Model-Based Improvement

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Outline

Understanding Process Models

Understanding the CMMI

Model-Based Acquisition Improvement

Benefits of Acquisition Improvement (Aggregated)

Summary

What is a Process Model?

A process model is defined as:

> *a structured collection of elements (practices) that describes characteristics of effective processes.*

Processes and practices included in models are those proven by experience to be effective.

Effective processes are those that have been demonstrated to be effective within their respective environment.

Process Models

Process Models provide:

- The benefit of a community's experiences

- A common language and a shared vision

- A framework for prioritizing actions

- A "benchmark" for assessing different organizations for equivalent comparison

- A way to define and measure what "improvement" means for your organization

A model is NOT a process. The model shows WHAT to do, but neither HOW to do it nor WHO should do it.

"All models are wrong; some are useful."
- George Box

Why Is a Process Model Important?

A process model can be used as a "yardstick" to determine where the process is now and where the process should go to improve.

Associated appraisal techniques enable benchmarking and clearly define strengths, weaknesses, and potential improvement areas.
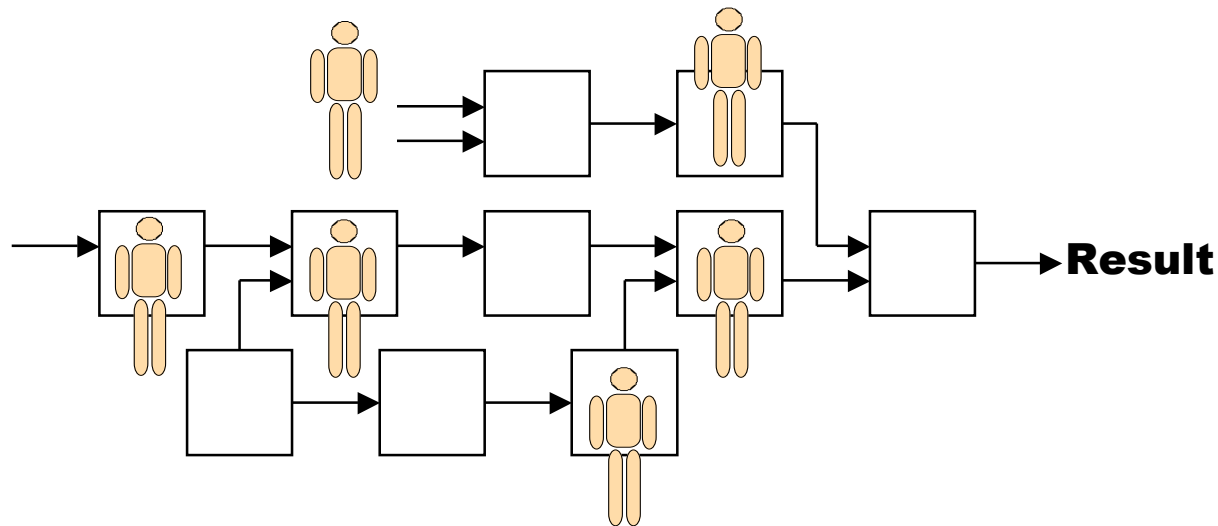
A process model can serve in appraisals:

by project offices for self improvement

by external agencies to stimulate improvement

What is a Process?

A **process** is a logical organization of people and technology into work activities designed to transform information, materials, and energy into a specified result.

Process Improvement flows from and extends the general management theories developed over the past ~30 years (Juran, Deming, Crosby, etc)

Is Process Important?

Repeated investigation says "yes"

- There exist about a dozen common patterns of failure
  (so while each program is unique, they fail in familiar ways).

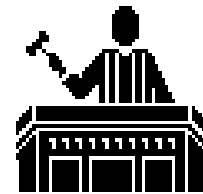**Desired characteristics are also known**

- Mature process,

- Experienced program management,

- Skilled staff,

- Familiar domain,

- Stable requirements and scope,

- Stable funding,

- …

Characteristics of Effective Processes

documented
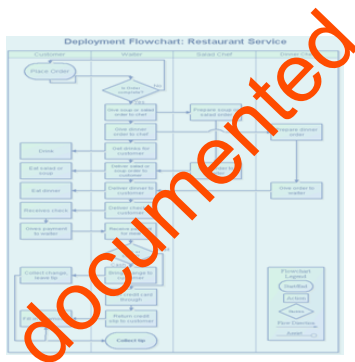
simple
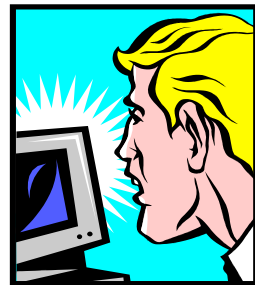
trackable

enforced

trained

measurable

flexible

practiced
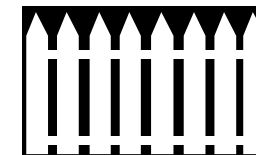
supported

STABLE

Well-defined gates

Benefits of Effective Processes

Shared language

Easy to train

Predictable and can be estimated

Skilled resources are available

Doesn't generate (much) rework or waste

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What is the CMMI?

