Using PSM to Implement Measurement in a CMMI Process Improvement Environment

STC 2003

28 April 2003

Cheryl Jones

Overview

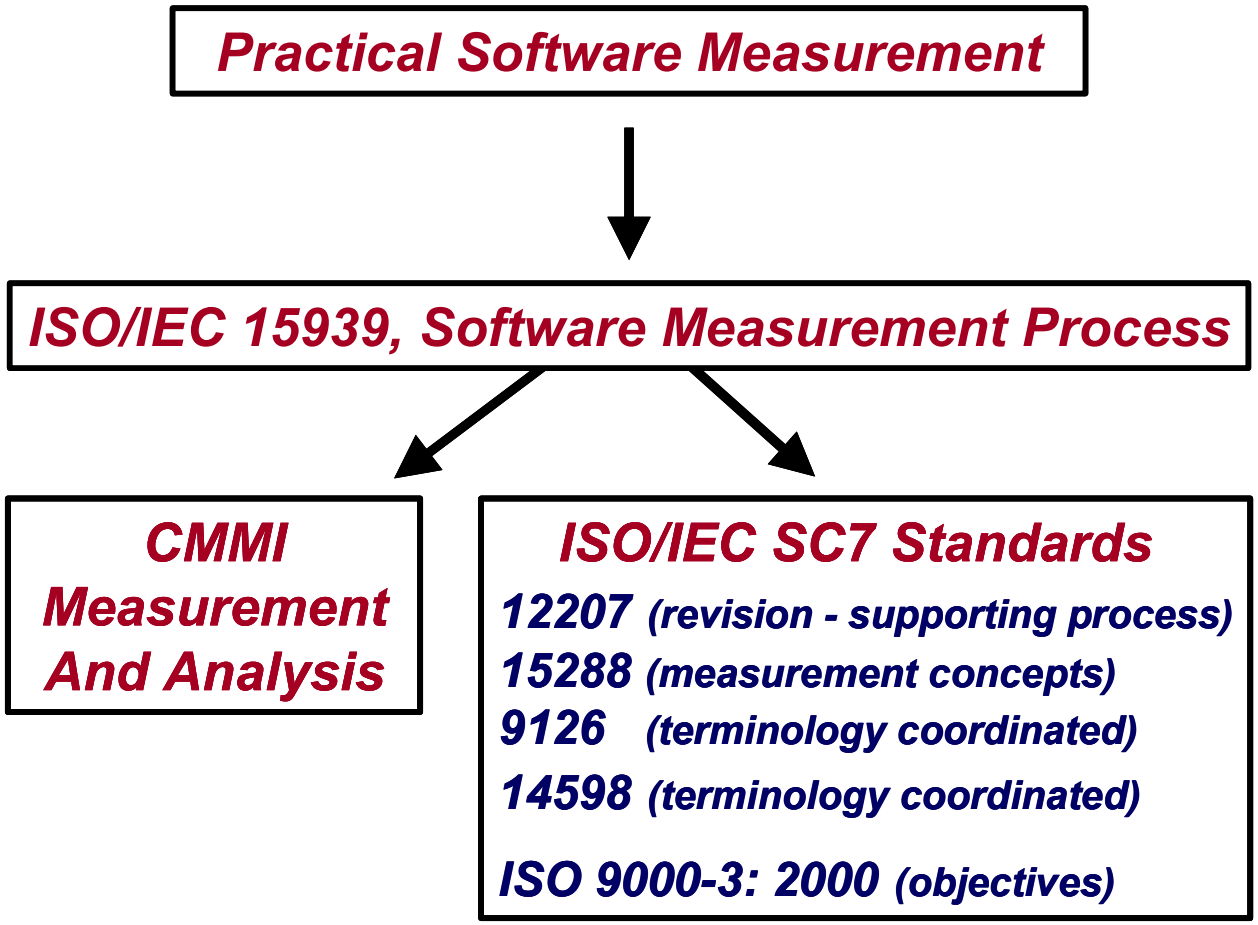
- Measurement Process
- TACOM-ARDEC CMMI-Based Process Improvement
- Using PSM to Fulfill the Measurement Requirements
- Lessons Learned
- PSM: What's Next?

