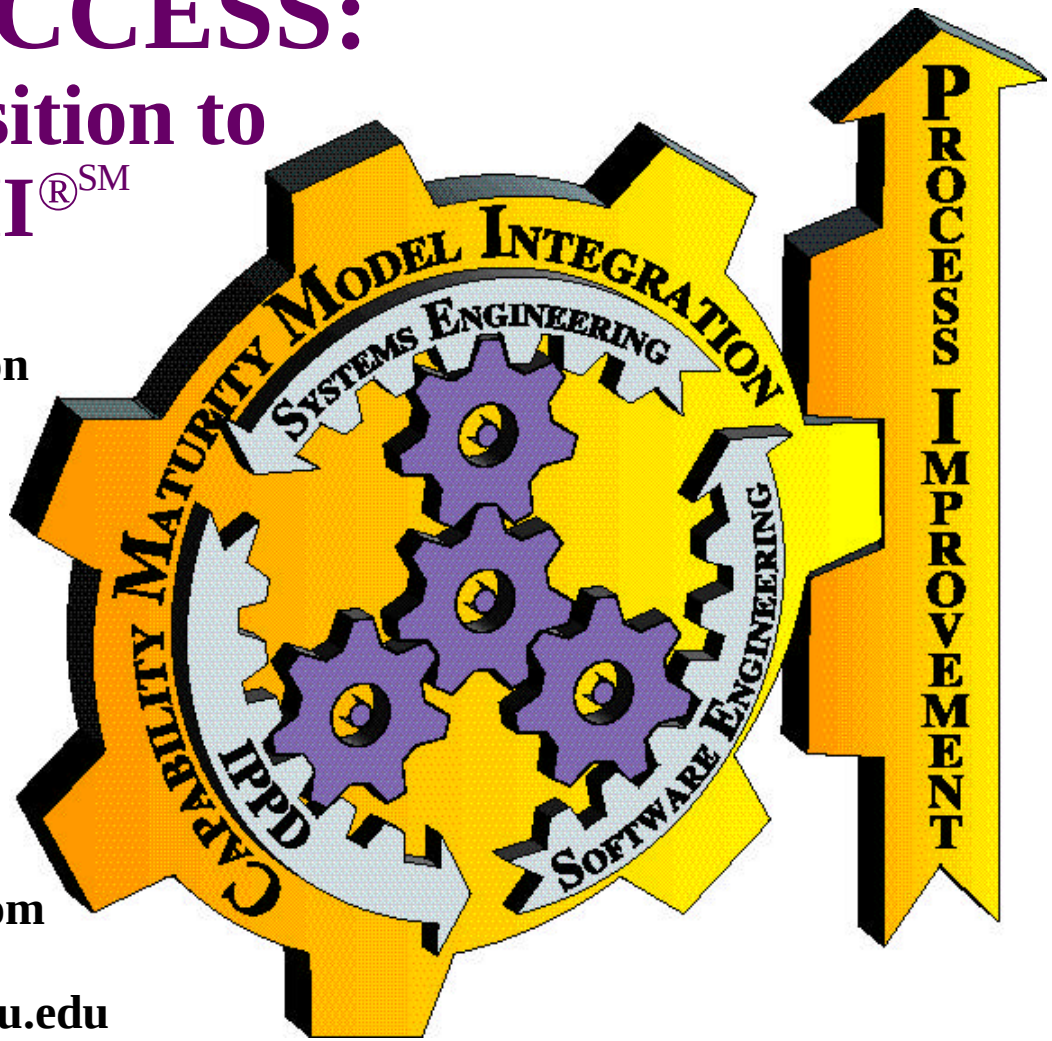
MEASURED SUCCESS:
Facilitating the Transition to ISO 15939 and CMMI®SM



Capability Maturity Model Integration
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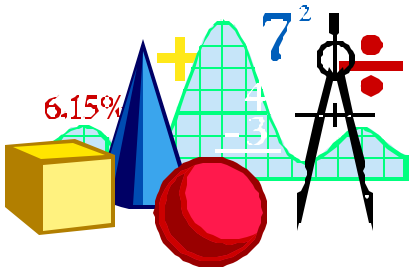
MEASURED SUCCESS:

Facilitating the Transition to Use of ISO 15939 & CMMI

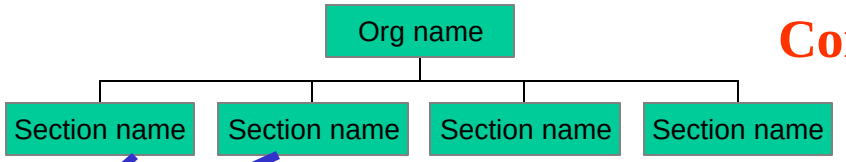
- Provide Background Information:
  - Role of models relative to process improvement
  - Capability Maturity Model Integration (CMMI) background
  - Discuss relationship between CMMI & ISO/IEC 15504
- Provide a Context for Measurement
  - Framework for measurement in models and related standards
  - Measurement practices in CMMI
  - Mapping of measures to business objectives
- Provide a Measurement Plan Template
- Discuss CMMI Transition Support



See CMMI at http://www.sei.cmu.edu/cmm/cmmi/public-review/public-review.html

Steps to Organizational Maturity

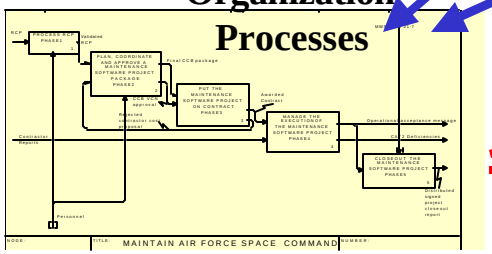
1. Vision & Goals



Commitment

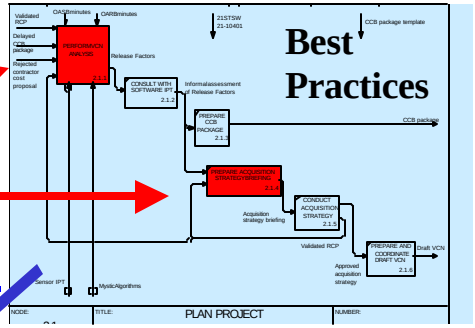
2. Process Capture

Organization Processes

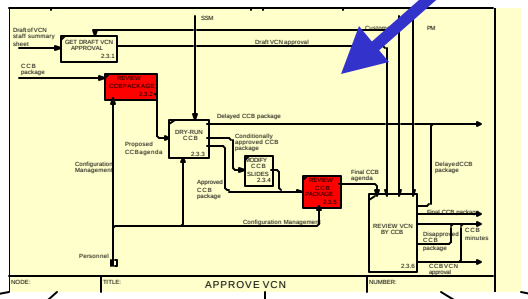


3. Gap Analysis

Best Practices



4. Process Transformation



From Process, all good things flow!

Project Management

Process Level Evolution

Metrics Capture

Activity Based Costing

Simulation

Process Improvement Business Case

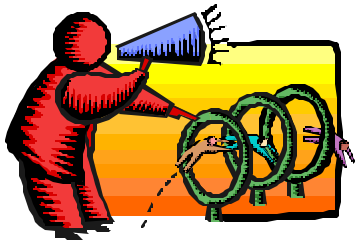
- US Data & Analysis Center for Software (DACS) State-of-the-Art Report
  - "A Business Case for Software Process Improvement - Revised: Measuring Return on Investment (ROI) from Software Engineering and Management," 30 Sep 99 - http://www.dacs.dtic.mil/techs/roispi2/ - documents that:
    - many organisations have reported a 7:1 ROI
    - Improves professional staff morale and retention (less overtime, less crisis, less employee turnover with less need for retraining)

- Process improvement efforts quantifiably justify funding (USAF AFMC ALCs)

–Demonstrated Return on Investment	of 4:1 - 19:1 *
–Earlier detection of software defects	from 22% - 90%
–Reduction in post-release defects	from 39% - 84%
–Reduction in schedule time	from 19% - 23%
–Reduction in projected schedule variance	down to 2% *
–Increased productivity (less rework)	of 35% - 75%
–Reduced sustainment costs	by 30% - 55%

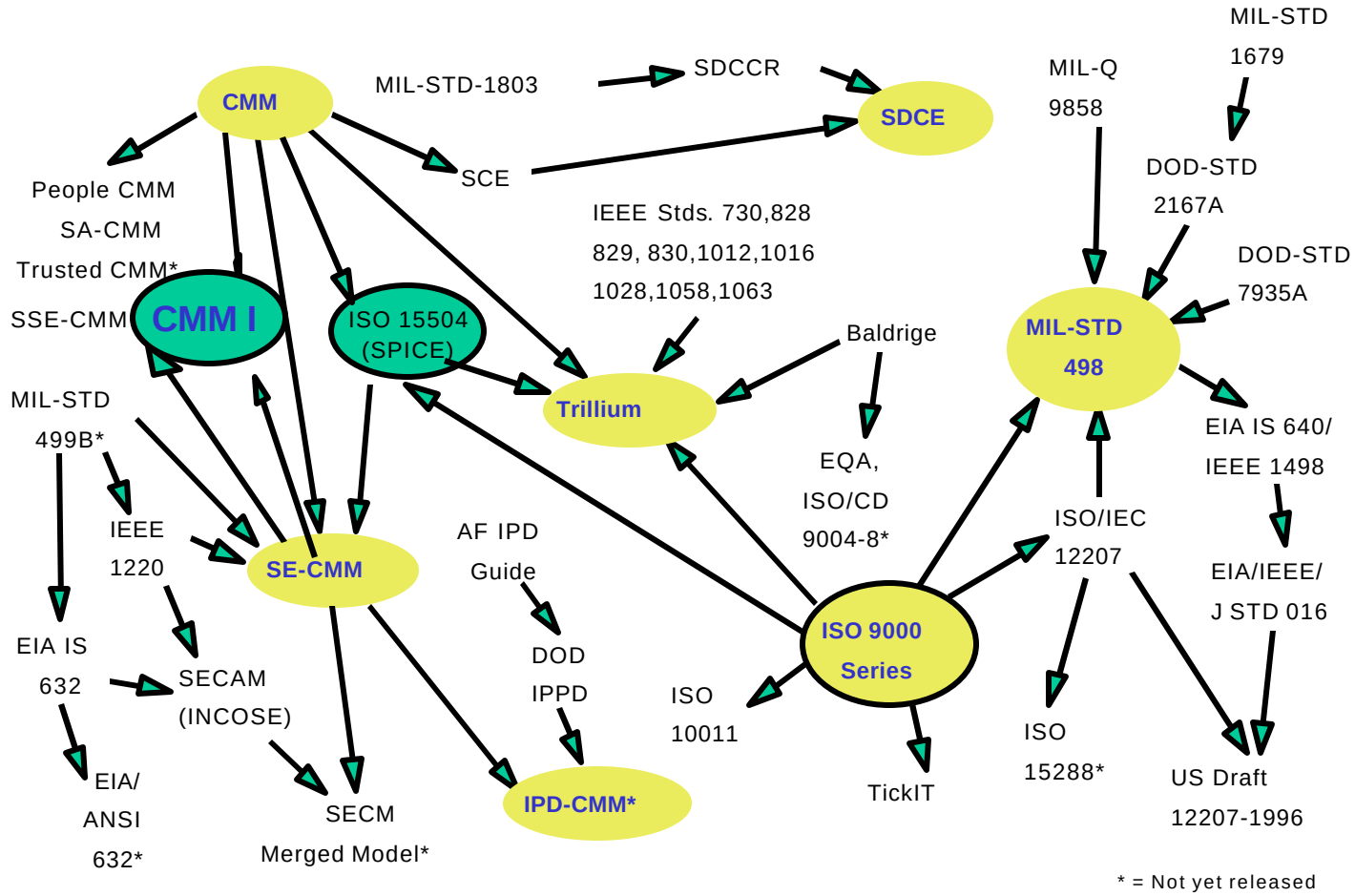
* for CMM level 5 organization

- Several programs have improved their capabilities based on Software CMM
  - –Enabled effective communication between separate business units;
  - –Reporting improved customer satisfaction - http://CRSIP.hill.af.mil



The Frameworks Quagmire

(Sarah Sheard, Software Productivity Consortium)

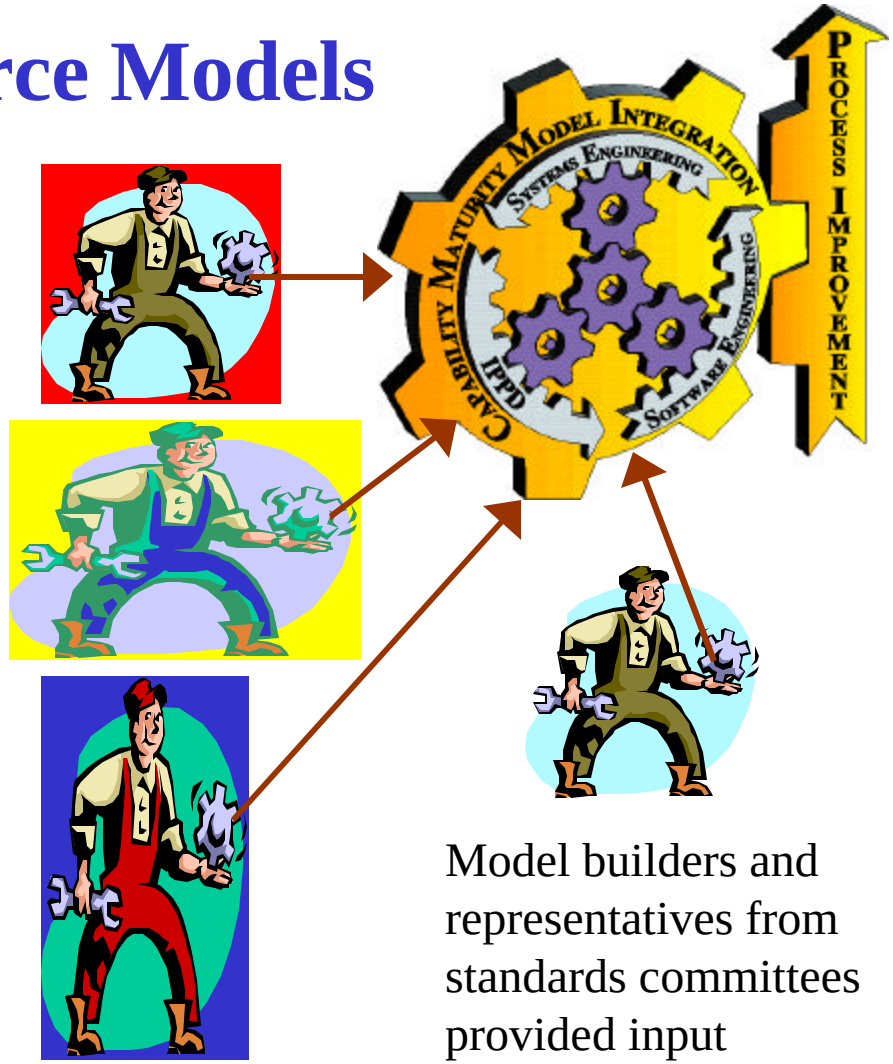


Study group report for JTC1/SC7:

"The international community should pool its resources to develop a standard for software process assessment incorporating the best features of existing software assessment methods."

CMMI Source Models

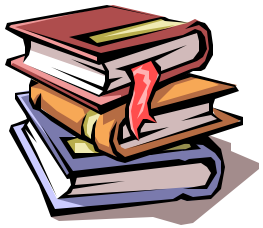
- Capability Maturity Model for Software Ver 2, draft C (SW-CMM V2C)
- EIA Interim Standard 731, System Engineering Capability Model (SECM)
- Integrated Product Development Capability Maturity Model, draft Ver 0.98 (IPD-CMM)



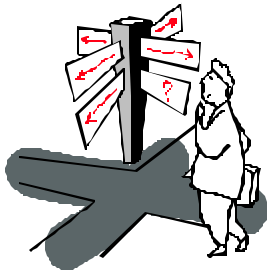
Model builders and representatives from standards committees provided input

SW/SE/IPPD include most acquisition processes, and an “Acquisition” discipline-specific model is now being considered for later integration

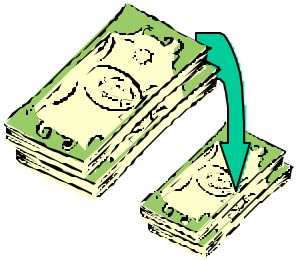
CMMI Design Goals



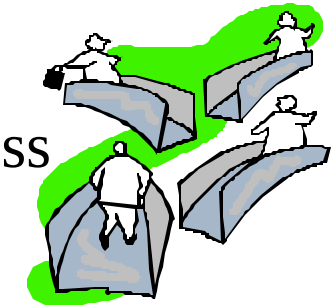
- Integrate the models, eliminate inconsistencies, reduce duplication
- Increase clarity and understanding
  - Common terminology
  - Consistent style
  - Uniform construction rules
  - Common components



- Reduce the cost of implementing model-based process improvement



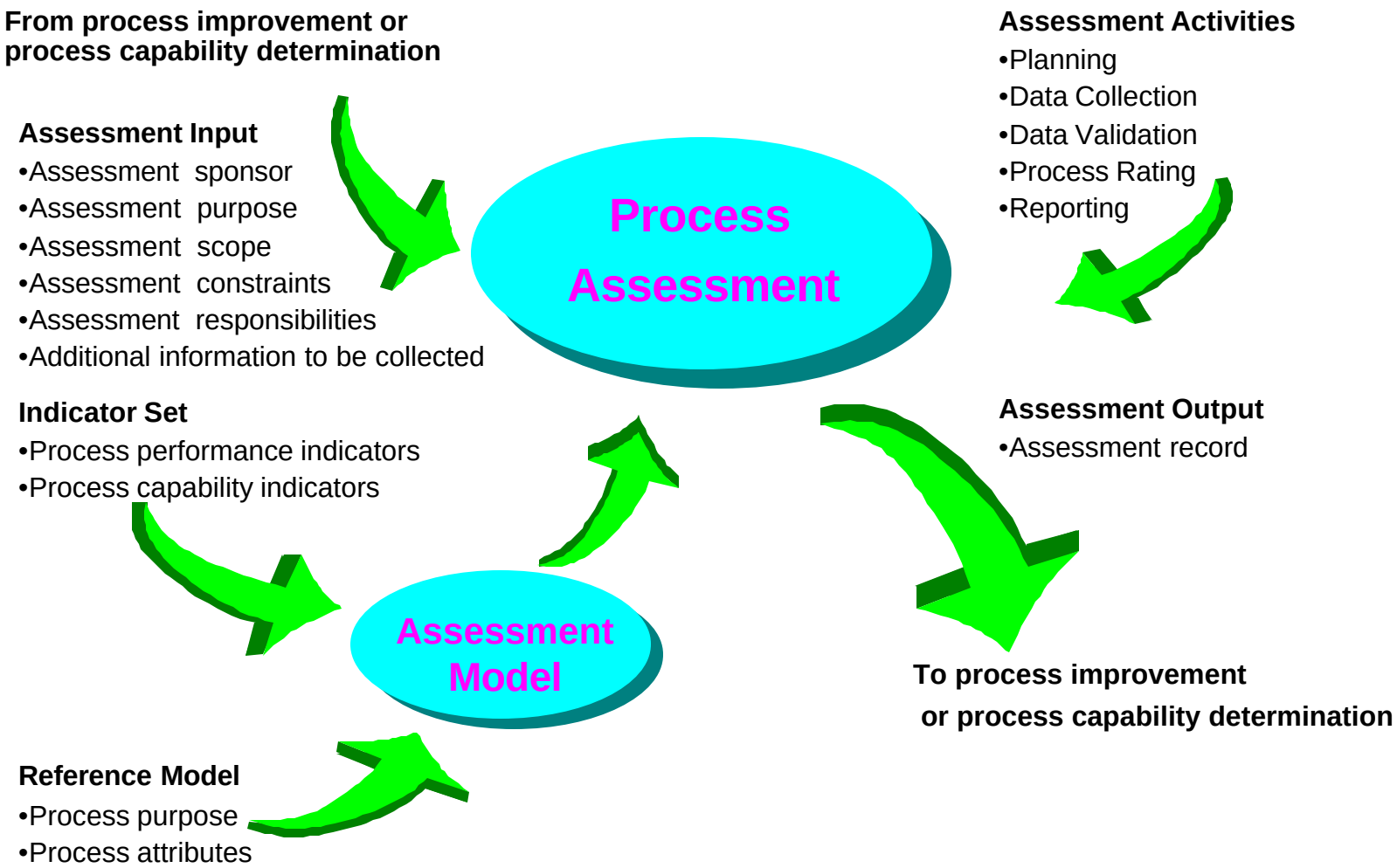
- Be sensitive to impact on legacy efforts
- Assure consistency with ISO/IEC 15504, Information Technology – Software Process Assessment



