



Understanding the CMMISM

**A presentation for the Delaware Valley Chapter of
INCOSE adapted from a tutorial from the Software
Productivity Consortium (SPC) with permission from
Jim Armstrong, Manager, Systems Engineering**

8 May 2001

1. Introduction

2. CMMI Model

3. CMMI Organizational Process Assets

4. INCOSE Position

Topic 1

Introduction

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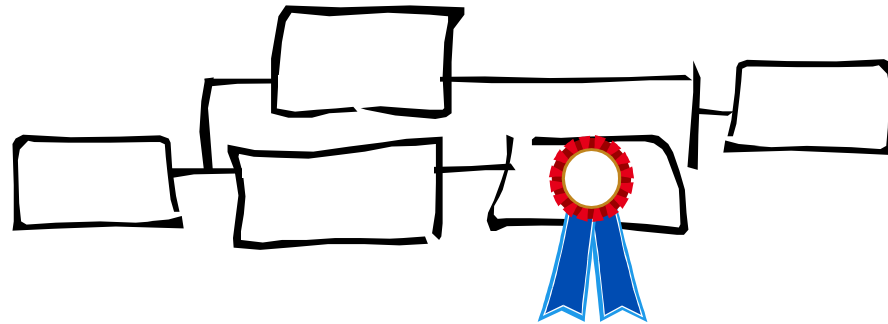
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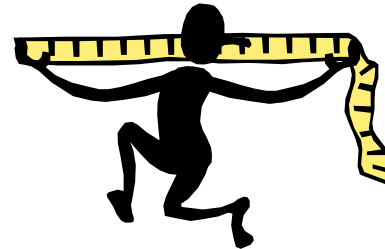
Why Maturity Models?

To support process improvement, maturity models provide

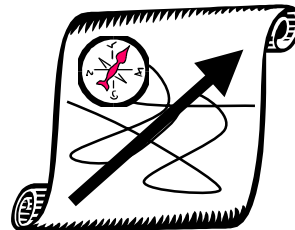
- **Best practices**



- **Measurement standards**

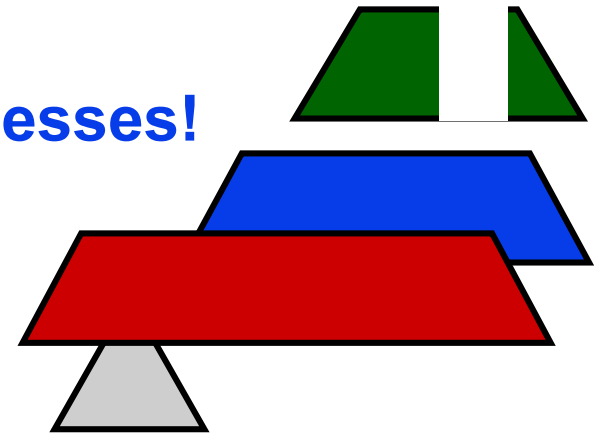


- **Improvement paths**

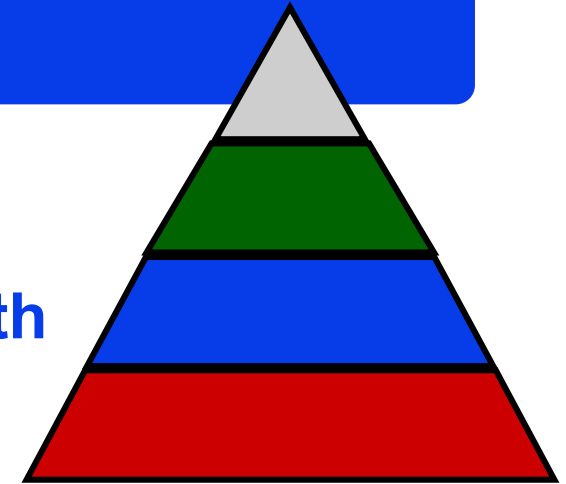


Current Situation: Implications

- **Organizational processes not aligned**
 - **Business**
 - **Acquisition**
 - **Systems engineering**
 - **Software engineering**
 - **Hardware engineering**
 - **Security engineering**
- **Separate process improvement efforts**
 - **Compete for resources**
 - **Create stovepiped processes**
- **Resulting in suboptimal enterprise processes!**