Capability Maturity Model Integrated (CMMI) is a Process Model

The CMMI is a *model* that describes the key features or characteristics of effective processes for a given discipline.

As with other process *models*, a CMMI is *NOT* a process. It describes some features or characteristics of a process

The primary purpose of CMMI is to focus on *improving processes* within an organization for a given discipline. (e.g., acquisition, software development, systems engineering, etc.)

CMMI Process Categories

Project Management

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management
- Risk Management
- Quantitative Project Management

Engineering

- Requirements Development
- Requirements Management
- Verification
- Validation
- Product Integration
- Technical Solution

Support

- Measurement and Analysis
- Decision Analysis and Resolution
- Transition to Operations and Support
- Process and Product Quality Assurance
- Configuration Management
- Causal Analysis and Resolution

Process Management

- Organizational Process Management
- Organizational Process Focus
- Process Innovation and Deployment
- Organizational Training
- Organizational Process Performance

What Is Its Range Of Use?

CMMI

- Emphasizes the development of processes to improve product development, acquiring products, and customer services in organizations

- Provides a framework from which to organize and prioritize process improvement activities (product, business, people, technology)

- Supports the coordination of multi-disciplined activities that may be required to successfully build a product

- Emphasizes the alignment of process improvement objectives with organizational business objectives

CMMI Is Used By Organizations Of All Sizes
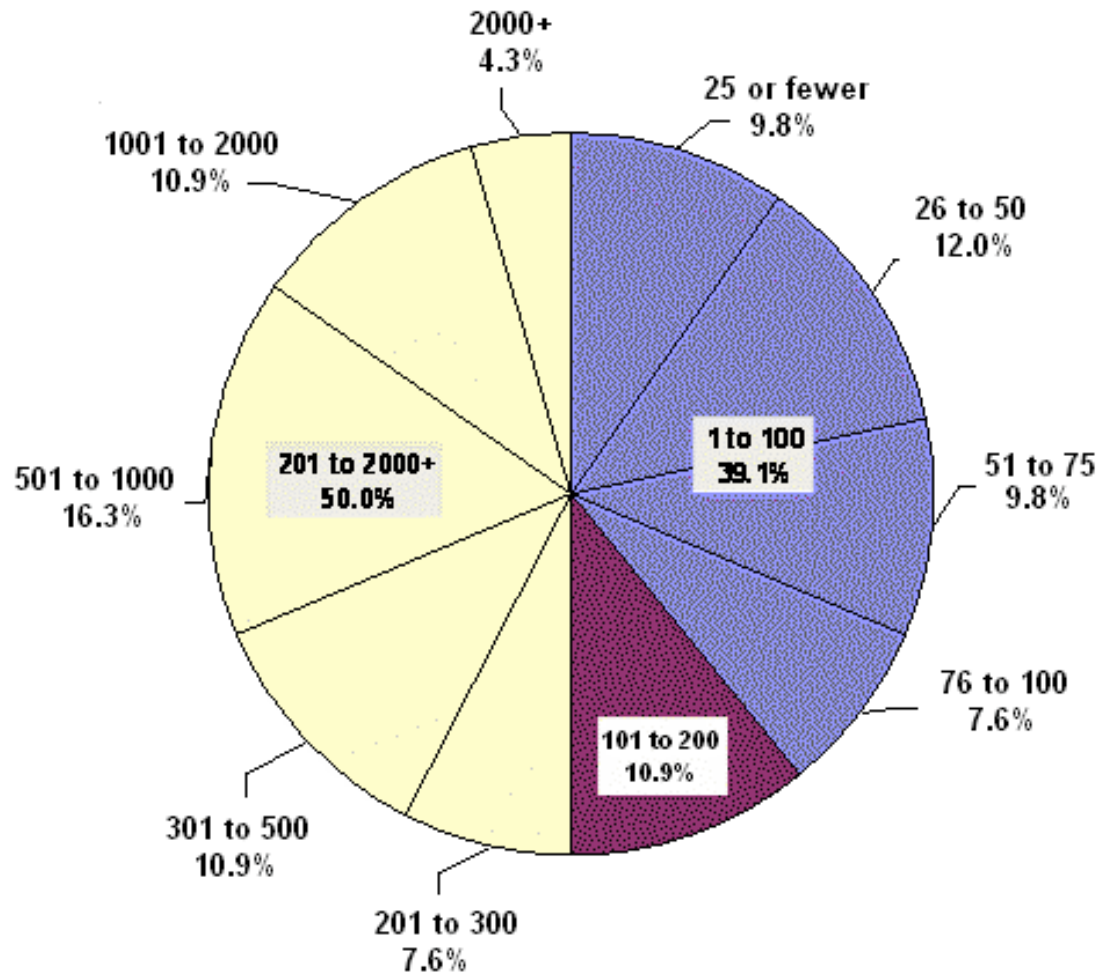
CMMI Model Representations

There are two types of representations in CMMI models:

- staged

- continuous

A representation in CMMI is analogous to a view into a data set provided by a database.

Both representations provide ways of implementing process improvement to achieve business goals.

Both representations provide essentially the same content and use the same model components but are organized in different ways.

