Applying CMMI® Generic Practices with Good Judgment

SEPG Conference Tutorial

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Objectives

- **Provide an understanding of CMMI model components contributing to institutionalization**

- **Emphasize the definition, deployment, and institutionalization of processes for business value**

- **Provide guidance for the effective implementation and appraisal of CMMI generic practices**

- **Describe and illustrate typical problem areas relative to generic practices or situations where good judgment is needed**

Agenda

- **Introduction**
  - **Process Institutionalization Concepts**
  - **CMMI Generic Goals and Generic Practices**
  - **Comparison with Legacy Models**

- **Challenges in Implementation**
  - **Process Architecture vs. CMMI Model Architecture**
  - **Maintaining Focus on Business Value**

- **Challenges in Appraisal**
  - **Effort Required**
  - **Understanding PA / GP Relationships**
  - **Reaching Appraiser Consensus**

- **Generic Practice Breakdown**
  - **Implementation Guidance**
  - **Appraisal Guidance**
  - **Examples**

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Caveats

- **The model is the model – everything else is not**
  - **The CMMI models and SCAMPI MDD are the authoritative references**
  - **Information provided in this tutorial reflects the authors' experience, attitudes and best judgment for processes based on business value**
  - **Should not be construed as "official" or "approval"**
  - **Consider this material as informative, similar to interpretative guidance**
- **Organizations must use their own best judgment on effective or CMMI-compliant process implementations**
  - **When in doubt, consult your SCAMPI Lead Appraiser or other experts**

What is a Process?

A process is a set of practices performed to achieve a given purpose; it may include tools, methods, materials, and/or people.

[SEI definition]

PEOPLE

PROCESS   TECHNOLOGY
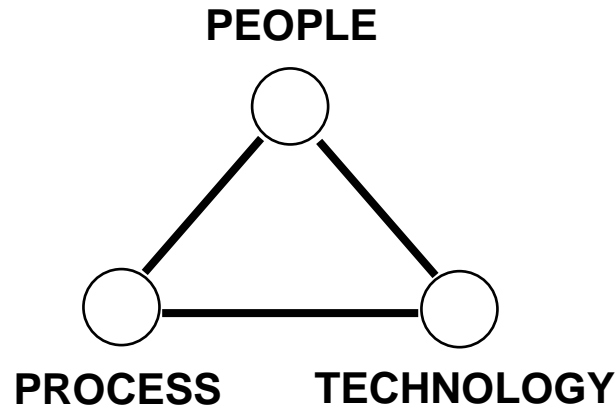
Organizations define, implement, and institutionalize processes that are consistent with the CMMI model.

Processes should be designed to fit the organizational business objectives and culture.

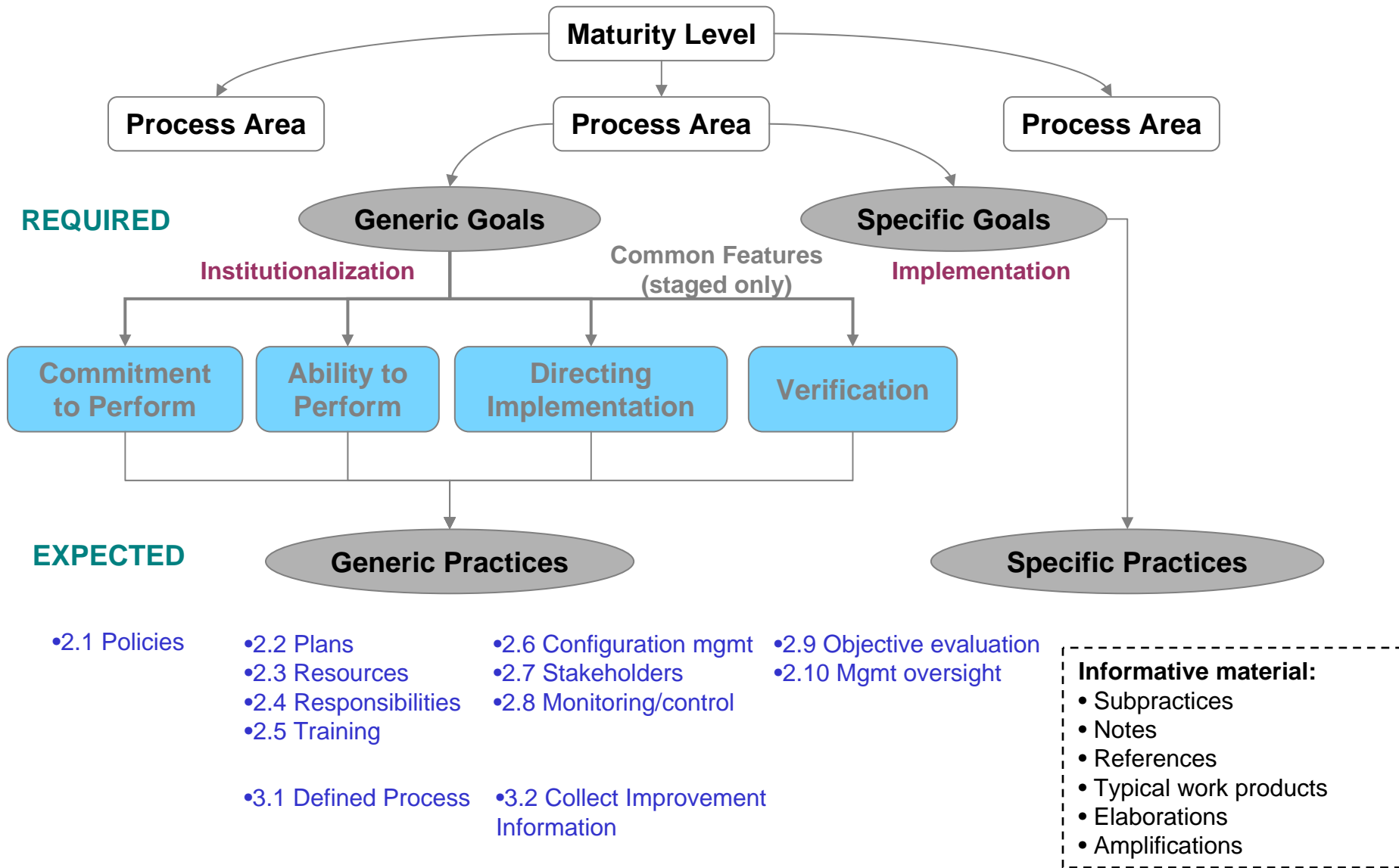# *What is Institutionalization?*

Institutionalization:

- **The ingrained way of doing business that an organization follows routinely as part of its corporate culture.**
  [CMMI model glossary]

In CMMI appraisals, institutionalization is judged by achievement of generic goals at the appropriate capability level / maturity level.

