Measures for Success: Lessons Learned from Applying PSM

Measurement Principles

- Measurement Is a Consistent but Flexible Process that Must Be Tailored to the Unique Information Needs and Characteristics of the Project or Organization
- Decision Makers Must Understand What is Being Measured and Trust the Information
- Measurement Must Be Used to be Meaningful
Fact-Based Management

• Requires Measurement Information to Support Critical Project and Organizational Business and Technical Decisions
• Measurement Results Must Be Communicated and Used Across the Entire Corporate Entity
• Measurement Results Must Be Incorporated with Risk Management and Context Information
**Consistent but Flexible Process**

**Measurement Activities**

1. Scope of PSM
Plan Measurement

• Measures Are Defined to Provide Insight into a Project or Organization’s Information Needs by
  - Identifying what the decision makers need to know
  - Relating these to entities that can be measured
  - Selecting and specifying measures based on project and organizational processes

Information Categories

• Schedule and Progress
• Resources and Cost
• Product Size and Stability
• Product Quality
• Process Performance
• Technology Effectiveness
• Customer Satisfaction
Plan Measurement - Lessons Learned

- Start by Implementing a Small Set of Measures
  - Reduces the level of change, resources required, and impact on the workload
  - Add additional measures later, incrementally
- The Measurement Plan Should Specify Both “What” Will be Measured and “How” the Process Will Work

Multi-Level Measurement Requirements

- Organizational Management: Process Improvement, Project Planning Guidelines, Performance Based Guidelines, Organizational Norms & Benchmarks
- Project Management: Project Estimation & Planning, Project Performance Tracking, Project Tradeoff Analysis, Resource Management
Plan Measurement - Lessons Learned (cont).

- Workshops Are Good For Defining Information Needs
- Allow Tailoring of Organizational Measures
- Successful Measurement Programs Integrate the Needs of all Decision-Makers
  - This simplifies data collection and reduces duplication

Perform Measurement

- Collecting Measurement Data, Performing Analysis, and Presenting Results
- Analysis Can Include Estimation, Feasibility Analysis of Plans, and Performance Analysis of Actual Data Against Plans
PSM Analysis Model

- Technology Effectiveness
- Process Performance
- Product Size and Stability
- Resources and Cost
- Schedule and Progress
- Customer Satisfaction
- Product Quality

Measurement Feasibility Analysis

Size - Effort Estimating Relationship

- Project: PSM
- Data as of 31 Mar 98
Lessons Learned - Perform Measurement

• Automate Data Collection Whenever Possible
• It Take About 6 to 9 Months to Establish Measures
  - Initial focus is on ensuring data is provided
  - Next focus in on data problems
  - After these are resolved, focus can move to performance issues
• Clearly Identify the Reporting Mechanisms at Both the Project and Organizational Levels
• Aggregation Approaches Need to be Specified, Especially When Measures Are Tailored

Establish and Sustain Commitment

• Includes Establishing the Resources, Training, and Tools to Implement a Measurement Program Effectively and Ensuring Commitment to Use the Information that is Produced
• Need to have Commitment Reinforced and Demonstrated Regularly
• Need to Adopt an Action Orientation
Gain Support for Measurement

- The Resulting “Culture Shock” from Implementing any new Process causes a Natural Reaction of Personal Resistance
  - Overcome resistance to change
- Provide the Participants with an Understanding of the Measurement Process and the Benefits to Their Projects
  - Training programs should help project representatives identify information needs and measures
  - Planning workshops should include representatives at all levels of the organization

Lessons Learned - Evaluate Measurement

- Both the Measurement Process and the Specific Measures Should be Periodically Evaluated and Improved
- Measurement is an Iterative Process: the Measures are Refined as Information Needs Change and the Organization Implements Improvement Actions
Understand and Trust Measurement Information

Information Model: High-Level View

- Information Need
- Information Product
- Measurable Concept
- Measurement Construct
- Entity
- Attribute

Adapted from ISO/IEC 15939 - Software Measurement Process
Measurement Construct - Levels

- Information Product
  - Indicator
    - Derived Measure
      - Base Measure
        - Attribute

