

# **МУК 2015/2016:**

Модели за управление на качеството.  
[Курс на базата на CMMI]

Software Quality Models  
[CMMI based course]

## **PART 3: Maturity Level 2**

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[www.esicenter.bg](http://www.esicenter.bg)

# Информация, източници:

[www.esicenter.bg](http://www.esicenter.bg) >> general info and in “Resources”

links to CMMI models

<http://cmmiinstitute.com/cmmi-solutions/>

<http://www.sei.cmu.edu/cmmi/tools/index.cfm>

CMMI –DEV v 1.3 model (CMMI Institute, and SEI, Carnegie Mellon University)

<http://cmmiinstitute.com/resource/cmmi-for-development-version-1-3/>

[www.sei.cmu.edu/reports/10tr033.pdf](http://www.sei.cmu.edu/reports/10tr033.pdf)

General

[www.sei.cmu.edu](http://www.sei.cmu.edu)

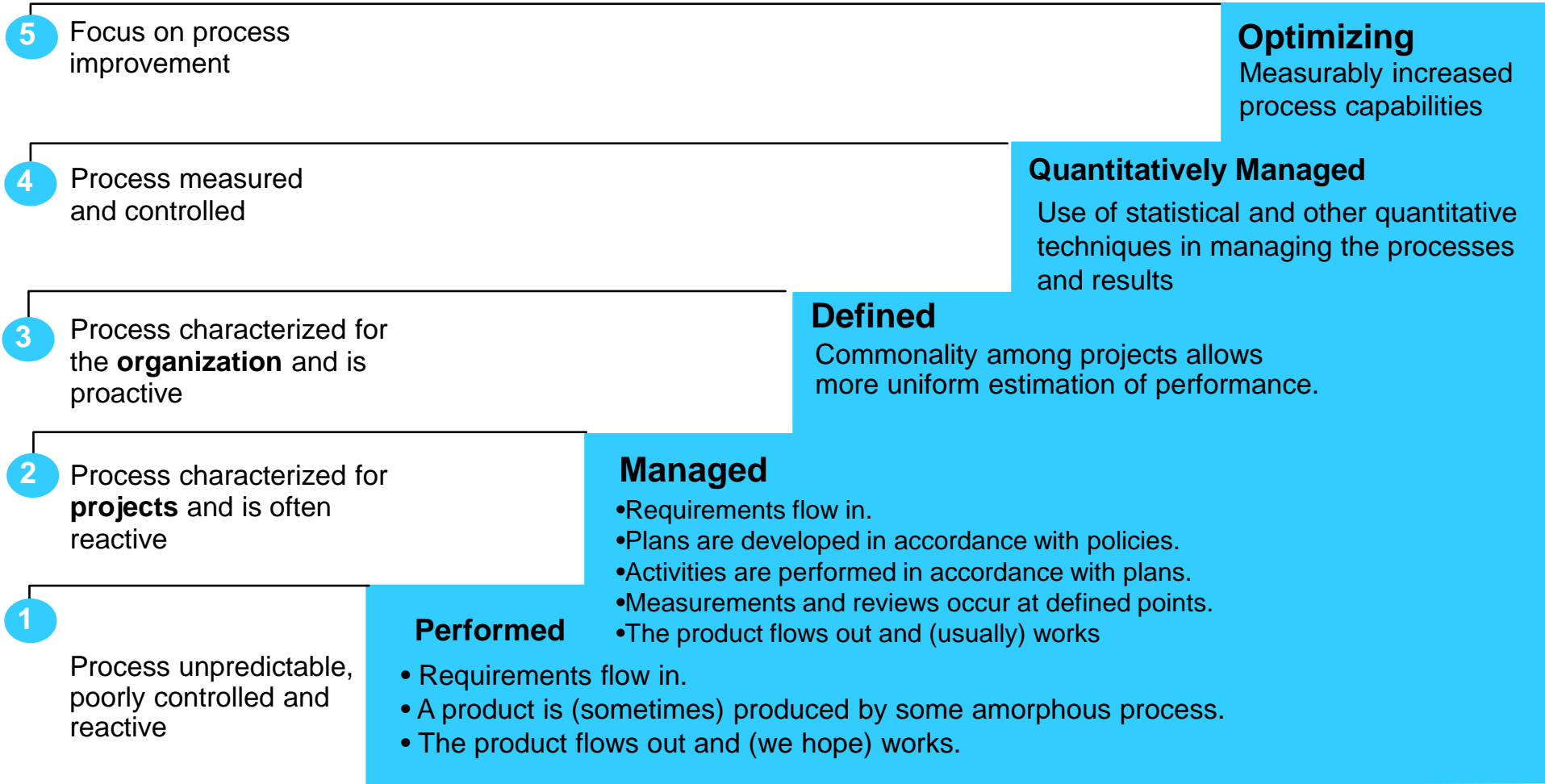
[www.cmmiinstitute.com](http://www.cmmiinstitute.com)

# Къде сме?

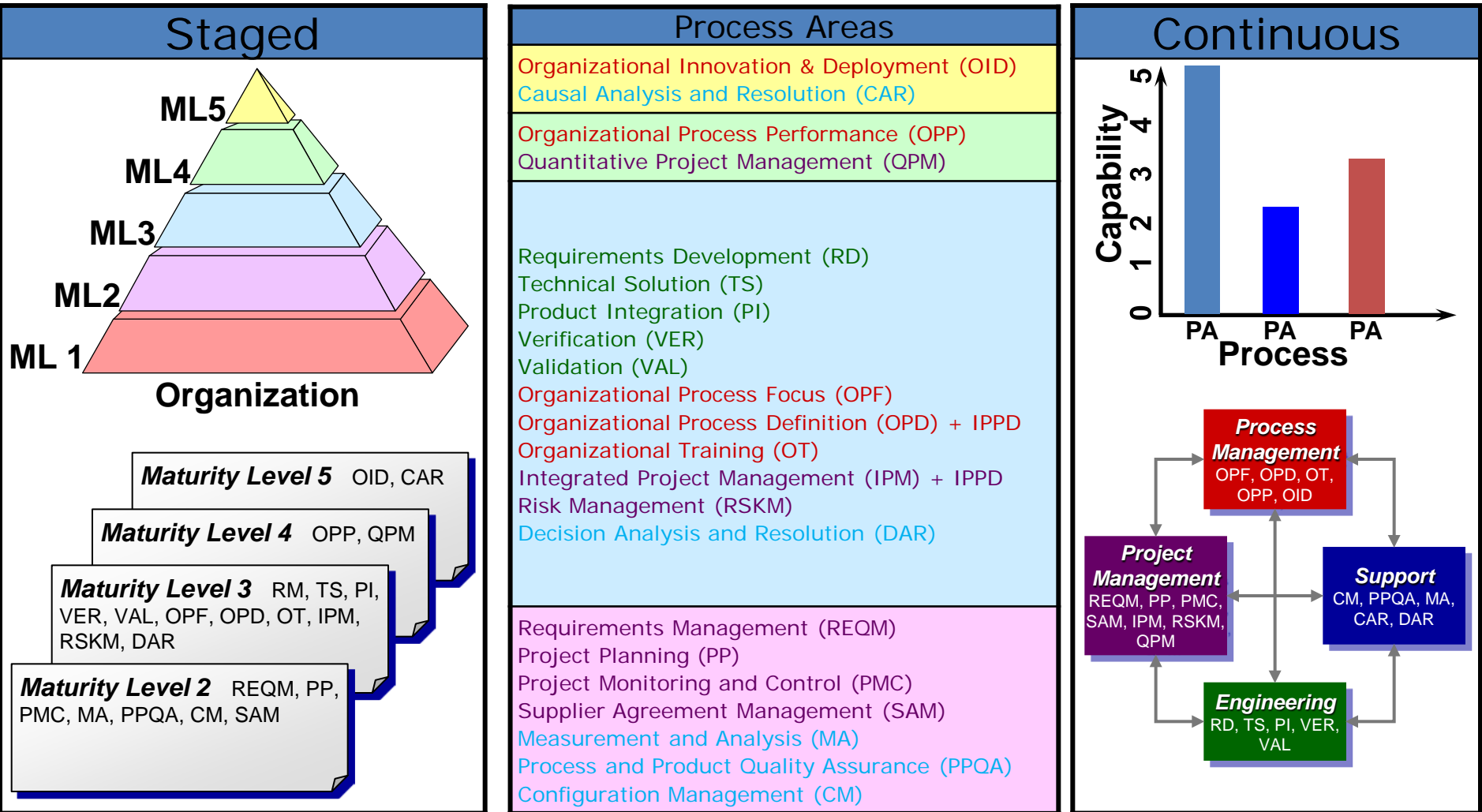
1	Увод в управление на качеството. Компоненти и цена на качеството. Процеси. Преглед на моделите за управление на качеството и подобряване на процесите. Методи за оценка на зрелостта на ИТ-интензивни и софтуерни организации. Стратегически карти/Балансирана система от показатели (balanced ScoreCards).
2	Модел CMMI (ver 1.3). История, внедряващи организации. Обща структура. Процесни области. Генерични и специфични цели и практики. Презентации – Maturity/Capability нива на Continuous и Staged representations. Категории процесни области: Process Management, Project Management, Engineering, Support.
3	<p><b>Процесни области от ниво 2 на CMMI. Детайлно представяне на:</b></p> <p><b>REQM – Requirements Management</b></p> <p><b>PP – Project Planning</b></p> <p><b>MA – Measurement and Analysis</b></p> <p><b>PPQA – Process and Product Quality Assurance</b></p> <p><b>CM – Configuration Management</b></p> <p><b>PMC – Project Monitoring and Control</b></p> <p><b>Преглед на: SAM-Supplier Agreement Management</b></p>
4	<p>Процесни области от ниво 3 на CMMI. Детайлно представяне на:</p> <p>RD – Requirements Development</p> <p>VAL - Validation</p> <p>VER - Verification</p> <p>RSKM - Risk Management</p> <p>TS - Technical Solution</p> <p>Преглед на: DAR - Decision Analysis and Resolution , IPM - Integrated Project Management , OPD - Organizational Process Definition , OPF - Organizational Process Focus, OT - Organizational Training , PI - Product Integration</p> <p>Преглед на Maturity Level 4 и 5.</p> <p><b>Обобщение на връзките между процесните области: Tying all together</b></p>
5	Внедряване на програма за подобряване на процесите на база CMMI. Адаптирани подходи – Agile CMMI, CMMI/ISO. Нови модели CMMI – CMMI for Services, CMMI for Acquisition. Оценка (SCAMPI), роли.
6	Подобряване на процесите в малки фирми – IT Mark. Компоненти на зрелостта – бизнес, организация/процеси, информационна сигурност. Оценка на нивото и план за подобрения.

# CMMI (SEI/CMU) – reference model or **de facto** industrial standard


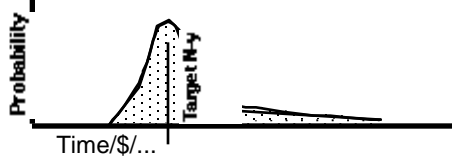
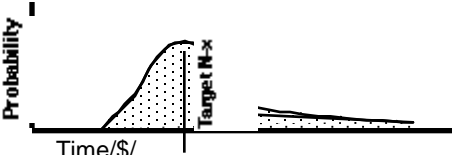
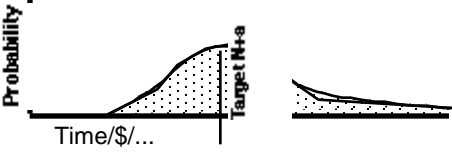
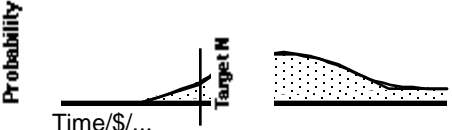
## CMMI-DEV, CMMI-ACQ, CMMI-SVC



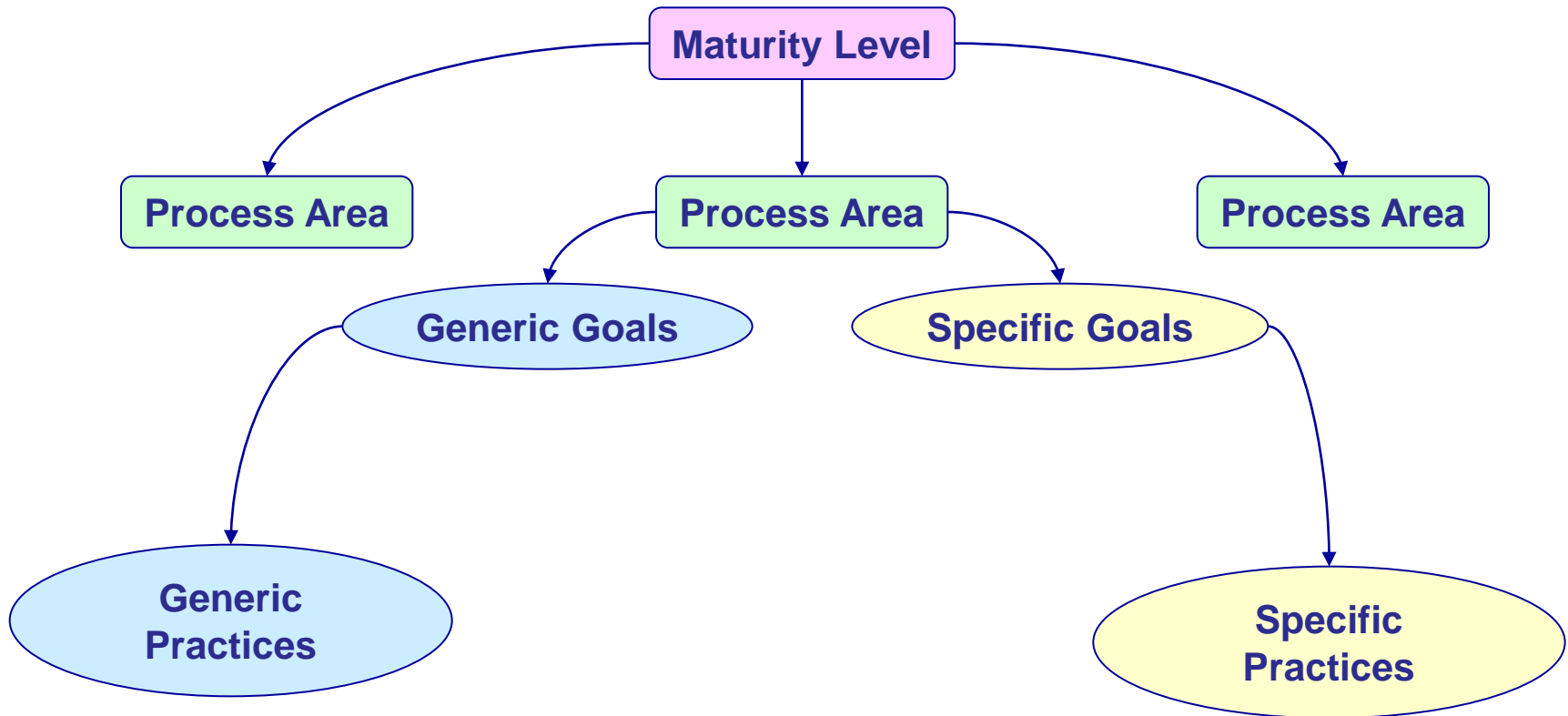
# Remember: CMMI Representations



# Remember: Evolution of Process Capability

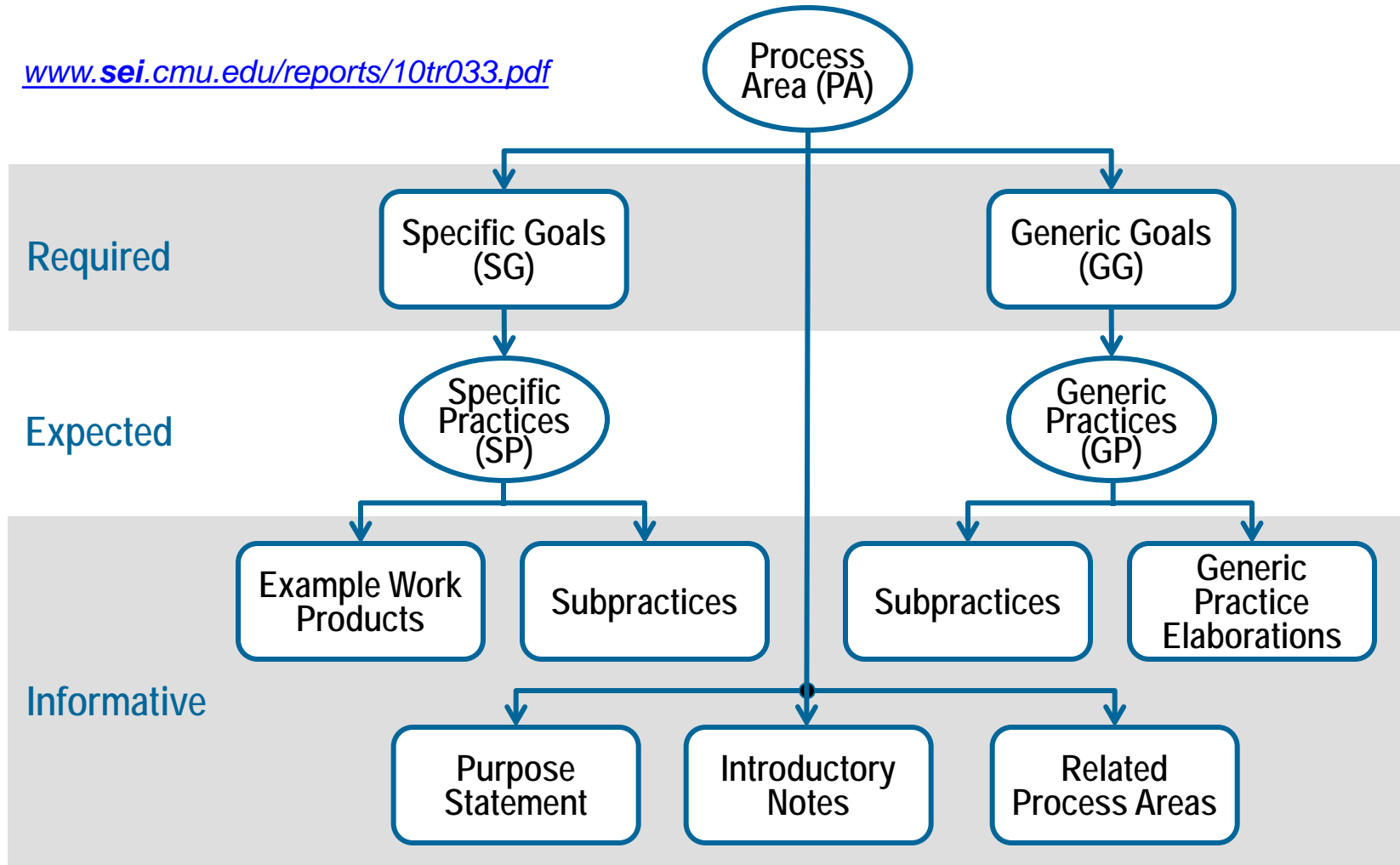
Level	Process Characteristics	Predicted Performance
5 Optimising	Process improvement is institutionalised	
4 Quantitatively Managed	Product and process are quantitatively controlled	
3 Defined	Software engineering and management processes are defined and integrated	
2 Managed	Project management system is in place; performance is repeatable	
1 Initial	Process is informal and unpredictable	

# Structure of the CMMI Staged Representation



# What's in the model & book: Process Area Components

[www.sei.cmu.edu/reports/10tr033.pdf](http://www.sei.cmu.edu/reports/10tr033.pdf)





# Remember:

## Maturity Levels Cannot Be Skipped

A level provides a necessary foundation for effective implementation of processes at the next level.

- Higher level processes are easily sacrificed without the discipline provided by lower levels.
- The effect of innovation is obscured in a noisy process.