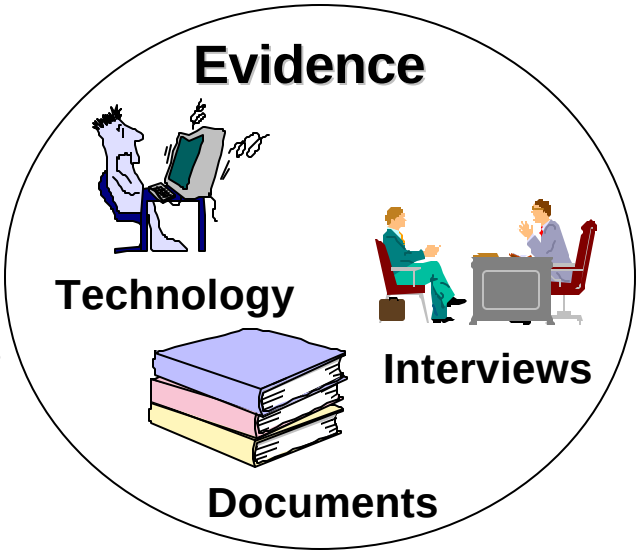
The Assessment Framework

- A framework for conducting consistent assessments of process capability
- A reference model for software engineering activities covering both processes and process capability, enabling expression of results in consistent terms
- An embedded model for use in process assessments, compatible with the reference model
- Guidance for applying assessment results in two contexts:
  - Process Improvement
  - Process Capability Determination

ISO 15504 - Framework for Assessment



Requirements for an Assessment



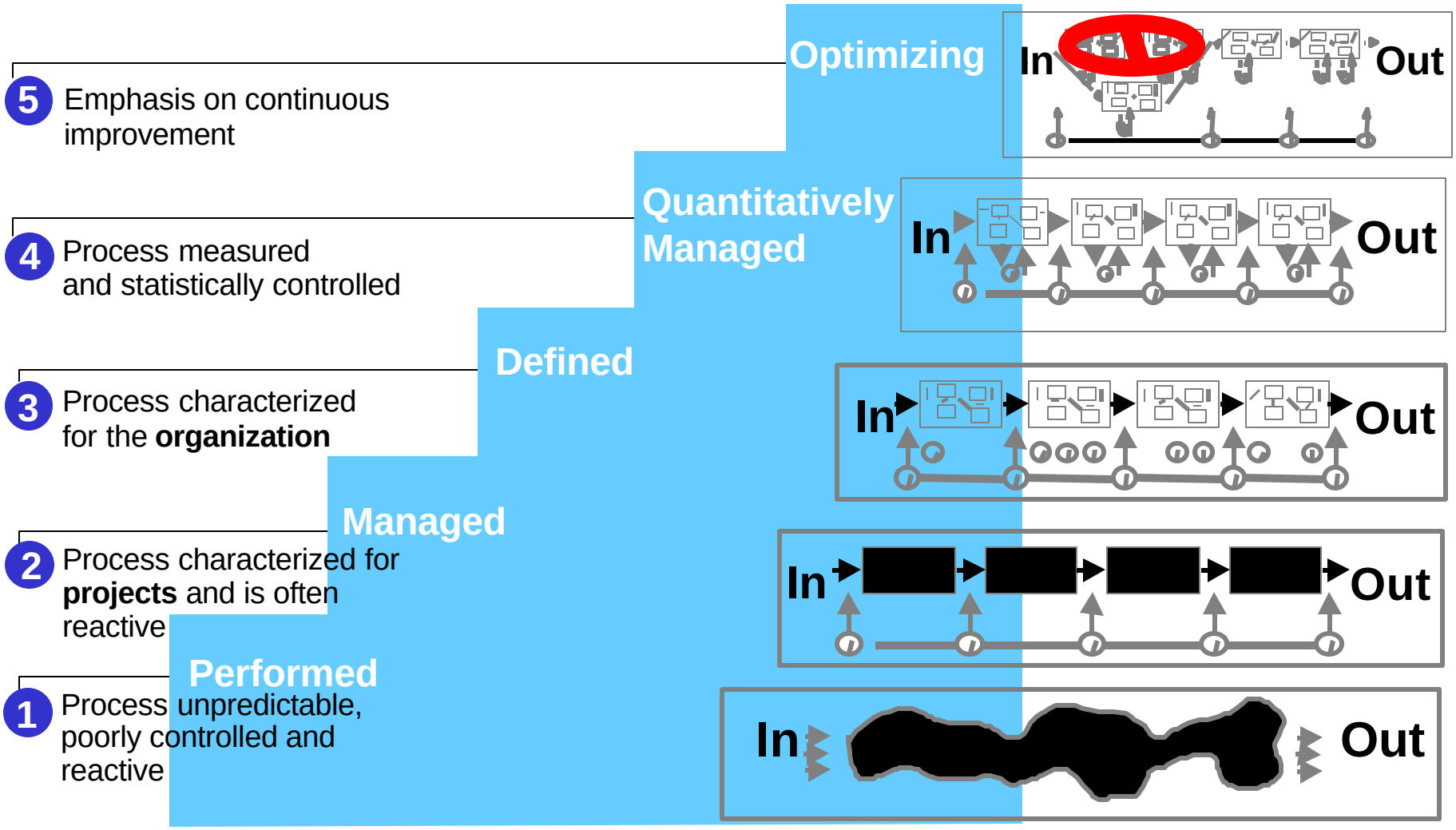
- To achieve the desired consistency, it is required that:

  - defined inputs must be identified;
  - a process model compatible with reference model must be used;
  - a documented assessment process must be followed;
  - the documented process must include specific required activities;
  - justification for ratings must be documented in terms of achievement of specified indicators of performance and capability;
  - a competent assessor must oversee the assessment;
  - defined outputs must be produced.

Measurement Scale of Capability

- Process capability is defined on a six point ordinal scale of measurement
  - the bottom of the scale: the Incomplete Process
  - the top of the scale: the Optimising Process
- The scale represents increasing capability of the process
  - Incomplete: Performance that is not capable of fulfilling its goals
  - Optimising: Performance that is capable of meeting its goals and sustaining continuous process improvement.
- The scale defines a well defined route for improvement for each individual process.

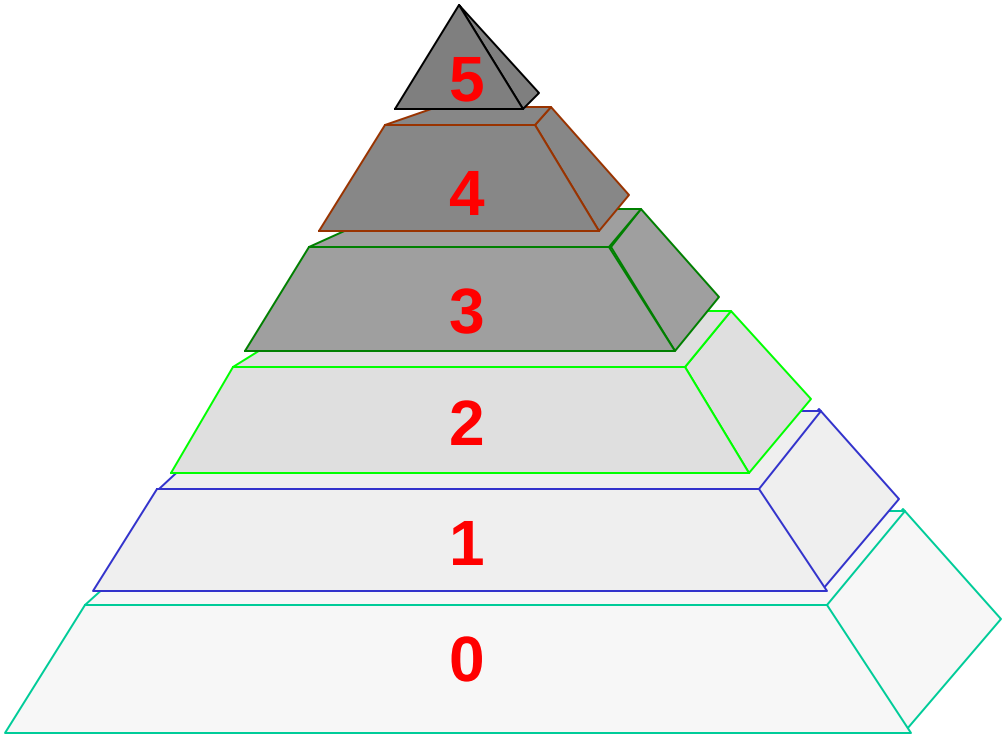
CMMI Staged Maturity Levels / Process Capabilities



Capability Levels

ISO 15504

- **Optimising**
- **Predictable**
- **Established**
- **Managed**
- **Performed**
- **Incomplete**



CMMI

Optimizing

Quantitative

Defined

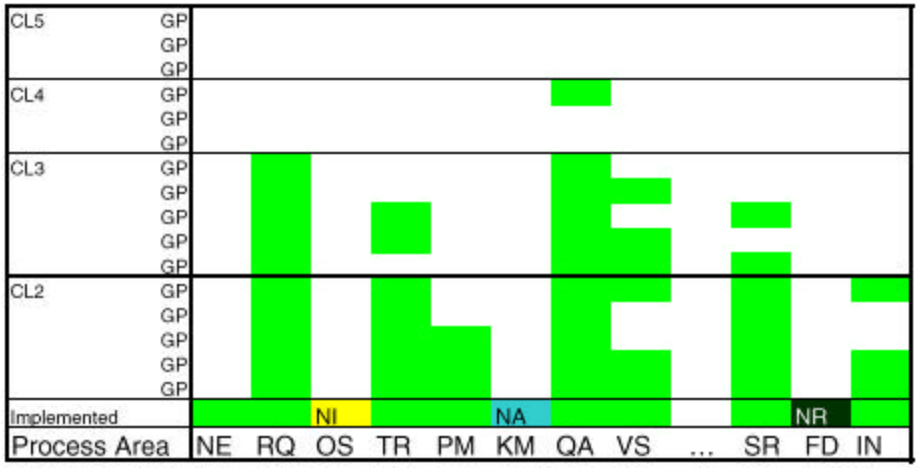
Managed

Performed

Incomplete

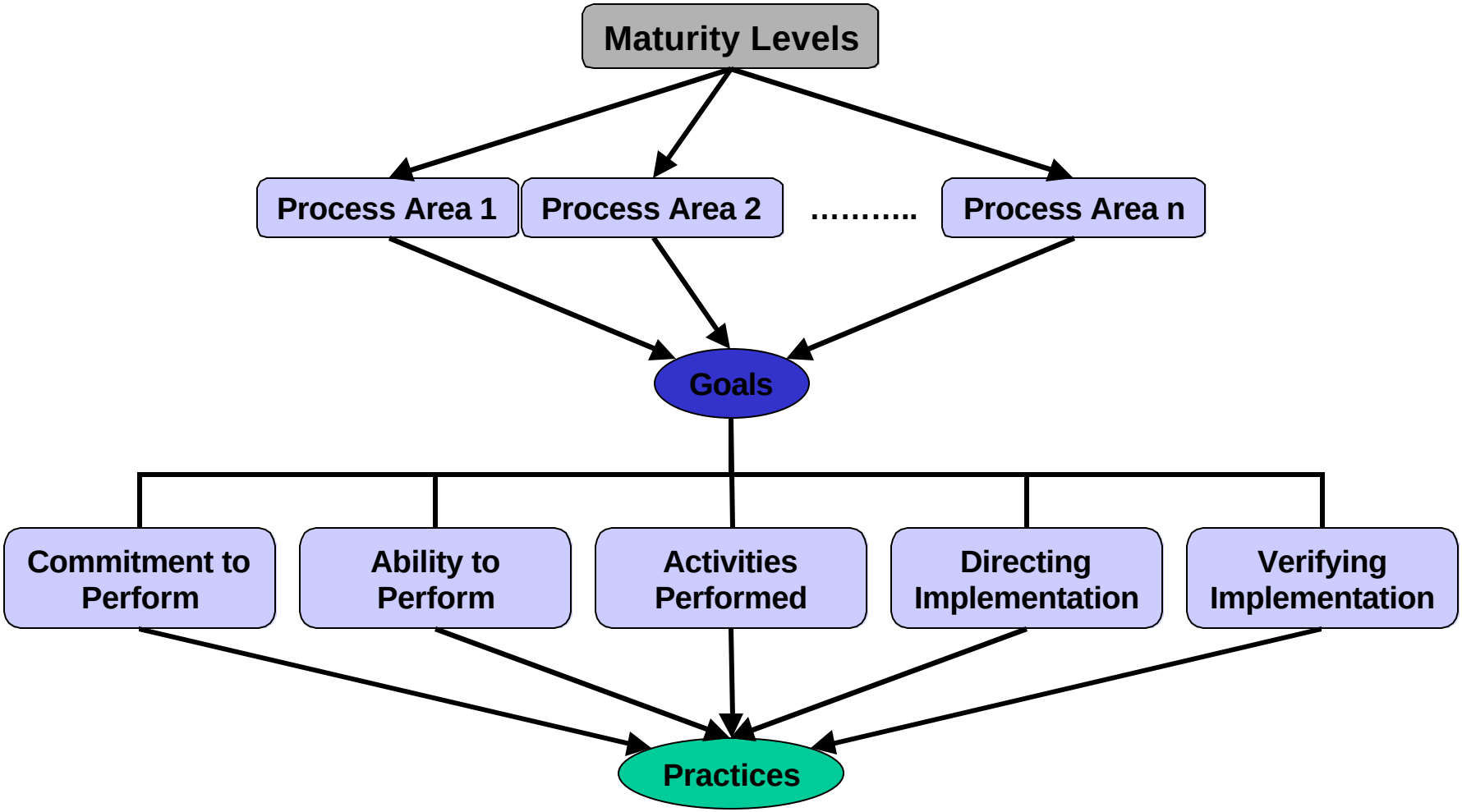
Compatibility to ISO 15504 has been a key design goal for CMMI, and that will facilitate the use of CMMI as a model for ISO 15504 conformant assessments

Two views in CMMI & ISO 15504

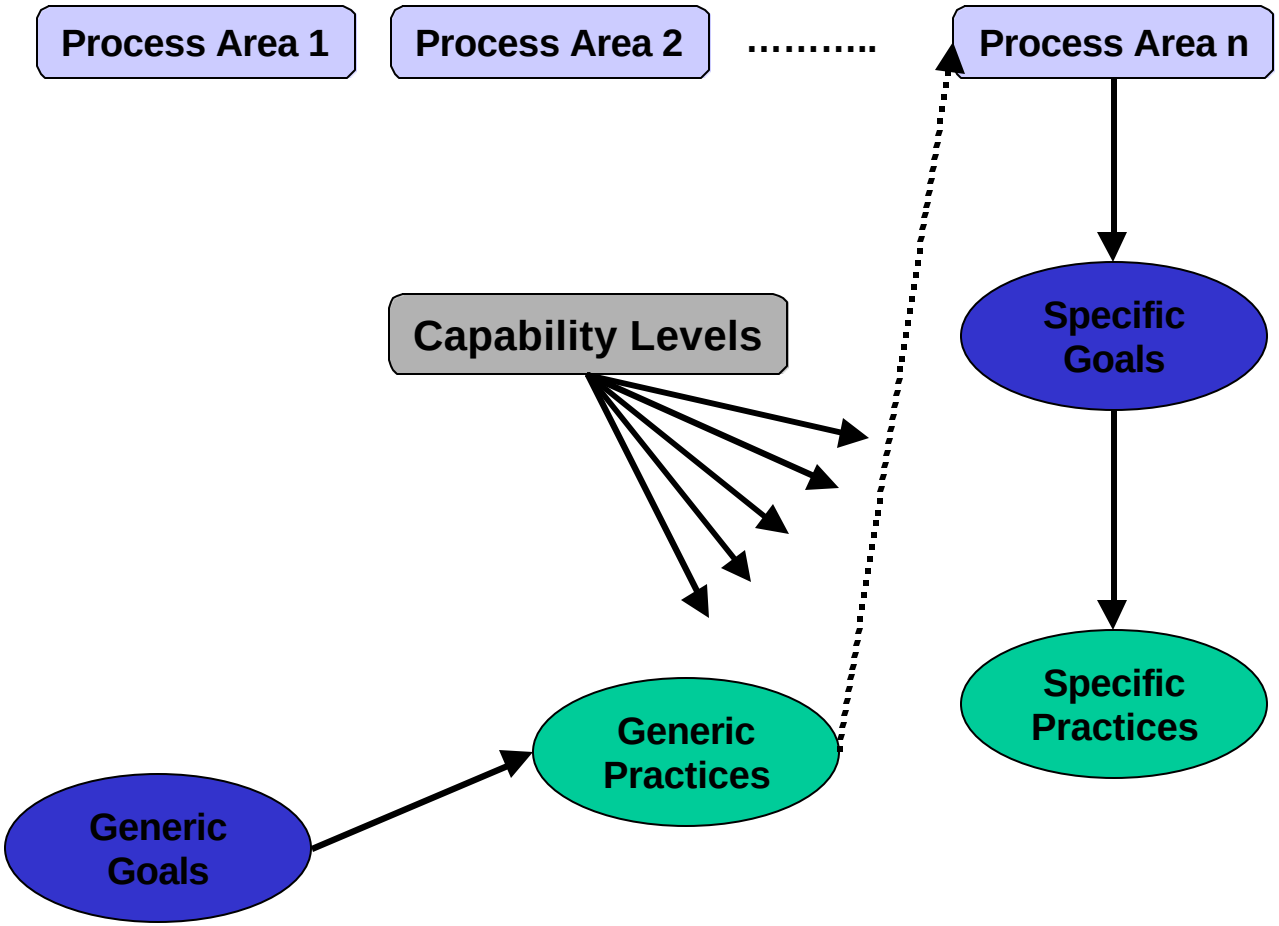


- Staged Representation
  - Process Areas are grouped in the stages (levels) from 2 to 5
  - A Process Area contains specific practices (activities) to achieve the purpose of the process area.
- Continuous Representation
  - A process area contains specific practices to achieve the purpose of the process area.
  - Generic practices are grouped in Capability Levels

