

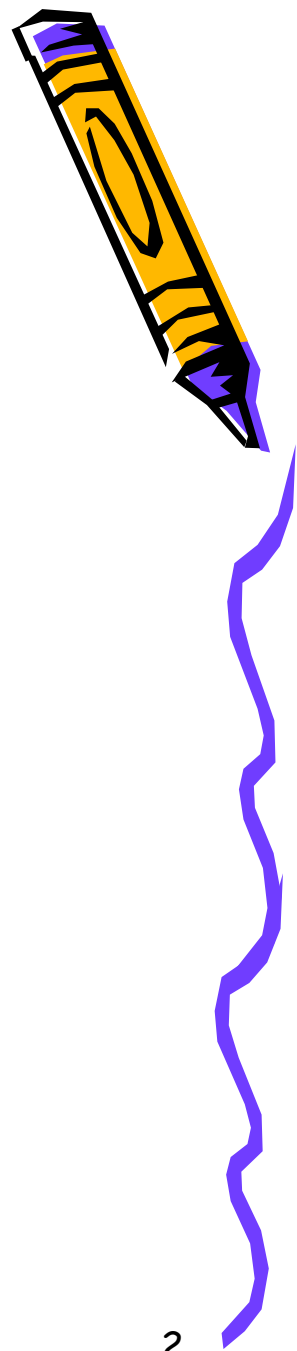
A sunset over the ocean with a large shadow of a person in the foreground. The sun is low on the horizon, creating a bright orange and yellow glow. The water is dark blue with some whitecaps. The shadow of a person is cast from the top left, appearing as a dark silhouette against the bright sky.

CMMI® for Development, Version 1.3

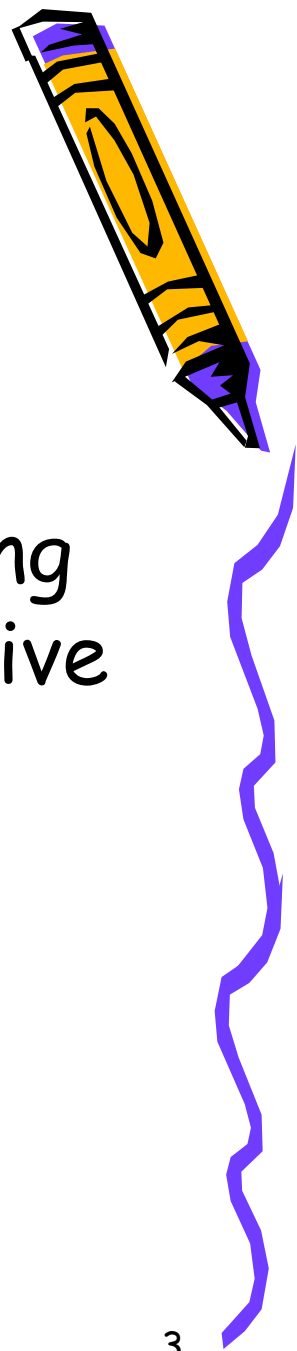
*Improving processes for developing
better products and services*

Agenda

- Introduction
- Process Area Components
- Tying It All Together
- Relationships Among Process Areas
- Using CMMI Model
- CMMI Adoption



Objectives



- Provide an overview of the CMMI Model in order to allow participating member to be able to make effective decision related \integration of CMMI best practices



Audience



- The audience for CMMI-DEV includes anyone interested in process improvement in a development environment.
- Whether you are familiar with the concept of Capability Maturity Models or are seeking information to begin improving your development processes, CMMI-DEV will be useful to you.
- This model is also intended for organizations that want to use a reference model for an appraisal of their development related processes

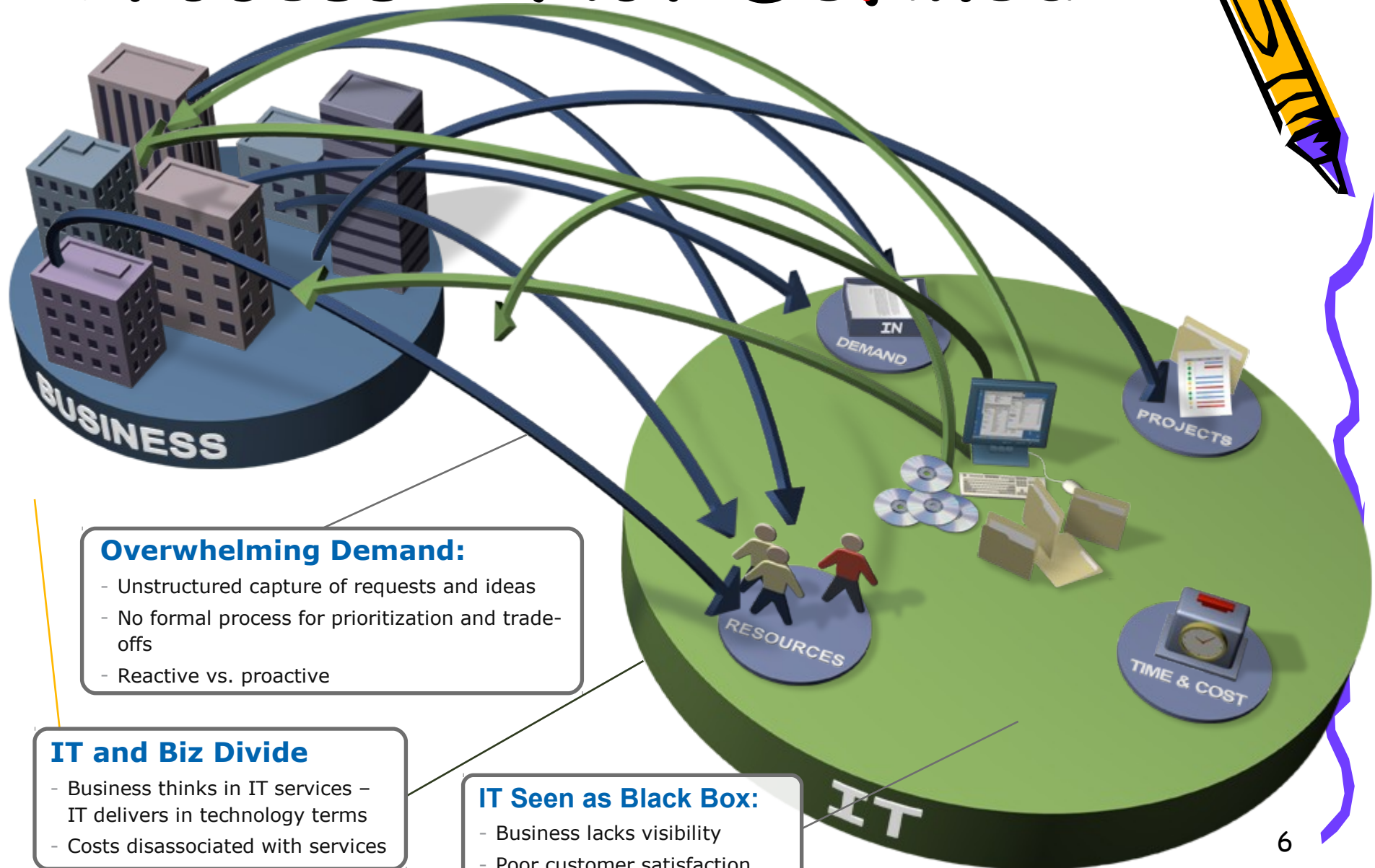


Have These Symptoms?

- Missed Commitments
 - Late delivery
 - Last minute crunches
 - Spiraling costs
- No/Inadequate management visibility
 - Too many surprises
- Quality problems
 - Too much rework
 - Functions not working correctly
 - Customer complaints
- Poor morale
 - People frustrated



Process - Not Defined



Overwhelming Demand:

- Unstructured capture of requests and ideas
- No formal process for prioritization and trade-offs
- Reactive vs. proactive

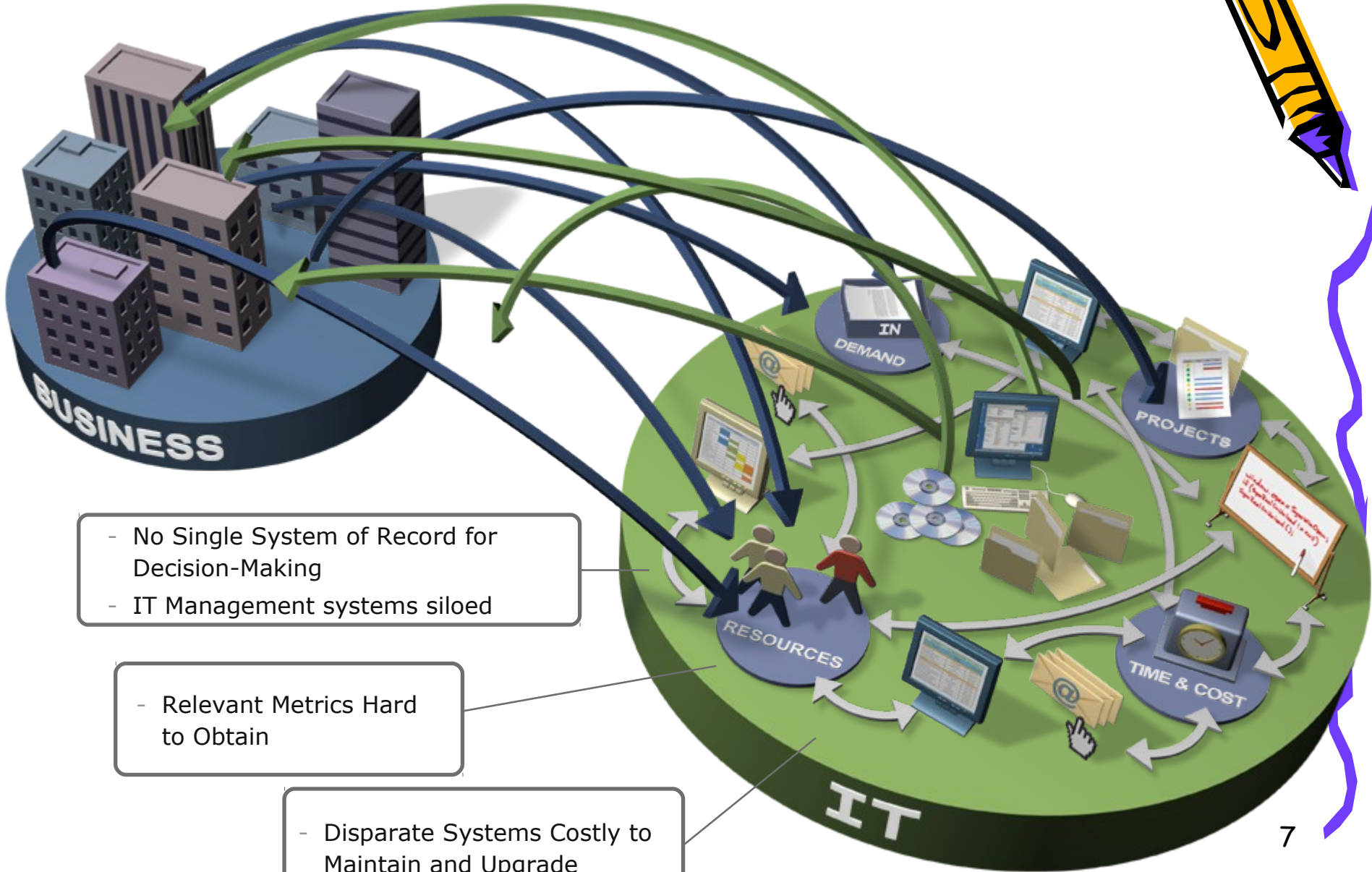
IT and Biz Divide

- Business thinks in IT services – IT delivers in technology terms
- Costs disassociated with services

IT Seen as Black Box:

- Business lacks visibility
- Poor customer satisfaction

Process Failure



- No Single System of Record for Decision-Making
- IT Management systems siloed

- Relevant Metrics Hard to Obtain

- Disparate Systems Costly to Maintain and Upgrade

Project Failure

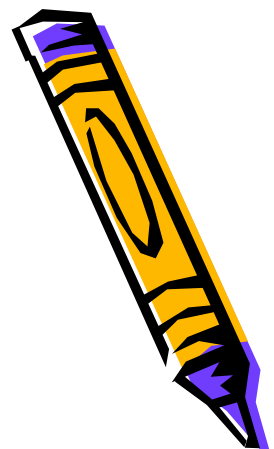
- Nearly 1/3 of information technology (computer and software) projects were cancelled before completion
- Average overrun of project budgets was 189%
- The average schedule overrun for projects that were in difficulty was 222%
- On average, the delivered product contained only 61% of the originally-specified features.
- Only 16% (1 of 6) software projects were completed on time, on budget



Why Do Projects Fail

- Failure to manage risks
- Poor or mismanaged requirements
- Misunderstood user needs
- Poor, undefined, or unproved processes
- Lack of consideration for the entire product / service lifecycle
- Lack of planning for transition to deployment
- Inadequate management of the procurement process

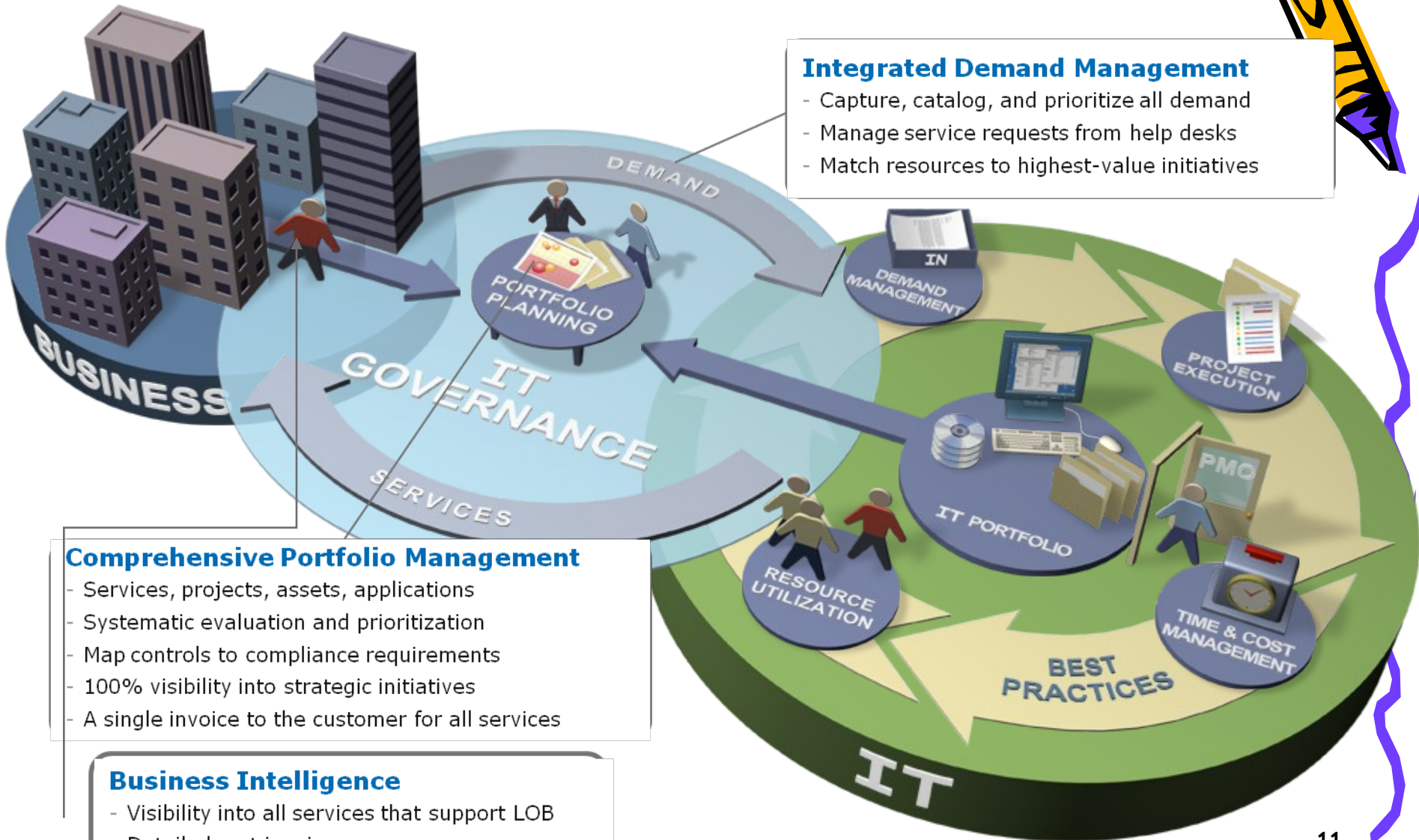
These problems are Managerial – not Technical !



Putting Process In Place



Process Improvement



Integrated Demand Management

- Capture, catalog, and prioritize all demand
- Manage service requests from help desks
- Match resources to highest-value initiatives

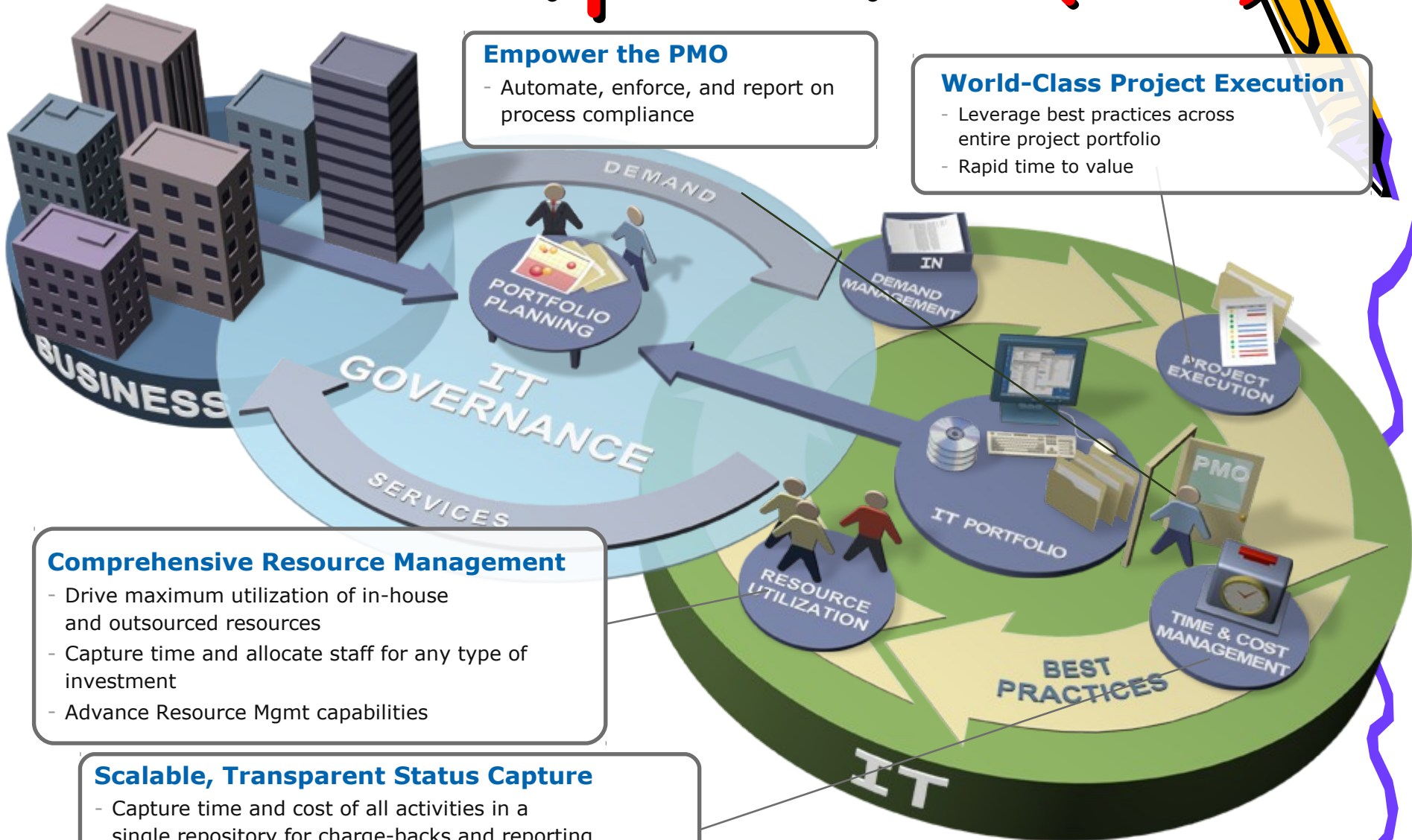
Comprehensive Portfolio Management

- Services, projects, assets, applications
- Systematic evaluation and prioritization
- Map controls to compliance requirements
- 100% visibility into strategic initiatives
- A single invoice to the customer for all services

Business Intelligence

- Visibility into all services that support LOB
- Detailed cost invoices

Process Improvement (con't)



Empower the PMO

- Automate, enforce, and report on process compliance

World-Class Project Execution

- Leverage best practices across entire project portfolio
- Rapid time to value

Comprehensive Resource Management

- Drive maximum utilization of in-house and outsourced resources
- Capture time and allocate staff for any type of investment
- Advance Resource Mgmt capabilities

Scalable, Transparent Status Capture

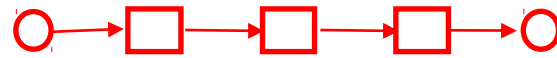
- Capture time and cost of all activities in a single repository for charge-backs and reporting
- Capture asset costs through integration with Asset Management Solution

Attributes to Successful Project

- Effective project planning
- Effective project cost estimating
- Effective project measurements
- Effective project milestone tracking
- Effective project quality control
- Effective risk management
- Effective project change management
- Effective processes
- Effective communications
- Capable project managers
- Capable technical personnel
- Significant use of specialists
- Substantial volumes of reusable material



The Three Elements

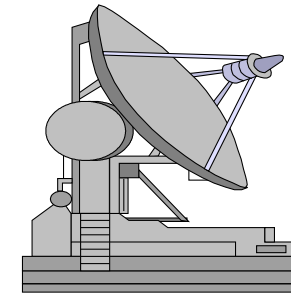
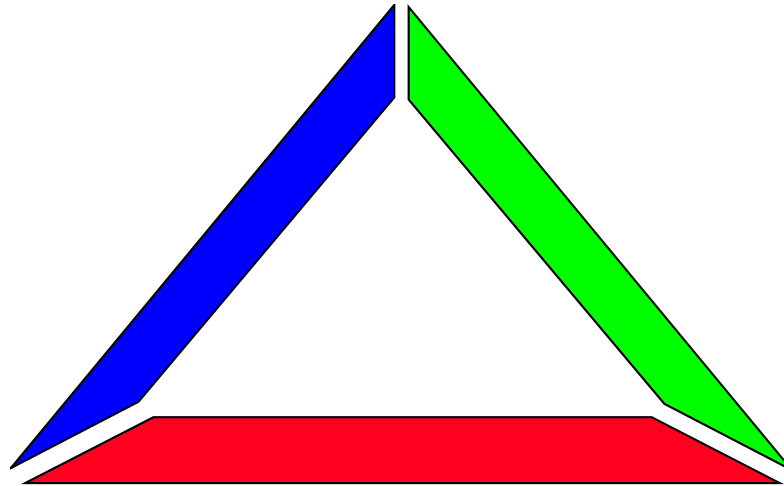


Process: a defined method involving steps or operations



People:

**Skills, Training,
Management**



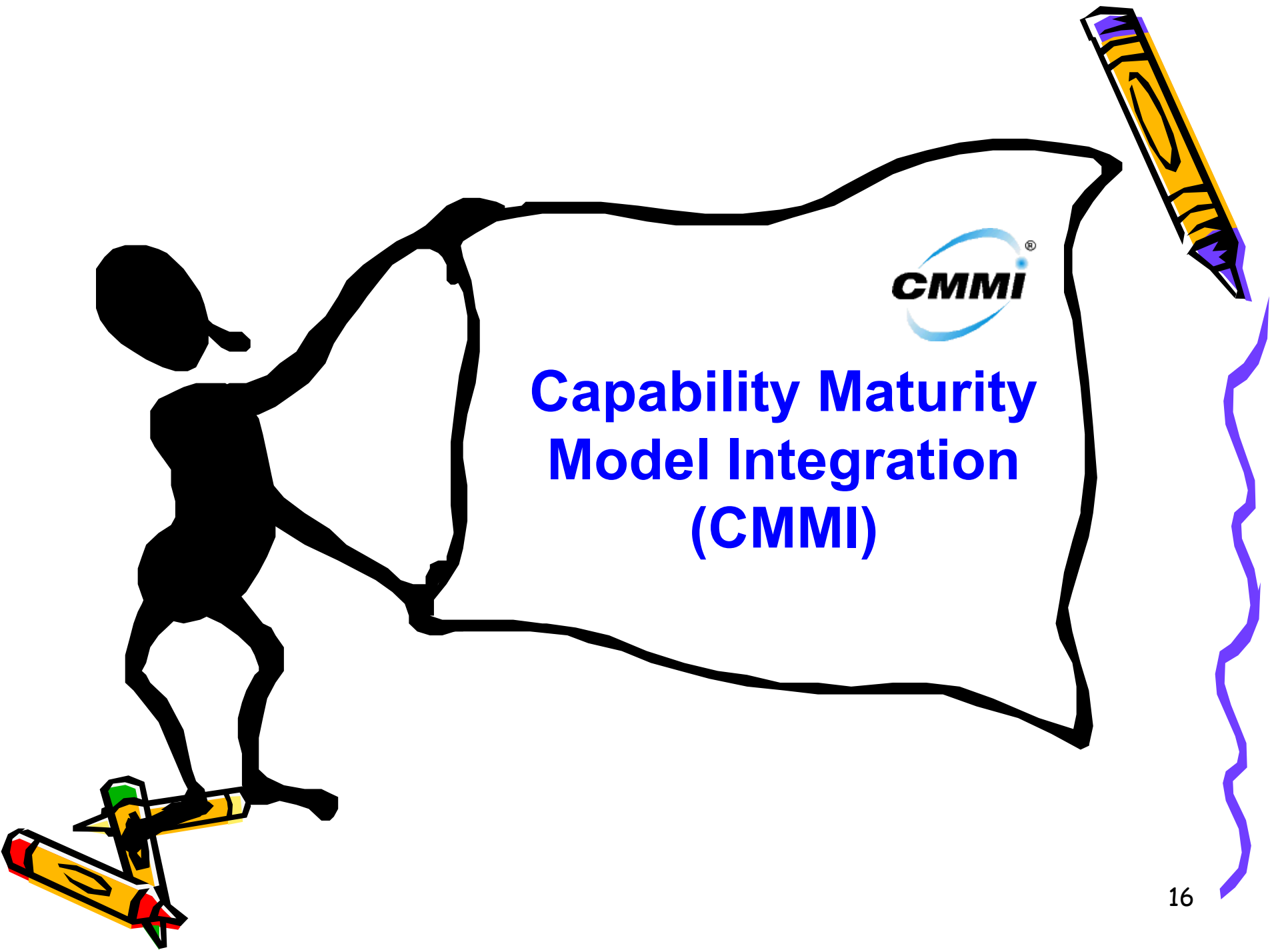
Technology:

**Application domains,
tools, languages,
information, environments**

**Improved Process + Competent Workforce + Appropriate Technology
=
Reduced Risk, Higher Productivity, and Better Quality**



CMMI Overview



**Capability Maturity
Model Integration
(CMMI)**



What is CMMI?

