



Maturing Measurement Capability

The CMMISM Measurement Thread and Recognized Industry Guidance - Standards

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Context - Introduction

- Measurement History - Plethora of Guidance
- Measuring Software Activities - Quantifying Goo
- The BIGGEST Challenge: Where's that list of metrics?
- Measurement as a PROCESS (ISO 15939 - CMMI)
- Measurement Thread within CMMI
- Measurement: Am I Mature? Am I Capable?
- Facilitating Transition

Measurement History - 1



➤ Measurement Direction & Guidance

- ✓ PSM
- ✓ GQM
- ✓ SEI - SEMA
- ✓ DoD Directive 5000.2R
- ✓ SW-CMM Measurement & Analysis Common Feature
- ✓ 5495 books on “Measurement” @ Amazon.com
- ✓ 64 books on “Software Measurement” @ Amazon.com

Measurement History - 2



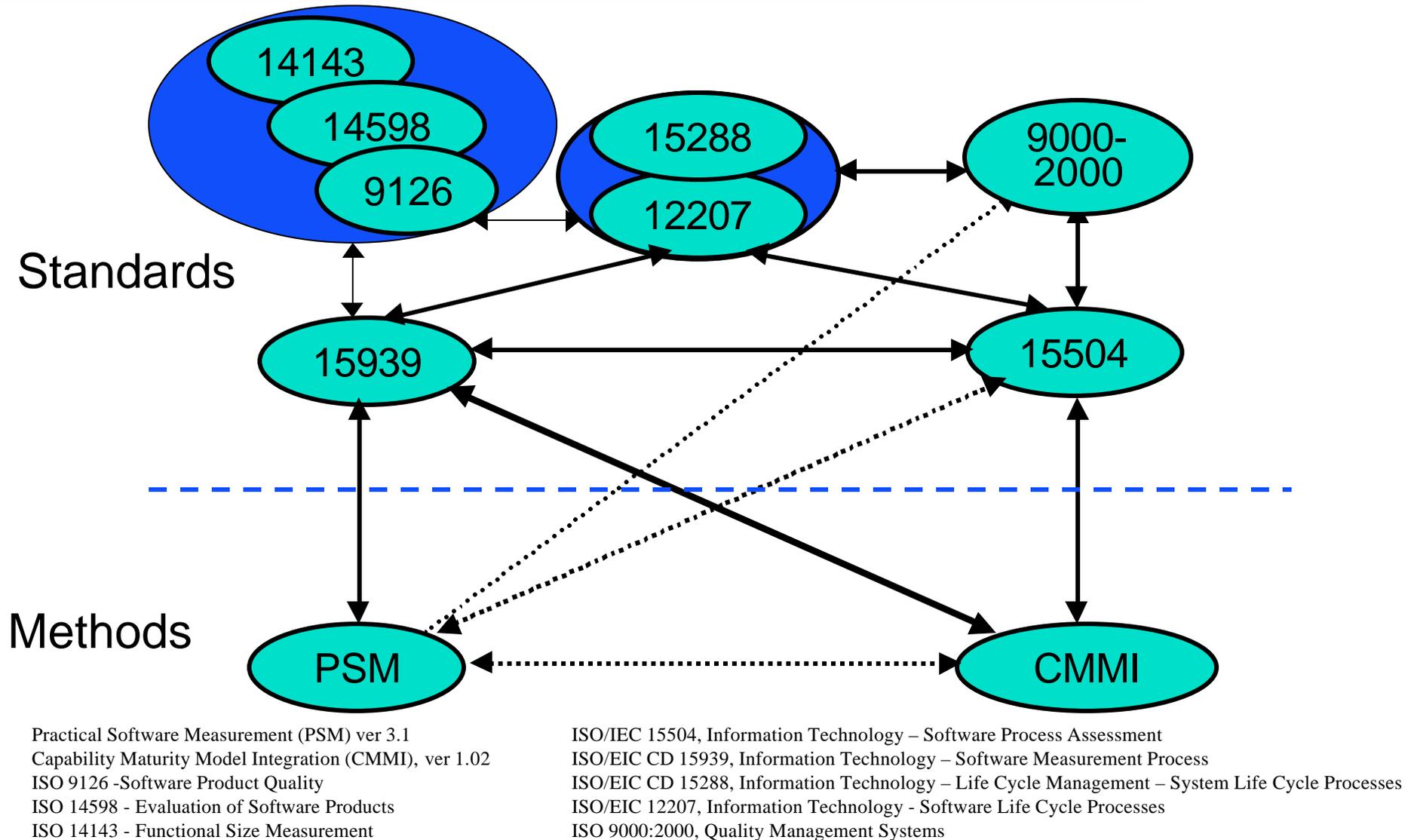
➤ Standards for Measurement

- ✓ ISO 14143 Functional Size
- ✓ ISO 9126 Software Product Quality
- ✓ ISO 15939, IT - Software Measurement Process

➤ Measurement in Standards

- ✓ ISO 15504 Software Process Assessment
- ✓ ISO 14598 Software Product Evaluation
- ✓ ISO 12207 Software Life Cycle Process
- ✓ ISO 15288 Systems Life Cycle Process
- ✓ ISO 9000:2000 Quality Management System