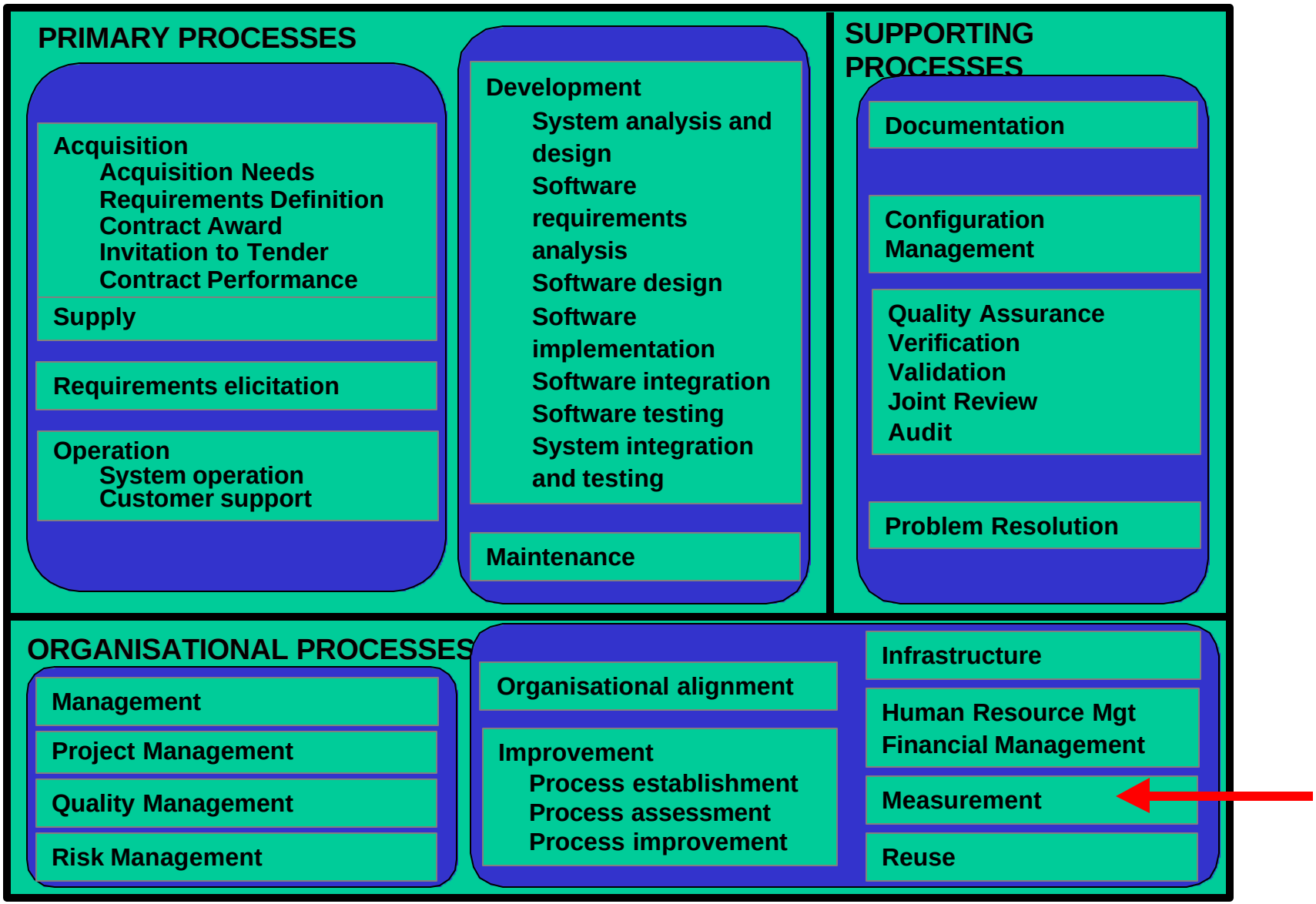
Elements of the Staged View



Elements of the Continuous View

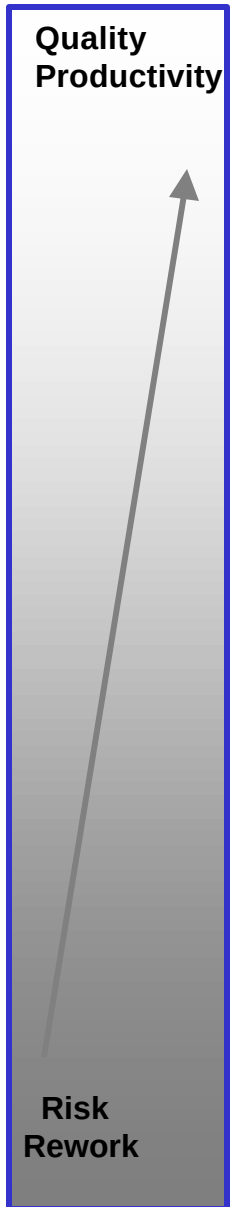


ISO 15504 Process Dimension



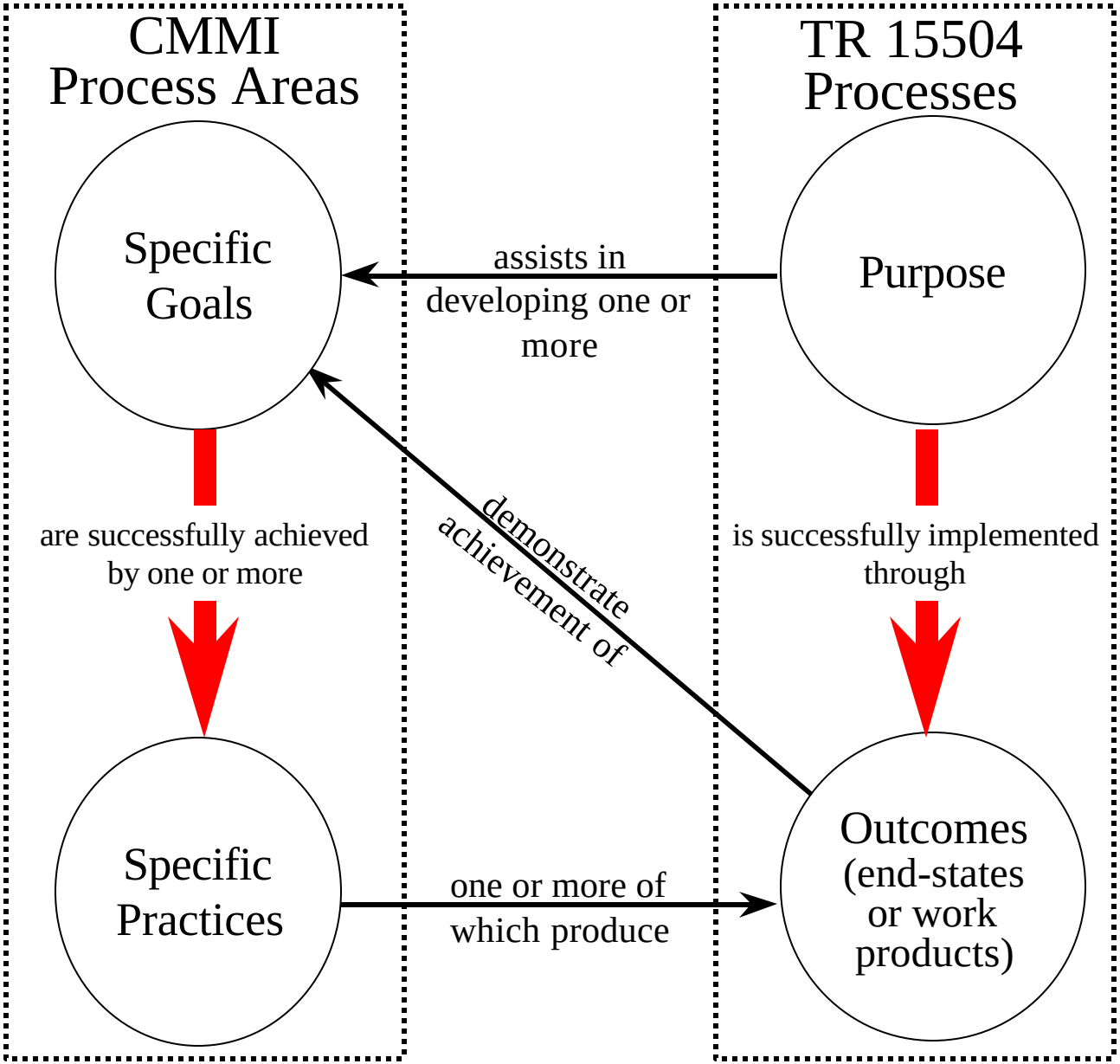
CMM Integration (CMMI) Process Areas

Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	Causal Analysis and Resolution (CAR) Organizational Process Technology Innovation Process Innovation Deployment (PID)
4 Quantitatively Managed	*Quantitative management*	Quantitative Management of Quality and Process Organizational Process Performance (OPP)
3 Defined	*Process standardization*	Organizational Process Focus (OPF) Organizational Process Definition (OPD) Organizational Training (OT) Integrated Project Management (IPM) Risk Management (RSKM) Decision Analysis and Resolution (DAR) Customer and Product Requirements (CPR) Technical Solution (TS) Product Integration (PI) Product Verification (PV) Validation (VAL) Integrated Team (IT) Organizational Environment for Integration (OEI)
2 Managed	*Basic project management*	Requirements Management (REQM) Project Planning (PP) Project Monitoring and Control (PMC) Measurement and Analysis (MA) Process and Product Quality Assurance (PPQA) Configuration Management (CM) Data Management (DM) Supplier Agreement Management (SAM) Collaborative Leadership (CL) Shared Vision (SV)
1 Performed		



CMMI - ISO/IEC TR 15504
Process Relationships

Assuring Compatibility between CMMI and ISO/IEC TR15504



Model Metrics

Release	PAs/ FAs	Goals/ Themes*	Activities/ Practices**
SW-CMM V1.1	18	52	316
SW-CMM V2c	19	62	318
EIA/IS 731	19	77	383
IPD-CMM V.98	23	60	865
CMMI V0.1 SE/SW	27	149	550
CMMI V0.2 SE/SW	24	80	431
CMMI V0.2 SE/SW/IPPD	28	92	501

Source Models for CMMI v1 Iteration2

38

139

701

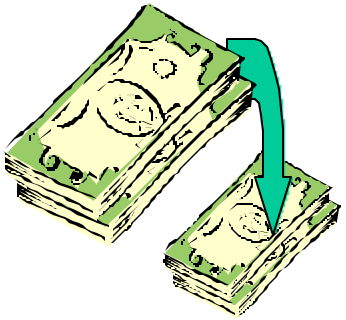
* Ratable components

** Key to implementation effort

CMMI Benefits

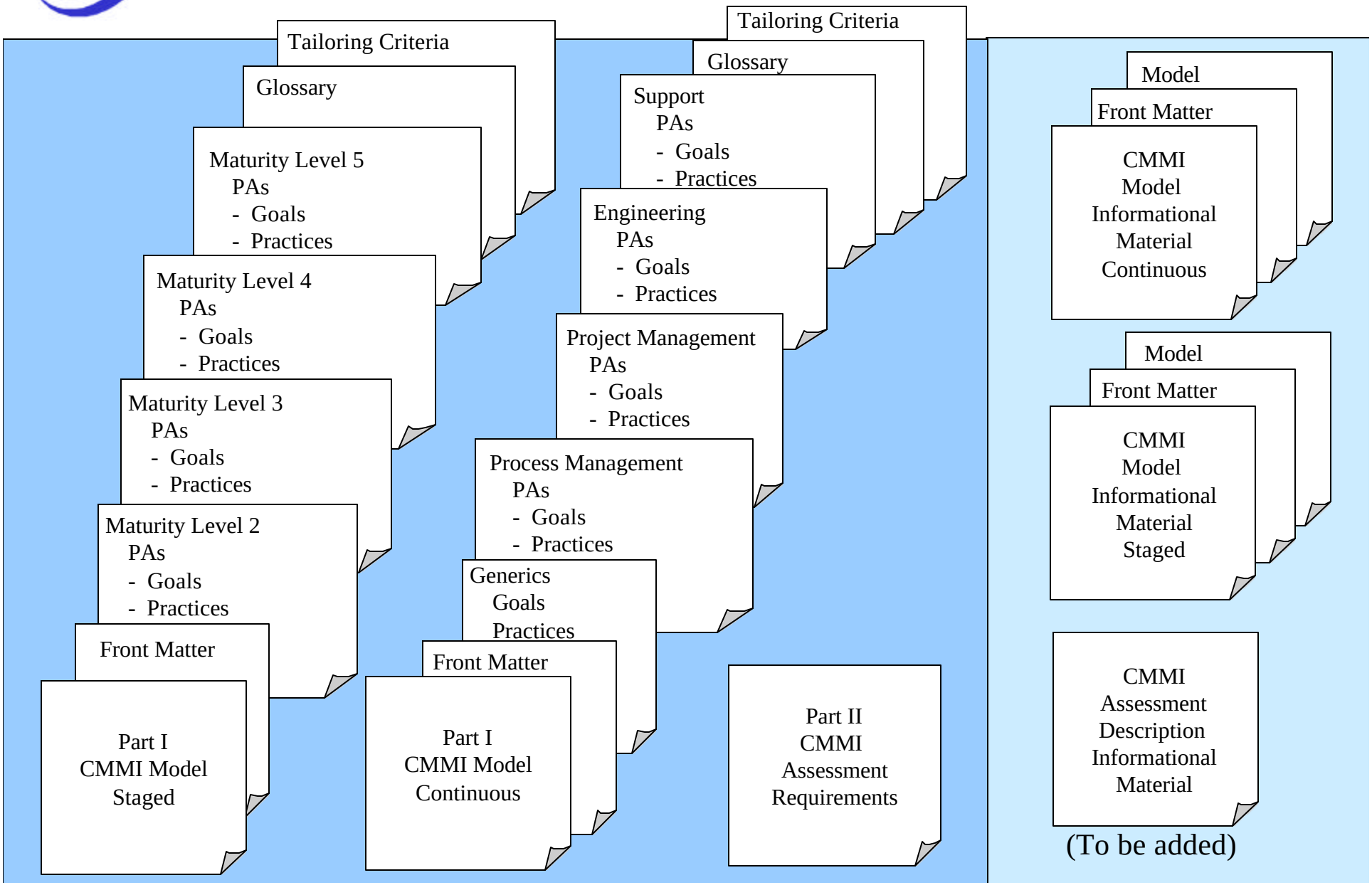
- Efficient, effective assessment and improvement across multiple process disciplines in an organization
- A common, integrated vision of improvement for all elements of an organization

- A means of representing new discipline-specific information in a standard, proven process improvement context
- Reduced assessment and training costs



CMMI at http://www.sei.cmu.edu/cmm/cmmi/public-review/public-review.html

CMMI Structure



Apply Lessons Learned in transitioning from single-discipline models

- Memorandum of Agreement among co-sponsors
  - Inter-departmental / inter-directorate Management Steering Group
  - Shared Strategic Visioning and Business Goal development
  - Proper cross-function sponsorship and commitment
    - ensure consistency of purpose and define the higher concepts
    - document communication mechanisms and direction
  - Phasing and time-line consensus; evolutionary (not revolutionary) changes
  - Pilot project(s) - representative of organization's business practices
  - Outcomes defined and results (not activity) measured
  - Proper use of Assessment Questionnaire to reduce assessment time
- Use of model(s), gap analysis & support tools
  - Comparison of current processes relative to best practices
  - Change agents (practitioners, not "fixers") refine "how"
  - ROI (identify process / practice changes with the most business value)
  - Guide for resource allocation & training; support documentation coordination

Paradigm for Business Results

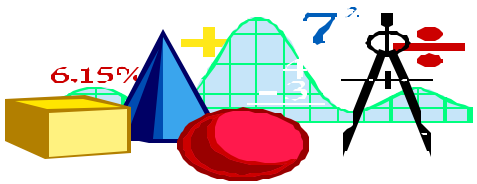
Integrated process improvement is key!

- ***Processes*** define the "What"
- ***Practices & Techniques*** define "How"
- ***Tools*** enhance "What & How"
- ***Environment***:
  - addresses policy, information needs and technology requirements
  - enables/disables "What & How"

Facilitating the Transition to Use of the CMMI: Implementation of an internationally recognized measurement program

- For organizations to be internationally competitive, they will have to consider the impact that several standards and methods could have on their process improvement efforts.
  - Several standards and models have evolved since release of the Software Capability Maturity Model (CMM).
  - Evolving ISO standards refer to ISO 15939 for measurement guidance.