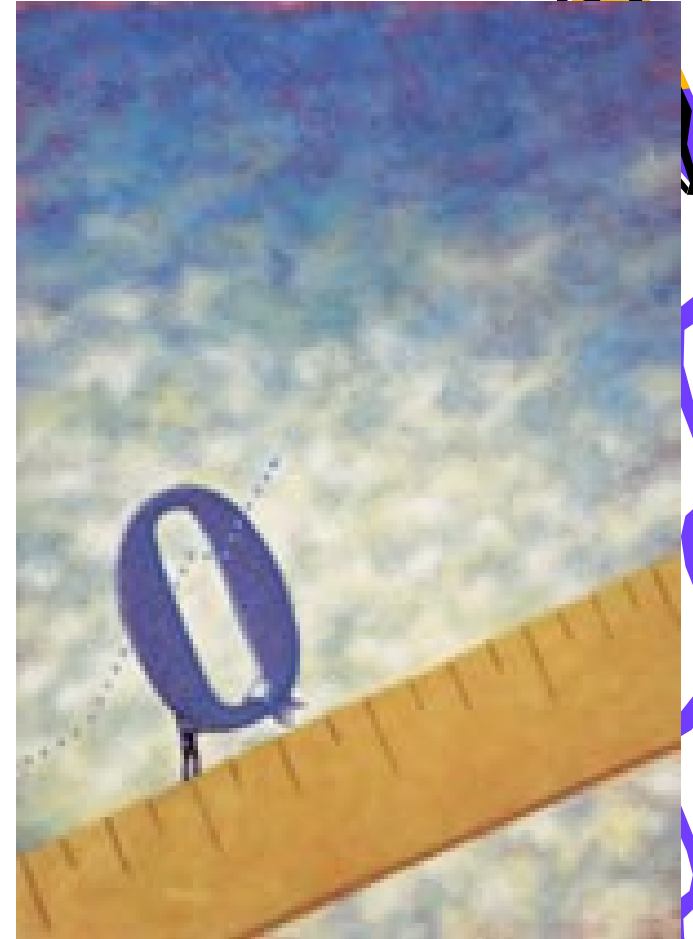


Consultant
Money
Making
Initiative



CMMI Defined

- Model
- Practices
- Process Improvement

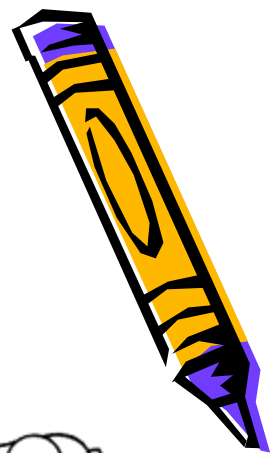


Model

- Say what you do
- Do what you say
- Prove It



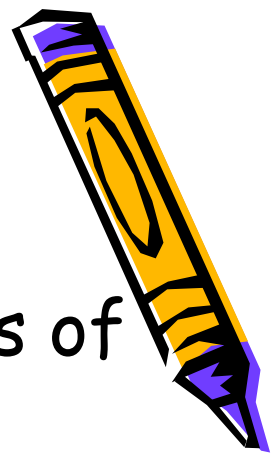
"We installed little monitors because they make all of our problems look smaller."



CMMI Model

- A framework that describes key elements of effective processes
- A guide to evolutionary improvement from ad hoc, immature activities to mature, disciplined processes
- A description of practices for planning, engineering and managing business processes that can help you achieve business goals related to things such as:

- ❖ cost
- ❖ schedule
- ❖ functionality
- ❖ product / service quality



CMMI Model (con't)

- A yardstick against which the maturity of an organization's product development, acquisition, and/or service related processes can be measured and compared with industry state of the practice
- A basis for planning improvements to your business processes
- CMMI best practices tell you
- ❖ **WHAT** to do, not **HOW** to do nor **WHO** should do it



CMMI Model Foundation



- Provides an internally consistent set of core components that apply to every constellation or model
- All models use the foundation without deleting or changing any of the content



What is CMMI Model?



- Organized collections of best practices

Based on work by Crosby, Deming, Juran,
Humphrey...

- Systematic ordered approach to process improvement.
- Means of measuring organizational maturity.
- Have proven to bring significant return on investment in productivity and quality.



CMMI Project

ADPBAE SYSTEMSBOEINGCSCERICSSONER
SYSTEMSGENERAL DYNAMICS HARRISHoneywellLitton
PRCLOCKHEED MARTINMarconiMOTOROLANORTHROP GRUMMANPACIFIC BELLRaytheonRockwellSOFTWARE
PRODUCTIVITY
CONSORTIUMSverdrupTHOMSON-CSFTRW

The Product/Services Development Paradox



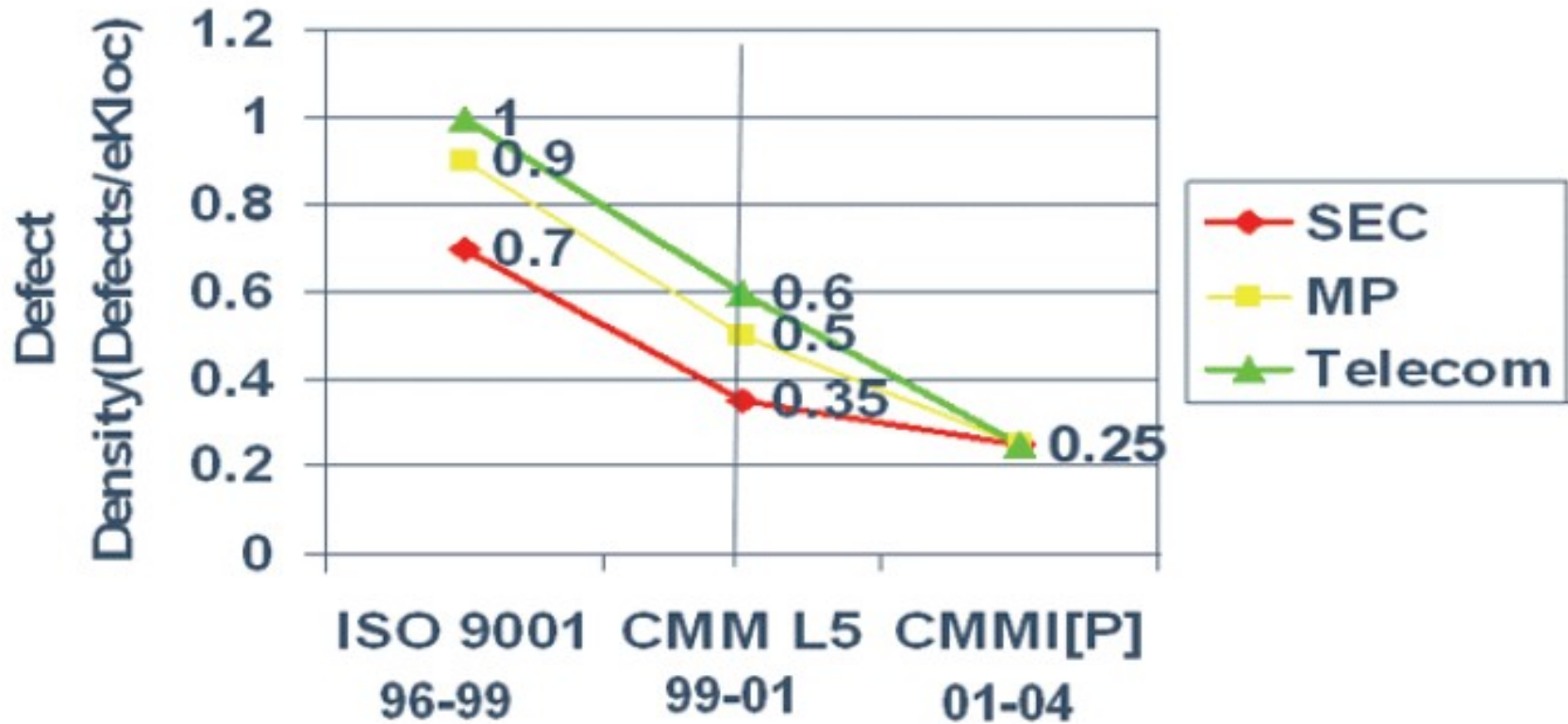
CMMI - Quality Improvement



- Siemens Information Systems Ltd.
 - internal document

Product Quality

71% reduction in defect density



CMMI Improvement - Schedule Adherence



The E-Trading team at J.P. Morgan Chase was delivering products with an average slippage of 6-8 weeks. When they achieved CMMI Level 2, the average slippage dropped to one week.

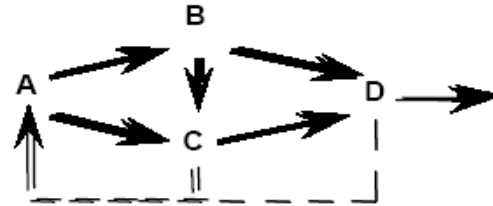


JP Morgan Chase. "IB Technology Examples of CMMI Benefits." Tower, James. CMMI Technology Conference and User Group. Denver, CO, November 17, 2004.

About Capability Models



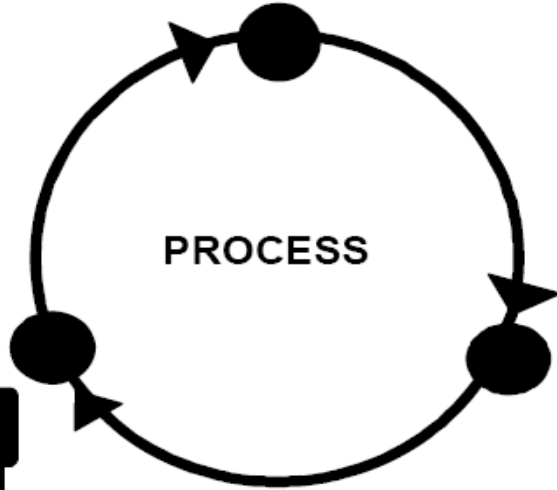
Procedures and methods
defining the relationship of
tasks



People
with skills,
training, and
motivation



PROCESS



Tools and
equipment

The Three Critical Dimensions

Caveat Emptor



- A CMMI model is not a process.
- A CMMI model describes the characteristics of effective processes.



Caveat Emptor

This Is Not the Goal!



"Certification"

CMMI

Beware of Process for Its Own Sake!

Certification Does Not Guarantee Good Outcomes!

Process Improvement Is About Better Outcomes and Experiences for Customers

CMMI Best Practices are used for ...



- The development, acquisition, and maintenance of products and services
- Software-intensive products and services
- Product and service life cycles from conception through delivery and maintenance
- Benchmarking your organization against others in a variety of industries



Underlying Premise of Process Improvement

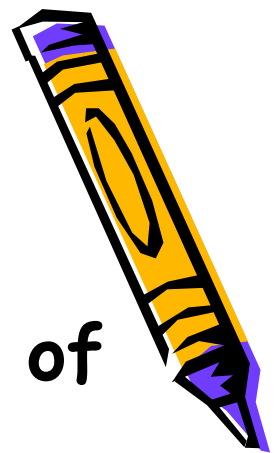


“The quality of a product is largely determined by the quality of the process that is used to develop and maintain it.”

Based on TQM principles as taught by Shewhart, Juran, Deming and Humphrey.



CMMI Framework



CMMI currently addresses three areas of interest:

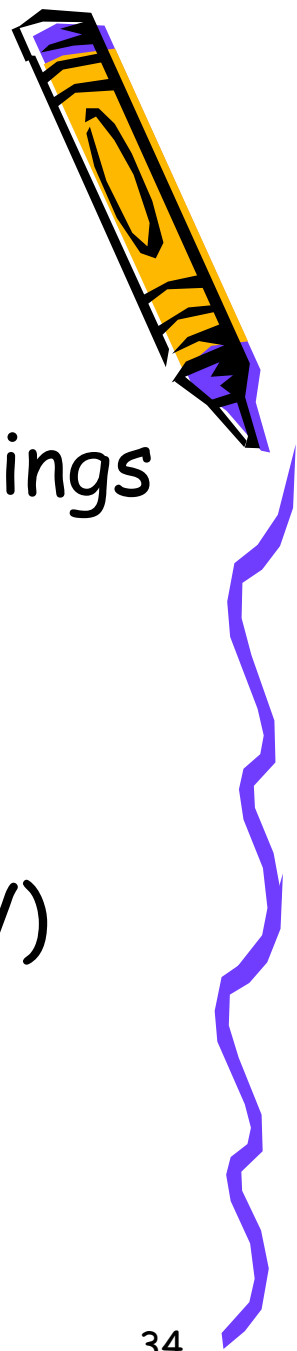
- Product and service development — CMMI for Development (CMMI-DEV)
- Service establishment, management, and delivery — CMMI for Services (CMMI-SVC), and:



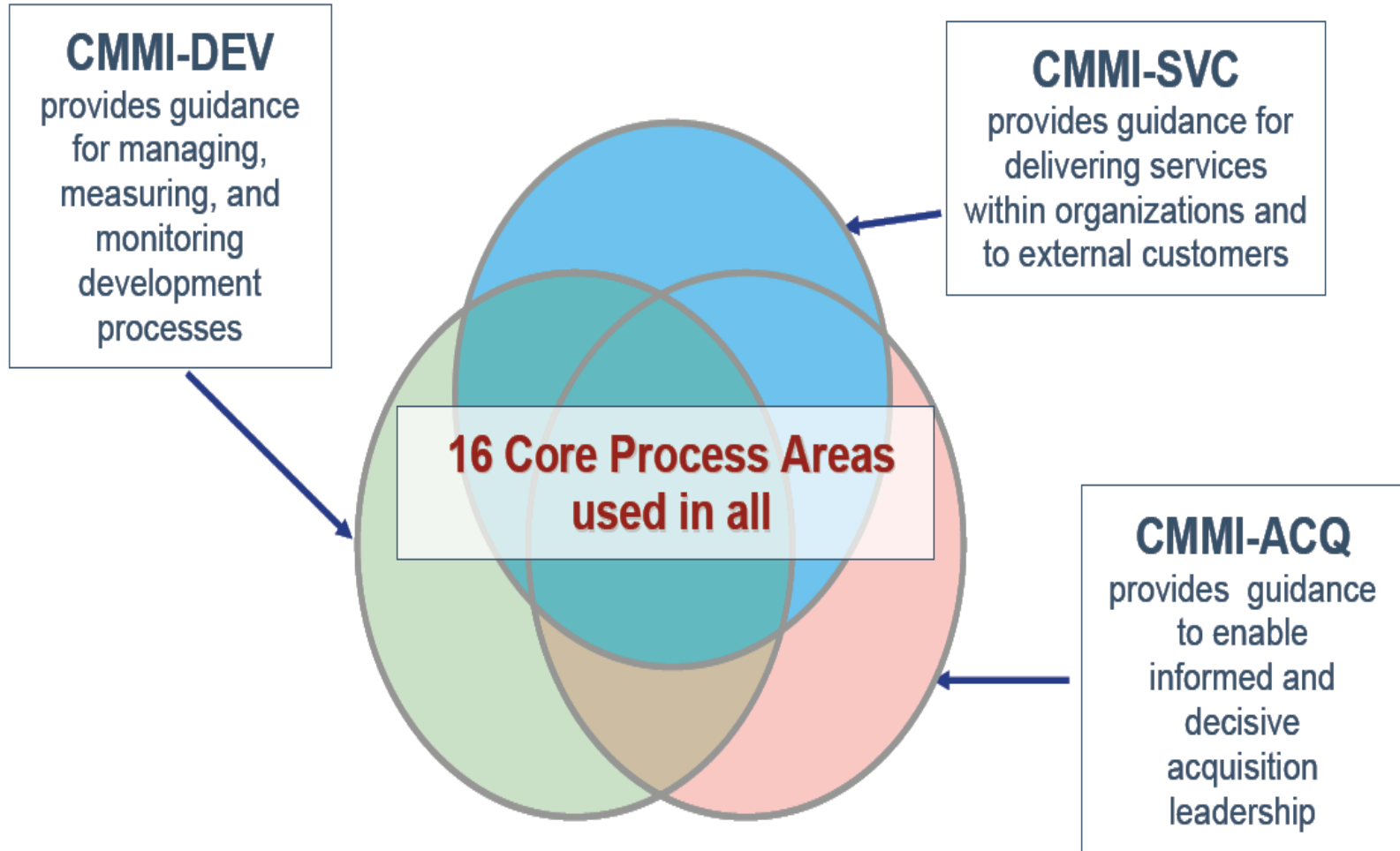
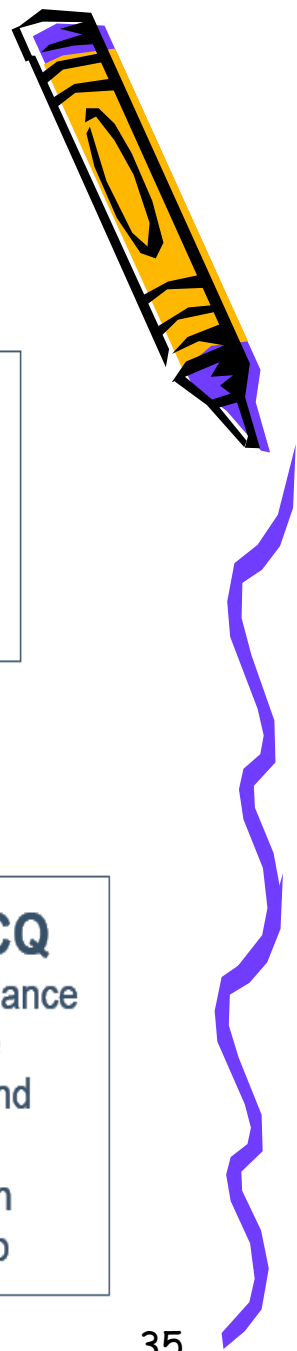
Product and service acquisition — CMMI for Acquisition (CMMI-ACQ)

Constellations

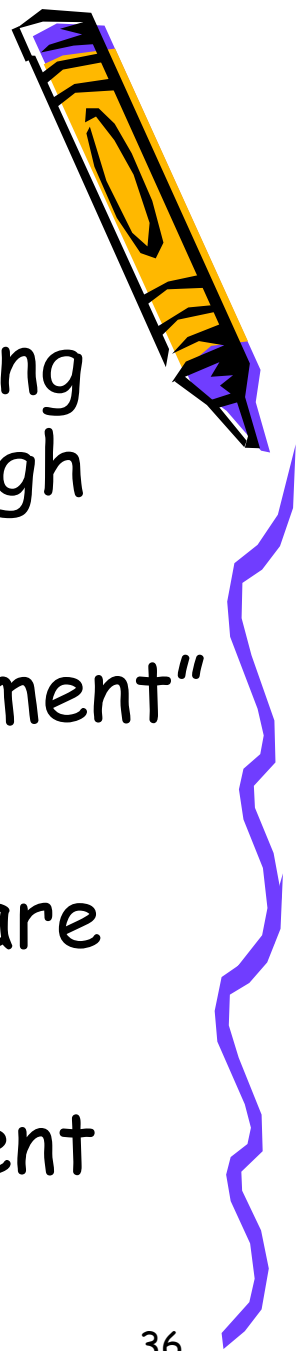
- The components of the CMMI Framework are organized into groupings called constellations that facilitate construction of approved models
 - ❖ CMMI for Acquisition (CMMI-ACQ)
 - ❖ CMMI for Development (CMMI-DEV)
 - ❖ CMMI for Services (CMMI-SVC)



Evolution of CMMI



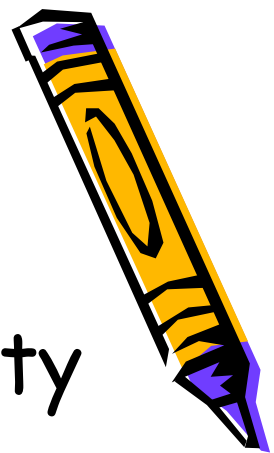
CMMI for Acquisitions



- Acquisition is the process of obtaining products (goods and services) through contract
- Some call these processes "procurement" or "outsourcing"
- Includes acquisition practices that are useful, but not
- covered in the CMMI for Development model