CMMI Model Structure
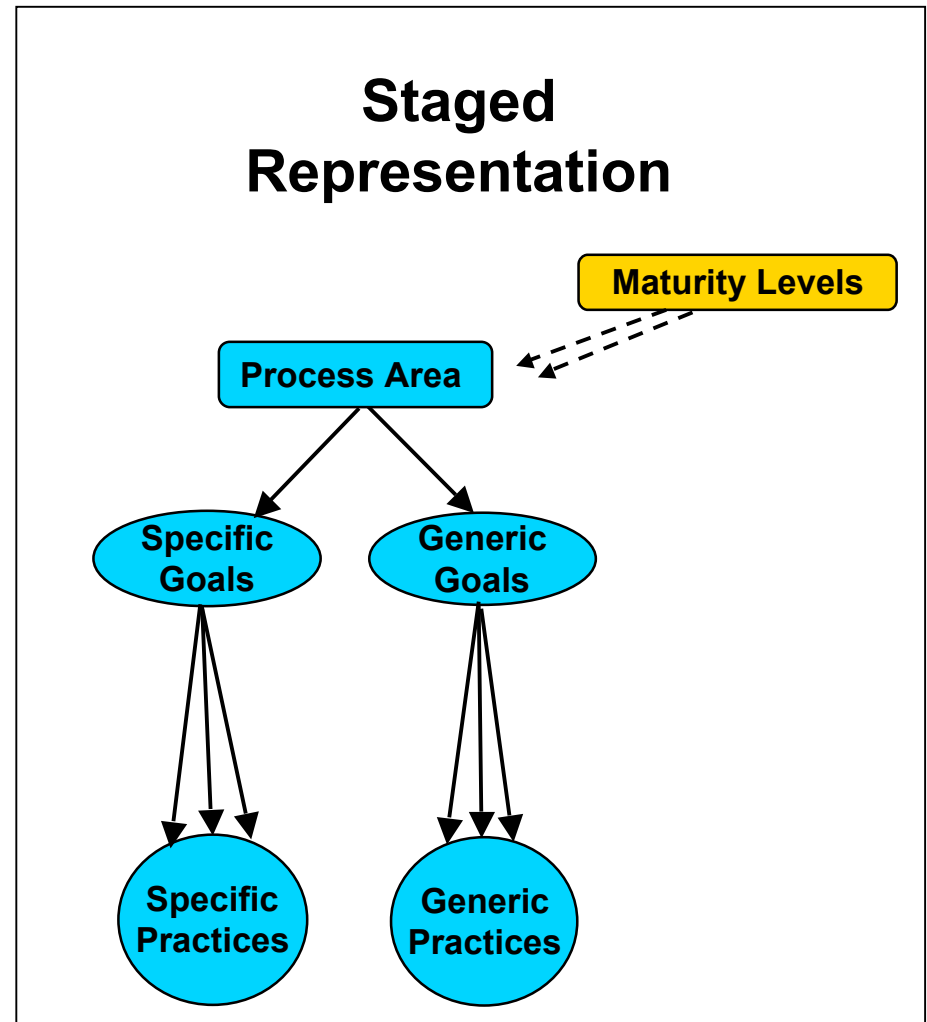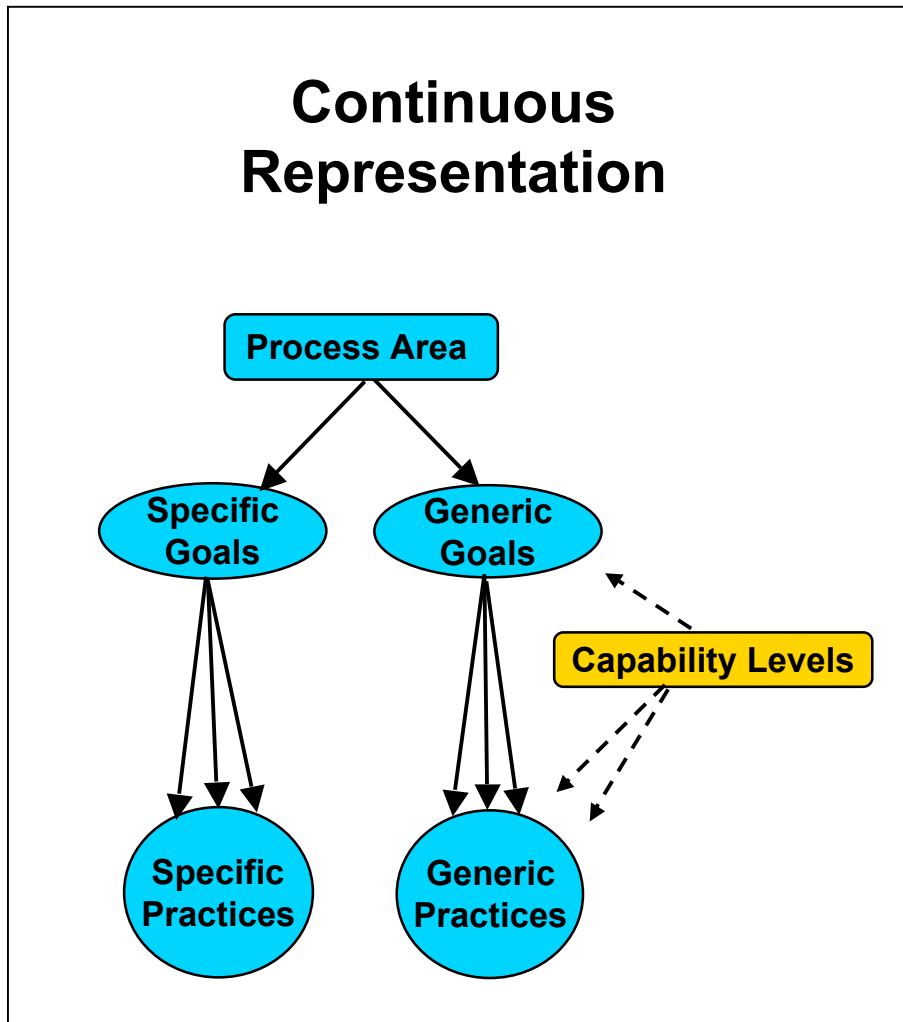
Process Area Organization in the Two Representations