CMMI Model Structure
- Staged Representation

```
                          ┌─────────────────┐
                          │  Maturity Level  │
                          └─────────────────┘
         ┌────────────────────────┼────────────────────────┐
┌─────────────────┐     ┌─────────────────┐      ┌─────────────────┐
│  Process Area   │     │  Process Area   │      │  Process Area   │
└─────────────────┘     └─────────────────┘      └─────────────────┘
```

REQUIRED

(**Generic Goals**)   (**Specific Goals**)

Institutionalization   Common Features   **Implementation**
                             (staged only)

| **Commitment to Perform** | **Ability to Perform** | **Directing Implementation** | **Verification** |

EXPECTED

(**Generic Practices**)   (**Specific Practices**)

•2.1 Policies

•2.2 Plans
•2.3 Resources
•2.4 Responsibilities
•2.5 Training

•2.6 Configuration mgmt
•2.7 Stakeholders
•2.8 Monitoring/control

•2.9 Objective evaluation
•2.10 Mgmt oversight

Informative material:
• Subpractices
• Notes
• References
• Typical work products
• Elaborations
• Amplifications

•3.1 Defined Process

•3.2 Collect Improvement Information

CMMI Generic Goals

Achievement of a generic goal in a process area signifies improved control in planning and implementing the processes associated with that process area thus indicating whether these processes are likely to be effective, repeatable, and lasting.
[CMMI model]

GG 1	**Achieve Specific Goals**

GG 2	**Institutionalize a Managed Process**

GG 3	**Institutionalize a Defined Process**

GG 4	**Institutionalize a Quantitatively Managed Process**
GG 5	**Institutionalize an Optimizing Process**

Continuous representation only

Satisfaction of the generic goals is determined through implementation of the generic practices that contribute to each generic goal.

Capability Level

0. Incomplete

1. Performed   GP 1.1   Perform Base Practices

2. Managed
- GP 2.1   Establish an Organizational Policy
- GP 2.2   Plan the Process
- GP 2.3   Provide Resources
- GP 2.4   Assign Responsibility
- GP 2.5   Train People
- GP 2.6   Manage Configurations
- GP 2.7   Identify and Involve Relevant Stakeholders
- GP 2.8   Monitor and Control the Process
- GP 2.9   Objectively Evaluate Adherence
- GP 2.10   Review Status with Higher Level Management

3. Defined
- GP 3.1   Establish a Defined Process
- GP 3.2   Collect Improvement Information

4. Quantitatively Managed
- GP 4.1   Establish Quantitative Objectives for the Process
- GP 4.2   Stabilize Subprocess Performance

5. Optimizing
- GP 5.1   Ensure Continuous Process Improvement
- GP 5.2   Correct Root Causes of Problems
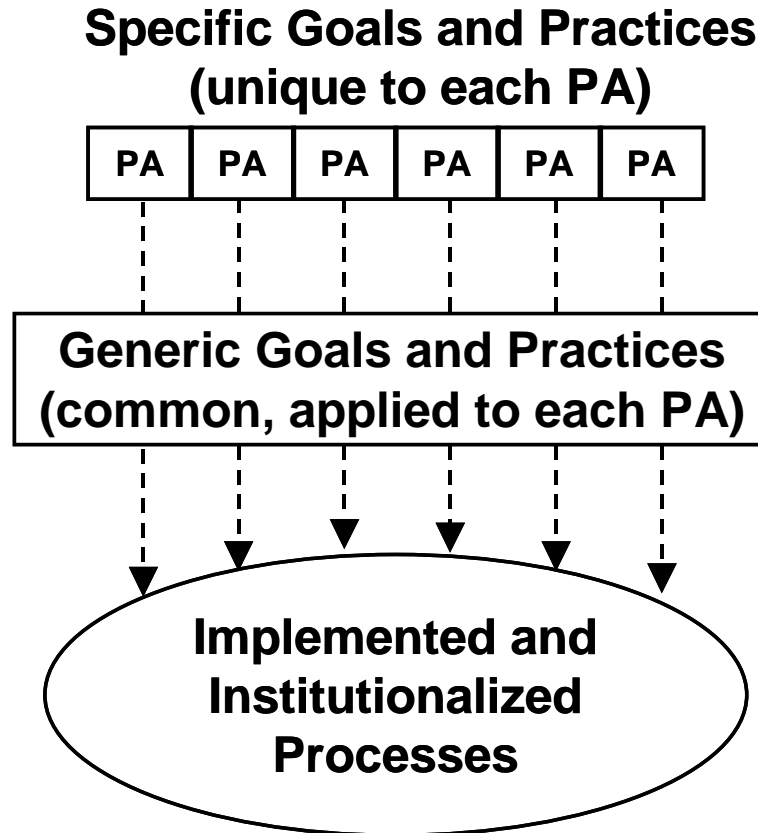
Continuous representation only

Common Features
Staged Representation

Commitment to Perform	Ability to Perform
Policies and sponsorship	*Project and/or organizational resources*
GP 2.1 Establish Organizational Policy	*GP 2.2 Plan the Process* *GP 2.3 Provide Resources* *GP 2.4 Assign Responsibility* *GP 2.5 Train People* *GP 3.1 Establish a Defined Process*
Directing Implementation	**Verifying Implementation**
Managing performance of the process	*Management review, process conformance*
GP 2.6 Manage Configurations *GP 2.7 Identify/Involve Relevant Stakeholders* *GP 2.8 Monitor and Control the Process* *GP 3.2 Collect Improvement Info.*	*GP 2.9 Objectively Evaluate Adherence* *GP 2.10 Review Status with Higher Level Management*

Common features can help provide structure to organize the effective implementation, institutionalization, or appraisal of CMMI generic practices.

**Specific Goals and Practices
(unique to each PA)**

PA	PA	PA	PA	PA	PA

**Generic Goals and Practices
(common, applied to each PA)**

**Implemented and
Institutionalized
Processes**

**What really needs to be institutionalized are the organizational processes –
not the CMMI process areas**

Comparison with Legacy Models
- SW-CMM

CMMI Generic Practices	SW-CMM Key Practices (Institutionalization Common Features for typical KPAs)
GP 2.1 – Establish an Organizational Policy	CO.1 - Follow organizational policy for…
GP 2.2 – Plan the Process	AC.x – A <xyz> plan is prepared… …according to a documented procedure
GP 2.3 – Provide Resources	AB.2 – Adequate resources and funding…
GP 2.4 – Assign Responsibility	AB.1 - Responsibility is established for… <role/group> is assigned responsibility for…
GP 2.5 – Train People	AB.3 – People are trained… (ML2) AB.3 – …receive required training (ML3)
GP 2.6 – Manage Configurations	Software Configuration Management KPA
GP 2.7 – Identify and Involve Relevant Stakeholders	Intergroup Coordination KPA
GP 2.8 – Monitor and Control the Process	ME.1 – Measurements are made and used… VE.2 – Periodic and event-driven reviews…
GP 2.9 – Objectively Evaluate Adherence	VE.3 – The SQA group reviews/audits…
GP 2.10 – Review Status with Higher Level Management	VE.1 – Activities are reviewed with sr. mgmt…
GP 3.1 – Establish a Defined Process	Organizational Process Definition KPA Integrated Software Management KPA
GP 3.2 – Collect Improvement Information	Organizational Process Definition KPA

Comparison with Legacy Models
- EIA/IS 731-1 (SECM)