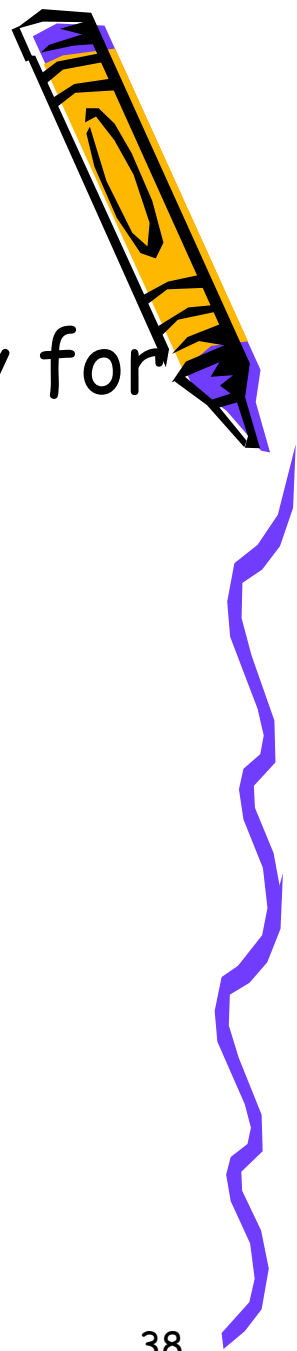
CMMI for Services

- Products may be delivered in a variety of forms, including artifacts (e.g. hardware, software, or user documentation), services (e.g. training, maintenance, or operational support), and combinations of these
- A service is a product that is intangible and non-storable



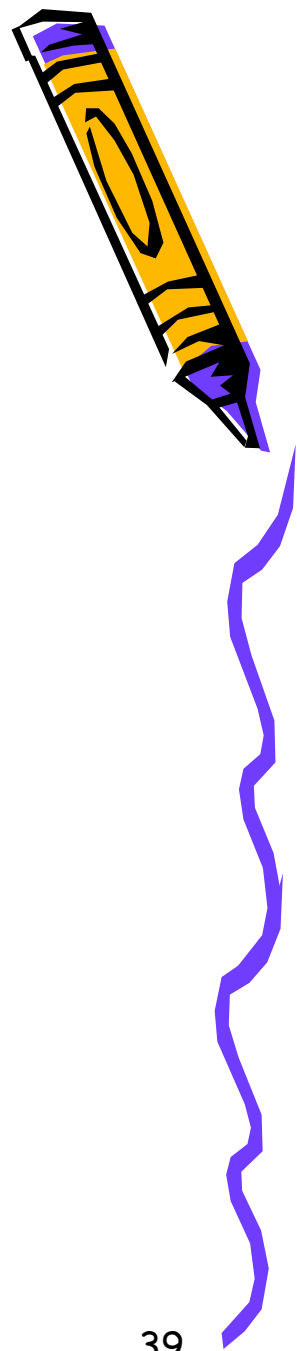
CMMI for Development

- Has been available to the community for many years
- Includes the development and maintenance practices



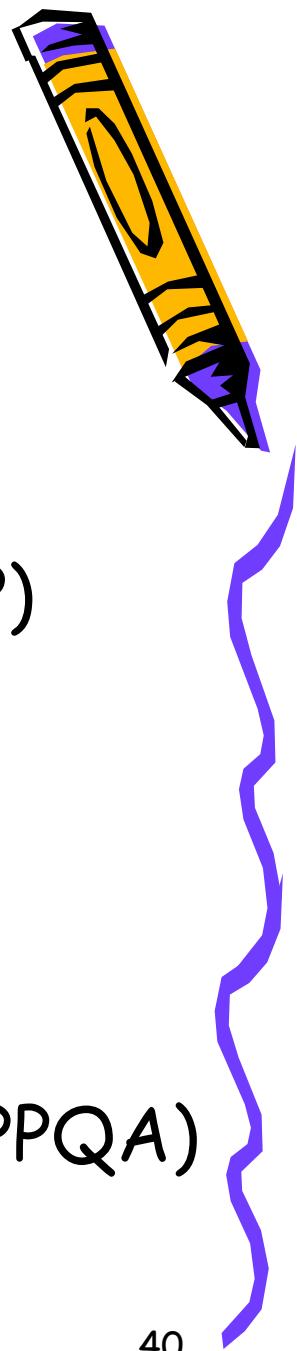
CMMI - Process Areas

- Causal Analysis and Resolution (CAR)
- Configuration Management (CM)
- Decision Analysis and Resolution (DAR)
- Integrated Project Management (IPM)
- Measurement and Analysis (MA)
- Organizational Process Definition (OPD)
- Organizational Process Focus (OPF)



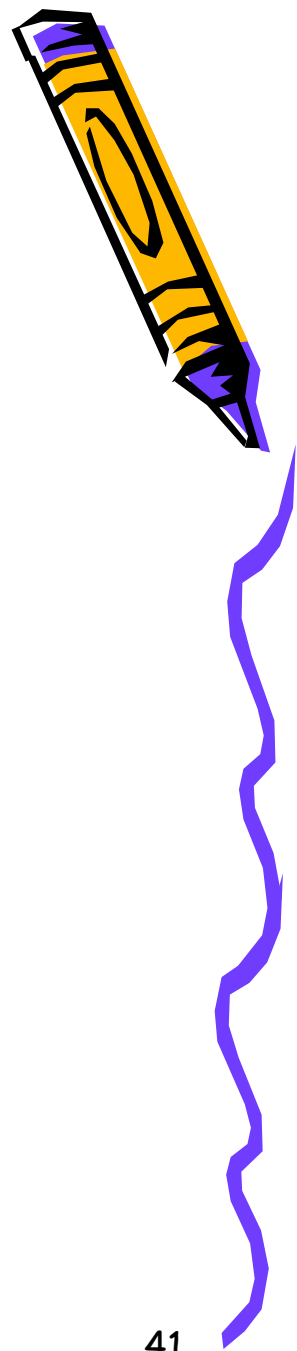
CMMI - Process Areas

- Organizational Performance Management (OPM)
- Organizational Process Performance (OPP)
- Organizational Training (OT)
- Product Integration (PI)
- Project Monitoring and Control (PMC)
- Project Planning (PP)
- Process and Product Quality Assurance (PPQA)



CMMI - Process Areas

- Quantitative Project Management (QPM)
- Requirements Development (RD)
- Requirements Management (REQM)
- Risk Management (RSKM)
- Supplier Agreement Management (SAM)
- Technical Solution (TS)
- Validation (VAL)
- Verification (VER)



CMMI Design Goals

- Integrate the models, eliminate inconsistencies, reduce duplication
- Reduce the cost of implementing model-based process improvement
- Increase clarity and understanding
- Common terminology
- Consistent style
- Uniform construction rules
- Common components
- Assure consistency with ISO 15504
- Be sensitive to impact on legacy efforts



What Changes in V1.3

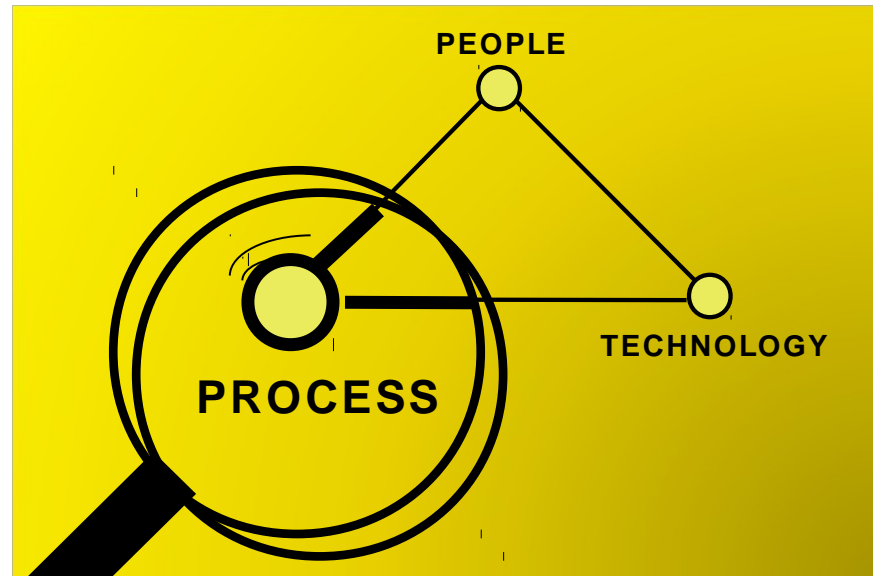


- Version 1.3 is better, but in many ways a minor revision.
 - The most substantive changes are to the high maturity PAs.
 - Generic goals 4 & 5 have been eliminated.
 - Category and PA names have changed slightly.
 - Language and architecture has been harmonized and aligned wherever possible.
 - Glossary and informative material have all been improved.



CMMI Process Improvement

Quality Leverage Point



Major determinants of product cost, schedule, and quality

What is a Process?

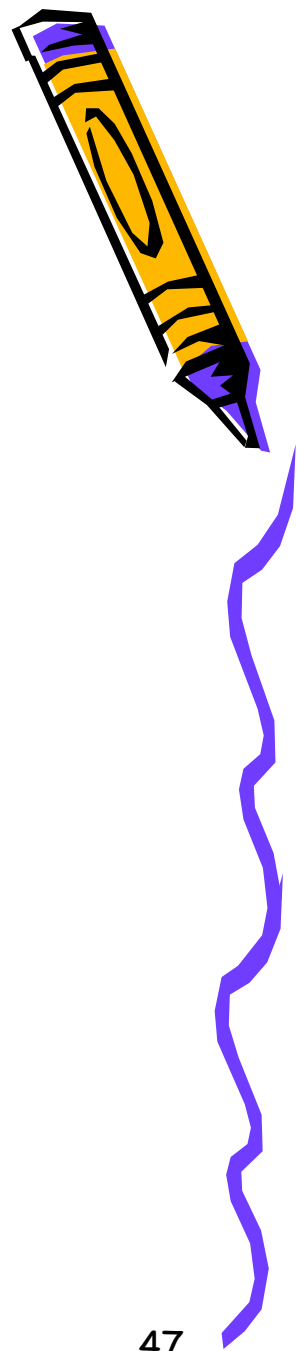


- A **process** is a set of practices performed to achieve a given purpose; it may include tools, methods, materials, and/or people. [*SEI definition*]
- While process is often described as a leg of the process-people-technology triad, it may also be considered the "**glue**" that unifies the other aspects.



Common Fallacies

- I don't need process, I have
 - ❖ really good people
 - ❖ advanced technology
 - ❖ an experienced manager
- Process ...
 - ❖ interferes with creativity
 - ❖ introduces bureaucracy and regimentation
 - ❖ isn't needed when building prototypes
 - ❖ is only useful on large projects
 - ❖ hinders agility in fast-moving markets
 - ❖ costs too much



Why Focus On Process?

- It complements your focus on people
 - The experience and training of your work force is not always enough.
 - Working harder is not the answer.
 - A **well-defined process** can provide the means to working smarter.
- It complements your focus on technology
 - Technology applied without a suitable roadmap will not result in significant payoff
 - Technology provides the most benefit in the context of an **appropriate process roadmap**.



Importance of Process

“The quality of a product is largely determined by the quality of the process that is used to develop and maintain it.”



Based on TQM principles as taught by Shewhart, Juran, Deming and Humphrey.



Process Improvement Benefit



- Process improvement benefits fall into one of eight general categories:
 - improved schedule and budget predictability
 - improved cycle time
 - increased productivity
 - improved quality (as measured by defects)
 - increased customer satisfaction
 - improved employee morale
 - increased return on investment
 - decreased cost of quality



Flow down of Business Goal

Business Goals/ Objectives

Senior & Middle
Management
Focus

Project Goals/ Objectives

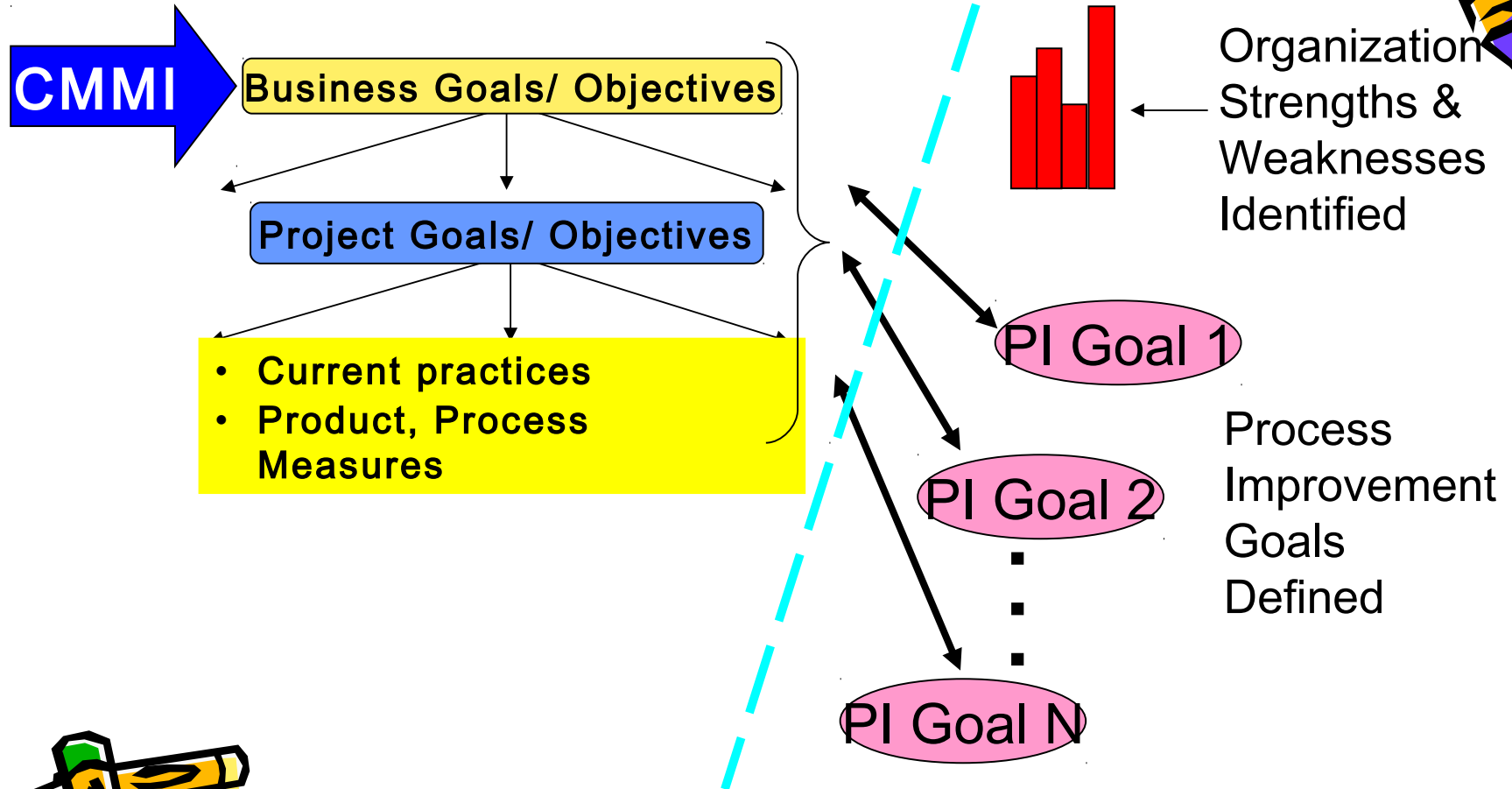
Project
Management Focus

- Current practices
- Product, Process Measures

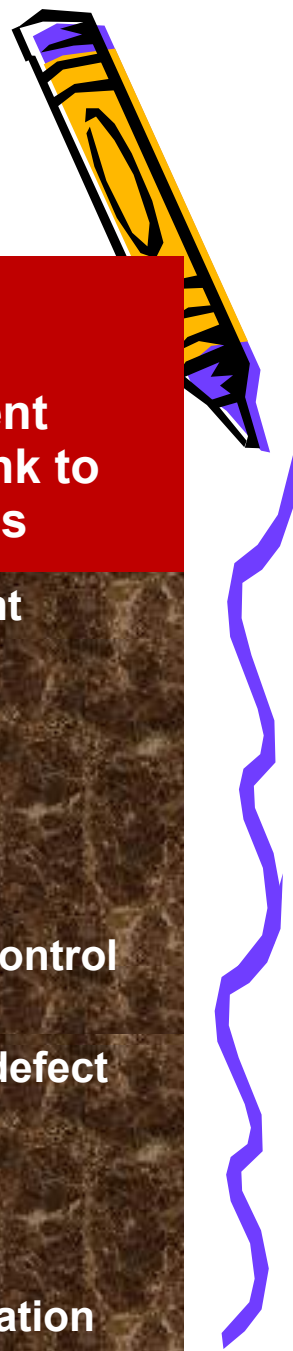
Practitioners
Focus



Relationship between Business Goals and Process Improvement



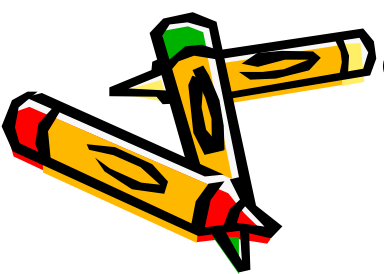
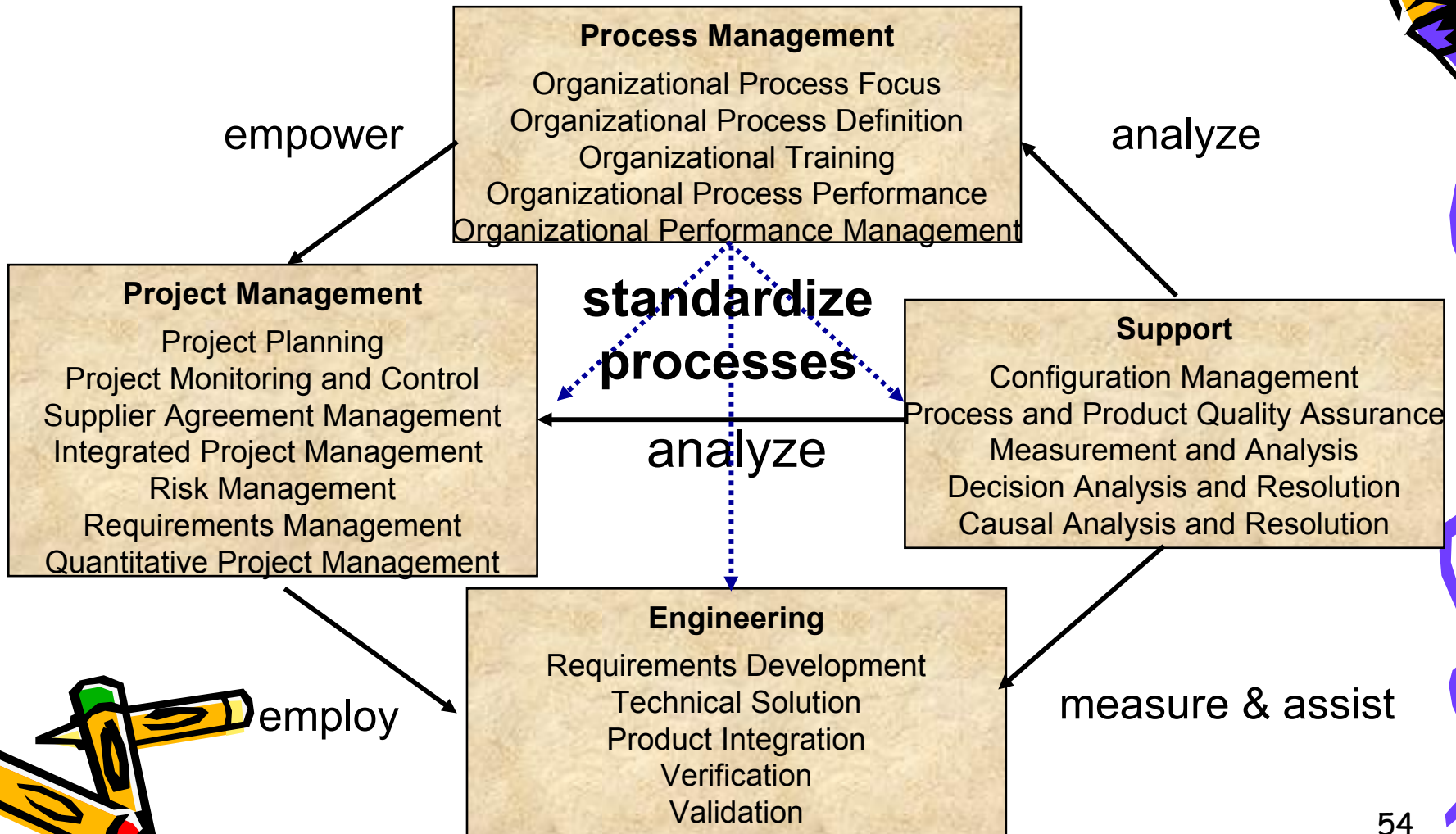
Example



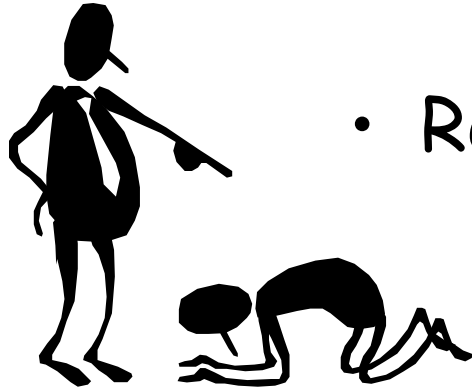
EXAMPLE

Business Goals/ Objectives	Project Goals/ Objectives	Process Improvement Goals/Objectives & link to CMMI Process Areas
Reduce time to market	Improve projects schedule predictability by%	Improve Project Management Processes: <ul style="list-style-type: none">- Process Areas:<ul style="list-style-type: none">- Project Planning- Project Monitoring & Control
Improve Customer satisfaction	Reduce defects found in verification and validation by ... %	Improve life cycle in-phase defect detection: <ul style="list-style-type: none">- Process Areas:<ul style="list-style-type: none">- Verification and Validation

Process Area Category



Model Components



- Required
 - Specific Goals
 - Generic Goals

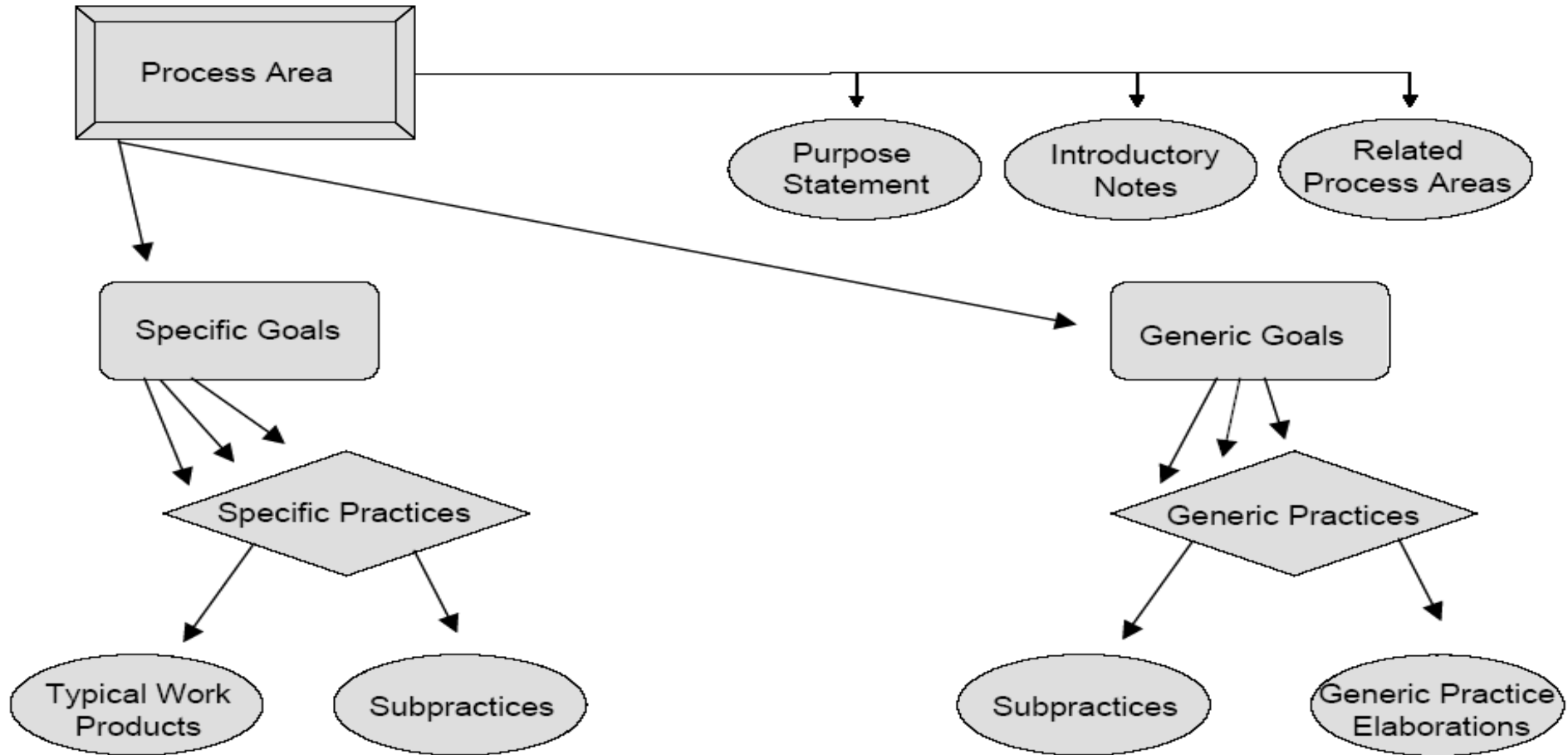
- Expected
 - Specific Practices
 - Generic Practices



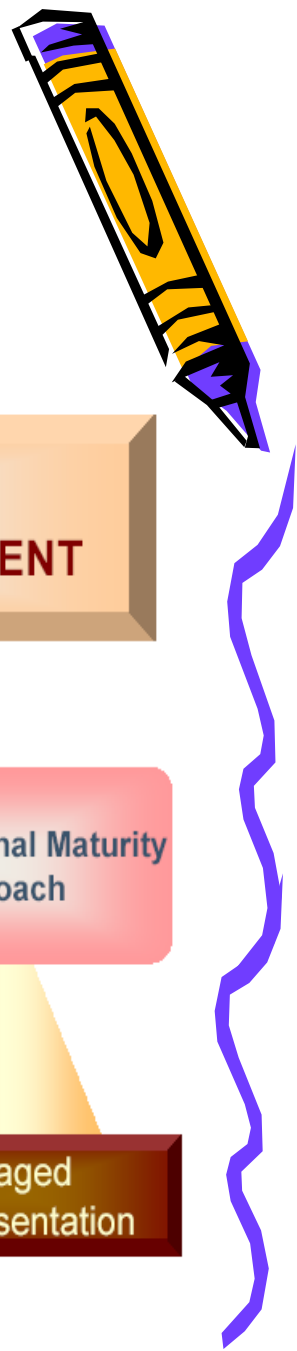
- Informative
 - Subpractices
 - Typical Work Products
 - Generic Practice Elaborations
 - Discipline Amplifications



Process Area Components



CMMI Representations



- A representation allows an organization to pursue different **improvement paths**.
- Process area capability and organizational maturity are similar concepts.