- CMM Integration (CMMI) will provide more explicit measurement-related information to guide process improvement and assessments.
  - CMMI will be conformant with ISO 15504 assessments;
  - CMMI will have a measurement process area that is staged at level two maturity that is compatible with ISO 15939



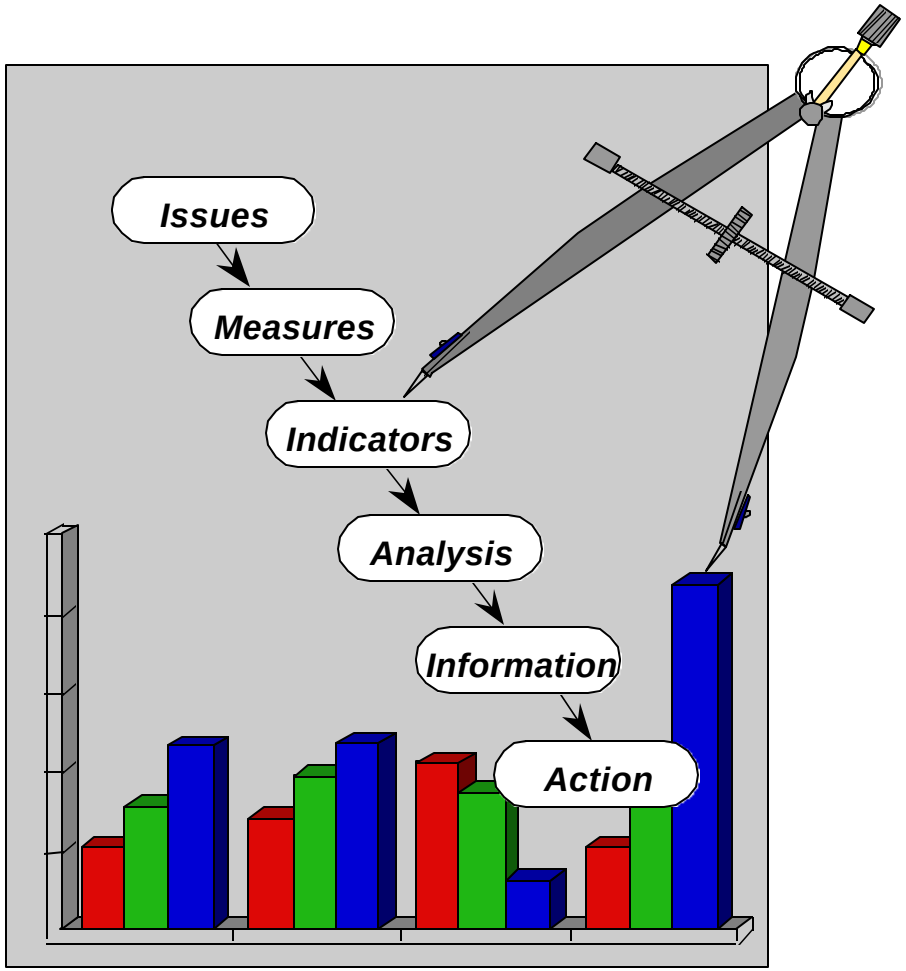
Facilitating the Transition to Use of the CMMI: Implementation of an internationally recognized measurement program

- To help organizations in transitioning to the CMMI, being released August 2000, this part of the presentation will discuss:
  - Evolving standards and models within the context of a consistent framework for measurement;
  - Role of measurement in assessments;
  - Role of measurement in process improvement;
  - Managing projects with measures, and
  - Implementing a measurement program.

- As additional material for the presentation, a draft Measurement Plan template is available via the STSC web site that could be used by organizations in implementing a measurement program consistent with measurement-related practices in the CMMI, ISO 15939, and Practical Software/Systems Measurement (PSM).
  - http://www.stsc.hill.af.mil

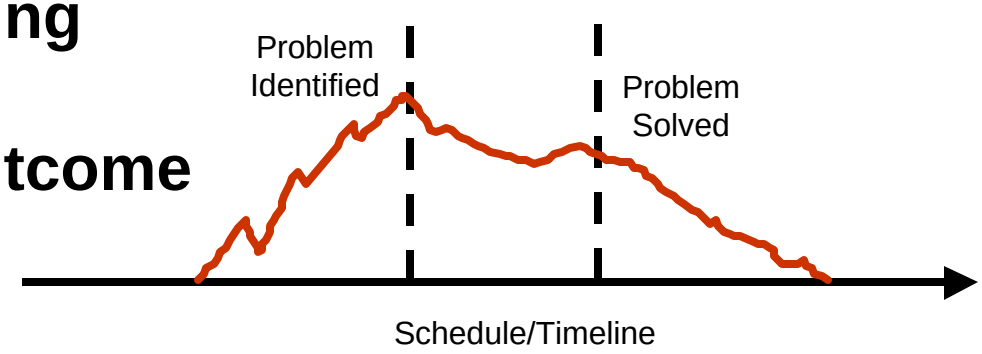
Why Measurement is Important –
"You can't manage it if you can't measure it"

Measure
Everything
That
Results
In
Customer
Satisfaction

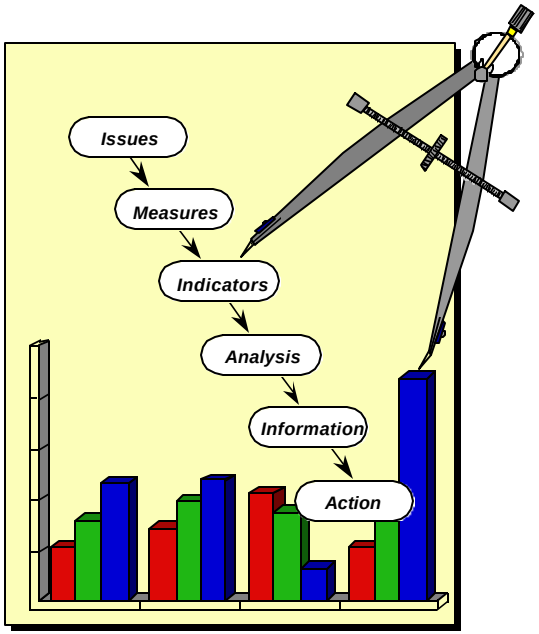


How Measurement Helps

- **Objective Insight Into Issues and Processes**
- **Ability to Objectively Identify and Manage Risk**
- **Early Detection and Resolution of Problems**
- **Objective Team Communication**
- **Ability to Assess Organizational Performance**
- **Ability to Defend and Justify Decisions**
- **Provides Information that Improves Decision Making <u>in Time</u> to Affect the Business or Mission Outcome**

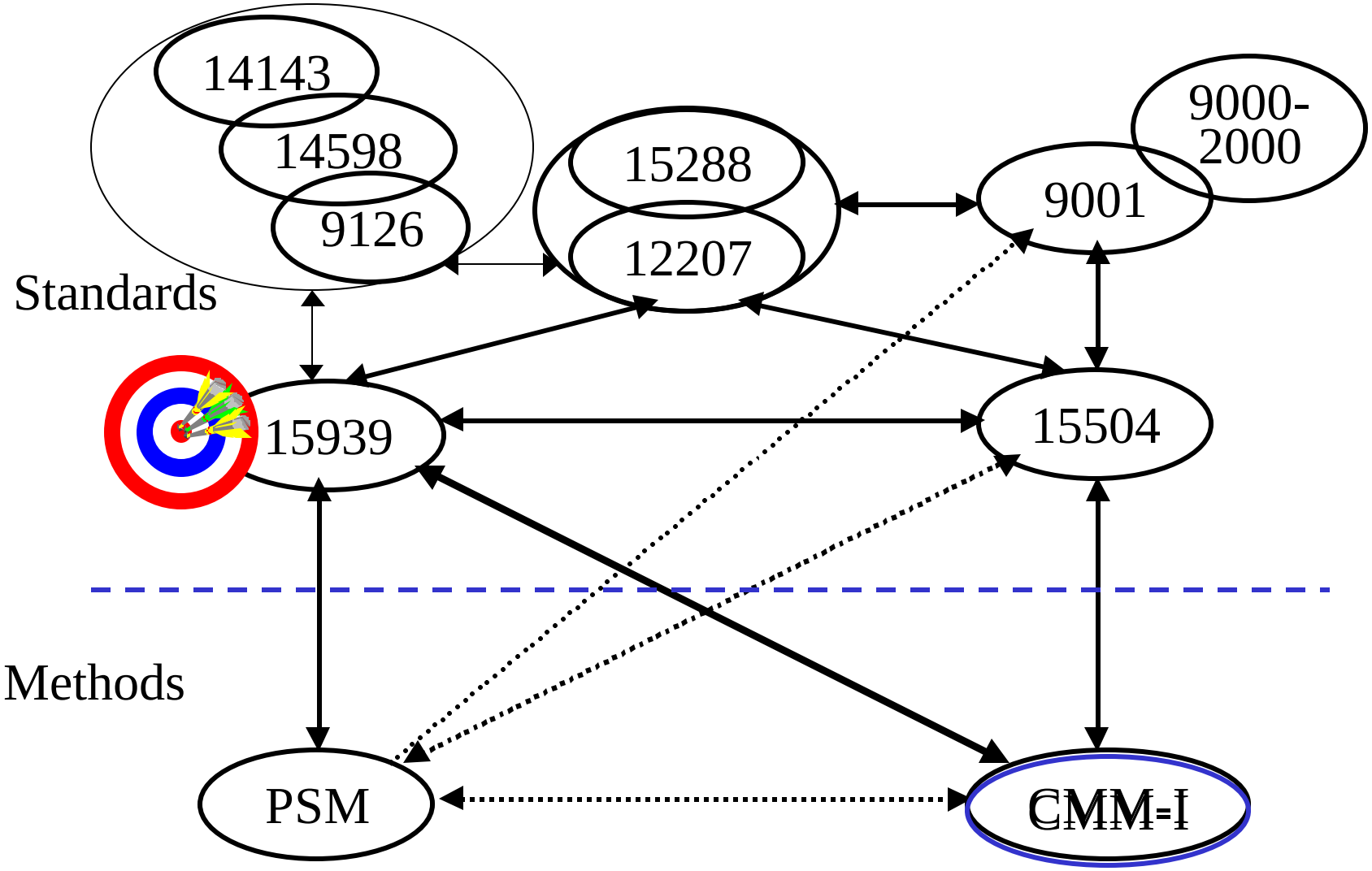


What Program Managers Need to Know



- ***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?***

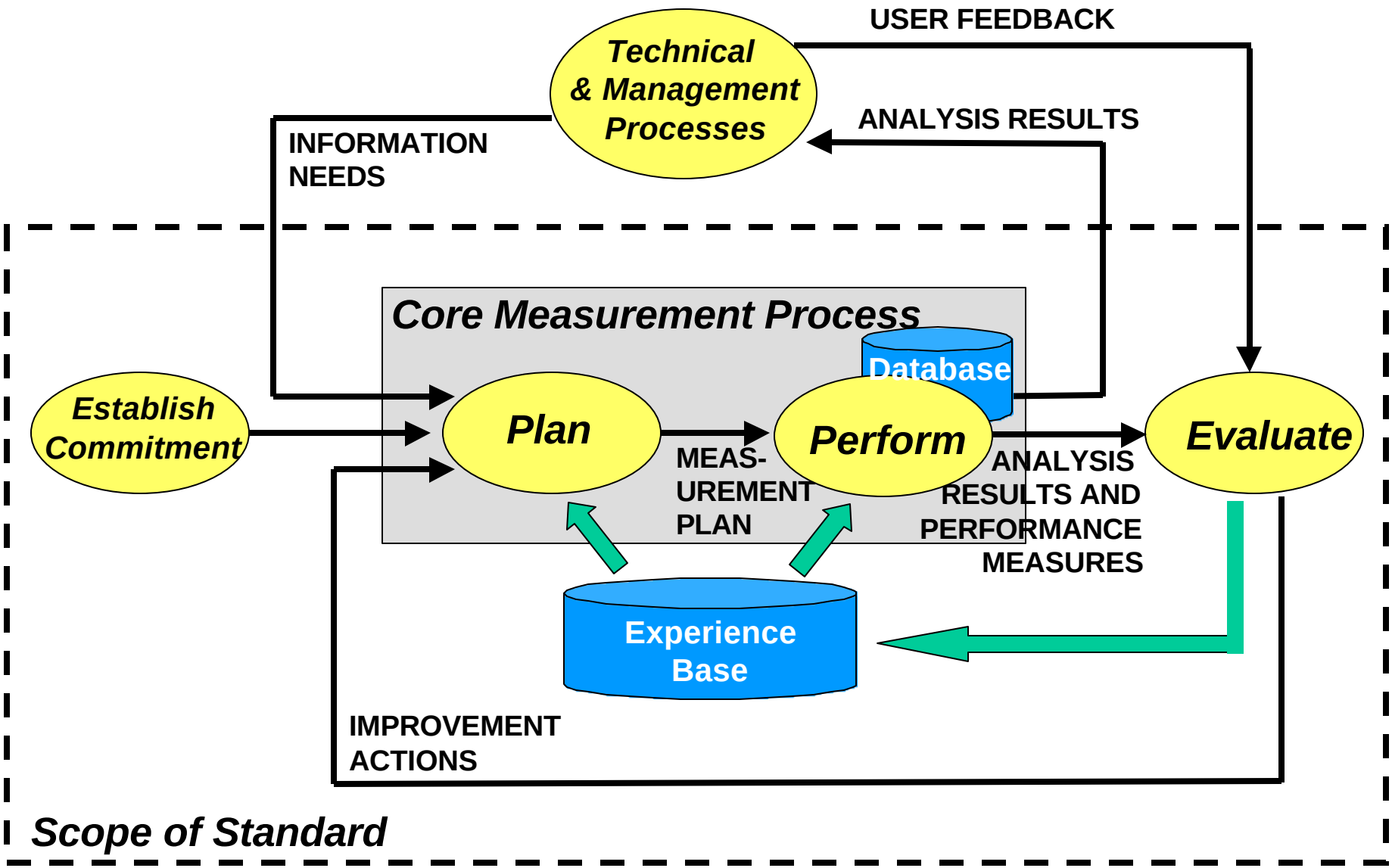
A Consistent Framework for Measurement



Practical Software Measurement (PSM) ver 3.1
Capability Maturity Model Integration (CMMI), draft 0.2
ISO 9126 -Software Product Quality
ISO 14598 - Evaluation of Software Products
ISO 14143 - Functional Size Measurement

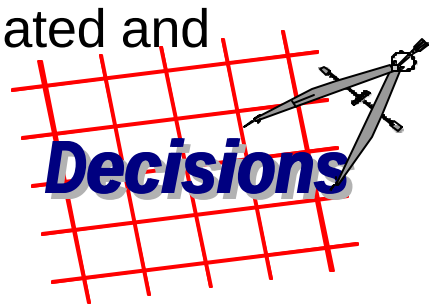
ISO/IEC 15504, Information Technology – Software Process Assessment
ISO/IEC CD 15939, Information Technology – Software Measurement Process
ISO/IEC CD 15288, Information Technology – Life Cycle Management – System Life Cycle Processes
ISO/IEC 12207, Information Technology - Software Life Cycle Processes
ISO 9001, Quality Systems -Models for QA in design/development, production, installation & servicing

ISO 15939 Measurement Process Model



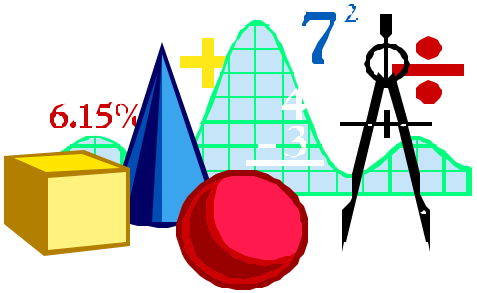
ISO 15939 Process Outcomes

- Organizational commitment will be established and sustained
- The information needs of technical and management processes will be identified
- An appropriate set of measures, driven by the information needs will be identified and/or developed
- Measurement activities will be planned
- The required data will be collected, stored, analyzed, and the results interpreted
- Analysis results will be used to support decisions and provide an objective basis for communication
- The measurement process and measures will be evaluated and improvements communicated to the process owners



MATURING MEASUREMENT CAPABILITIES:
CMM Integration (CMMI) Measurement Thread

- Provide a Context for Measurement
  - Framework for Measurement
  - Evolving ISO 15939 Measurement Standard



- Measurement practices in CMMI

- Address CMMI Measurement-related FAQs

See CMMI at http://www.sei.cmu.edu/cmm/cmmi/public-review/public-review.html

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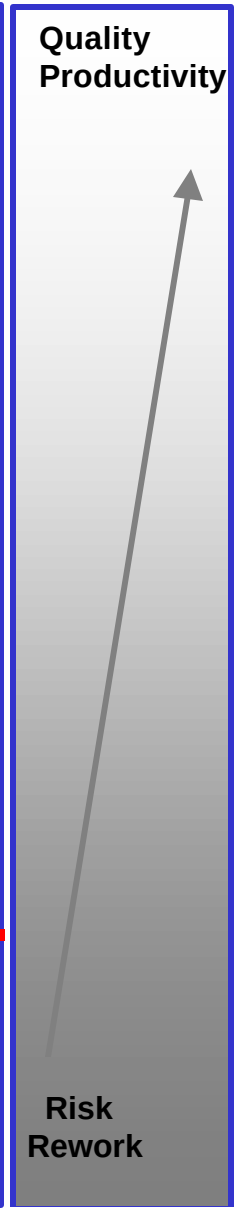
CMM Integration (CMMI) Process Areas

Maturing Measurement Capabilities

Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	*Causal Analysis and Resolution (CAR)* *Organizational Process Technology Innovation* *Process Innovation Deployment (PID)*
4 Quantitatively Managed	*Quantitative management*	*Quantitative Management of Quality and Process* *Organizational Process Performance (OPP)*
3 Defined	*Process standardization*	*Organizational Process Focus (OPF)* *Organizational Process Definition (OPD)* Organizational Training (OT) *Integrated Project Management (IPM)* Risk Management (RSKM) Decision Analysis and Resolution (DAR) Customer and Product Requirements (CPR) Technical Solution (TS) Product Integration (PI) Product Verification (PV) Validation (VAL) Integrated Team (IT) Organizational Environment for Integration (OEI)
2 Managed	*Basic project management*	Requirements Management (REQM) *Project Planning (PP)* *Project Monitoring and Control (PMC)* *Measurement and Analysis (MA)* *Process and Product Quality Assurance (PPQA)* Configuration Management (CM) Data Management (DM) Supplier Agreement Management (SAM) Collaborative Leadership (CL) Shared Vision (SV)
1 Performed		