GP 2.1	Follow recorded and approved plans and processes, that were developed to meet program performance goals, in implementing the Focus Area. •e.g., assign responsibilities; allocate adequate resources; define process measures
GP 2.2	Verify compliance with approved plans and processes, and take appropriate action when performance deviates from plan or when processes are not followed.
GP 3.1	Standardize and record a well-defined FA process for the organization that is designed to meet specific business goals, and is based on experiences captured from previous programs.
GP 3.2	Tailor the organization's standard process using standard guidelines to meet specific program or organizational needs.
GP 3.3	Implement and improve the FA activities (i.e., tailored process) per established and approved formal procedures.
GP 3.4	Improve the organization's standard process using information from work product reviews and process compliance reviews.
GP 4.1	Collect and analyze metrics to determine the performance of the tailored FA activities.
GP 4.2	Take appropriate action to align tailored FA performance and expectations.
GP 5.1	Identify FA activities for which it is appropriate, and inappropriate, to quantify process repeatability.
GP 5.2	Establish quantitative goals for improving the effectiveness of the standard process.
GP 5.3	Improve the organization's standard process based on data and metrics collected from a continuing program of process compliance reviews and work product reviews.
GP 5.4	Perform causal analysis of process and work product defects and eliminate causes of variation in quality, cost, and cycle time by changing the standard process.

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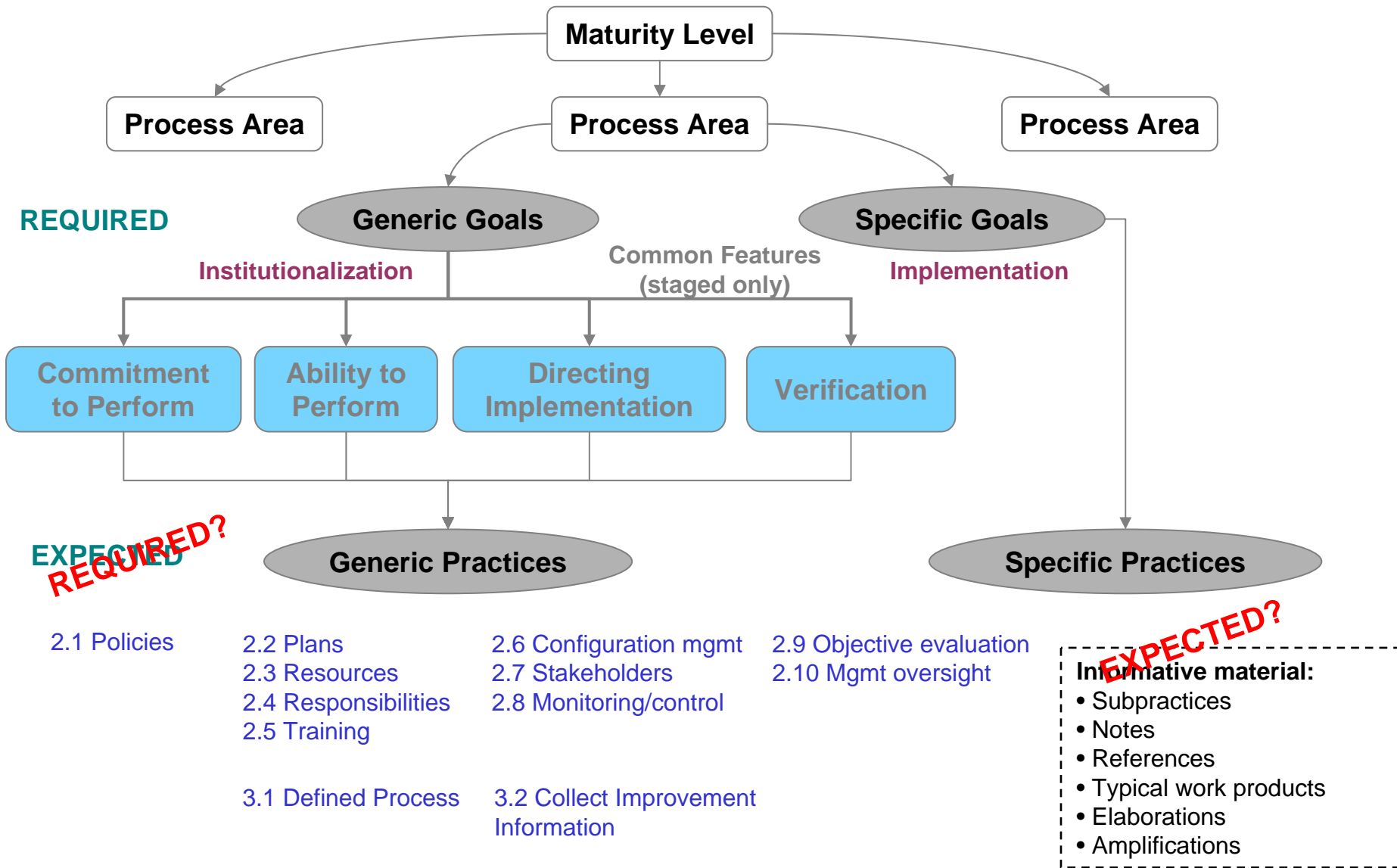 - **Maintaining Focus on Business Value**

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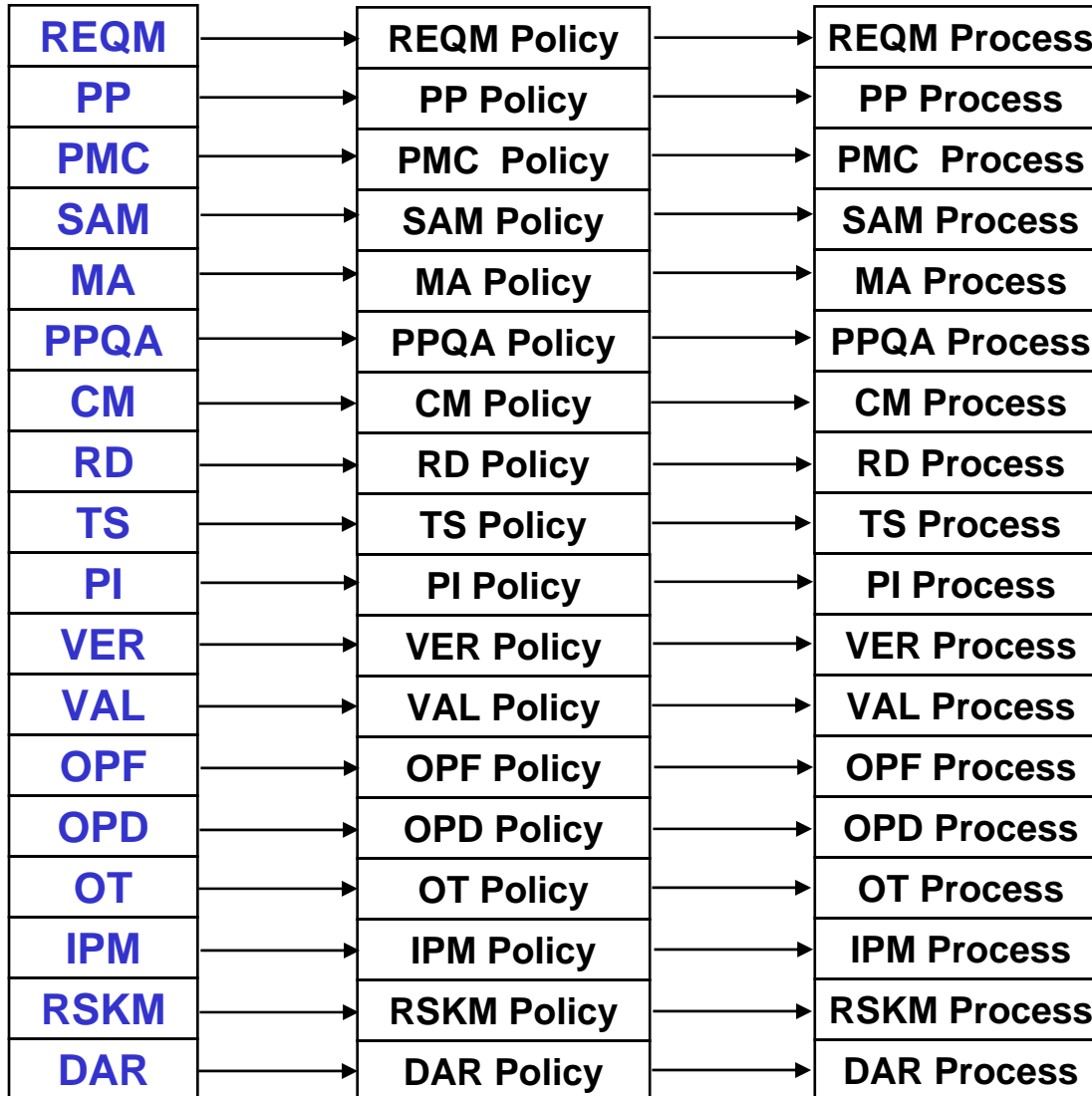
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CMMI Model Structure