In the continuous representation, process areas are organized by process area category:

- Process Management

- Project Management

- Engineering

- Support

In the staged representation, process areas are organized by maturity level.

Continuous Representation: PAs by Category

Category	Process Areas
Process Management	**Organizational Process Focus** **Organizational Process Definition +IPPD** **Organizational Training** **Organizational Process Performance** **Organizational Innovation and Deployment**
Project Management	**Project Planning** **Project Monitoring and Control** **Supplier Agreement Management** **Integrated Project Management +IPPD** **Risk Management** **Quantitative Project Management**
Engineering	**Requirements Management** **Requirements Development** **Technical Solution** **Product Integration** **Verification** **Validation**
Support	**Configuration Management** **Process and Product Quality Assurance** **Measurement and Analysis** **Decision Analysis and Resolution** **Causal Analysis and Resolution**

Staged Representation: PAs by Maturity Level

Level	Focus	Process Areas	
5 Optimizing	*Continuous Process Improvement*	Organizational Innovation and Deployment Causal Analysis and Resolution	Quality Productivity
4 Quantitatively Managed	*Quantitative Management*	Organizational Process Performance Quantitative Project Management	
3 Defined	*Process Standardization*	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition +IPPD Organizational Training Integrated Project Management +IPPD Risk Management Decision Analysis and Resolution	
2 Managed	*Basic Project Management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management	
1 Initial			Risk Rework

Understanding Levels -1

Levels are used in CMMI to describe an evolutionary path for an organization that wants to improve the processes it uses to develop and maintain its products and services.

CMMI supports two improvement paths:

- **continuous** - enabling an organization to incrementally improve processes corresponding to an individual process area (or set of process areas) selected by the organization

- **staged** - enabling the organization to improve a set of related processes by incrementally addressing successive predefined sets of process areas

Understanding Levels -2

These two improvement paths are associated with two types of levels that correspond to the two representations, staged and continuous.

For the continuous representation, we use the term capability level or process area capability.

For the staged representation, we use the term maturity level or organizational maturity.

Understanding Levels -3

Regardless of the representation you select, the concept of levels is the same.

Levels characterize improvement from an ill-defined state to a state that uses quantitative information to determine and manage improvements that are needed to meet an organization's business objectives.

To reach a particular level, an organization must satisfy all of the appropriate goals of the process area or set of process areas that are targeted for improvement, regardless of whether the level is a maturity or a capability level.

Capability Levels -1

A capability level consists of a generic goal and its related generic practices that can improve the organization's processes associated with a process area.

Capability levels provide a scale for measuring your processes against each process area in a CMMI model.

There are six capability levels.

Each level is a layer in the foundation for continuous process improvement.

Capability levels are cumulative (i.e., a higher capability level includes the practices of the lower levels).