Measurement Process

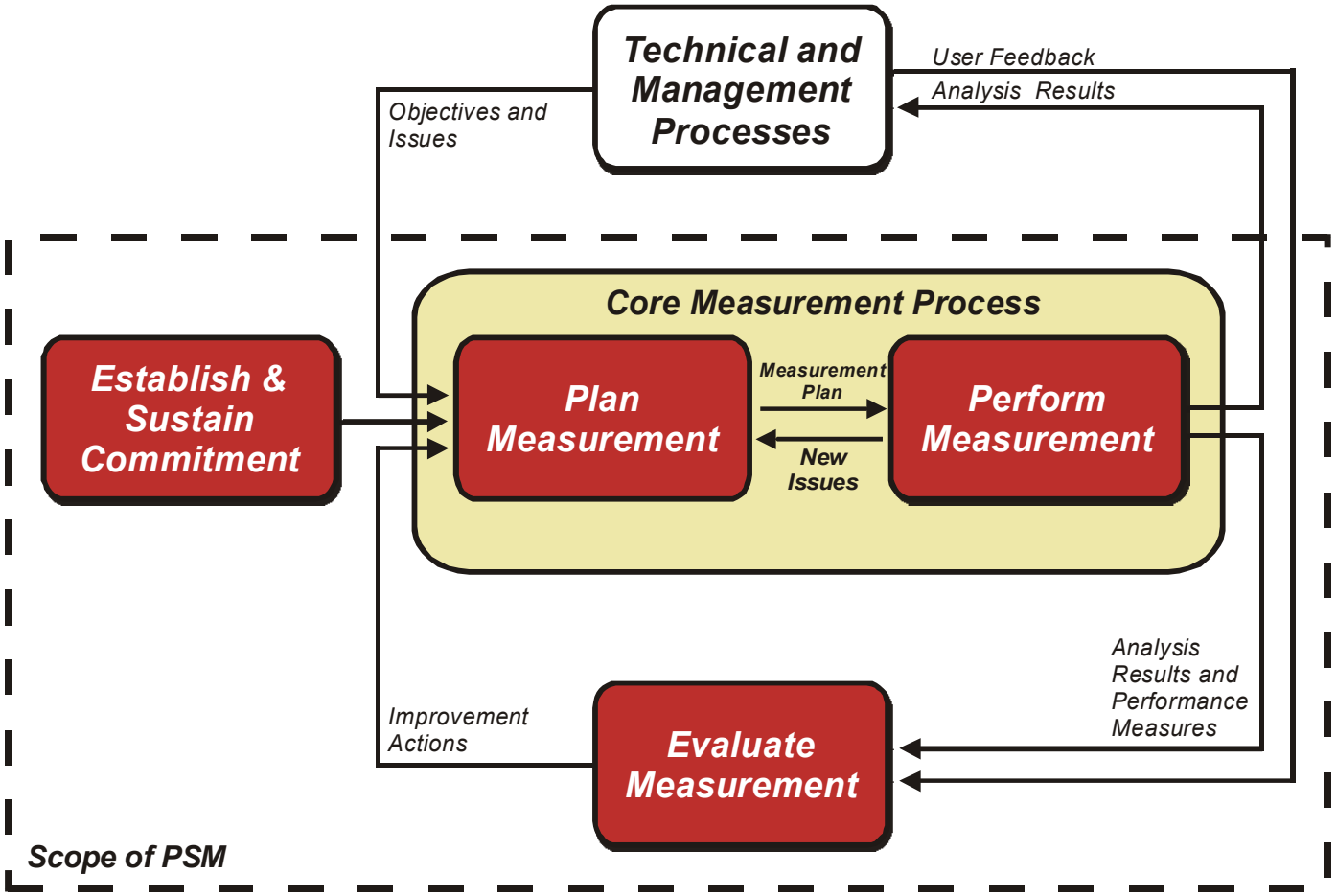
Measurement

- Measurement Is Increasingly Important to Software Acquisition, Development, and Maintenance Projects
- Standards and Guidance Have Been Provided through PSM, ISO/IEC 15939, CMMI M&A, and Other Documents
- Performance Measurement Requirements Have Been Specified in the Defense Appropriations Bill, Section 804 Legislative Requirements

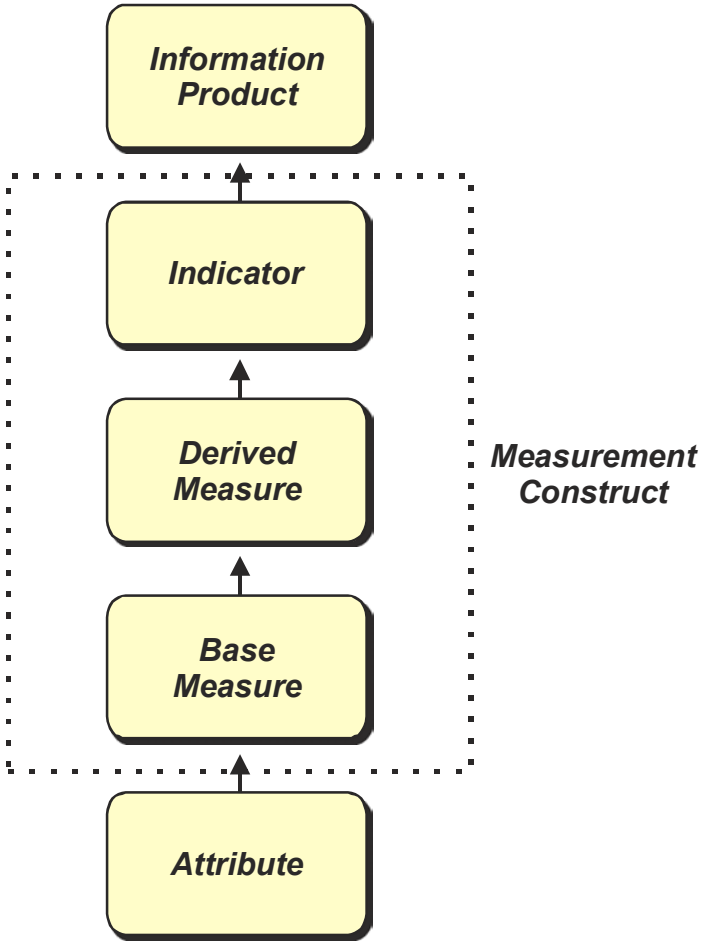
Measurement



Measurement Process



Measurement Information Model



Measurement

- Practical Software Measurement Published in 2001
  - Terminology Updated to ISO/IEC 15939
  - Measurement Information Model
  - Sample Measurement Specifications
  - "How-to" guidance including sample measures, lessons learned, case studies, implementation guidance, and sample measures
  - Earlier versions of PSM available through PSM web site (www.psmsc.com)
- ISO/IEC 15939 Published in 2002
  - Describes purpose and outcomes of a compliant process, with associated activities and tasks

Measurement (cont.)