Maturity Level

Process Area   Process Area   Process Area

REQUIRED

Generic Goals   Specific Goals

Institutionalization   **Common Features (staged only)**   **Implementation**

| Commitment to Perform | Ability to Perform | Directing Implementation | Verification |

EXPECTED   ~~REQUIRED?~~

Generic Practices   Specific Practices

~~EXPECTED?~~

2.1 Policies

2.2 Plans	2.6 Configuration mgmt	2.9 Objective evaluation
2.3 Resources	2.7 Stakeholders	2.10 Mgmt oversight
2.4 Responsibilities	2.8 Monitoring/control	
2.5 Training		

3.1 Defined Process   3.2 Collect Improvement Information

Informative material:
- Subpractices
- Notes
- References
- Typical work products
- Elaborations
- Amplifications

REQM →	**REQM Policy** →	**REQM Process**
PP →	**PP Policy** →	**PP Process**
PMC →	**PMC Policy** →	**PMC Process**
SAM →	**SAM Policy** →	**SAM Process**
MA →	**MA Policy** →	**MA Process**
PPQA →	**PPQA Policy** →	**PPQA Process**
CM →	**CM Policy** →	**CM Process**
RD →	**RD Policy** →	**RD Process**
TS →	**TS Policy** →	**TS Process**
PI →	**PI Policy** →	**PI Process**
VER →	**VER Policy** →	**VER Process**
VAL →	**VAL Policy** →	**VAL Process**
OPF →	**OPF Policy** →	**OPF Process**
OPD →	**OPD Policy** →	**OPD Process**
OT →	**OT Policy** →	**OT Process**
IPM →	**IPM Policy** →	**IPM Process**
RSKM →	**RSKM Policy** →	**RSKM Process**
DAR →	**DAR Policy** →	**DAR Process**

Option #1: Brute Force

- **Processes directly derived from CMMI model**

Advantages:

- **"Idiot-proof" linkage for CMMI appraisals**
- **Supports explicit implementations of specific/generic practices (PIIs)**

Disadvantages:

- **Unlikely to fit the real business processes**
- **Lost opportunities for process efficiency**

		Estimating Process
REQM	Project Management Policy	Project Management Process
PP		...
PMC		
SAM		Lifecycle Processes
MA	Quality Policy	Engineering Development Process
PPQA	Config Mgmt Policy	
CM		
RD	Engineering Policy	O&M Process
TS		
PI		
VER	...	R&D Process
VAL		
OPF	Process Improvement Policy	...
OPD		
OT		• Processes
IPM	Training Policy	• Procedures
RSKM		• Methods / Guidance
DAR	...	• Checklists
		• Templates
		• etc.
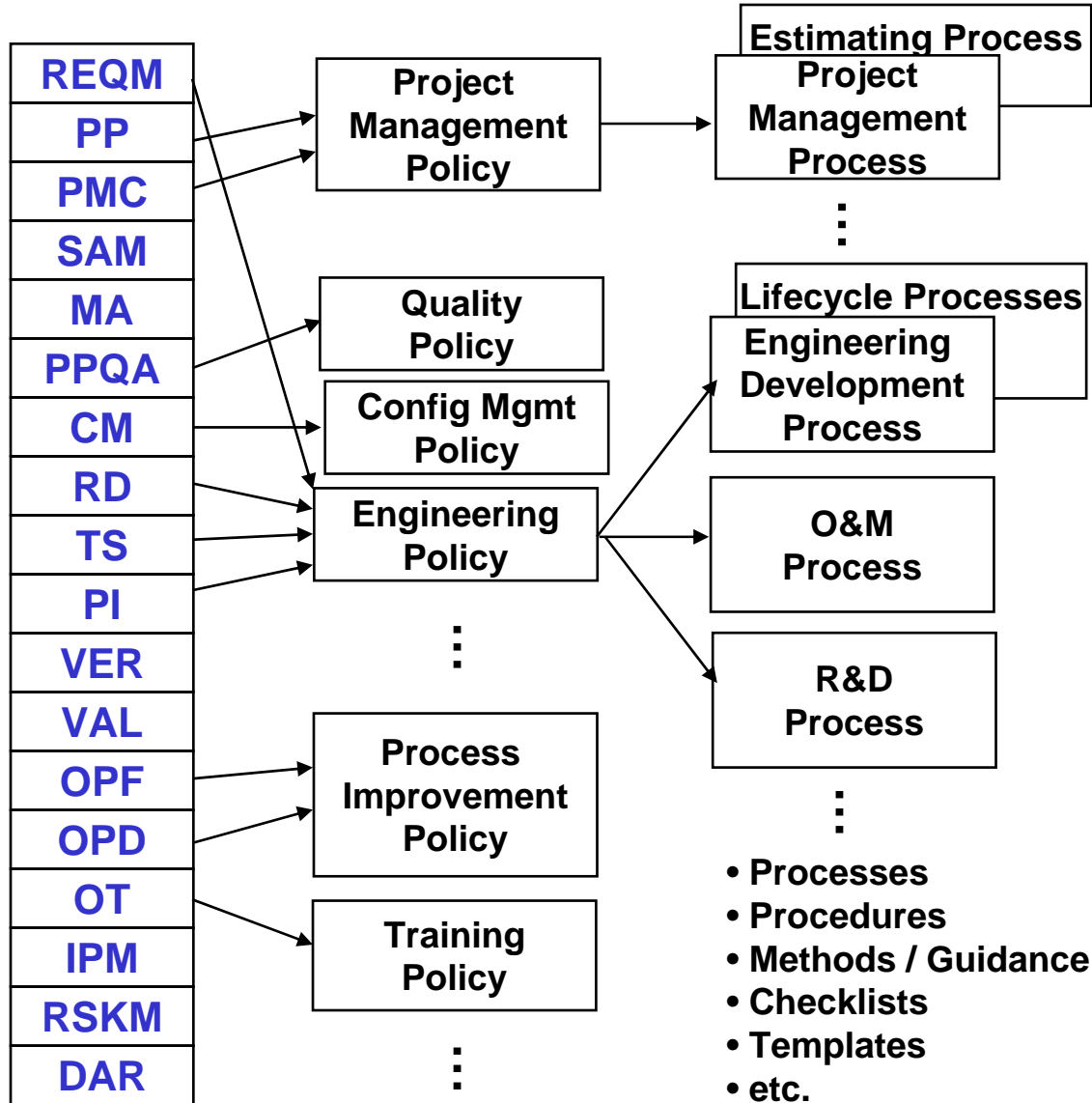
Option #2: Thought and Judgment