Measurement History - Order

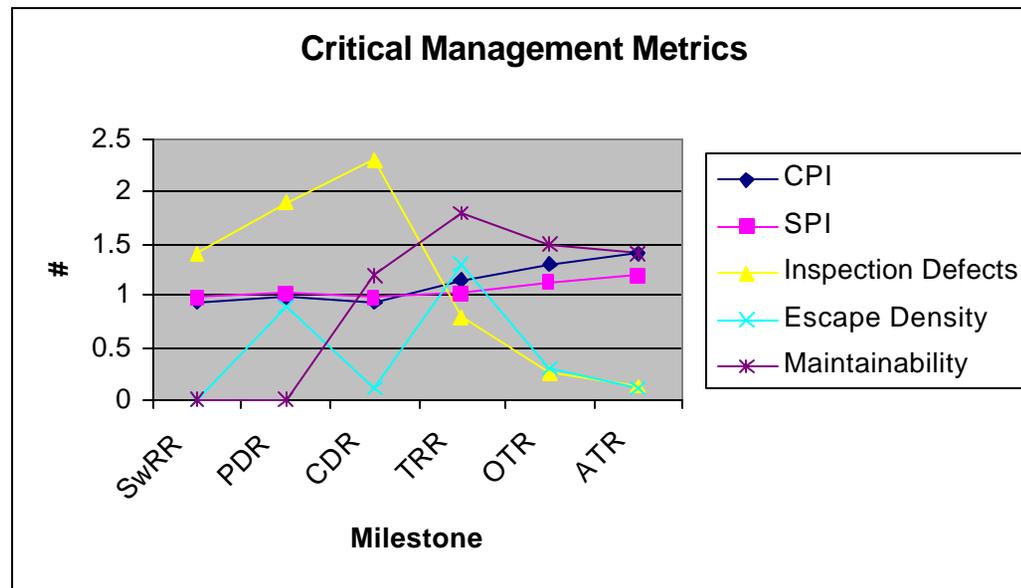


Measuring SW / Systems - Goo

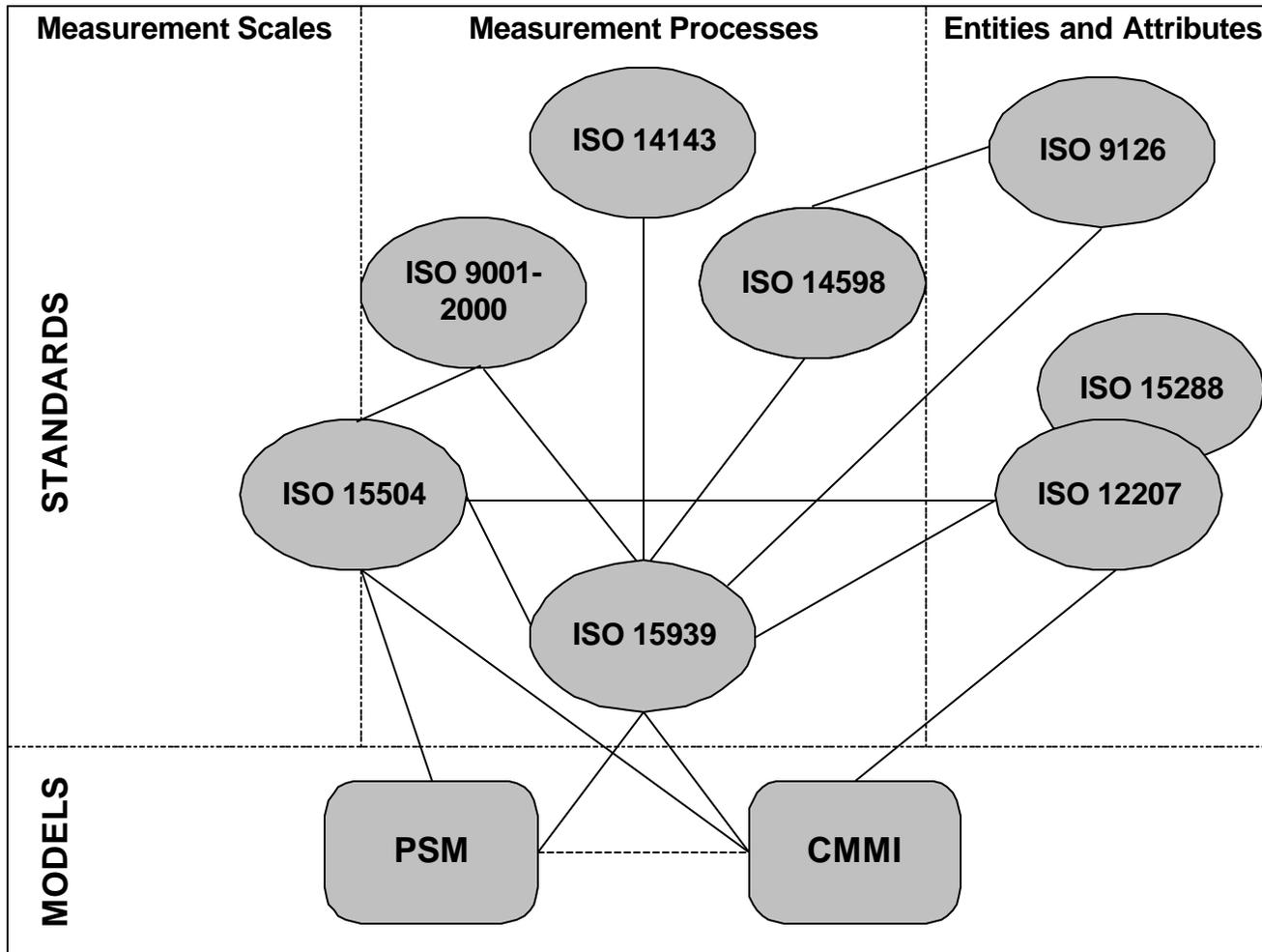


- There are metrics,
 - ✓ Size Metric: 1000 SLOC
 - ✓ Quality Metric: 3 Defects / 1000 SLOC
 - ✓ Management Metric: $CPI - ACWP / BCWP$

- And then there are METRICS



Conquering Semantics



Measurement Drivers



- What Managers Need to Know
 - ✓ Is there really a problem? How big is the problem?
 - ✓ What is the scope of the problem?
 - ✓ What is causing the problem?
 - ✓ Are there related problems?
 - ✓ Can I trust the data?
 - ✓ What should I expect; what will happen?
 - ✓ What are my alternatives? What is the recommended course of action?
 - ✓ When can I expect to see results?

- These are the questions management should be THINKING about and using measurement to provide useful information in time to support decision-making.

- When Project Managers are unable to get the INFORMATION they and their upper management need in time to support decision-making, then specified METRICS often become mandated

Where's that list of metrics?



➤ Defense Science Board Task Force (November 2000)

- ✓ Finding # 4 - Collect, Disseminate, and Employ Best Practices. Sub-section Better use of Metrics states in part:

A Best Practice that all major defense software-intensive projects should adopt is core metrics collection. ...