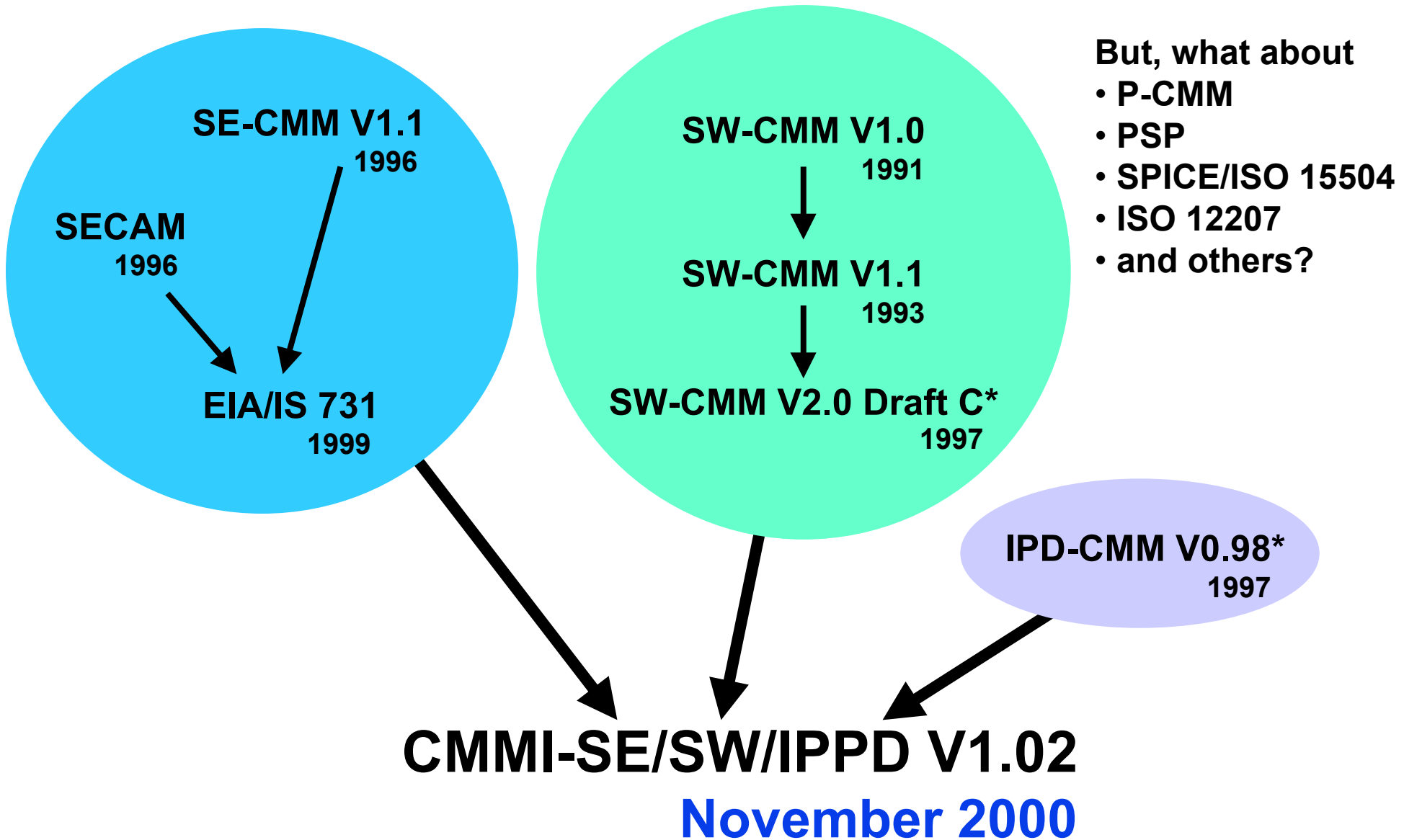
Solution Areas



- **Integrate processes**
 - Create organizational processes with
 - Well-coordinated interfaces
 - Common processes, wherever possible
 - Careful consideration of negotiation and commitment process
 - Emphasis on critical information flows
 - Industry example responses
 - University of Southern California's MBASE
 - Consortium's Integrated Systems and Software Engineering Process (ISSEP)

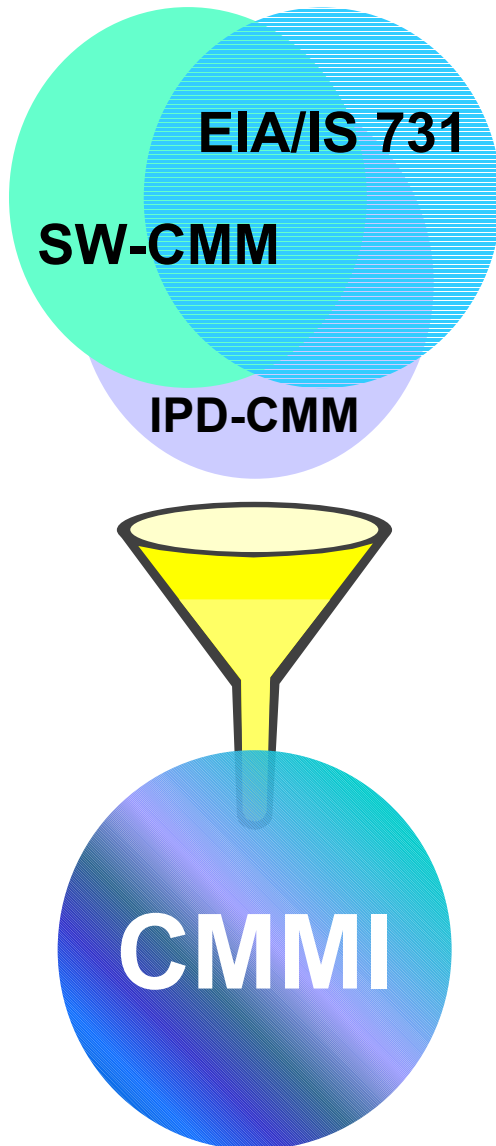
- **Integrate process improvement initiatives**
 - Industry response: CMMI

How Did We Get Here?



* Not released

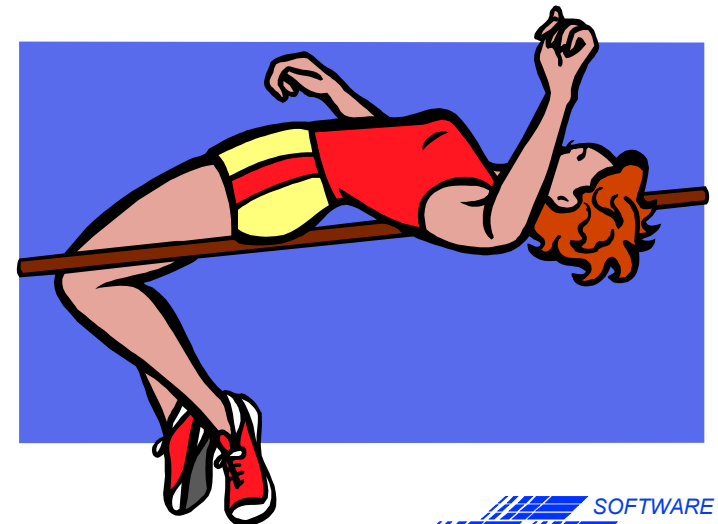
Objectives of CMMI



- Encourage integration of disciplines
- Integrate models
 - Eliminate duplication of material
 - Remove conflicts between models
- Provide an efficient integrated model for
 - Process improvement
 - Process assessment
- Improve the models
- Apply equally to defense and civil agencies of government; aerospace, defense, and systems integration companies; and commercial organizations

Major Sources of Changes

- Generalized wording applied to both systems and software engineering
- Took “union” of source models
- “Raised the bar” on some legacy elements
- Expanded Software Product Engineering (SPE) key process area (KPA)
 - Requirements Development
 - Technical Solution
 - Product Integration
 - Verification
 - Validation



CMMI Product Suite

A complete set of products developed around the CMMI concept, including

- The CMMI framework database**
- Multiple models**
- The SCAMPI assessment method**
- Training materials**