- **Processes organized to fit the business and culture**

Advantages:

- **Model tailoring based on business value**
- **Emphasize key subprocesses**
- **Processes more intuitive to implement and institutionalize**

Disadvantages:

- **Indirect mapping and CMMI tailoring could complicate appraisal risk**
- **Reduced visibility of PA-based generic practices for objective evidence**

Implementing the Generic Practices

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For the Project Mgmt, Engineering, and Support process areas, the generic practice may be implemented by:
- Projects
- Organization
- Either
- Both

(details in later charts)

For organizational implementations, how will you count "instantiations" in an appraisal?

Example Implementation

Generic Practice	Project	Organization
GP 2.1 Policy	X ← BOTH →	X
GP 2.2 Plan	X	
GP 2.3 Resources	X	
GP 2.4 Responsibility	X	
GP 2.5 Training	X ← BOTH →	X
GP 2.6 Manage Configurations	X	
GP 2.7 Stakeholders	X	
GP 2.8 Monitor & Control	X	
GP 2.9 Objective Evaluation	X	
GP 2.10 Management Review		X
GP 3.1 Defined Process	X ← BOTH →	X
GP 3.2 Improvement Info		X

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Example scope:
- **CMMI-SE/SW (staged)**
- **ML3 model scope**
- **4 projects**

	Projects (4)	Org Unit (1)	Total
PAs	15	3 **OPF,OPD,OT**	18
SPs	117	19	**136**
GPs	180	36	**216**
PII Direct Artifacts	SP: 468 GP: 720	SP: 19 GP: 36	SP: 487 GP: 756
PII Indirect /Affirmation	SP: 468 GP: 720	SP: 19 GP: 36	SP: 487 GP: 756
Total PIIs (min.)	SP: 936 GP: 1,440 = 2,376	SP: 38 GP: 72 = 110	**SP: 974 GP: 1,512 = 2,486**

*SCAMPI requirements for Practice Implementation Indicators (PIIs):
-direct artifact for each specific and generic practice, for each instance (project or OU level)
-corroborated by an indirect artifact or affirmation

Generic Practice Appraisal Approaches

Staged	REQM	PP	PMC	SAM	MA	PPQA	CM	RD	TS	PI	VER	VAL	OPF	OPD	OT	IPM	RSKM	DAR
GG2																		
GP2.1																		
GP2.2																		
GP2.3																		
GP2.4																		
GP2.5																		
GP2.6																		
GP2.7																		
GP2.8																		
GP2.9																		
GP2.10																		
GG3																		
GP3.1																		
GP3.2																		

Vertical
- **PA-centric**
- **Mini-team**
- **Institutionalization within a process**

Horizontal
- **GP-centric**
- **Across PAs/ mini-teams**
- **Institutionalization across processes**

Hybrid
- **Approach varies by GP**
- **Vertical (mini-team): GPs that tend to be uniquely implemented by PA**
- **Horizontal (across mini-teams): GPs more effectively considered together across multiple PAs**

Generic Practice	Vertical	Horizontal
GP 2.1 Policy		X
GP 2.2 Plan	X	
GP 2.3 Resources	X	
GP 2.4 Responsibility	X	
GP 2.5 Training		X
GP 2.6 Manage Configurations	X	
GP 2.7 Stakeholders	X	
GP 2.8 Monitor & Control	X	
GP 2.9 Objective Evaluation	X	
GP 2.10 Management Review		X
GP 3.1 Defined Process	X	
GP 3.2 Improvement Info	X	

Understanding PA / GP Relationships

- **Linkages among PAs and GPs must be well understood for effective model implementation and appraisal**
  - **PAs that enable GPs**
    - E.g., CM capability $\Rightarrow$ GP2.6
  - **"Pitch/catch" relationships**
    - E.g., IPM assets $\Rightarrow$ GP3.2
  - **"Recursive" relationships**
    - E.g., PP GP 2.2: "plan for the plan"
    - Do project plans discuss how and when planning (and re-planning) is done?

Example PA/GP Relationship Issues

Generic Practice	Process Area
GP 2.1 Policy	Org. Process Definition
GP 2.2 Plan	Project Planning
GP 2.3 Resources	Project Planning
GP 2.4 Responsibility	Project Planning
GP 2.5 Training	Organizational Training
GP 2.6 Manage Configurations	Configuration Mgmt.
GP 2.7 Stakeholders	Integrated Project Mgmt.
GP 2.8 Monitor & Control	Project Monitoring & Control
GP 2.9 Objective Evaluation	Product & Process Quality Assurance
GP 2.10 Management Review	
GP 3.1 Defined Process	Integrated Project Mgmt.; Org, Process Definition
GP 3.2 Improvement Info	Integrated Project Mgmt.; Org, Process Definition

Reaching Appraiser Consensus

- **Many parts of the CMMI can be interpreted in multiple ways**
  - **Generic practices are especially difficult**

- **Must reach consensus on how the organization and projects will implement the generic practices**
  - **E.g., split of responsibilities between organization and projects**

- **Must reach consensus with the appraisers on how the generic practices are satisfied**
  - **Must be done long in advance of the actual appraisal**
  - **Following charts suggest a starting point for the discussion**

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Capability Level

0. Incomplete

1. Performed GP 1.1 Perform Base Practices

2. Managed
	GP 2.1	Establish an Organizational Policy
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- GP 3.1 Establish a Defined Process
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4. Quantitatively Managed
- GP 4.1 Establish Quantitative Objectives for the Process
- GP 4.2 Stabilize Subprocess Performance

5. Optimizing
- GP 5.1 Ensure Continuous Process Improvement
- GP 5.2 Correct Root Causes of Problems

Continuous representation only

Perform the base practices of the process area to develop work products and provide services to achieve the specific goals of the process area.

Elaborations	• **None**
Implementation Guidance	• **Achieved by implementing the specific practices** • **GP 1.1 does not make sense as an intermediate goal; need to institutionalize as you go**
Appraisal Guidance	• **None**

GP 2.1 – Establish an Organizational Policy

Establish and maintain an organizational policy for planning and performing the process.