Higher maturity level processes may be performed by organisations at lower maturity levels, with risk of not being consistently applied in a crisis.

# Maturity Levels & GPs

## Maturity Level 2

- Requirements management
- Project planning
- Project monitoring and control
- Supplier agreement management
- Measurement and analysis
- Process and product quality assurance
- Configuration management

- 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 2.6 **Control Work Products** (Manage configuration)
- 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

## Maturity Level 3




- Requirements development
- Technical solution
- Product integration
- Verification
- Validation
- Organizational process focus
- Organizational process definition + IPPD
- Organizational training
- Integrated project management + IPPD
- Risk management
- Decision analysis and resolution

**GP 3.1 Establish a defined process**

**GP 3.2 Collect improvement information**

# About Generic Goals and Institutionalization

The degree of institutionalization is embodied in the generic goals and expressed in the names of the processes associated with each goal as indicated below.

Generic Goal and Title		Progression of Processes
	Institutionalize a Defined Process	Defined Process
	Institutionalize a Managed Process	Managed Process
	Achieve Specific Goals*	Performed Process

\* This generic goal is only used in the continuous representation.

# ML2 GG&GPs

## **GG2: Institutionalize a Managed Process**

What should be applied to all PAs (from ML2 and up):

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: Control Work Products

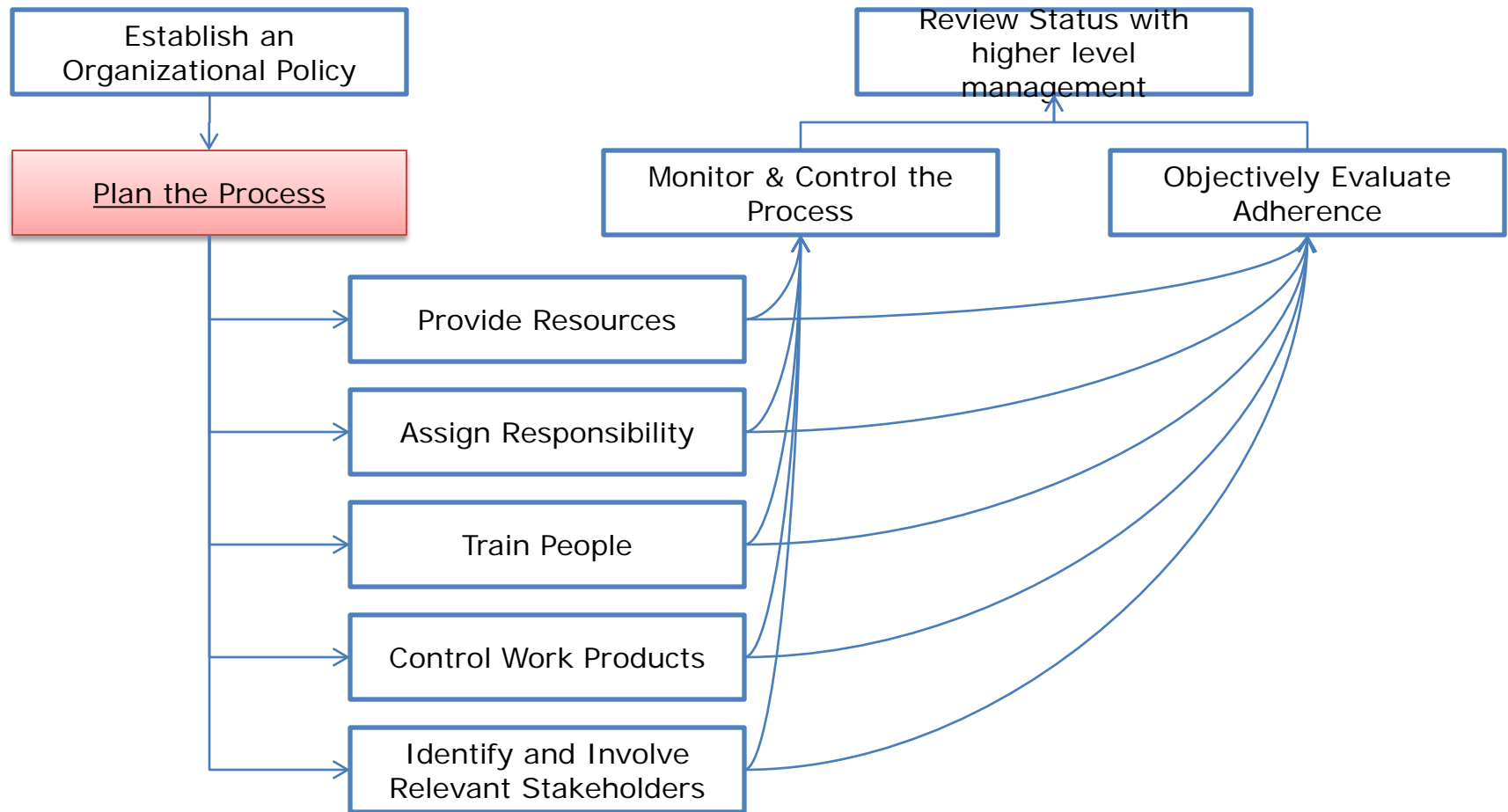
GP2.7: Identify and Involve Relevant Stakeholders

GP2.8: Monitor and Control the Process

GP2.9: Objectively Evaluate Adherence

GP2.10: Review Status with Higher Level Management

# How PAs relate to Generic Practices?



Source: Kiril Karaatanasov, ESI Center Bulgaria

# Note

A CMMI model is **not a process!**

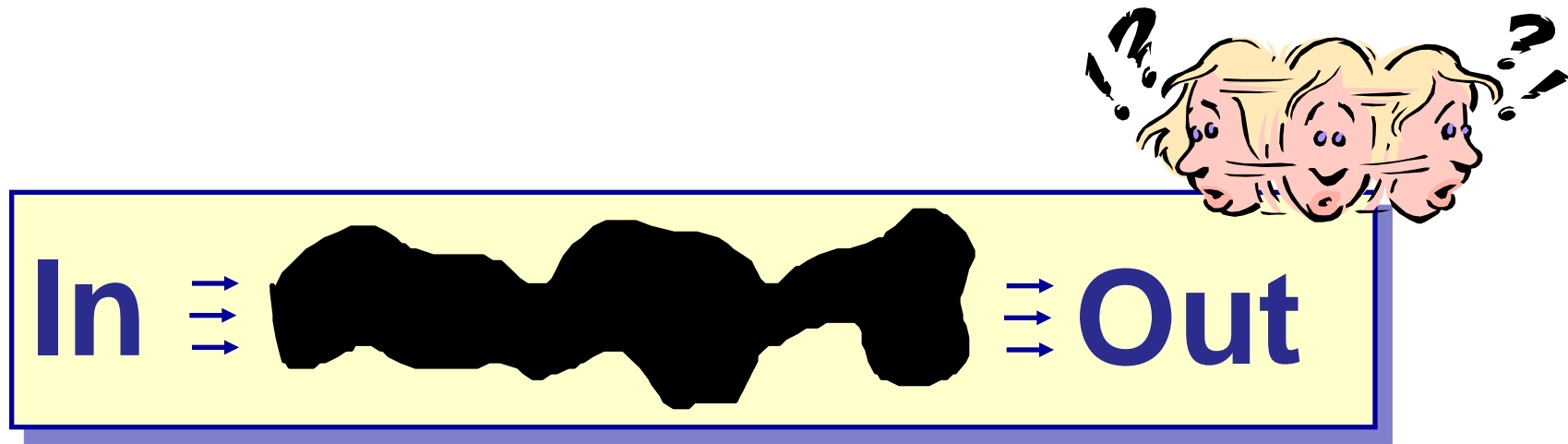
A CMMI model describes the **characteristics of effective processes** and **"WHAT TO DO-s"**

**"All models are wrong,  
but some are useful."**

George Box  
(Quality and Statistics  
Engineer)



# ML1: Performance Is Unpredictable



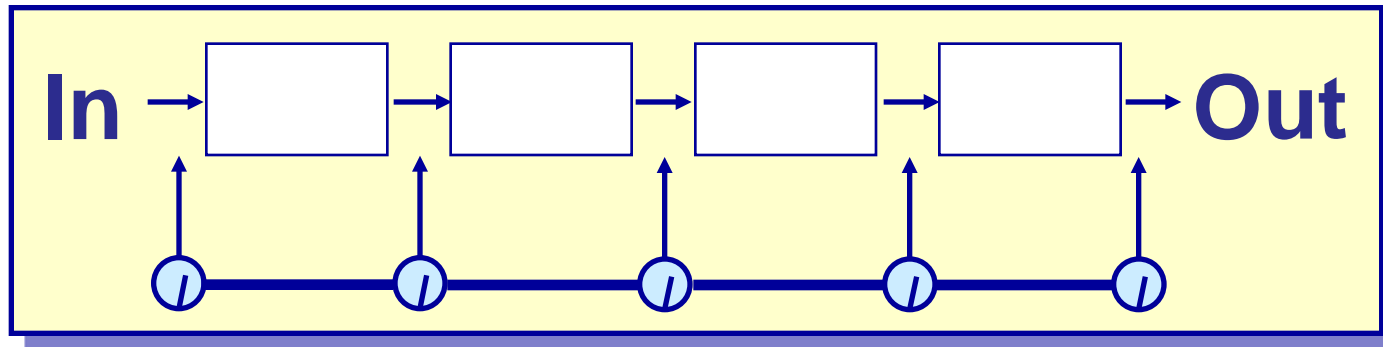
Requirements flow in.

A product is (sometimes) produced by some amorphous process.

The product flows out and (we hope) works.

# ML2: Processes are "Managed"

Processes characterized for **PROJECTS** and often reactive



Requirements flow in.

Plans are developed in accordance with policies.

Activities are performed in accordance with plans.

Measurements and reviews occur at defined points.

The product flows out and **(usually) works**.



# ML2: Managing the Project Involves

Understand and commit to the requirements

Estimating the scope and work that needs to be performed

Developing mechanisms to acquire identified products

Developing a project plan

Getting commitments to the plan

Working with suppliers to acquire identified products

Monitoring progress against the plan

Identifying and analyzing risks

Taking action to address significant deviations from the plan

Taking action to appropriately mitigate risks

# Project Management PAs (overview)

## Requirements management (REQM)

- **SG1: Manage requirements**

## Project Planning (PP)

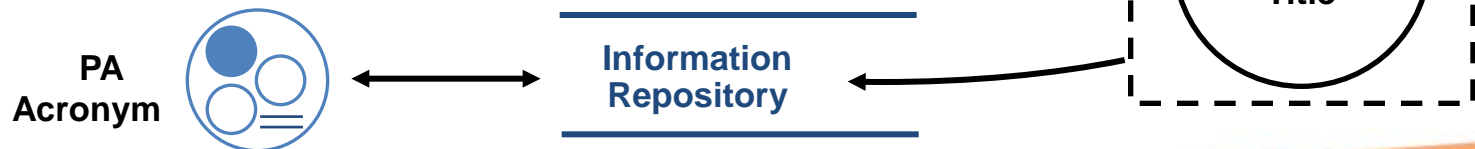
- SG1: Establish Estimates
- SG2: Develop a project plan
- SG3: Obtain Commitment to the plan

## Project Monitoring and Control (PMC)

- SG1: Monitor Project Against Plan
- SG2: Manage Corrective action to closure

# Context Diagrams

- Intended to show graphical mapping of practices to goals
- Not intended as a data flow diagram
- Not intended to show exhaustive relationships within a process area

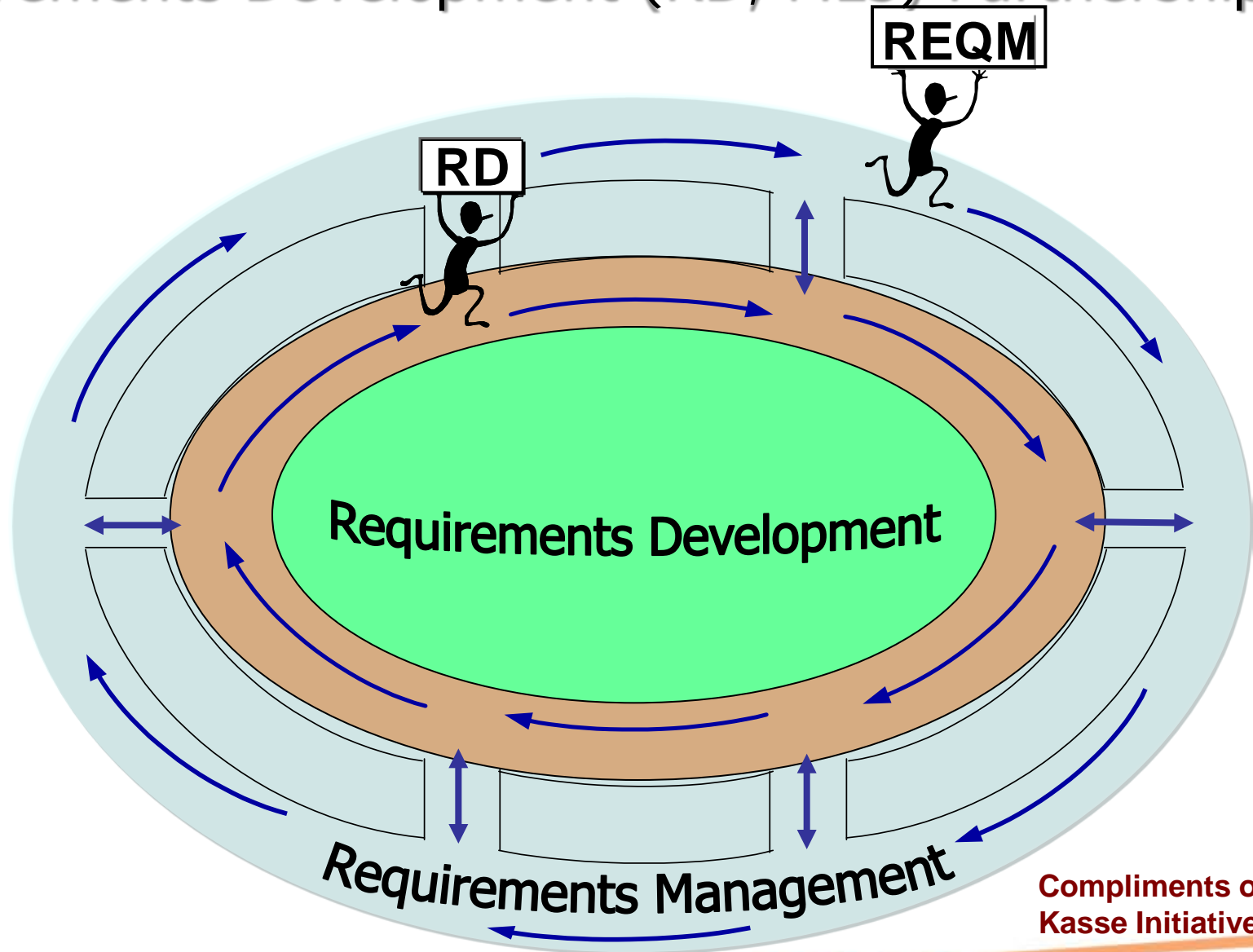


# Think about: What Product/SW Development Needs?

Establishing and maintaining sets of requirements

- customer requirements
- product requirements
- product component requirements
- managing the requirements as the product evolves

# The Requirements Management (REQM, ML2) and Requirements Development (RD, ML3) Partnership



Compliments of  
Kasse Initiatives, LLC

# Requirements Management (REQM)

*The purpose of Requirements Management (REQM) 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.*



## SG1: Manage Requirements

Requirements are managed and inconsistencies with project plans and work products are identified.

*The process area also has generic goals to support institutionalization.*

# When Requirements Management Is Not Done Well...

Requirements are accepted by staff from **any source** they deem to be authoritative.

The project experiences a high level of **requirements changes**.

There are high **levels of rework** throughout the project.

There is an inability to prove that **the product meets the approved requirements**.

Lack of requirements traceability often results **in incomplete or incorrect testing** of the product.

# Relevant Terminology

## Requirements traceability

A discernable association between requirements and related requirements, implementations, and verifications.

## Bidirectional traceability

An association among two or more logical entities that is discernable in either direction (i.e., to and from an entity).



# Requirements Management (REQM) Specific Practices

SP 1.1 Obtain an **Understanding** of Requirements

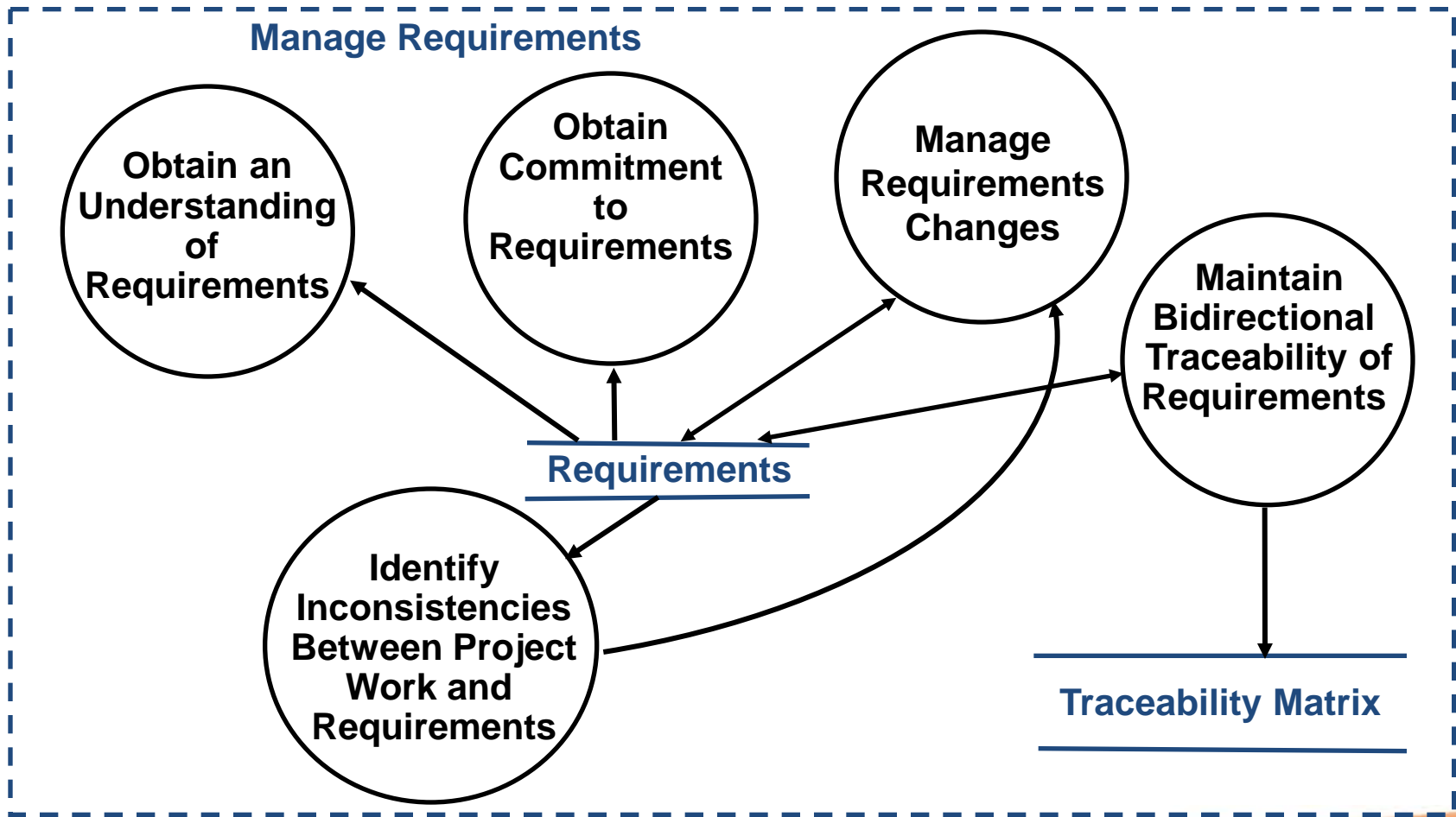
SP 1.2 Obtain **Commitment** to Requirements

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 Context



# REQM Practices implementation:

- Acceptance criteria in place?
- Requirements comply to criteria?
- Is understanding reached and is it documented? How?
- Who are the relevant stakeholders?
- Did they agree to requirements?
- Is the commitment documented? How?
- All requirements and their changes documented?
- Requirements change history and rationale documented?
- Are changes evaluated by affected stake holders?
- Bi-directional traceability among the requirements and the project plans and work products maintained?
- Are the project plan/activities/work products reviewed to assess the consistency with the (changed) requirements?
- If inconsistencies have been are corrective actions initiated to solve them?

