ESI European Software Institute Center Eastern Europe

Partner of: Software Engineering Institute | Carnegie Mellon

SEMP Software Engineering Management Program

Q.A.

Осигуряване на качество на софтуера

(2017/2018/…/2023/2024 редовно/задочно)

based on: Software Quality Management Models

PART 3: Maturity Level 2+

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МАТЕРИАЛИ:

http://edesign-bg.com/

Информация, източници:

ESI Center Eastern Europe - Resources:
https://esicenter.bg/resources
Education > Resources > (Software) Quality Management - CMMI
(+ the links: - model in pdf ver 1.3)

Links to CMMI models (from the new source – CMMI Institute, spin-off of Carnegie Mellon/SEI):
https://cmmiinstitute.com/resource-files/public/cmmi-v2-0-development-model (paid!!!)
[free] ver 2.0 Practices mapping (to ver 1.3)
https://cmmiinstitute.com/resource-files/public/v2-0-materials/cmmi-v2-0-to-v1-3-practice-mapping

> *Access V 1.3 to* download CMMI –DEV v 1.3 model *(free, upon registration)*

old SEI repository – VALID for FREE DOWNLOAD:
https://resources.sei.cmu.edu/asset_files/TechnicalReport/2010_005_001_15287.pdf

https://en.wikipedia.org/wiki/Capability_Maturity_Model_Integration

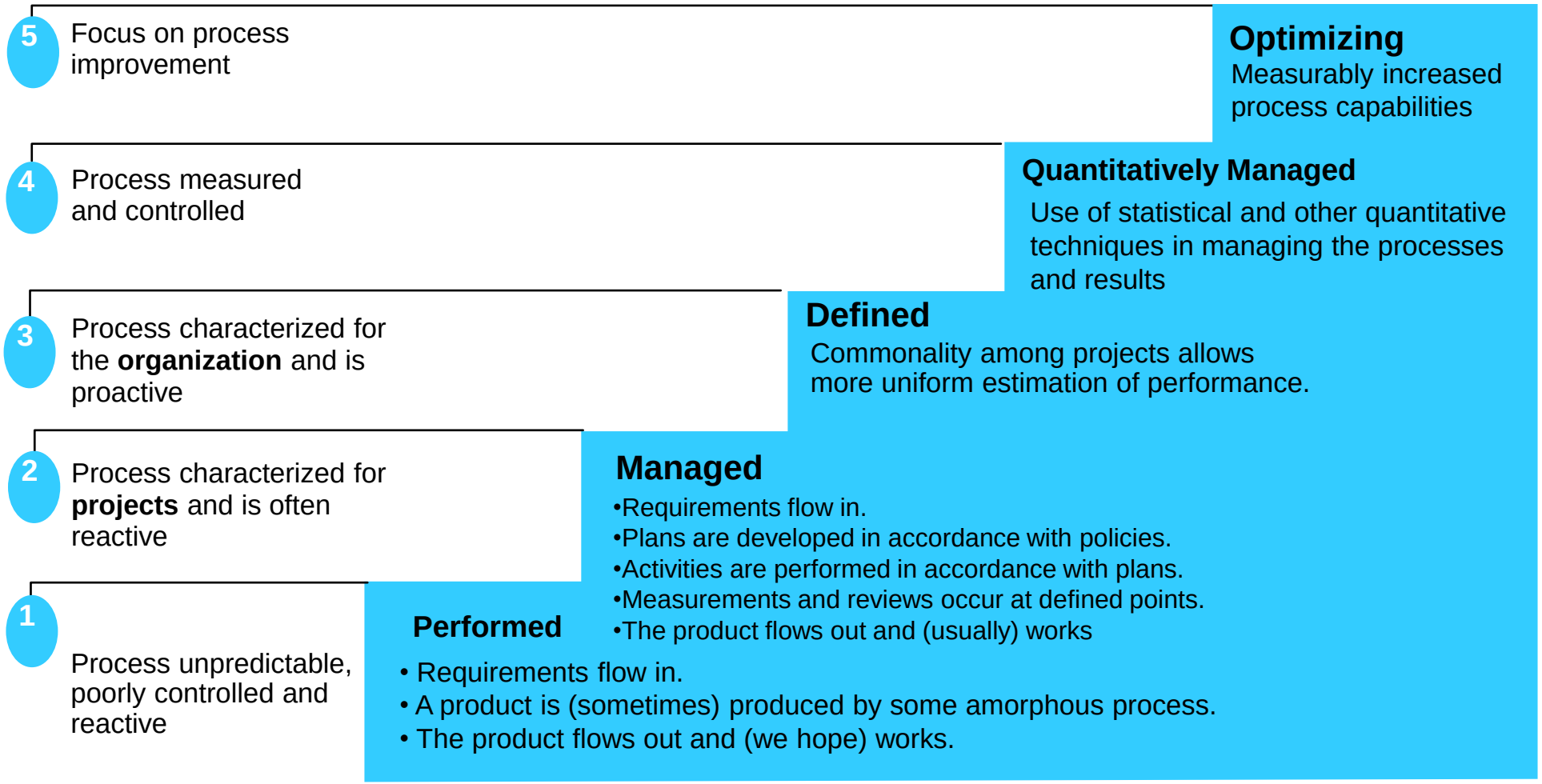
General sources (Software Engineering, Quality)

www.sei.cmu.edu
http://resources.sei.cmu.edu/library/
www.cmmiinstitute.com

Къде сме? Съдържание (модули)

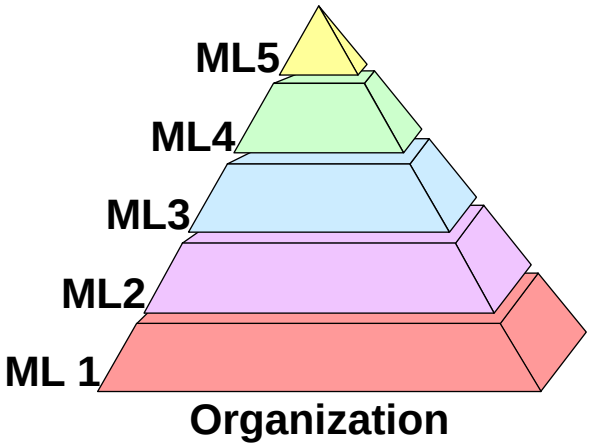
1	Увод в управление на качеството. Компоненти и цена на качеството. Процеси. Преглед на моделите за управление на качеството и подобряване на процесите. Методи за оценка на зрелостта на ИТ-интензивни и софтуерни организации. Стратегически карти/Балансирана система от показатели (balanced ScoreCards).
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	**Процесни области от ниво 2 на CMMI. Детайлно представяне на:** **REQM – Requirements Management** **PP – Project Planning** **MA – Measurement and Analysis** **PPQA – Process and Product Quality Assurance** **CM – Configuration Management** **PMC – Project Monitoring and Control** **Преглед на:SAM-Supplier Agreement Management**
4	Процесни области от ниво 3 на CMMI. Детайлно представяне на: **RD – Requirements Development** VAL - Validation VER - Verification RSKM - Risk Management; TS - Technical Solution **Обобщение на връзките между процесните области: Tying all together** **Update for ver. 2.0 (CMMI Institute)**
5	Методи и средства за извършване на тестове на качеството на софтуер. Видове тестове. Автоматизирани тестове. **Интегриране на CMMI с модел на зрялост за планиране и провеждане на тестове – TMMi.**
6	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. DevOps, DevSecOps – Security Requirements (for SW), Security by Design, Resilience by Design (CERT RMM), TMM (Testing Maturity Model)
7	Подобряване на процесите в малки фирми – IT Mark. Компненти на зрелостта – бизнес, организация/процеси, информационна сигурност. Оценка на нивото и план за подобрения.

CMMI (SEI/CMU, CMMI Institute/ISACA) reference model & de facto industrial standard



Remember: CMMI Representations

Staged



Maturity Level 5 OID, CAR

Maturity Level 4 OPP, QPM

Maturity Level 3 RM, TS, PI, VER, VAL, OPF, OPD, OT, IPM, RSKM, DAR

Maturity Level 2 REQM, PP, PMC, MA, PPQA, CM, SAM

Process Areas

Organizational Innovation & Deployment (OID)
Causal Analysis and Resolution (CAR)

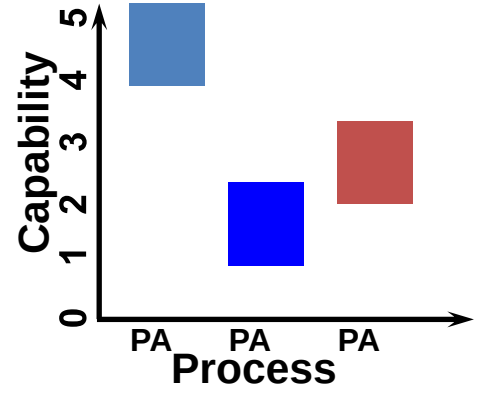
Organizational Process Performance (OPP)
Quantitative Project Management (QPM)

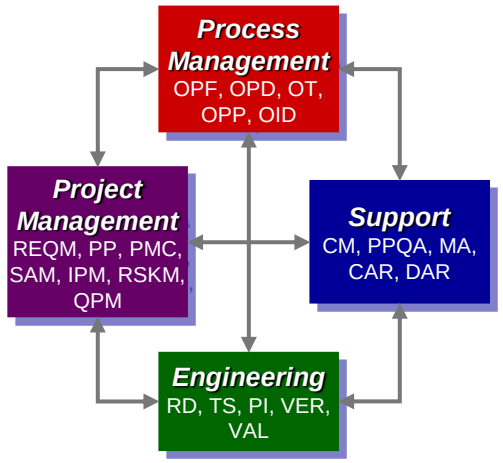
Technical Solution (TS)
Product Integration (PI)
Verification (VER)
Validation (VAL)
Organizational Process Focus (OPF)
Organizational Process Definition (OPD) + IPPD
Organizational Training (OT)
Integrated Project Management (IPM) + IPPD
Risk Management (RSKM)
Decision Analysis and Resolution (DAR)