- CMMI Measurement and Analysis Process Area
  - Detailed as a separate level 2 process area (previously was detailed in all process areas)
  - "Plan Measurement" and "Perform Measurement" are detailed in two specific goals and eight specific practices
  - "Evaluate Measurement" and "Establish and Sustain Commitment" are considered through the generic goals
  - Provides a methodology for assessing compliance with 15939 and helps to institutionalize measurement

Measurement (cont.)

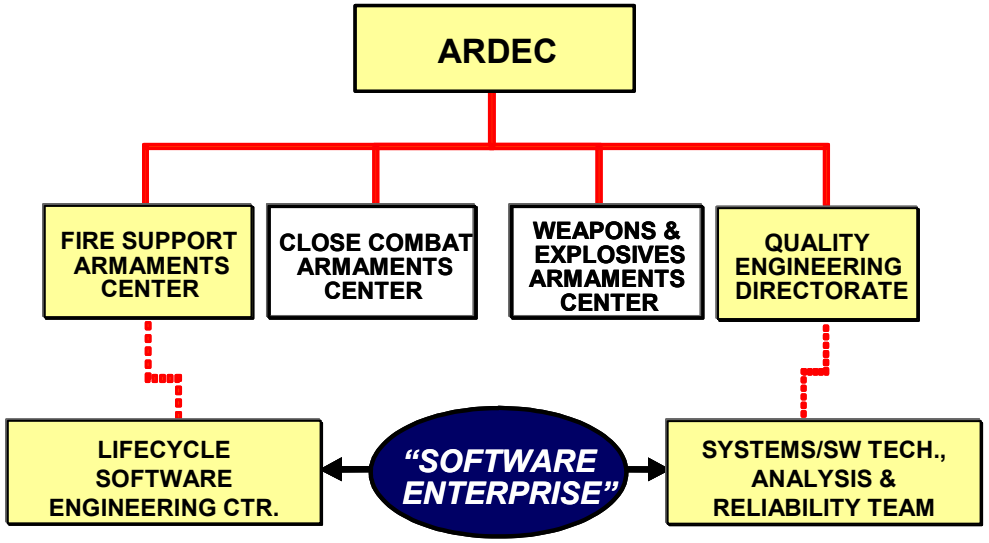
- ISO / IEC SC7 Standards
  - Revision to ISO/IEC 12207, Software Life Cycle Processes, includes a new supporting process, entitled Measurement
  - Measurement concepts have been added to ISO/IEC 15288, System Life Cycle Processes
  - New measurement terminology has been coordinated with the revisions to ISO/IEC 9126, Software Product Quality and ISO/IEC 14598, Evaluation of Software Products
  - Purpose and outcomes of the measurement process have been added to ISO 9000-3: Application of ISO 9001:2000 to Software

TACOM-ARDEC CMMI-Based Process Improvement

TACOM-ARDEC Software Enterprise

- *Address the Software Missions of:*
  - *Quality Engineering Directorate (QED), and*
  - *Life-Cycle Support Engineering Center (LCSEC)*
- *Improve Processes*

ARDEC Organizational Structure



SW Enterprise Goals

- **Achieve CMMI Level 3**
  - In February 2002, the Software Enterprise of TACOM-ARDEC Was Formally Assessed at CMMI[SM] Level 3
- **Implement Policies and Procedures**
  - Approved Project Plans
- **Apply to Multiple Project Types**
  - Software development and maintenance
  - Acquisition support
  - Infrastructure - CM, QA, etc.
  - Technology

Challenges

- Cultural Change Required
- Aggressive Implementation Schedule
- New Processes to be Implemented
- Middle Management Support
- Relatively Young Workforce
- Previous Process Improvement Efforts Encountered Difficulties in Parts of Organization