Capability Levels -2

5 Optimizing

4 Quantitatively Managed

3 Defined

2 Managed

1 Performed

0 Incomplete
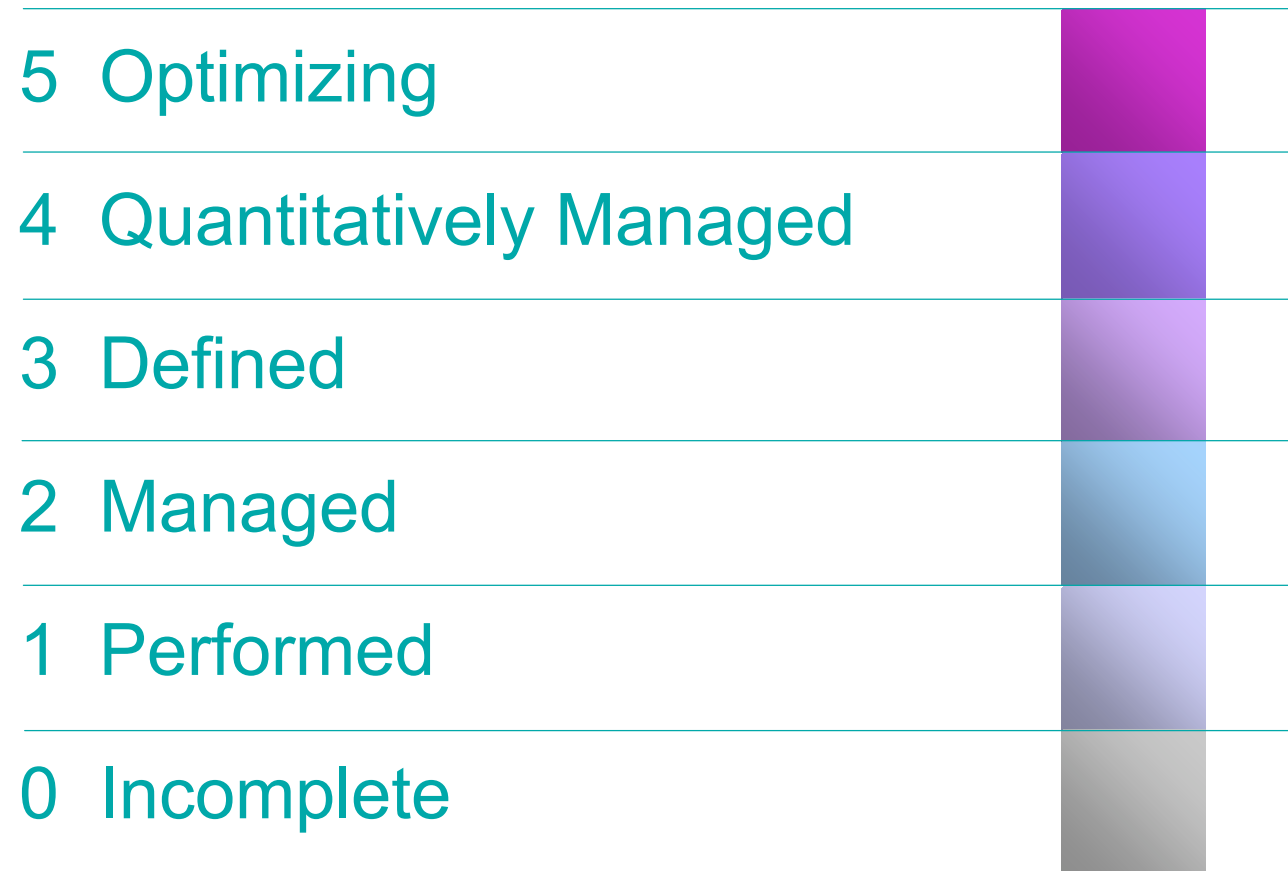
Comparative Advantages of Continuous and Staged Representations

Continuous	Staged
• Freedom to select order of improvement	• Predefined and proven improvement path
• Mitigates areas of risk	• Focuses on set of processes that provide organization with a specific capability
• Increased visibility of the capability achieved	• Characterizes each maturity
• Sets order of processes to be performed	• Summarizes process improvement results in simple form-single maturity level

Representations Support Each Other

Most organizations use both representations in their pursuit of process improvement.

- **Continuous for**
  - tactical planning
  - to focus attention on individual process areas as they are being implemented
  - to gain the more granular visibility into progress

- **Staged**
  - for strategic planning
  - to focus attention at the organizational level
  - to focus on comparisons with other organizations at the higher level of granularity – and perhaps to indicate satisfaction of a contractual requirement

Applying CMMI Effectively

To effectively apply CMMI implies reflecting on the realities of your business environment and applying the model in a thoughtful, appropriate manner

- Identifying problems as objectively as possible and tie process improvement to your business goals
- Tailoring (interpreting) CMMI to fit your context and needs
- Using for professional judgment
- Not forcing inappropriate solutions simply because a practice is identified in the model

Use CMMI as a GUIDE not as a DICTATE

How CMMI Can Help -1

Establishing and applying product development and management processes that implement **Specific Practices (SPs)** of selected CMMI **Process Areas (PAs)** can help strengthen related areas of weakness.

For example:

Requirements Development process area

- Elicit customer needs, expectations, constraints and interfaces and develop their requirements

- Develop, refine and establish product and product component and interface requirements

- Analyze and validate requirements

How CMMI Can Help -2

For example:

Project Planning process area

- Establish a work breakdown structure

- Use a rigorous technical approach, an estimating model, etc., to determine effort, cost, schedule complexity, etc.

- Consider supporting infrastructure needs, use historical data

- Develop the project plan

- Obtain commitment to the plan

How CMMI Can Help -3

For example:

Requirements Management process area

- Develop an understanding with the requirements providers on the meaning of the requirements

- Obtain commitment to the requirements from the project participants

- Manage requirements changes and maintain bi-directional traceability of requirements

- Identify inconsistencies between project plans and work products and requirements

How CMMI Can Help -4

Using the CMMI model you:

- Begin by focusing attention on the specific business issues that are important to your organization (e.g., cost overruns)

- Start using practices defined in the model

- Do so on specific projects & measure results

- Do so consistently

Then

- Use measurement data to determine how these processes are working

- Improve these processes based on your experience and the measurement data

- Become more effective dealing with those issues on a repeatable basis

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Understanding the CMMI-ACQ

 Model-Based Acquisition Improvement

Benefits of Acquisition Improvement (Aggregated)

Summary

The Process Improvement Journey

"Along the way more discipline, awareness, skilled /trained people, helped identify resource needs, identified supplier problems more easily – morale is high… people are proud… we see the light at the end of the tunnel."