The core metrics are:

- Progress (CPI, SPI, Milestone Slippage, Segment Completion)
- Staffing (Vacancies, Turnover)
- Requirements (Implemented %, Volatility)
- Quality (Defects open/closed, Test coverage)
- Product Stability (Peer Review coverage, Rework)

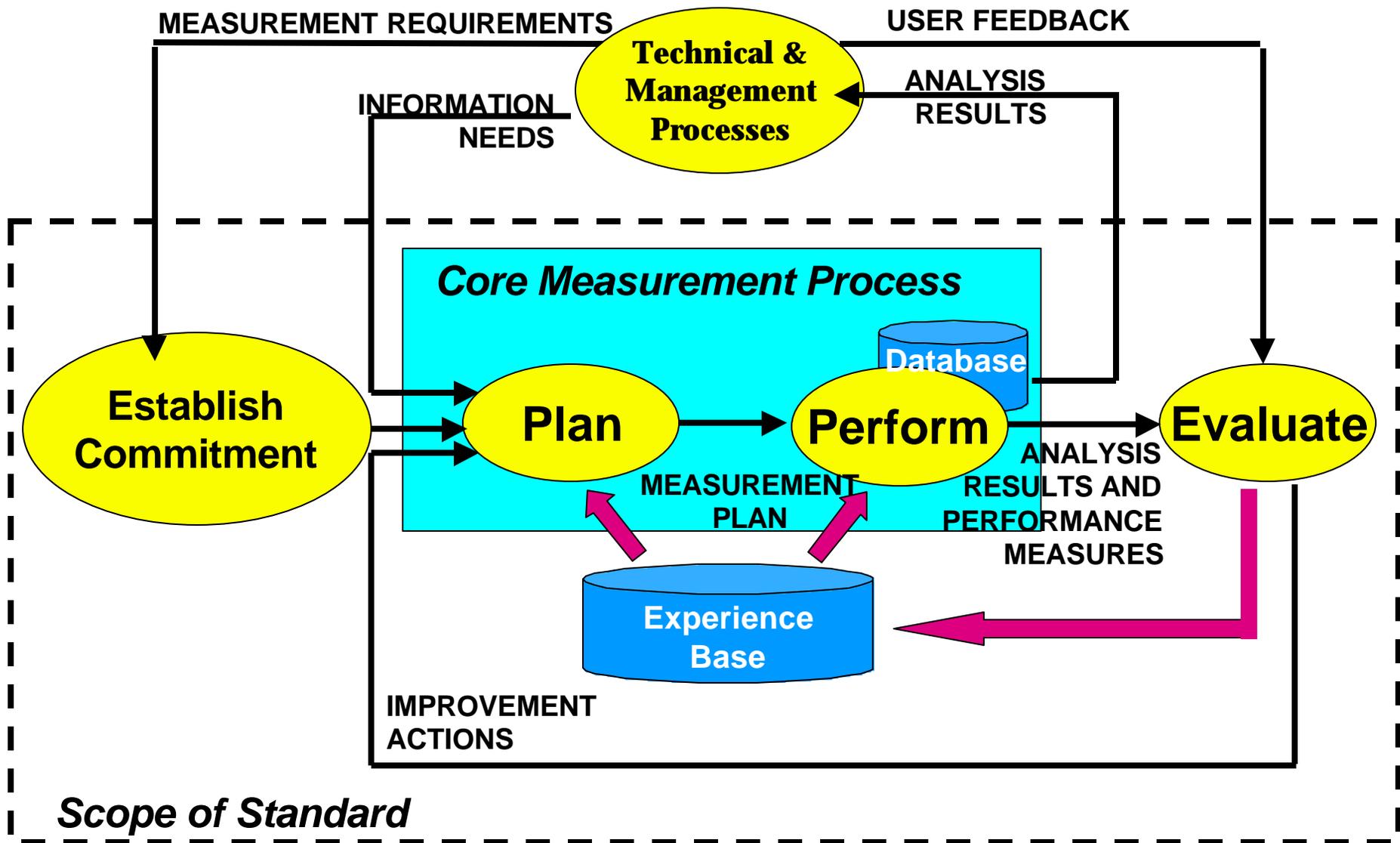
Where's that list of metrics?