Using PSM to Fulfill the Measurement Requirements

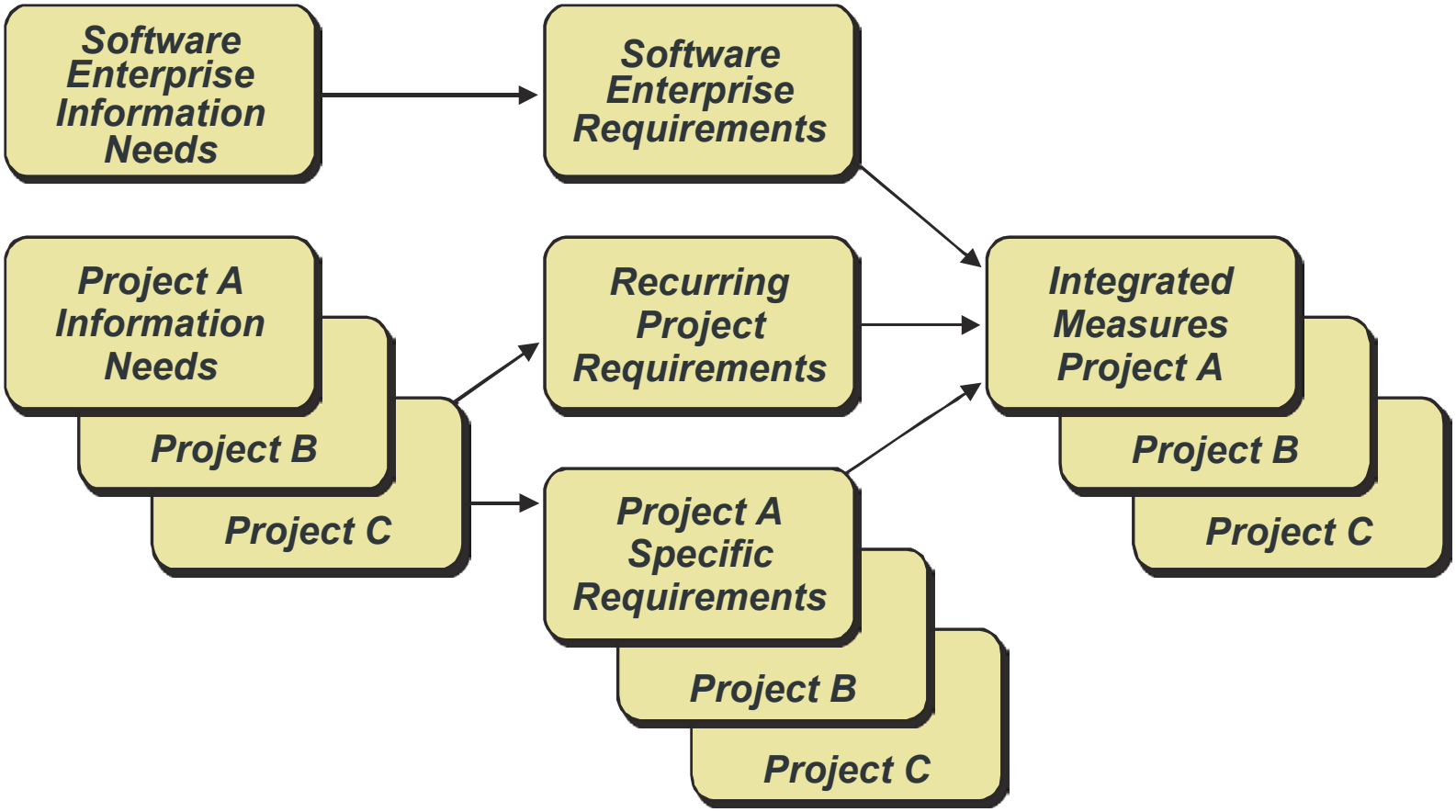
Measurement Goals

- Organizational Measurement Based on Defined Business Goals and Information Needs
- Project Measurement That Supports Organizational Measures and Addresses Project-Specific Information Needs
- Coordinated Policy, Procedures, and Plans
  - Integrated with Risk Management and Estimation activities

SWE Performance Management

- SWE Policy on Performance Management Addresses:
  - Measurement and analysis (MA)
  - Risk management
  - Decision-making
- Software Enterprise Performance Management (SWEPM) Project Provides:
  - Procedures (MA, RISK, Estimation)
  - Training and workshops
  - Organizational measurement plan including specifications
  - Project review and support
  - Organizational measurement analysis
  - Organizational estimation models

Measurement Across the SWE



Organizational Measurement

- Organizational Workshop Held to Identify Information Needs and Potential Measures
  - Based on Business Goals
  - Six standard measures defined for organization
  - Tailoring is allowed
  - Alternative measures defined for specific project types and additional information needs
- Organizational Measurement Plan Includes:
  - Description of roles, responsibilities
  - Organizational data collection and analysis processes
  - Measurement specifications for standard measures

A Necessary Trade-Off - Common Measures

The Challenge: Identify project measures that address both organizational and project-specific information needs

Software Enterprise Information Need	Common Organizational Measure
Schedule and Progress	• Schedule Performance - Milestones
Resources and Cost	• Effort • Cost
Product Size and Stability	• Size - Measured by the number of Lines of Code (LOC) for the development projects, or the number of tasks for the acquisition services and support projects
Product Quality	• Defect Profile • Peer Review Profiles
Process Performance	• Audit Profiles

Project Measurement

- Project Workshops Held to Identify Project-Specific Information Needs and Measures:
  - Organizational information needs and standard measures must be considered (tailoring allowed)
  - Project-specific information needs identified including risks and obstacles
  - Measures specified based on project processes
- Documented in Project Measurement Plan (Appendix to Project Plan):
  - Description of roles, responsibilities
  - Project data collection and analysis processes
  - Measurement specifications (reference to organizational measures allowed)

Cost and Effort Template

TACOM ARDEC ORGANIZATIONAL OVERSIGHT MEASUREMENT DATA

Government Cost and Effort Planning Data - Org 6 & Org 9

Project Name: Project aaa

			Period of Performance				
Date	Project	Job Order Number	Start Date	Expiration Date	Planned/Budget Dollar Amount	Estimated Hours	Cost Center
12/31/2003		xyz	10/6/02	4/14/03	$ 165,000.00	2342.00	LC5
12/31/2003		abc	10/20/02	4/28/03	$ 35,000.00	497.00	LC2