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Process Assets**

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Topic 2

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CMMI Model

Basic Concepts and Components

Levels, Generic Goals, Generic Practices

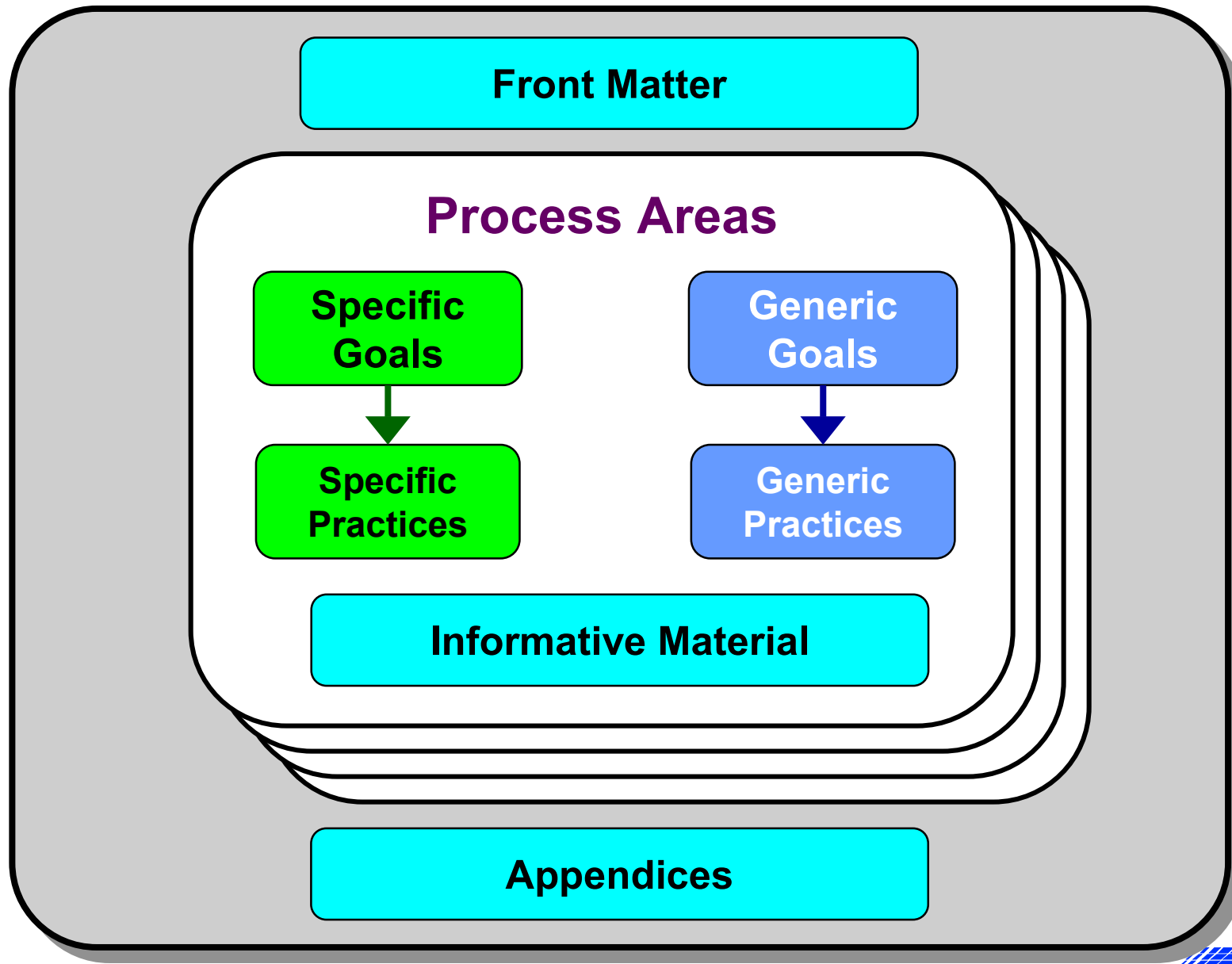
How well things are done



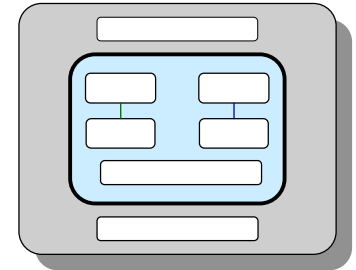
Things to do

Process Areas, Specific Goals, Specific Practices

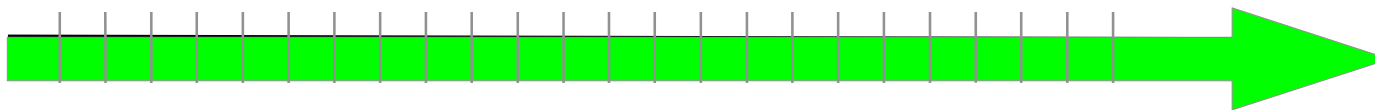
Model Components



Process Areas

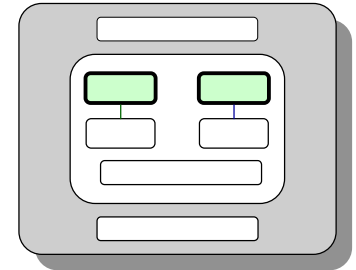


- **Basic organization of the CMMI model's technical content**
- **Each process area contains**
 - **Goals** ∴ **Required**
 - **Practices** ∴ **Expected**
 - **Additional informative material**
- **Nominal process areas are arrayed on the horizontal axis of model representations in this course**



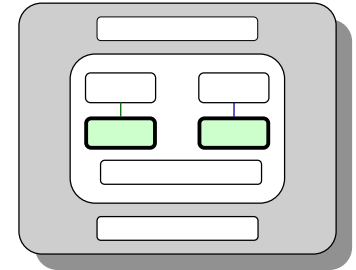
Things to do

Goals



- **Required element of the model**
 - **Goals must be satisfied**
- **Concepts essential to achieving process improvement in a given process area**
- **Used to determine process performance**
- **Specific and generic axes**
- **Goals call for practices to support them**

Practices



- **Expected to support satisfaction of a goal**
 - **Expected means either these practices or appropriate alternative practices are used**
- **Explain what must be done to cover the scope of a process area or level and its goals**
- **Are meant to guide model users and help assessors**
- **Specific and generic axes**

Maturity Levels

How well things are done



- A maturity level is a well-defined evolutionary plateau describing the manner in which a specified set of processes is performed
- Maturity levels apply to organizations
- There are five maturity levels
 - Level 0 is not used as a maturity level
- Units of the vertical axis in figures of staged representations that follow