Requirements Development (RD)

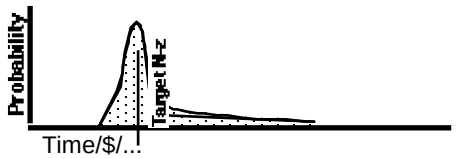
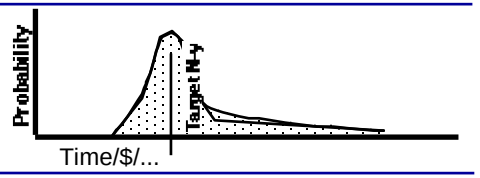
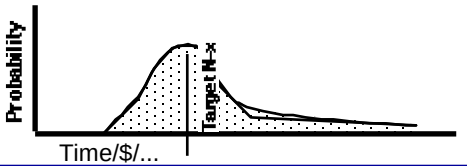
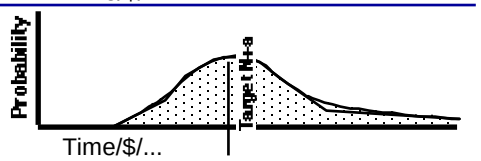
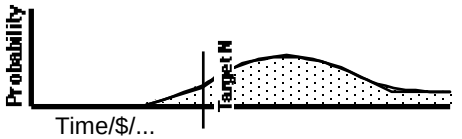
Requirements Management (REQM)
Project Planning (PP)
Project Monitoring and Control (PMC)
Supplier Agreement Management (SAM)
Measurement and Analysis (MA)
Process and Product Quality Assurance (PPQA)
Configuration Management (CM)

Continuous

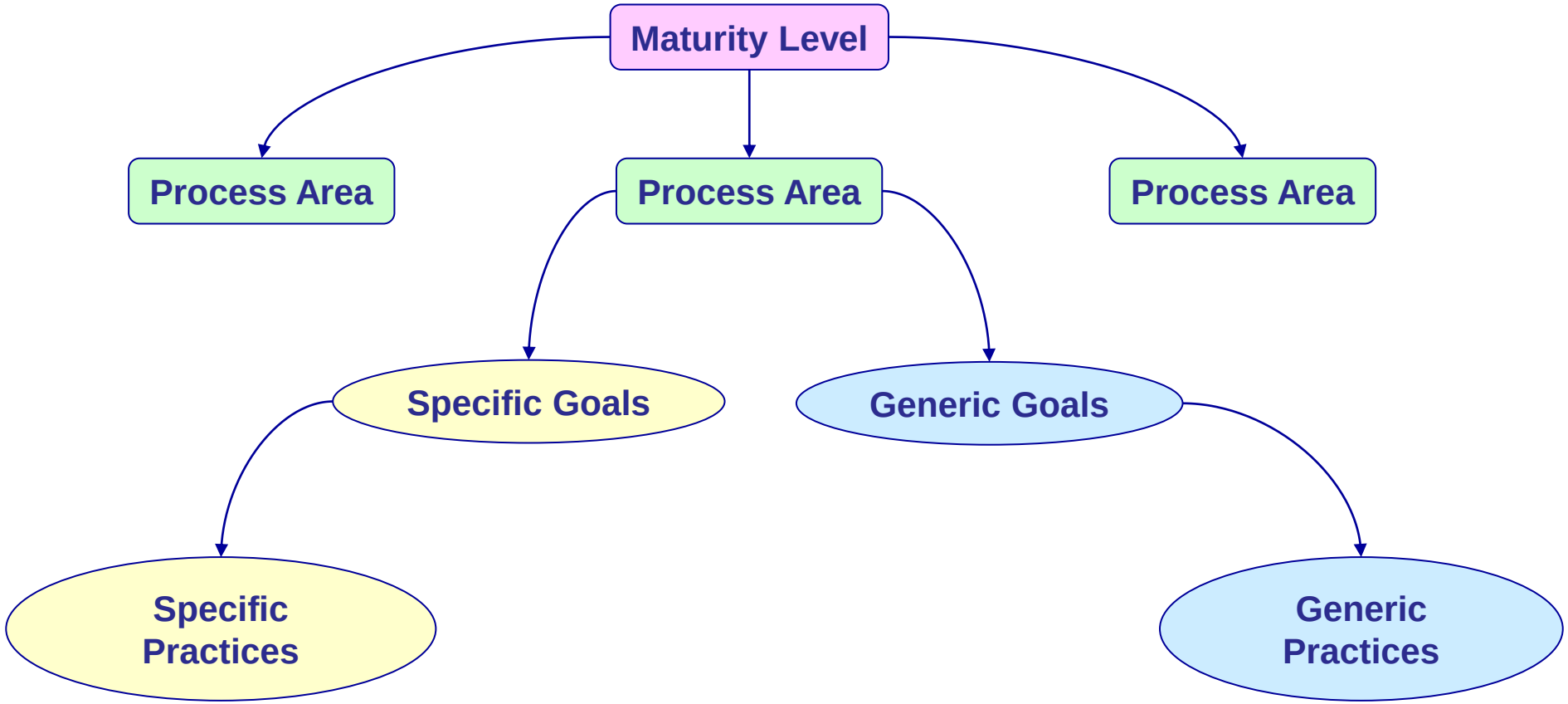




Remember: Evolution of Process Capability

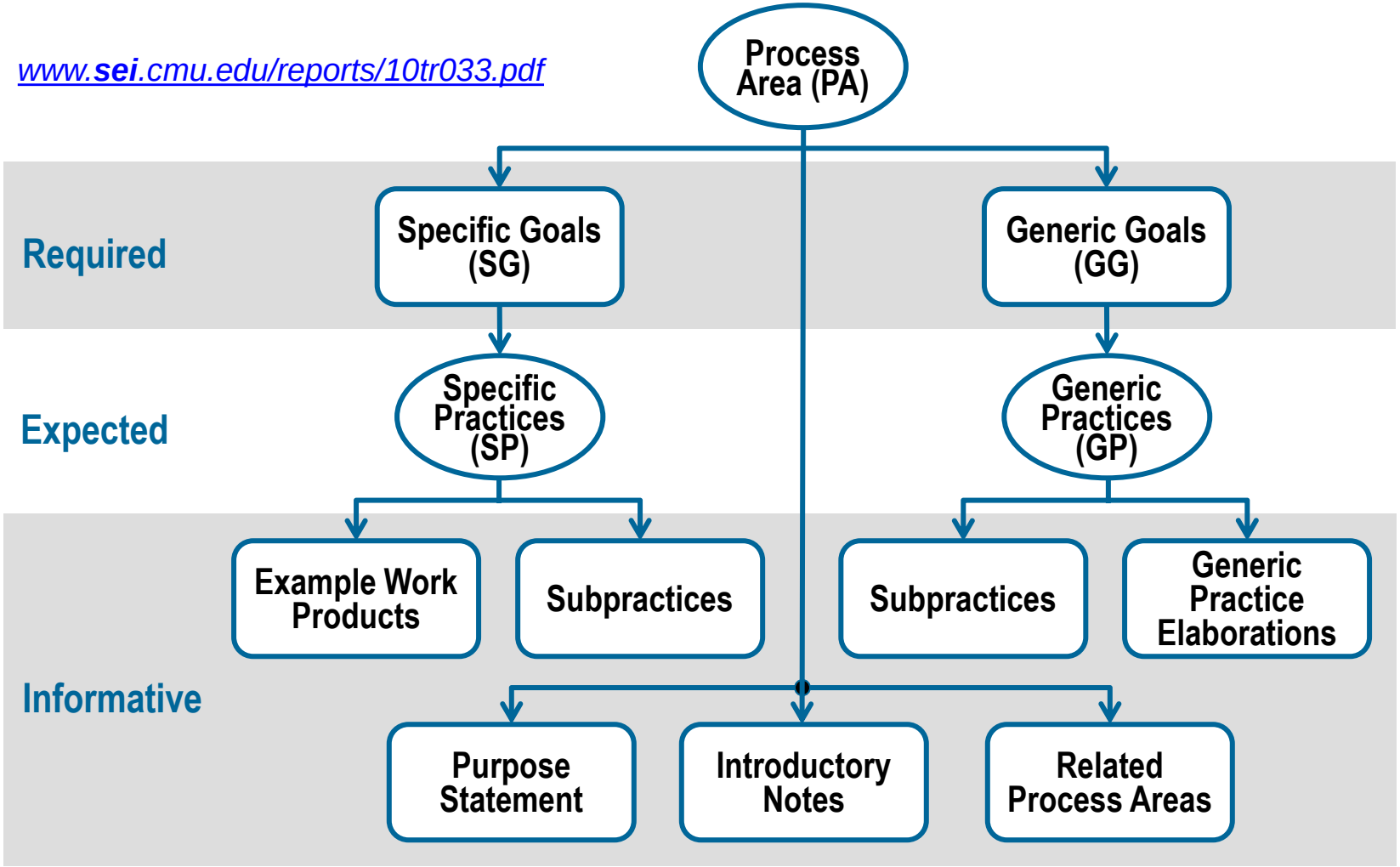
Level	Process Characteristics	Predicted Performance
5 Optimising	Process improvement is institutionalised	
4 Quantitatively Managed	Product and process are quantitatively controlled	
3 Defined	Software engineering and management processes are defined and integrated	
2 Managed	Project management system 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



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.