Measurement Construct

- Information Needs
  - Interpretation
    - Analysis Model
      - Derived Measure
        - Measurement Method
          - Base Measure
            - Measurement Function
              - A Measure of a Single Attribute
                By a Specific Method
              - Operations Quantifying an Attribute Against a Scale
            - Property Relevant to Information Needs
          - Entity
  - Estimate or Evaluation that Provides a Basis for Decision Making
    - Algorithm Combining Measures and Decision Criteria
      - Quantity Defined as a Function of Two or More Measures
      - Algorithm Combining Two or More Base Measures
  - Attribute
**Lessons Learned**

- **Provide Well Defined Base Measures to Ensure Consistency**
- **Present Information in a Format that is Understandable to the Decision Maker**
- **People Doing Measurement Aren’t Generally Making the Decisions - It Is Important to Present Information Clearly and Concisely**
- **Just Because the Measurement Information is Accurate and Objective, Does Not Mean It Will be Acted On**
Lessons Learned

- The Measurement Process Should be an Integral Part of the Way Business Is Conducted
- Data Must be Provided Early Enough to Allow Managers to Take Action
- Results Must Be Communicated Throughout the Organization in a Timely Manner
- Decisions Should Not Wait for Perfect Data, but Should be Based on Accurate Data, Augmented by Risk Management and Context Information
Lessons Learned (cont.)

- The Measurement Results Should Help Decision-Makers Optimize Overall Performance
- Most Organizations are Composed of a Portfolio of Distinct Projects, So Project-Level Information Must Be Aggregated to Appropriate Levels of the Organization to be Used Effectively

Project-Level Focus

Discovered vs. Closed Defects

- Discovered
- Closed and implemented
**Aggregated Data Highlights Issues**

Time to Fix vs. Time to Close
Closed Defects
As of 25 Sep 03

- 93% of the PCRs follow the Normal Flow
- 7% of the PCRs involve Rework

**Summary**
Opportunities / Threats

• More Use/Mis-Use of Measurement
• Continuous Requests for the “List” of Best Measures
• Constrained Environments that Don’t Let You Act on the Measurement Results
• Changing DoD Requirements for Measurement
  - Greatly reduced requirements/standards (e.g. DoDI-5000)
  - Continued emphasis on performance requirements

Recommendations for Improvements

• Align Information Needs Across All Perspectives
• Put Your Energy into Making Sure Information Is the Best It Can Be (Versus The Most It Can Be)
  - Fewer but better measures
• Design the Measurement Process to React to Continuous Change
• Use the measurement results
  - Use the measurement results
  - Use the measurement results
  - ….
PSM Products

PSM Products Available

- PSM Book - Version 5 - Published by Addison Wesley
- PSM Insight
- PSM Guidebook - Version 4
- 1 and 2 day Training Sessions
- Measurement Workshops for Programs or Organizations
- Measurement Experience Reports
- Sample Measurement Specifications
PSM Products Available (cont)

- DoD Implementation Guidance
- Measurement White Papers
  - Evolutionary Acquisition
  - Interoperability
  - Object-Oriented Design
  - Product Lines
- Applying PSM to Enterprise Measurement (PSM and the Balanced Scorecard)
- Rational Unified Process (RUP) Measurement Plug-In

PSM Products Under Development

- Measurement White Papers
  - Acquisition Measurement
  - Safety and Security Measurement (UK/Australian collaboration)
  - Systems Engineering Technical Measures (INCOSE collaboration)
  - System of System Measurement (DAU collaboration)
  - Process Improvement Measurement
  - Organizational / Enterprise Measurement
For More Information

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PSM Participating Organizations

DoD and Government
- US Air Force AFMC
- US Air Force SSSG
- US Air Force STSC
- US Army AMIC
- US Army CECOM
- US Army RDECOM-ARDEC
- US Army SAALT
- US Army SMDC
- USMC MCTSSA
- US Navy AEDC
- US Navy ASN RDA
- US Navy FMISO
- US Navy NAVAIR
- US Navy NAVSEA
- US Navy NAWC
- US Navy NAWC
- US Navy NAVE
- US Navy NUWC
- US Navy OPTEVFOR
- OSD NI
- OSD PA&E
- ODUSD (S&T)
- Aerospace Corp.
- Dept of Homeland Security, Customs & Border Protection
- DAU-DSMC
- DCMA
- DFAS
- DISA
- DLA
- FAA
- IDA
- MITRE Corp.
- NASA
- Sandia National Lab
- Soc. Sec. Admin.
- Software Engineering Institute