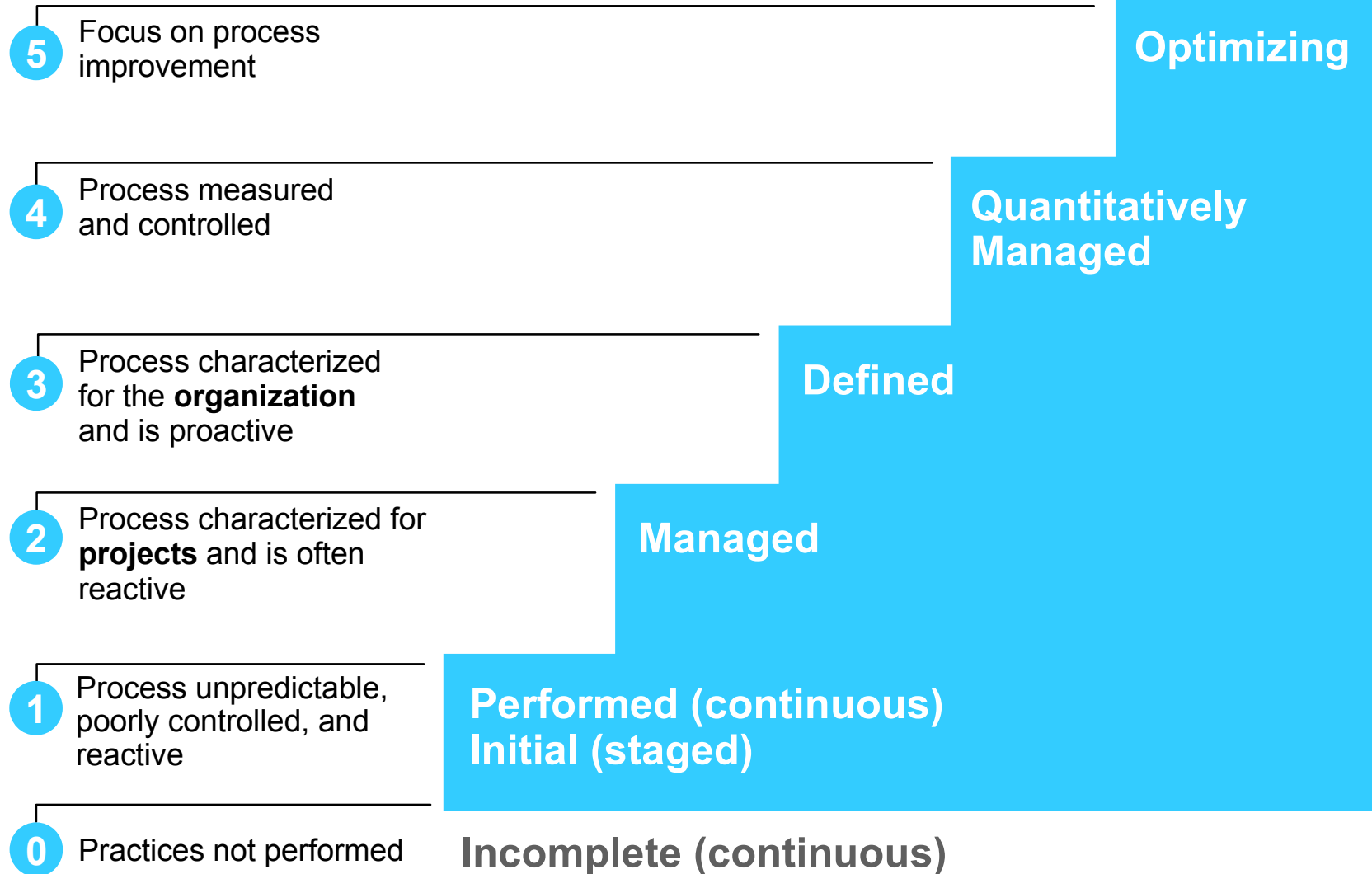
Capability Levels

How well things are done



- A capability level is a well-defined evolutionary plateau describing the manner in which a process is performed
- Capability levels apply to individual process areas
- There are six capability levels
- Units of the vertical axis in figures of continuous representations that follow

The Levels



Level Requirements

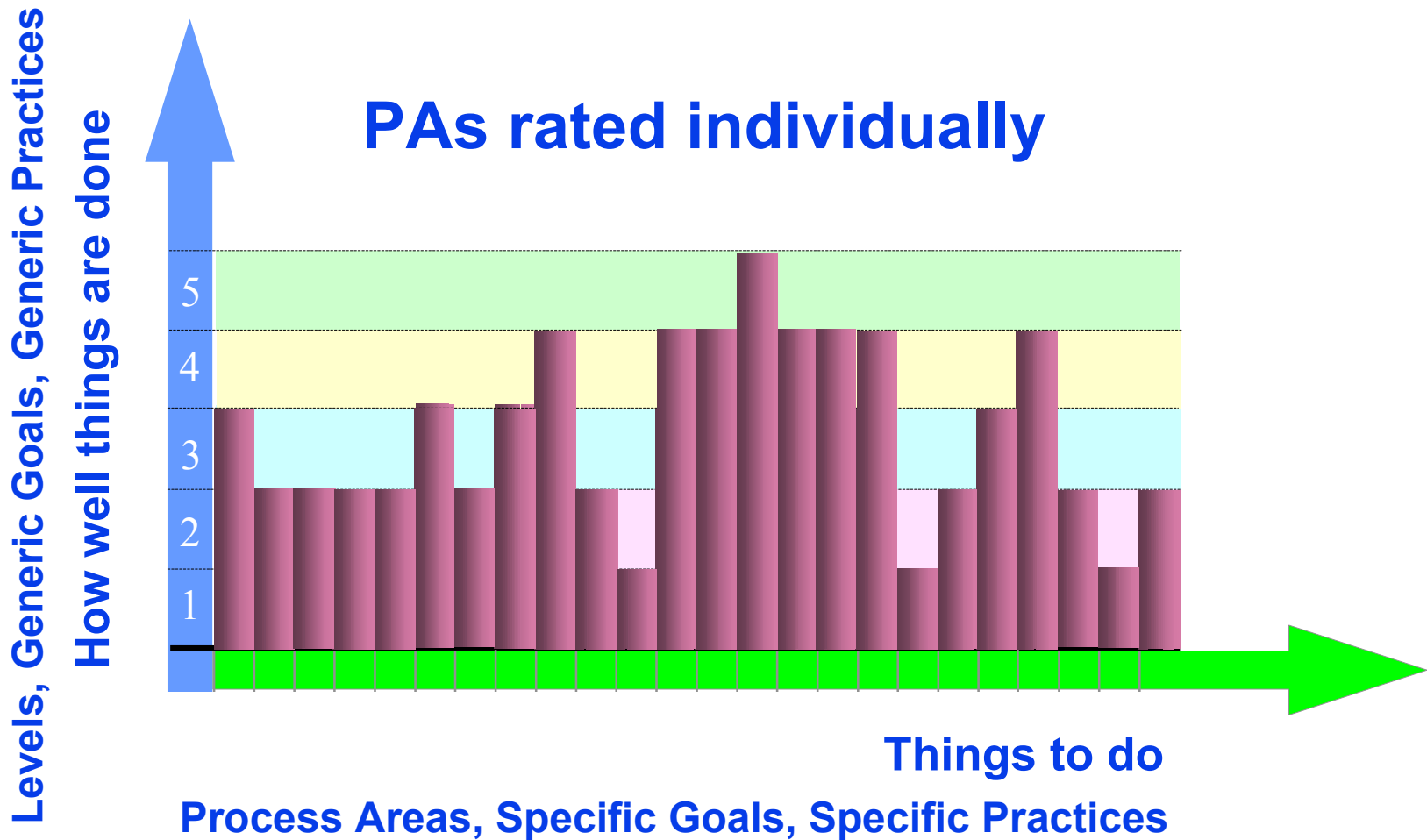
Lev	Generic Goals	Generic Practices	Characteristics
1	Generic Goals of the process area (Continuous)	<ul style="list-style-type: none"> • Identify Work Scope • Perform Base Practices 	Essential activities performed; Process unstable and inconsistently performed; Cost, schedule, quality objectives may not be met
2	Institutionalize a managed process	<ul style="list-style-type: none"> • Establish and Maintain Organizational Policy • Plan the Process • Provide Resources • Assign Responsibility • Train People • Manage Configurations • Identify and Involve Relevant Stakeholders • Monitor and Control the Process • Objectively Evaluate Adherence • Review Status with Higher Level Management 	<ul style="list-style-type: none"> • Process is planned, documented, performed, monitored, and controlled at the local (project/group) level • Process is institutionalized and has become an ingrained part of the way work is performed • Process achieves other objectives that are established, such as cost, schedule, and quality objectives