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
GG 3	Institutionalize a Defined Process	**Defined Process**
GG 2	Institutionalize a Managed Process	**Managed Process**
GG 1	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

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

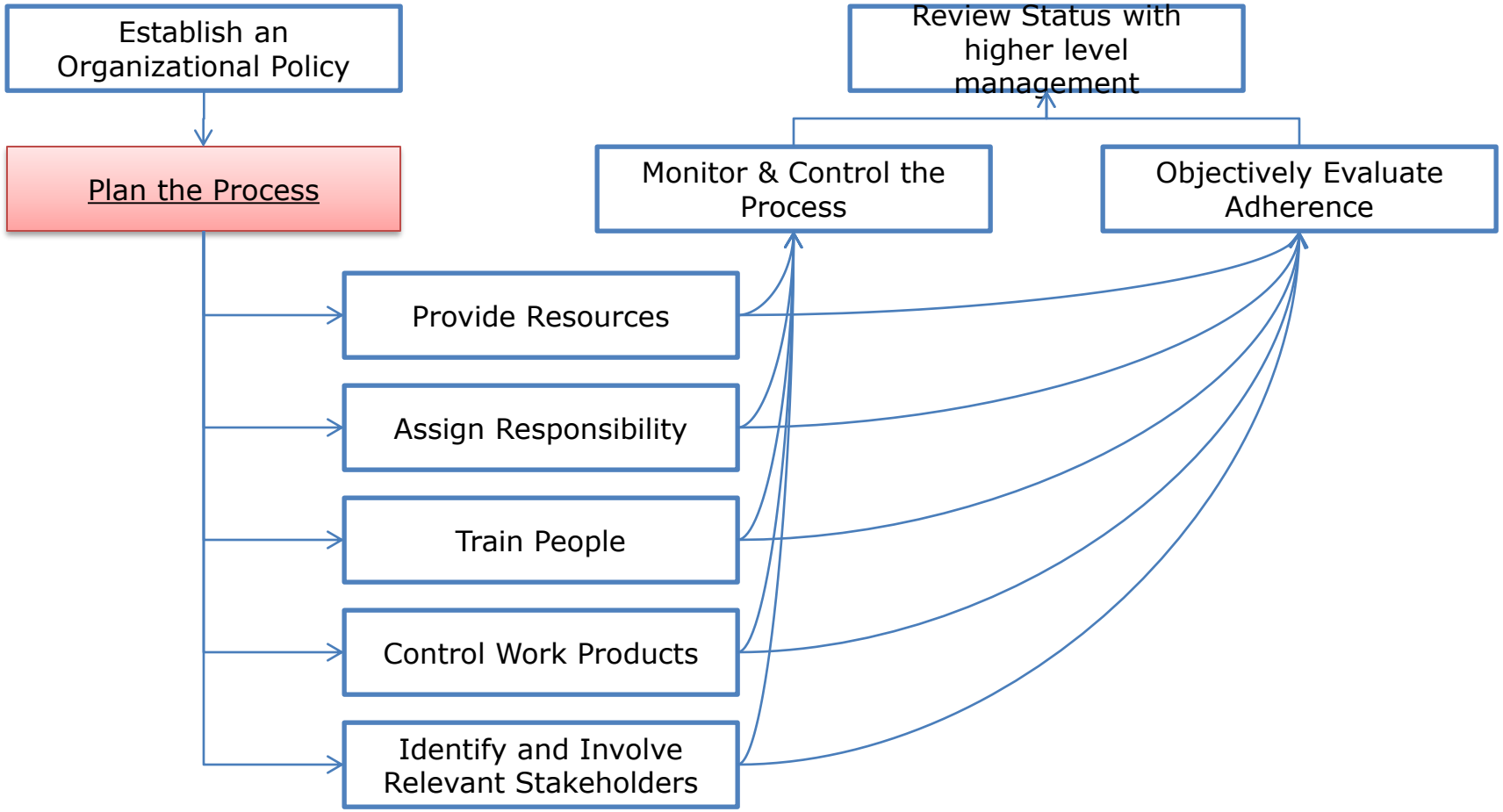
Maturity Level 3

- 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

How PAs relate to Generic Practices?

Example: Plan the plan (plan the process of project planning)

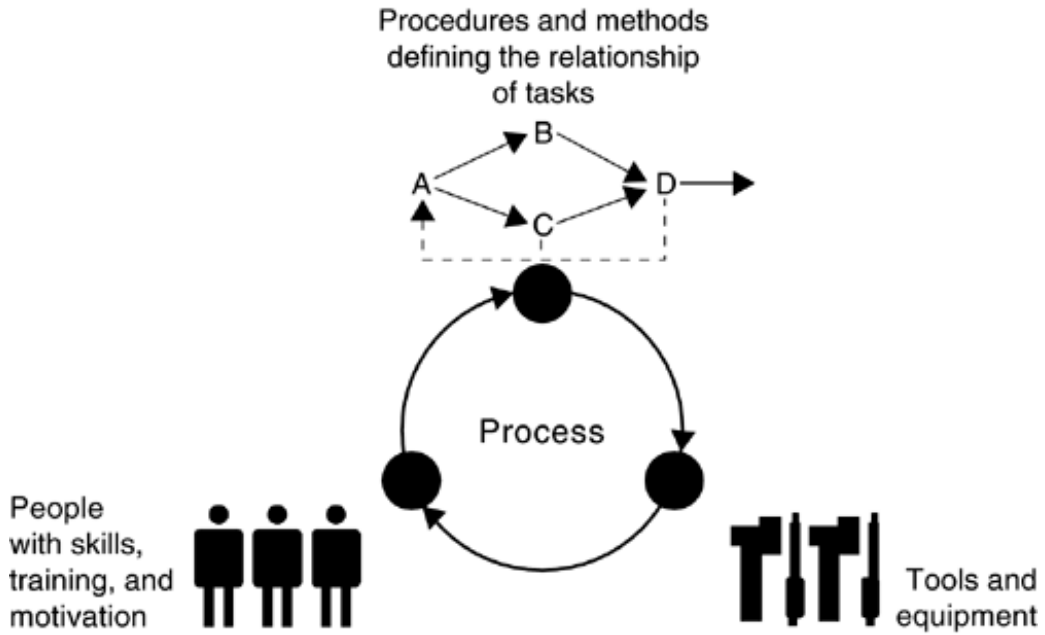


Source: Kiril Karaatanasov, ESI Center Bulgaria

Note

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

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

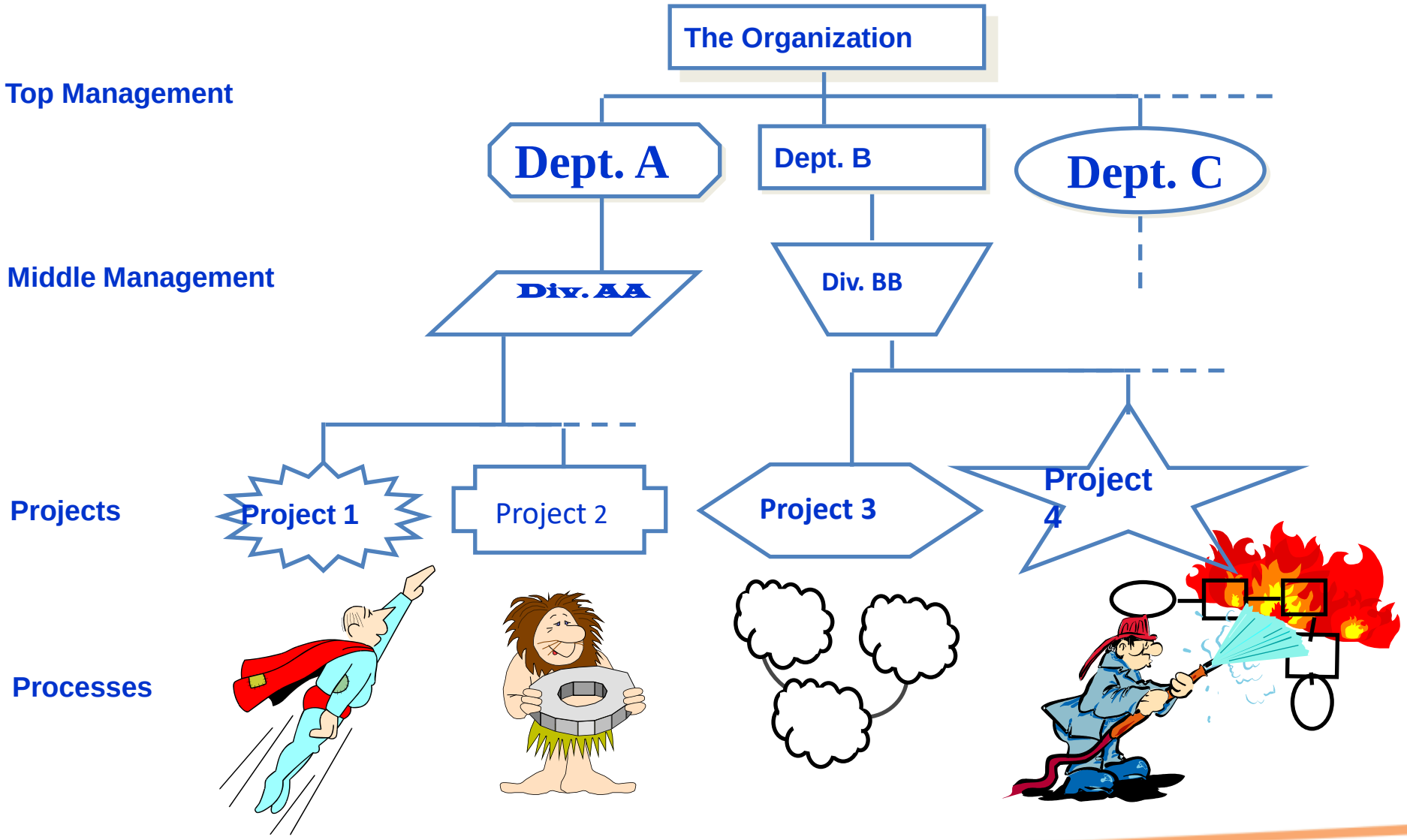


"All models are wrong, but some are useful."