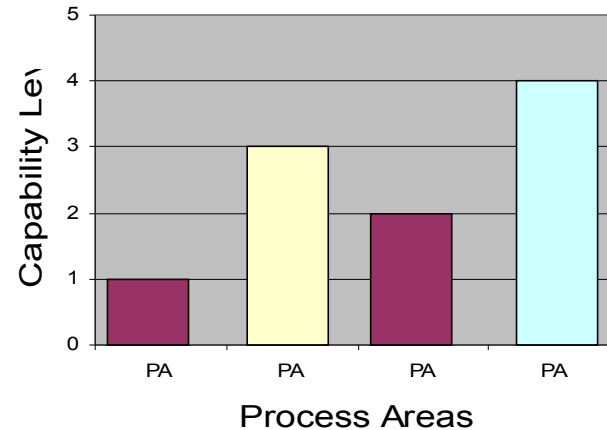
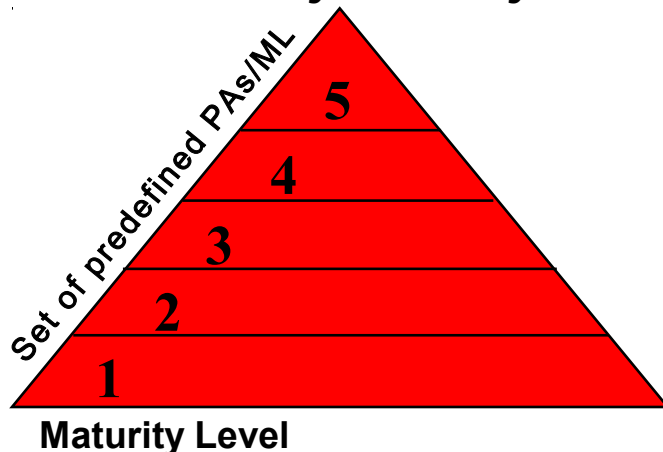
CMMI Model - Two Representations



STAGED

Provides pre-defined roadmap for *organizational improvement*, based on *proven grouping* of processes and associated organizational relationships.

Structured by Maturity Levels.

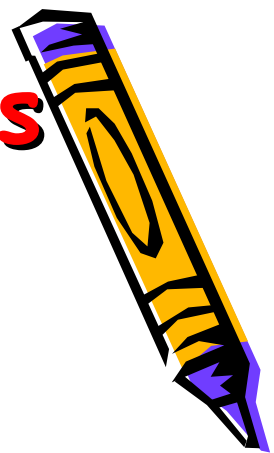


CONTINUOUS

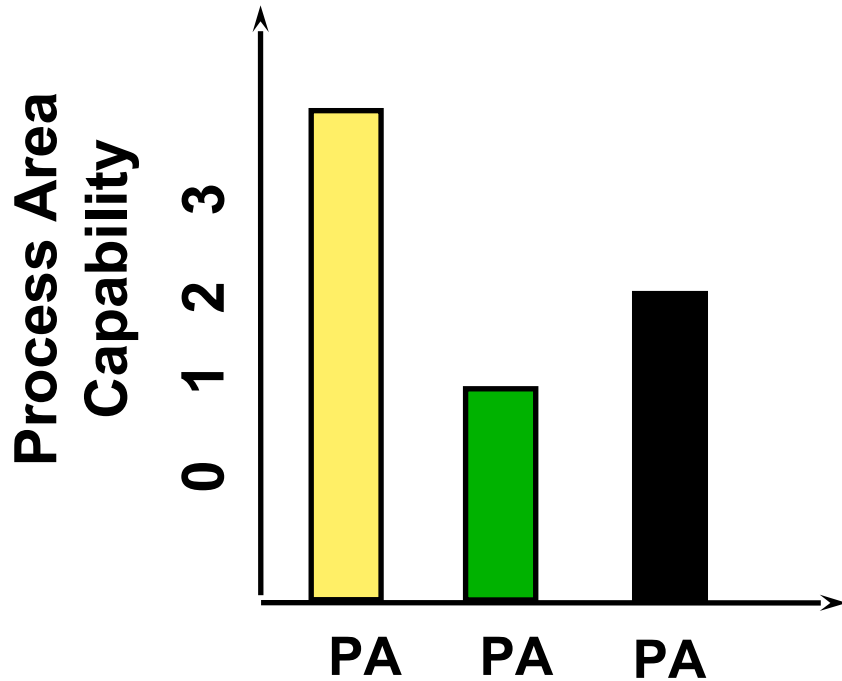
Provides *flexibility* for organizations to choose *which processes* to emphasize for improvement, as well as *how much* to improve each process.

Structured by Categories of Process Areas.

Comparing Model Representations

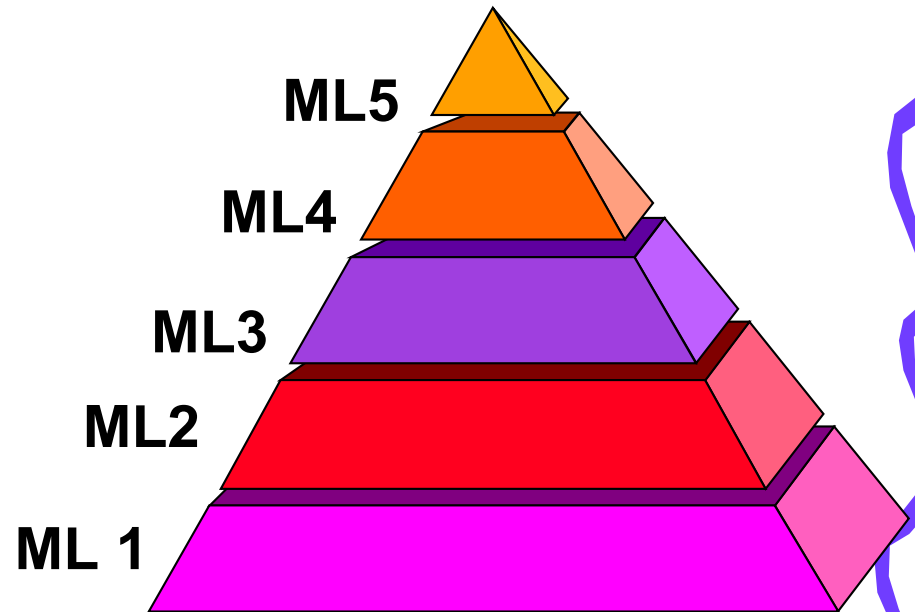


Continuous



...for a single process area or a set of process areas

Staged



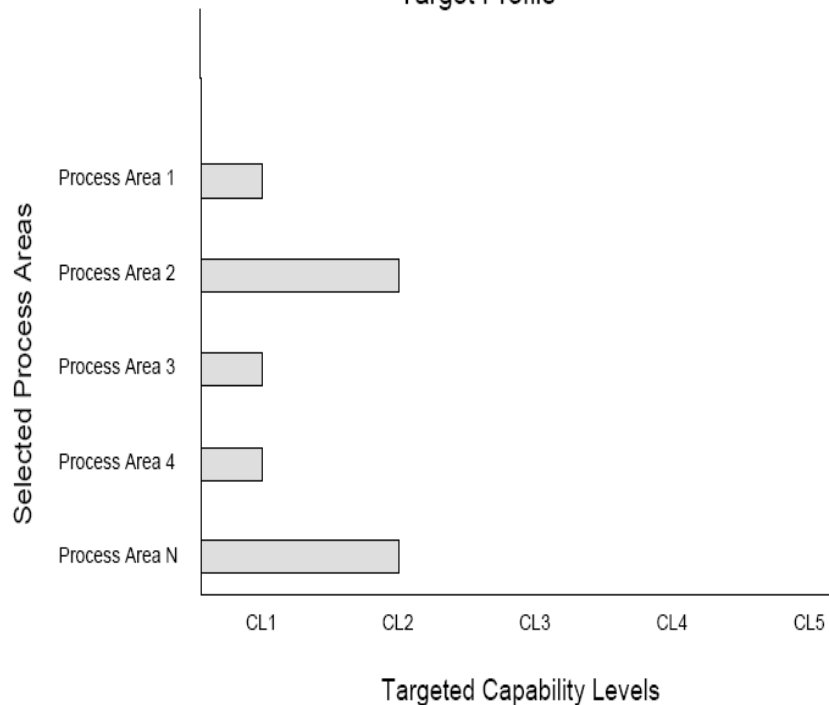
...for an established set of process areas across an organization

Process Areas

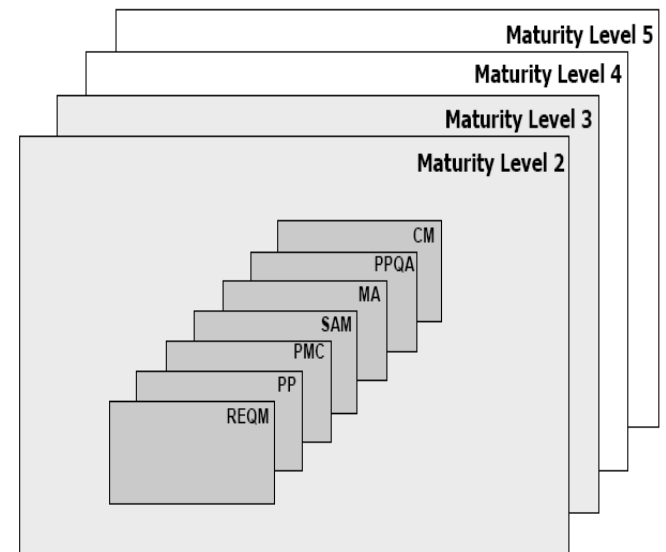


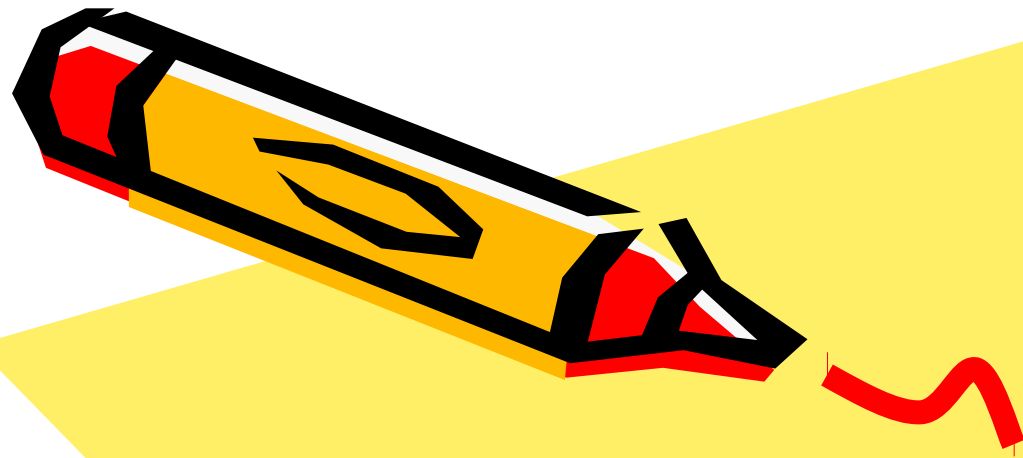
- How PAs used in two representations

Continuous
Target Profile



Staged
Selected Maturity Level





CMMI

Staged Representation

Organizational maturity

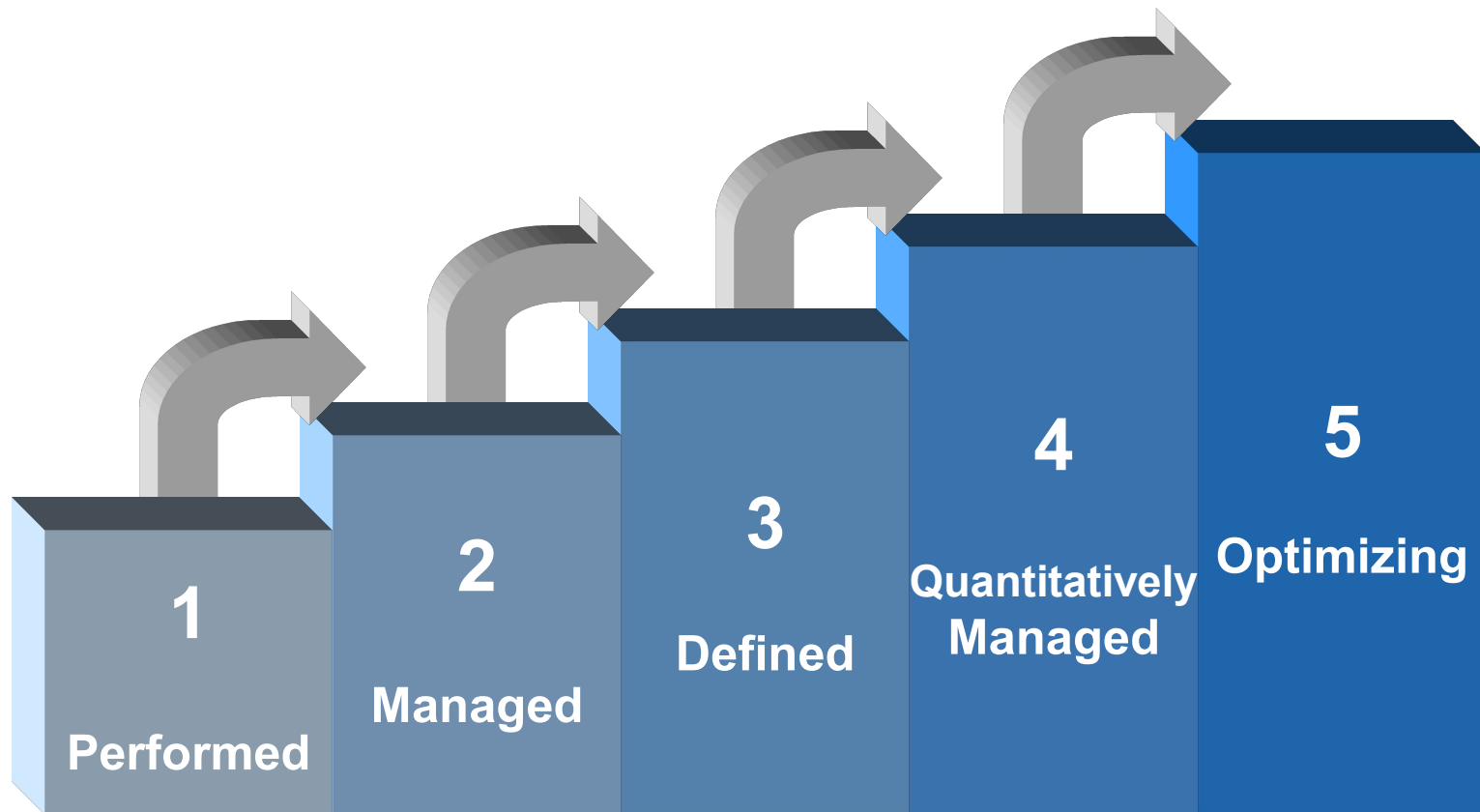


Maturity Levels

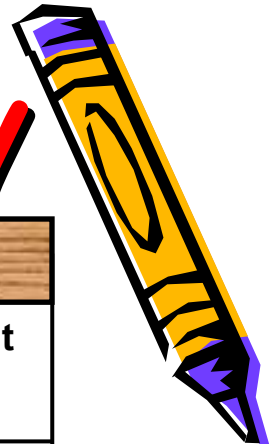


- A well-defined evolutionary plateau on the path to becoming a mature organization.
- Maturity levels consist of a predefined set of **process areas**.
- The maturity levels are measured by the achievement of the **specific and generic goals** that apply to each predefined set of process areas.
- There are **five** maturity levels.
- Each level is a layer in the foundation for continuous process improvement.

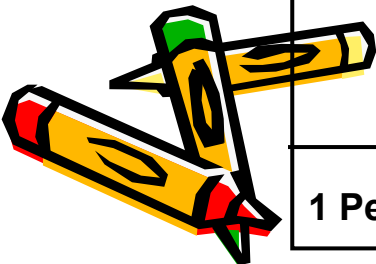
Maturity Levels - Staged



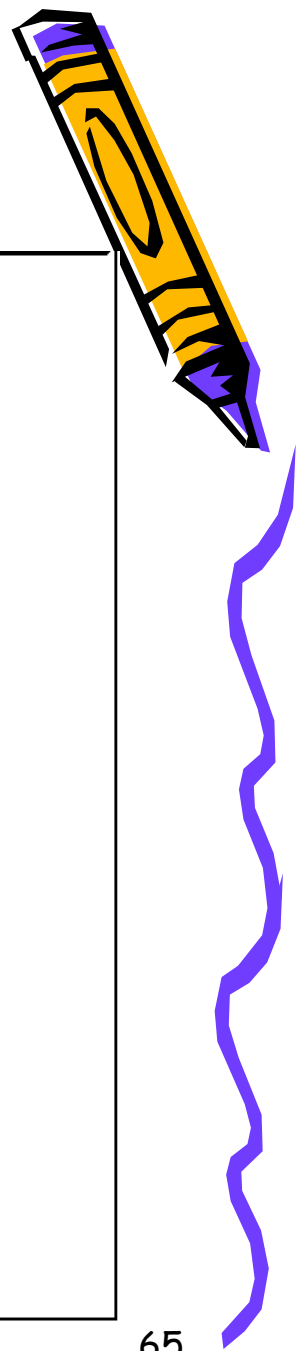
Process Area - Maturity



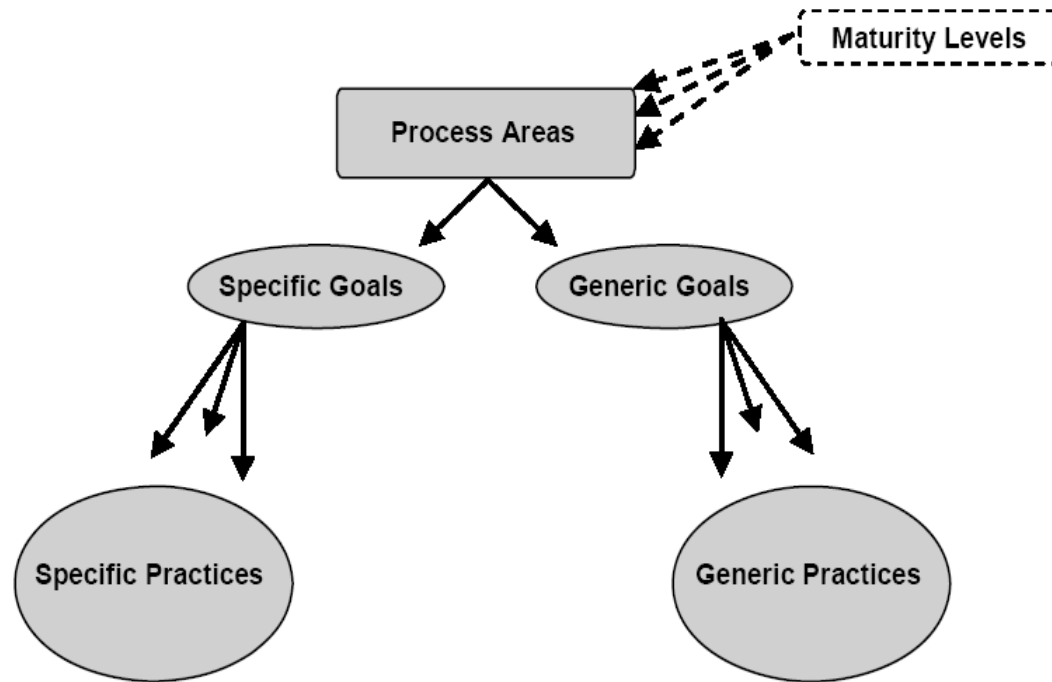
Level	Focus	Process Areas
5 Optimizing	<i>Continuous process improvement</i>	Organizational Performance Management Causal Analysis and Resolution
4 Quantitatively Managed	<i>Quantitative management</i>	Organizational Process Performance Quantitative Project Management
3 Defined	<i>Process standardization</i>	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	<i>Basic project management</i>	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed		



Staged Representation



Staged Representation



Process Areas (PAs)

- PA is clusters of related practices performed collectively to achieve a set of goals.
- PAs are organized by maturity levels.
- They are the major building blocks in establishing the process capability of an organization.



Specific Goals & Practices



- Specific Goals (SGs)
 - SGs apply to a process area and address the unique characteristics that describe what must be implemented to satisfy the process area.
 - SGs are **required** model components and are used in appraisals to help determine whether a process area is satisfied.
- Specific Practices (SPs)
 - SP is an activity that is considered important in achieving the associated specific goal.
 - SPs describe the activities expected to result in achievement of the specific goals of a process area.
 - SPs are **expected** model components.



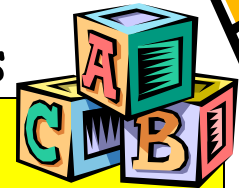
Practices

- Practices are the building blocks of the process areas

Example - Project Planning Process Area

Specific Practice 1.1 - Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.