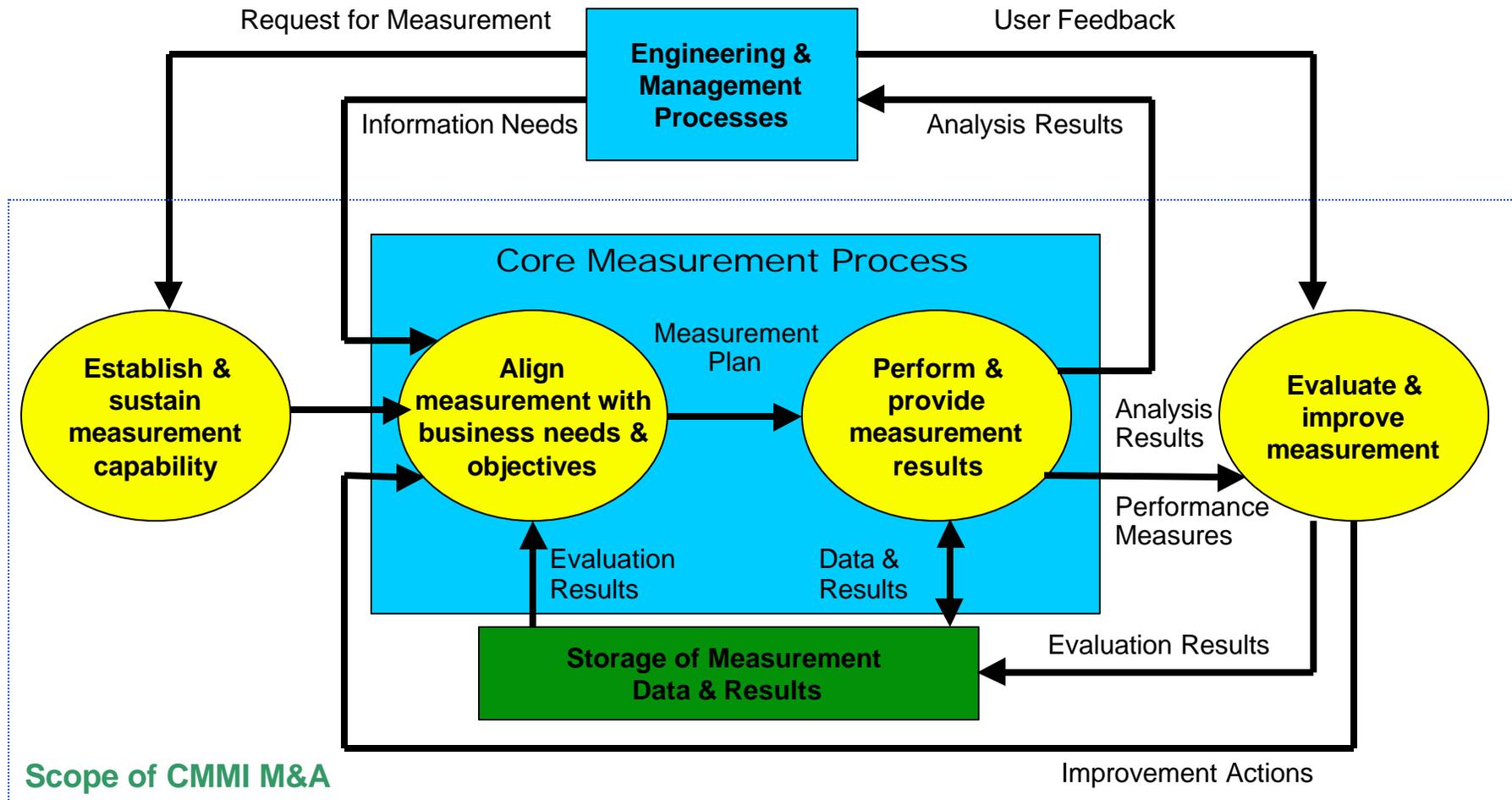
- Inquiries at the STSC Help Desk regarding ‘metrics’
 - ✓ We in the HQ Information Project Office (HIPO) are looking for the best methods to implement automation metrics. ... I was wondering **what kind of metrics** might be used in a Headquarters information environment to gauge "improvements" (what ever they are...!)
 - ✓ [Our] product is a database ... which tracks the individual training requirement for personel in the field at the wings. ... it also tracks dogs as in canines. [We] have hired a contractor to make improvements to [our] database and to do some data standardization. **[We] want some metrics** on how [we] are doing.

- In both instances, they wanted a ‘list’ !

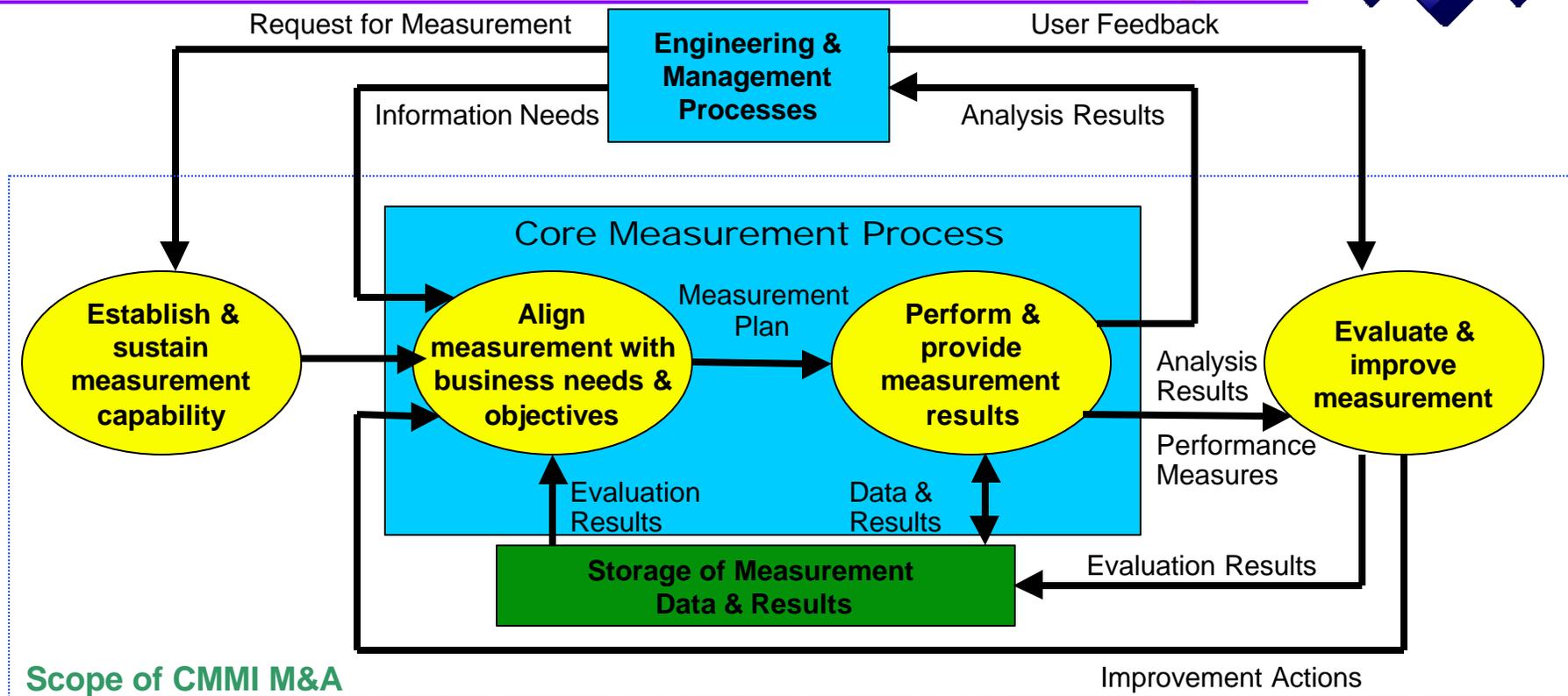
ISO 15939 Measurement Process



CMMI Representation



Core M&A PA Practices



Align with Needs & Objectives

M&A Specific Goals:

1. Measurement objectives and practices are aligned with identified information needs and objectives

SP 1.1 Establish measurement objectives

Specific Practices:

SP 1.2 Specify measures

SP 1.3 Specify data collection & storage procedures

SP 1.4 Specify analysis procedures

Perform & Provide Results

2. Measurement results that address identified information needs and objectives are provided

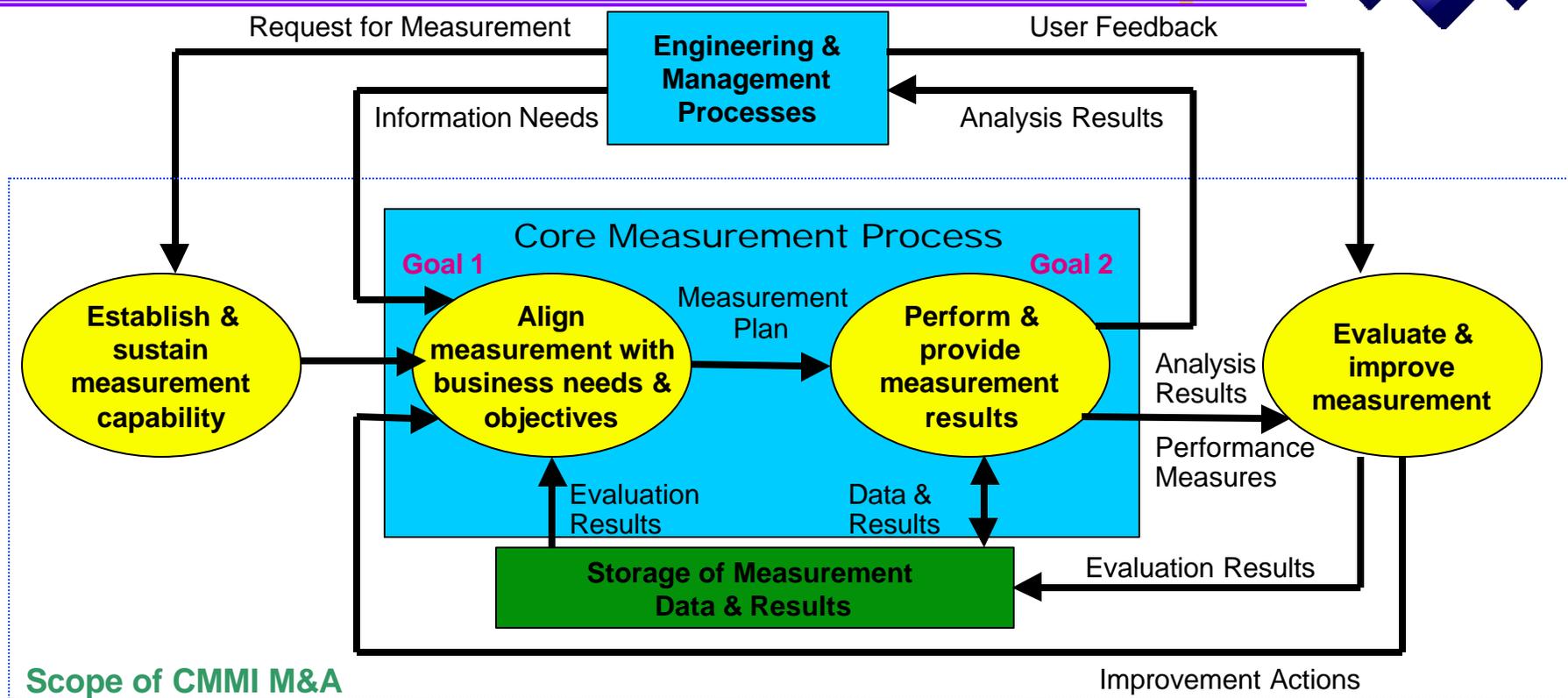
SP 2.1 Collect measurement data

SP 2.2 Analyze measurement data

SP 2.3 Store data & results

SP 2.4 Communicate results

Maturing Measurement w/ GP's



Establish & Sustain Process

- GP 2.1 Establish an organizational policy
- GP 2.3 Provide resources
- GP 2.4 Assign responsibility
- GP 2.5 Train people
- Level 2** **Level 4**

Level 3 **Level 5**
PSM-MSR-010724

Align with Needs & Objectives

- GP 2.2 Plan the process
- GP 3.1 Establish defined process
- GP 4.1 Establish quality objectives
- GP 5.1 Ensure continuous process improvement