However, the "real" benefits are realized in the *journey*, rather than the end result of maturity/capability level.

Two Basic Approaches to Improvement

Benchmarking

- Compare yourself to others who have similar strategies (but not necessarily similar products).

- **Top-down strategy** of borrowing from others to learn something new.

- Decomposes the improvement needs into processes.

Quality-Management

- Improve the quality of your processes by eliminating waste and variation.

- **Bottom up strategy** where improvement begins at the work-team level.

- Used to solve specific problems.

Both CMMI & LSS have roots in the Quality-Management tradition.

- They take different paths to the goal.

- There are advantages to combining the approaches.

"Must-Haves" for Process Improvement

A compelling reason for change

Leadership of the change effort by the top executive in the organization — responsibility cannot be delegated

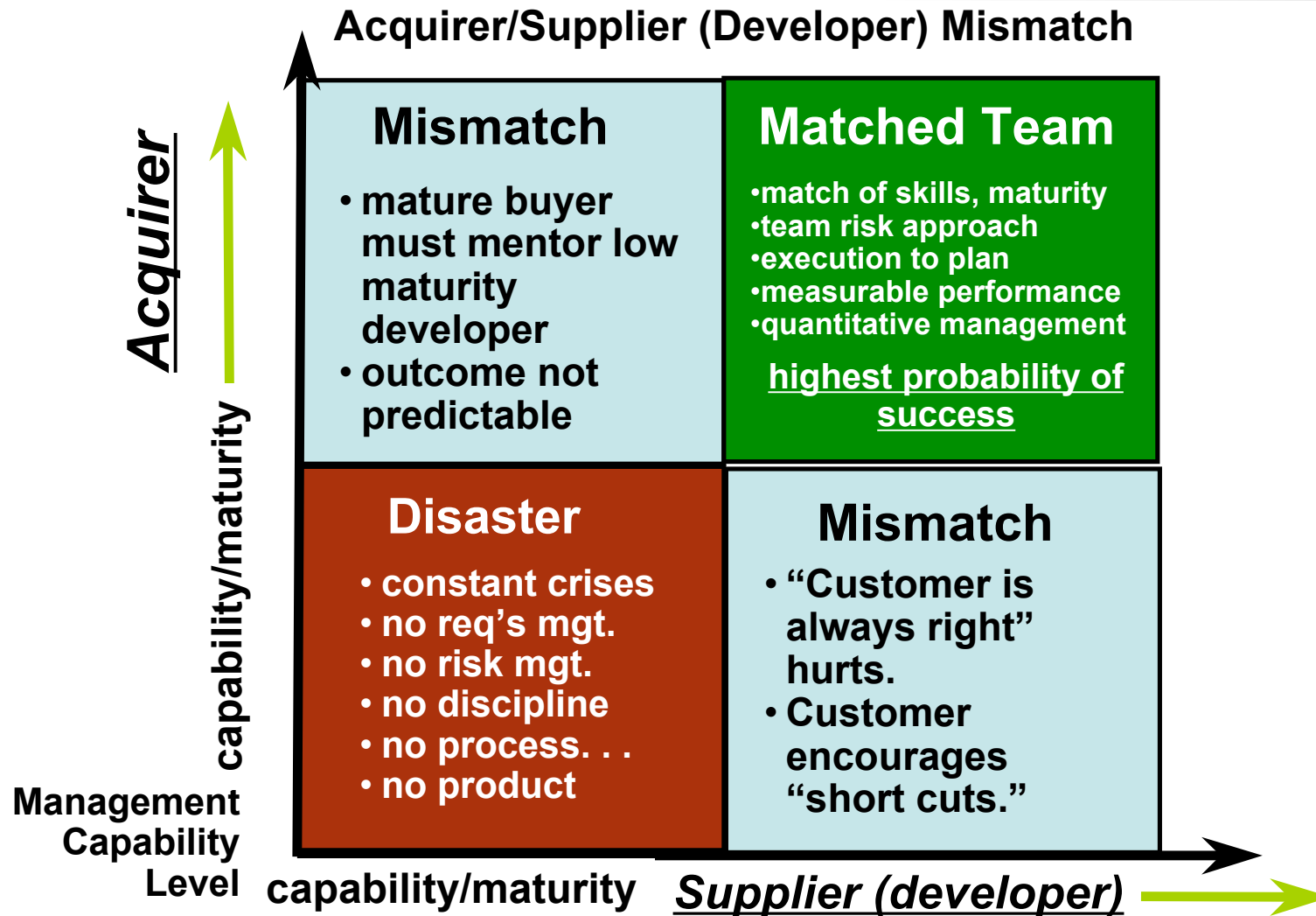Informed commitment of the top management team