George Box (Quality and Statistics Engineer)

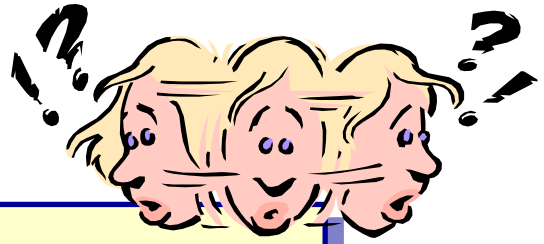
Sample Level 1 Organization

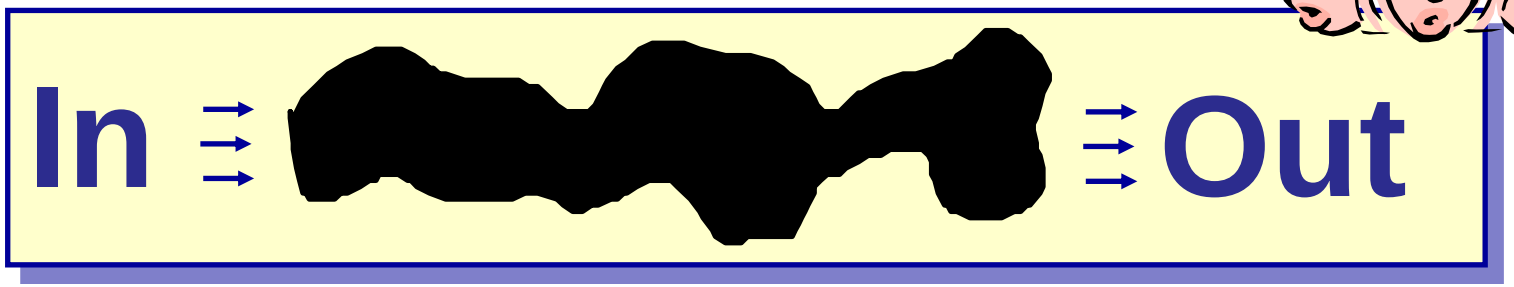
few processes in place



Remember:

ML1: Performance Is Unpredictable





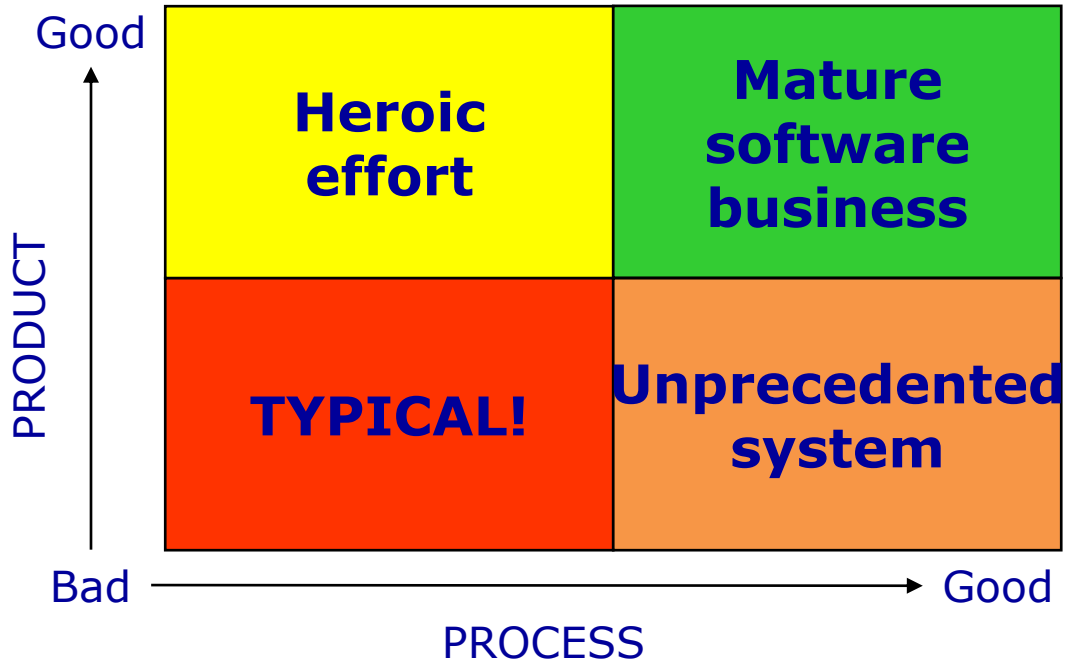
Requirements flow in.

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

The product flows out and (we hope) works.

Corporate excellence – INTERNAL

The corporate excellence is BASED on good internal processes

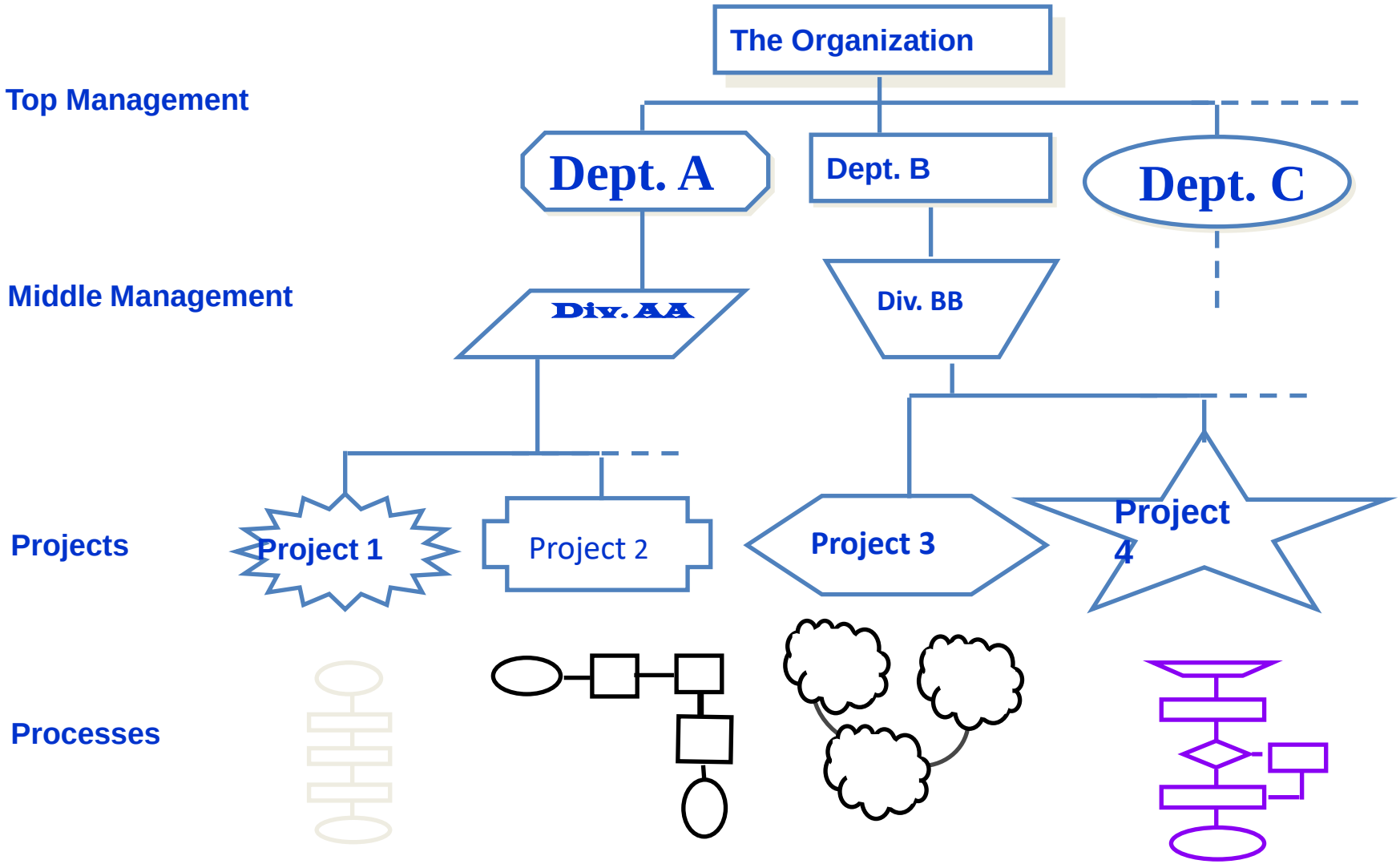


"The quality of a product is largely determined by the quality of the process that is used to develop and maintain it."

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

Sample Level 2 Organization

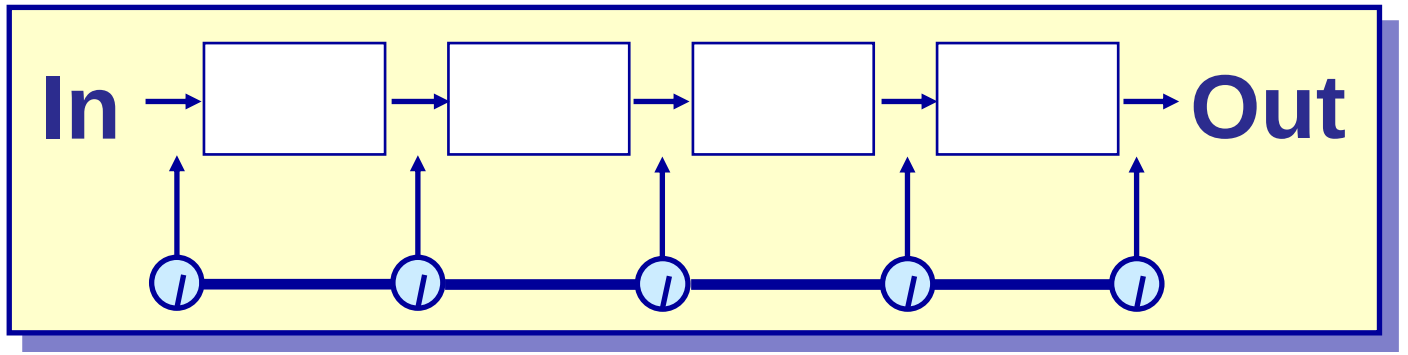
many processes in place; but they are project-specific



Remember:

ML2: Processes are “Managed”

Processes characterized for **PROJECTS** and often reactive



Requirements flow in.