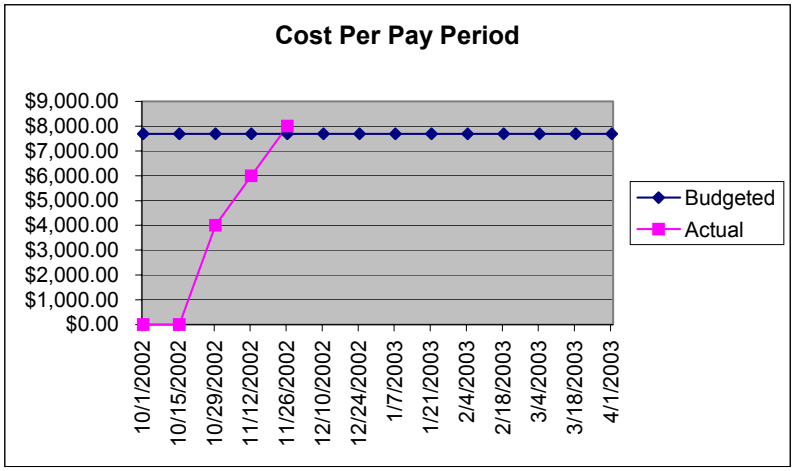
Calculate Spreadsheets

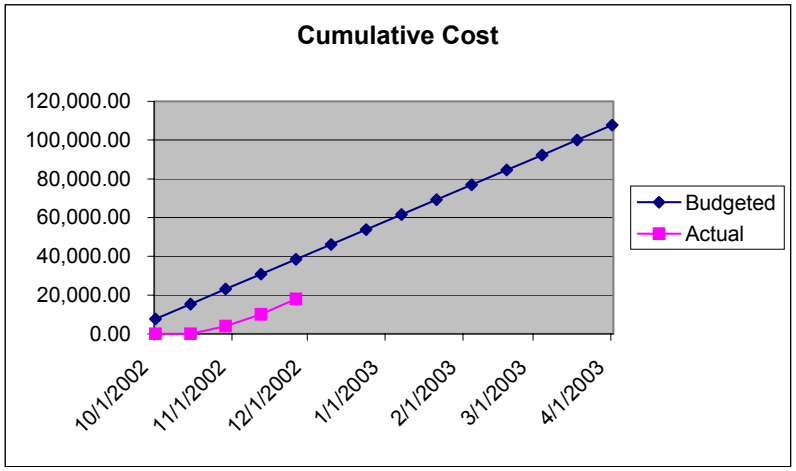
Note: You need to hit this button only once to setup the next page

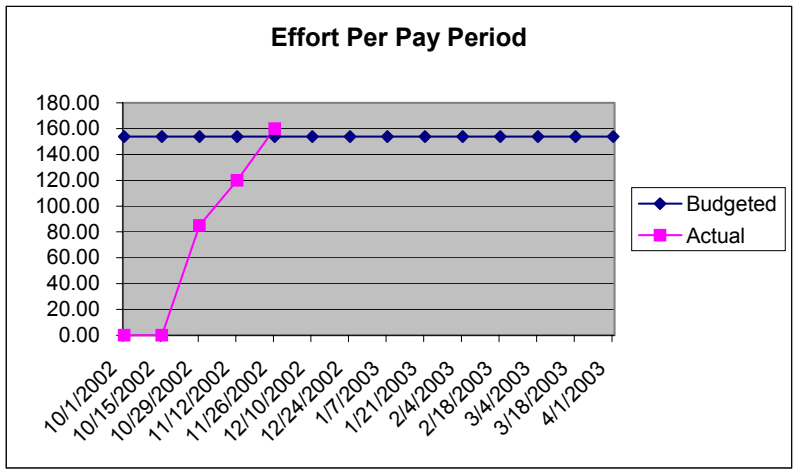
Cost and Effort Template (cont)