- To satisfy the required goals, you are expected to perform the practices
 - Most commercial and defense projects/organizations will implement as written
- You may perform equivalent practices if they have an equivalent effect toward satisfying the generic or specific goal
 - These are termed "alternative practices"
 - "Equivalent" is a judgment call



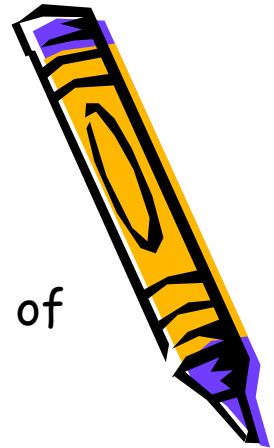
Generic Goals & Practices



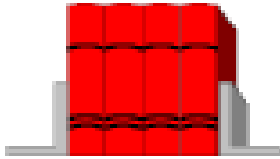
- Generic Goals (GGs)
 - GGs are called "generic" because the same goal statement appears in multiple process areas.
 - In the staged representation, each process area has only one generic goal. (Only the generic goal title and statement appear in the process areas.)
 - GGs are **required** model components and are used in appraisals to determine whether a process area is satisfied.
- Generic Practices (GPs)
 - GPs provide institutionalization to ensure that the processes associated with the process area will be effective, repeatable, and lasting.
 - GPs are categorized by generic goals and common features and are expected components in CMMI models.



Common Features



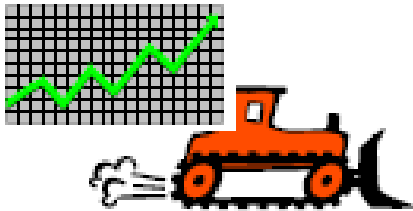
- Common features are a means of categorizing generic practices of each PA.



- *Commitment to perform (CO):*
establishment of management policies



- *Ability to perform (AB):*
establishment and maintenance of plans, resources, assigned responsibility and authority, and training



- *Directing implementation (DI):*
measurement, control, and performance practices



- *Verification (VE):*
ensure implementation and compliance

Informatives



- Typical Work Product
 - an informative model component that provides example outputs from a specific or generic practice.
- Subpractices
 - are detailed descriptions that provide guidance for interpreting specific or generic practices.
- Discipline Amplifications
 - are informative model components that contain information relevant to a particular discipline and are associated with specific practices.



Requirements Management



- Purpose:
 - The purpose of Requirements Management is to manage the requirements of the project's products and product components and to identify inconsistencies between those requirements and the project's plans and work products.



Requirements Management



- SG 1 Manage Requirements
 - *Requirements are managed and inconsistencies with project plans and work products are identified.*
 - SP 1.1 Obtain an Understanding of Requirements
 - SP 1.2 Obtain Commitment to Requirements
 - SP 1.3 Manage Requirements Changes
 - SP 1.4 Maintain Bidirectional Traceability of requirements
 - SP 1.5 Identify Inconsistencies between Project Work and Requirements



Requirements Management



- GG 2 Institutionalize a Managed Process
 - *The process is institutionalized as a managed process.*
 - GP 2.1 (CO 1) Establish an Organizational Policy
 - » *Establish and maintain an organizational policy for planning and performing the requirements management process.*
 - GP 2.2 (AB 1) Plan the Process
 - » *Establish and maintain the plan for performing the requirements management process.*
 - GP 2.3 (AB 2) Provide Resources
 - GP 2.4 (AB 3) Assign Responsibility
 - GP 2.5 (AB 4) Train People
 - GP 2.6 (DI 1) Manage Configurations
 - GP 2.7 (DI 2) Identify and Involve Relevant Stakeholders
 - GP 2.8 (DI 3) Monitor and Control the Process
 - GP 2.9 (VE 1) Objectively Evaluate Adherence
 - GP 2.10 (VE 2) Review Status with Higher Level Management
 - » *Review the activities, status, and results of the requirements management process with higher level management and resolve issues.*



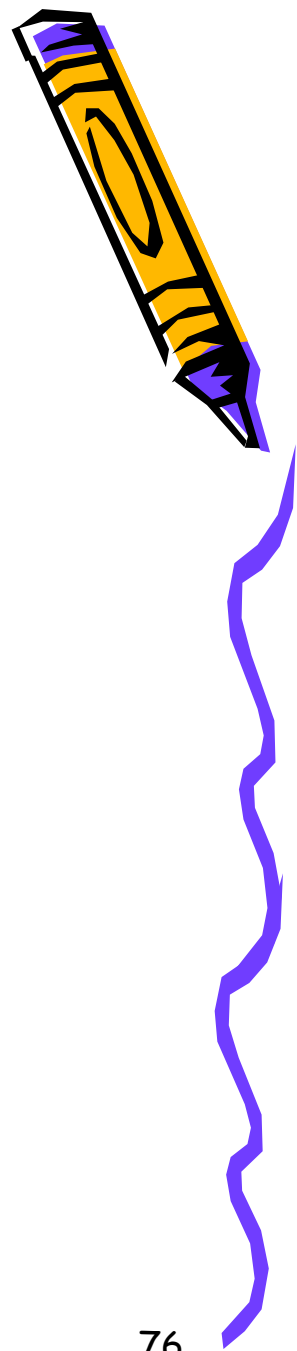
Requirements Management



- GG 3 Institutionalize a Defined Process
 - *The process is institutionalized as a defined process.*
 - GP 3.1 Establish a Defined Process
 - » *Establish and maintain the description of a defined requirements management process.*
 - GP 3.2 Collect Improvement Information
 - » *Collect work products, measures, measurement results, and improvement information derived from planning and performing the requirements management process to support the future use and improvement of the organization's processes and process assets.*



How Long To Move Up



1992 to June 2005*

Maturity Level	Median # Months
level 1 to 2	19
level 2 to 3	20
level 3 to 4	25
level 4 to 5	13

* Software CMM® Appraisal Results through June 2005

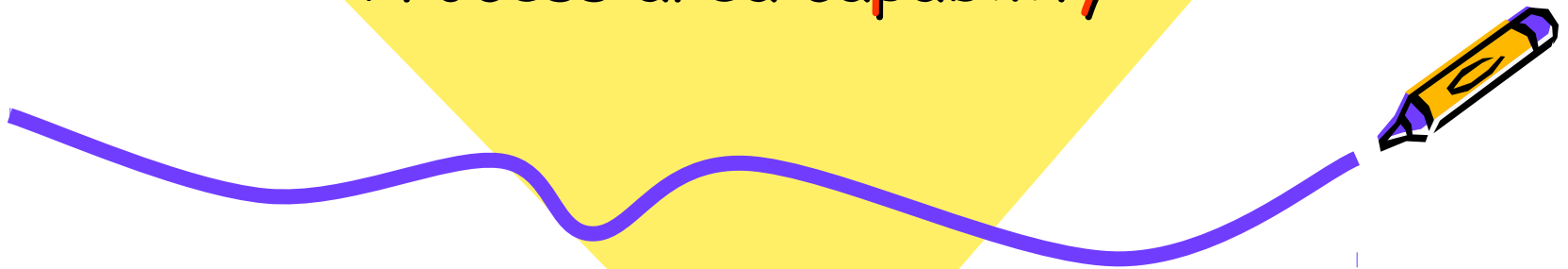




CMMI

**Continuous
Representation**

Process area capability



Process Area Capability Profile



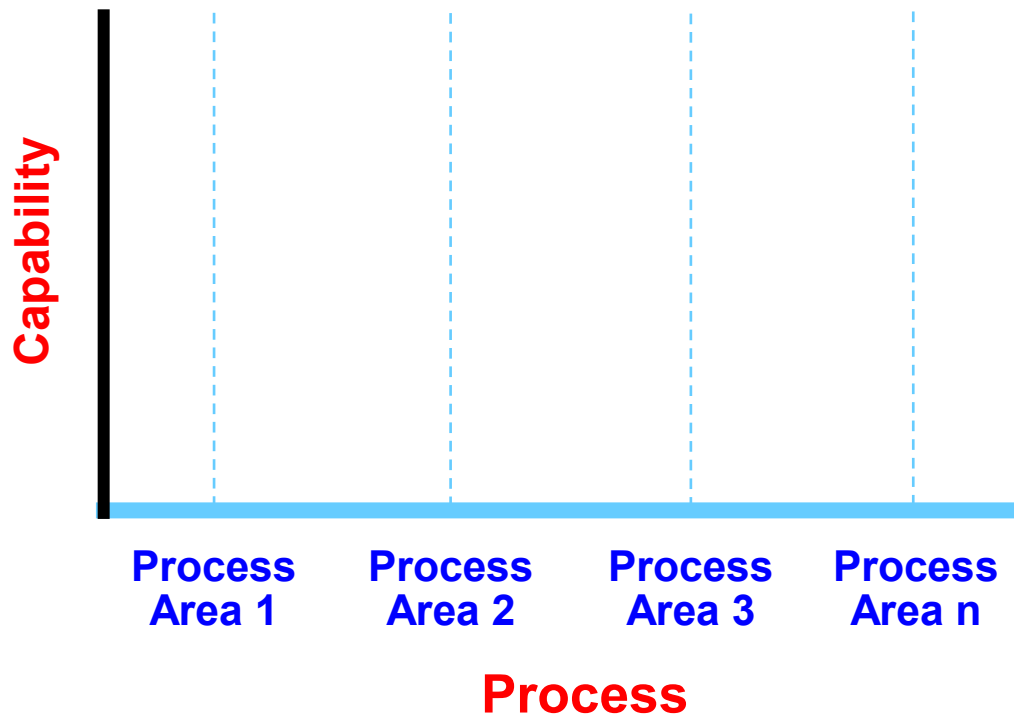
- A process area capability profile may be represented by a set of points in two dimensions.
 - the *process dimension* - "What" you do
 - the *capability dimension* - "How well" you do it



Process Dimension



- The values on this axis describe what processes (described within *Process Areas*) you perform.



Capability Levels

- A capability level is a well-defined evolutionary plateau describing the capability of a *process area*.
- There are **four** capability levels.
- Each level is a layer in the foundation for continuous process improvement.
- Thus, capability levels are cumulative, i.e., a higher capability level includes the attributes of the lower levels.



The Capability Levels

3 Defined

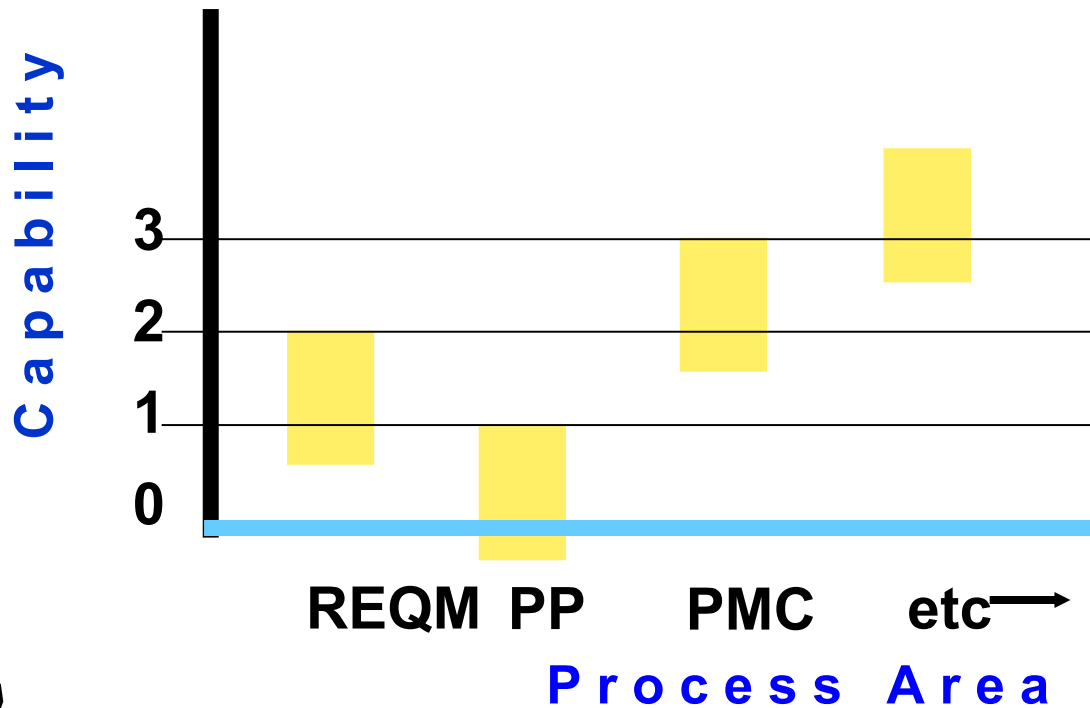
2 Managed

1 Performed

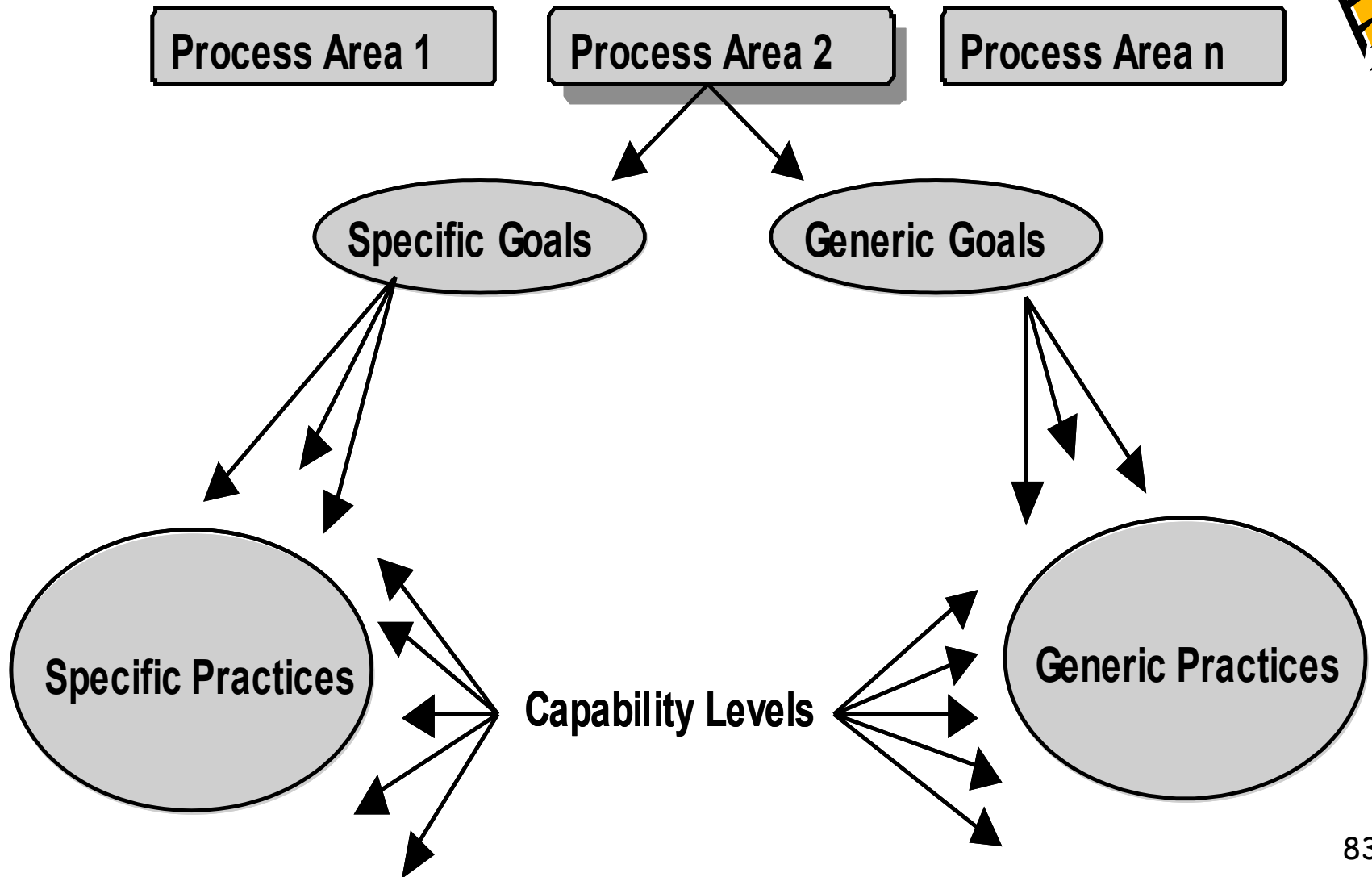
0 Incomplete



Example Process Area Capability Profile



Model Components

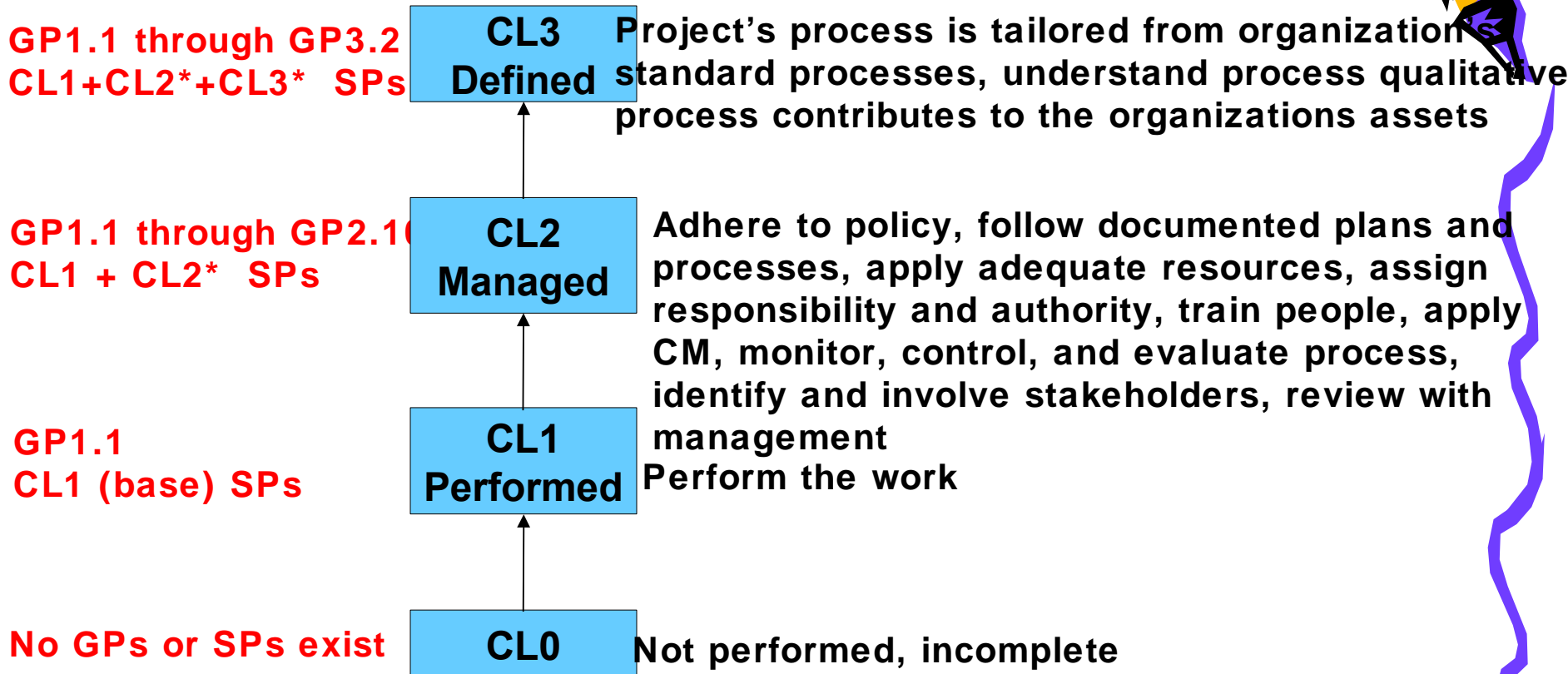


Continuous Representation

- Measures maturity (capability level) of each process area
- Permits maturing of selected processes

		Requirements Management	Project Planning	Project Monitoring and Control	Supplier Agreement Management	Measurement and Analysis	Process and Product Quality Assurance	Configuration Management	Requirements Development	Technical Solution	Product Integration	Verification	Validation	Organization Process Focus	Organization process definition	Organizational Training	Integrated Project Management	Risk Management	Decision Analysis and Resolution	Organizational Process Performance	Quantitative Project Management	Organizational Innovation and Deployment	Causal Analysis and Resolution	
GG 5	Institutionalize an Optimizing Process																							
	GP 5.1 Ensure Continuous Process Improvement																							
	GP 5.2 Correct Root Causes of Problems																							
GG 4	Institutionalize a Quantitatively Managed Process																							
	GP 4.1 Establish Quantitative Objectives for the Process																							
	GP 4.2 Stabilize Subprocess Performance																							
GG 3	Institutionalize a Defined Process																							
	GP 3.1 Establish a Defined Process																							
	GP 3.2 Collect Improvement Information																							
GG 2	Institutionalize a Managed Process																							
	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																							
GG 1	Achieve Specific Goals																							
	GP 1.1 Perform Base Practices																							

Improving a Process Area



REQM - Capabilities Level 1 & 2

Requirements Management

Specific practices (CL1 - "base")

- SP1.1-1: Obtain an Understanding of Requirements
- SP1.3-1: Manage Requirements Changes
- SP1.5-1: Identify Inconsistencies Between Project Work and Requirements

Generic practices (CL1)

- GP1.1: Perform Base Practices

Specific practices (CL2 - "advanced")

- SP1.2-2: Obtain Commitment to Requirements
- SP1.4-2: Maintain Bidirectional Traceability of Requirements

Generic practices (CL2)

- GP2.1: Establish an Organizational Policy
- GP2.2: Plan the Process
- GP2.3: Provide Resources
- GP2.4: Assign Responsibility
- GP2.5: Train People
- GP2.6: Manage Configurations
- GP2.7: Identify and Involve Relevant Stakeholders
- GP2.8: Monitor and Control the Process
- GP2.9: Objectively Evaluate Adherence
- GP2.10: Review Status with Higher Level Management



REQM - Capabilities Level 2 & 3

Requirements Management



Specific practices (CL1 & CL2)

- SP1.1-1: Obtain an Understanding of Requirements
- SP1.2-2: Obtain Commitment to Requirements
- SP1.3-1: Manage Requirements Changes
- SP1.4-2: Maintain Bidirectional Traceability of Requirements
- SP1.5-1: Identify Inconsistencies Between Project Work and Requirements

Generic practices (CL1 & CL2)

- GP1.1: Perform Base Practices
- GP2.1: Establish an Organizational Policy
- GP2.2: Plan the Process
- GP2.3: Provide Resources
- GP2.4: Assign Responsibility
- GP2.5: Train People
- GP2.6: Manage Configurations
- GP2.7: Identify and Involve Relevant Stakeholders
- GP2.8: Monitor and Control the Process
- GP2.9: Objectively Evaluate Adherence
- GP2.10: Review Status w/Higher Level Management

Specific practices (CL3)

All the CL1 & CL2 Specific Practices

Generic practices (CL3)

All the CL1 & CL2 Generic Practices plus(+):

- GP3.1: Establish a Defined Process
- GP3.2: Collect Improvement Information



Equivalent

- a target staging that is equivalent to the maturity levels of the staged representation.
 - To achieve target profile 2 (equivalent to ML 2), the process areas to the left of target profile 2 must have satisfied CL 1 and 2.

OR

- To achieve ML 2, all process areas assigned to maturity level 2 must achieve CL 2 or above.