Plans are developed in accordance with policies.

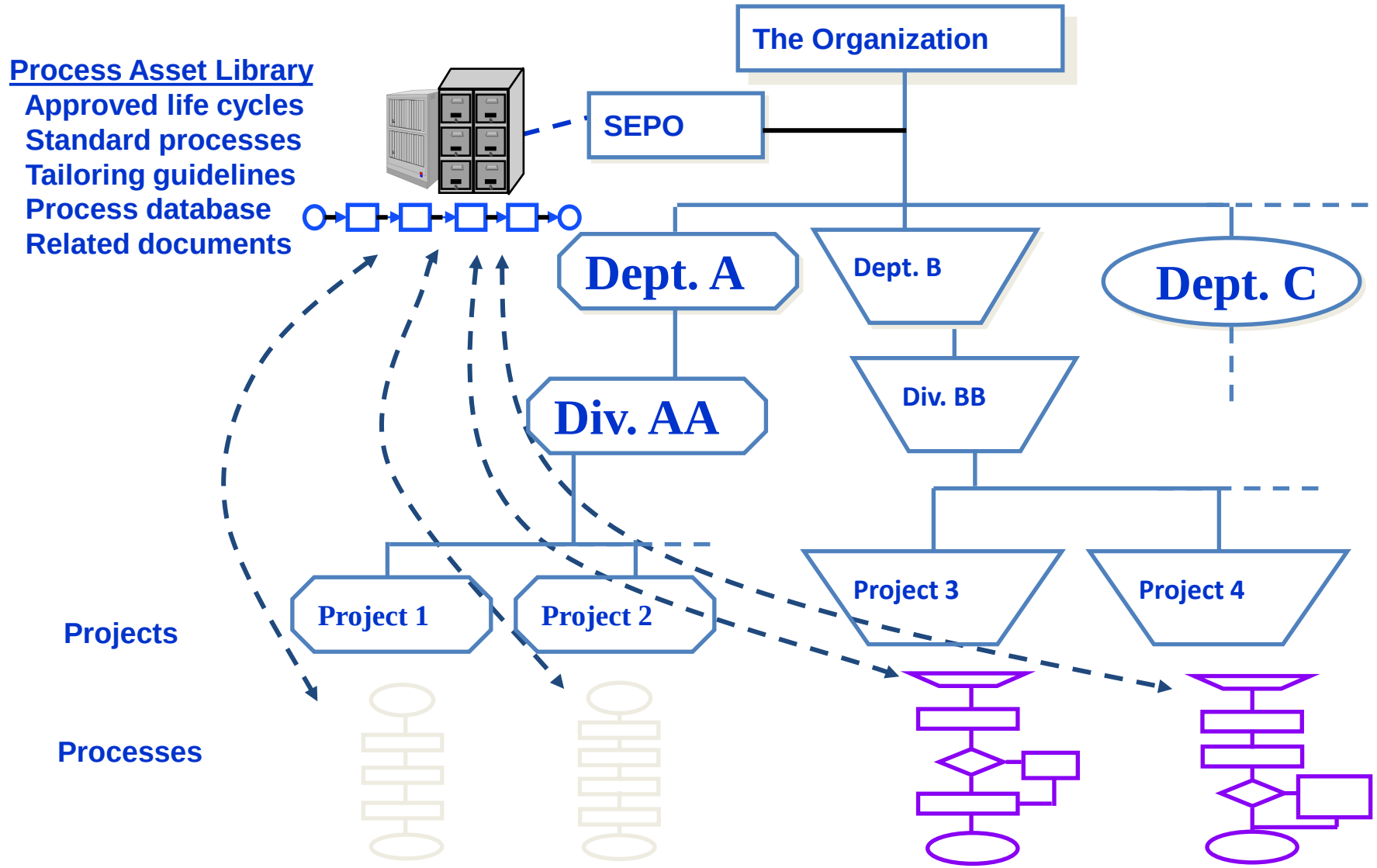
Activities are performed in accordance with plans.

Measurements and reviews occur at defined points.

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

Sample Level 3 Organization

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



Project Management PAs (overview + Specific Goals)

Requirements management (REQM)

- **SG1: Manage requirements**

+ Requirements Development (RD, ML3)

- **SG 1 Develop Customer Requirements**
- **SG 2 Develop Product Requirements**
- **SG 3 Analyze and Validate 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

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

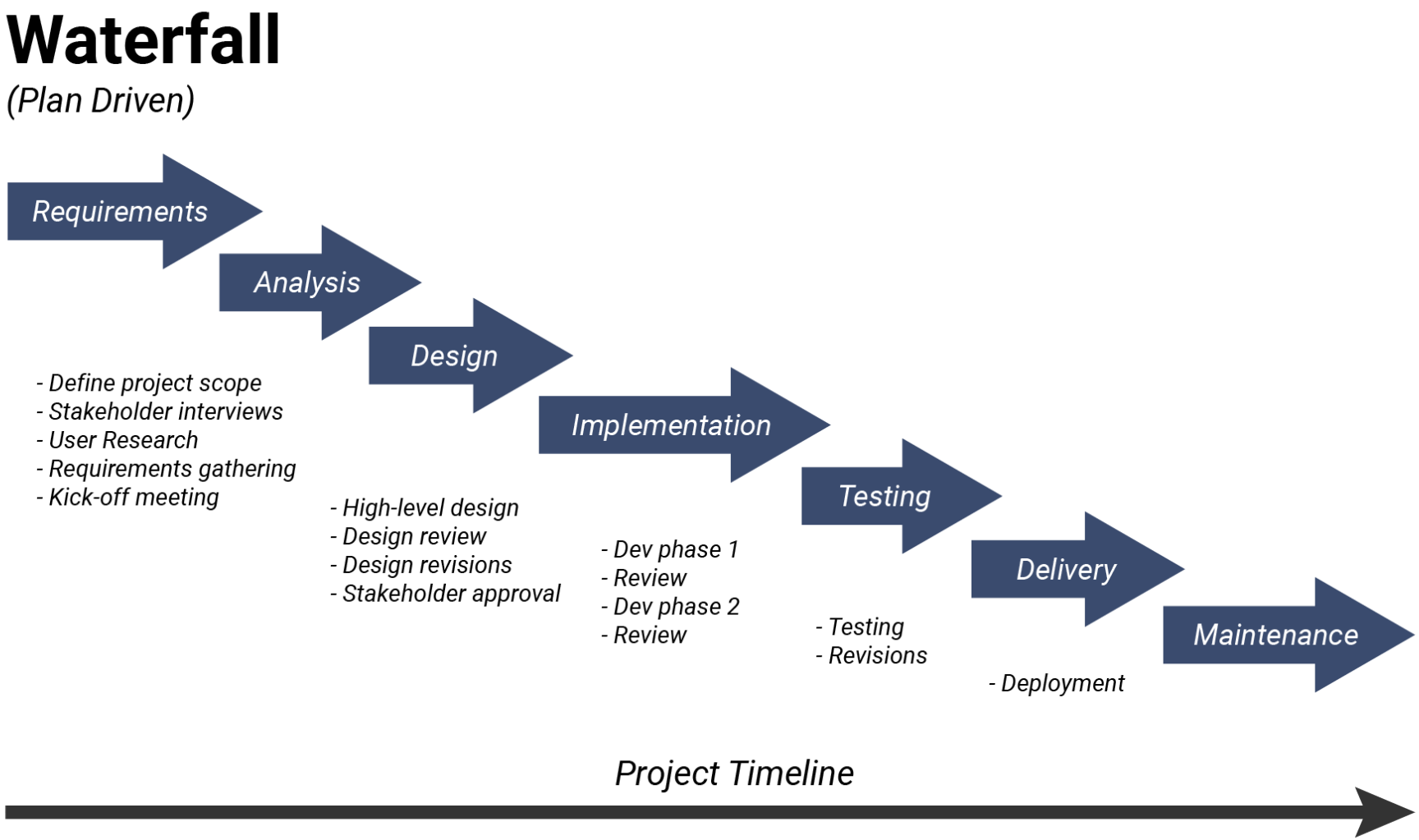
Taking action to appropriately mitigate risks

Think about:
What Product/SW Development Needs?