# Remember:

## Why do we need **bidirectional traceability**???

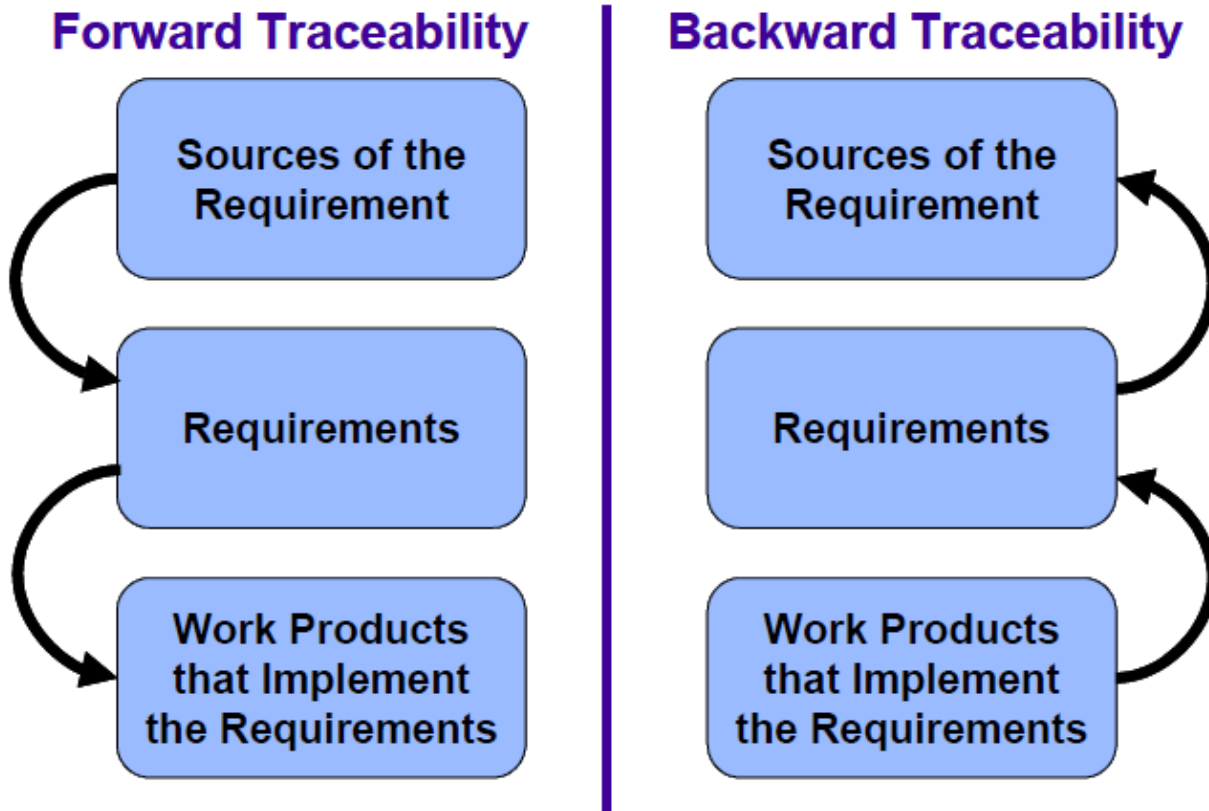


Figure 1: Bidirectional (Forward & Backward) Traceability

### Benefits:

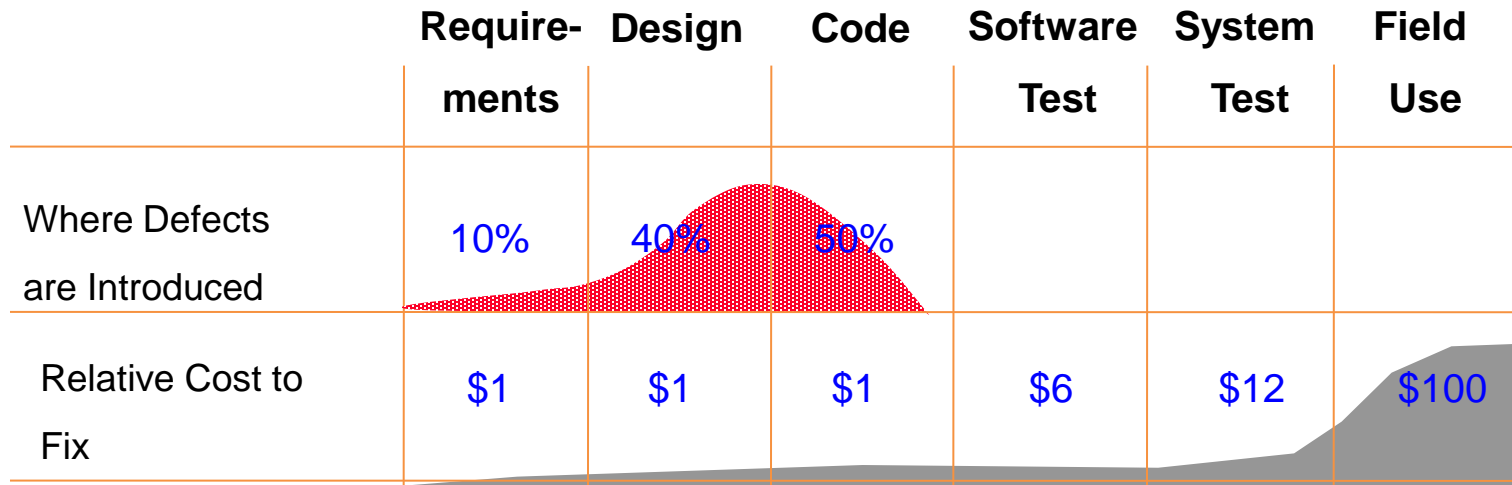
#### Analyze the impact of a change

- All **work products affected** by a changed requirement
- All **requirements affected** by a change or defect in a work product

#### Assess current status of the requirements and the project

- Identify **missing** requirements
- Identify **gold plating** (overdoing)

# Defects : Insertion Pattern & Cost of Removal



Source: SEPG Asia Pacific 2009  
presented by Ravindra Nath, KUGLER MAAG CIE GmbH

# Sampling the Generic Practices

## GP 2.1: Establish an Organizational Policy

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

### *Elaboration for Requirements Management*

This policy establishes organizational expectations for managing requirements and identifying inconsistencies between the requirements and the project plans and work products.

# Sampling the Generic Practices

## GP 2.3: Provide resources

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

### *Elaboration for Requirements Management*

Examples of resources provided include the following tools:

- **Requirements tracking tools**
- **Traceability tools**

# Sampling the Generic Practices

## GP 2.6: Manage Work Products (Configurations)

*Place designated work products of the requirements management process under appropriate levels of control.*

### *Elaboration for Requirements Management*

Examples of work products placed under control include the following:

- Requirements
- **Requirements traceability matrix**



# Sampling the Generic Practices

## GP 2.7: Identify and Involve relevant Stakeholders

*Identify and involve the relevant stakeholders of the requirements management process as planned.*

### *Elaboration for Requirements Management*

Select relevant stakeholders from customers, end users, developers, producers, testers, suppliers, marketers, maintainers, disposal personnel, and others who **may be affected by, or may affect**, the product as well as the process.

Examples of activities for **stakeholder involvement** include the following:

- **Resolving issues on the understanding of the requirements**
- **Assessing the impact of requirements changes**
- **Communicating the bidirectional traceability**
- **Identifying inconsistencies among project plans, work products, and requirements**

# Sampling the Generic Practices

## GP 2.8: Monitor and Control the process

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

### *Elaboration for Requirements Management*

Examples of measures and work products used in monitoring and controlling include the following:

- Requirements volatility (percentage of requirements changed)
- Schedule for coordination of requirements
- Schedule for analysis of a proposed requirements change

# Sampling the Generic Practices

## GP 2.9: Objectively Evaluate Adherence

*Objectively evaluate adherence of the requirements management process against its process description, standards, and procedures, and address noncompliance.*

### *Elaboration for Requirements Management*

Examples of activities reviewed include the following:

- Managing requirements
- Identifying inconsistencies among project plans, work products, and requirements

Examples of work products reviewed include the following:

- Requirements
- Requirements traceability matrix

# Sampling the Generic Practices

## GP 2.10: Review Status with Higher Level Management

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

### *Elaboration for Requirements Management*

Proposed changes to **commitments to be made external to the organization** are reviewed with higher level management to ensure that all commitments **can be accomplished**.

# Project Management PAs (overview)

## Requirements management (REQM)

- SG1: Manage requirements

## Project Planning (PP)

- **SG1: Establish Estimates**
- **SG2: Develop a project plan**
- **SG3: Obtain Commitment to the plan**

## Project Monitoring and Control (PMC)

- SG1: Monitor Project Against Plan
- SG2: Manage Corrective action to closure

# Think about: What a typical Project Plan includes?

- Resources
- Budget
- Schedule (Milestones)
- Stakeholders
- Commitments – dependencies, deliverables
- Data Plan
- Knowledge and skills - Training
- Risks

# PP: Project Planning

*The purpose of Project Planning (PP) is to **establish and maintain plans** that define project activities.*



## SG1: Establish Estimates

Estimates of project planning parameters are established and maintained.

## SG2: Develop a Project Plan

A project plan is established and maintained as the basis for managing the project.

## SG3: Obtain Commitment to the Plan

Commitments to the project plan are established and maintained.

# When Project Planning Is Not Done Well...

**Estimates** of project attributes are inaccurate.

It is difficult to **identify deviations** from poorly documented plans.

**Resources** are not available/applied when needed.

Future projects cannot learn from completed projects because there are **no lessons learned**.



# Relevant Terminology

## Project

A managed set of interrelated resources which delivers one or more products to a customer or end user. A project has a definite beginning (i.e., project startup) and typically operates according to a plan. Such a plan is frequently documented and specifies what is to be delivered or implemented, the resources and funds to be used, the work to be done, and a schedule for doing the work. A project can be composed of projects.

## Program

(1) A project. (2) A collection of related projects and the infrastructure that supports them, including objectives, methods, activities, plans, and success measures.

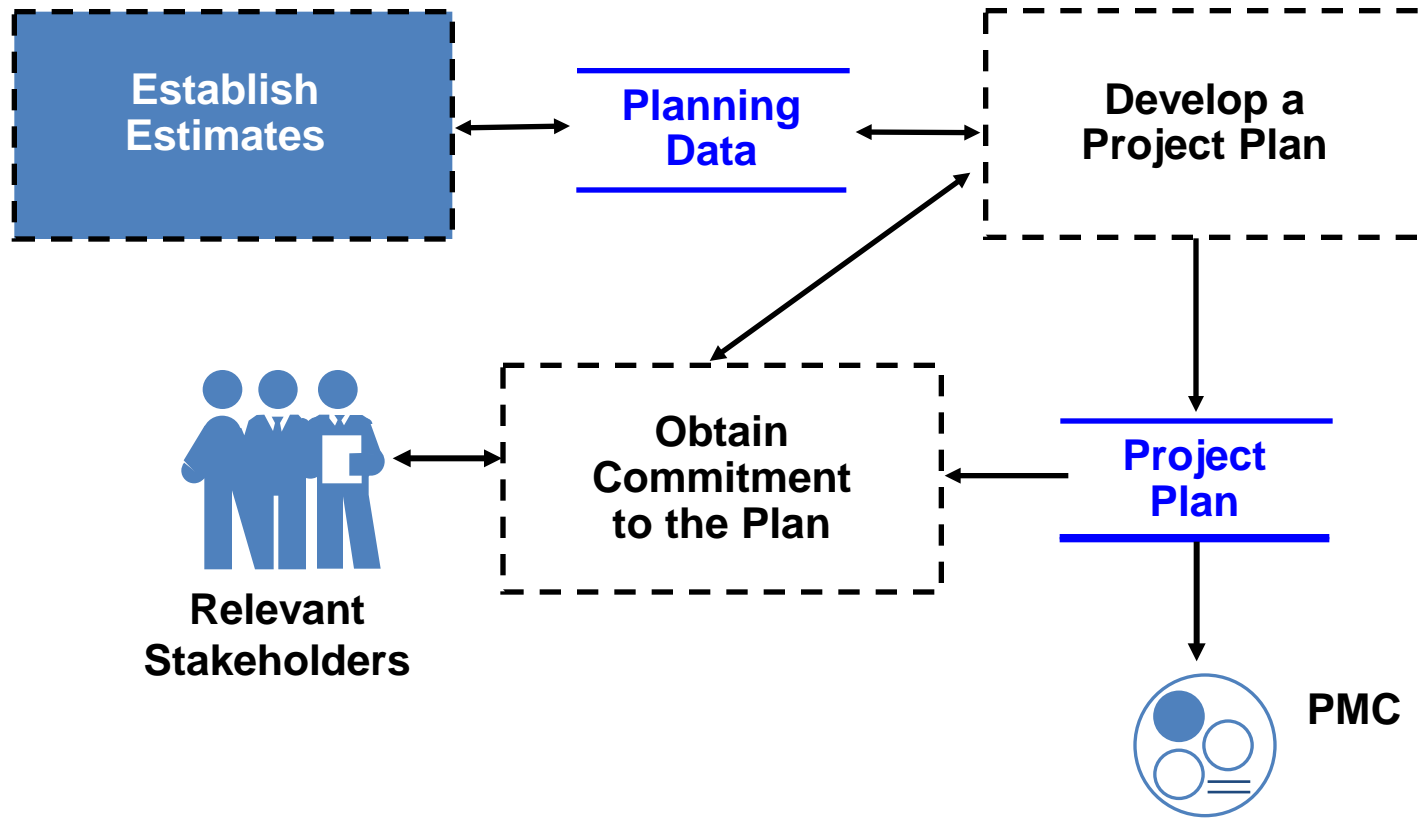
## Work breakdown structure (WBS)

An arrangement of work elements and their relationship to each other and to the end product.

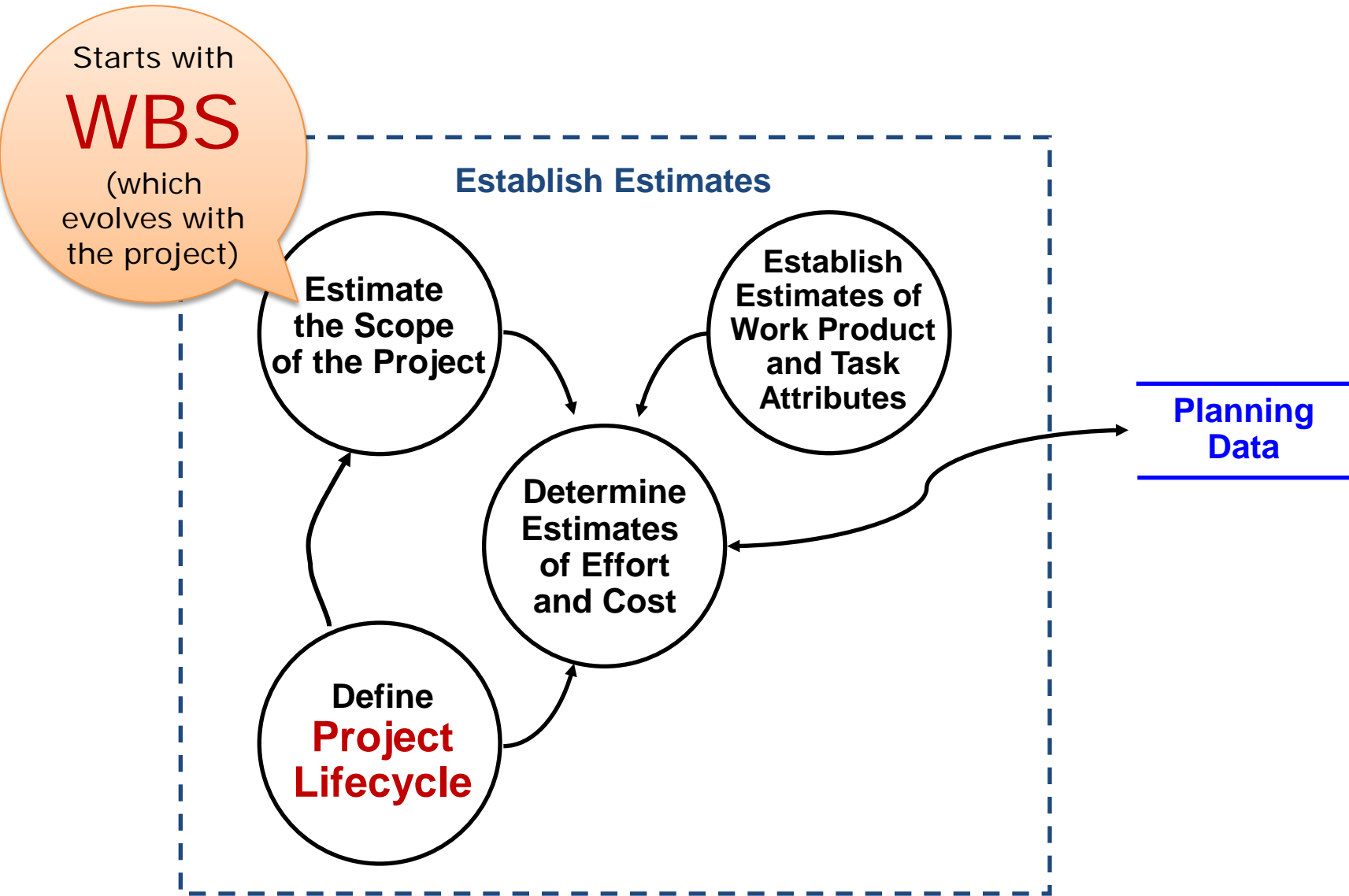


WBS

# Project Planning Context -1



# Project Planning Context -2





ADAM SAVAGE'S WORKSHOP

# Step One: Make a List

*If you think any detail is too small to write down in your initial project plan, you're going to get it wrong.*

I love lists. Always have. When I was 14, I wrote down every dirty word I knew on file cards and placed them in alphabetical order. I have a thing about collections, and a list is a collection with purpose.

Lists are how I parse and manage the world. I make lists for fun (I have more than 17,000 palindromes) and to relax (I can eliminate distractions and focus on what's important). But mostly I make lists for projects. This can be daunting. Breaking something big into its constituent parts will help you organize your thoughts, but it can also force you to confront the depth of your ignorance and the hugeness of the task.

That's OK. The project may be the lion, but the list is your whip.

The first thing I write down is whatever I hope to end up with—a Maltese Falcon, a Hellboy hand, or a map of all of Middle-earth (at the end of the Third Age, of course). That used to be the header in a notebook. Now it's generally the name of a folder on my computer, and the list of tasks will be a series of subfolders and sub-subfolders.

When I want to build something, I'll start collecting images, drawings, and information in the main folder. After a few weeks or months, I'll parcel this raw info into subfolders. If I'm building a spacesuit, I'll make separate subfolders for the helmet, gloves, boots, front control module, backpack, and so on. Unforeseen challenges—the checklists on the wrists of NASA's Apollo-era suits, for instance—will get even more subfolders.