Process Areas at Level 2

Requirements Management

Project Planning

Project Monitoring and Control

→ **Measurement and Analysis**

Process and Product Quality Assurance

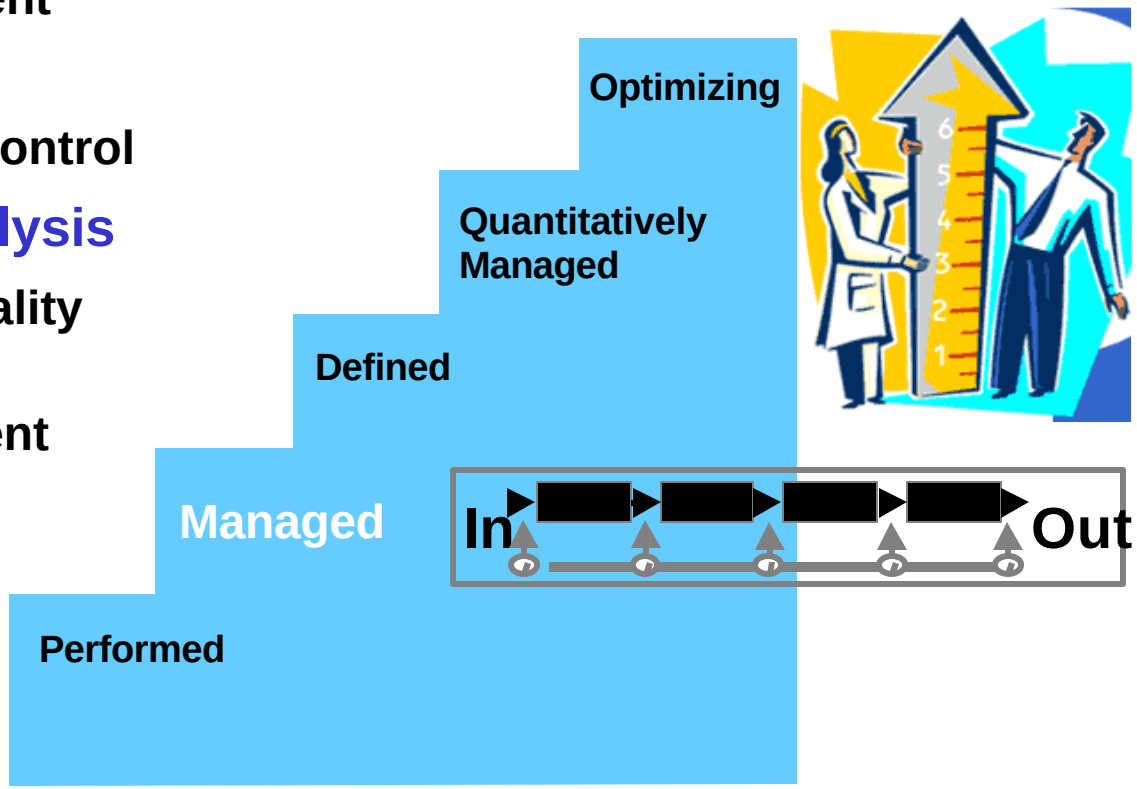
Configuration Management

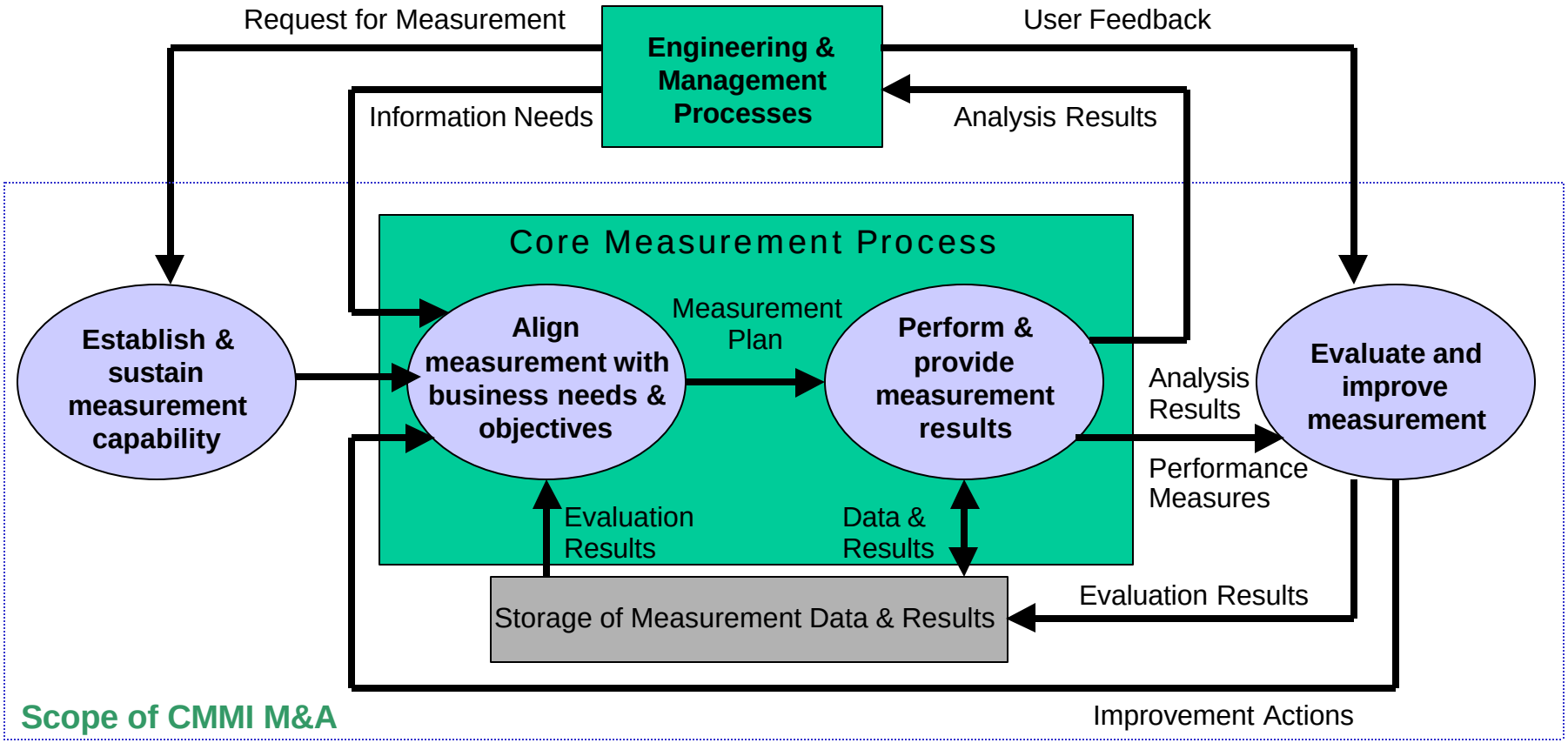
Data Management

Supplier Agreement Management

Collaborative Leadership

Shared Vision





Objectives:

Discuss how CMMI measurement capability is matured:

- through specific practices in activities performed
- through application of CMMI generic practices (common features)

Discuss relationship of CMMI measurement-related practices providing guidance:

- within the M&A Process Area
- traced through a measurement thread in CMMI Process Areas

Scope of CMMI
Measurement and Analysis (M&A) Process Area

Purpose:

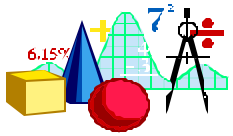
Develop and sustain a measurement capability in support of management information needs

Goals:

Goal 1 -- Measurement objectives and practices are aligned with established information needs and objectives.

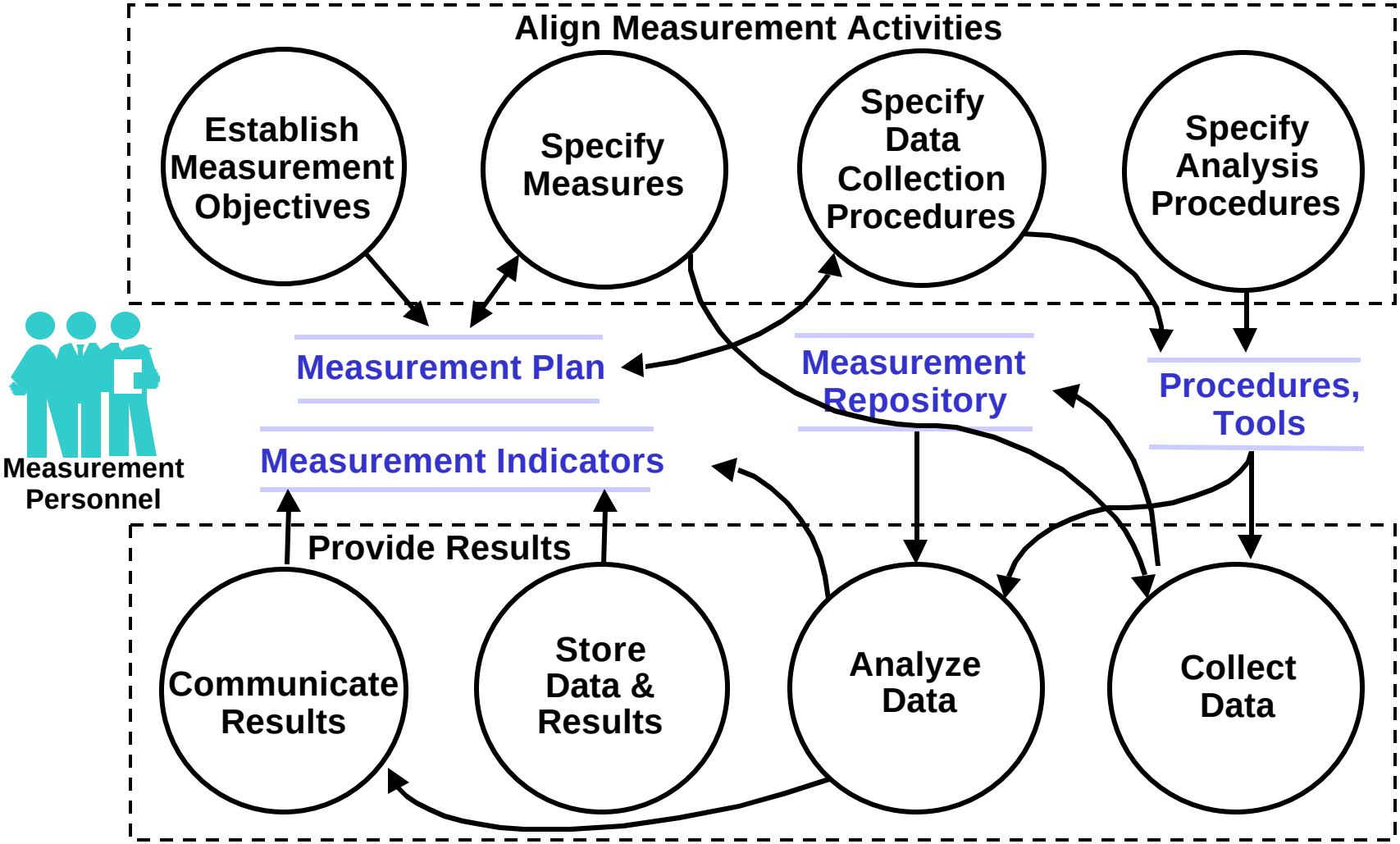
Goal 2 -- Measurement results that address information needs are available.

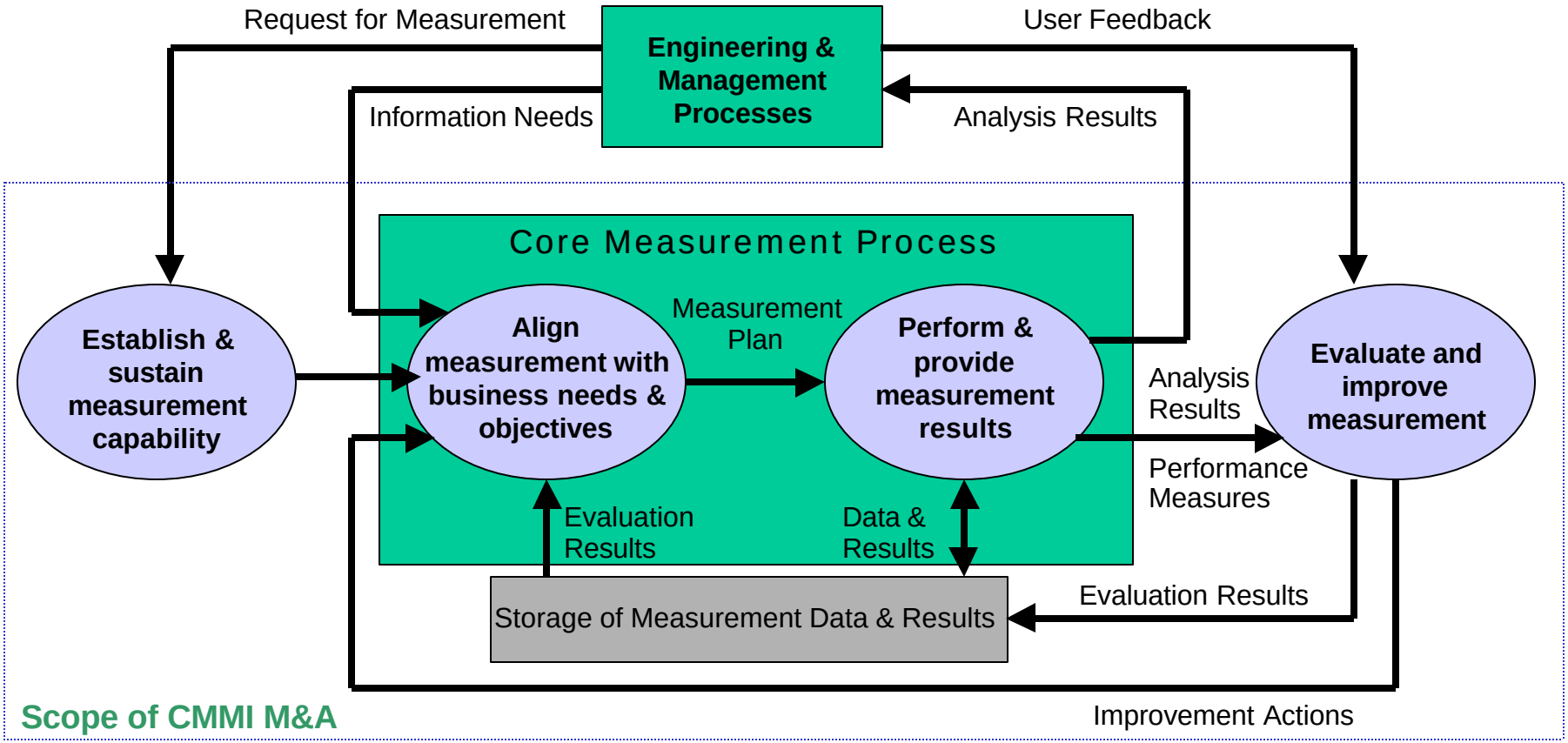
CMMI M&A PA involves:



- Establishing & maintaining measurement objectives
- Specifying measures & procedures for data collection, storage & analysis
- Collecting and analyzing measurement data
- Managing & storing data, measurement definitions and results
- Communicating results of M&A activities to appropriate end users

Measurement & Analysis





Consistent with ISO 15939, the measurement elements in a CMMI model provide an evolutionary means of increasing the capability with which an organization can develop a quantitative understanding of process performance and product quality.

These measurement elements support the establishment and achievement of specific product improvement objectives, control process performance using quantitative information, and ensure the feasibility of plans and the adherence of activities to those plans.

CMMI FAQs: Measurement & Analysis

- Q1. My organization has institutionalized a measurement process that focuses on the collection, analysis, and reporting of measurement information. Does the fact that this process exists mean that we already satisfy the goal of Aligning Measurement and Analysis Activities or must this goal be satisfied by practices included in the process itself?

- A1. Existence of a measurement process within an organization contributes much towards satisfying the goal because there would probably be evidence of specified measures, specified data collection and storage procedures, specified analysis procedures, as well as collection of measurement data, analysis of measurement data, and storage of measurement data and results; yet often two primary determinants are lacking in many organizational measurement programs:
  - Evidence that measurement objectives were established based on the organization-unit's business needs and objectives
  - Evidence that measurement results are systematically communicated to respective stakeholders to support decision-making

CMMI FAQs: Measurement & Analysis

- Q2. Is the new M&A process in the CMMI intended just for measurement related to process improvement, or does it apply to measurement for projects and products as well?

- A2. The CMMI M&A process area is a process model that is intended for measurement related to:
  - project management,
  - process improvement, and
  - product improvement for both work products and deliverables

CMMI FAQs: Measurement & Analysis

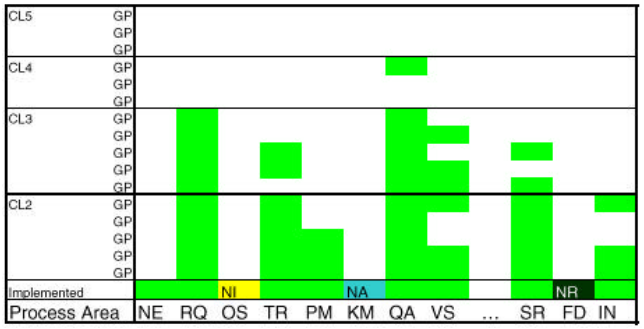
- Q3. The staged representation of the CMMI includes a common feature entitled Directing Implementation that involves collection and analysis of measurement information. How does this common feature relate to the Activities Performed in the Measurement and Analysis process area?

- A3. Practices found in common features in the staged representation equate to generic practices in the continuous representation of the CMMI. Activities Performed in the staged representation equate to specific practices in the respective process area in the continuous representation. Thus, any assessment of an organization using either representation of the model should result in the same findings for the respective process areas.

CMMI FAQs: Measurement & Analysis

- Q4. In the CMMI, is measurement practiced differently depending on whether the staged or continuous representation is used?

- A4. Similar to the previous answer, because there are equivalent practices in both representations of CMMI, there is no reason why the model representation should ‘drive’ any difference in the way measurement is practiced.



CMMI FAQs: Measurement & Analysis

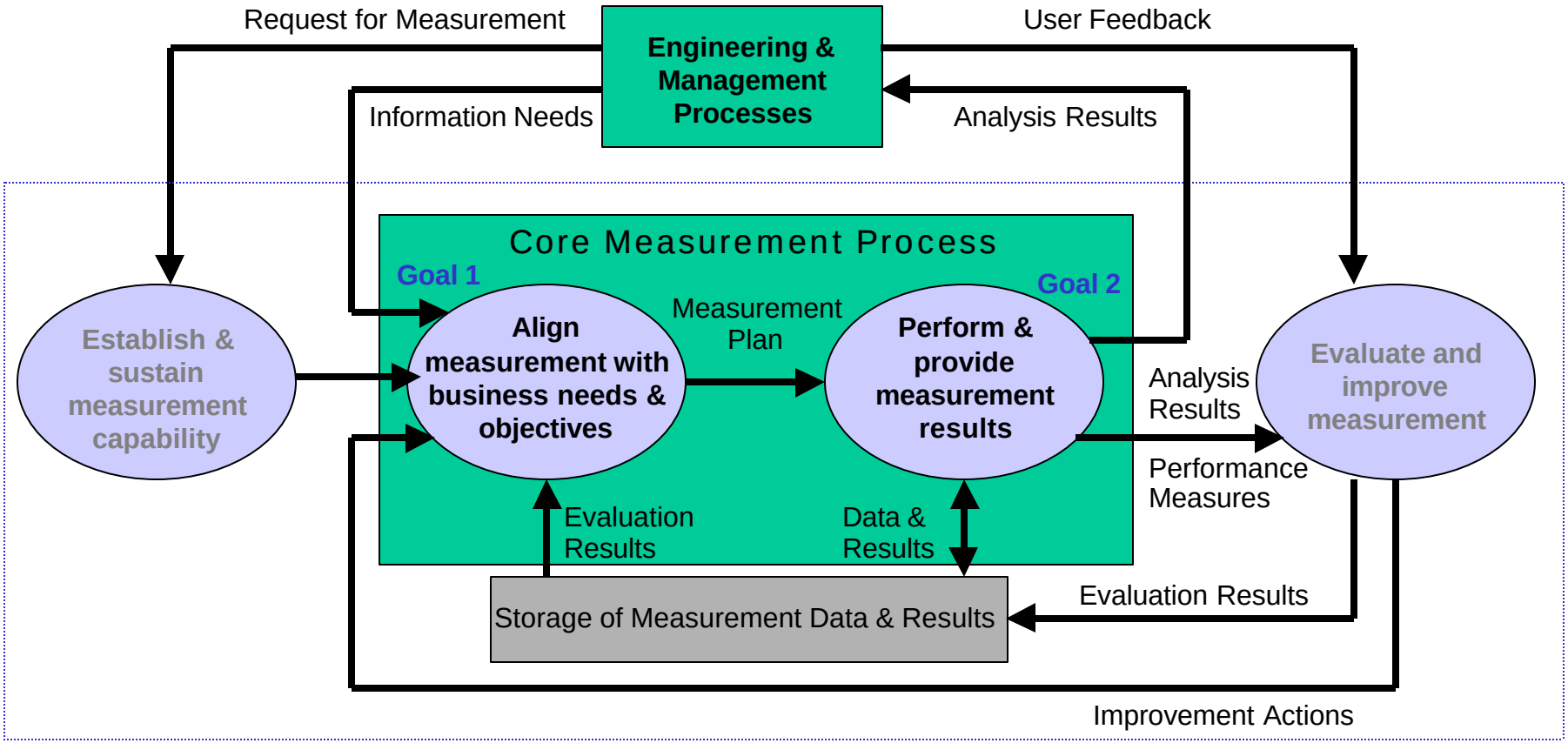
Q5. In the CMMI, how is ‘measurement’ capability matured?