Level Requirements

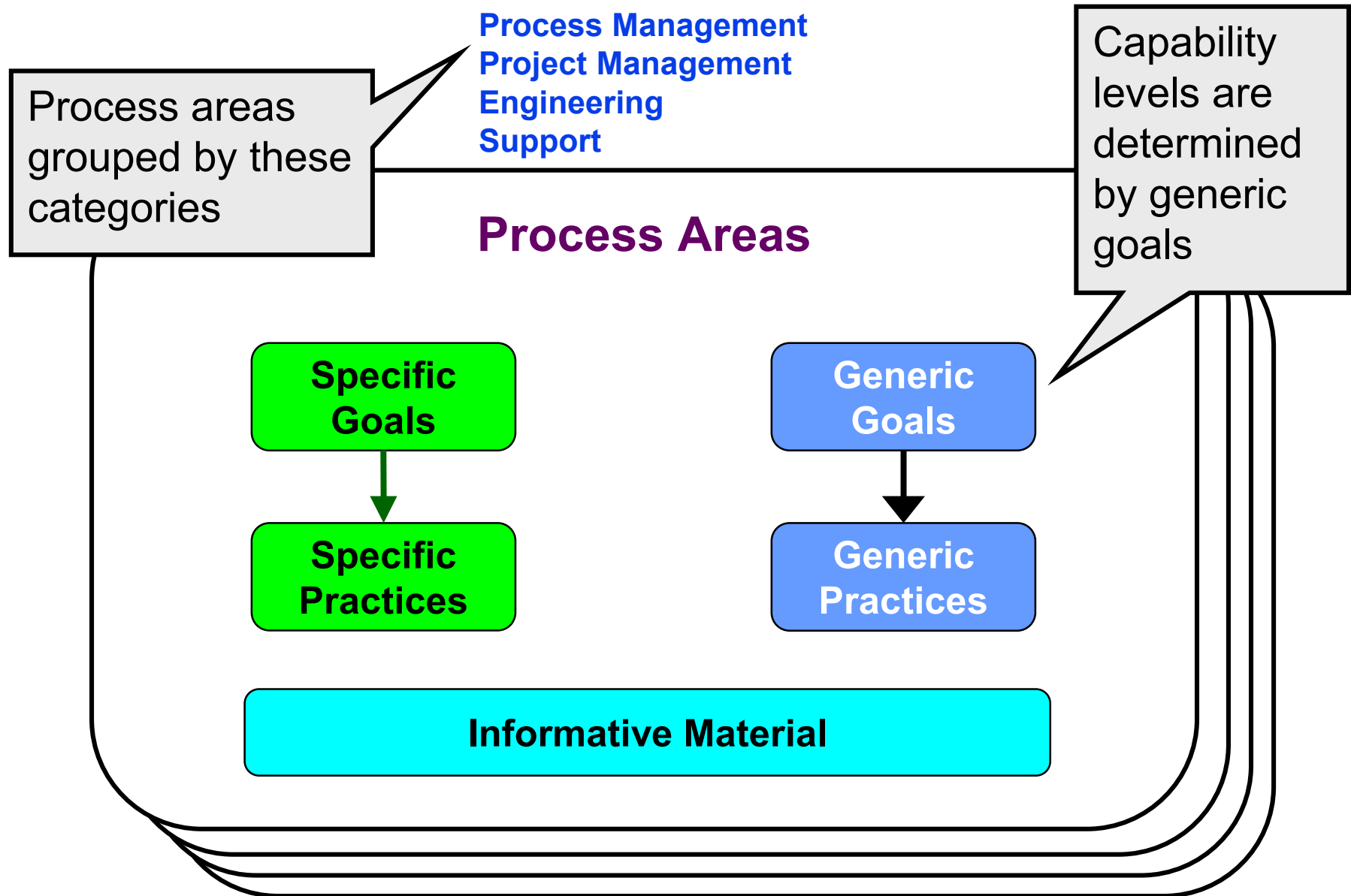
Lev	Generic Goals	Generic Practices	Characteristics
3	Institutionalize a Defined Process	<ul style="list-style-type: none"> • Establish a Defined Process • Collect Improvement Information 	<ul style="list-style-type: none"> • Management establishes process objectives • Organization's set of standard processes is established and improved • Standard process and process assets tailored for projects
4	Institutionalize a Quantitatively Managed Process	<ul style="list-style-type: none"> • Establish Quality Objectives • Stabilize Subprocess Performance 	<ul style="list-style-type: none"> • Process is controlled using statistical and other quantitative techniques • Quantitative objectives for product quality, service quality, and process performance are established and used as criteria in managing the process • People performing the process are directly involved in quantitatively managing the process • Statistical predictability is achieved
5	Institutionalize an Optimizing Process	<ul style="list-style-type: none"> • Ensure Continuous Process Improvement • Correct Common Causes of Problems 	<ul style="list-style-type: none"> • Process is improved, changed, and adapted to meet business objectives • Improve performance through technological improvements • Quantitative process improvement objectives are established