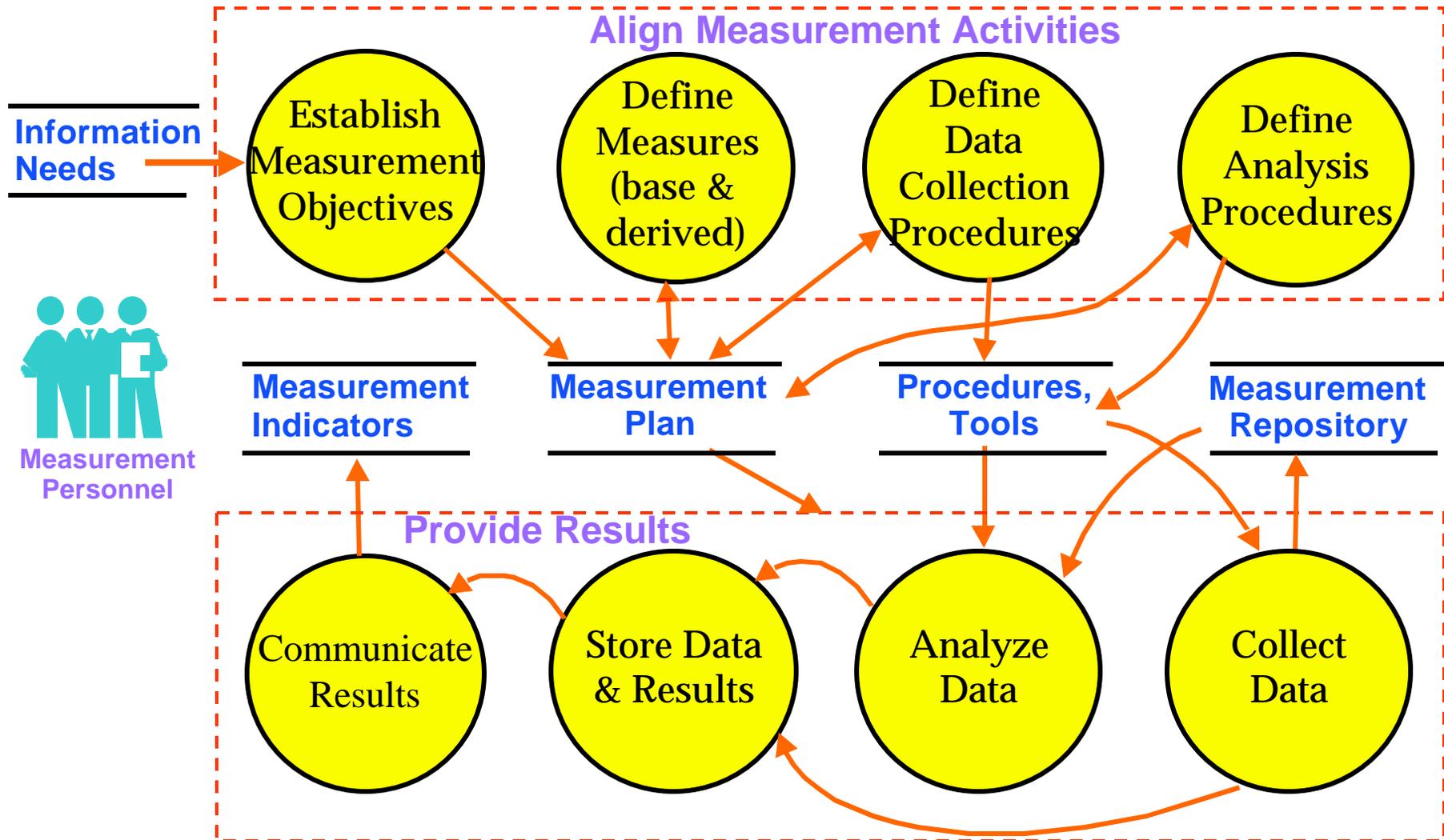
Perform & Provide Results

- GP 2.6 Manage configurations
- GP 2.7 Identify & involve relevant stakeholders
- GP 4.2 Stabilize sub-process performance

Evaluate & Improve

- GP 2.8 Monitor & control
- GP 2.9 Objectively Evaluate adherence
- GP 2.10 Review status with higher level management
- GP 3.2 Collect improvement information
- GP 5.2 Correct common cause of problems

Measurement & Analysis



Measurement @ CMMI ML 2



- Where do information needs come from?
 - ✓ The Front Door - 'Required'
 - Project Monitoring & Control Process Area
 - Specific Goal 1: “Actual performance and progress of the project is monitored against the project plan”
 - ✓ The Side Door - 'Expected'
 - PM&C PA Specific Goal 1, Specific Practice 1:
 - Monitor the actual values of the project planning parameters against the project plan
 - SP1 Note: Project planning parameters constitute typical **indicators** of project progress and performance and include **attributes** of work products and tasks, cost, effort, and schedule. Attributes of the work products and tasks include such items as size, complexity, weight, form, fit, or function

Measurement @ CMMI ML 2



➤ Where do information needs come from?

✓ The Back Door - 'Informative'

- Project Monitoring & Control - Specific Practice 1.1
 - Sub-Practice 1: Monitor progress against the schedule
 - Sub-Practice 2: Monitor the project's cost and expended effort
 - Sub-Practice 3: Monitor the attributes of the work products and tasks
 - Sub-Practice 4: Monitor resources provided and used
 - Sub-Practice 5: Monitor the knowledge and skills of project personnel
 - **“Monitoring of ... typically includes the following: Periodically measuring the ...”**
- Generic Practice 2.8 Monitor & Control the Process -
SubPractice 1 - Measure actual performance against the plan
- Project Planning PA - Specific Practice 1.4
 - Sub-Practice 1: Collect the models or *historical data* that will be used to transform the attributes of the work products and tasks into estimates of the labor hours, schedule, and cost

Measurement @ CMMI ML 3



- How does measurement benefit the organization?
 - ✓ The Front Door - Required
 - Organizational Process Definition Process Area
 - Specific Goal 1 “Create Organizational Process Assets”
 - Specific Goal 2 “Process assets that support the use of the organization's set of standard processes are available”
 - ✓ The Side Door - Expected
 - Organizational Process Definition Process Area
 - Specific Practice 1.1 Establish Standard Processes
 - Includes process for all ML2 PA's
 - Organizational Process Definition Process Area
 - Specific Practice 2.1 'Establish an Organizational Measurement Repository'

Measurement @ CMMI ML 3



➤ How does measurement benefit the organization?

✓ The Side Door

- Requirements Development Process Area
 - Specific Practice 3.3, Sub-Practice 5 'Identify technical performance measures that will be tracked during the development effort'
- Peer Reviews Process Area
 - Specific Practice 2.2 'Conduct Peer Reviews', Sub-Practice 4 "Collect Peer Review data"
 - Specific Practice 2.3 'Analyze Peer Review Data'

Measurement @ CMMI ML 3



➤ How does measurement benefit the organization?