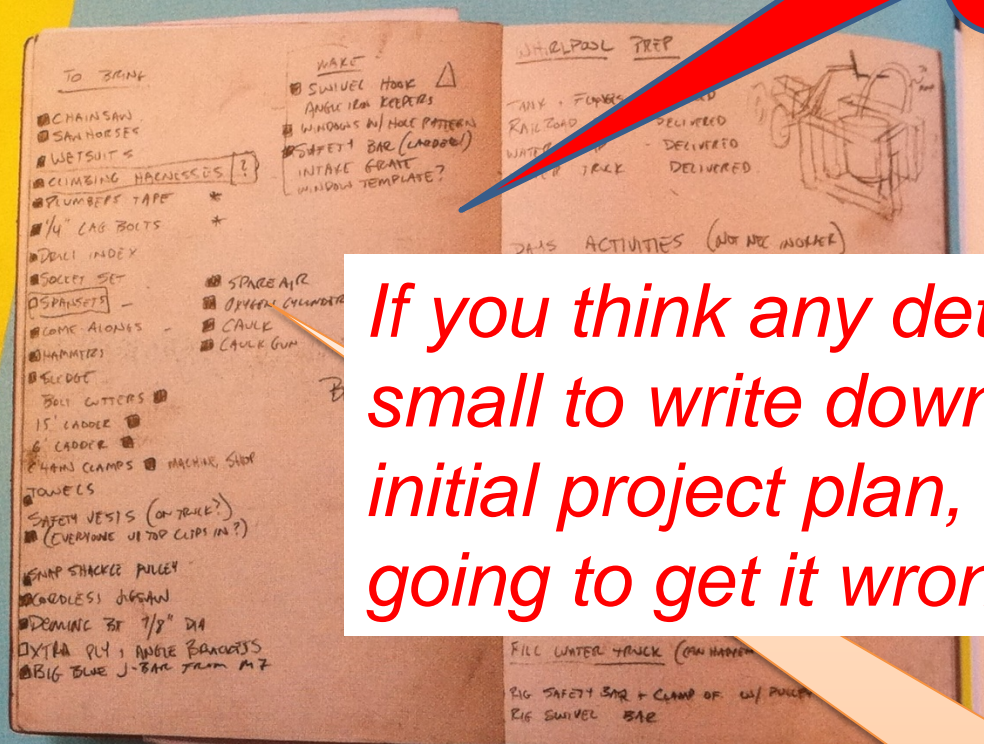
Eventually I'll create a folder called Adam's Progress. As I chug along, I take photos with my phone and drop them into this folder for a quick reference of how far I've come. These images provide inspiration and momentum. A list

of what I've already done makes the list of what's left to do a bit more manageable. And when I'm finished, this folder will be my diary of the project. It's something I'll keep forever.

Just like that collection of dirty words.

**ADAM SAVAGE** (adamsavage.com) is a sculptor, special-effects fabricator, and cohost of Discovery Channel's *MythBusters*.

What is this?

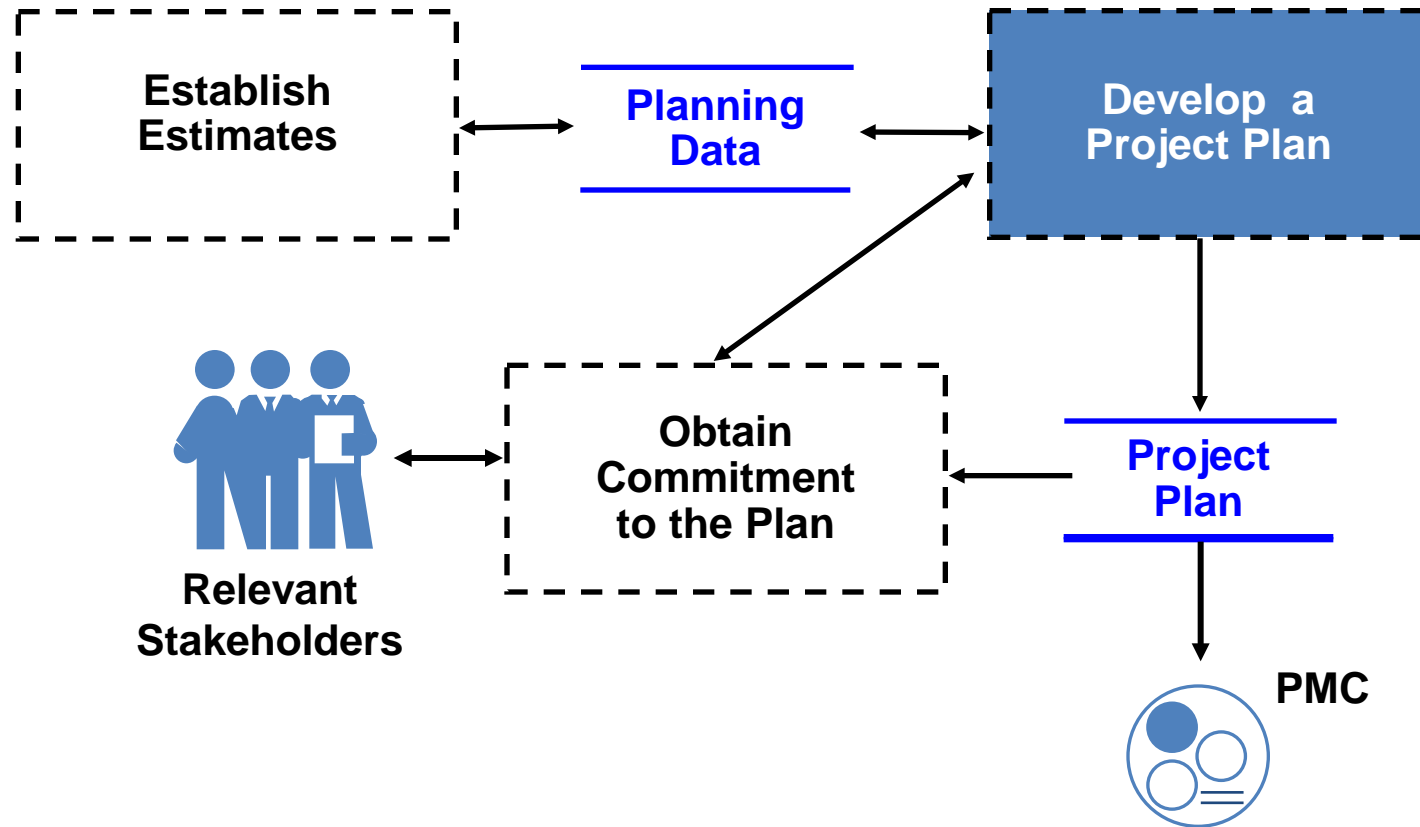


*If you think any detail is too small to write down in your initial project plan, you're going to get it wrong.*

WBS ?

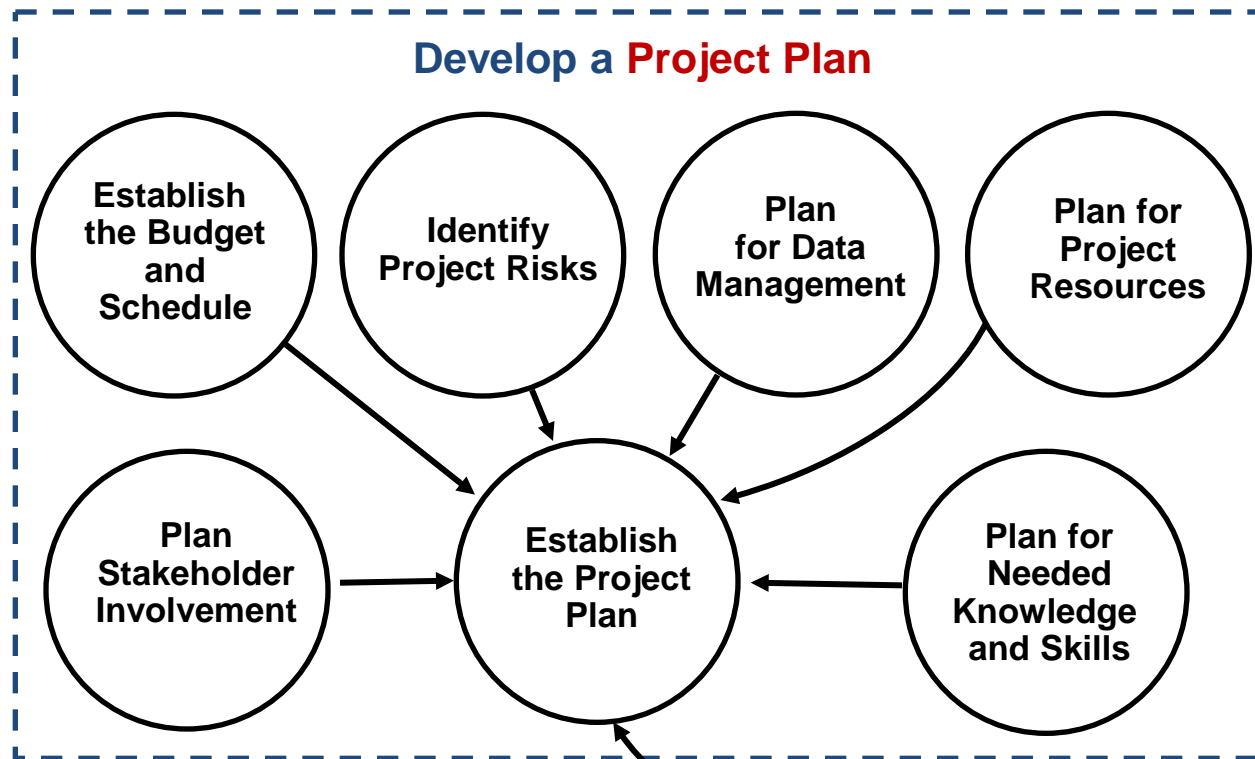


# Project Planning Context -3



# Project Planning Context -4

Planning Data

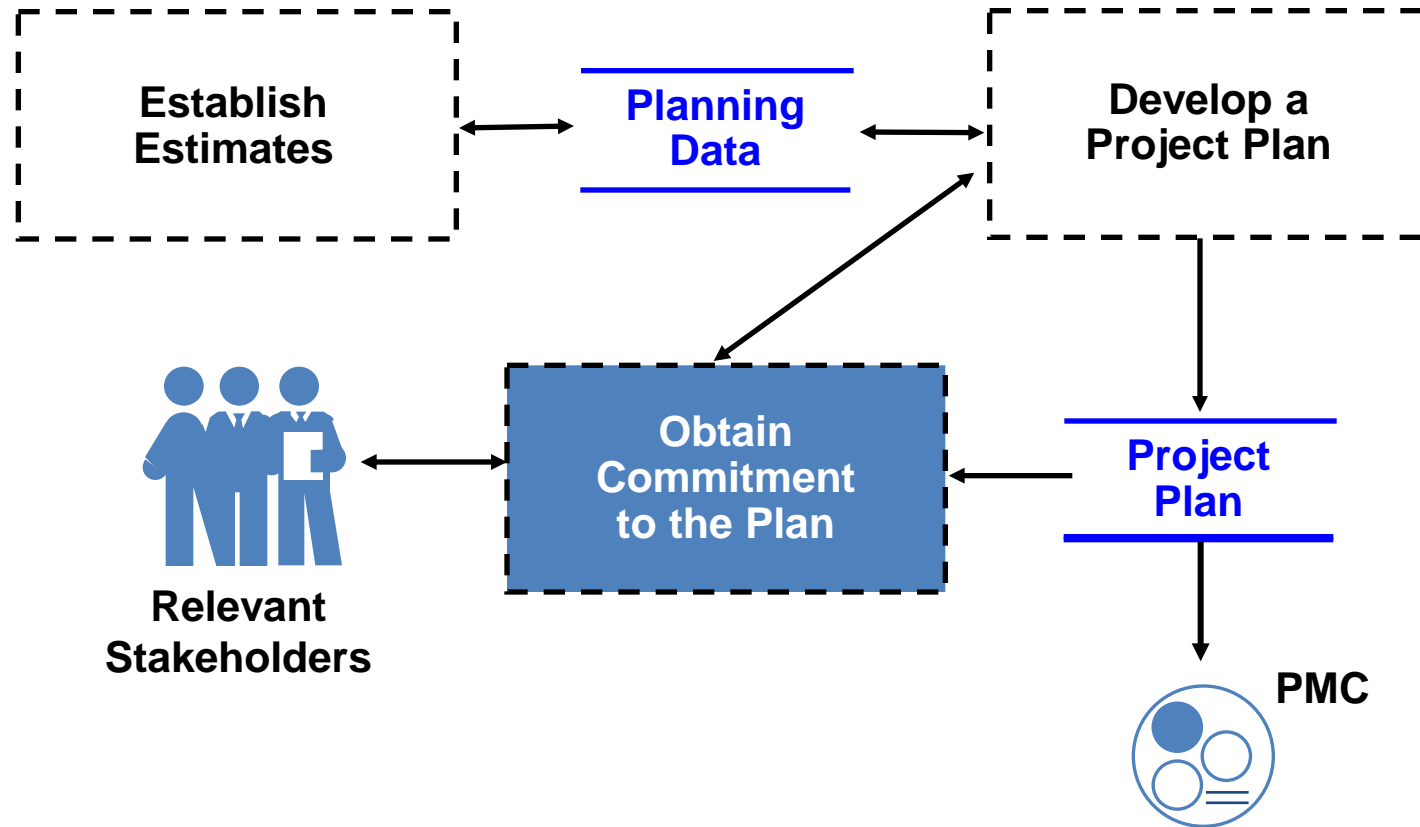


Project Plan

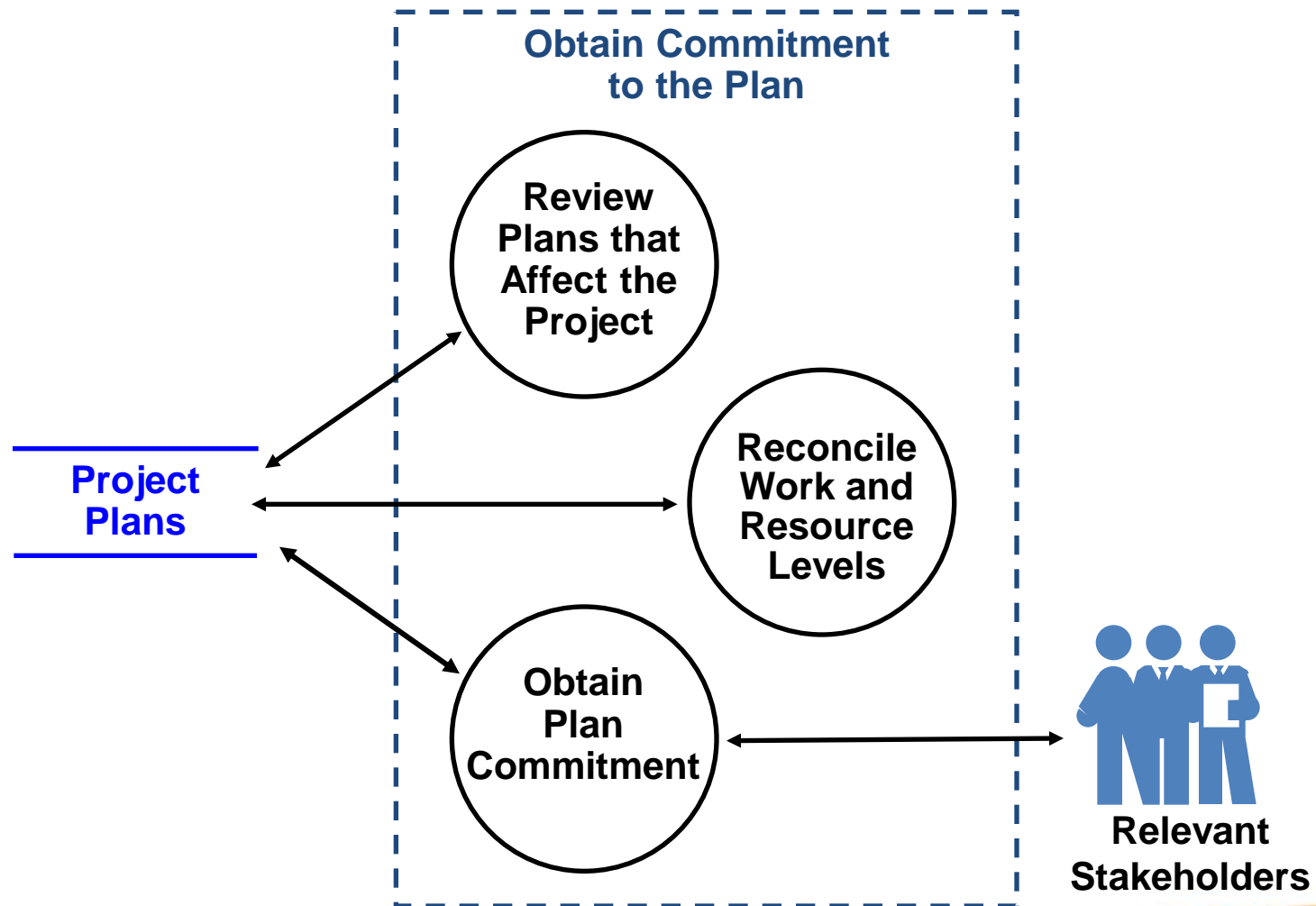
PMC



# Project Planning Context -5



# Project Planning Context -6





# Sampling the Generic Practices

## GP 2.2: Plan the Process

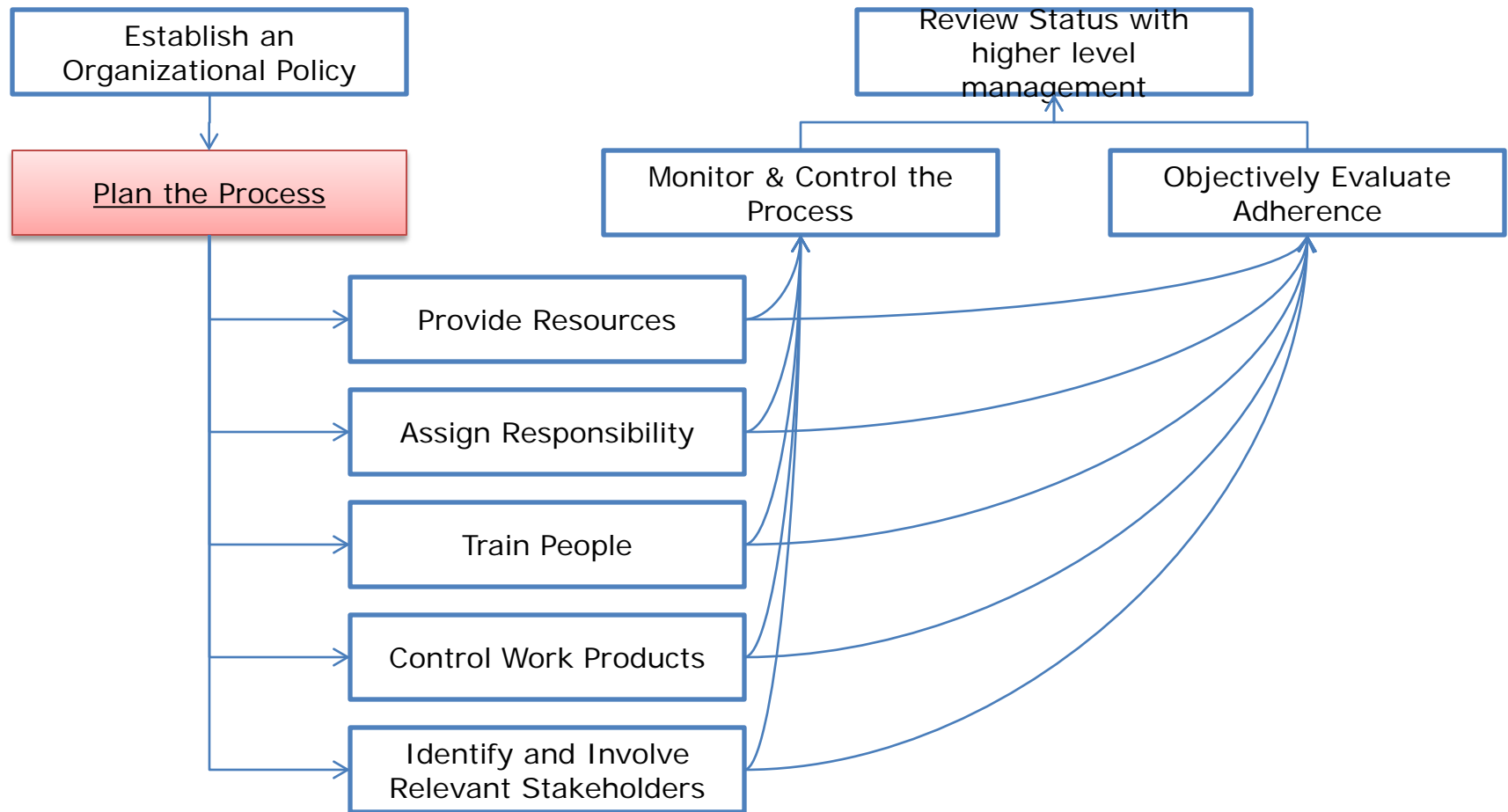
Establish and maintain the plan for performing the project planning process.