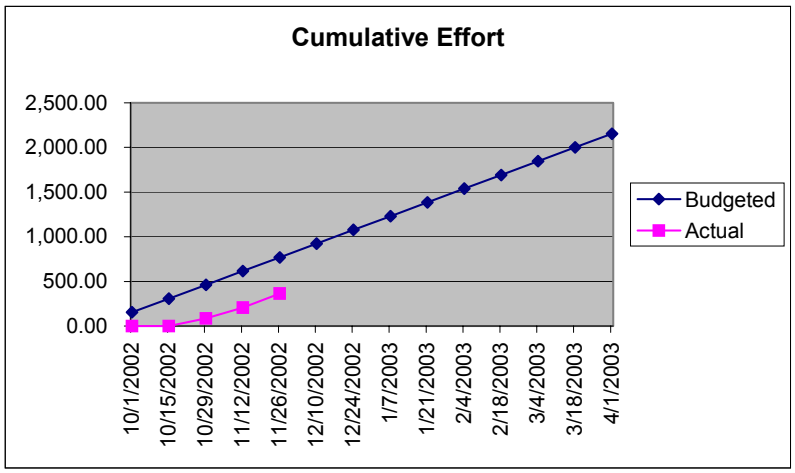
Date	Project	Job Order Number	Budgeted Cost Per Payperiod	Cumulative Cost	Planned Hours Per PayPeriod	Cumulative Effort	Center	Actual Cost	Cumulative Cost	Actual Effort	Cumulative Effort
10/1/2002	abc	abcdef	$7,692.31	7,692.31	153.85	153.85	lc5	0	0	0	0
10/15/2002	abc	abcdef	$7,692.31	15,384.62	153.85	307.69	lc5	0	0	0	0
10/29/2002	abc	abcdef	$7,692.31	23,076.92	153.85	461.54	lc5	4000	4000	85	85
11/12/2002	abc	abcdef	$7,692.31	30,769.23	153.85	615.38	lc5	6000	10000	120	205
11/26/2002	abc	abcdef	$7,692.31	38,461.54	153.85	769.23	lc5	8000	18000	160	365
12/10/2002	abc	abcdef	$7,692.31	46,153.85	153.85	923.08	lc5				
12/24/2002	abc	abcdef	$7,692.31	53,846.15	153.85	1,076.92	lc5				
1/7/2003	abc	abcdef	$7,692.31	61,538.46	153.85	1,230.77	lc5				
1/21/2003	abc	abcdef	$7,692.31	69,230.77	153.85	1,384.62	lc5				
2/4/2003	abc	abcdef	$7,692.31	76,923.08	153.85	1,538.46	lc5				
2/18/2003	abc	abcdef	$7,692.31	84,615.38	153.85	1,692.31	lc5				
3/4/2003	abc	abcdef	$7,692.31	92,307.69	153.85	1,846.15	lc5				
3/18/2003	abc	abcdef	$7,692.31	100,000.00	153.85	2,000.00	lc5				
4/1/2003	abc	abcdef	$7,692.31	107,692.31	153.85	2,153.85	lc5				
4/15/2003	abc	abcdef	$7,692.31	115,384.62	153.85	2,307.69	lc5				
4/29/2003	abc	abcdef	$7,692.31	123,076.92	153.85	2,461.54	lc5				
5/13/2003	abc	abcdef	$7,692.31	130,769.23	153.85	2,615.38	lc5				
5/27/2003	abc	abcdef	$7,692.31	138,461.54	153.85	2,769.23	lc5				
6/10/2003	abc	abcdef	$7,692.31	146,153.85	153.85	2,923.08	lc5				
6/24/2003	abc	abcdef	$7,692.31	153,846.15	153.85	3,076.92	lc5				
7/8/2003	abc	abcdef	$7,692.31	161,538.46	153.85	3,230.77	lc5				
7/22/2003	abc	abcdef	$7,692.31	169,230.77	153.85	3,384.62	lc5				
8/5/2003	abc	abcdef	$7,692.31	176,923.08	153.85	3,538.46	lc5				
8/19/2003	abc	abcdef	$7,692.31	184,615.38	153.85	3,692.31	lc5				
9/2/2003	abc	abcdef	$7,692.31	192,307.69	153.85	3,846.15	lc5				
9/16/2003	abc	abcdef	$7,692.31	200,000.00	153.85	4,000.00	lc5				