✓ The Back Door

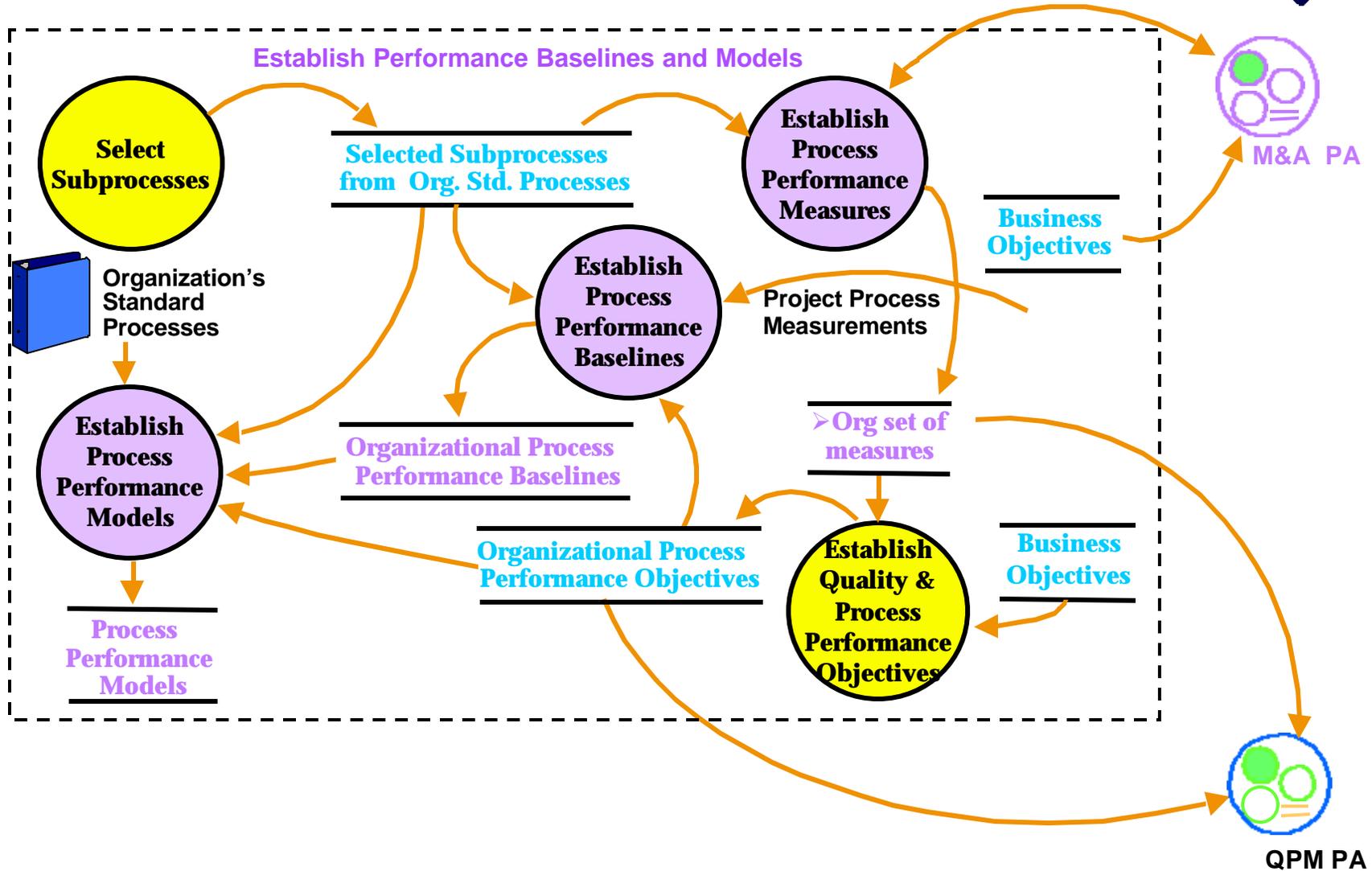
- Organizational Process Focus Process Area
 - Specific Practice 2.4 'Incorporate Process-Related Experiences into the Organization's Process Assets ', Sub-practice 5 "Analyze the organization's common set of measures"
- Organizational Process Definition Process Area
 - Specific Practice 2.1 'Establish an Organizational Measurement Repository ', Sub-practice 2 "Define a common set of process and product measures for the organization's set of standard processes"
- Integrated Project Management Process Area
 - Specific Practice 1.4 'Manage the project using the project plan, the subordinate plans, and the project's defined process', Sub-practice 3 "Obtain and analyze the selected measures to manage the project and support the organization's needs"