Designation of a primary change agent (the SAPG Leader) and an adequate mandate for change
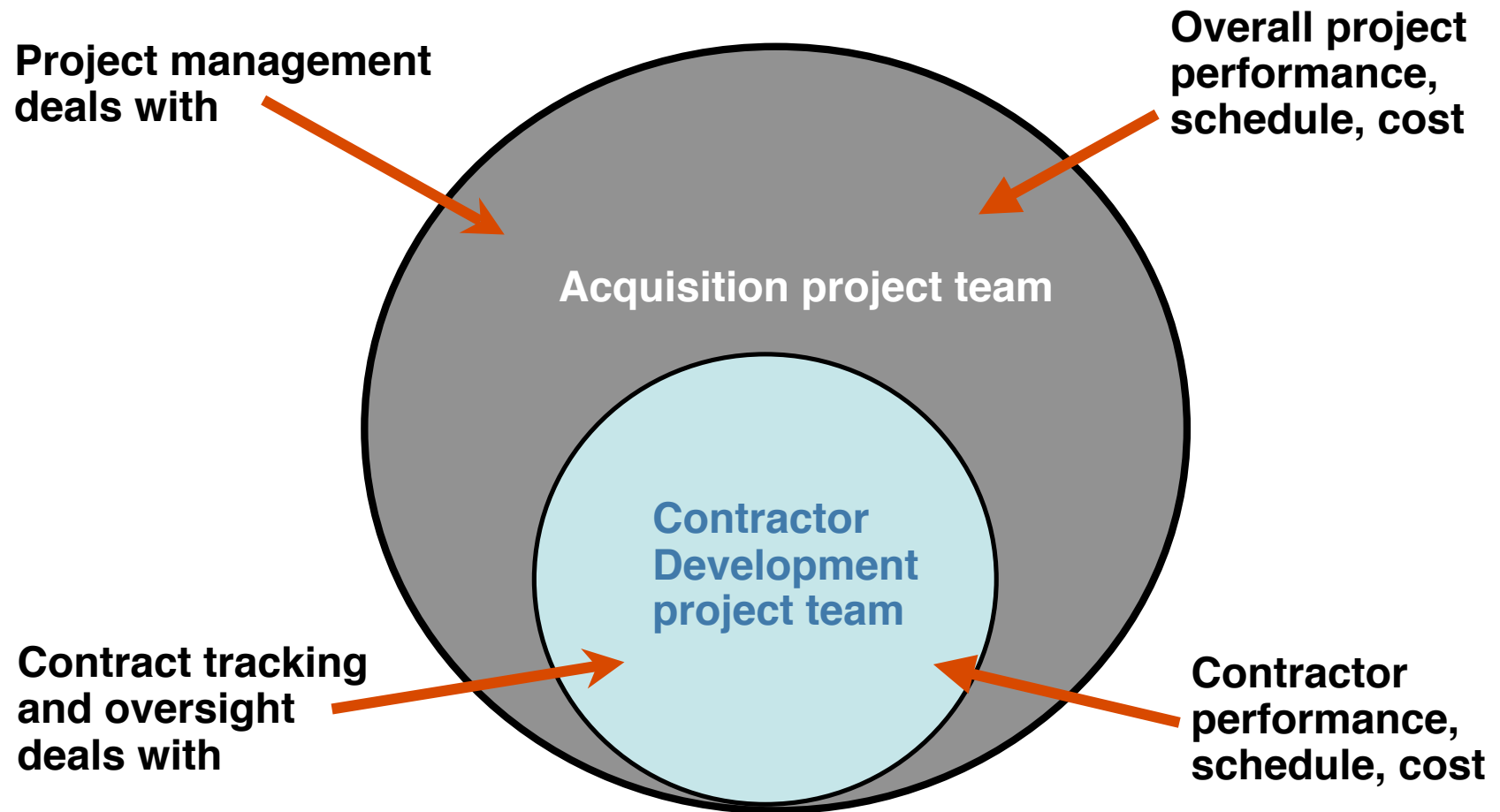
Sound performance measures that drive change

Without these, it's very likely that you will experience a "false start" of your process improvement program.

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What's the Problem ? -1

Acquirer/Supplier (Developer) Mismatch

Acquirer capability/maturity

Mismatch	**Matched Team**
• mature buyer must mentor low maturity developer • outcome not predictable	•match of skills, maturity •team risk approach •execution to plan •measurable performance •quantitative management <u>highest probability of success</u>
Disaster	**Mismatch**
• constant crises • no req's mgt. • no risk mgt. • no discipline • no process. . . • no product	• "Customer is always right" hurts. • Customer encourages "short cuts."

Management Capability Level

capability/maturity *Supplier (developer)*

Acquisition Project Management vs. Contract Monitoring

Project management deals with

Overall project performance, schedule, cost

Acquisition project team

Contractor Development project team

Contract tracking and oversight deals with

Contractor performance, schedule, cost

Possible PMO Improvements

Improve program office operating practices

- Improve Reviews – documents, PMRs, PDRs, CDRs…

- Improve specific areas: risk management, requirements mgt, configuration control, contracting actions (including source selection)

- Improve communications

- Create a "strategic rhythm"

Facilitate contractor processes

- Oversight/Insight into contractor processes

- Potentially going to work with contractor(s) for many years; Encourage PMO-contractor teamwork

Using the CMMI-ACQ Model

Use the model to…:

- look for possible causes of problems

- identify potential improvement projects

- benefit from a large community's prior experience

- create a common language and a shared vision

- help prioritize improvement projects

- define what "improvement" means for your organization

The CMMI-ACQ model is NOT a process.

