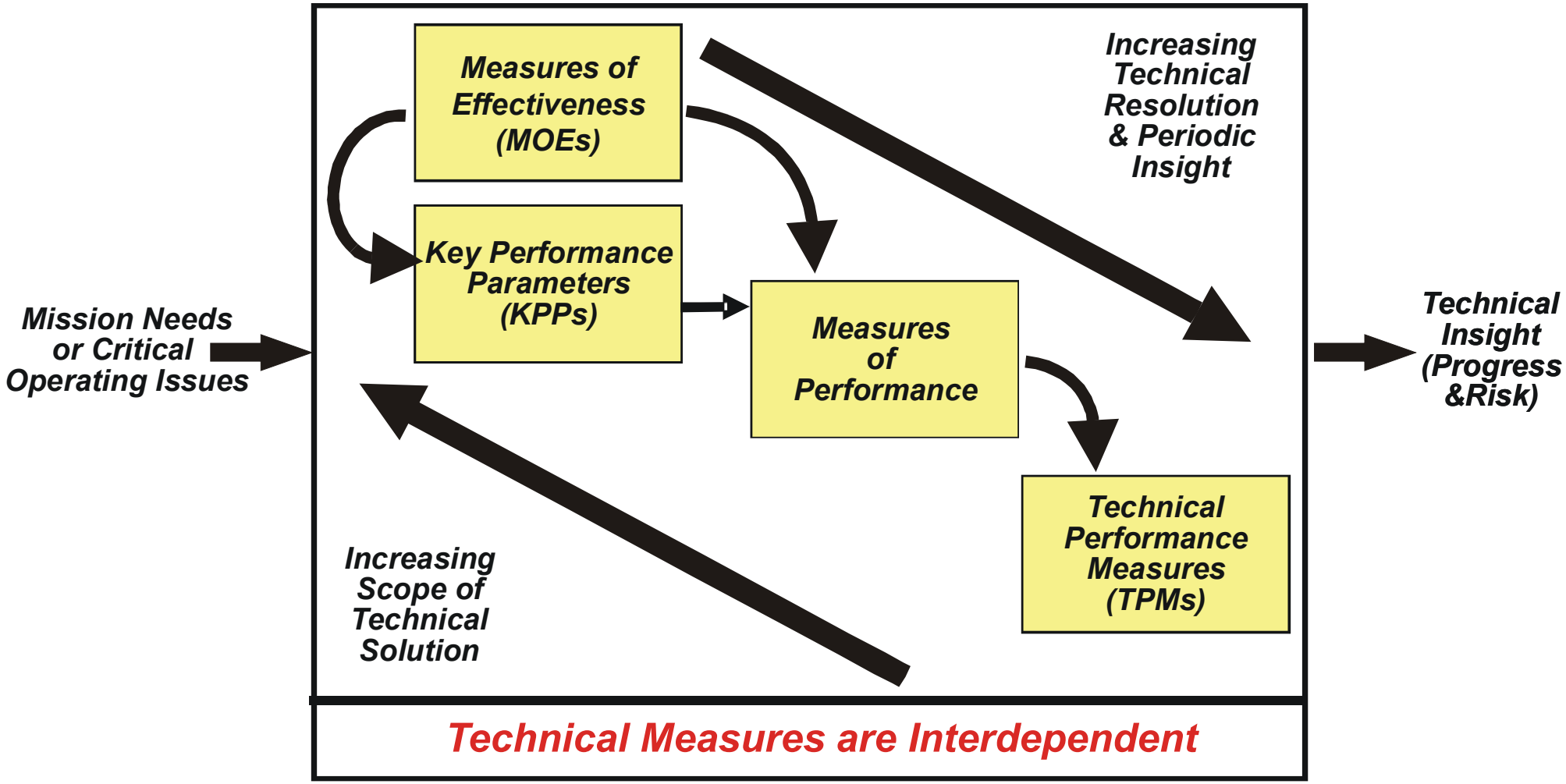


Practical Software and System Measurement

# What is Technical Measurement?

- Set of measurement activities and measures used to provide insight into the technical solution
  - Requirements (performance, quality, etc.)
  - Risks
  - Progress
- Tracked across the life cycle
  - Established early in the life cycle
  - Increasing levels of fidelity as technical solution is developed

# Relationship of the Technical Measures



# Background

- Technical measurement is very important in the development of systems
  - Performance insight
  - Risk management tool
- Previous version of guide widely used
  - Primary guidance in industry on topic
  - But published in 2005, it is in need of revision
  - Received feedback on potential changes
- Need to align with evolution of engineering in past 15 years

# Objectives of the Project

- Determine changes needed in Technical Measurement guidance
- Revise guidance on technical measurement that:
  - Addresses engineering today, including usage of advanced technologies
  - Accounts for incremental, iterative projects
  - Incorporates user feedback received
  - Is based on lessons learned across DoD and industry
  - Aligns with changes in SE guidance & stds
  - Aligns with SE leading indicators