Not an SPC Chart

Capability Levels



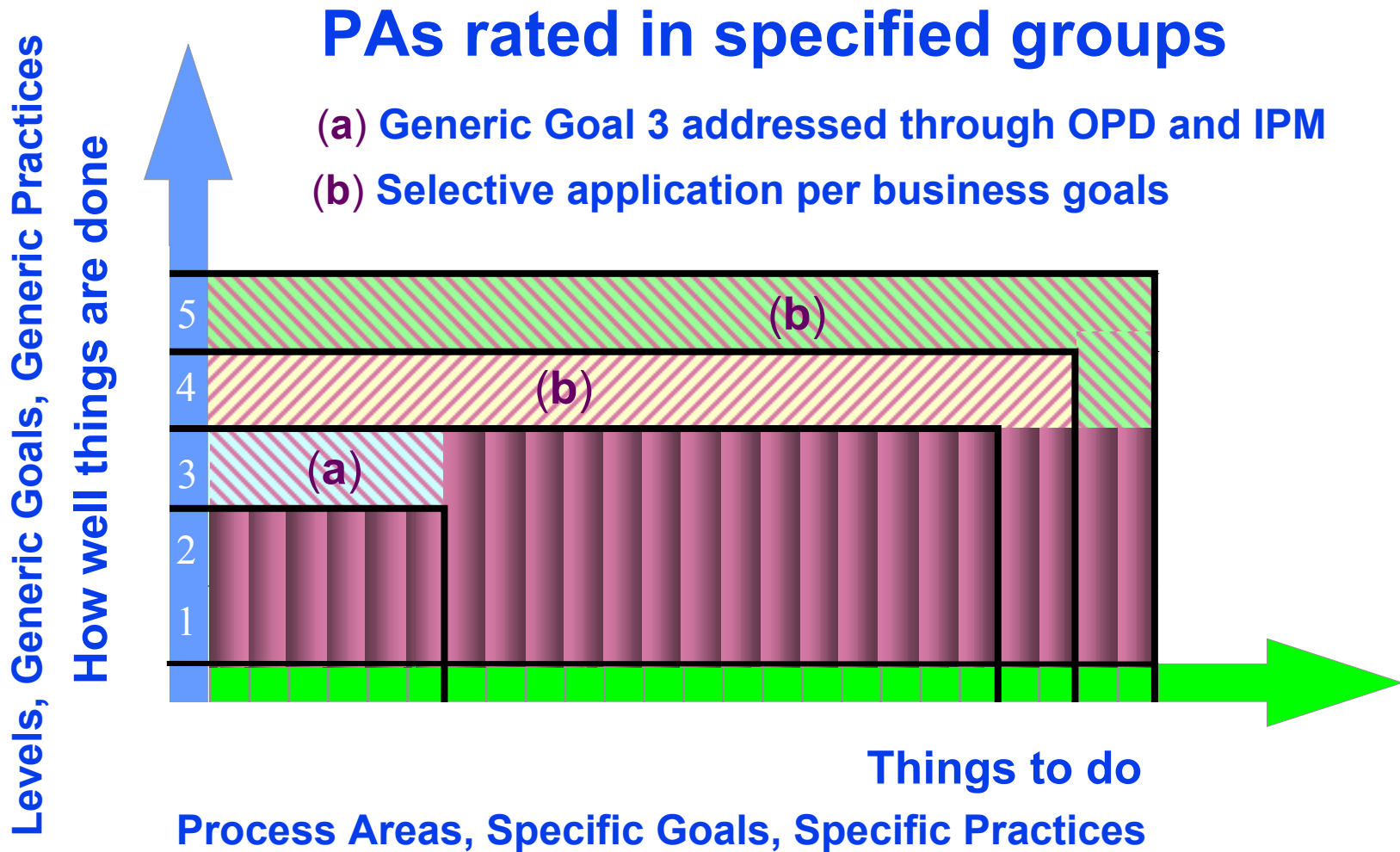
Continuous Representation



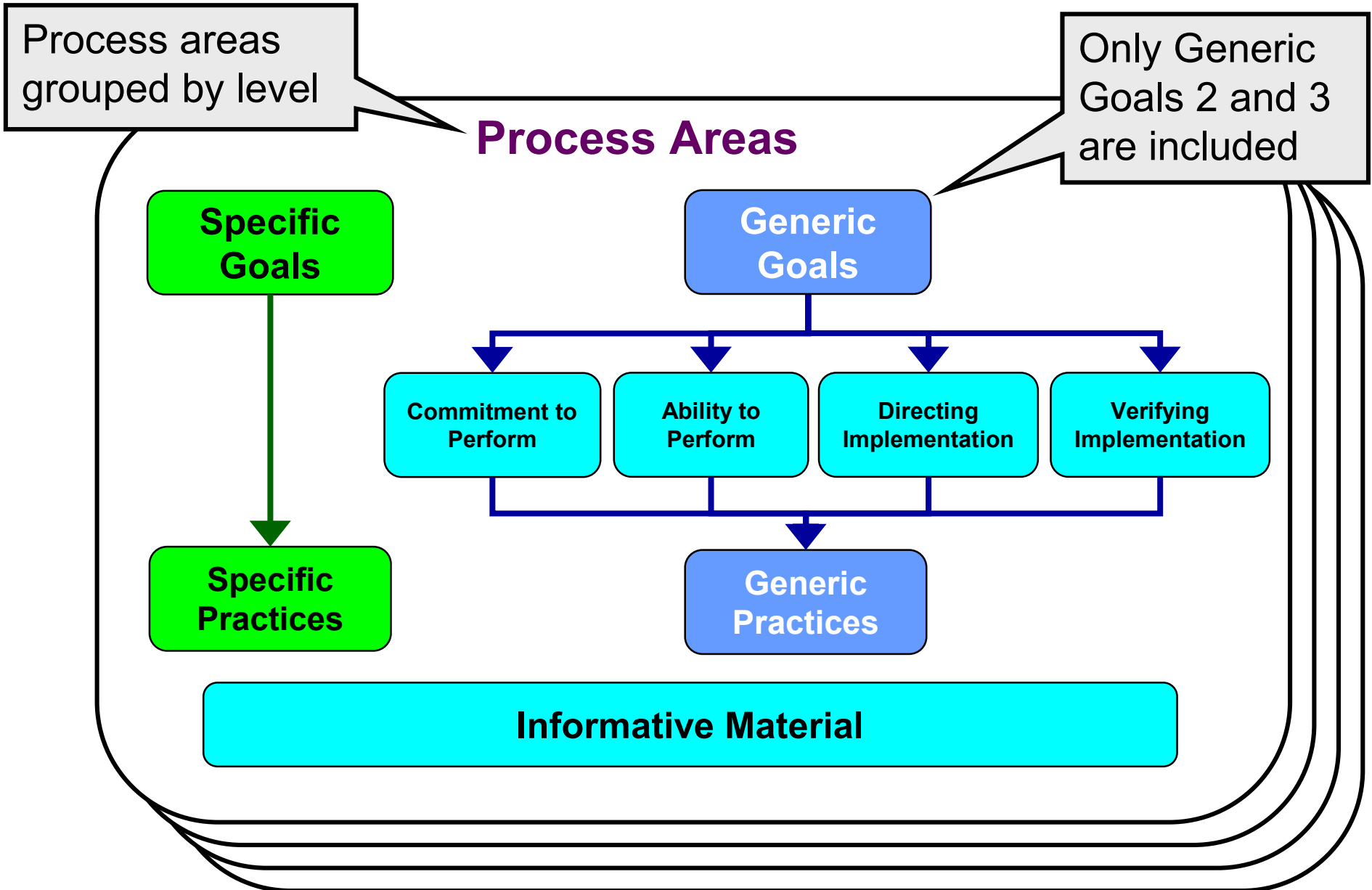
CMMI Process Area Categories

Category	SE/SW Process Areas
<p>Process Management</p>	<p>Organizational Process Focus (OPF) Organizational Process Definition (OPD) Organizational Training (OT) Organizational Process Performance (OPP) Organizational Innovation and Deployment (OID)</p>
<p>Project Management</p>	<p>Project Planning (PP) Project Monitoring and Control (PMC) Supplier Agreement Management (SAM) Integrated Project Management (IPM) Risk Management (RSKM) Quantitative Project Management (QPM)</p>
<p>Engineering</p>	<p>Requirements Management (REQM) Requirements Development (RD) Technical Solution (TS) Product Integration (PI) Verification (VER) Validation (VAL)</p>