*Or .... PLAN THE PLAN !!!*

### *Elaboration for Project Planning*

Refer to Table 6.2 in Generic Goals and Practices in Part Two for more information about the relationship between generic practice 2.2 and the Project Planning process area.

# How PP relates to Generic Practices?



Source: Kiril Karaatanasov, ESI Center Bulgaria

# Project Planning "translated":

- The Project Planning involves:
  - Developing the project plan
  - Getting commitment to the plan
  - Maintaining the plan
- Planning begins with requirements that define the product/project.
- Planning includes:
  - Estimating the attributes of the work products/tasks
  - Determining the resources needed
  - Negotiating commitments
  - Producing a schedule
  - Identifying and analyzing project risks
- The project plan will usually need to be revised to address:
  - changes in requirements/commitments
  - inaccurate estimates
  - corrective actions
  - process changes
- "Project plan" - the overall plan for controlling the project.

# Project Planning actions (elaborate):

- Is there **WBS/Project work packages** based on project's workproducts?
- Work products to be **externally acquired/reused** identified?
- Technical approach of work products determined?  
(Development strategy – client-server/distributed, technologies)
- Duration, people, knowledge, inputs, outputs, infrastructure, etc. for the project determined and **how (what methods)?**
- Resources required estimated?
- Project life cycle/phases determined?
- **Project schedule and budget established?**
- Risks that can affect to the project **identified, documented and revised?**
- Project data management issues addressed?
- **Knowledge and skills** requirements identified and addressed?
- **Stakeholders** identified, and project tasks related to them **according their expertise?**
- Project plan established and **commitments to it identified and documented?**
- Is the project plan **reviewed and actualized?**

# Planning example:

sampling **Gantt Charts**

**Critical Path** Analysis – CPA

**PERT** - Program Evaluation and Review  
Technique:

shortest, most likely, longest  
(optimistic, realistic, pessimistic)

# SW Project Plan – example - 1

Figure 1. Gantt Chart Example: Planning a custom-written computer project

Task	Earliest start	Length	Type	Dependent on...
A. High level analysis	Week 0	1 week	Sequential	
B. Selection of hardware platform	Week 1	1 day	Sequential	A
C. Installation and commissioning of hardware	Week 1.2	2 weeks	Parallel	B
D. Detailed analysis of core modules	Week 1	2 weeks	Sequential	A
E. Detailed analysis of supporting modules	Week 3	2 weeks	Sequential	D
F. Programming of core modules	Week 3	2 weeks	Sequential	D
G. Programming of supporting modules	Week 5	3 weeks	Sequential	E
H. Quality assurance of core modules	Week 5	1 week	Sequential	F
I. Quality assurance of supporting modules	Week 8	1 week	Sequential	G
J. Core module training	Week 6	1 day	Parallel	C,H
K. Development and QA of accounting reporting	Week 5	1 week	Parallel	E
L. Development and QA of management reporting	Week 5	1 week	Parallel	E
M. Development of Management	Week 6	1 week	Sequential	I

**Step 1. List all activities in the plan**

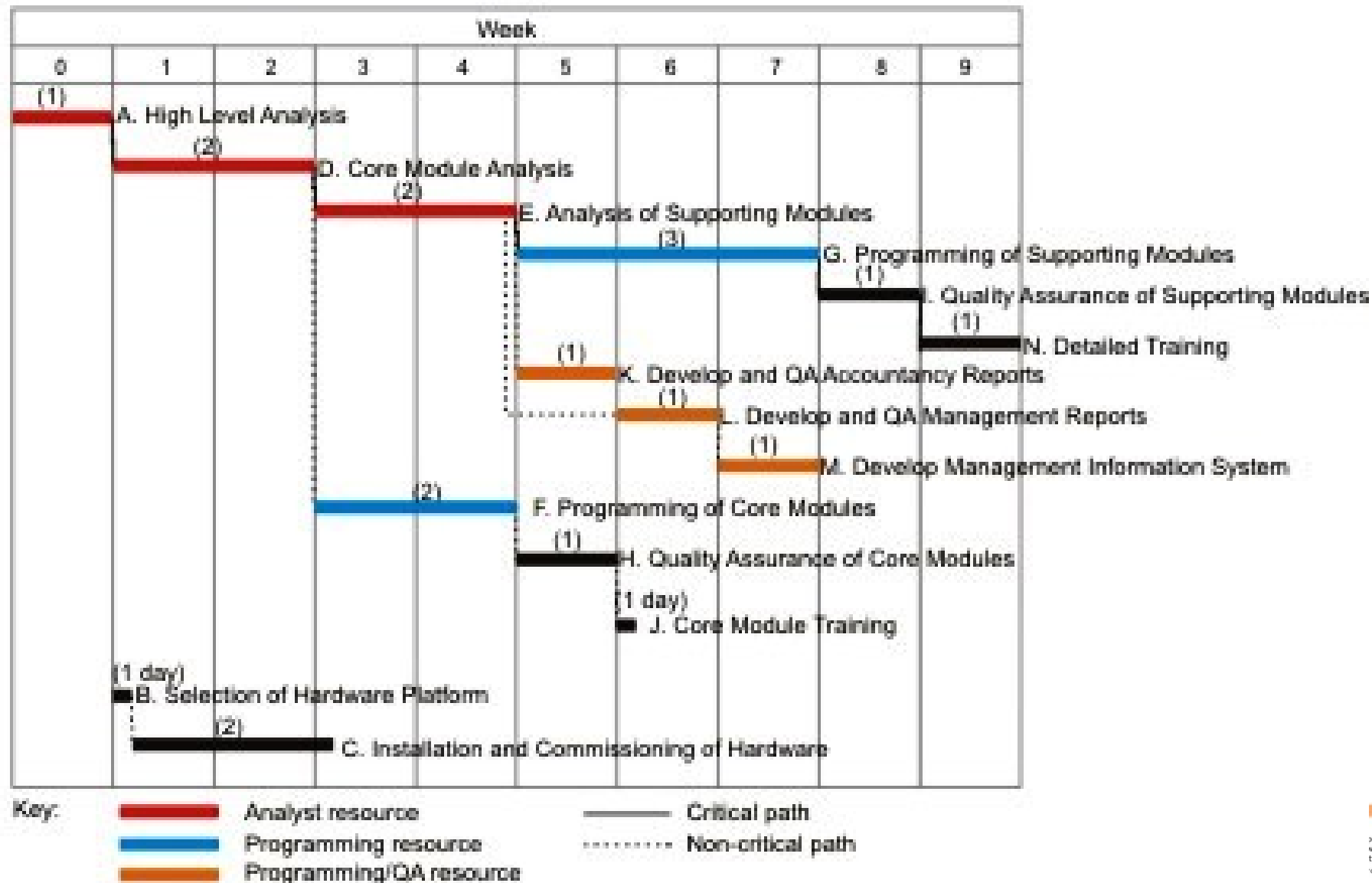
**Sequential and parallel activities**

Courtesy to [www.mindtools.com](http://www.mindtools.com)

# SW Project Plan – example - 2

## Gantt Chart

Figure 3: Critical Path Analysis: Activities Scheduled on a Gantt Chart



# SW Project Plan – example - 3

## Critical Path

[http://www.mindtools.com/pages/article/newPPM\\_03.htm](http://www.mindtools.com/pages/article/newPPM_03.htm)

By drawing this example Gantt Chart, you can see that:  
If all goes well, the project can be completed in 10 weeks.  
If you want to complete the task as rapidly as possible, you need:

- 1 analyst for the first 5 weeks.

- 1 programmer for 5 weeks starting week 4.

- 1 programmer/QA expert for 3 weeks starting week 6. Note: Activities L and M have been moved back a week. This does not affect the critical path, but it does mean that a single programming/QA resource can carry out all three of activities K, L and M.

Analysis, development and testing of supporting modules are essential activities that must be completed on time.

Hardware installation and commissioning is not time-critical as long as it is completed before the Core Module Training starts.

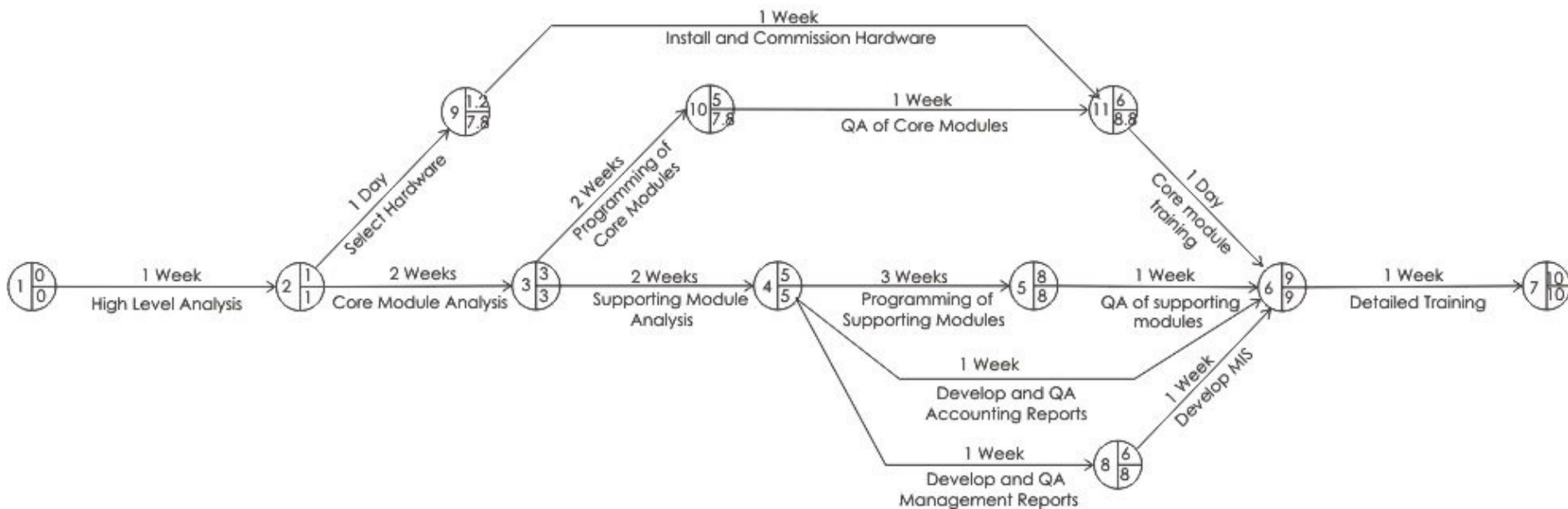
Courtesy to [www.mindtools.com](http://www.mindtools.com)



# SW Project Plan – example - 4

## Critical Path Analysis

Figure 5: Critical Path Analysis for Example Computer Project



Courtesy to [www.mindtools.com](http://www.mindtools.com)

# SW Project Plan – example - 5

## CPA and PERT

**Critical Path Analysis (CPA)** - method of assessing:

- What tasks must be carried out.
- Where parallel activity can be performed.
- The shortest time in which you can complete a project.
- Resources needed to execute a project.
- The sequence of activities, scheduling and timings involved.
- Task priorities.
- The most efficient way of shortening time on urgent projects.

**PERT** (Program Evaluation and Review Technique) is a variant of Critical Path Analysis that takes a more skeptical view of the time needed to complete each project stage:

shortest, most likely, longest

or ***optimistic, realistic, pessimistic***

Courtesy to [www.mindtools.com](http://www.mindtools.com)

# Project Management PAs (overview)

## Requirements management (REQM)

- SG1: Manage requirements

## Project Planning (PP)

- SG1: Establish Estimates
- SG2: Develop a project plan
- SG3: Obtain Commitment to the plan

## Project Monitoring and Control (PMC)

- **SG1: Monitor Project Against Plan**
- **SG2: Manage Corrective action to closure**

# PMC: Project Monitoring and Control

*The purpose of Project Monitoring and Control (PMC) is to 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: Monitor Project Against Plan

Actual performance and progress of the project are monitored against the project plan.

## SG 2: Manage Corrective Action to Closure

Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan.

# When Project Monitoring and Control Is Not Done Well...

Too much time is spent trying to determine **project status**.

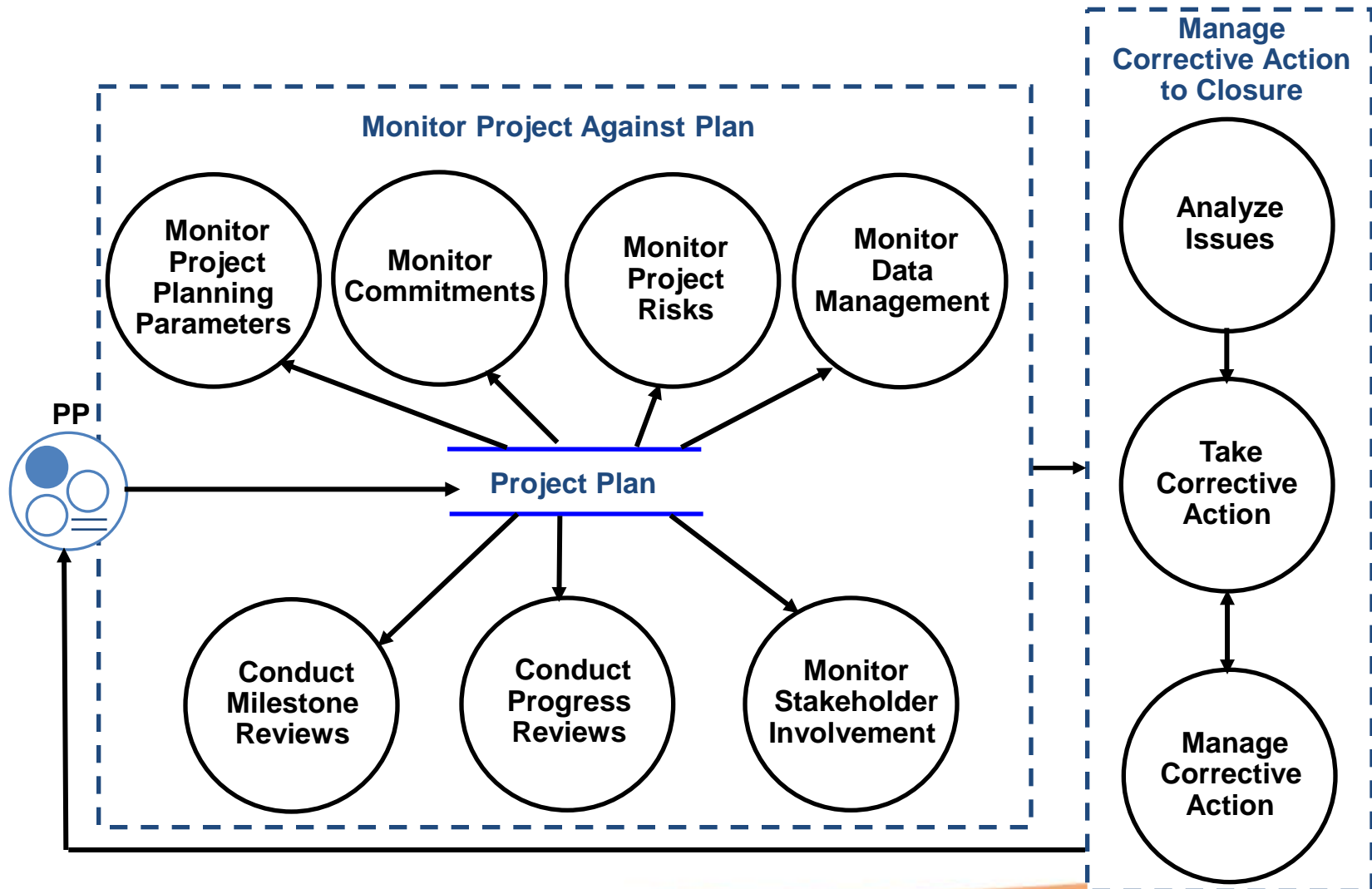
**Data** needed for management decisions are **not available** when needed.

**Corrective action** is not taken early when it is least expensive.

Lack of management insight makes project **results highly unpredictable**.

The **customer does not have confidence** in the project status reporting.

# Project Monitoring and Control Context



# The essence of PMC

- PMC:
  - monitoring activities
  - communicating status
  - taking corrective action
- Progress – at **prescribed milestones** (WBS/Schedule) comparing to the planned:
  - Actual work product and task attributes
  - Effort, cost, and schedule
- When actual status **deviates significantly** – corrective actions
- Corrective actions may include **re-planning** (PP)

# PMC Actions

- **Monitored:**
  - Progress against the schedule
  - Cost, expended effort, staffing and training
  - Actual resources usage
- **Deviations documented?**
- Internal and external commitments **regularly reviewed?**
- **Risks status** regularly reviewed/communicated to relevant stakeholder?
- Data management tasks regularly reviewed?
- **Progress reviews:**
  - Task status communicated?
  - Results documented?
- **Milestone reviews** conducted?
- Manage **corrective actions to closure**
  - Issues analyzed and documented?
  - Corrective actions tracked to closure?
  - Results analyzed?