Cost and Effort Template - Graphs

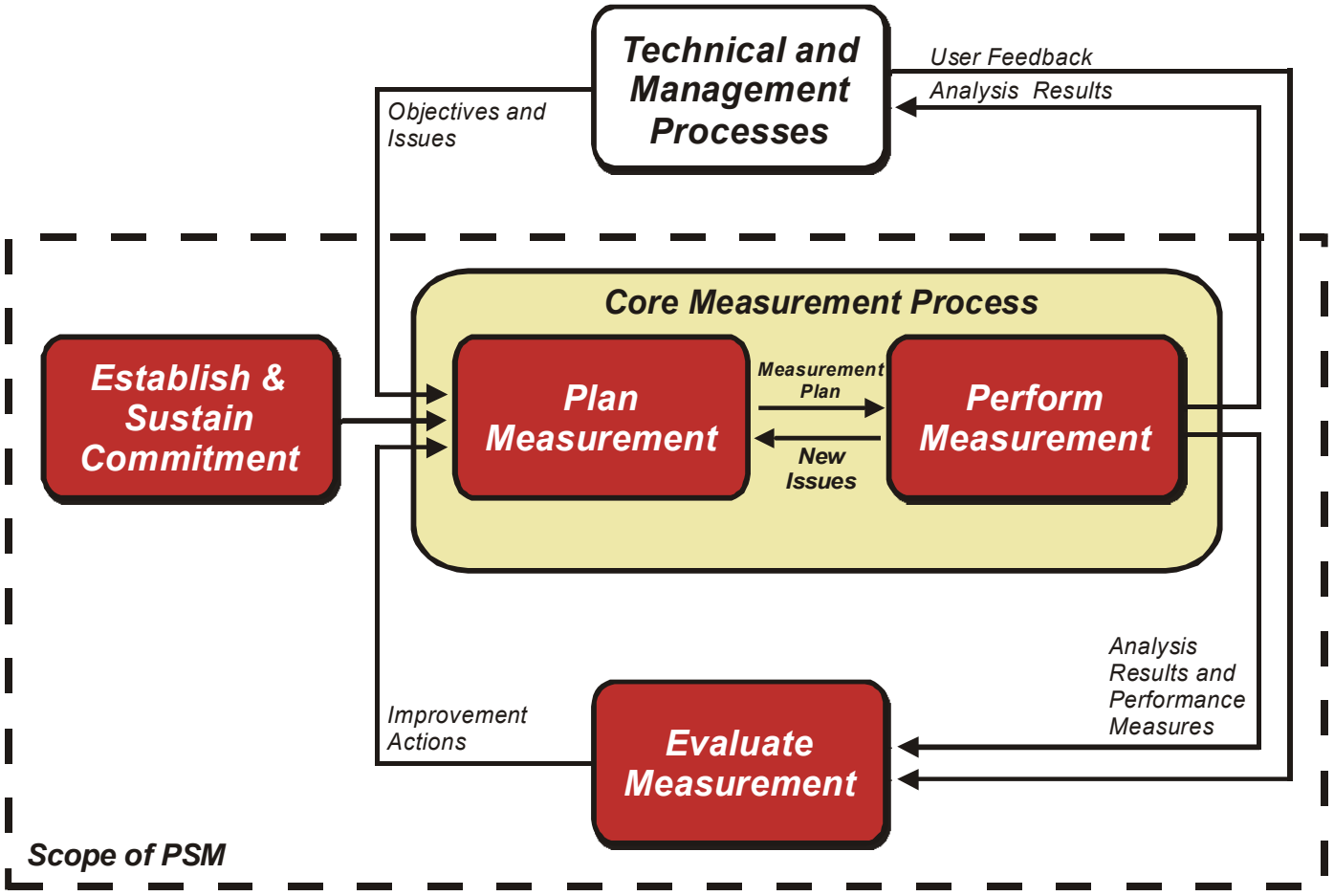








PSM Process


Technical and Management Processes
User Feedback
Analysis Results
Objectives and Issues
Core Measurement Process
Establish & Sustain Commitment
Plan Measurement
Measurement Plan
New Issues
Perform Measurement
Analysis Results and Performance Measures
Improvement Actions
Evaluate Measurement
Scope of PSM

Perform Measurement

- Organizational Analysis Occurs Monthly
  - Projects provide specified data, along with explanations of any major outliers
  - Monthly organizational report is generated (to managers and posted on PAL)
  - Analysis is focused on organizational issues, across projects
  - Also report data status including any missing data
- Analysis Addresses:
  - Standard indicators against decision criteria
  - Detailed analysis of identified problems

Perform Measurement (cont.)

- Project Analysis Occurs As Needed
  - Monthly during management reviews
  - Weekly on selected projects / issues, especially for development and large projects
  - Quarterly during Senior Management Reviews
  - Typically report common measures / indicators, plus any project-specific measures

Evaluation and Commitment

- Evaluate Measurement
  - Measures Are Periodically Reviewed with Management Team to Discuss Data and Analysis
  - Workshops Are Held Periodically to Review Business Goals, Information Needs, and Selected Measures
- Establish and Sustain Commitment
  - Managers Were Involved in Defining Business Goals, Information Needs, and Common Measures
  - Analysis Results Are Regularly Reviewed with Managers

Applying the PSM Principles

- Information Needs and Objectives Drive Measurement Requirements
- Measures Based on Technical and Management Processes
- Level of Detail Sufficient to Identify and Isolate Risks and Problems
- Independent Analysis Capability Implemented
- Systematic Analysis Process to Trace Measures to Decisions
- Measurement Results in Context of Other Project Information
- Measurement Integrated Throughout Life Cycle
- Measurement Process as a Basis for Objective Communications
- Focus Initially on Project-Level Analysis

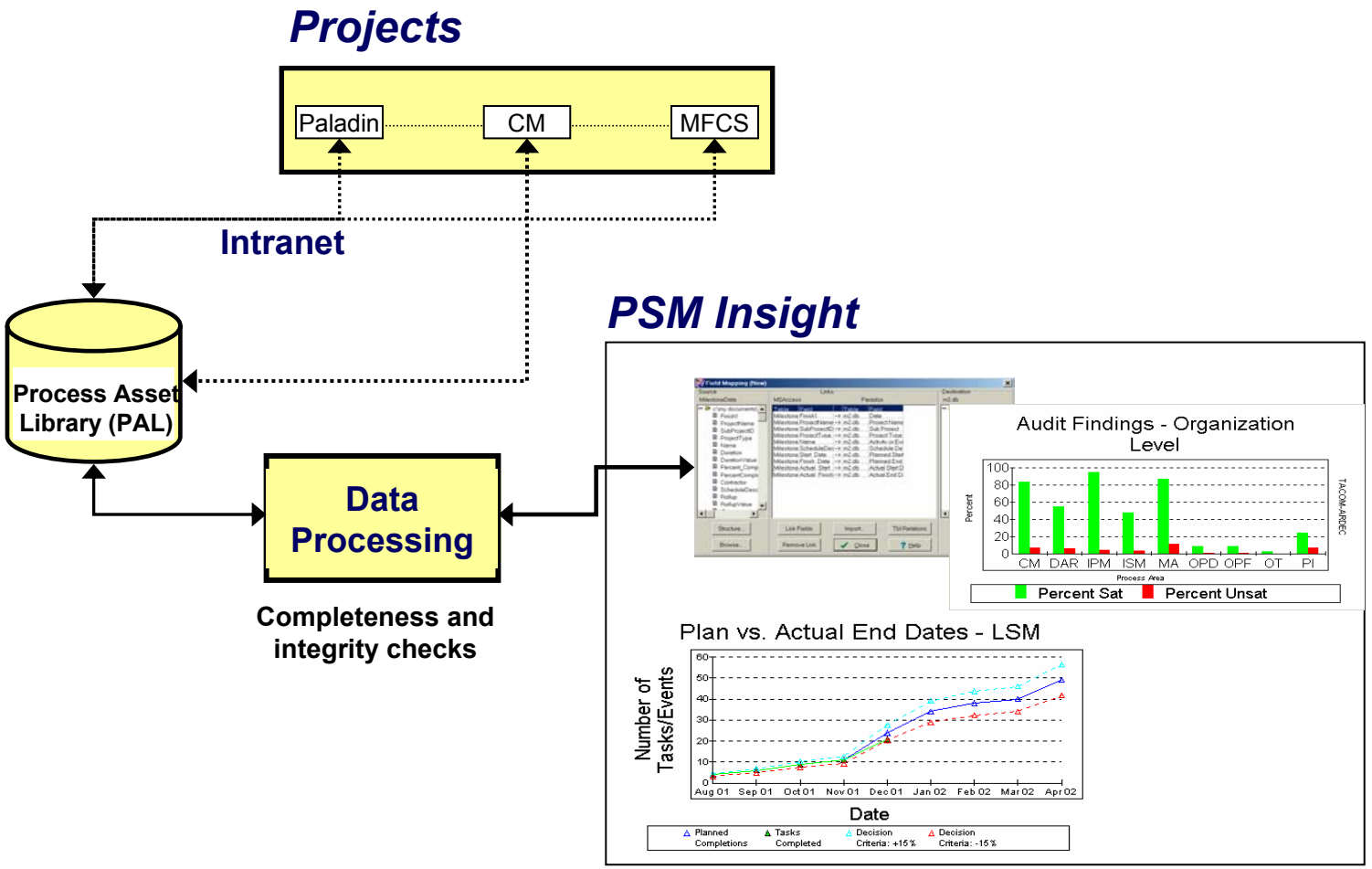
Early Benefits from Organizational Measurement Analysis