Elaborations	• **Typical contents of policy for each PA**
Implementation Guidance	• **Policies provide clear senior management direction** • **Must be implemented by the organization, but at any level or multiple levels of the organization** 　– **E.g., policies at both the Corporate and Division level**
Appraisal Guidance	• **"Establish and maintain" implies creation, maintenance, and usage (see CMMI Chapter 3)** • **Appraisers must see evidence of the policy being used** 　–**E.g., audits, mapping policies to processes used**

Establish and maintain the plan for performing the process.

Elaborations

- **May be included in, or referenced by, the project plan**
  - **Elaborations for 13 of 15 project-focused PAs through ML3 (except PP, PI)**

Implementation Guidance

- **Plan = description of activities + budget + schedule**
  - **Includes other generic practices (e.g., process descriptions, resources, responsibilities, CM)**
- **Must distinguish between plans (GP 2.2) and process descriptions (GP 3.1)**
  - **Much of the plan is replaced by the process description**

Appraisal Guidance

- **Schedules may be tied to program events as opposed to shown on a Gantt chart**
  - **E.g., DAR events**
  - **Plans should make clear the conditions under which a DAR is to be conducted**

What's In a Plan (GP2.2)?

- **A plan for each process typically includes:**
  - **Process description**
  - **Standards and requirements for the work products and services**
  - **Objectives for the performance of the process (e.g., quality, time scale, cycle time, and resource usage)**
  - **Resources (including funding, people, and tools)** *[GP2.3]*
  - **Assignment of responsibility and authority** *[GP2.4]*
  - **Training needed** *[GP2.5]*
  - **Work products to be placed under configuration management** *[GP2.6]*
  - **Involvement of identified stakeholders** *[GP2.7]*
  - **Measurement requirements** *[GP2.8]*
  - **Activities for monitoring and controlling the process** *[GP2.8]*
  - **Objective evaluation for the process and work products** *[GP2.9]*
  - **Management review activities** *[GP2.10]*

- **For many process areas, GP 2.2 is part of the overall project plan**

- **For Project Planning, GP 2.2 applies to the planning process (not the project plan itself)**
  - **"Plan for the Plan"**

Formality of Plans may Vary

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- **Plans need not necessarily be bound documents**
  - **Worksheets**
  - **Templates**
  - **Etc.**

- **Look for essential content required for a reasonable, executable plan**
  - **Activities**
  - **Schedule**
  - **Resources**

- **Can be supplemented with other materials, e.g.,**
  - **Process / procedure descriptions**
  - **Training**

PAGE 1

PROGRAM PLANNING WORKSHEET

Program Name: _____ **Job #:** _____
Activity: _____ **Plan Date:** _____
Objectives: _____ **Plan Version:** _____
Constraints: _____

Participants / Stakeholders:
Facilitator: _____
Functional Leads: _____
Support Staff: _____
Other: _____

Planning Inputs: *(item and location)*	Planning Outputs: *(item and location)*

Planning Task Schedule	Start Date	End Date	Comments
	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	
	_____	_____	

Planning Resources:	Plan	Actual	Comments
Staffing *(hours)*	_____	_____	
Cost *($)*	_____	_____	
Other			

Evaluation Criteria	Y	N	Comments
	☐	☐	
	☐	☐	
	☐	☐	

Signatures:

_____ _____
Program Manager   Quality Assurance

_____ _____
Project Engineer   Systems Engineering

_____ _____
Software Engineering *(Other)*

Provide adequate resources for performing the process, developing the work products, and providing the services of the processes.

Elaborations

- Often emphasize tools applicable to the process area
- Some PAs cite specialized groups or skills

Implementation Guidance

- Resources = budget + facilities + tools + skilled people
- All activities should be budgeted, but budget categories may be organized around the organization's process architecture, not CMMI process areas

Appraisal Guidance

- "Adequate" must be interpreted as sufficient to execute the plan and schedule
  - Not based on asking performers whether they have adequate resources (everybody wants more time to do their work)

GP 2.4 – Assign Responsibility

Assign responsibility and authority for performing the process, developing the work products, and providing the services of the process.

Elaborations

- **Typically none; some groups identified**

Implementation Guidance

- **Responsibility assigned in various ways**
  - **E.g., project plans, process descriptions, job descriptions, work authorizations, stakeholder matrix, team charter**
- **May have multiple roles assigned for portions of a PA**
- **Must have authority to take appropriate action**

Appraisal Guidance

- **Job assignments may be to functions (e.g., systems engineering)**
  - **Can judge "reasonableness" of the approach by whether performers must understand who is responsible to perform each task**

Train the people performing or supporting the process as needed.

Elaborations	• **Examples of training topics applicable to PA practices**

Implementation Guidance	• **Training <u>proactively</u> ensures individuals possess the minimum skills and knowledge to perform their job competently**
	   – **The organization should address training for all process areas and job functions**
	   – **Project responsibility for project-specific training, if needed**

Appraisal Guidance	• **Must establish appraiser consensus on how this practice is interpreted**
	   – **Also on how to judge partial satisfaction, e.g., if XX% of the people are trained**
	 • **Need to determine how "instantiations" are counted**
	   – **E.g., in a particular process area, there may be organizational and some project-specific training**

Example Training Mechanisms

- **Formal classroom training**
- **Industry/vendor certifications**
- **Video**
- **Computer Based Training (CBT)**
- **Structured mentoring**
- **Self-study**
- **"Train the trainer"**

Various forms of training may be suitable, but must be planned for each process.

Place designated work products of the process under appropriate levels of configuration management.

Elaborations

- **Examples of work products applicable to the process area (often a subset of key Typical Work Products)**

Implementation Guidance

- **Must identify which work products are to be controlled and how they will be controlled (level of formality)**
  - **It is NOT necessary to designate and control every work product; omission implies "not controlled"**
- **Responsibility and level of control may vary across the product life cycle**

Appraisal Guidance

- **A list of what is being controlled (e.g., a DM master document list) is not sufficient**
  - **Must understand what is <u>planned</u> to be controlled**

GP 2.7 – Identify and Involve Relevant Stakeholders

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Identify and involve relevant stakeholders of the process as planned.