VIA 9GAG.COM

# Remember - Generic practices ML2?

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 Work Products

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

# Sampling the Generic Practices

## GP 2.8: Monitor and Control the Process

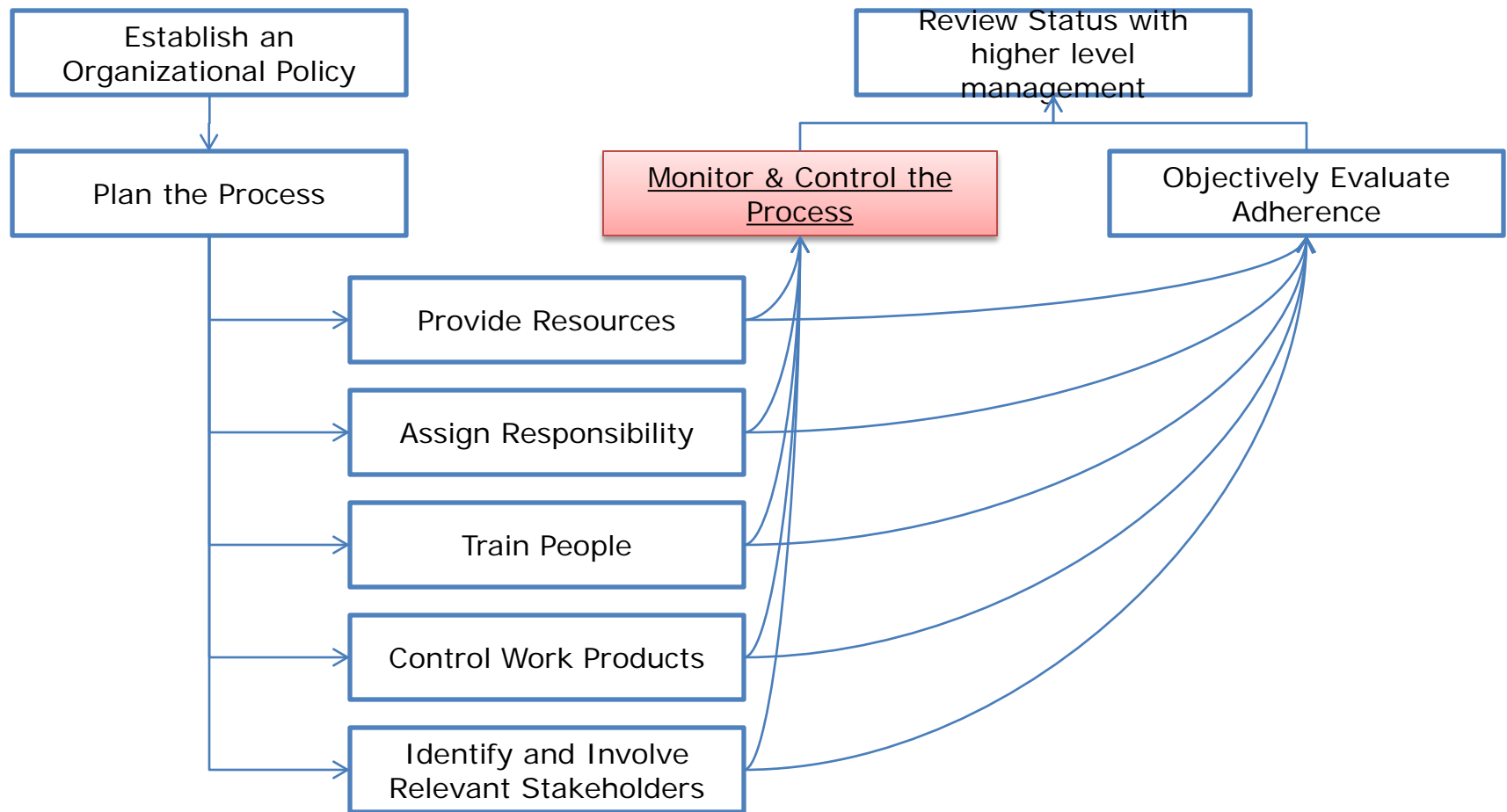
Monitor and control the project monitoring and control process against the plan for performing the process and take appropriate corrective action.

### *Elaboration for Project Monitoring and Control*

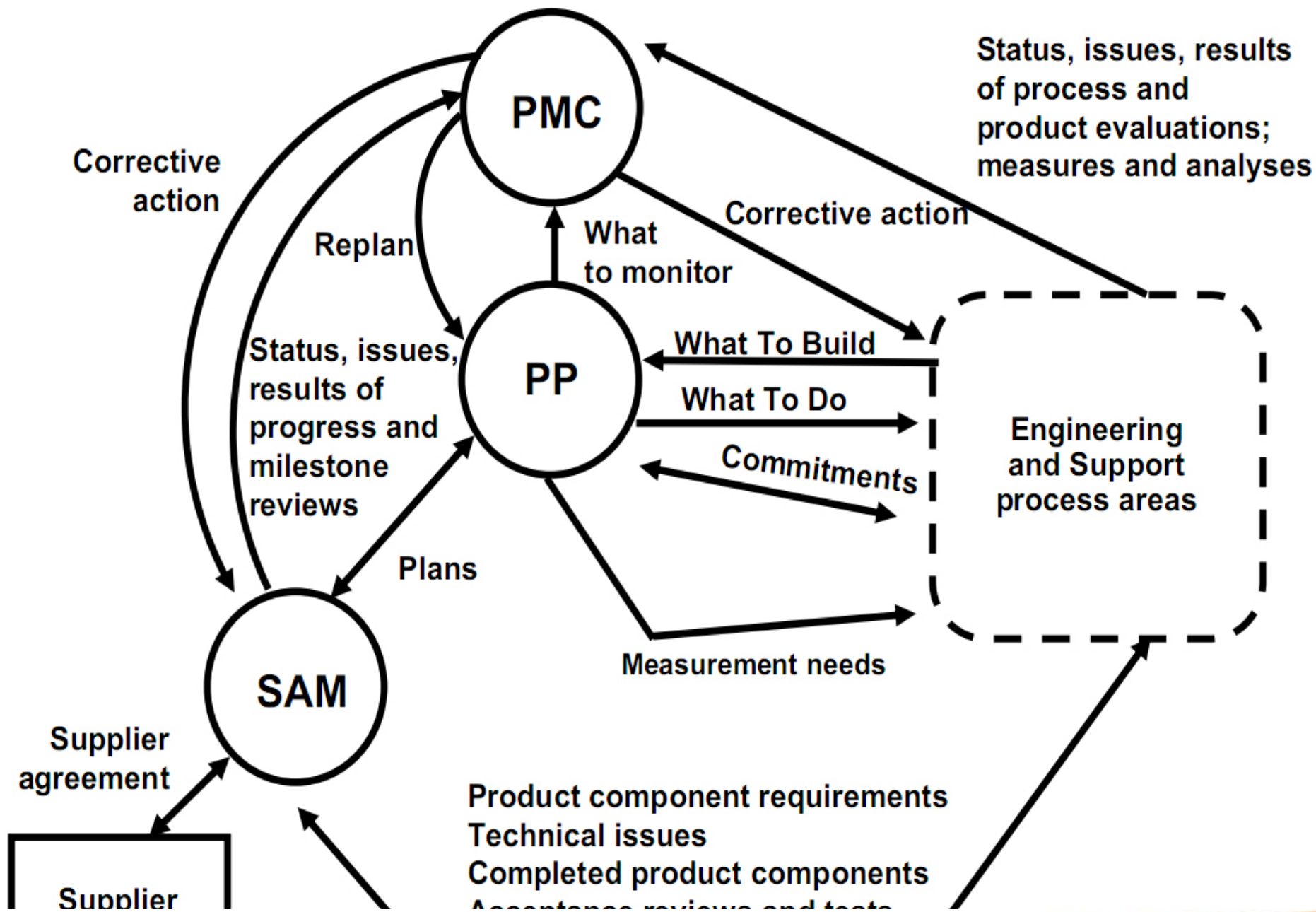
Examples of measures and work products used in monitoring and controlling include the following:

- number of open and closed corrective actions
- schedule with status for monthly financial data collection, analysis, and reporting
- number and types of reviews performed
- review schedule (planned versus actual and slipped target dates)
- schedule for collection and analysis of monitoring data

# How PMC relates to Generic Practices?



Source: Kiril Karaatanasov, ESI Center Bulgaria



# Just to mention SAM

## (Supplier Agreement Management)

*The purpose of Supplier Agreement Management (SAM) is to **manage the acquisition of products and services** from suppliers.*



### **SG 1: Establish Supplier Agreements**

Agreements with the suppliers are established and maintained.

### **SG 2: Satisfy Supplier Agreements**

Agreements with suppliers are satisfied by both the project and the supplier.

# The essence of SAM

**Applies** to the acquisition of:

**products/components** that are **delivered** to the project's customer

significant products/components **not delivered** to the project's customer (for example, development tools and test environments).

**Does not apply** when supplier is part of the team

Suppliers:

in-house vendors

fabrication capabilities and laboratories

commercial vendors

The acquired product is delivered to the project from the supplier and **becomes part of the products delivered to the customer**

# SAM Practices:

Type of acquisition (COTS, contract, in-house, from the customer) determined?

Supplier **selection based on evaluation?**

**Criteria for evaluation** established/documentated?

Criteria for evaluation of proposals?

Agreement with supplier documentated?

Agreement revised during project?

Criteria of evaluation of COTS?

Risk analysis performed on COTS?

Monitoring activities defined in the agreement?

Technical/management reviews with supplier performed?

Acceptance test/verification performed and results documentated?



# Next: Supporting PAs ML2:

- Requirements Management
- Project Planning
- Project Monitoring & Control
- **Process and Product Quality Assurance**
- **Measurement & Analysis**
- **Configuration Management**
- Supplier Agreement Management

# Supporting PAs (overview)

## Process and Product Quality Assurance (PPQA)

- **SG 1: Objectively Evaluate Processes and Work Products**
- **SG 2: Provide Objective Insight**

## Measurement and Analysis (MA)

- SG 1: Align Measurement and Analysis Activities
- SG 2: Provide Measurement Results

## Configuration Management (CM)

- SG 1: Establish Baselines
- SG 2: Track and Control Changes
- SG 3: Establish Integrity

# Process & Product Quality Assurance (PPQA)

The purpose of Process and Product Quality Assurance (PPQA)

is to

provide **staff and management**

with objective insight into

**processes** and

associated **work products**.

# What PPQA provides?

Management knows if **process assets** are being used

Failures to follow process that may **endanger projects become visible early on**

Problems with **process definitions** are uncovered and addressed

Process descriptions are **followed**

# Terminology

## Quality assurance

- A planned and systematic means for assuring management that defined standards, practices, procedures, and methods of the process are applied.

## Objectively evaluate

- To review activities and work products against criteria that minimize subjectivity and bias by the reviewer.

# Analyze that (1):

“I'd rather have it wrong than have it late.  
We can always fix it later.”

# Process and Product Quality Assurance (PPQA)

*The purpose of Process and Product Quality Assurance (PPQA) is to provide staff and management with objective insight into processes and associated work products.*



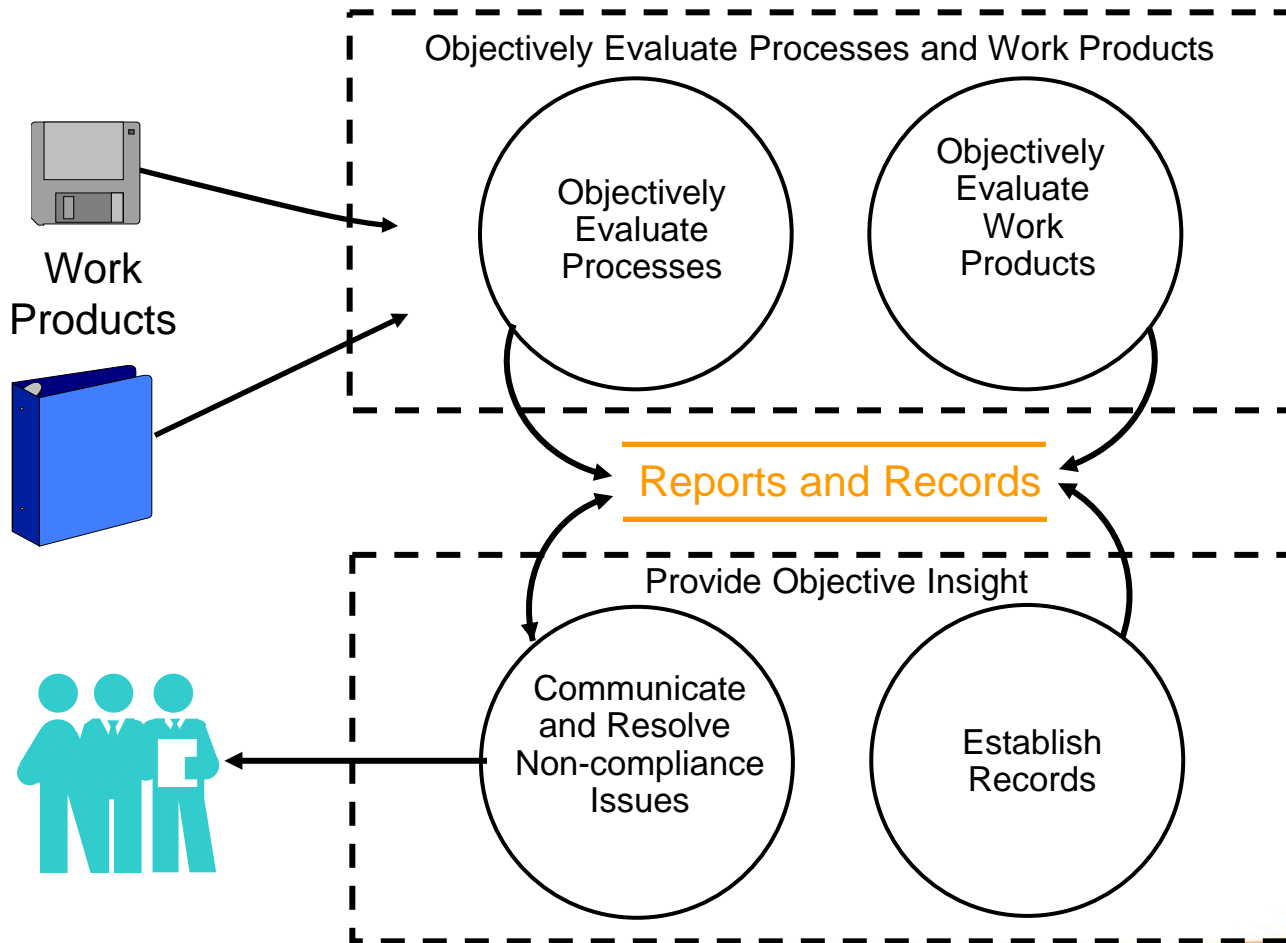
## SG 1: Objectively Evaluate Processes and Work Products

Adherence of the performed process and associated work products to applicable process descriptions, standards, and procedures is objectively evaluated.

## SG 2: Provide Objective Insight

Noncompliance issues are objectively tracked and communicated, and resolution is ensured.

# Process and Product Quality Assurance - Context

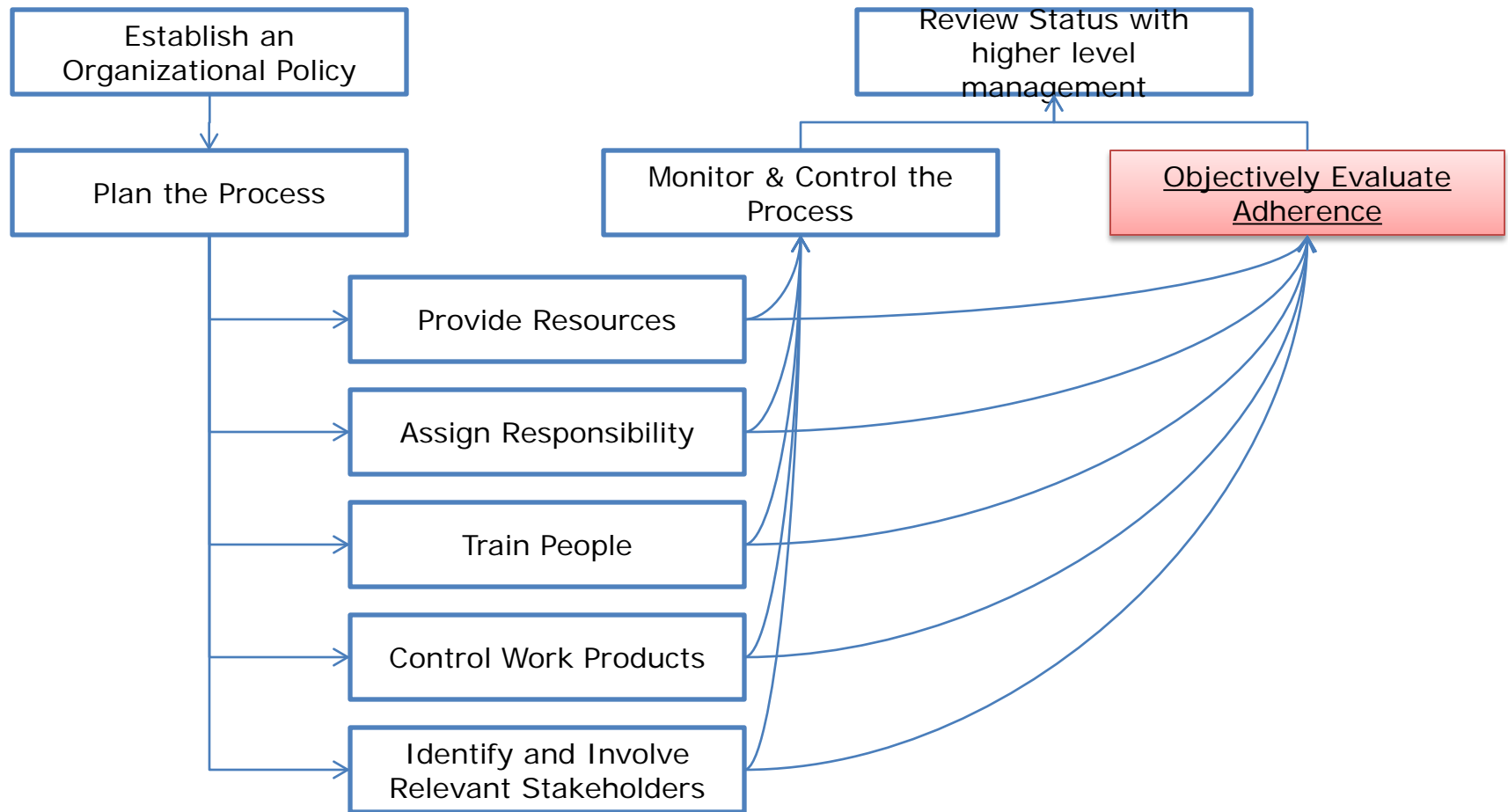




# PPQA Practices translated:

- Are QA evaluations performed on processes/workproducts according to **predefined criteria**?
- Performed processes **adhere to the standards, process descriptions and procedures**?
- **Non-compliance** identified during the QA evaluations of processes/work products?
- **Lessons learned** collected?
- Non-compliances resolved within the project/escalated?
- **Relevant stakeholders aware** of the results of the QA evaluations?
- **Management reviews** on non-compliances on periodic basis?
- Non-compliances **tracked until closure**?
- QA activities **documented in sufficient detail**?
- QA **status and results known**?

# How PPQA relates to Generic Practices?



Source: Kiril Karaatanasov, ESI Center Bulgaria

# Analyze that (2)

Statement:

If programing is “creative” &  
**fun**,

Why the software engineering  
is a **job**?





Analyze  
that (3):

What's  
wrong?

PAs  
SPs  
GPs  
..  
we?

# Supporting PAs (overview)

## Process and Product Quality Assurance (PPQA)

- SG 1: Objectively Evaluate Processes and Work Products
- SG 2: Provide Objective Insight

## Measurement and Analysis (MA)

- **SG 1: Align Measurement and Analysis Activities**
- **SG 2: Provide Measurement Results**

## Configuration Management (CM)

- SG 1: Establish Baselines
- SG 2: Track and Control Changes
- SG 3: Establish Integrity

# Measurement & Analysis

The purpose of Measurement and Analysis (MA) is  
to **develop and sustain**  
a measurement capability  
that is used to support  
**management**  
**information needs.**

# What does Measurement and Analysis Provide?

Insight to process performance

Means to compare different instances - past to present, project to project, team to another team etc.

Signals deviations from planned parameters

Basis for statistical management

# Terminology

## Base Measure

- A distinct property or characteristic of an entity and the method for quantifying it.

## Derived Measure

- Data resulting from the mathematical function of two or more base measures.