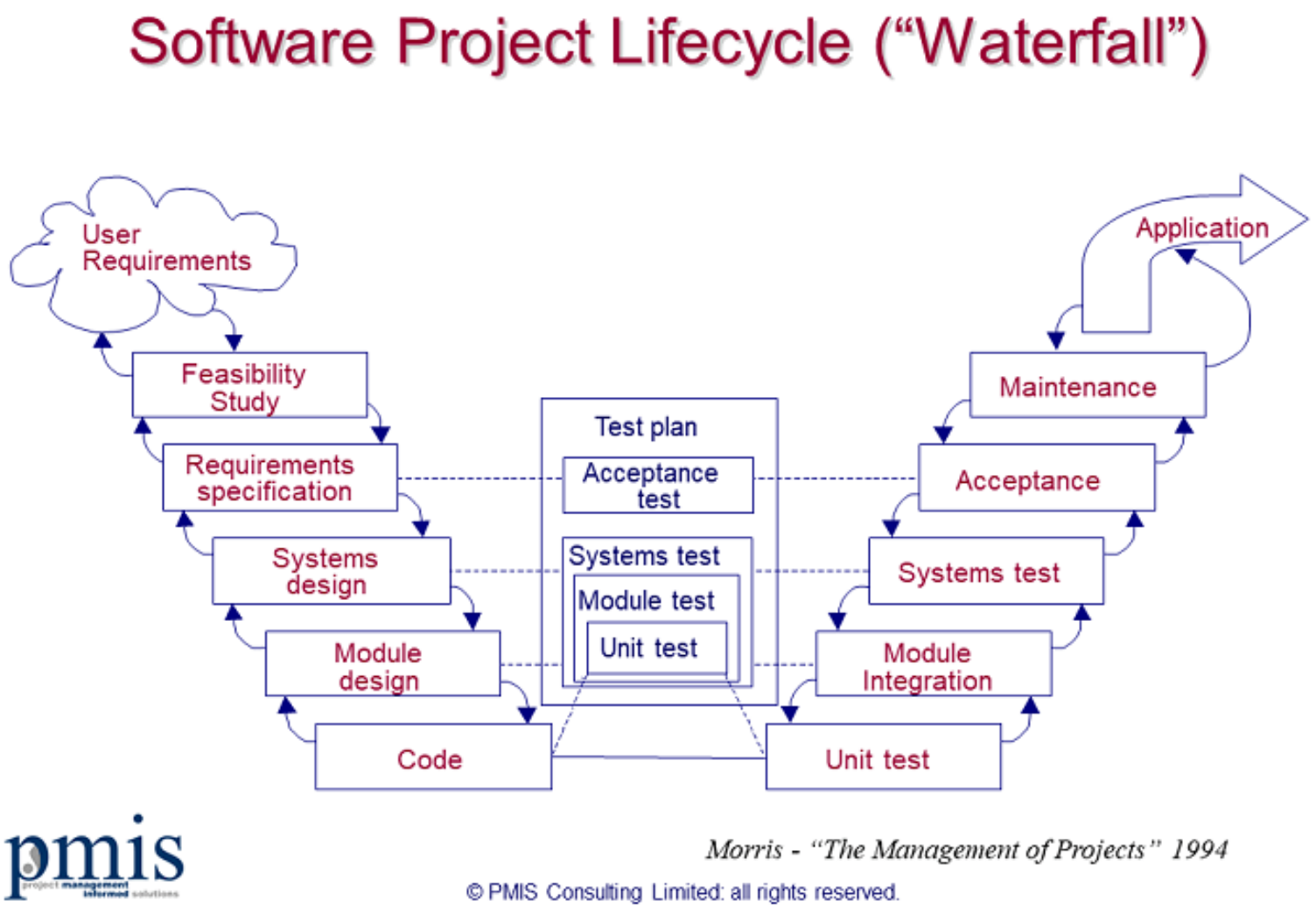
Establishing and maintaining sets of requirements

- customer requirements
- product requirements
- product component requirements
- **But also, managing the requirements as the product evolves**

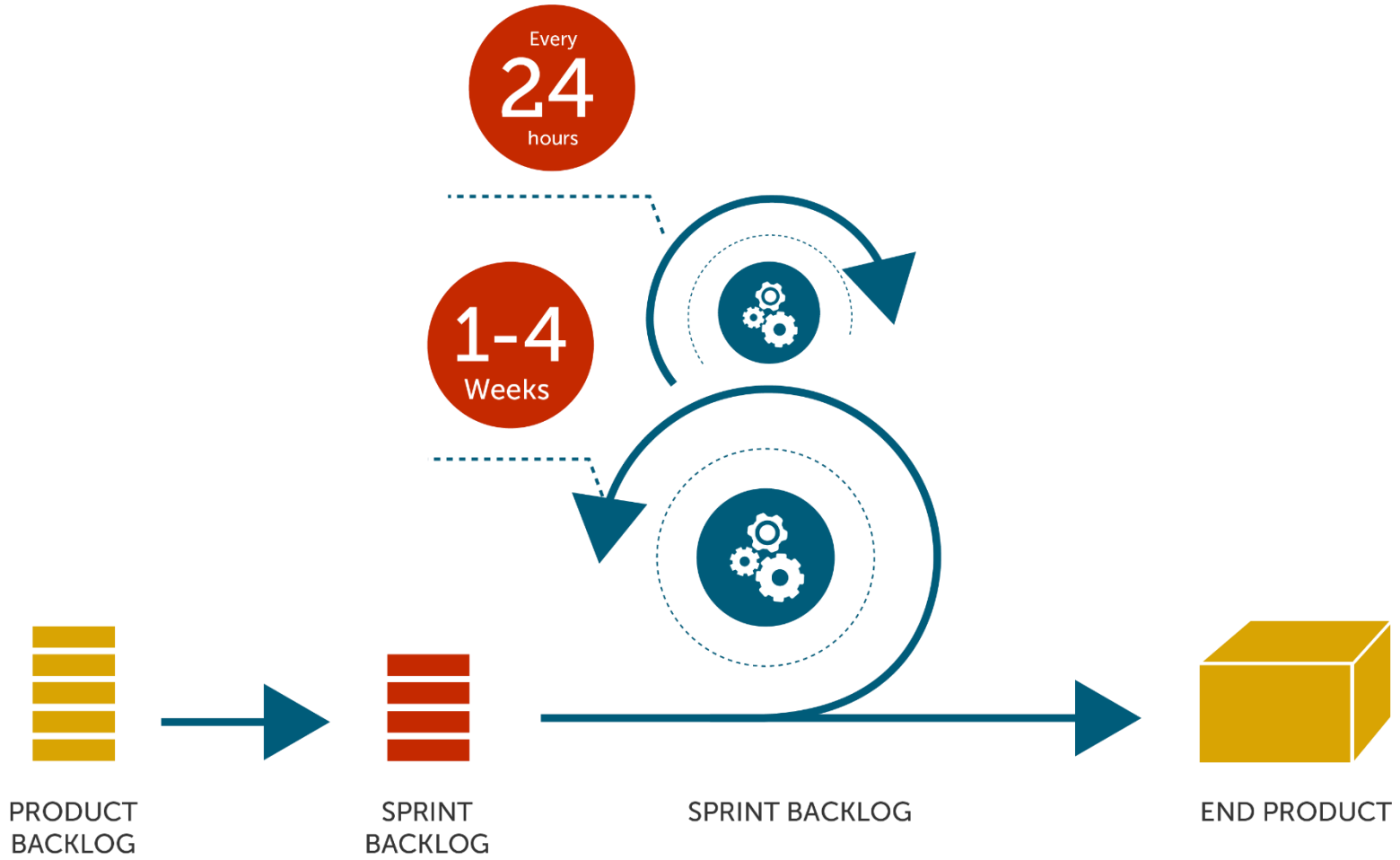
The “classical” and ideal SW Project Lifecycle (waterfall)



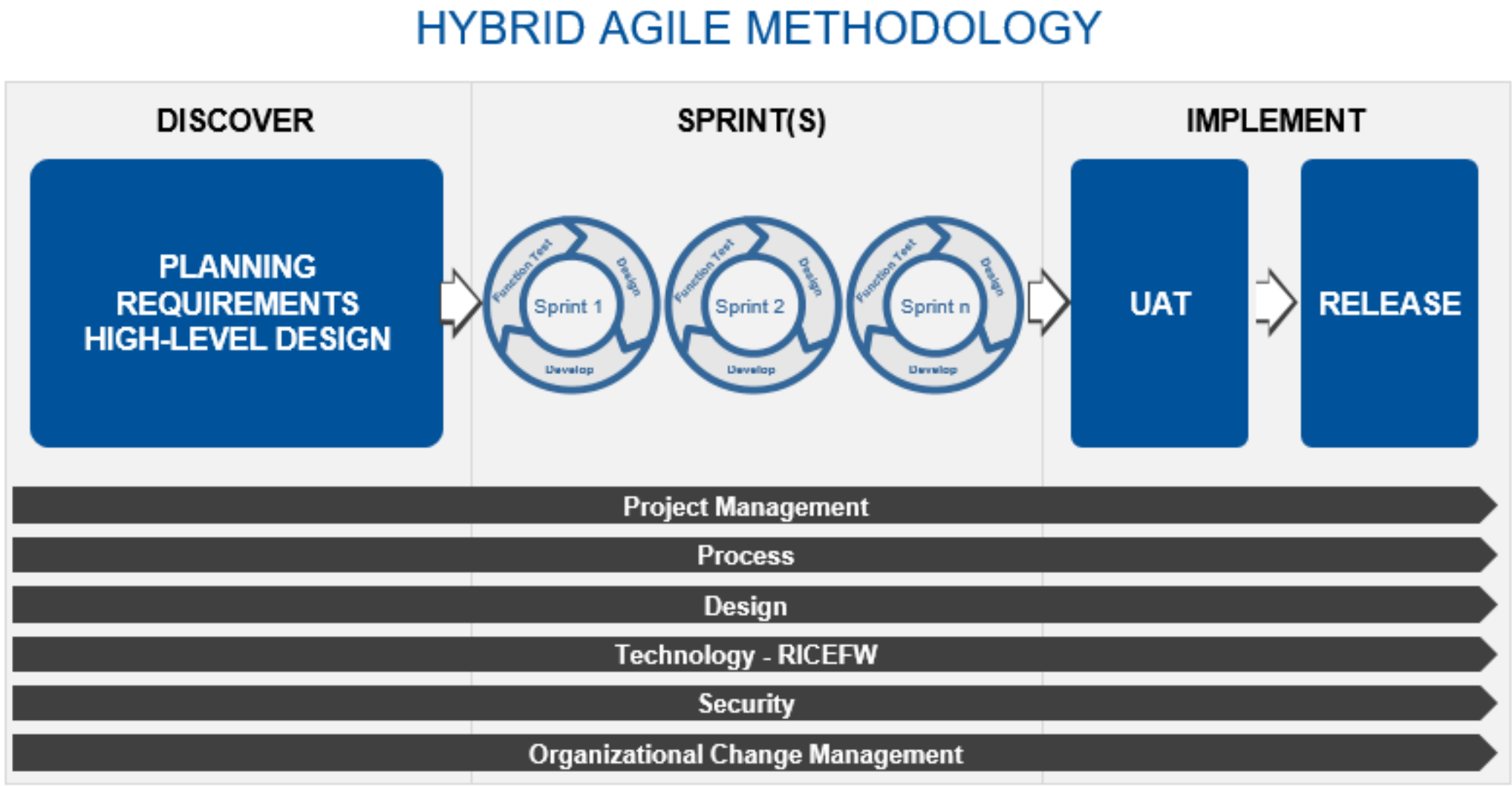
The V-scheme – the elements and the role of a Test-plan