A5. CMMI M&A Goals are satisfied by expected specific practices in “core measurement process” and elaborated by generic practices [GPs] (institutionalization common features)

- CMMI M&A process area specific practices, elaborated by level 1 and level 2 GPs, provides guidance for a measurement program that is compliant with most of ISO/IEC 15939 *Software Measurement Process*
- M&A evaluation & improvement accomplished at level 3 in Organizational Process Focus PA

M&A capability is further matured through application of the generic practices in the CMMI continuous representation and through application of the common features in the CMMI staged representation.

Moreover, M&A capability is further matured in CMMI Level 4 & 5 PAs.



Align with Needs & Objectives | **Perform & Provide Results** | **M&A Specific Goals:**

Specific Practices:

- **SP 1.1 Establish measurement objectives**
- **SP 1.2 Specify measures**
- **SP 1.3 Specify data collection & storage procedures**
- **SP 1.4 Specify analysis & reporting procedures**
- **SP 2.1 Collect measurement data**
- **SP 2.2 Analyze & interpret measurement data**
- **SP 2.3 Store data & results**
- **SP 2.4 Communicate results**

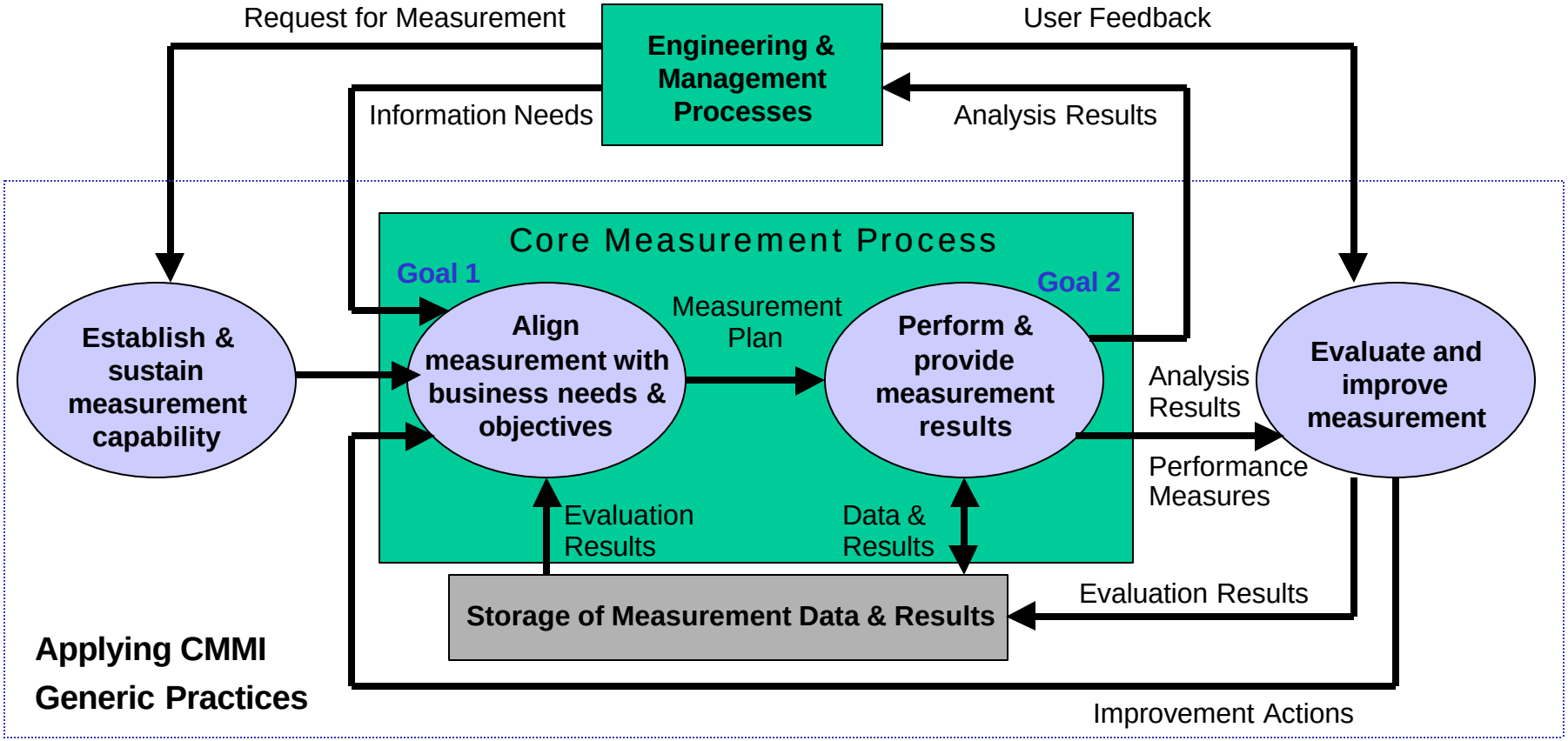
1. Measurement components are established in alignment with information needs and objectives

2. Measurement results that fulfill information needs are available

Level 1 Generic Practices:

GP 1.1 Identify work scope

GP 1.2 Perform basic activities



Establish & Sustain Process

GP 2.1 Establish organizational policy

GP 2.3 Provide resources

GP 2.4 Assign responsibility

GP 2.5 Train people

Level 2

Level 3

Level 4

Level 5

Align with Needs & Objectives

GP 1.1 Identify work scope

GP 2.2 Plan the process

GP 3.1 Establish defined process

GP 4.1 Establish quality objectives

GP 5.1 Establish process improvement objectives

Perform & Provide Results

GP 1.2 Perform basic activities

GP 2.6 Perform managed process

GP 2.7 Manage configurations

GP 3.2 Perform defined process

GP 3.3 Coordinate with affected stakeholders

GP 4.2 Quantitatively manage process performance

Evaluate & Improve

GP 2.8 Monitor & control

GP 2.9 Verify adherence

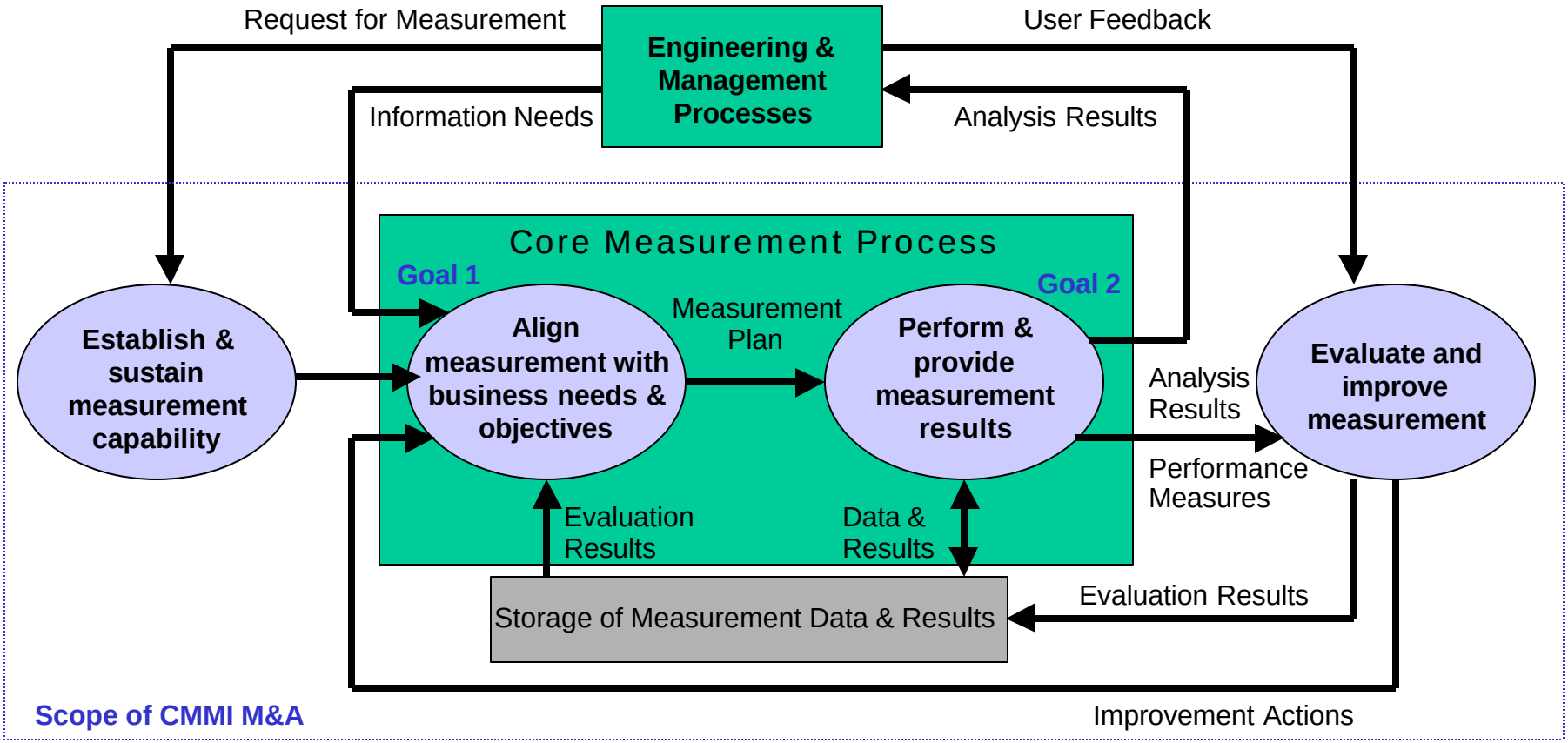
GP 2.10 Review activities & results w/ management

GP 3.4 Collect improvement information

GP 5.2 Address common cause of problems

GP 5.3 Identify process improvements

GP 5.4 Deploy improvement



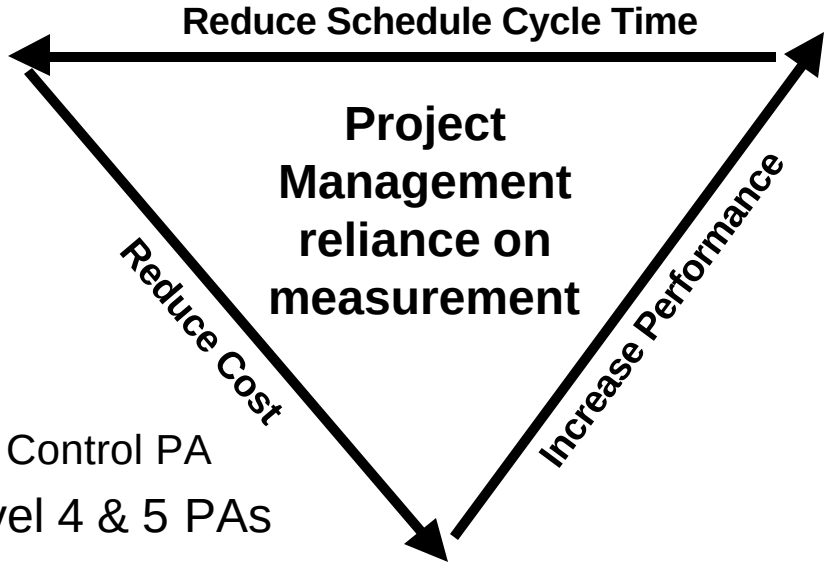
CMMI M&A Goals are satisfied by expected specific practices in “core measurement process” and elaborated by generic practices (institutionalization common features)

1. Measurement components are established in alignment with information needs & objectives
2. Measurement results that fulfill information needs are available

CMMI M&A process area specific practices, elaborated by level 1 and level 2 generic practices, provides guidance for a measurement program that is compliant with most of ISO/EIC 15939 *Software Measurement Process*

M&A evaluation & improvement accomplished at level 3 Organizational Process Focus

Measurement Thread:

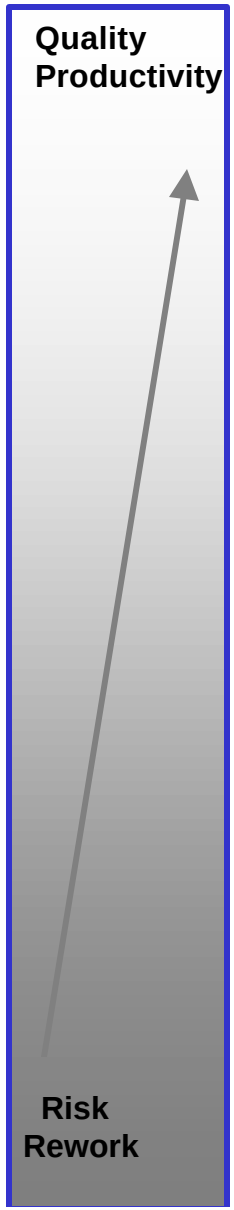


- Level 2
  - Establish performance baselines:
    - M&A PA specific practices (activities),
    - Generic Practices (common features),
    - Project Planning PA & Project Monitoring & Control PA
  - Essential preparation for accomplishing level 4 & 5 PAs
- Level 3
  - Measurement practices are matured through Generic Practices
  - Measurement data is stored in repositories available for organization-wide use
    - Organizational Process Definition (OPD) PA specific practice (activity), “Establish and maintain the organization's measurement repository.”
  - Organizational Process Focus - provides the evaluation and improvement practice to complete the correspondence of CMMI measurement with ISO 15939
  - Analysis focuses on explicit comparisons among projects / organization roll-ups
- Level 4 & 5
  - Measurement establishes crucial baselines for comparisons made among projects and across the organization
  - More sophisticated quantitative analysis is used, such as statistical process control, structured modeling, or multivariate statistical methods

Draft CMM Integration (CMMI) Process Areas

Maturing Measurement Capabilities

Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	*Causal Analysis and Resolution (CAR)* Organizational Process Technology Innovation *Process Innovation Deployment (PID)*
4 Quantitatively Managed	*Quantitative management*	*Quantitative Management of Quality and Process* *Organizational Process Performance (OPP)*
3 Defined	*Process standardization*	*Organizational Process Focus (OPF)* *Organizational Process Definition (OPD)* Organizational Training (OT) *Integrated Project Management (IPM)* Risk Management (RSKM) Decision Analysis and Resolution (DAR) Customer and Product Requirements (CPR) Technical Solution (TS) Product Integration (PI) Product Verification (PV) Validation (VAL) Integrated Team (IT) Organizational Environment for Integration (OEI)
2 Managed	*Basic project management*	Requirements Management (REQM) *Project Planning (PP)* *Project Monitoring and Control (PMC)* *Measurement and Analysis (MA)* *Process and Product Quality Assurance (PPQA)* Configuration Management (CM) Data Management (DM) Supplier Agreement Management (SAM) Collaborative Leadership (CL) Shared Vision (SV)
1 Performed		

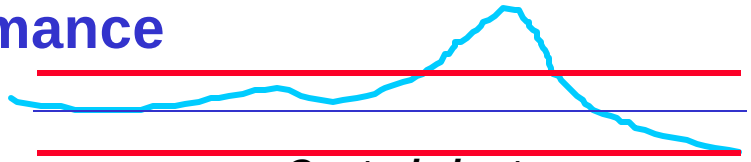


Higher Level
Measurement-Related Process Areas

Level 4 Process Areas

Quantitative Process Management

Organizational Process Performance

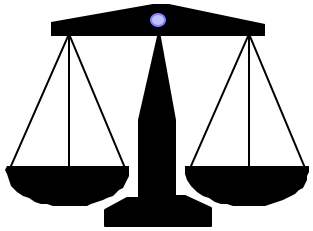


Control chart

Level 5 Process Areas

Causal Analysis and Resolution

Process Improvement Deployment



Quantitative Process Management (QPM)

Purpose:

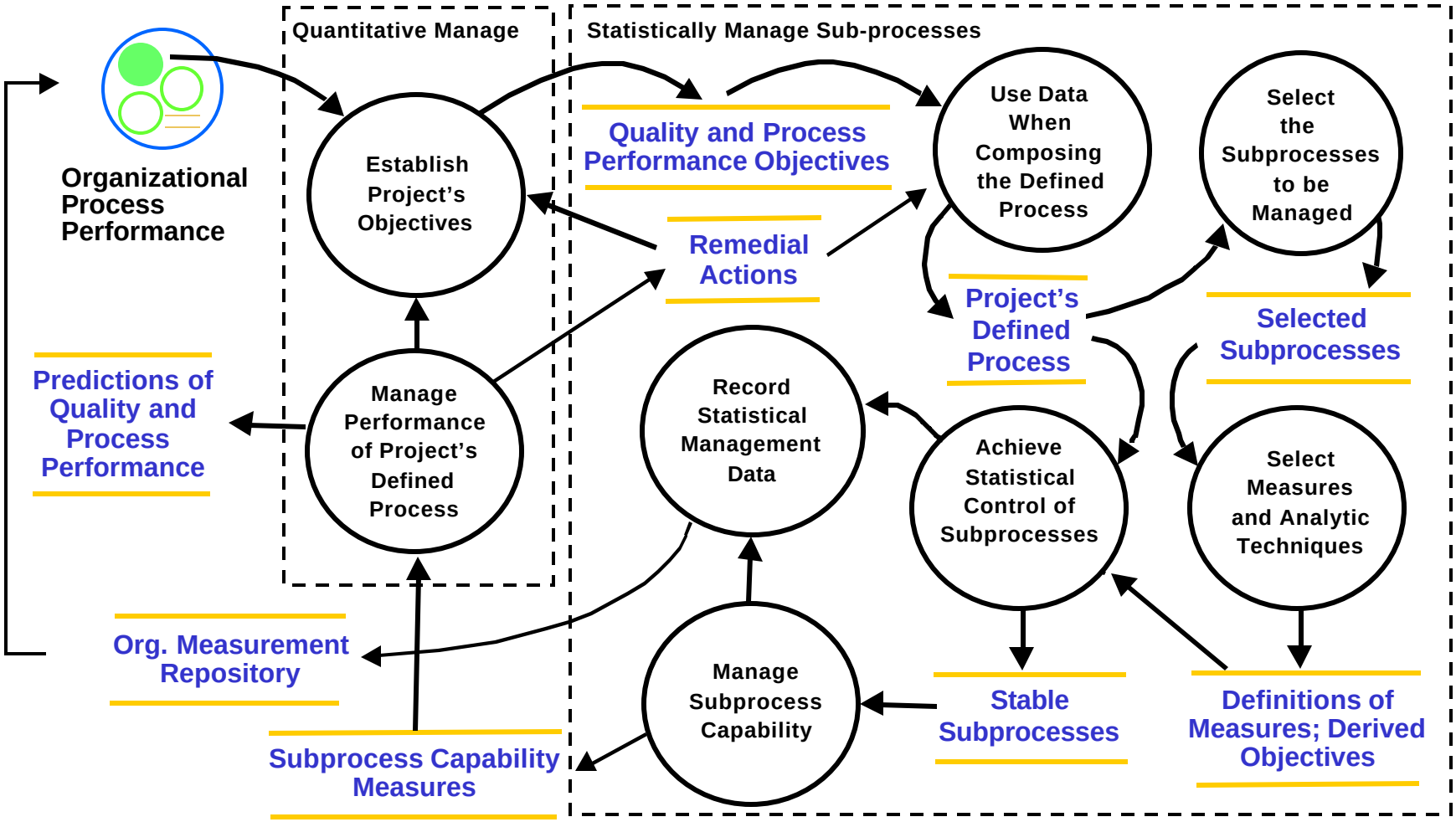
Quantitatively manage the project's defined process to achieve the project's established quality and process performance requirements and objectives

Goals:

Goal 1 -- The ability of the project's defined process to achieve the project's quality and process performance objectives is quantitatively managed.