Measurement @ CMMI ML 4

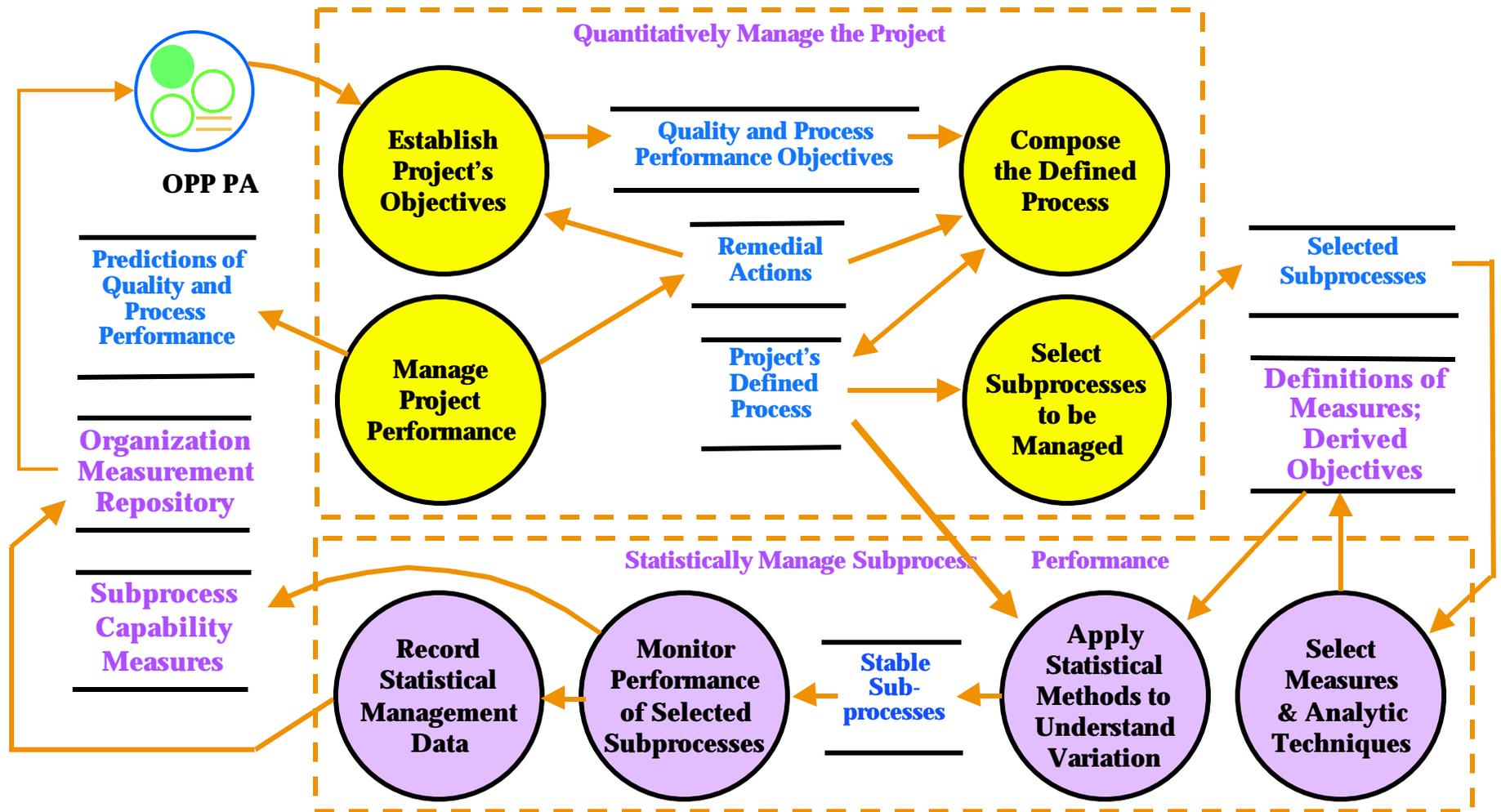


- Maturity Level 4 gets serious about measurement
- When the software division (TIS) @ Hill AFB went from SW-CMM ML 3 to ML 5 they had to almost completely reconstruct their measurement program
- 2 Process Areas
 - ✓ Quantitative Project Management
 - ✓ Organizational Process Performance
- Requires statistical thinking, not SPC
- Requires a culture of TRUST !!!

Measurement @ CMMI ML 4



Measurement @ CMMI ML 4



Measurement @ CMMI ML 5



➤ Measurement & Process Improvement

✓ The Front Door

- Organizational Innovation Deployment Process Area
 - Specific Goal 2 “Measurable improvements to the organization's processes and technologies are continually and systematically deployed”

✓ The Side Door

- Organizational Innovation Deployment Process Area
 - Specific Goal 2 ‘Measurable improvements to the organization's processes and technologies are continually and systematically deployed’, Specific Practice 2.3 “Measure the effects of the deployed process and technology improvements”
- Causal Analysis & Resolution Process Area
 - Specific Goal 1 ‘Determine Causes of Defects’, Specific Practice 1.1 “Select Defect Data for Analysis”

Measurement @ CMMI ML 5



➤ Measurement & Process Improvement

✓ The Back Door

- Organizational Innovation Deployment Process Area
 - Specific Goal 2 'Deploy Improvements', Specific Practice 2.1 'Plan the Deployment', Sub-practice 4 "Establish measures and objectives for determining the value of each process and technology improvement with respect to the organization's business objectives"
- Causal Analysis & Resolution Process Area
 - Specific Goal 1 'Address Causes of Defects', Specific Practice 2.2 'Evaluate the Effect of Changes',
 - > Sub-practice 1 "Measure the change in the performance of the project's defined process as appropriate"
 - > Sub-practice 2 "Measure the capability of the project's defined process as appropriate"

How do I know I'm compliant?



- SCAMPI Appraisals (Assessments , Evaluations, etc.)
 - The best indication of compliance

- CMMI Snapshots
 - Provides 'independent' confirmation of compliance status

- CMMI Practice Implementation Indicators
 - ✓ The results of incessant wrangling between the staged (CBA-IPI) and the continuous (EIA731 Evaluation) worlds
 - ✓ Assessment Methodology Integrated Team is the father of the idea
 - ✓ The real issue is 'objective evidence' sufficient to make a determination of compliance
 - ✓ A formal recognition that 'objective evidence' may be
 - Artifacts - direct evidence of process execution
 - Indirect Artifacts - ancillary evidence of process execution
 - Affirmations - Verbal confirmation of process execution

Facilitating Measurement Use



- **Various disciplines rely on measurement to support decision making associated with their practices**

- **A Role for our Measurement Community of Practice**
 - ✓ Evolution of Core Measurement Process / Practices
 - Update of informative material
 - Recommendations for changes to normative (mandatory) material in models and assessments
 - ✓ Measurement Planning Template
 - ✓ CMMI Practice Implementation Indicators
 - Measurement & Analysis Process Area (PA)
 - Measurement-related Process Areas and practices
 - ✓ Measurement relationship to other disciplines
 - Risk Management
 - Earned Value Management
 - Quality Management
 - ✓ Mapping of measurement-related practices –
 - Standards compliance matrix

For Further Information

- Effective Measurement Implementation Workshop
 - ✓ Thursday morning of PSM Users' Group Conference
 - ✓ CMMI M&A Practice Implementation Indicators
 - ✓ Standards Compliance Matrix
 - ✓ etc.

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Glossary of Terms

➤ **Defined Process**

- ✓ **A “defined process” is a managed process that is tailored from the organization’s set of standard processes according to the organization’s tailoring guidelines; has a maintained process description; and contributes work products, measures, and other process improvement information to the organization’s process assets**

(CMMI SW/SE/IPPD Chp 3 Model Terminology - CMMI Specific Terminology)

➤ **Organizational Measurement Repository**

- ✓ **The “organizational measurement repository” is a repository used to collect and make available measurement data on processes and work products, particularly as they relate to the organization’s set of standard processes. This repository contains or references actual measurement data and related information needed to understand and assess the measurement data**

(CMMI SW/SE/IPPD Chp 3 Model Terminology - CMMI Specific Terminology)