SW Project Lifecycle (Agile/SCRUM, simplified)



The Hybrid Agile (and integration with larger-scale “Waterfall”)



ML3: Requirements Development (RD)

*The purpose of Requirements Development (RD) is to produce and analyze **customer, product**, and product **component** requirements.*

SG 1 Develop Customer Requirements

Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements.

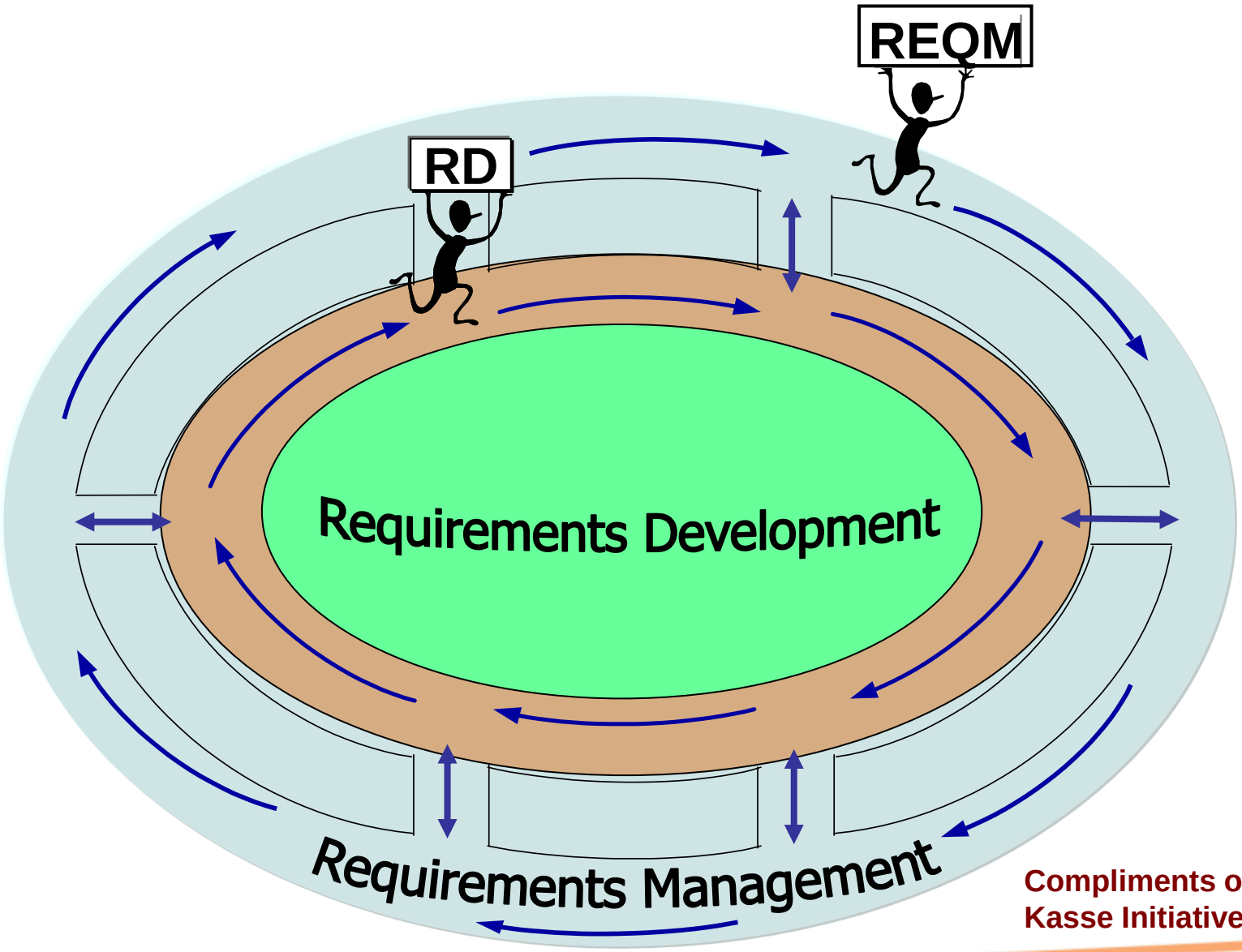
SG 2 Develop Product Requirements

Customer requirements are refined and elaborated to develop product and product component requirements.

SG 3 Analyze and Validate Requirements

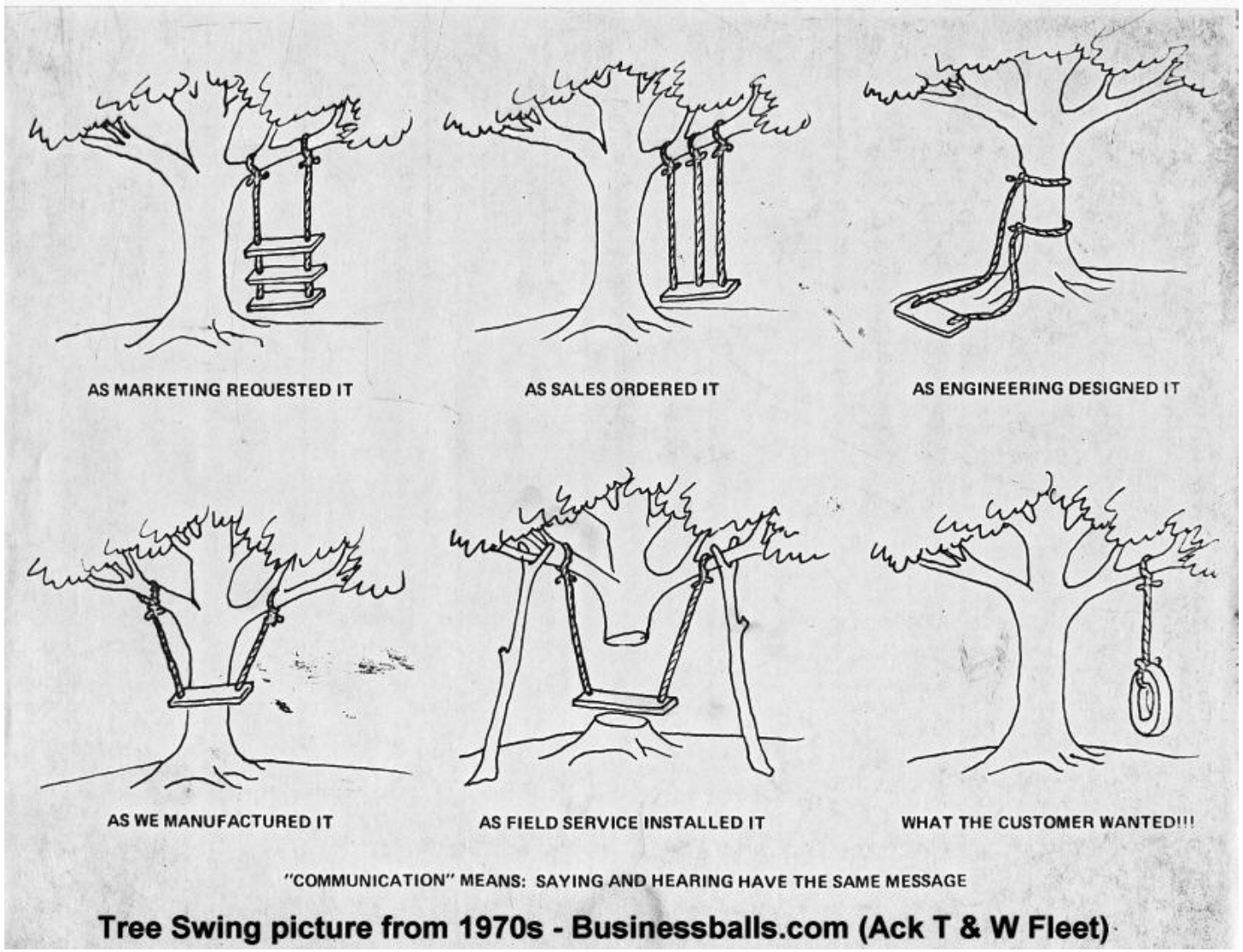
The requirements are analyzed and validated, and a definition of required functionality is developed.

Requirements Management and Requirements Development

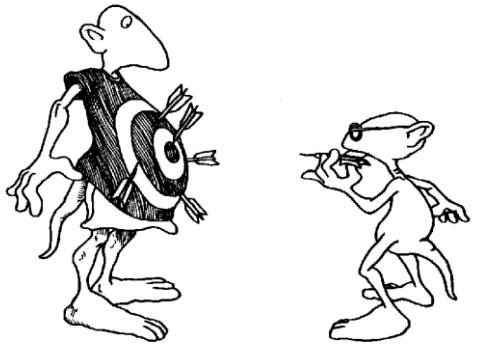


Compliments of
Kasse Initiatives, LLC

Remember: We want to avoid this!