# Objectives of the Guide

Create guidance on technical measurement that:

- Establishes guidance that reflects state-of-the-practice in industry
- Establishes lessons learned across industry - i.e., what are the proven methods
- Provides a consistent approach to technical measurement for projects

# Approach

- Continue to leverage existing proven guidance from across industry and government
- Collaborate between PSM, INCOSE, NDIA, and industry companies to:
  - Leverage industry resources and knowledge
  - Influence industry guidance to be consistent
- Update understanding of state-of-the-industry (e.g., surveys, workshops)
- Incorporate into revision and other documentation

# Anticipated Next Steps

- Coordinate effort with collaborating organizations
- Establish project team
- Conduct kick-off meeting at INCOSE International Workshop
  - Torrance, CA – January 25-28, 2020
- Ongoing telecons quarterly
- F2F meetings at PSM, INCOSE, and NDIA SED Events

# Back-up Slides

# Measures of Effectiveness (MOE)

- "Operational" measures of success that are closely related to the achievement of the mission or operational objective being evaluated, in the intended operational environment under a specified set of conditions
  - Stated from the user/customer viewpoint
  - Focused on most critical mission performance needs
  - Independent of any particular solution
  - Actual measures at end of development – estimates prior
- MOEs are used to:
  - Compare operational alternatives
  - Investigate performance sensitivities to changes in assumptions from the user view
  - Define operational requirement values
  - Assess achievement of intended purpose
    - Mission needs for performance, suitability, and affordability
    - Operational success criteria

# Measures of Performance (MOP)

- Measures that characterize physical or functional attributes relating to the system operation
  - Supplier's viewpoint
    - "System" technical requirements vice user needs
  - Measured under specified testing or operational conditions
  - Derived from MOEs (many to one)
  - Assesses delivered solution performance against critical system level specified requirements
  - Risk indicators that are monitored progressively
- MOPs are used to:
  - Compare alternatives to quantify technical or performance requirements as derived from MOEs
  - Investigate performance sensitivities to changes in assumptions from the technical view
  - Define Key Performance Parameters (KPPs)
  - Assess achievement KPPs

# Technical Performance Measures (TPM)

- Measures used to assess design progress, compliance to performance requirements, and technical risks
  - Focus on the critical technical parameters of specific system elements
    - Definition includes the projected performance, such as a performance profile with tolerance bands of acceptable variance
    - Measures includes range, accuracy, weight, size, availability, and many others
  - Derived from the MOPs (many to one)
  - Measured as solution is designed and implemented
    - Estimates the values of essential performance parameters of the design through engineering analyses and tests
    - Tracked against performance profile with projected final value

# Technical Performance Measures (TPM)

- TPMs are used to:
  - Forecast the values to be achieved
  - Identify differences between actual versus planned performance
  - Assess and predict progress towards achieving the performance values
  - Determine the impact of these differences on system effectiveness
  - Provide an indicator of risks and problems requiring management attention (early identification)
  - Determine where opportunities exist to make design trades to reduce overall risk (e.g., where positive margins exist)
  - Support assessment of system element design alternatives or impacts of proposed change alternatives

# Planning Technical Measurement

Establish Mission Operational Objectives → Establish System Performance Requirements → Establish Lower-level Technical Requirements

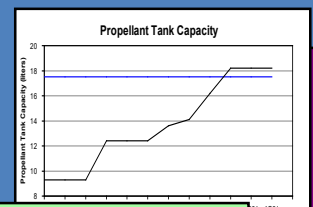
Information Needs

Select & Define MOEs → Select & Define MOPs → Select & Define TPMs → Plan Analysis, Models & Progress → Perform Technical Measurement

Measures of Effectiveness
1. Service Life
2. Mission Critical Ops
3. ……..

Measures of Performance
1. Propulsion Capacity
2. Battery Cycle
3 Solar Cell Life
4. ……..

Technical Performance Measures
1. Propellant Tank Capacity
2. Thruster Efficiency
3. Propellant Energy/Volume
4. Propellant S/S Reliability