Industry
- ACS GSG
- Accenture, Quality and Performance
- Allion Science and Technology
- American Sys. Corp.
- Ameritrade Corporation
- Argon Engineering Associates
- Assurance Engineering
- BAE Systems
- Bloodworth Int. Tech.
- Booz Allen Hamilton
- CMIS
- CTA
- Carnegie Mellon Univ.
- Computer Sciences Corp.
- David Consulting Group
- Distributive Software
- Federal Reserve Bank
- First Line Partners
- Fraunhofer Ctr. For Experimental Software Engineering
- GTE
- Galbraith, Inc.
- General Dynamics
- General Scientific Corporation
- Graeme & Garland
- Hawaiian Electric
- IEEE
- IPFUG
- ITI
- INCOSE
- ITABHI
- Independent Engineering, Inc.
- IBM
- Jacobs Sverdrup
- James Gregory Assoc.
- Kodak Health Imaging
- L3 Communications
- Lockheed Martin
- Nat. Renewable Energy Lab.
- Northrop Grumman
- OAO Corporation
- Praga Systems Corporation
- PRICE Systems, LLC
- QSM
- Quality Plus Tech.
- Raytheon - Hughes
- Reifler Consultants
- Robbins, GIOIA
- Rockwell Collins
- SAIC
- Sallie Mae
- SETA
- Sentinel
- Software Engineering Assoc., Inc.
- Software Management Solutions
- Software Metrics, Inc.
- Software Productivity Consortium
- TeraQuest Metrics
- Texas Guaranteed Student Loan Corporation
- Titan Corporation
- Tivo
- United Defense
- Univ. Southern CA
- Upstart Systems, LLC
- User Trust Network
- US West
- VPI - State University
- West Virginia High Tech. Consortium
- West Virginia University
- Whittaker Group
- Wind River Systems
- Xcel Energy

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PSM Participating Organizations

International
- Liveware I.S.S.A. (Argentina)
- ADI Limited (Australia)
- Australian Defence Force Academy (Australia)
- Defence Materiel Org. - Australian DoD (Australia)
- Jacobs Sverdrup Technology (Australia)
- Motorola SOC Design Center (Australia)
- S-3 Consulting Pty. Ltd (Australia)
- Saab Systems Pty. Ltd. (Australia)
- Software Improvements Pty. Ltd. (Australia)
- Software Quality Institute (Australia)
- Tenix ESD (Australia)
- ti Metrics (Brazil)
- General Dynamics (Canada)
- NRC (Canada)
- Amdocs (Israel)
- Tangram Hi-Tech Solutions (Israel)
- Centro de Investigacion en Matematicas (Mexico)
- Ericsson Espana SA (Spain)
- Defense Science and Technology Labs (UK)
- UK Ministry of Defense (UK)
- University of York / YorkMetrics Ltd. (UK)

Transition Organizations

DoD and Government
- US Army RDECOM – ARDEC (PSM Support Center)
- US Air Force Software Technology Support Center
- US Navy NAVAIR
- Naval Undersea Warfare Center
- Aerospace Corporation
- Defense Contract Management Agency
- Defense Acquisition University - Defense Systems Management College
- Federal Aviation Administration
- MITRE Corporation
- Software Engineering Institute
Transition Organizations

Industry
- Argon Engineering Associates
- Computer Sciences Corporation
- David Consulting Group
- Distributive Software
- INCOSE
- Lockheed Martin
- Northrop Grumman
- Quality Plus Technologies, Inc.
- Software Management Solutions
- Software Productivity Consortium
- TeraQuest Metrics
- Texas Guaranteed Student Loan Center
- Titan Corporation

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- Centro de Investigacion en Matematicas (Mexico)
- University of York/York Metrics Ltd (UK)