The model shows WHAT to do, but neither HOW to do it nor WHO should do it.

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➡ **Benefits of Acquisition Improvement (Aggregated)**

Summary

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Benefits From Other Acquisition Organizations

Discipline

"Achieved structured and disciplined acquirer and supplier organizations - a matched team situation**.**"

Communications

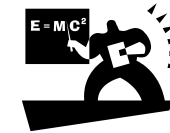"Improved communications between the acquirer, software supplier, and the user community."

Stabilized Terminology

"The terms that have been solidified and documented in the organizational processes are now regular day to day lingo."

Benefits

Training established - How we do Business

"The CMM has helped the organizational learning curve describing how we do business."

Empowerment

"People in the organization feel empowered because the organization is now clear on who's responsible for what."

Benefits

Repository and Its Implications

"Repository has improved communication and coordination among team mates as well as allowed for easier retrieval of artifacts for assessment purposes."

Oversight Scrutiny

"Our oversight groups ……..have gained confidence in organizational maturity."

Benefits

Resources

"Since this issue was raised through assessments with no attribution of source, many additional personnel have been brought on board with skills more in line with the role of the acquisition organization."

Organizational Pride

"The successes we've had in process improvement have been a source of great pride for our organization."

Benefits

Policies, Processes, and Procedures

"Processes, procedures, policies, and other work rules have been thought out and documented so the organization understands what is expected of their project teams."

Instilled discipline into the organization's acquisition processes

Transition from IT Culture

"We all took a sharp turn away from an IT way of looking at things to a more acquisition and management way of looking at things with software in the background."
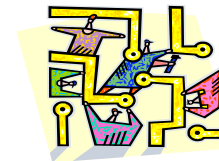
Benefits

Better Management Skills

"We became better at managing; the use of more disciplined approaches, assessments, techniques and acquisition management planning Captured best-processes expertise before it's gone."
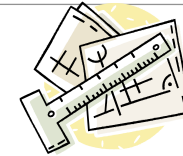
Alignment with Contractors

"The CMM promoted better understanding of roles, responsibilities and alignment of processes. Leveled playing field with contractors"

Benefits

Planning and Use of Plans

"Activities are now planned out in advance (on paper) in the acquisition management plan for each task order by the acquisition team members. Roles and responsibilities are more clearly understood… team members feel more involved in the program.. not simply bystanders … expectations are clearly understood… its not just 'the contractor's' problem any more."

Measuring and Improving Processes
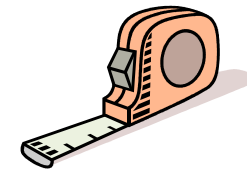
"The standard documented organization processes have helped the procurement organization in performing root-cause analyses, characterize the pre-award timeline process and to the measures needed improve it as well as form the basis for future acquisitions."

Who Has Improved or Performed Better?

- Air Force Missile Warning and Space Surveillance Sensors
- Air Force Mission Planning Systems Program Office
- Navy Cruise Missile Weapon Systems Program Office
- NRO
- Warner Robins AFB
- PM Abrams
- Keystone (Personnel Command)
- Customs Border Protection Modernization Office
- Military Health Systems
- General Motors
- PEO Aviation

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Summary 1

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A process model can be used as a "yardstick" to determine where the process is now and where the process should go to improve.

A **process** is a logical organization of people and technology into work activities designed to transform information, materials, and energy into a specified result.

Benefits of Effective Practices

- Shared language
- Easy to train
- Predictable and can be estimated
- Skilled resources are available
- Doesn't generate (much) rework or waste

Summary 2

CMMI is a collection of effective, "best practices" that provide significant leverage in solving product development and acquisition problems that plague industry today

CMMI is a model that integrates those practices from proven multidisciplinary models and can be used as the basis for model-based process improvement in a wide range of organizations and product domains

CMMI is NOT a set of process descriptions

CMMI identifies; for effective product development, acquisition, & maintenance; WHAT to do but neither HOW to do it nor WHO should do it.

Summary 3

To Improve - organizations need:

- Set of goals

- An improvement approach

- New or revised practices

What happens - more discipline, awareness, skilled /trained people, helped identify resource needs, identified supplier problems more easily – morale is high… people are proud… we see the light at the end of the tunnel.

Summary 4

Benefits of Acquisition Improvement

• Establish a common language; forge a shared vision.

• Build on a set of processes and practices developed with input from a broad section of the systems acquisition community.

• Provide a framework for prioritizing actions.

• Provide a framework for performing reliable and consistent appraisals (comparing yourself to others).

• CMMI defines needed structures for improvement.

Backup Slides

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Acquisition Process Inputs and Outputs

Sponsor

PO

Contractor

Suppliers

Users

Mission changes
Funding changes
Resources
Schedule targets
Policy directives

Status
Exceptions
Risks & Issues
Change requests

Evaluation results
Priorities
Requirement changes

• Process performance effectiveness
• Quality of internal products & services

Intermediate products

Feedback
Change requests

Status and Progress
Technical Performance
Risks
Change requests