Name	Abbr	ML	CL1	CL2	CL3	CL4	CL5
Requirements Management	REQM	2	Target Profile 2				
Measurement and Analysis	MA	2					
Project Monitoring and Control	PMC	2					
Project Planning	PP	2					
Process and Product Quality Assurance	PPQA	2					
Supplier Agreement Management	SAM	2					
Configuration Management	CM	2					
Decision Analysis and Resolution	DAR	3	Target Profile 3				
Product Integration	PI	3					
Requirements Development	RD	3					
Technical Solution	TS	3					
Validation	VAL	3					
Verification	VER	3					
Organizational Process Definition	OPD	3					
Organizational Process Focus	OPF	3					
Integrated Project Management (IPPD)	IPM	3					
Risk Management	RSKM	3					
Integrated Supplier Management	ISM	3					
Organizational Training	OT	3					
Integrated Teaming	IT	3					
Organizational Environment for Integration	OEI	3					
Organizational Process Performance	OPP	4	Target Profile 4				
Quantitative Project Management	QPM	4					
Organizational Innovation and Deployment	OID	5	Target Profile 5				88
Causal Analysis and Resolution	CAR	5					

Level 1 Organization

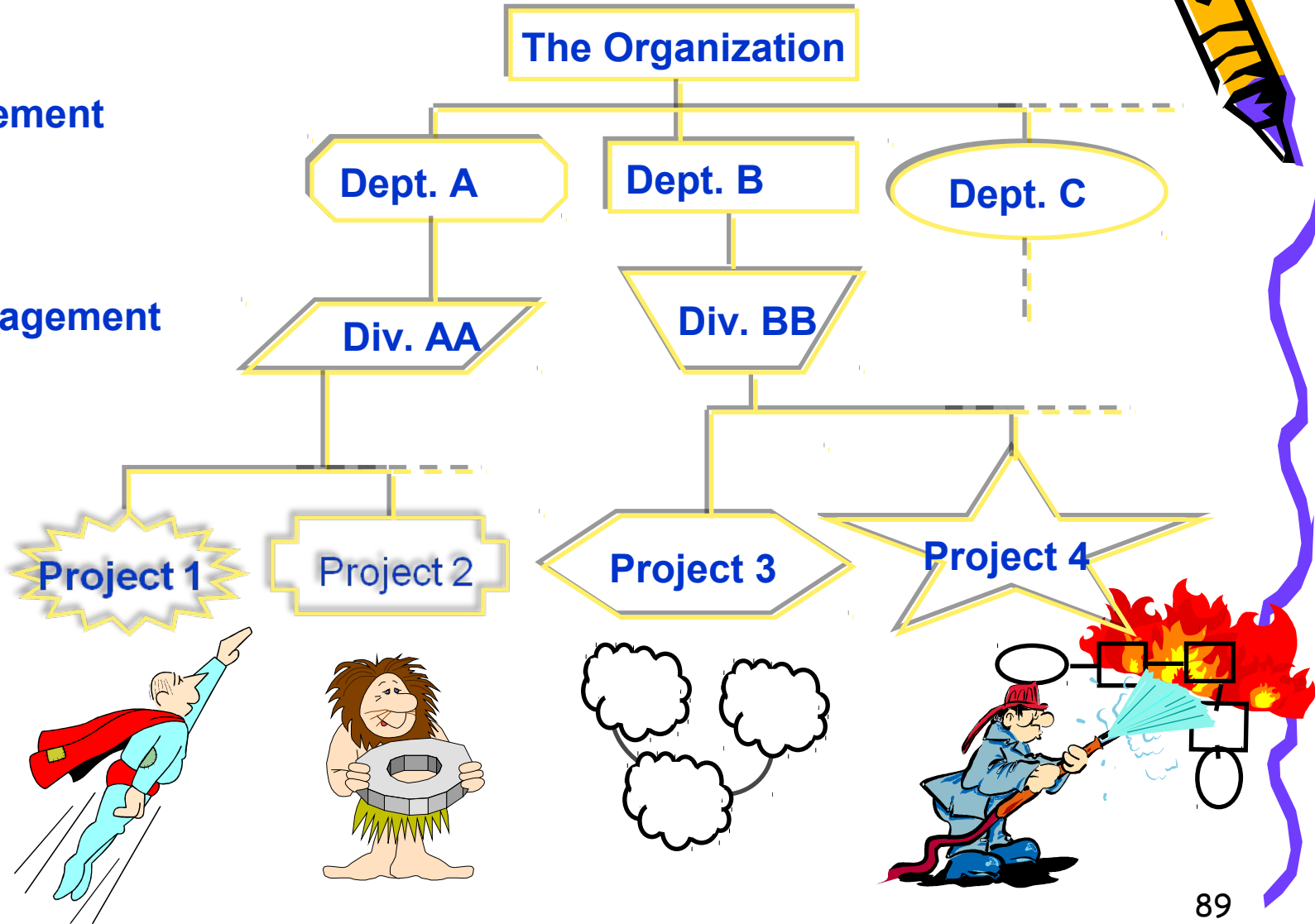


Top Management

Middle Management

Projects

Processes



Level 2 Organization

many processes in place; but they are project-specific

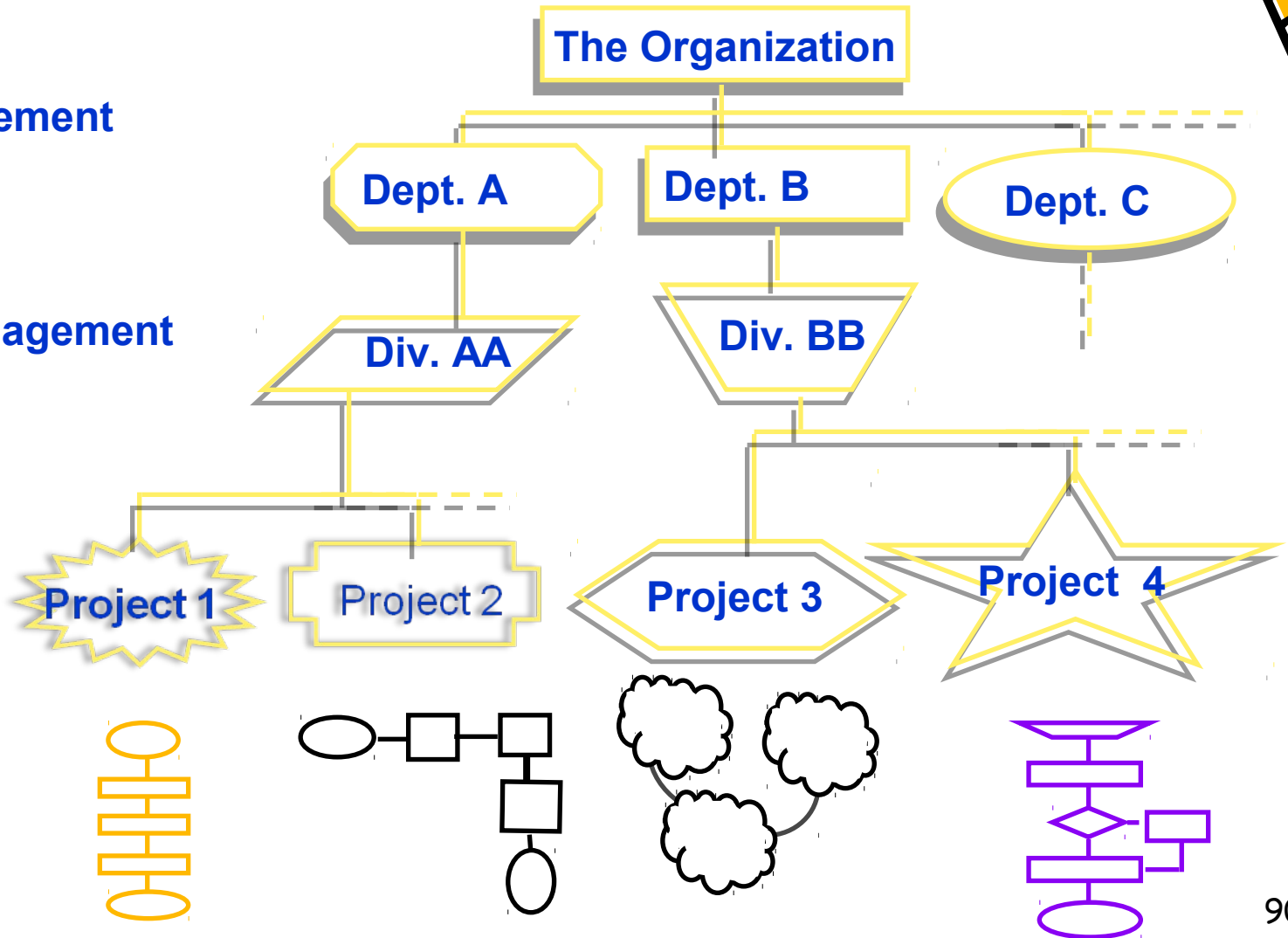


Top Management

Middle Management

Projects

Processes



Level 3 Organization

processes based on organization's Process Asset Library (PAL)



Process Asset Library

- Approved life cycles
- Standard processes
- Tailoring guidelines
- Process database
- Related documents



The Organization

SEPO

Dept. A

Dept. B

Dept. C

Div. AA

Div. BB

Project 1

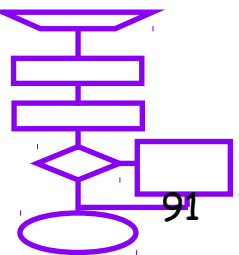
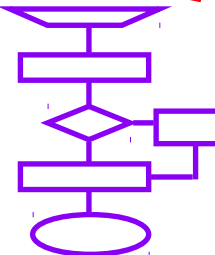
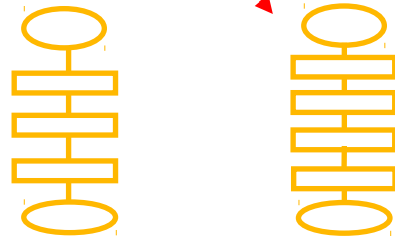
Project 2

Project 3

Project 4

Projects

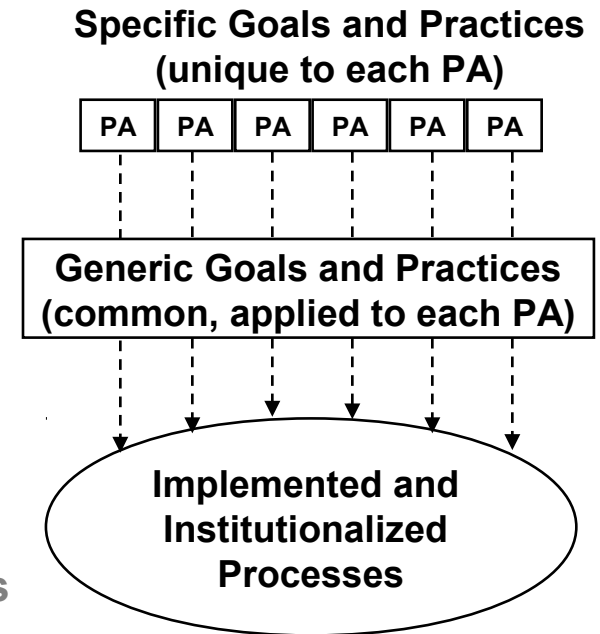
Processes



CMMI Generic Practices

Institutionalization of each Process Area

- GP1.1 Perform Base Practices
- GP2.1 Establish an Organizational Policy
- GP2.2 Plan the Process
- GP2.3 Provide Resources
- GP2.4 Assign Responsibility
- GP2.5 Train People
- GP2.6 Manage Configurations
- GP2.7 Identify and Involve Relevant Stakeholders
- GP2.8 Monitor and Control the Process
- GP2.9 Objectively Evaluate Adherence
- GP2.10 Review Status with Higher Level Management
- GP3.1 Establish a Defined Process
- GP3.2 Collect Improvement Information
- GP4.1 Establish Quantitative Objectives for the Process
- GP4.2 Stabilize Subprocess Performance
- GP5.1 Ensure Continuous Process Improvement

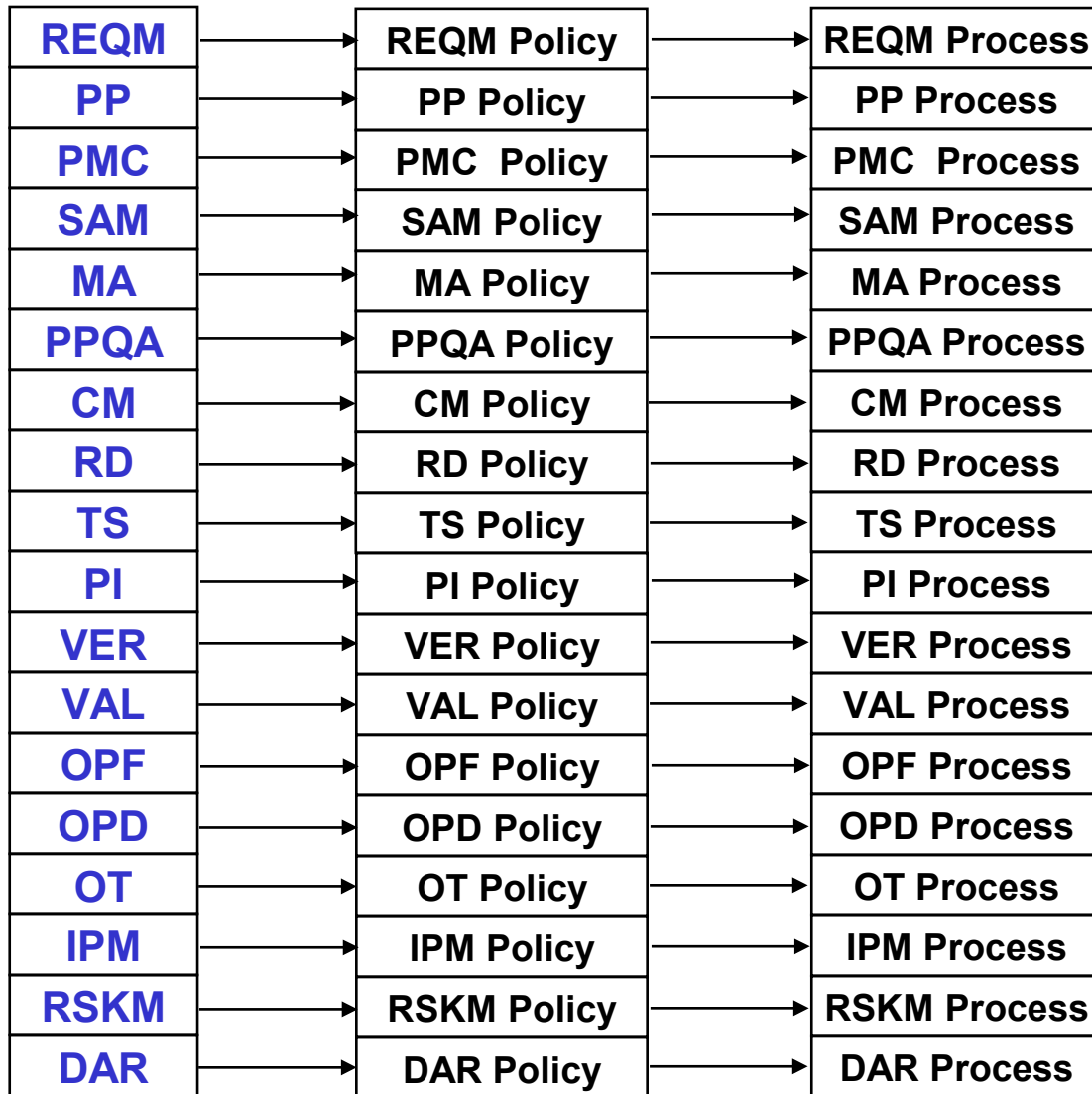


Continuous representation only

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

Implementing CMMI Model

Process Architecture - 1



Option #1: Brute Force

- Processes directly derived from CMMI model

Advantages:

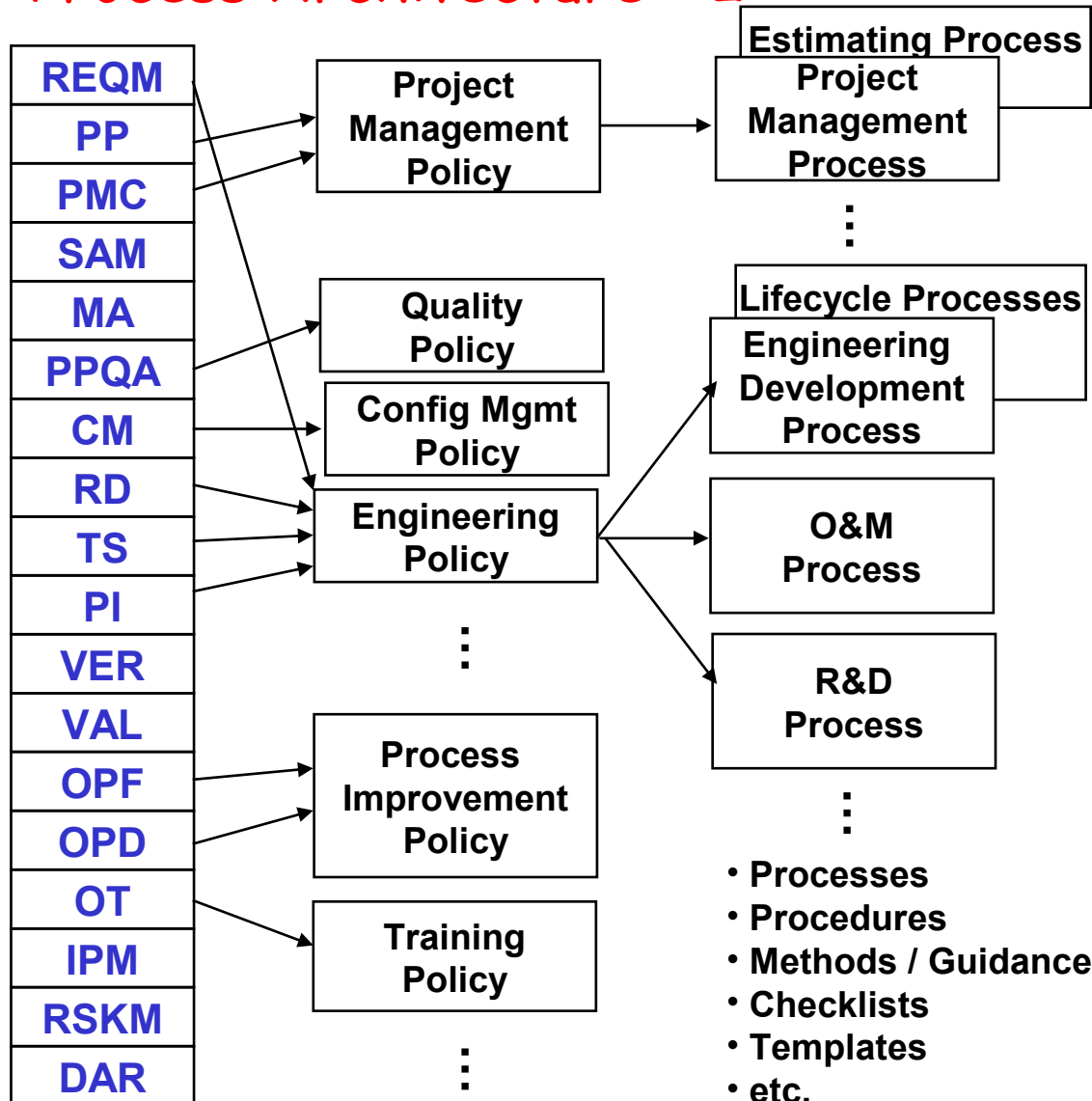
- "Idiot-proof" linkage for CMMI appraisals
- Supports explicit implementations of specific/generic practices (PIIs)

Disadvantages:

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

Implementing CMMI Model

Process Architecture - 2



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

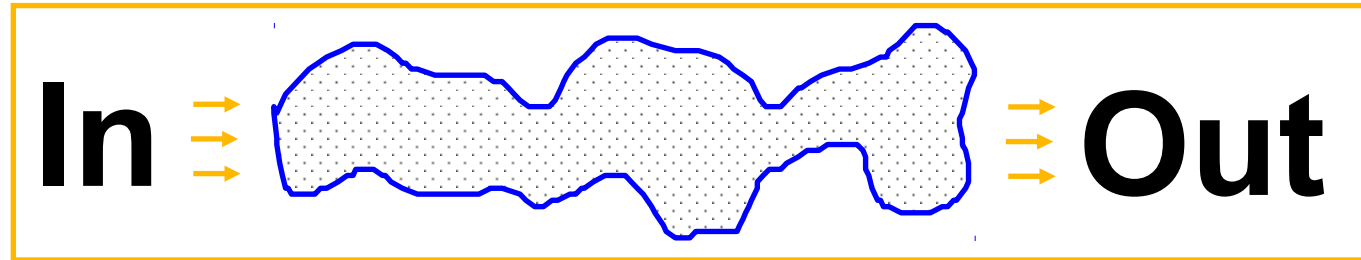
- Processes
- Procedures
- Methods / Guidance
- Checklists
- Templates
- etc.



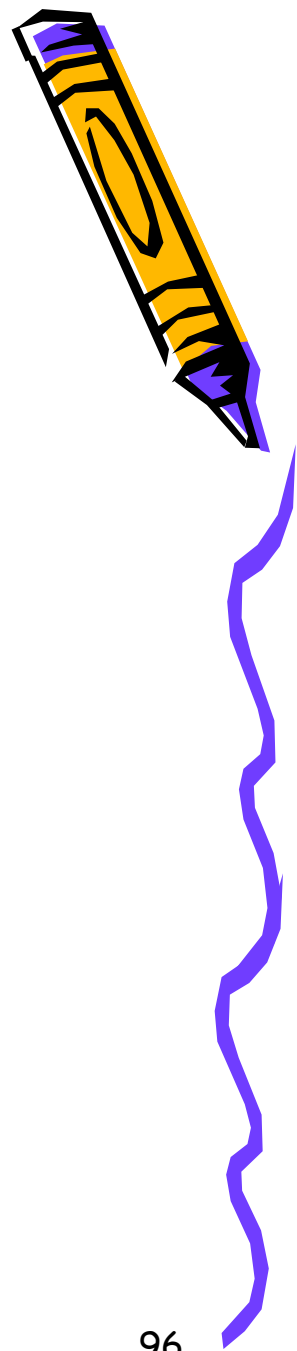
Maturity Level

Maturity Level 1

Performance Unpredictable



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



Level 1: "Initial" Level

Good performance is possible - but

- Requirements often misunderstood, uncontrolled
- Schedules and budgets frequently missed
- Progress not measured
- Product content not tracked or controlled
- Engineering activities nonstandard, inconsistent
- Teams not coordinated, not trained
- Defects proliferate

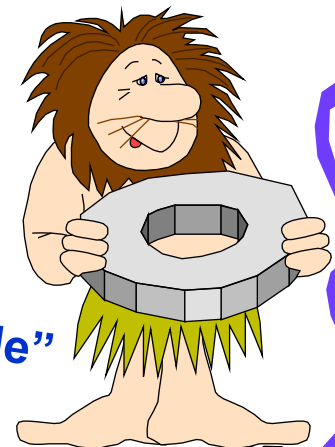
"Schedules
run everything"

"Just send in
the Tiger Team"

"Processes limit my creativity"

"Processes don't help my delivery schedule"

Success depends on heroes



Process Areas - Maturity Level 2

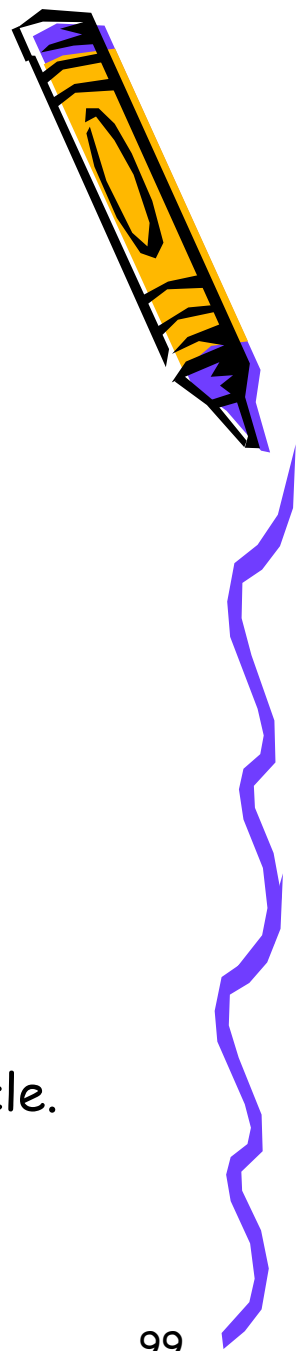


Level	Focus	Process Areas
2 Managed	Basic Project Management	Requirements Management (REQM) Project Planning (PP) Project Monitoring and Control (PMC) Supplier Agreement Management (SAM) Measurement and Analysis (MA) Process and Product Quality Assurance (PPQA) Configuration Management (CM)

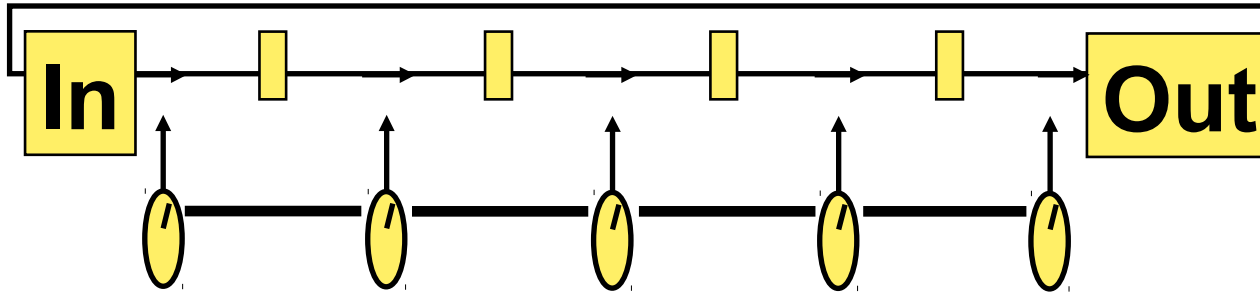


Level 2: "Managed"

- Past successes can be expected on *similar* projects.
- Organizational policies are established and followed.
- Projects plans and process descriptions are documented and followed.
- Resources are adequate
- Responsibility and authority is assigned over the life cycle.