# Measurement and Analysis

*The purpose of Measurement and Analysis (MA) is to develop and sustain a measurement capability used to support management information needs.*



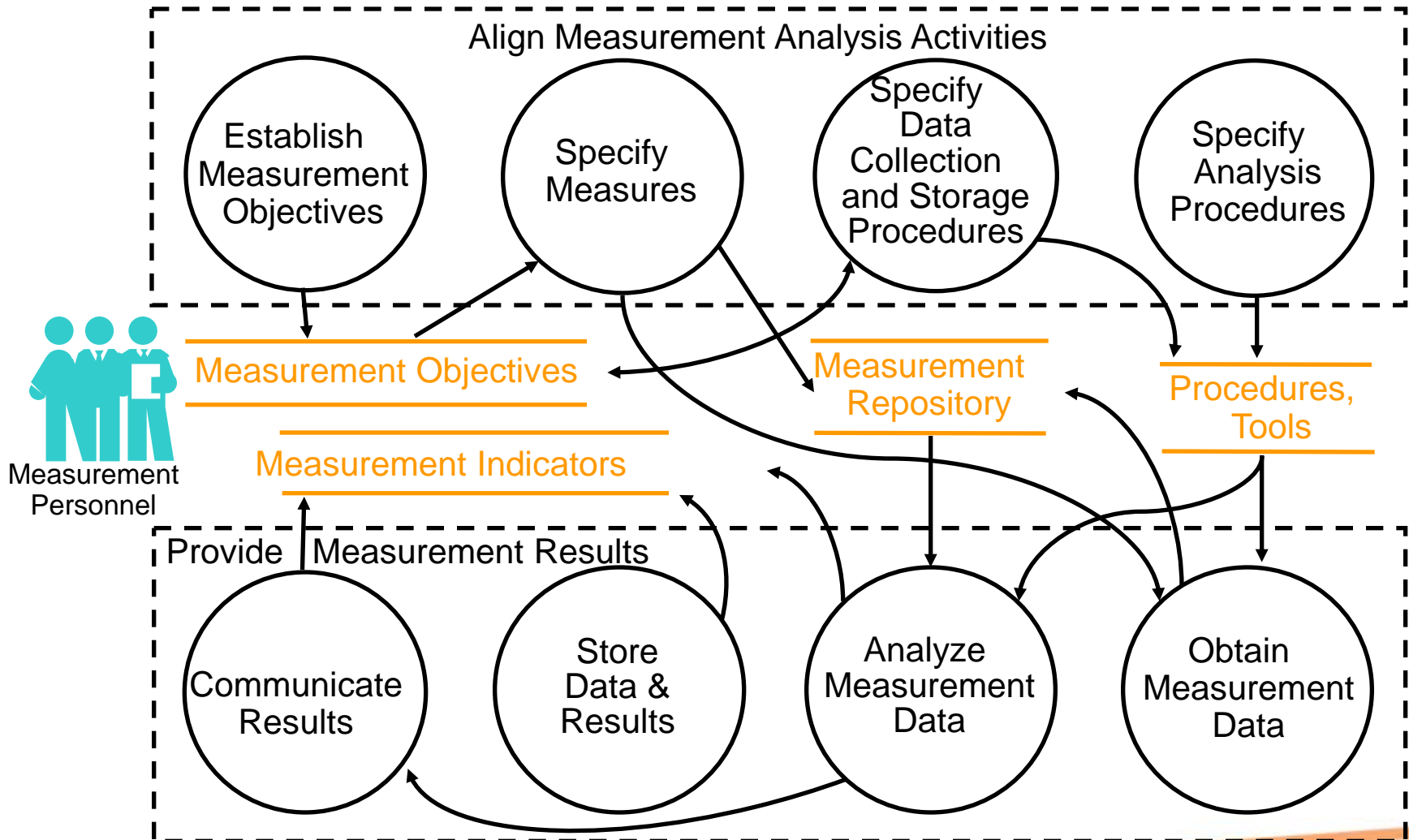
## SG 1: Align Measurement and Analysis Activities

Measurement objectives and activities are aligned with identified information needs and objectives.

## SG 2: Provide Measurement Results

Measurement results, which address identified information needs and objectives, are provided.

# Measurement & Analysis - Context



# The essence of MA

- Specifying **objectives** of measurement/analysis - **aligned with information needs**
- Specifying measures, data collection and storage mechanisms, analysis techniques, and reporting and feedback mechanisms
- Implementing the collection, storage, analysis, and reporting of the data
- Providing **objective results** for making **informed** decisions, and taking appropriate corrective actions
- Integration of measurement and analysis into the project **supports**:
  - Planning and estimating
  - **Tracking actual performance** against established plans and objectives
  - Identifying and resolving process-related issues
  - Providing a basis for incorporating measurement into additional processes in the future
- The staff - from the projects or separate organization functions (e.g., QA).
- Initial focus - **at the project level**, MA might be useful for organization/enterprise information needs.
- Project-specific data/results stored in a project-specific repository or organization's measurement repository.

# MA – Metrics example 1

## ***REQM (Requirements Management)***

1. **Requirements volatility (percentage of requirements changes)**
2. Number of requirements **by type or status**  
(defined, reviewed, approved, and implemented)
3. Cumulative **number of changes to the allocated requirements**, including total number of changes proposed, open, approved, and incorporated into the system baseline
4. **Number of changes requests per month**, compared to the original number of requirements for the project
5. Number of **time spent, effort spent, cost** of implementing change requests
6. **Number and size of change requests after the Requirements phase is finished**
7. **Cost** of implementing a change request
8. Number of change requests versus the total number of change requests during the life of the project
9. Number of change requests **accepted but not implemented**
10. **Number of requirements (changes and additions to the baseline)**

# MA – Metrics example 2

## ***PP (Project Planning)***

1. **Completion of milestones** for the project planning activities compared to the plan (**estimates versus actuals**)
2. **Work completed, effort expended, and funds expended in the**  
project planning activities compared to the plan
3. **Number of revisions to the project plans**
4. Cost, schedule, and effort variance per plan revision
5. **Re-planning effort due to change requests**
6. **Effort expended over time to manage the project compared to the plan !**
7. **Frequency, causes, and magnitude of the re-planning effort**

# MA – Metrics example 3

## ***PMC (Project Monitoring and Control)***

1. Effort and other resources expended in performing monitoring and oversight activities (**cost of monitoring**)
2. Change activity for the project plan, which includes changes to size estimates of the work products, cost estimates, resource estimates, and schedule
- 3. Number of open and closed corrective actions or action items**
4. Project milestone dates (**planned versus actual**)
- 5. Number of project milestone dates made on time**
6. Number and types of reviews performed
7. Schedule, budget, and size variance between planned versus actual reviews
- 8. Comparison of actuals versus estimates for all planning and tracking items**

# MA – Metrics example 4

## ***MA (Measurement and Analysis)***

1. Number of projects using progress and performance measures
2. Number of measurement objectives addressed

## ***SAM (Supplier Agreement Management)***

1. Cost of the COTS (commercial off-the-shelf) products
2. Cost and effort to incorporate the COTS products into the project
3. Number of changes made to the supplier requirements
4. Cost and schedule variance per supplier agreement
5. Costs of the activities for managing the contract compared to the plan
6. Actual delivery dates for contracted products compared to the plan
7. Actual dates of prime contractor deliveries to the subcontractor compared to the plan
8. Number and severity of errors found after delivery
9. Number of on-time deliveries from the vendor, compared with the contract
10. Number of exceptions to the contract to ensure schedule adherence
11. Number of quality audits compared to the plan
12. Number of senior management reviews to ensure adherence to budget / schedule versus the plan
13. Number of contract violations by supplier or vendor

# MA – Metrics example 5

## ***Process and Product Quality Assurance (QA)***

1. Completions of milestones for the QA activities compared to the plan
2. Work completed, effort expended in the QA activities compared to the plan
3. Numbers of product audits and activity reviews compared to the plan
4. Number of process audits and activities versus those planned
5. Number of defects per release or build
6. Amount of time/effort spent in rework
7. Amount of QA time/effort spent in each phase of the life cycle
8. Number of reviews and audits versus number of defects found
9. Total number of defects found in internal reviews and testing versus those found by the customer or end user after delivery
10. Number of noncompliances written versus number resolved
11. Number of defects found in each phase of the life cycle
12. Number of defects injected during each phase of the life cycle
13. Number of noncompliances elevated to senior management
14. Complexity of module or component (McCabe, McClure, and Halstead metrics)



# MA – Metrics example 6

## ***Configuration Management (CM)***

- 1. Number of change requests processed per unit of time**
2. Completions of milestones for the CM activities compared to the plan
3. Work completed, effort expended, and funds expended in the CM activities
- 4. Number of changes to configuration items**
5. Number of configuration audits conducted
6. Number of fixes returned as "Not Yet Fixed"
7. Number of fixes returned as "Could Not Reproduce Error"
8. Number of violations of CM procedures (noncompliance found in audits)
9. Number of outstanding problem reports versus rate of repair
10. Number of times changes are overwritten by someone else (or number of times people have the wrong initial version or baseline)
11. Number of engineering change proposals proposed, approved, rejected, implemented
12. Number of changes by category to code source, and to supporting documentation
13. Number of changes by category, type, and severity
- 14. Source lines of code stored in libraries placed under configuration control**

# The lessons ... ? **Analysis paralysis ?**

Michael J. Ashworth, CIO of the investment banking unit at J.P. Morgan Chase & Co stated that the move from Level 1 to Level 2 brought with it more reliable planning, so application features were more likely to be right the first time, reducing costly rework. The investment bank has seen the following additional benefits, he said:

A 20% to 25% reduction in postimplementation defects.

Reduced efforts to support operational systems because they are more reliable.

**"Emergency" releases to fix bugs have fallen by 60%.**

Better management of globally distributed projects **because terminology and specifications are standardized.**

Better performance from suppliers because **requirements are better specified.**

Nevertheless, Ashworth cautions against **"analysis paralysis"** when it comes to evaluating the results of CMM.

**"We found it not useful to spend too much time trying to measure things, rather than just doing it"**

(Quality Model Mania, Gary Anthes, Computerworld IT Management, 2004)

# Generic 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: Control Work Products

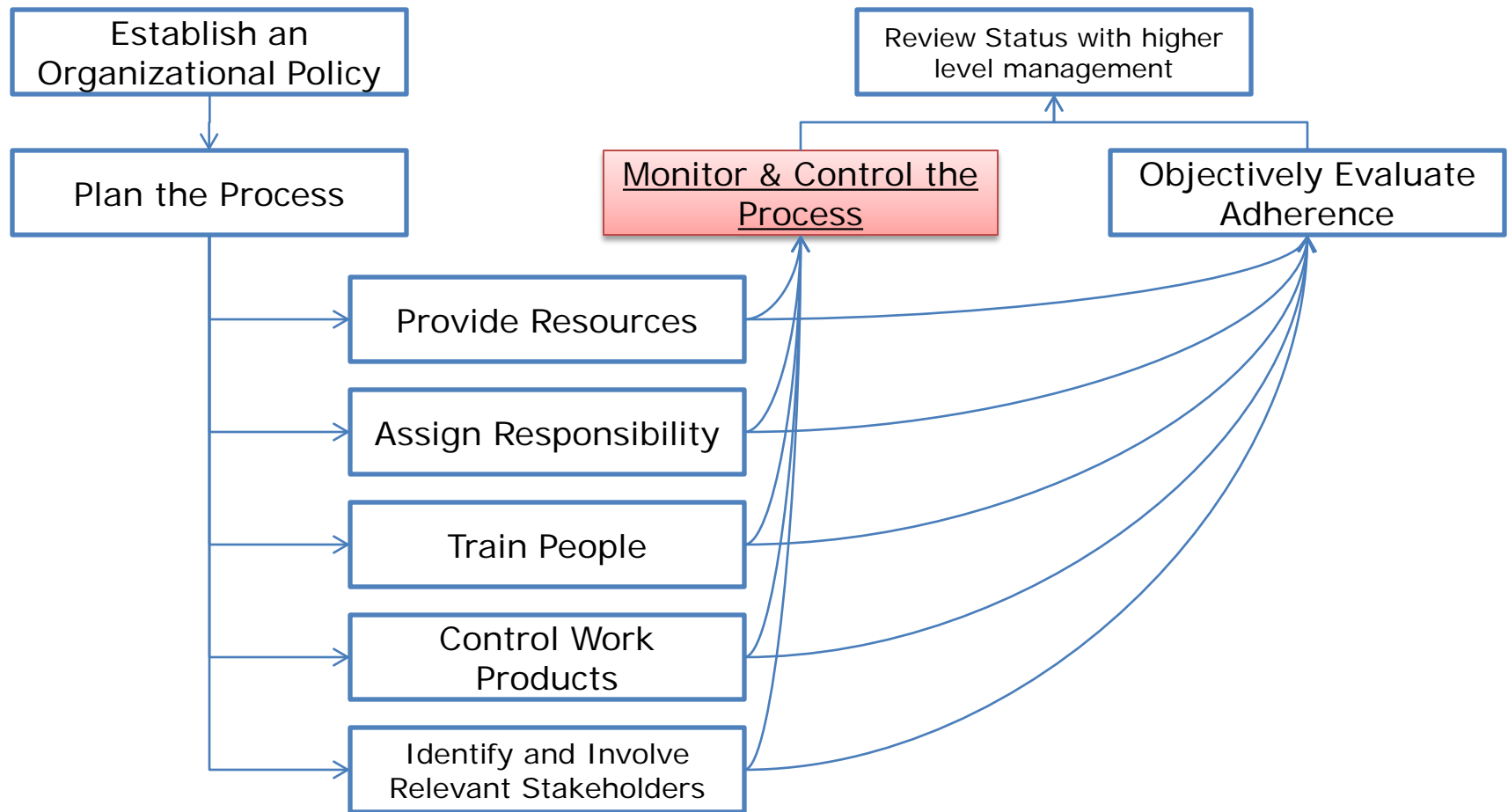
GP2.7: Identify and Involve Relevant Stakeholders

**GP2.8: Monitor and Control the Process**

GP2.9: Objectively Evaluate Adherence

GP2.10: Review Status with Higher Level Management

# How MA relates to Generic Practices?



Source: Kiril Karaatanasov, ESI Center Bulgaria

# Supporting PAs (overview)

## Process and Product Quality Assurance (PPQA)

- SG 1: Objectively Evaluate Processes and Work Products
- SG 2: Provide Objective Insight

## Measurement and Analysis (MA)

- SG 1: Align Measurement and Analysis Activities
- SG 2: Provide Measurement Results

## Configuration Management (CM)

- **SG 1: Establish Baselines**
- **SG 2: Track and Control Changes**
- **SG 3: Establish Integrity**

# Configuration Management (CM)

*The purpose of Configuration Management (CM) is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.*



## **SG 1: Establish Baselines**

Baselines of identified work products are established.

## **SG 2: Track and Control Changes**

Changes to the work products under configuration management are tracked and controlled.

## **SG 3: Establish Integrity**

Integrity of baselines is established and maintained.

# What does CM Provide?

State of components is known and there is confidence what and when can be released

When needed baselines can be recovered

Changes from baseline are identifiable

Past product releases can be rebuilt

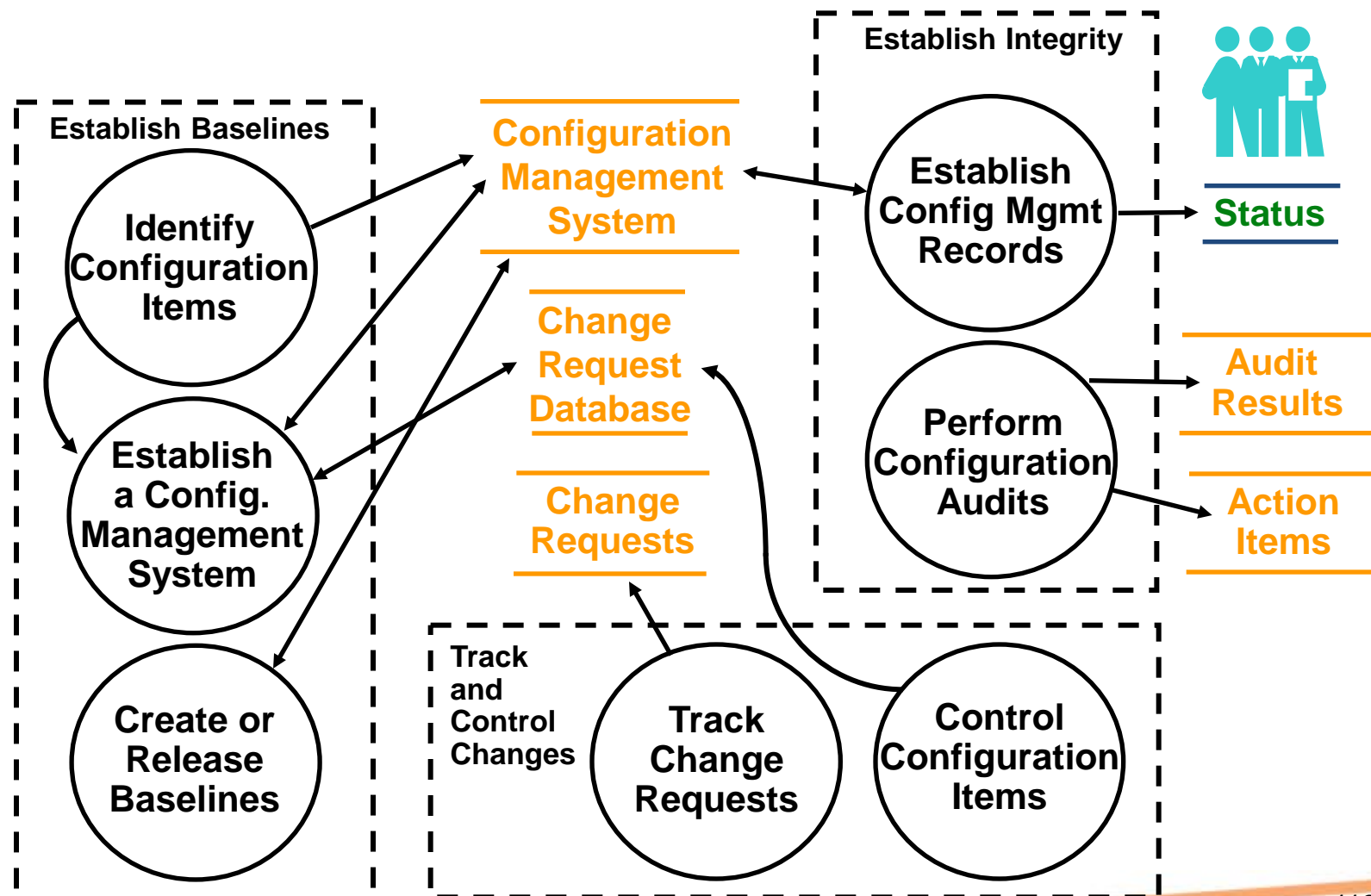
Reasons for changes to plans are clear

# Baseline

- A set of specifications or work products that has been formally reviewed and agreed on, which thereafter serves as the basis for further development, and which can be changed only through change control procedures. (See also “configuration baseline” and “product baseline.”)



# Configuration Management - Context



# The essence of CM

CM Involves:

- Identifying the configuration of work products that compose the baselines
- Controlling changes to configuration items
- Building work products from the configuration management system
- Maintaining the integrity of baselines
- Providing status / configuration data to developers, end users, and customers

Work products placed under configuration management:

- products delivered to the customer
- internal work products
- acquired products
- tools

Configuration item may be:

- configuration component
- configuration unit

Baselines:

- provide a basis for evolution of configuration items
- added to the configuration management system as they are developed
- Changes to, are systematically controlled/monitored

This PA applies not only to **projects, but also to organization work products** (standards, procedures, etc)

This PA is applicable to all work products that are placed under configuration management.

# CM practices

Configuration items/work products **selected in the initial planning** of the project?

An **owner** responsible for each CI?

Configuration management system supports **multiple control levels**?

Employees can store and recover the **different versions of CI's** in the CMS?

Team members store, update and retrieve **CM Records** in the CMS?

CMS supports the creation of **CM Reports**?