Elaborations

- **Examples of activities for stakeholder involvement**
  - **Often a subset of specific practices or reviews of associated work products**

Implementation Guidance

- **Relevant stakeholders must be <u>identified</u>, along with their planned <u>involvement</u>**
  - **Typically done as a stakeholder plan or matrix**
  - **Might also be used to document responsibilities (GP 2.4)**

Appraisal Guidance

- **Evidence of "involvement" could easily get overwhelming (e.g., attendance at meetings, review signoffs)**
  - **Must establish appraiser consensus on what constitutes a reasonable sampling**

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Project Processes	Customer	Operations	Field Support	Program Management	System Engineering	Software Engineering	System Test	Integration & Test	Integrated Logistics Support	Quality Assurance	Configuration Management	Subcontracts	Helpdesk	Suppliers
Proposal Generation	R			L	R	R	R	A	R			R		A
Project Planning	R		R	L	R	R	R	R	R			R		R
Project Monitoring and Control				L	R	R	A	R	R			R		A
Metrics				R	L	R				O				
Risk Management	R			L	R	R	A	A	A					
Requirements Development	R	R	O		L	R	R		A	R				
Operations Telecons	R	R	O	O	L	R	O			O				A
System Engineering Review	R	R	R	R	L	R	R	R	R	R	R	R		R
Technical Exchange Meeting	R	A	R	R	L	R	R	A	A	O				A
Interface Control Working Group	R		R	R	L	R	R							A
Software Reviews					O	L	O		O	R				A
SW CCB				O	R	R	R	O	O	R	L			A
HW CCB				O	R		R	R		R	L			
Integration Testing					A	A	L			A				
Validation Testing		L	R		A	A	R			O				
Verification Testing			R				L			O				
Regression Testing			R				L			O				
Site Installation	R		R		A	A	A	L		R	A		A	
Leased Service Support				A	A	A	A	A	A		A	A	L	A
2nd Level Engineering Support					L	R	R		A		A		A	A
Subcontract Mgmt				A	A	A				A		L		A

Legend R = Required O = Optional A = As Needed L = Leader

GP 2.8 – Monitor and Control the Process

Monitor and control the process against the plan for performing the process and take appropriate corrective action.

Elaborations

- **Limited to examples of process measures for each PA**

Implementation Guidance

- **Activities must be reviewed against plan, budget, and schedule**
  - **Typically performed in staff meetings, cost/schedule reviews, variance reports**
  - **Detailed review of the process performed against the process description is performed in the QA audits**

Appraisal Guidance

- **Must establish appraiser consensus**
  - **Frequency, formality of review**
  - **Budgets need not be tracked to individual process areas, but each process area must be covered in some budget**
- **Often difficult to find direct evidence that something is tracked**
  - **E.g., tracking of Project Management PAs**

Measurement in CMMI

- **Does the CMMI model expect that measures are collected for each process area?**

  – **Not necessarily.**

    GP2.8 expects that appropriate visibility is provided into performance of the process against the plan so that corrective action can be taken when necessary.

    Visibility can be obtained using approaches beyond just measurement, such as reviews of activities, status, and results.

    GP3.2 expects that information is collected to improve the future performance of the process – this may include measures, work products, artifacts, lessons learned, or other improvement information.

GP 2.9 – Objectively Evaluate Adherence

Objectively evaluate adherence of the process and the work products and services of the process to the applicable requirements, objectives, and standards, and address noncompliance

Elaborations

- Example activities and work products for objective review; typically derived from specific practices or Typical Work Products

Implementation Guidance

- Process audits determine whether the project performs each process, as documented in the plans or tailoring report
  - Not just audits against policy
  - Also against the appropriate procedure and work product standards, if they exists
- Must be objective, but not necessarily QA

Appraisal Guidance

- Must establish appraiser consensus on how to handle work products for which no standard exists, procedures used as "guidance"

GP 2.10 – Review Status with Higher Level Management

Review the activities, status, and results of the process with higher level management and resolve issues.

Elaborations	• **Typically none, except REQM (commitments), OPF (improvement status), RSKM (risk status)**

Implementation Guidance	• **Must decide who is designated as the "senior management" reviewer**
	  – **Must be above the project level**
	  – **Concern should be long term heath of the organization; sometimes in conflict with short-term project goals**
	• **Reviews are not necessarily face-to-face (e.g., status reports)**

Appraisal Guidance	• **Must establish appraiser consensus on:**
	  – **Who acts as "senior management"**
	  – **Depth of review**
	• **Evidence must show review of each process area**
	  – **Not every PA will be covered at every review**
	  – **May review by business process, not by PA**

Examples - Reviewing Status with Higher Level Management

- **Regular (e.g., monthly) project reviews and/or status reports**
  - **Cost, schedule, progress, risks, key issues, metrics, etc.**
- **Periodic (e.g., quarterly) steering / oversight reviews**
  - **Quality System Management Review**
  - **Process improvement council**
  - **Organizational training committee**
  - **Organizational metrics analysis**
- **Event-driven status, meetings, or reviews**
  - **Proposal estimates**
  - **Project milestone reviews**
  - **Assessment results (e.g., process, technical, risk)**
  - **Strategic or tactical planning**
  - **Corrective action or causal analysis meetings**

GP 3.1 – Establish a Defined Process

Establish and maintain the description of a defined process.

Elaborations

- **None (except IPM, distinguishing from the project's defined process)**

Implementation Guidance

- **Includes organizational standard process + tailoring by project or organization (tailoring report)**
- **May establish a family of process descriptions**
- **The enterprise should also consider tailoring for their organizational processes (OPF, OPD, OT, OPP, OID)**
  - **Organizational processes may be implemented differently at multiple levels of the enterprise**

Appraisal Guidance

- **Standard process may be organized by business process, not by PA**
- **Must establish appraiser consensus on what constitutes tailoring**

What is a Defined Process? (GP3.1)

- **A defined process clearly states:**
    - **Purpose**
    - **Inputs**
    - **Entry Criteria**
    - **Activities**
    - **Roles**
    - **Measures**
    - **Verification Steps**
    - **Outputs**
    - **Exit Criteria**
- **A defined process is institutionalized by:**
    - **Following a plan (GP 2.2) that incorporates a defined process**
    - **Collecting work products, measures, and improvement information for supporting the use and improvement of the organizational process assets (GP 3.2)**

[CMMI model]

OVERVIEW

Entry Criteria | **Exit Criteria**

Inputs | **Outputs**

Required Activities

Stakeholders   L=lead; S=support; R=review; O=optional (as necessary)

Measures

Organizational Process Improvement Information

Verification

Tailoring

Implementation Guidance

Supporting Documentation and Assets

Collect work products, measures, measurement results, and improvement information derived from planning and performing the process to support the future use and improvement of the organization's processes and process assets.

Elaborations

- None (except for IPM, distinguishing from SP1.5; see below)

Implementation Guidance

- Includes
  - Process Asset Library (work products)
  - Measurement repository (measures, results)
  - Improvement information database or feedback
- Connected to
  - IPM SP 1.5 Contribute to the Organizational Process Assets
  - OPD SP 1.4 (Measurement repository) and SP 1.5 (PAL)

Appraisal Guidance

- "Collect" implies an organizational responsibility (not "submit", which is a project responsibility)
  - Organization must collect in all PAs, but projects are not expected to submit in all PAs
  - Not all items submitted must be made available to all projects

CMMI Generic Practices

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Capability Level

0. Incomplete

1. Performed   **GP 1.1**   **Perform Base Practices**

2. Managed   **GP 2.1**   **Establish an Organizational Policy**
                                 GP 2.2   **Plan the Process**
                                   GP 2.3   **Provide Resources**
                                   GP 2.4   **Assign Responsibility**
                                   GP 2.5   **Train People**
                                   GP 2.6   **Manage Configurations**
                                   GP 2.7   **Identify and Involve Relevant Stakeholders**
                                   GP 2.8   **Monitor and Control the Process**
                                   GP 2.9   **Objectively Evaluate Adherence**
                                   GP 2.10 **Review Status with Higher Level Management**