- Better Definition of the Tasks Performed in Each of the Project's Processes
- Early and Improved Visibility into the Performance of Each Project
- Improved Communication Between Organizational Managers and Project Personnel
- A Baseline of Actual Data to Improve the Accuracy of Estimates for Future Projects

Key Tools - Collecting Data

- PSM Insight Used as Basis for Organizational Database
  - Larger projects use Insight for the project database
  - Smaller projects use Excel, Access
  - All data imported into PSM Insight
- Data Collected Monthly
- Existing Excel Spreadsheets Used in Beginning - Moved to Templates for Common Measures
- Automatic Imports from Standard Tools Are Being Established (e.g. Government Personnel System, QA Audit Database)
- Data Validated During Import Process

PSM Insight as a Repository



Lessons Learned

Lessons Learned

- Process Improvement Requires Investment
- Clearly Identify Roles and Responsibilities
  - Team Members Need to Understand Their Responsibilities
  - An Organizational WBS Can Help Identify Common Technical Tasks and Activities
- Templates Help Team Members Focus on What Needs to be Done, If Tailored As Appropriate
- One-on-One Meetings with All Levels of Project Personnel Are Useful
- Appropriate Training Needs to be Provided
- PSM Principles Apply at the Organization

Lessons Learned - Plan Measurement

- Start by Implementing a Small Set of Measures to Address Defined Organizational Information Needs - Allow Tailoring
- Executive-Level and Project-Level Workshops Are Good for Defining Information Needs
- The Measurement Plan Should Specify Both "What" Will be Measured and "How" the Process Will Work
- Provide Well Defined Base Measures to Ensure Consistency

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

Two Keys for Success

- Control the Level of Change that is Required to Implement a New Measurement Program
  - Avoid excessive cost
- Gain the Support of the Members of the Organization
  - Overcome resistance to change

Control the Level of Change

- **Start Small**
  - *A Small Initial Effort Reduces the Level of Change and Impact on the Resources and Workload of the Project Personnel*
    - *Projects should collect a small set of organizational measures*
    - *If list of measures is large, prioritize prospective measures for incremental implementation*
- **Choose Organizational Measures Wisely**
  - *The Organizational Measurement Program must Collect Data to Address Common Organizational Information Needs - Business Goals*

Gain Support for Measurement

- The Resulting "Culture Shock" from Implementing any new Process causes a Natural Reaction of Personal Resistance
- 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

Practical Software and Systems Measurement: What's Next?

PSM Users' Group Conference

- 14-18 July 2003
- Keystone, Colorado
- Theme: Making Measurement Work throughout the Enterprise
- Presentations, Workshops, and Training
- Initial Schedule Available from PSM Web Site (www.psmsc.com)
- 1½ hours from Denver
- New facilities - complimentary recreation pass included

PSM Accomplishments

- Sample Measurement Specifications Developed (template, 11 drafted)
- Experience Reports Documented (template, 5 completed)
- New Technology Paper
  - Applying PSM to Enterprise Measurement
- PSM Insight Releases - through v4.2.1
- DoD Implementation Guidance
- Web Site Redesigned
- PSM 4.0 Finalized and Posted to Web

PSM FY03 Focus Areas - Get Involved

- Complete PSM Survey (www.psmsc.com)
- Technology Papers (Review Team):
  - Systems Engineering Technical Measures
  - Enterprise Measurement
  - System of Systems Measurement
  - Safety Process Measurement
- Develop Additional Measurement Specifications
- Develop Experience Reports

FY03 Schedule - Public Courses

- PSM Training
  - June 2003 (dates TBD) - VA area
  - 8-9 September 2003 - VA area
- PSM Insight Training
  - June 2003 (dates TBD) - VA area
  - 10-12 September 2003 - VA area

For More Information

Cheryl Jones - PSM Project Manager
cljones@pica.army.mil
(973) 724-2644 (Voice)

U.S. Army TACOM - ARDEC
AMSTA-AR-QAT-S
Building 62
Picatinny Arsenal, NJ 07806-5000
(973) 724-2382 (FAX)
psm@pica.army.mil
www.psmsc.com