Level 2: Mgmt Visibility



- Requirements flow in.
- Plans are developed in accordance with policies.
- Activities are performed in accordance with plans.
- Measurements and reviews occur at defined points (major milestones in life cycle).

The product flows out and (usually) works.



CMMI Terminology



- **Managed process**
 - Planned and executed in accordance with organizational policy
 - Employs skilled people having adequate resources to produce controlled outputs
 - Involves relevant stakeholders
 - Is monitored, controlled and reviewed
 - Is evaluated for adherence to its process description
 - *Exists at the project level*



Requirements Management (REQM)



Purpose:

1. Manage the requirements of the project's products and product components
2. Identify inconsistencies between those requirements and the project's plans and work products

SG 1 Requirements are managed and inconsistencies with project plans and work products are identified



Project Planning (PP)



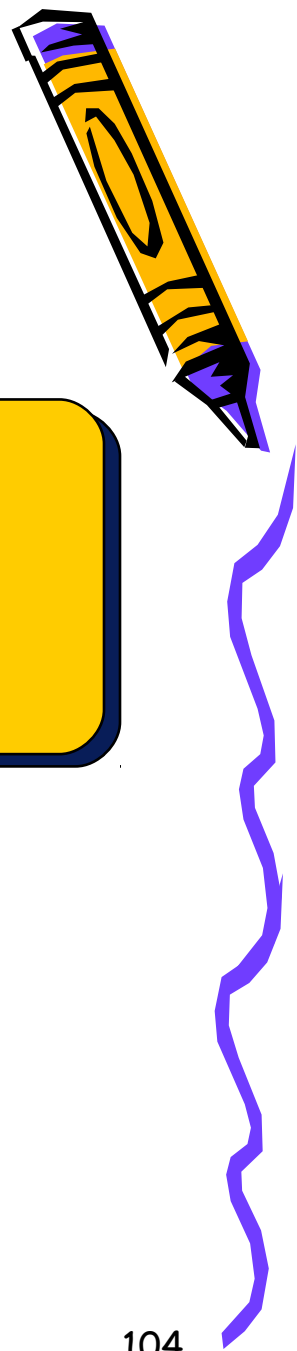
Purpose:

Establish and maintain plans that define project activities

- SG 1** Estimates of project planning parameters are established and maintained
- SG 2** A project plan is established and maintained as the basis for managing the project
- SG 3** Commitments to the project plan are established and maintained



Project Monitoring and Control (PMC)



Purpose:

Provide an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan.

- SG 1** Actual performance and progress of the project are monitored against the project plan
- SG 2** Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan



Supplier Agreement Management (SAM)



Purpose:

Manage the acquisition of products from suppliers for which there exists a formal agreement.

SG 1 Agreements with the suppliers are established and maintained

SG 2 Agreements with the suppliers are satisfied by both the project and the supplier

Definition of Supplier:

An entity delivering products or performing services being acquired.

An individual, partnership, company, corporation, association, or other service having an agreement (contract) with an acquirer for the design, development, manufacture, maintenance, modification, or supply of items under the terms of an agreement (contract).

Note: SAM primarily applies to acquisition of products and product components delivered to project's customer.

Measurement and Analysis (MA)

Purpose:

Develop and sustain a measurement capability that is used to support management information needs.

- SG 1** Measurement objectives and activities are aligned with identified information needs and objectives
- SG 2** Measurement results that address identified information needs and objectives are provided



Process & Product Quality Assurance (PPQA)



Purpose:

Provide staff and management with objective insight into processes and associated work products.

- SG 1** Adherence of the performed process and associated work products and services to applicable process descriptions, standards, and procedures is objectively verified

- SG 2** Non-compliance issues are objectively tracked and communicated and resolution is ensured



Configuration Management (CM)

Purpose:

Establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.

SG 1 Baselines of identified work products are established

SG 2 Changes to work products under configuration control are tracked and controlled

SG 3 Integrity of baselines is established and maintained



Level 2 - Generic Practices



GG 2: Institutionalise as a Managed Process

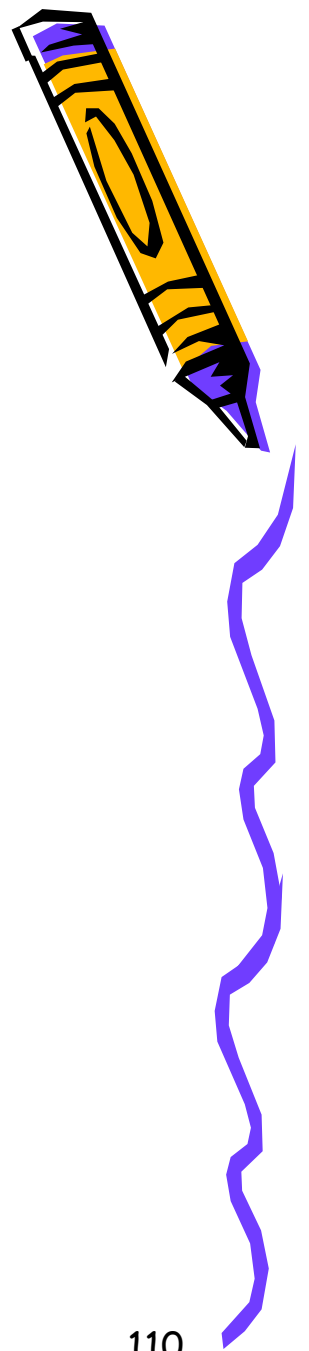
- GP 2.1 (CO 1): Establish an Organizational Policy
- GP 2.2 (AB 1): Plan the Process
- GP 2.3 (AB 2): Provide Resources
- GP 2.4 (AB 3): Assign Responsibility
- GP 2.5 (AB 4): Train People
- GP 2.6 (DI 1): Manage Configurations
- GP 2.7 (DI 2): Identify and Involve Relevant Stakeholders
- GP 2.8 (DI 3): Monitor and Control the Process
- GP 2.9 (VE 1): Objectively Evaluate Adherence
- GP 2.10 (VE 2): Review Status with Higher-Level Management

Note: GG2 and GP2.1 through GP2.10 apply to maturity levels 2 through 5 inclusive.





Level 2: Summary

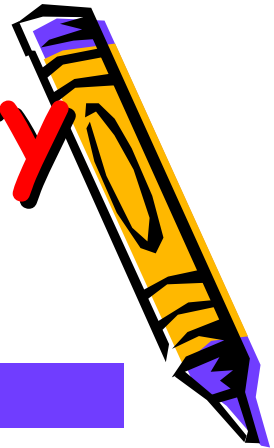


- Level 2 PAs - The Managed Level
 - Focus on project management rather than the organization
 - Individual projects have disciplined processes
 - Provide for establishing mechanisms for project management



The organization sets its project priorities through policies

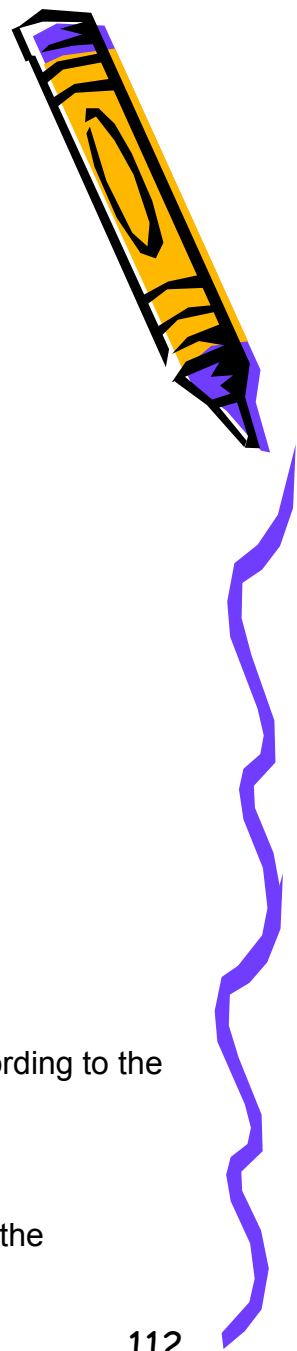
Process Areas - Maturity Level 3



Level	Focus	Process Areas
3 Defined	<i>Process</i>	Requirements Development (RD)
	<i>Standardization</i>	Technical Solution (TS)
		Product Integration (PI)
		Verification (VER)
		Validation (VAL)
		Organizational Process Focus (OPF)
		Organizational Process Definition (OPD)
		Organizational Training (OT)
		Risk Management (RSKM)
		Decision Analysis and Resolution (DAR)
		Integrated Project Management (IPM)



Maturity Level 3



■ Managed process (ML2)

- Planned and executed in accordance with organizational policy
- Employs skilled people having adequate resources to produce controlled outputs
- Involves relevant stakeholders
- Is monitored, controlled and reviewed
- Is evaluated for adherence to its process description
- ***Exists at the project level***

■ Standard process (ML3)

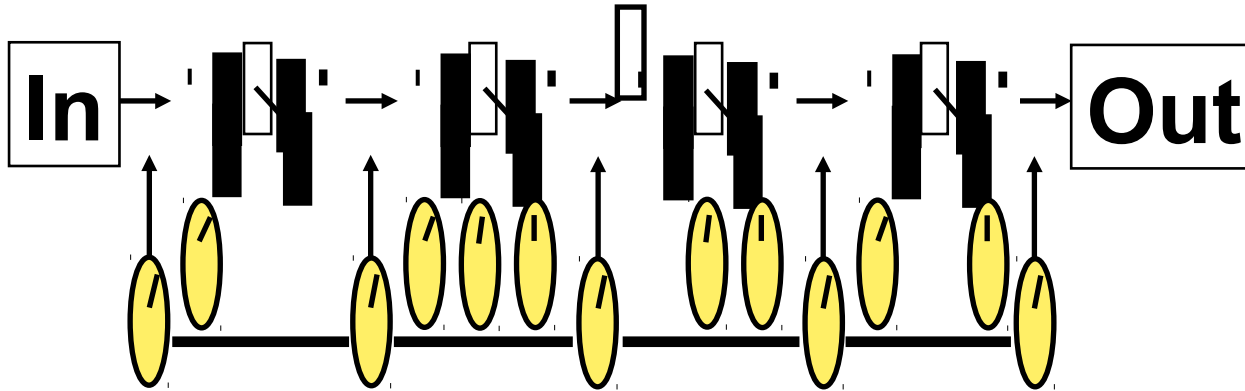
- Basic process guiding establishment of common processes across the organization
 - Describes fundamental elements expected in a process used by a project
 - Describes the relationships (e.g., ordering and interfaces) between these project process elements
- ***Exists at the organization level***

■ Defined process (ML3)

- A managed process that is ***tailored*** from the organization's set of standard processes according to the organization's tailoring guidelines;
- Has a maintained process description
- Contributes work products, measures, and other process-improvement information to the organizational process assets
- ***Exists at the project level***



Managed According to Defined Process



Commonality among projects allows more uniform estimation of performance.



Organization Process Focus (OPF)



Purpose:

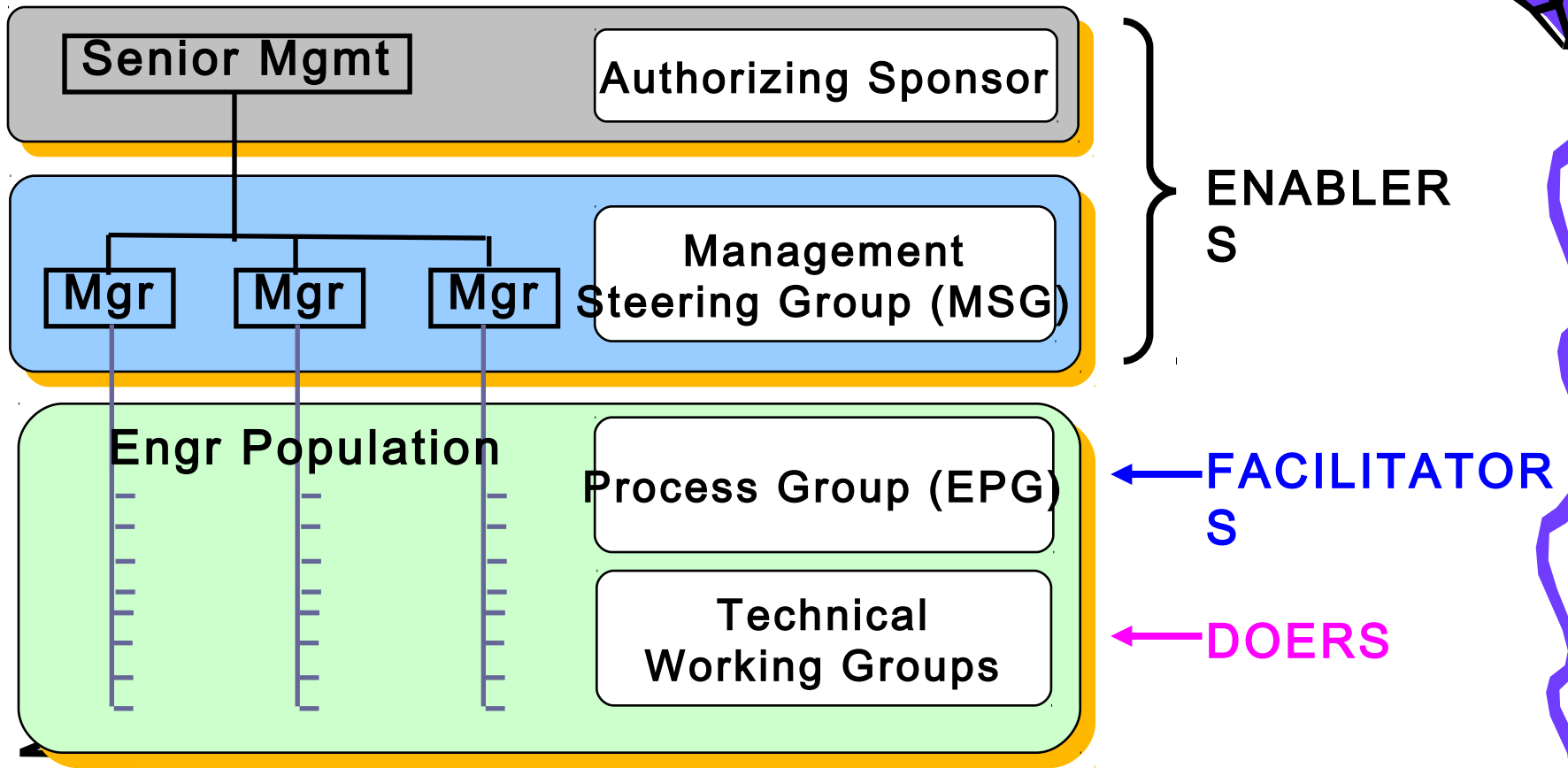
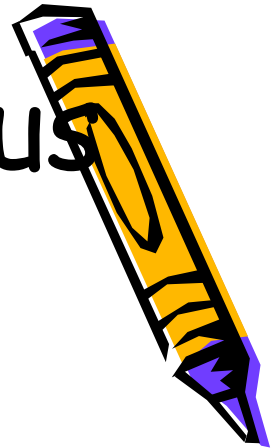
Plan and implement organizational process improvement based on a thorough understanding of the current strengths and weaknesses of the organization's processes and process assets.

SG 1 Strengths, weaknesses, and improvement opportunities for the organization's processes are identified periodically and as needed

SG 2 Improvements are planned and implemented, organizational process assets are deployed, and process-related experiences are incorporated into the organizational process assets



Organization Process Focus (con't)



Organization Process Definition (OPD)



Purpose:

Establish and maintain a usable set of organizational process assets.

SG 1 A set of organizational process assets is established and maintained



Organizational Training (OT)



Purpose:

Develop the skills and knowledge of people so they can perform their roles effectively and efficiently.

- SG 1** A training capability that supports the organization's management and technical roles is established and maintained

- SG 2** Training necessary for individuals to perform their roles effectively is provided.



Integrated Project Management (IPM)



Purpose:

Establish and manage the project and the involvement of the relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standard processes.

SG 1 The project is conducted using a defined process that is tailored from the organization's set of standard processes

SG 2 Coordination and collaboration of the project with relevant stakeholders is conducted



Risk Management (RSKM)



Purpose:

Identify potential problems before they occur, so that risk-handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives.

- SG 1** Preparation for risk management is conducted
- SG 2** Risks are identified and analyzed to determine their relative importance
- SG 3** Risks are handled and mitigated, where appropriate, to reduce adverse impacts on achieving objectives



Decision Analysis and Resolution (DAR)

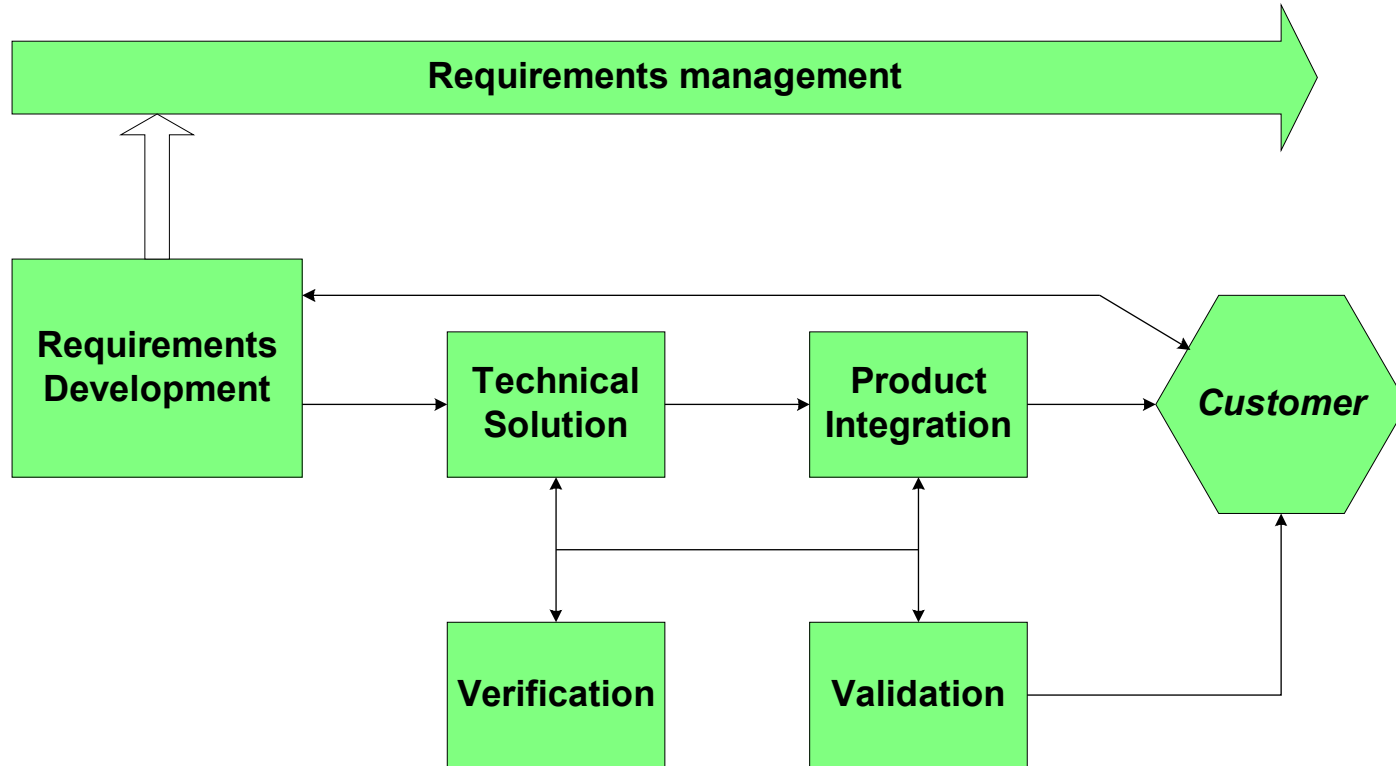
Purpose:

Analyse possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

SG 1 Decisions are based on an evaluation of alternatives using established criteria



Engineering Process Areas



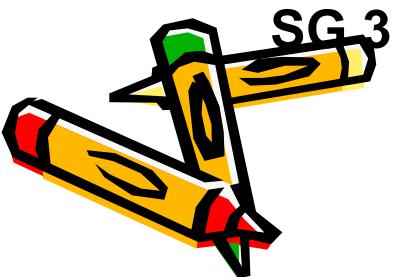
Requirements Development (RD)



Purpose:

Produce and analyse customer, product, and product component requirements

- SG 1** Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements
- SG 2** Customer requirements are refined and elaborated to develop product and product-component requirements
- SG 3** The requirements are analyzed and validated, and a definition of required functionality is developed



Technical Solution (TS)



Purpose:

1. Design, develop, and implement solutions to requirements.
2. Solutions, designs, and implementations encompass products, product components, and product-related life-cycle processes either singly or in combinations as appropriate .

SG 1 Product or product-component solutions are selected from alternative solutions

SG 2 Product or product-component designs are developed

SG 3 Product components, and associated support documentation, are implemented from their designs



Product Integration (PI)



Purpose:

Assemble the product from the product components, ensure that the product, as integrated, functions properly, and deliver the product.