3. Defined   **GP 3.1**   **Establish a Defined Process**
                                   GP 3.2   **Collect Improvement Information**

4. Quantitatively   **GP 4.1**   **Establish Quantitative Objectives for the Process**
    Managed   **GP 4.2**   **Stabilize Subprocess Performance**

5. Optimizing   **GP 5.1**   **Ensure Continuous Process Improvement**
                                   GP 5.2   **Correct Root Causes of Problems**

Continuous representation only

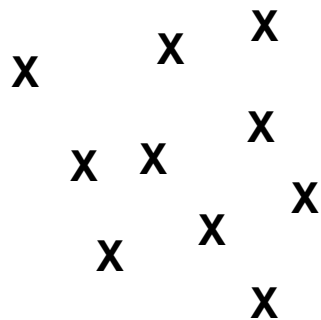# *In Which Process Areas Should High Capability Be Sought?*

- **Capability Level 4 requires control of subprocesses using statistical and quantitative techniques**
  - Addresses special causes of variation, to improve process stability/ predictability
  - Apply where performance needs to be highly predictable, or where quality or process performance must be high
    - Project Planning (especially estimation)
    - Verification (especially peer reviews)

- **Capability Level 5 requires continuous, measurable improvement in process performance**
  - Addresses common causes of process variation, to reduce overall variation or improve average performance
  - Apply where quantifiable improvement is needed

Control chart with Individual Value (y-axis, 0 to 15) vs Observation Number (x-axis, 0 to 15). UCL=11.17, Mean=7.268, LCL=3.363
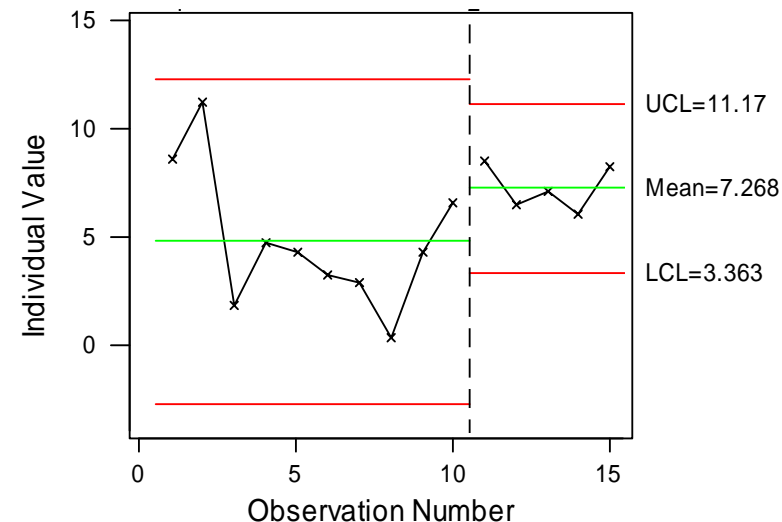
Some process areas are nearly impossible or useless to take to CL4/5
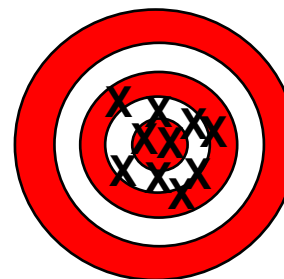
**Capability Level 1
- Initial**
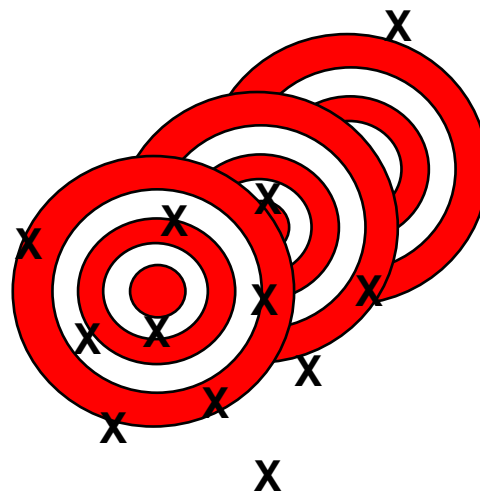
**Capability Level 2
- Managed**
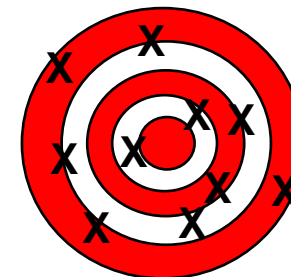
**Capability Level 3
- Defined**

**Capability Level 4
- Quantitatively Managed**

**Capability Level 5
- Optimizing**

Establish and maintain quantitative objectives for the process that address quality and process performance based on customer needs and business objectives.

Elaborations	• **None (except subpractices in Chapter 4)**
Implementation Guidance	• **Objectives apply either to a specific subprocess (e.g., peer review) or a set of processes (e.g., the entire development process)** • **Should relate to the customer's and users' perception of "quality" and "performance"**
Appraisal Guidance	• **Should agree whether both quality (e.g., defects) and process performance (e.g., productivity, effectiveness) are needed to meet the intent of the practice**

Stabilize the performance of one or more subprocesses to determine the ability of the process to achieve the established quantitative quality and process-performance objectives.

| **Elaborations** | • **None (except subpractices in Chapter 4)** |

| **Implementation Guidance** | • **"Stabilize" refers to removing special causes of variation until the resulting subprocess is predicable (within a computable variation)** |

- **Either a specific subprocess or a set of processes**
- **Some subprocesses are inherently not stabilizable**

• **Can stabilize by:**
- **Modifying the subprocess to eliminate special causes**
- **Stratifying data to separate special causes**
- **Eliminating explainable data points**

| **Appraisal Guidance** | • **Must agree on:** |

- **How much variation is acceptable in a "stable" process**
- **How much data is required for a meaningful calculation of variation**

Ensure continuous improvement of the process in fulfilling the relevant business objectives of the organization.

| **Elaborations** | • None (except subpractices in Chapter 4) |

| **Implementation Guidance** | • Organization must define quantitative process improvement objectives, identify improvements, define strategies, and manage improvements
• Improvement should be measurable quantitatively (note change in mean and variation), not just qualitatively |

| **Appraisal Guidance** | • An organizational responsibility; must agree on how project PAs (e.g., Project Planning) are to be interpreted and instantiated |

Identify and correct the root causes of defects and other problems in the process.

Elaborations
- **None**

Implementation Guidance
- **Analyze defects and other problems (characteristics) that were encountered**
  - **Identify/correct the root causes**
  - **Prevent them from occurring in the future**

Appraisal Guidance
- **Must agree on how sophisticated the analysis must be (e.g., Pareto chart, fishbone diagram)**
- **Must agree on the extent of defect prevention required**

Summary

- **Use reasonable judgment for interpreting model GPs**
  - **Both for implementation and appraisal**
  - **Trade off business value against "following the book" literally**

- **Document implementation / tailoring choices and rationale**
  - **Ratings may depend on your ability to communicate effectively to external appraisal teams**

- **SCAMPI method requires implementation evidence for each GP, for each project**
  - **Can be complicated when process architectures are not directly aligned with the model**

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