<p>Support</p>	<p>Configuration Management (CM) Process and Product Quality Assurance (PPQA) Measurement and Analysis (MA) Causal Analysis and Resolution (CAR) Decision Analysis and Resolution (DAR)</p>

Maturity Levels



Staged Representation

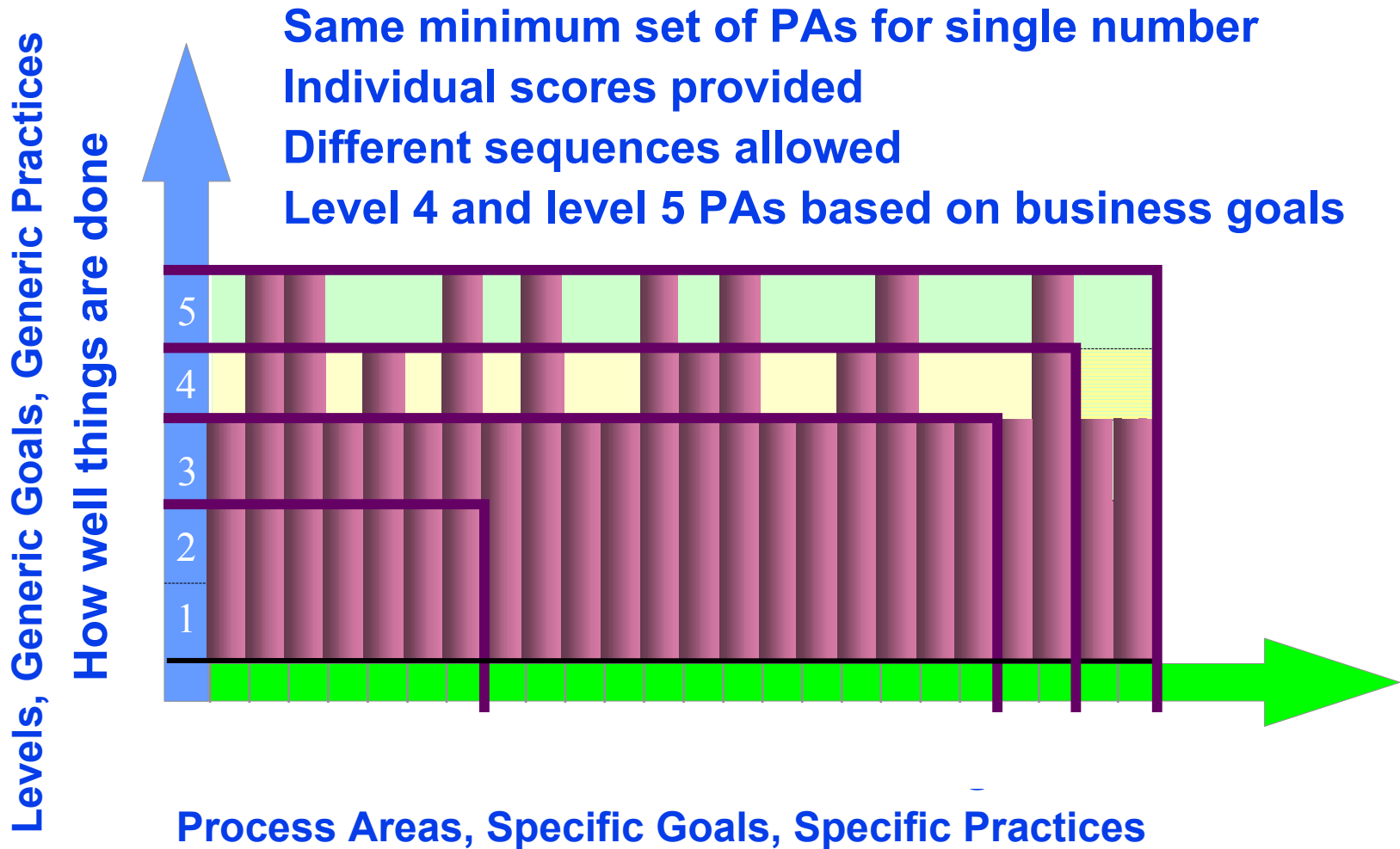


CMMI Process Area Levels

Level	Focus	SE/SW Process Areas	Quality
5 Optimizing	Continuous Process Improvement	Organizational Innovation and Deployment Causal Analysis and Resolution	
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 Organizational Training Integrated Project Management 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 Performed			

Risk
Rework

Equivalent Staging



See: CMMI-SE/SW v1.02 Continuous Representation, Appendix F. Equivalent Staging

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Topic 3

CMMI

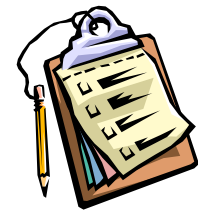
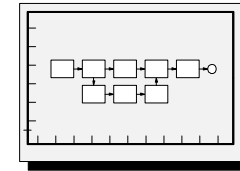
**Organizational
Process Assets**