- SG 1** Preparation for product integration is conducted
- SG 2** The product-component interfaces, both internal and external, are compatible
- SG 3** Verified product components are assembled and the integrated, verified, and validated product is delivered

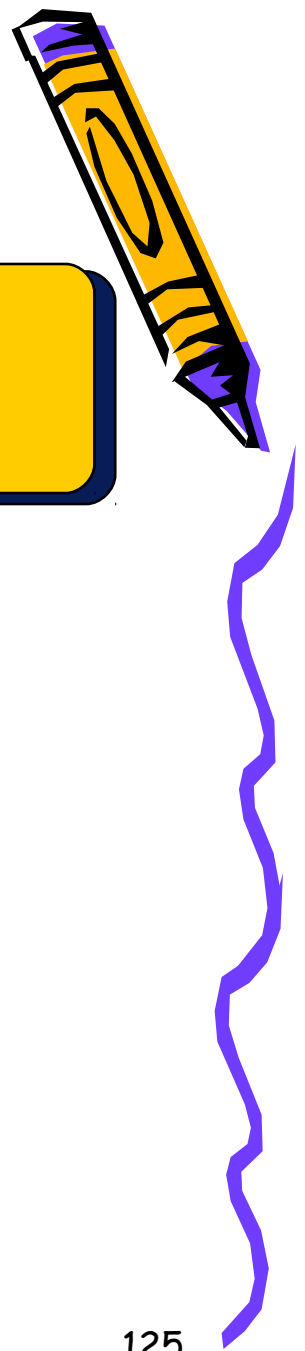


Verification (VER)

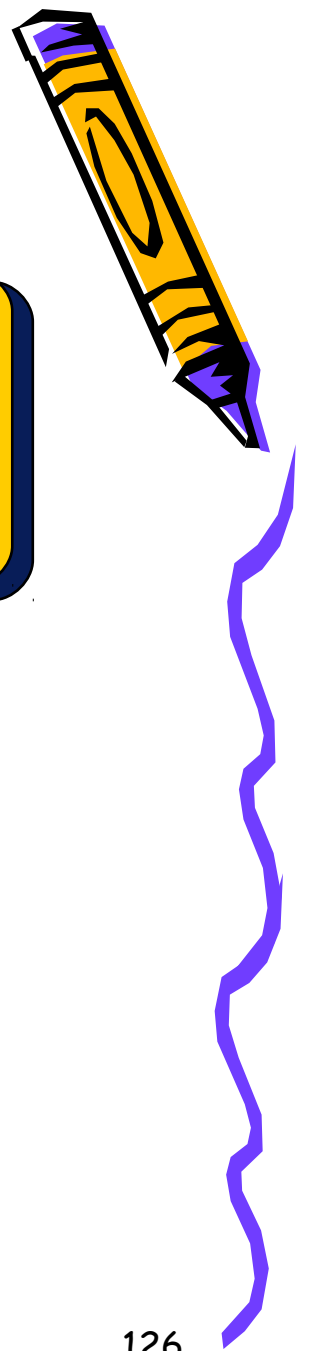
Purpose:

Ensure that selected work products meet their specified requirements

- SG 1** Preparation for verification is conducted
- SG 2** Peer reviews are performed on selected work products
- SG 3** Selected work products are verified against their specified requirements



Validation (VAL)



Purpose:

Demonstrate that a product or product component fulfils its intended use when placed in its intended environment.

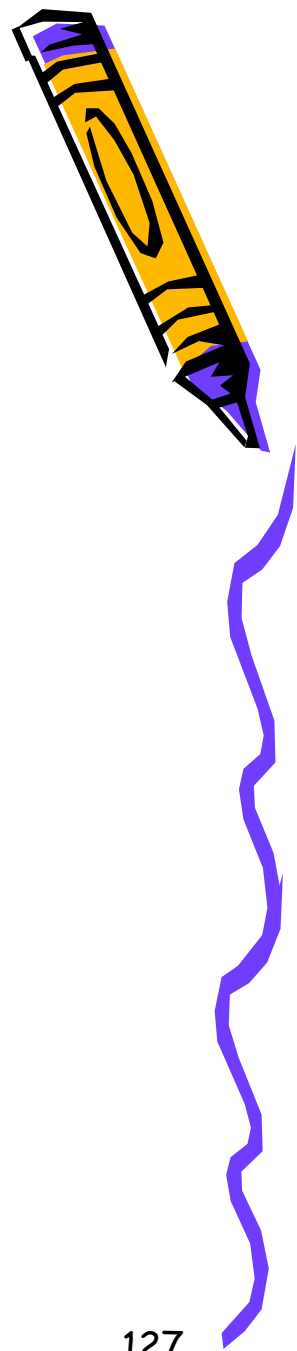
SG 1 Preparation for validation is conducted

SG 2 The product or product components are validated to ensure that they are suitable for use in their intended operating environment



Verification versus Validation

- Verification
 - Did you build the product right?
 - That is, did you meet the requirements specification?
- Validation
 - Did you build the right product?
 - That is, did you meet the operational need?
 - Customer usually more involved in Validation than Verification



Level 3: Summary

- A standard process is a defining characteristic of Maturity Level 3 organization.
 - OPD defines the standard process
 - Organization training provides a means to institutionalize the standard process
- A Maturity Level 3 organization is more proactive
 - Risk Management is a cornerstone proactive practice
 - In IPM, projects are managed using the integrated plans
- Engineering processes, protected by strong project management processes, are effectively implemented



Established Foundation Maturity Level 4



- The foundation for quantitative management comes from Maturity levels 2 and 3.
- Includes:
 - Defined processes
 - establishes a stable process
 - achieve consistency across the organization
 - provide a detailed understanding of sub-processes and their relationships
 - Common measures to accumulate sufficient and meaningful data across the organization
 - Organization measurement repository
 - Effective quality assurance to ensure process fidelity



Process Areas - Maturity Level 4



Level	Focus	Process Areas
4 Quantitatively Managed	<i>Quantitative Management</i>	Organizational Process Performance (OPP) Quantitative Project Management (QPM)



PAAs for The Quantitatively Managed Level

Quantitatively Managed (4)

Quantitative Project Management
Organizational Process Performance

How do athletes know if they will be able to qualify for the Olympics?

Do they know what is the criteria to qualify? Where does this criteria come from?

Do they know their “expected” range of performance?



Organization Process Performance (OPP)



Purpose:

Establish and maintain a quantitative understanding of the performance of the organization's set of standard processes in support of quality and process-performance objectives.

Provide the process performance data, baselines, and models to quantitatively manage the organization's projects.

SG 1 Baselines and models that characterize the expected process performance of the organization's set of standard processes are established and maintained



Quantitative Project Management (QPM)



Purpose:

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

SG 1 The project is quantitatively managed using quality and process-performance objectives

SG 2 The performance of selected subprocesses within the project's defined process is statistically managed

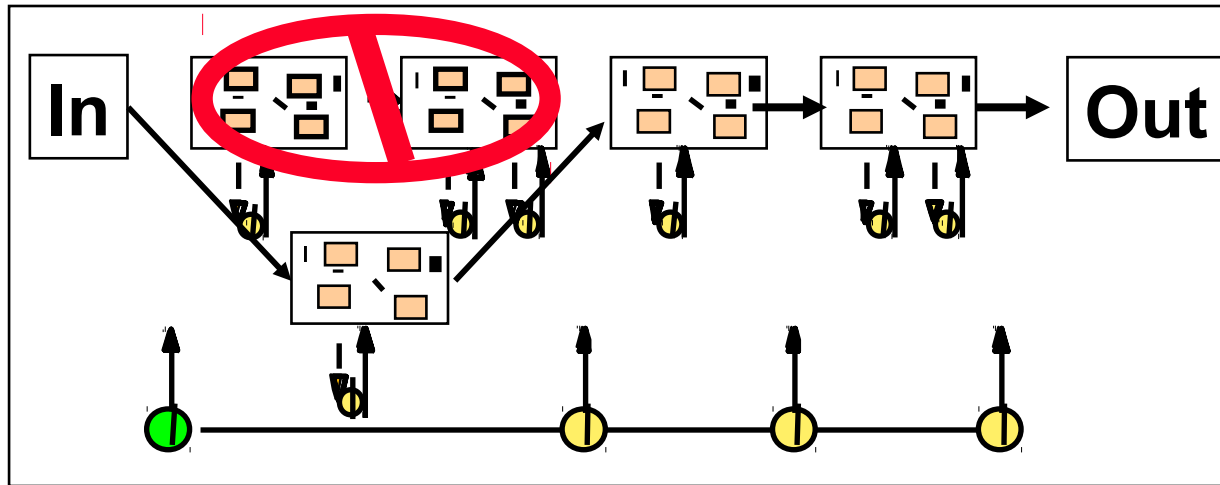


Level 4: Summary

- Statistical & quantitative methods are used to achieve the project's product quality, service quality, and process performance objectives.
- Process performance is predictable.
- The organization provides measurement data and quantitative models to support the quantitative management of process performance.



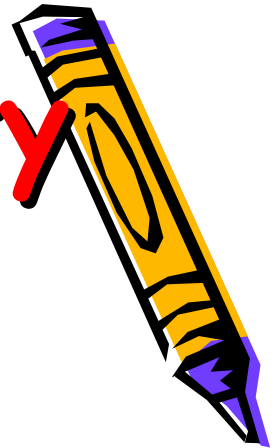
Maturity Level 5 - Optimizing Maturity Level



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



Process Areas - Maturity Level 5



Level	Focus	Process Areas
5 Optimizing	<i>Continuous</i>	Organizational Performance Management (OPM)
	<i>Process</i>	Causal Analysis and Resolution (CAR)
	<i>Improvement</i>	



Organizational Performance Management (OPM)



Purpose:

- 1. Select and deploy incremental and innovative improvements that measurably improve the organization's processes and technology.**
- 2. Improvements support the organization's quality and process performance objectives as derived from the organization's business objectives.**

SG 1 Process and technology improvement that contribute to meeting quality and process-performance objectives are selected

SG 2 Measurable improvements to the organization's processes and technologies are continually and systematically deployed

Causal Analysis and Resolution (CAR)



Purpose:

Identify causes of defects and other problems and take action to prevent them from occurring in the future.

- SG 1** Root causes of defect and other problems are systematically determined

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



Level 5: Summary



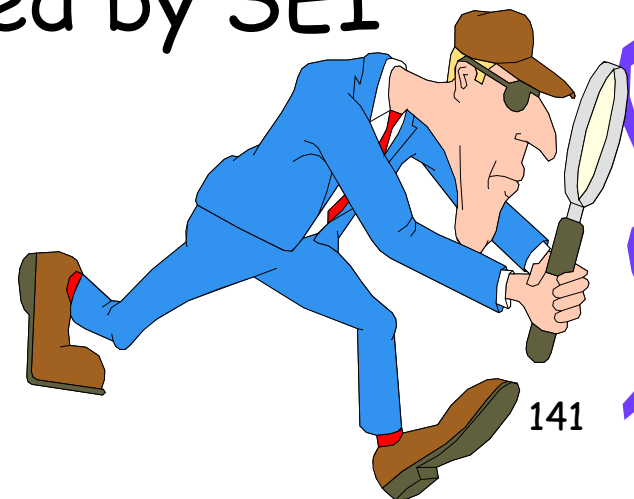
- Optimising processes are
 - agile and innovative
 - depend on the participation of an empowered workforce
 - aligned with the business values and objectives of the organization
- Organization's ability to rapidly respond to changes and opportunities is enhanced by finding ways to accelerate and share learning
- Improvement of the process is inherently part of everybody's role in the process, resulting in a cycle of continual improvement.



Appraisal Methodology

SCAMPI

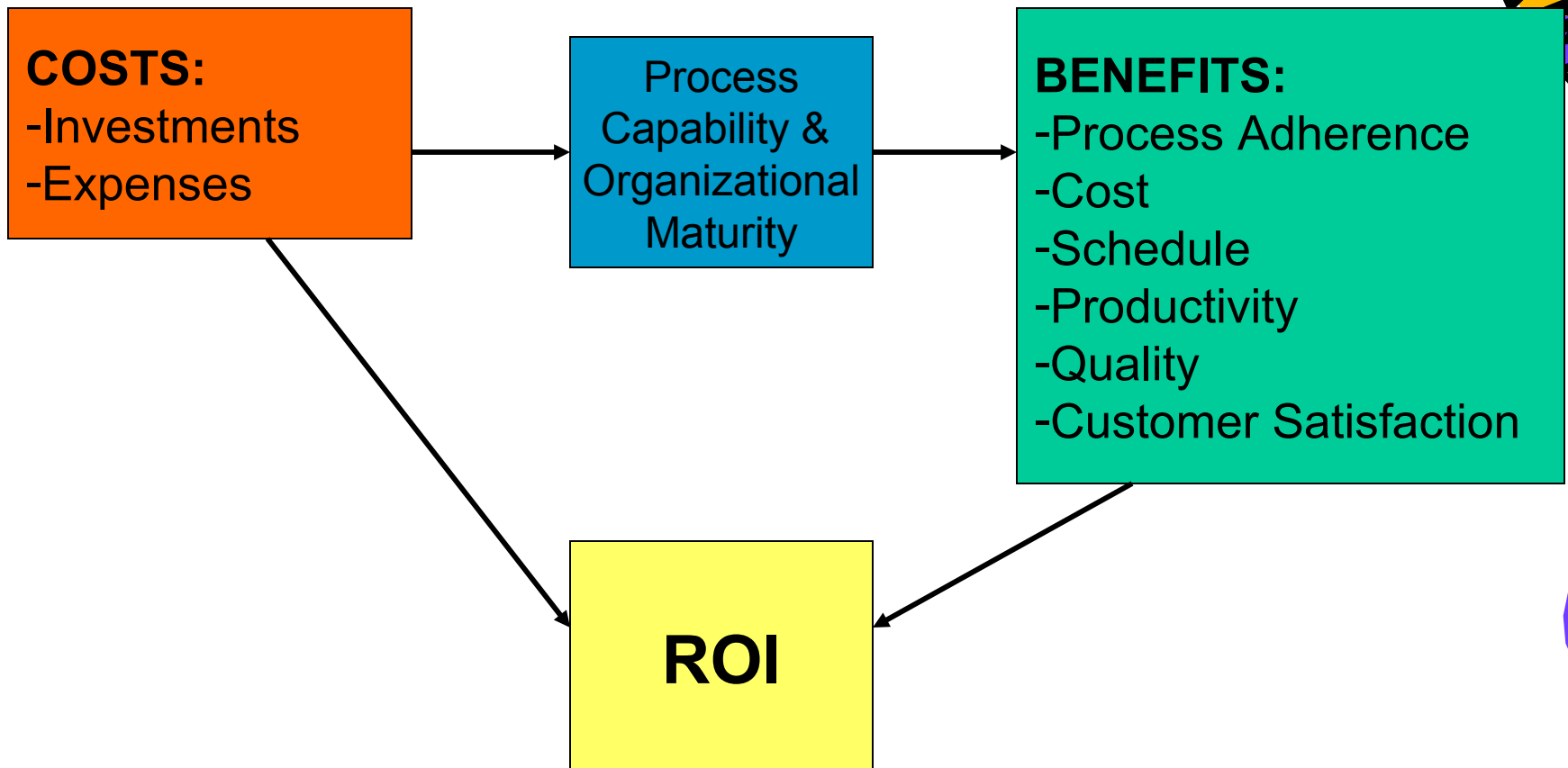
- Standard CMMI Appraisal Method for Process Improvement (SCAMPI)
- Similar to CBA IPI method
- ARC class A method
- Lead appraiser authorization program managed and administered by SEI





CMMI Benefits

Cost & Benefits of CMMI



For more detailed about CMMI benefits, see www.sei.cmu.edu/cmmi/results.html

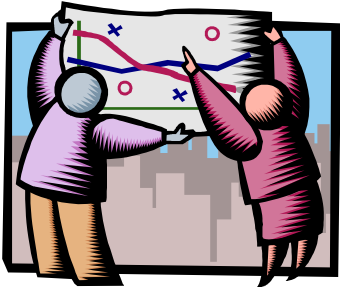


CMMI Adoption

8 Steps to Success in CMMI Compliant Process



1 Understand your business processes



2 Look to the CMMI for Process Completeness



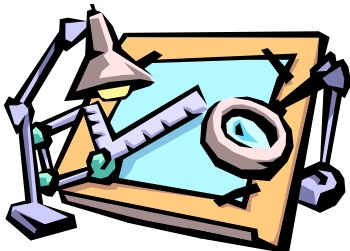
3 Look to Framework Standards for Life Cycle Definition



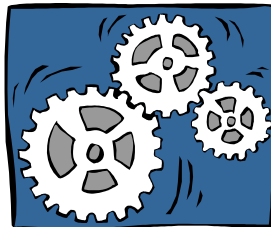
4 Look to Supporting Standards for Process Detail



5 Build or Refine Your Process Architecture



6 Execute Your Processes



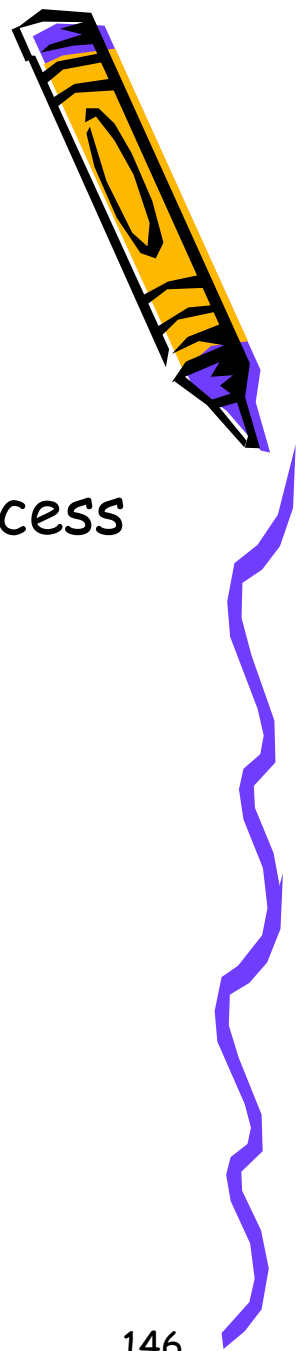
7 Measure Your Results - Modify Processes as Necessary



8 Confirm Your Status With Independent Appraisals



CMMI Implementation Steps



- Secure Sponsorship and Funding
- Take Core Training
- Select a **Model** and **Representation** for Your Process Improvement Program
- Prepare Your Organization for Change
- Form an Engineering Process Group
- Know Where You Are
- Know Where You Are Going
- Communicate and Coordinate
- Track Your Progress



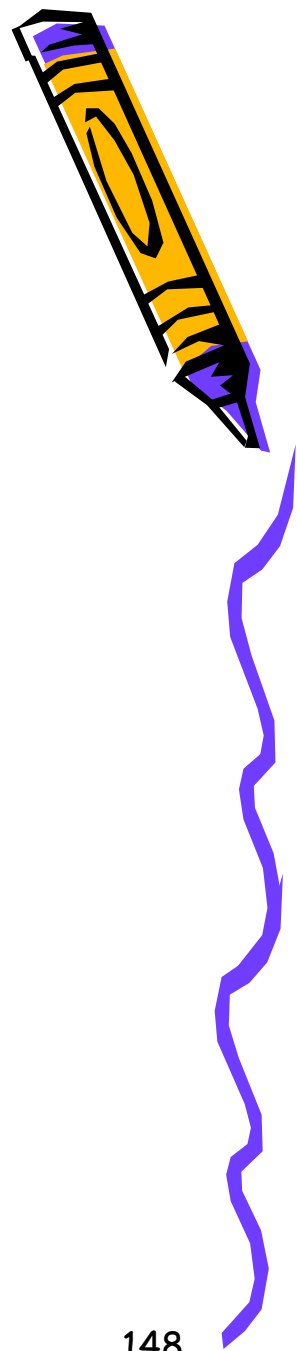
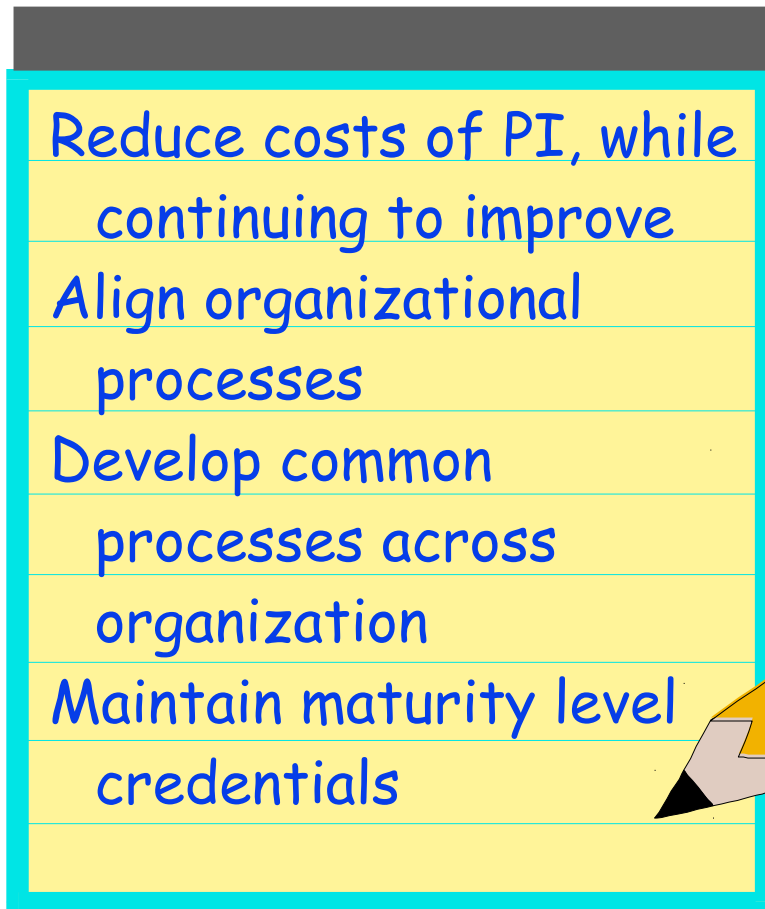
What Do You Do Now?



- Identify your business objectives
- Evaluate current processes
- Identify areas of the process infrastructure that overlaps and will support integration efforts
- Identify threads that cross discipline boundaries that are critical
- Identify processes that are used by both systems and software engineering
- Decide on Staged vs. Continuous PI Approach

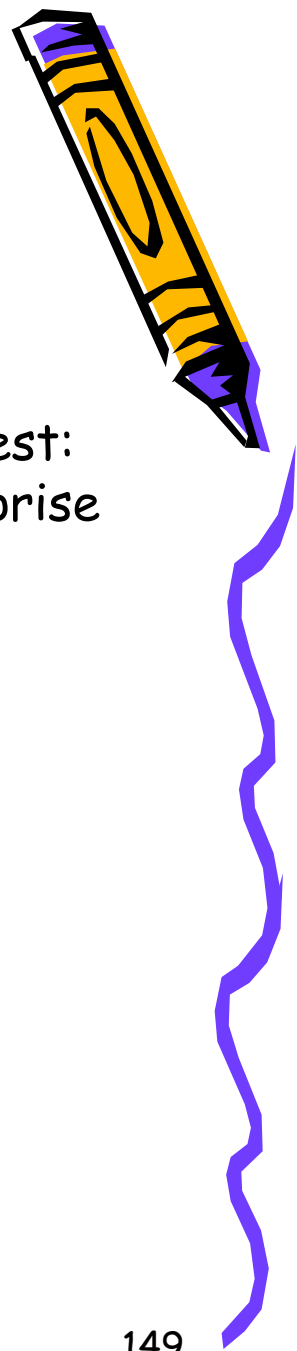
Business Objectives

- Identify your business objectives



Evaluate Processes

- Evaluate current processes
 - Map existing processes to models and standards of interest: CMM, EIA/IS 731, SE-CMM, ISO 9000, high level enterprise processes
 - Map existing processes to CMMI
 - Perform a quick-look evaluation



Process Infrastructure



- Identify areas of the process infrastructure that overlap and can support integration efforts



Begin now to consolidate the infrastructure



Process Threads

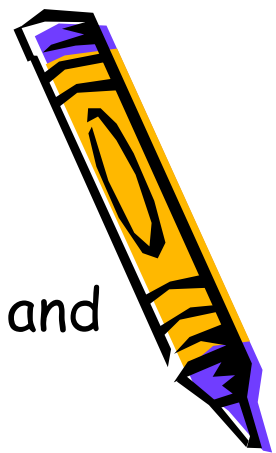
- Identify threads that cross discipline boundaries and are critical



Begin now to improve these processes



Common Processes



- Identify processes that are used by both systems and software engineering



Begin now to create one common process



Beware Miscommunication/ Misunderstanding

Senior management wants to adopt industry best practices (or wants the CMMI rating), but may not understand...

... implied costs

- Process improvement staff
- Policies, processes, procedures
- Training
- Quality assurance
- Measurement repository
- Learning curve
- Hiring expertise
- Appraisals

...improvement concepts

- Near-term investment, long-term benefits
- Bureaucracy vs. discipline
- Standardization vs. institutionalization
- Discipline makes the organizations less agile (initially)
- The need to enforce less popular practices

Summary



- The CMMI can provide valuable guidance for improving your processes
- Your strategy for adopting the CMMI is key to success
- Learning from experience and careful planning can reduce risk and ensure success



Word of Wisdom



- *"If you don't know where you're going, any road will do." - Chinese Proverb*

- *"If you don't know where you are, a map won't help." - Watts Humphrey*



More information about CMMI

- <http://www.sei.cmu.edu/cmmi/>