Contents of CMS's **preserved**?

Baselines built and released **from CI's kept in the CMS**?

**Descriptions** about the set of CI's that comprise each baseline?

Change requests initiated and recorded, their **impact analyzed**?

**Current set of baselines** available in the CMS?

Change requests reviewed with the **affected people**?

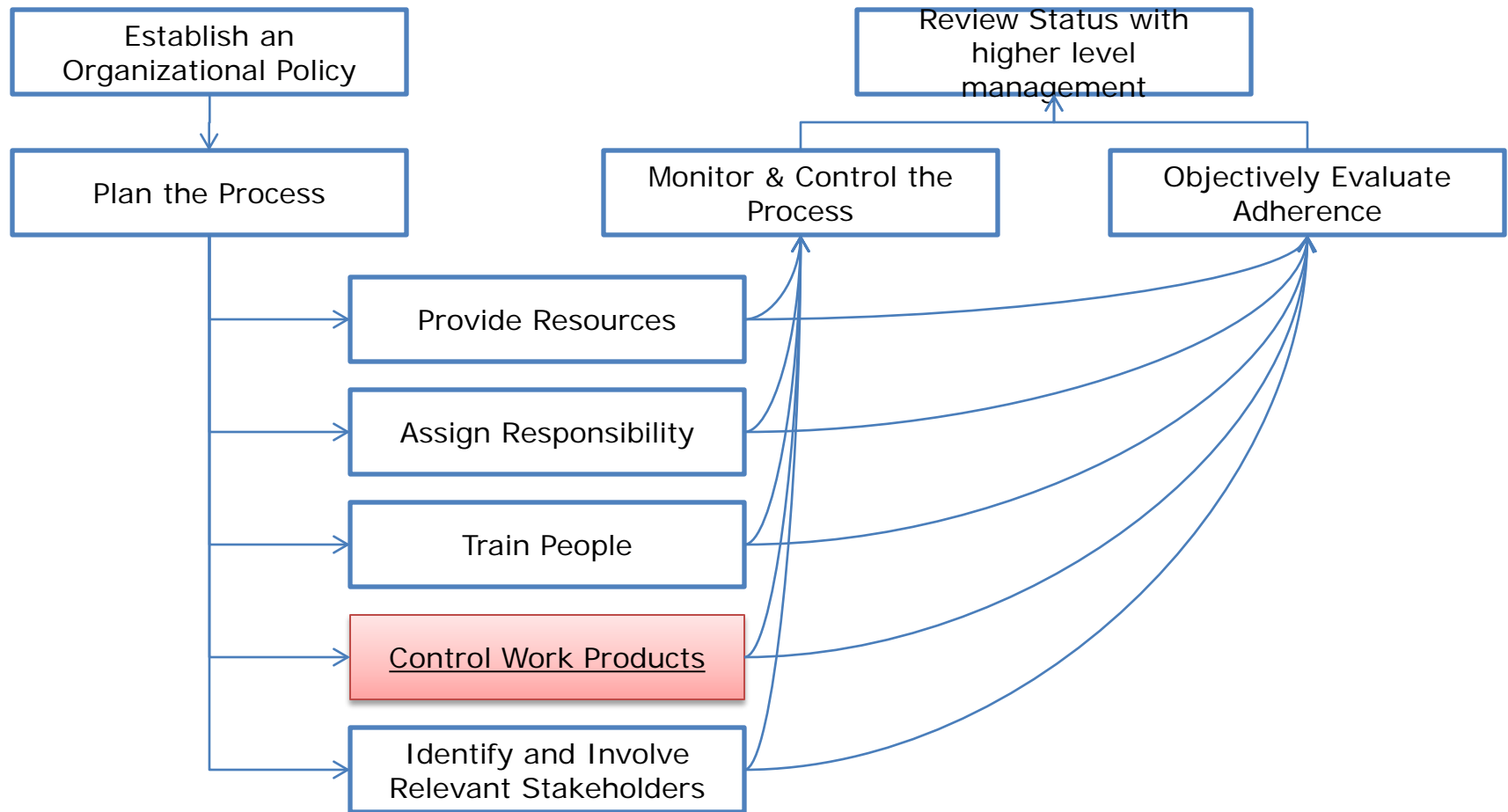
**Changes tracked to closure**, in order to check that all changes have been incorporated?

Changed CI's entered into the CMS only after **obtaining authorisation**?

After each CM action, are **CI's content and status updated** and is it possible to **recover previous versions of CI's**?

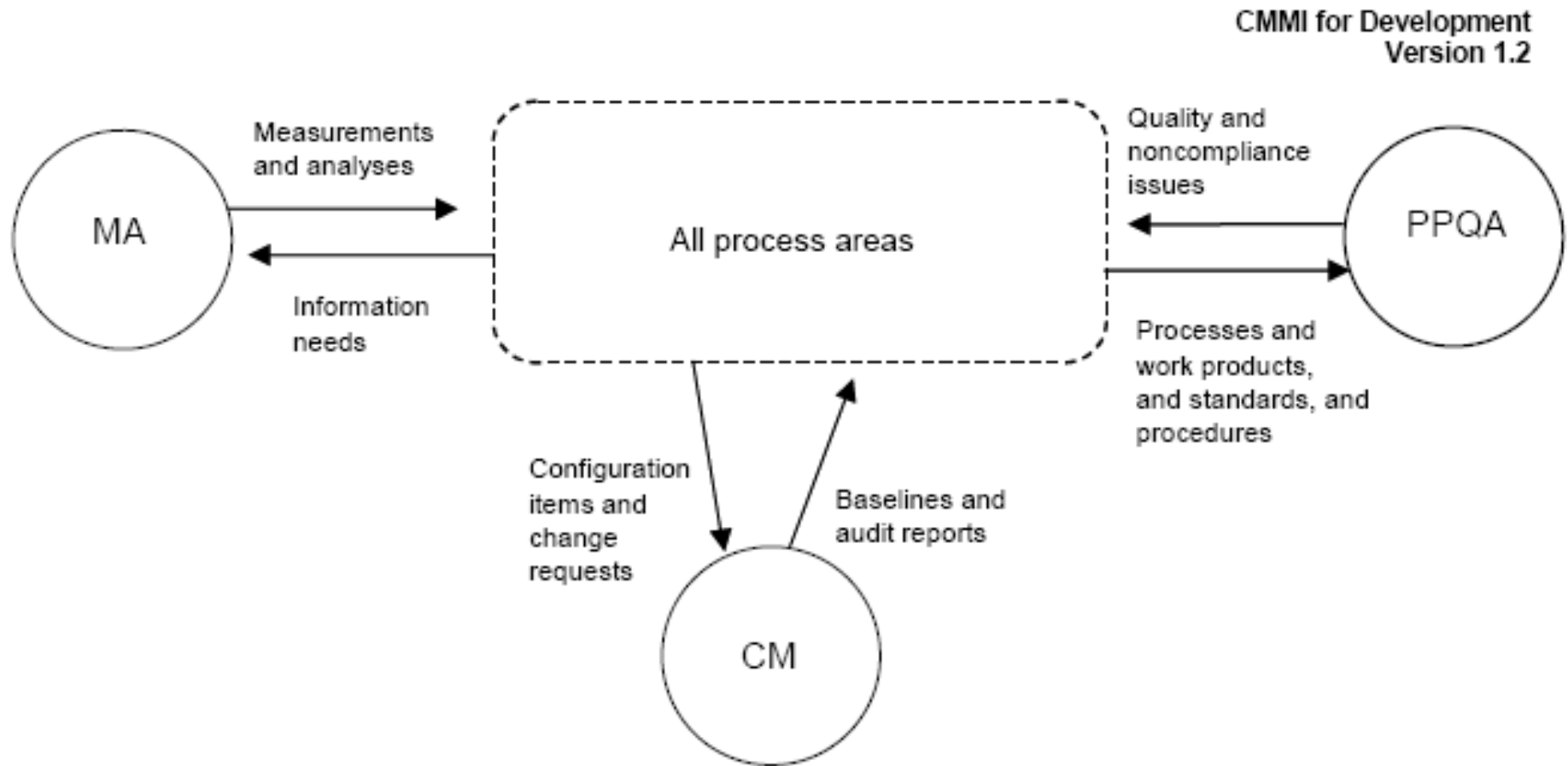
Is the CI's records' correctness/CMS structure and integrity verified/reviewed

# How CM relates to Generic Practices?



Source: Kiril Karaatanasov, ESI Center Bulgaria

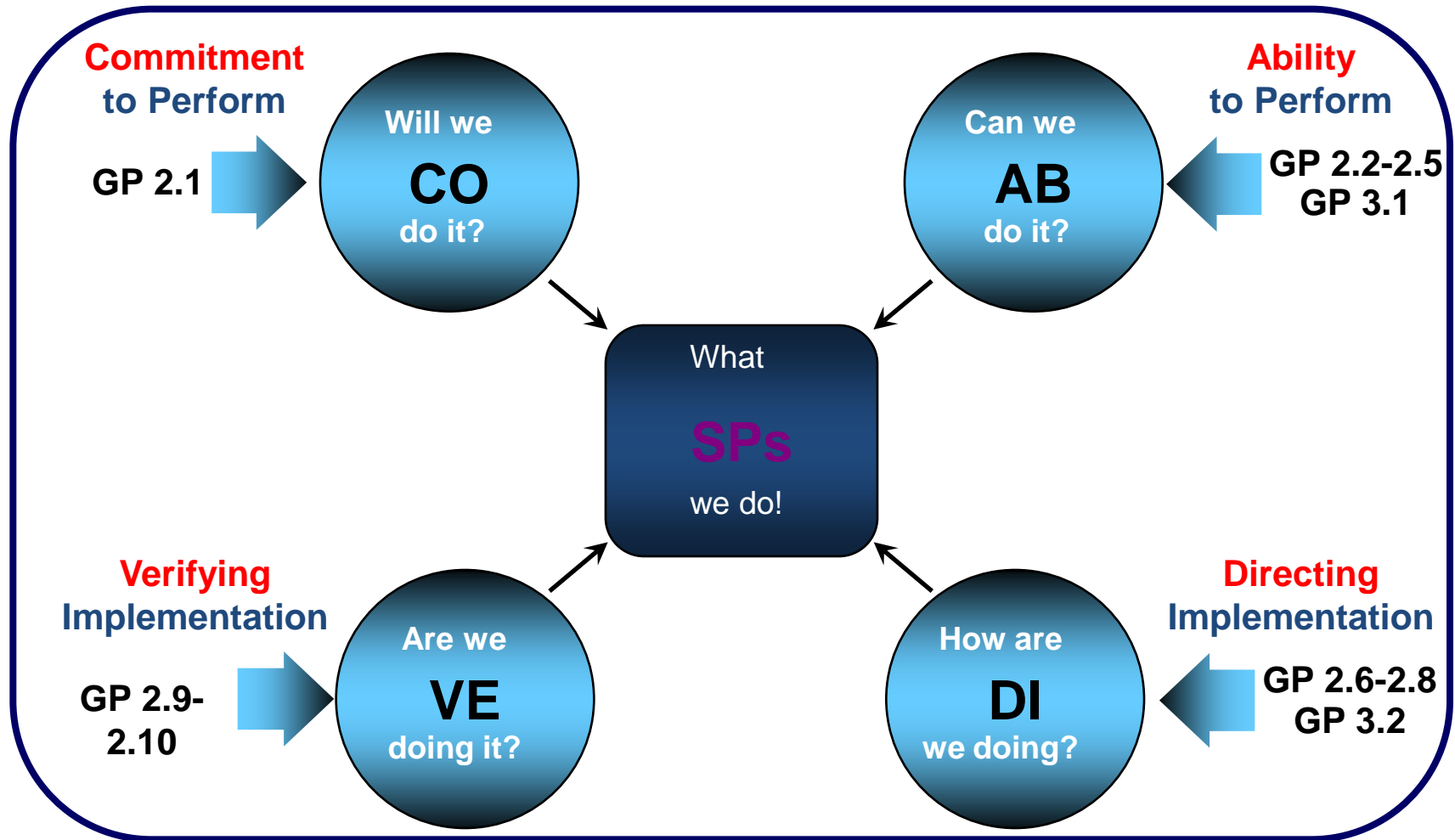
# Summary: How support process areas fit?



MA = Measurement and Analysis  
CM = Configuration Management  
PPQA = Process and Product Quality Assurance

# Common Features (GPs)

## - Basis for Institutionalization



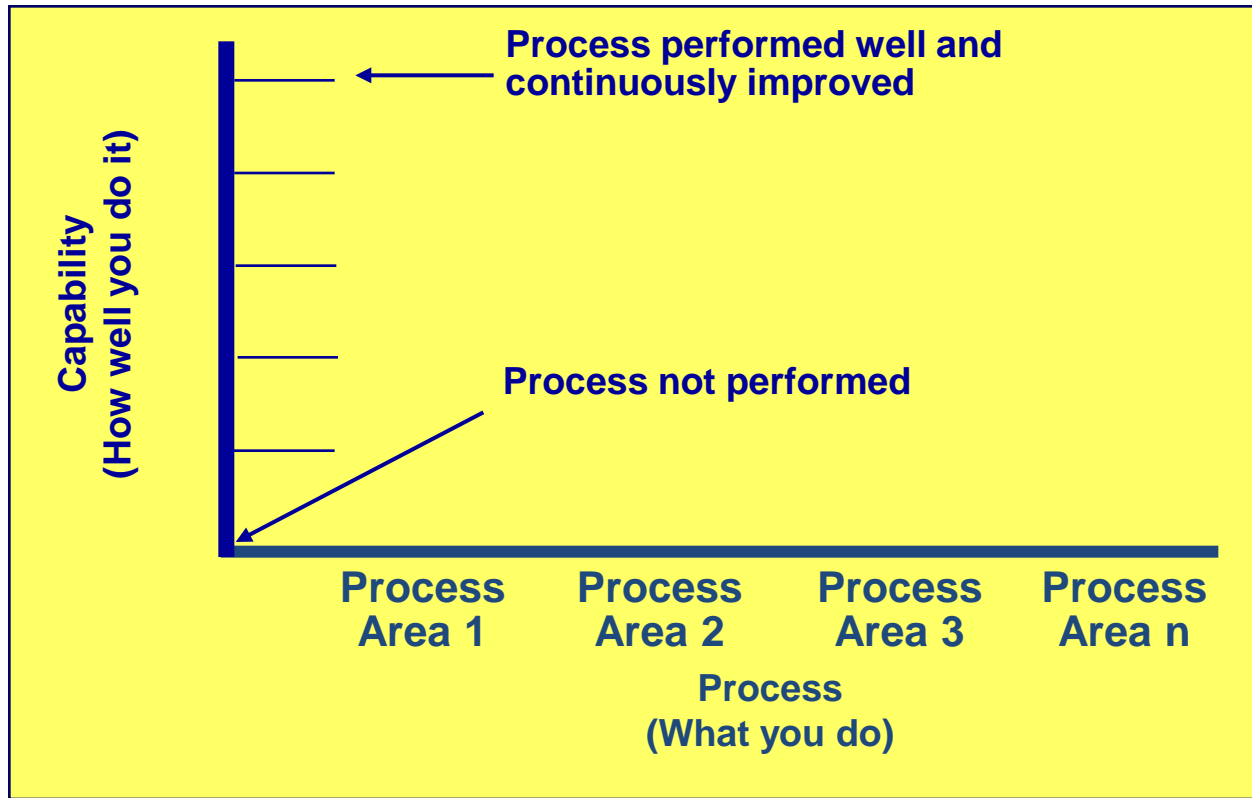
# Maturity <> Capability

## The Continuous Representation of CMMI

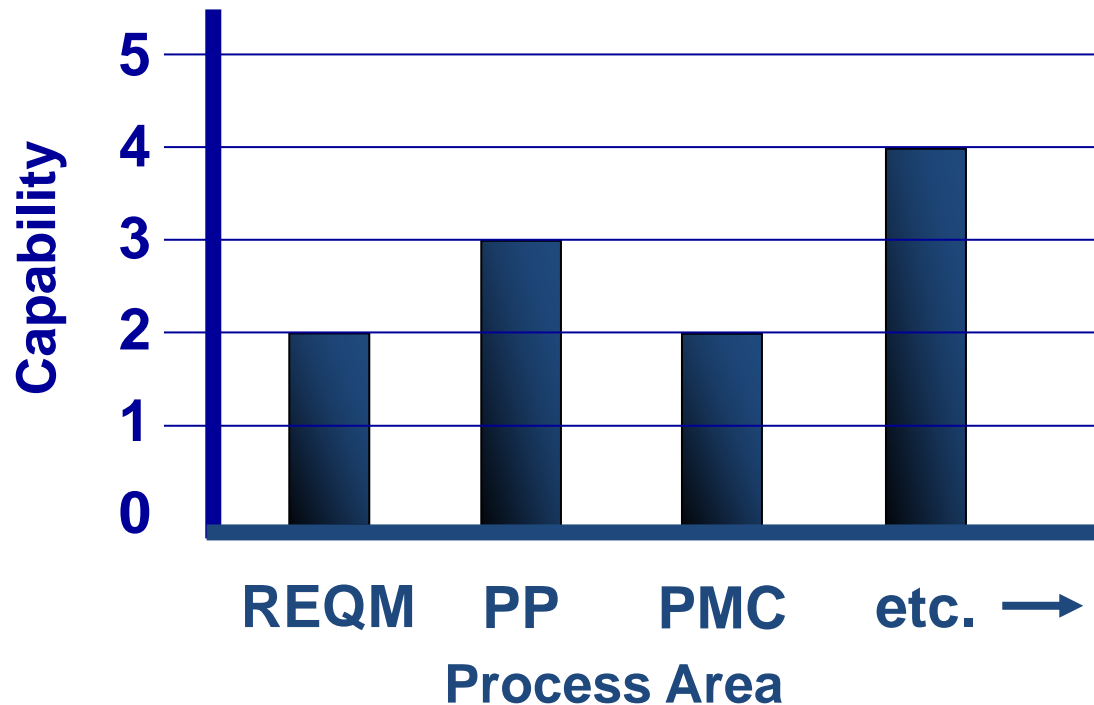
A process area capability profile may be represented by a set of points in two dimensions.

The process dimension  
“What” you do

The capability dimension  
“How well” you do it



Example: Company **Capability Profile**  
(compare to **Maturity Level** profiles of Staged representation)





# Example: Sample certification

List available at <http://seir.sei.cmu.edu/pars/>



Carnegie Mellon  
Software Engineering Institute

## List of Published SCAMPI Appraisal Results

ORGANIZATION NAME: Soluziona, S. A.  
SPONSOR NAME: Santiago Escribano  
LEAD APPRAISER NAME: Jose Arias  
SEI PARTNER: European Software Institute  
APPRAISAL END DATE: 11/25/2005  
MATURITY LEVEL ASSIGNED: 3  
APPRAISED ORGANIZATIONAL UNIT:

Entity Name: SOLUZIONA - Area de Tecnologia

Location(s): Madrid, Spain

CMMI MODEL USED: CMMI-SW, V1.1, Staged

APPRAISAL METHOD USED: SCAMPI v1.1

## MODEL SCOPE & CAPABILITY RATINGS ASSIGNED:

Process Management		Project Management		Engineering		Support	
OPF	Satisfied	PP	Satisfied	REQM	Satisfied	CM	Satisfied
OPD	Satisfied	PMC	Satisfied	RD	Satisfied	PPQA	Satisfied
OT	Satisfied	SAM	Not Applicable	TS	Satisfied	MA	Satisfied
OPP	Not Satisfied	IPM	Satisfied	PI	Satisfied	DAR	Satisfied
OID	Not Rated	RSKM	Satisfied	VER	Satisfied	OEI	Not Rated
		IT	Not Rated	VAL	Satisfied	CAR	Not Rated
		ISM	Not Rated				
		QPM	Not Satisfied				