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Organizational Process Assets

- Standard processes
- Life cycle descriptions
- Tailoring criteria and guidelines
- Measurement repository
- Process Asset Library



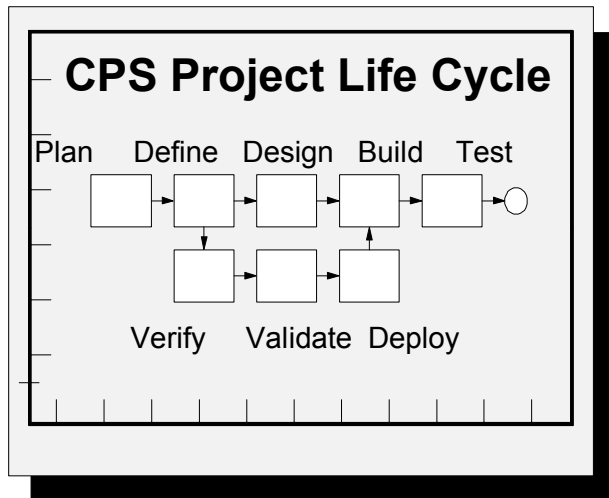
Standard Processes

- Standard processes may be defined at multiple levels in an enterprise and may be related in a hierarchical manner
- The standard process contains one or more process architectures that interconnect and describe the relationships among process elements
- The standard process is tailored for each business area, product line, or project



Life-Cycle Model Descriptions

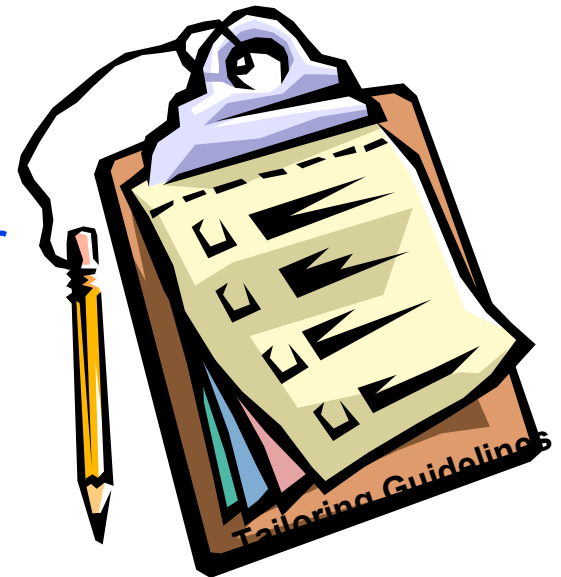
- One life cycle may not be appropriate for all situations
- Life cycles are normally developed for a variety of customers or in a variety of situations
- Life cycles partition product development into phases for which activities and requirements can be defined to promote a complete solution



Tailoring Criteria and Guidelines

Tailoring criteria and guidelines describe:

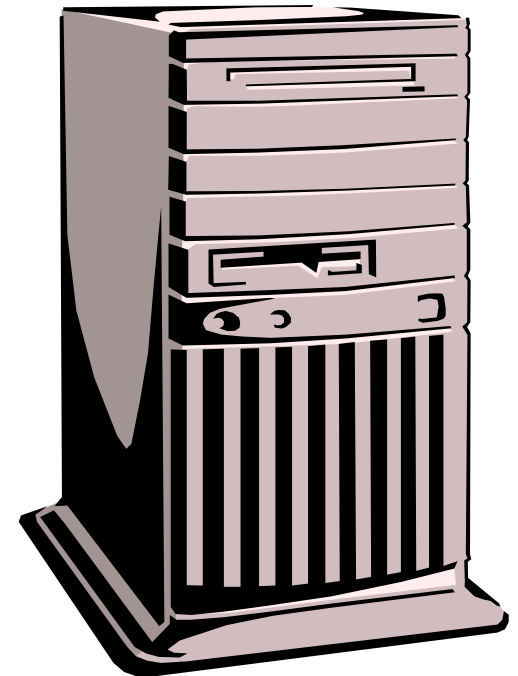
- How a set of standard processes and process assets are used to create a project's defined processes
- Mandatory requirements that must be satisfied by the defined processes
- Options that can be exercised and criteria for selecting among options
- Procedures that must be followed in performing process tailoring and documentation of tailoring performed



Measurement Repository

The repository contains:

- Both product and process measures that are related to the set of standard processes
- Information needed to understand and interpret measures and assess them for reasonableness and applicability
 - For example, definitions of measures are used to compare similar measures from different processes



Process Asset Library

- Stores process documents that are potentially useful to other current and future projects
- Examples of process-related documents include
 - Organizational policies
 - Defined process descriptions
 - Procedures (e.g., estimating)
 - Development plans
 - Quality assurance plans
 - Training materials
 - Process aids (e.g., checklists)
 - Lessons learned reports



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Topic 4

INCOSE

Position

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INCOSE Position

- **Use of CMMI:** INCOSE supports the use of CMMI as an integrated model for appraisals and process improvement
- **INCOSE Role:** INCOSE must be involved in the continuing development, review, and approval of the model and appraisal method
- **Performance Measures:** INCOSE supports the use of objective performance measures (effort and accuracy) to establish the value of process improvement and CMMI appraisals
- **Terminology:** Qualitative words such as “sufficient”, “acceptable” or “significant” in the model and the method should either be defined or replaced by objective, verifiable guidance
- **Appraisal Method Description:** INCOSE believes that the entire CMMI appraisal method description should be freely and publicly available and should be reviewed and approved using the same public, consensus-based, process used for the model
- **Reduced Cost Appraisals:** INCOSE supports improvement of the current Class A appraisal method so that it can be performed in less time and at lower cost. Other less formal methods are necessary to meet the needs of the broad user community, particularly for internal use by an organization.

INCOSE Position

- **Voluntary Reporting:** Delivery of Class B and Class C data to the CMMI steward (currently the SEI) should be voluntary.
- **Training:** INCOSE believes that training for appraisal teams should be focused and compact, to reduce the time commitment and expense to appraised organizations.
- **Identifying Systems Engineering Experienced Lead Appraisers:** Lead Appraisers who have significant skill and experience in Systems Engineering should be identified, both to ensure quality of SE appraisals and to guide organizations who want lead appraisers to provide process improvement guidance.
- **Model stability:** INCOSE supports the concept of maintaining model stability by limiting the number of releases.
- **Representation:** INCOSE believes that CMMI should converge upon a single representation that encompasses the strengths of both the staged and continuous representations.
- **Advanced Practices:** The use of advanced practices in the model should be increased to improve its use when the continuous representation is employed.