Goal 2 -- The performance of selected sub-processes of the project's defined process is statistically managed.

Quantitative Process Management (QPM)



Organizational Process Performance (OPP)

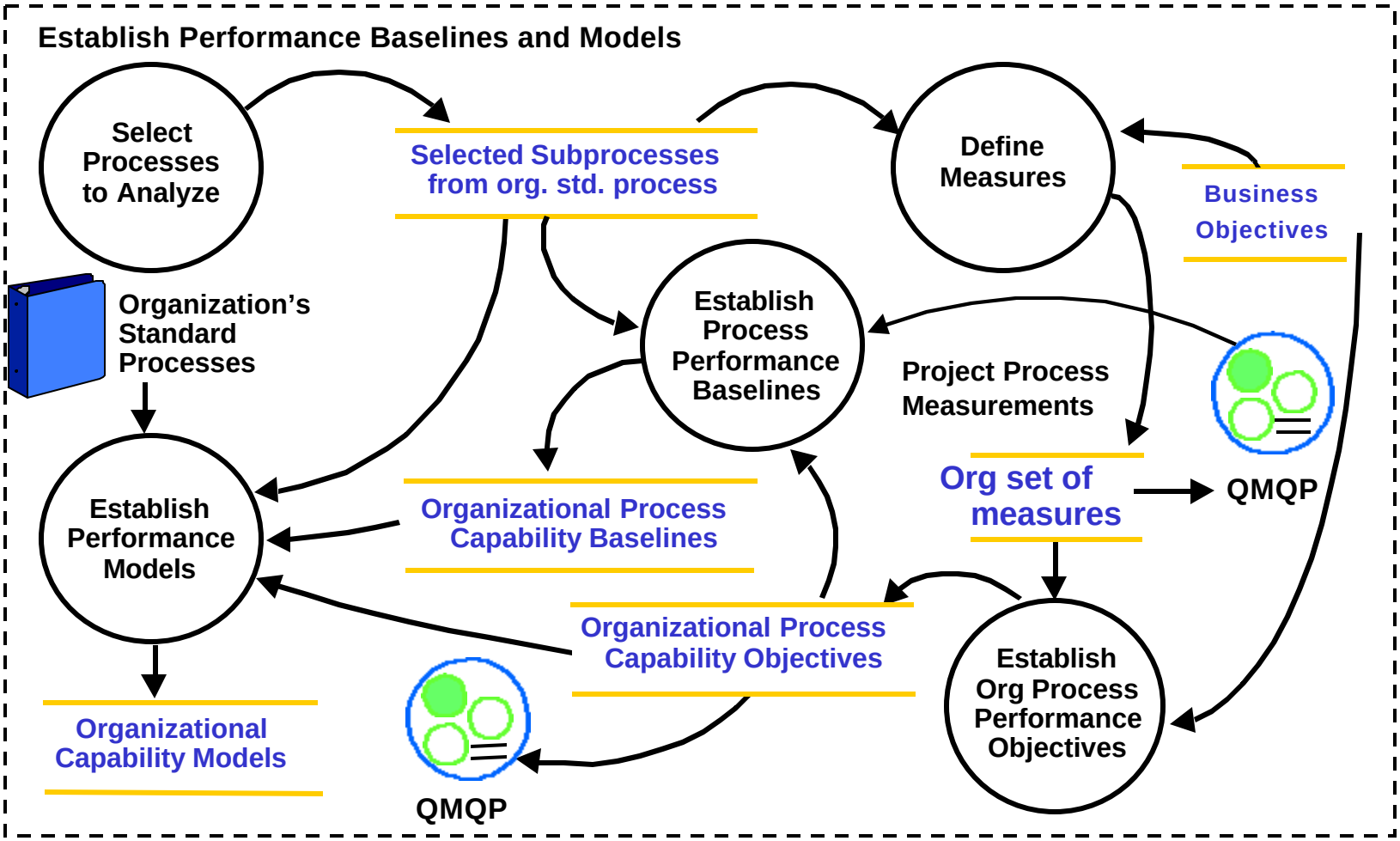
Purpose:

Provide the organizational data, baselines, and models to support quantitatively managing the organization's and project’s processes

Goal:

Baselines and models that characterize the expected process performance of the organization's set of standard processes are established and maintained.

Organizational Process Performance (OPP)



Causal Analysis and Resolution

Purpose:

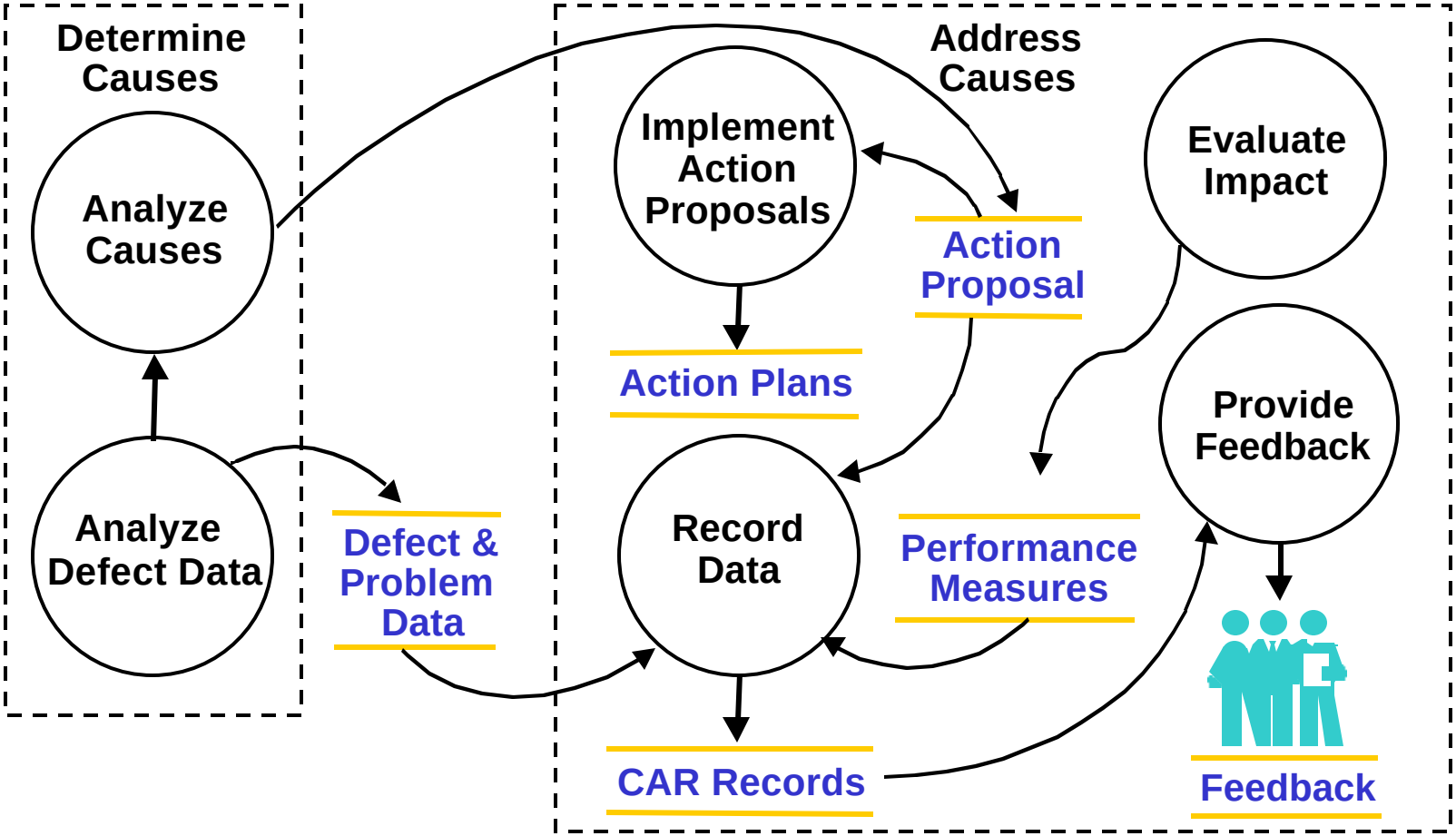
Improve process performance and product results by identifying causes of defects and other problems, and taking action to prevent them from occurring in the future.

Goals:

Goal 1 -- Root causes of defects and other problems are systematically determined.

Goal 2 -- Root causes of defects and other problems are systematically addressed to prevent their future occurrence.

Causal Analysis and Resolution (CAR)



Process Innovation Deployment

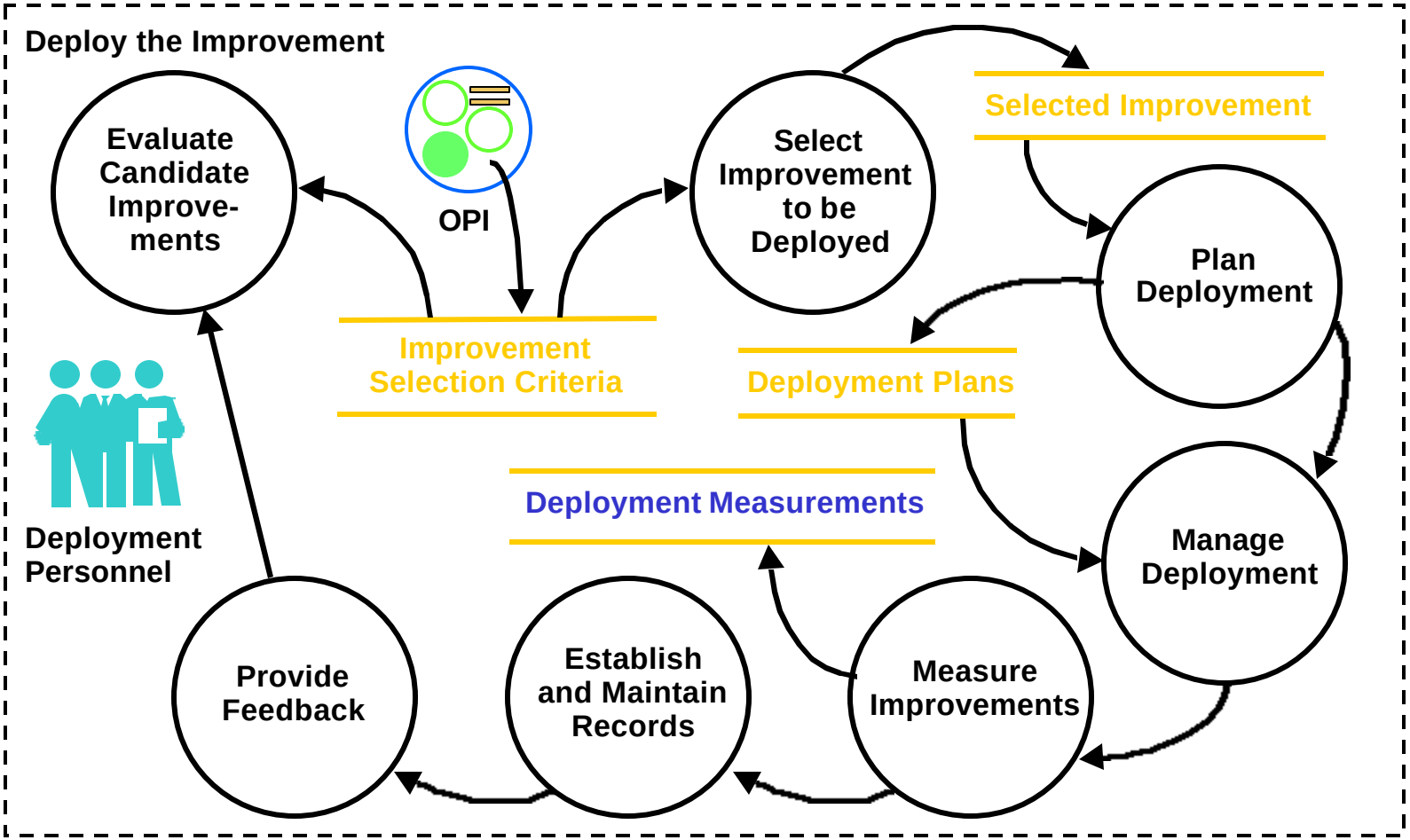
Purpose:

Continually and measurably improve the organization's processes by systematically transitioning incremental and innovative improvements into use.

Goal:

Measurable improvements to the organization's processes are continually and systematically deployed.

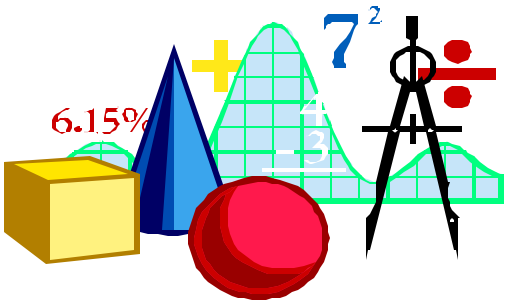
Process Innovation Deployment



CMMI Measurement-Related Support

- CMMI Model & Assessment Method
  - Introductory material on the ‘Measurement Thread’
  - Guidance for Assessment Teams

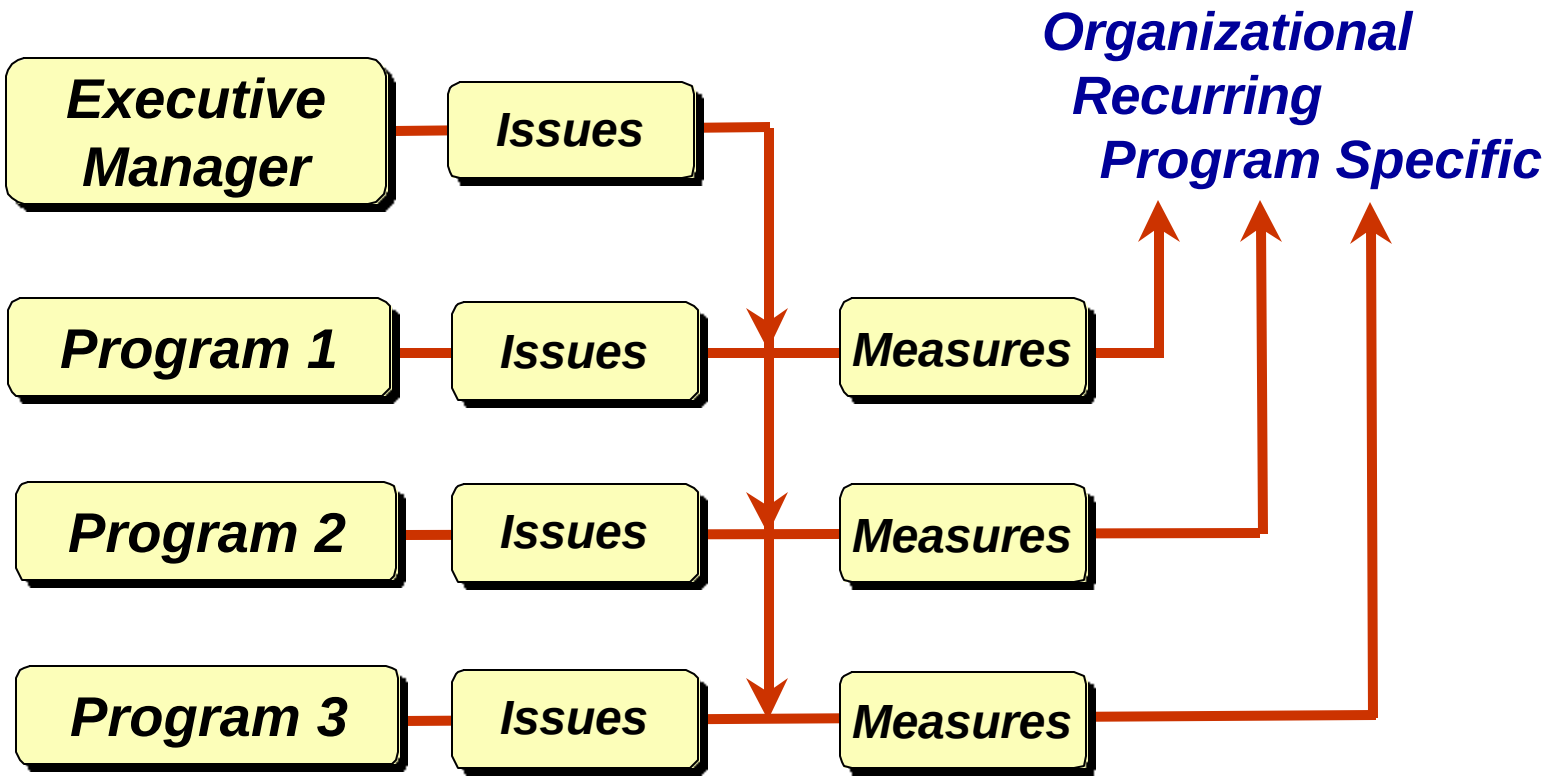
- Related Measurement Work
  - ISO 15939/CMMI Measurement Plan Template
  - CMMI Measurement Spec with links to PSM Insight
  - Presentations at STC & PSM Users Conference
  - Workshops from PSM Transition partners
  - Articles in CrossTalk, etc.
  - Measurement consulting services



Issue Mapping

Project Specific Issues	PSM Common Issues
Slipped Schedule *Concurrent Activities* *Critical Dependencies*	*Schedule and Progress*
Changing Mission Objective *Unstable Requirements* *Questionable Size Estimates*	*Growth and Stability*
Reliability Objectives *COTS Performance*	*Product Quality*
Fixed Budget *Staff Experience* *Staff Turnover*	*Resources and Cost*

Measurement Across Multi-Programs



- *There Are Multiple Sources of Issues -They Must Be Prioritized Together*
- *Focus Initially On Project Level Measurement*
- *Standard Organizational Measures Require Consistent Issues & Processes*