2-12 MOEs, Avg. = 6

1-10 MOPs Per MOE, Avg. = 5

1-7 TPMs Per MOP, Avg. = 4

Increasing Scope of Technical Solution

Increasing Resolution & Periodic Insight

Planning Technical Measurements

# PSM Product-Related Measurement Information

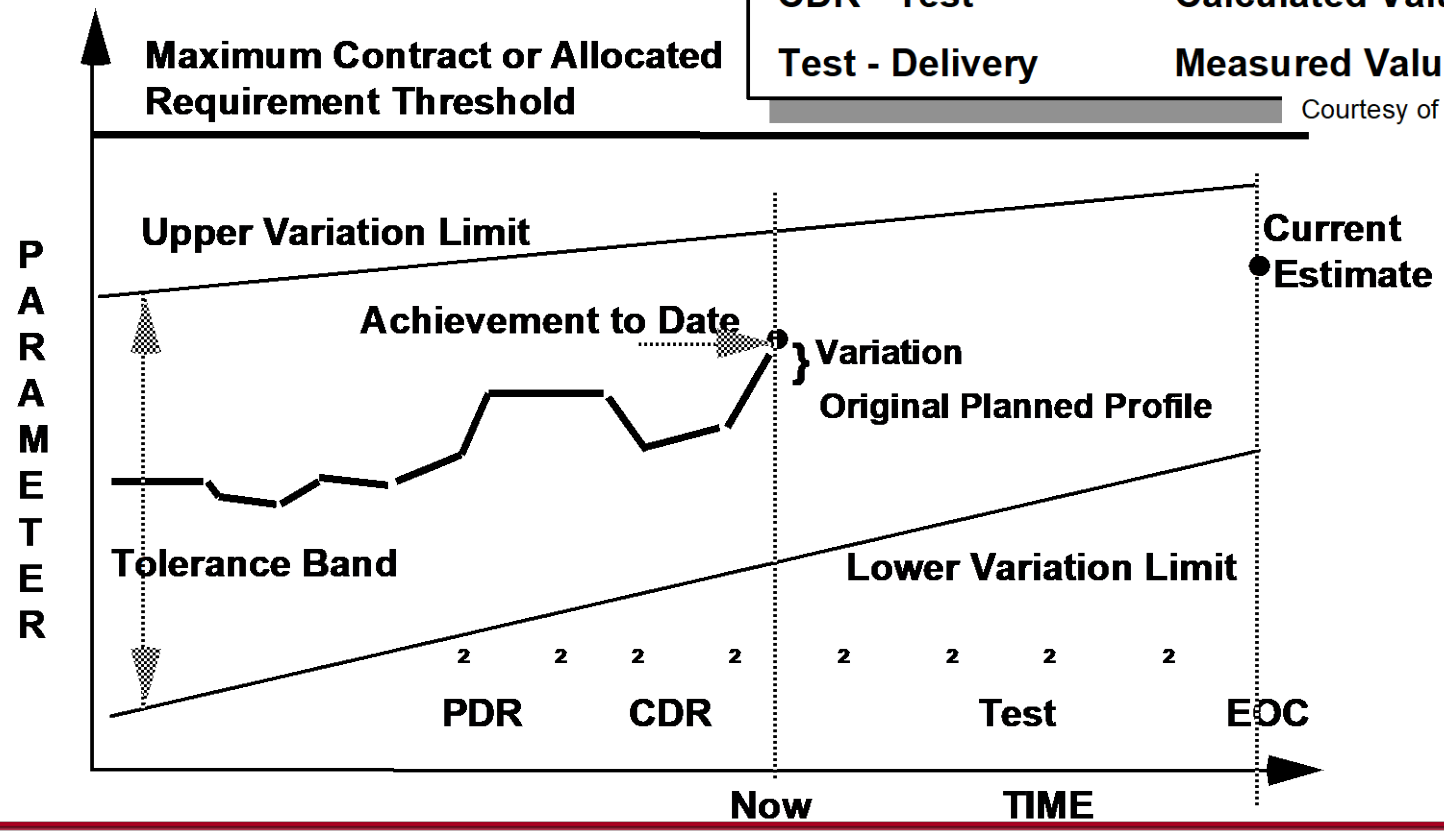
| Information Category | Measurable Concept | Measures |
|---|---|---|
| Product Size and Stability | Physical Size and Stability | Database Size<br>Components<br>Interfaces<br>Lines of Code<br>Physical Dimensions |
| Product Quality | Functional Correctness | Defects<br>Technical Performance |
| | Supportability-Maint. | Time to Restore<br>Maintenance Actions |
| | Efficiency | Utilization<br>Throughput<br>Timing |
| | Portability | Standards Compliance |
| | Usability | Operator Errors |
| | Dependability-Reliability | Failures<br>Fault Tolerance |

An example set of candidate measures was identified – but is not exhaustive

# Other Technical Measurement Concepts

| Development Phase | Measurement |
|---|---|
| Through PDR | Estimated Value |
| PDR - CDR | Allocated Value |
| CDR - Test | Calculated Value |
| Test - Delivery | Measured Value |

Courtesy of CSM



# Uses of Technical Measures

- Indicators of Operational Objectives
  - Ability of technical solution to meet mission needs
- Indicators of Technical Solution Progress
  - Track progress against plan through life cycle
- Indicators of Compliance to Performance Requirements
  - Predict likelihood of meeting performance rqts.
- Indicators of Technical Risk
  - Alert mgt of potential performance deficiencies before irrevocable cost/schedule impact occurs

# MOEs, MOPs, TPMs and the "V" Model of System Development