PSM Software-Intensive Systems I-C-M Mapping

Issue	Category	Measures
Schedule and Progress	Milestone Performance	Milestone Dates Critical Path
	Work Unit Progress	Requirement Status Problem Report Status Review Status Change Request Status Component Status Test Status Tracked Item Status
	Incremental Capability	Increment Content - Component Increment Content - Functionality
Resources and Cost	Personnel	Effort Staff Experience Staff Turnover
	Financial Performance	Earned Value Cost
	Environment and Other Resources	Resource Availability Resource Utilization
Product Size and Stability	Physical Size and Stability	Database Size Components Interfaces Lines of Code Physical Characteristics
	Functional Size and Stability	Requirements Change Requests Function Points

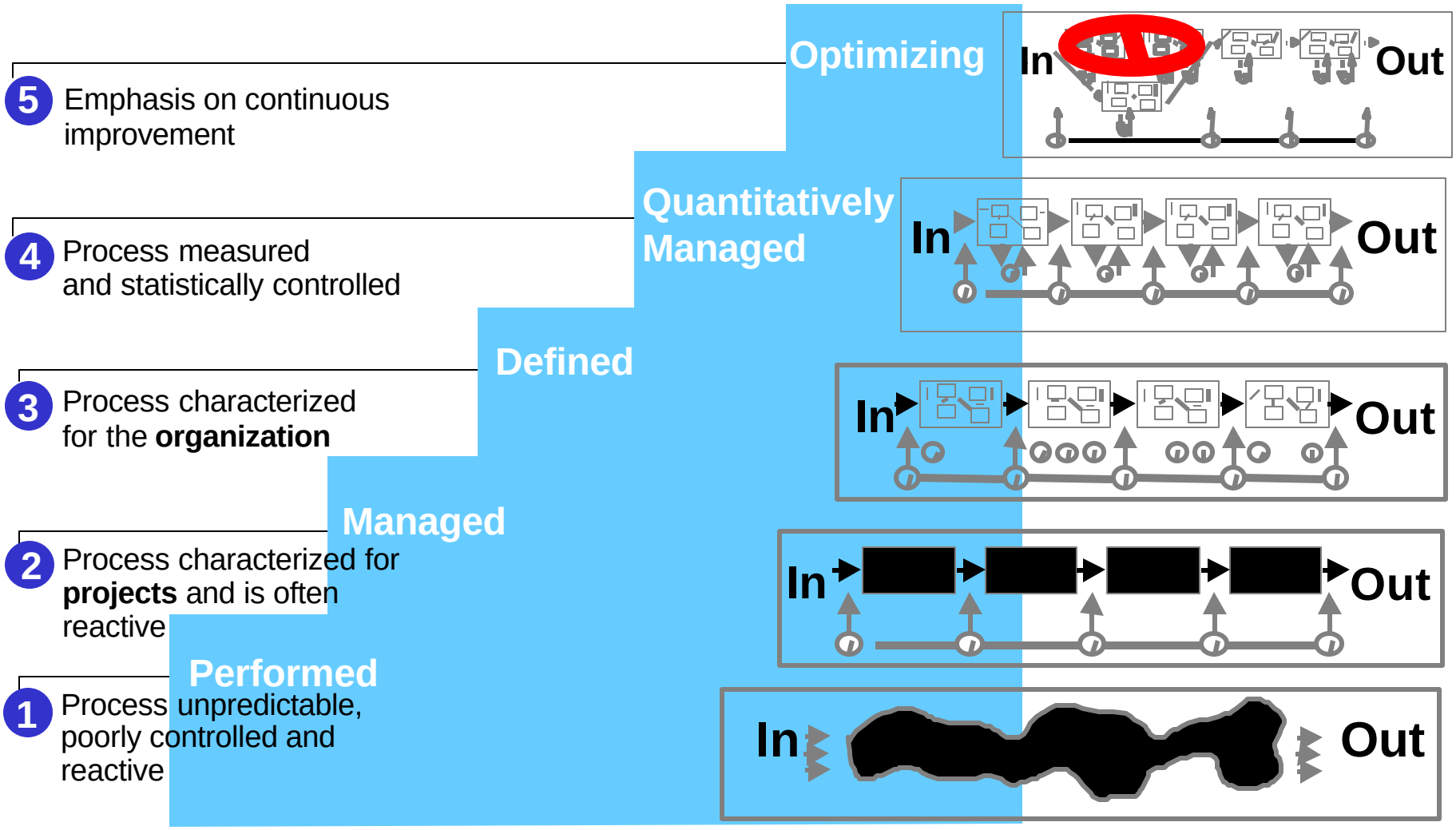
PSM Software-Intensive Systems I-C-M Mapping (cont)

Issue	Category	Measures
Product Quality	Functional Correctness	Defects Achieved Accuracy in Performance (Technical Performance Measures)
	Supportability (Maintainability)	Recovery Impact Cyclomatic Complexity System Maintenance Cohesion (n) Coupling (n)
	Efficiency	Utilization Throughput Timing
	Portability	Standards Compliance
	Usability	Operator Errors
	Dependability (Reliability, Availability)	Failures Fault Tolerance
Process Performance	Process Compliance	Reference Model Level Process Audit Findings
	Process Efficiency	Productivity Cycle Time
	Process Effectiveness	Escapes Rework
Technology Effectiveness	Technology Suitability	Technology Fit
	Impact	Technology Impact
	Technology Volatility	Product Releases
Customer Satisfaction	Customer Feedback	Survey Results Performance Award Unsolicited Comments
	Customer Support (n)	Requests for Support (n) Support Time (n)

Questions & Comments

Backup Material
Follows

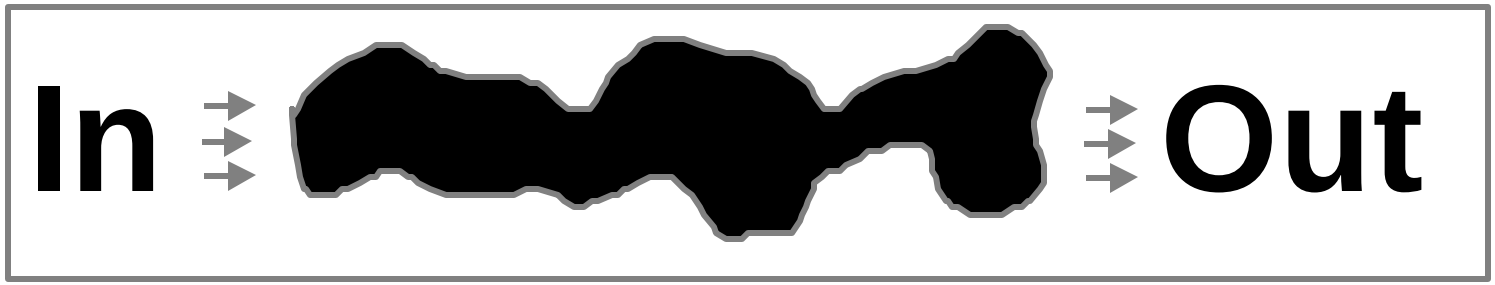
CMMI Staged Maturity Levels / Process Capabilities



Maturity Level 1 “Performed”

- Processes are performed but often in an ad hoc and occasionally chaotic manner.
- Performance is dependent on the competence and heroics of the people.
- High-quality and exceptional performance is possible, as long as the best people can be assigned to the task.
- Performance is difficult to predict.
- Management practices may not be effective.

Performance is Unpredictable

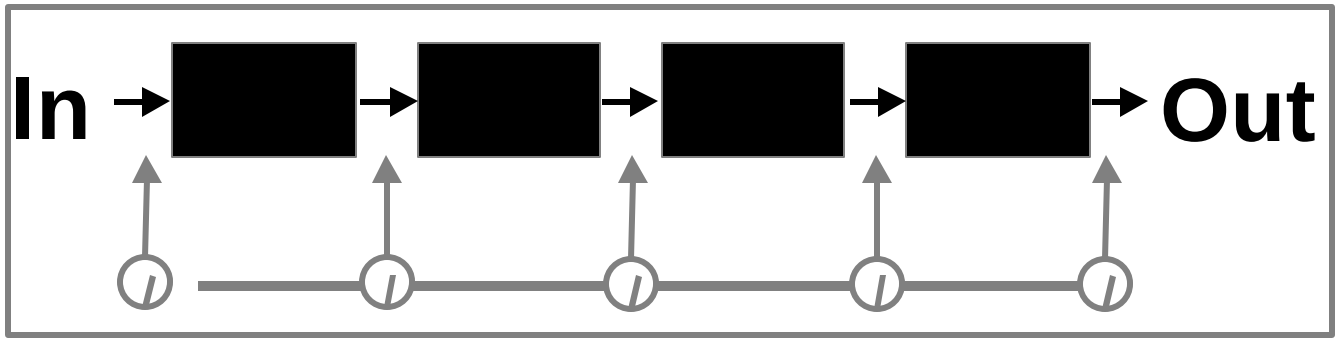


- Requirements flow in.
- A product is (sometimes) produced by some amorphous process.
- The product flows out and (we hope) works.

Maturity Level 2 “Managed”

- *Project* management is more disciplined.
- Organizational policies are established and followed.
- Project plans & process descriptions are documented & followed.
- Resources are adequate.
- Responsibility and authority is assigned over the life cycle.
- Past successes can be expected on *similar* projects.
- Discipline helps ensure existing practices are retained during times of stress.
- Status of activities and work products are visible to management at defined points.

Process is “Managed”



- Requirements flow in.
- Plans are developed in accordance with policies.
- Activities are performed in accordance with plans.
- Measurements and reviews occur at defined points.
- The product flows out and (usually) works.

Understanding Level 3, the Defined Maturity Level

- This level builds on the foundation of project management of Level 2.
  - The engineering processes are more effectively implemented.
  - The organization is more proactive.
  - Training is planned and required.
- The organization has a standard process, which individual projects tailor to their needs.

Some Key Terms -1

- Standard process (exists at the organizational level)
  - a basic process guiding establishment of a common process across the organization
  - describes fundamental elements expected to be incorporated into any defined process used by a project

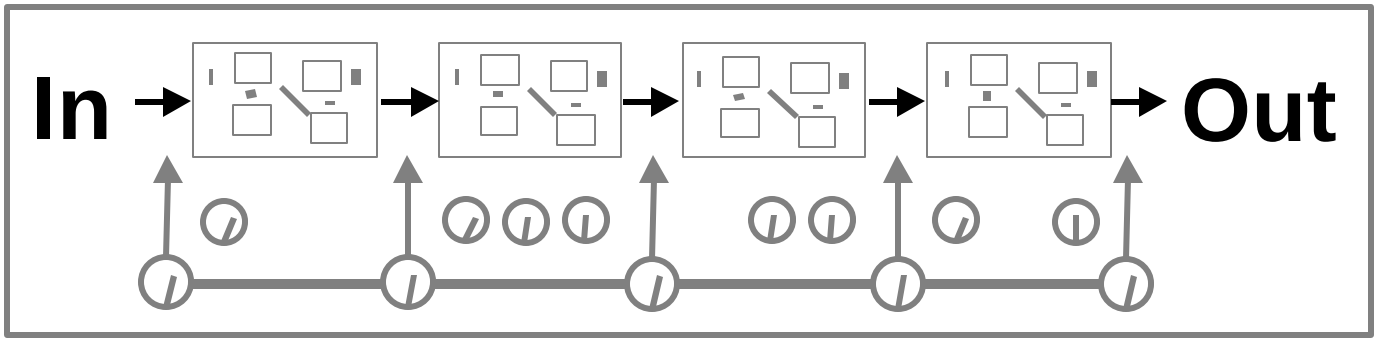
- Performed process
  - A process that accomplishes the needed work to produce identified output work products using identified input work products (also known as capability level 1).
  - The specific goals of the process area are satisfied.

Some Key Terms -2

- Managed process (also know as capability level 2)
  - a process that is planned, documented, performed, monitored, controlled
  - exists at the project (local) level

- Defined process (exists at the project level)
  - a ‘managed process’ tailored from the organization’s set of standard processes
  - has clearly stated inputs, entry criteria, activities, roles, measures, verification steps, outputs, and exit criteria
  - Deviations from the ‘managed process’ beyond those allowed by the tailoring guidelines are documented, justified, reviewed, and approved.

Managed According to a Defined Process



- Commonality among projects allows more uniform estimation of performance.

Source: Addison Wesley CMM v1.1

Why is Level 4 Important?

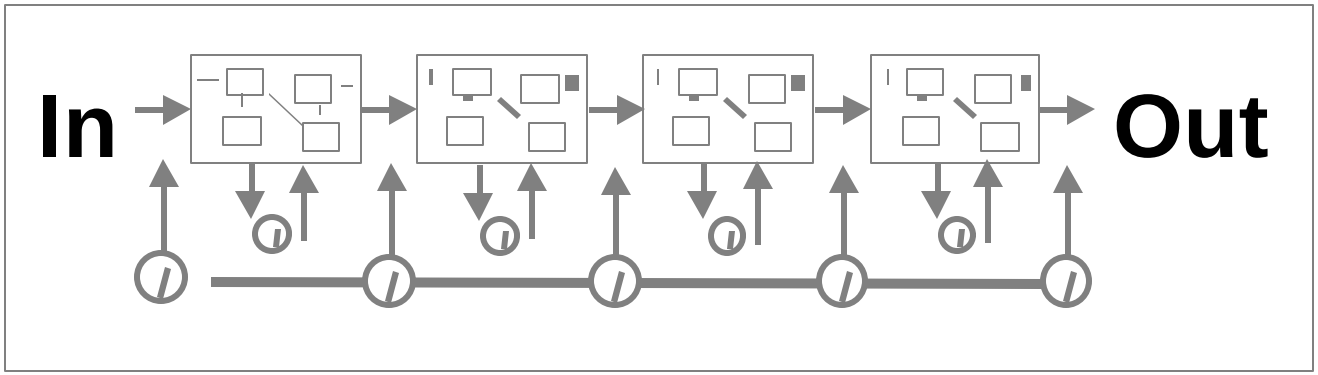
Measurements needed for Level 4 analyses may (or may not) be different from measurements needed for Level 3 analyses

Level 4 analyses usually require a history of measurement data

Delaying consideration of Level 4 measurement needs will

- impact existing measurement program
- delay Level 4 analysis after Level 3 is achieved

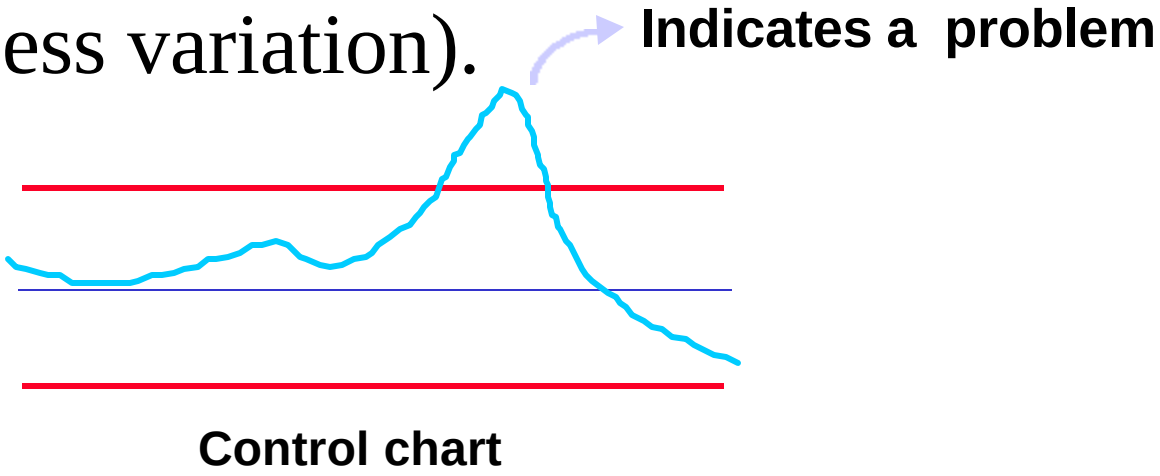
Products, Services, and Processes Are Quantitatively Managed



- The performance of the defined process is stable and predictable within the quantified observed bounds.
- Management has an objective basis for making decisions to achieve established product quality, service quality, and process performance goals.

Addressing Special Causes of Process Variation

- Apply the principles of statistical process control (address special causes of process variation).



Understanding Level 5, the Optimizing Maturity Level

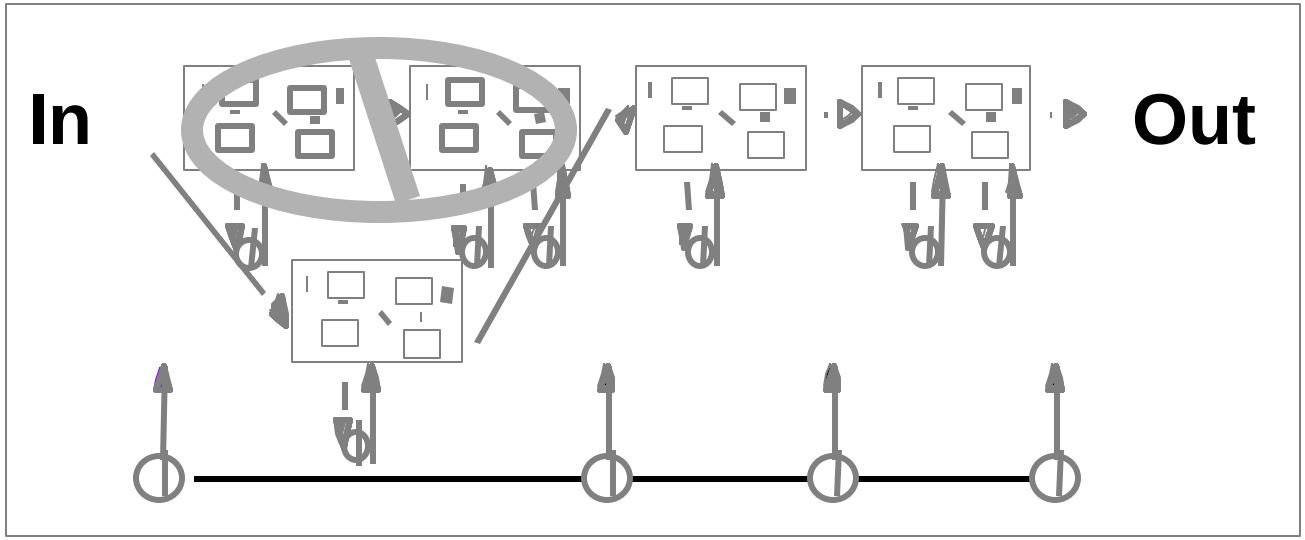
Both the defined processes and the organization's set of standard processes are targets of the improvement activities.

Quantitative process improvement goals for the organization are established and continually revised to reflect changing business objectives.

Both incremental and innovative improvements are addressed.

Process and technology improvements that would measurably improve the process performance are identified, evaluated, and deployed.

Understanding Level 5, the Optimizing Maturity Level



Continual and measurable process improvement (while managing process stability) is a way of life.