GOALS



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The requirements are analyzed and validated, and a definition of required functionality is developed.

Importance of Requirements Development

Present complete **clear validated** requirements **understood by all parties**

Establish solid **foundation** for downstream activities

Terminology – two types of requirements

Allocated Requirement

Typically, **explicitly outlined by the customer**.

Requirement that levies all or part of the performance and functionality of a higher level requirement on a lower-level architectural element or design component.

Derived Requirement

Requirements that are **not explicitly stated in the customer** requirements, but are inferred:

(1) from contextual requirements (e.g., applicable standards, laws, policies, common practices, and management decisions), or

(2) from requirements needed to specify a product component. D

(3) erived requirements can also arise during analysis and design of components of the product or system. (See also “product requirements.”)

Terminology II

Customer Requirement (also “Functional requirements”)

The result of eliciting, consolidating, and resolving conflicts among the needs, expectations, constraints, and interfaces of the product's relevant stakeholders in a way that is acceptable to the customer. (See also “customer.”)

Product Requirement (also “Technical requirements/specifications”)

A refinement of the customer requirements into the developers’ language, making implicit requirements into explicit derived requirements. (See also “derived requirements” and “product component requirements.”) The developer uses the product requirements to guide the design and building of the product.

Product Component Requirements - A complete specification of a product component, including fit, form, function, performance, and any other requirement.

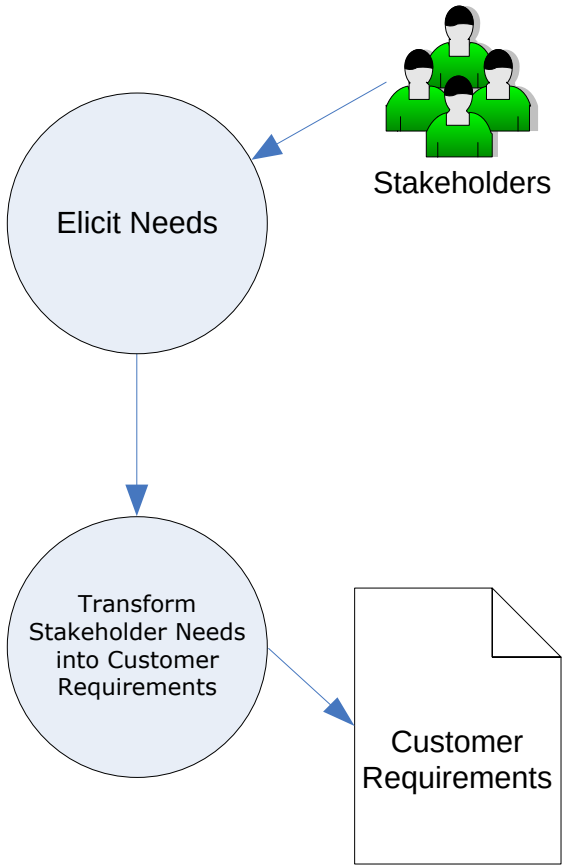
SG 1 Develop Customer Requirements

SP 1.1 Elicit Needs

Elicit stakeholder needs, expectations, constraints, and interfaces for all phases of the product lifecycle.

SP 1.2 Transform Stakeholder Needs into Customer Requirements

Transform stakeholder needs, expectations, constraints, and interfaces into customer requirements.



SG 2 Develop Product Requirements

SP 2.1 Establish Product and Product Component Requirements

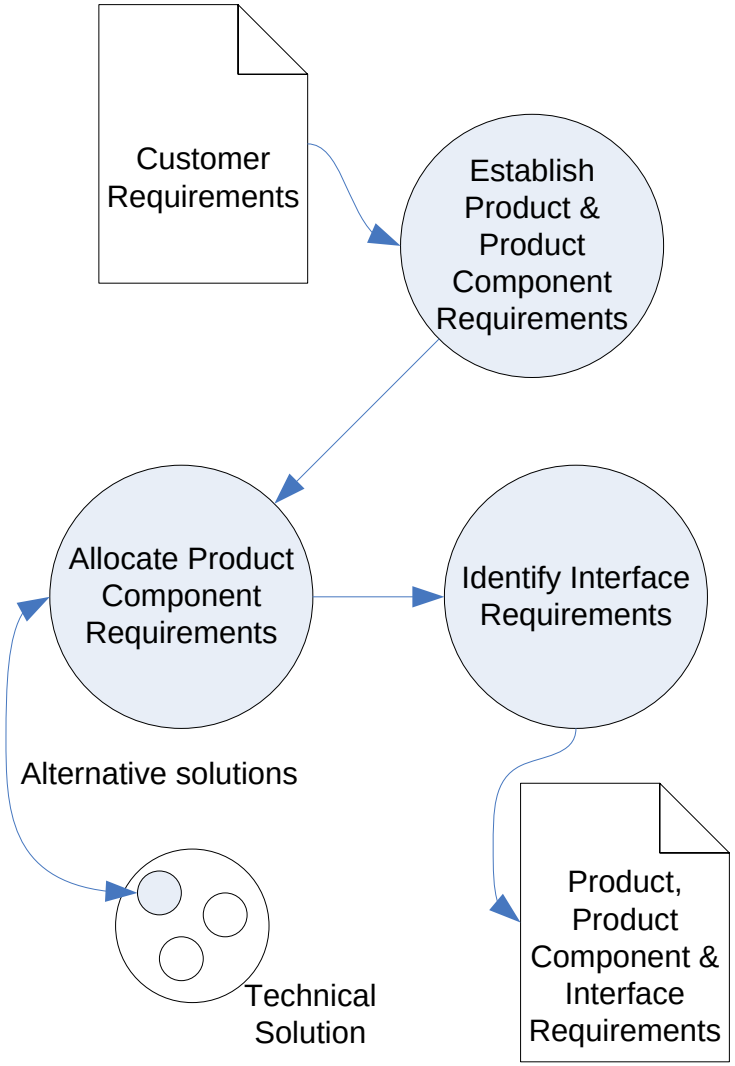
Establish and maintain product and product component requirements, which are based on the customer requirements.

SP 2.2 Allocate Product Component Requirements

Allocate the requirements for each product component.

SP 2.3 Identify Interface Requirements

Identify interface requirements.



SG 3 Analyze and Validate Requirements

SP 3.1 Establish Operational Concepts and Scenarios

Establish and maintain operational concepts and associated scenarios.

SP 3.2 Establish a Definition of Required Functionality

Establish and maintain a definition of required functionality.

SP 3.3 Analyze Requirements

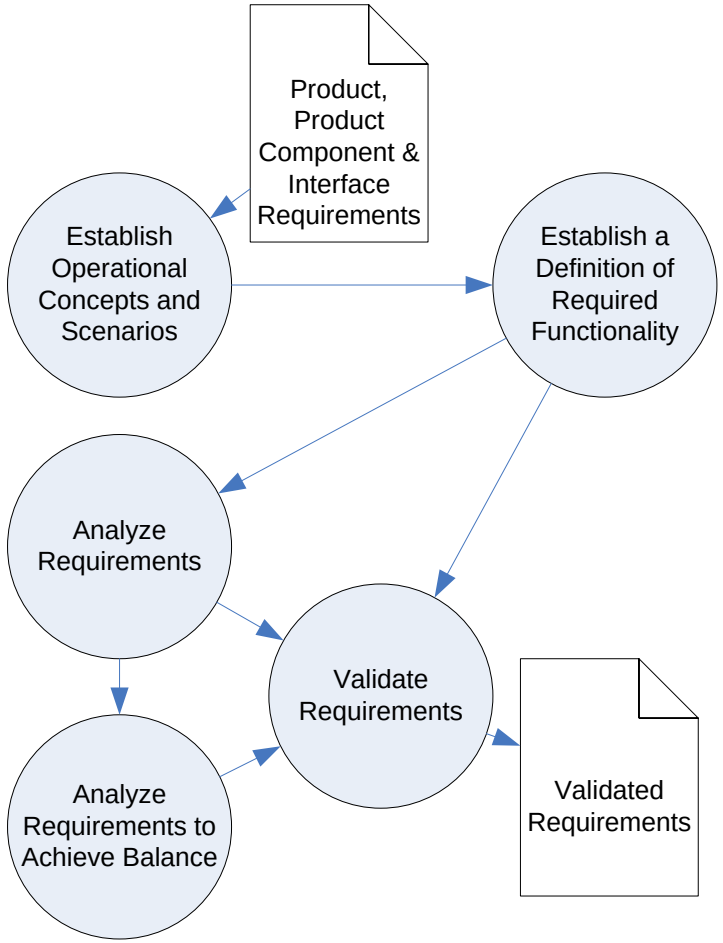
Analyze requirements to ensure that they are necessary and sufficient.

SP 3.4 Analyze Requirements to Achieve Balance

Analyze requirements to balance stakeholder needs and constraints.

SP 3.5 Validate Requirements

Validate requirements to ensure the resulting product will perform as intended in the user's environment.



NEW for “Analyze requirements” –with Cyber Resilience Act – SBOM (Software Bill Of Materials)

Helps to identify Component dependencies (interfaces) and external dependencies (supply chain) – also for cyber risk assessment and reduction, vulnerabilities monitoring

Documentation

The product documentation must have the following (full list in Annex V):

- A description of the design, development, and vulnerability handling process
- Assessment of cybersecurity risks
- A list of harmonized EU cybersecurity standards the product meets
- A signed EU Declaration of Conformity that the above essential requirements have been met
- A **Software Bill of Materials (SBOM) documenting vulnerabilities and components in the product**

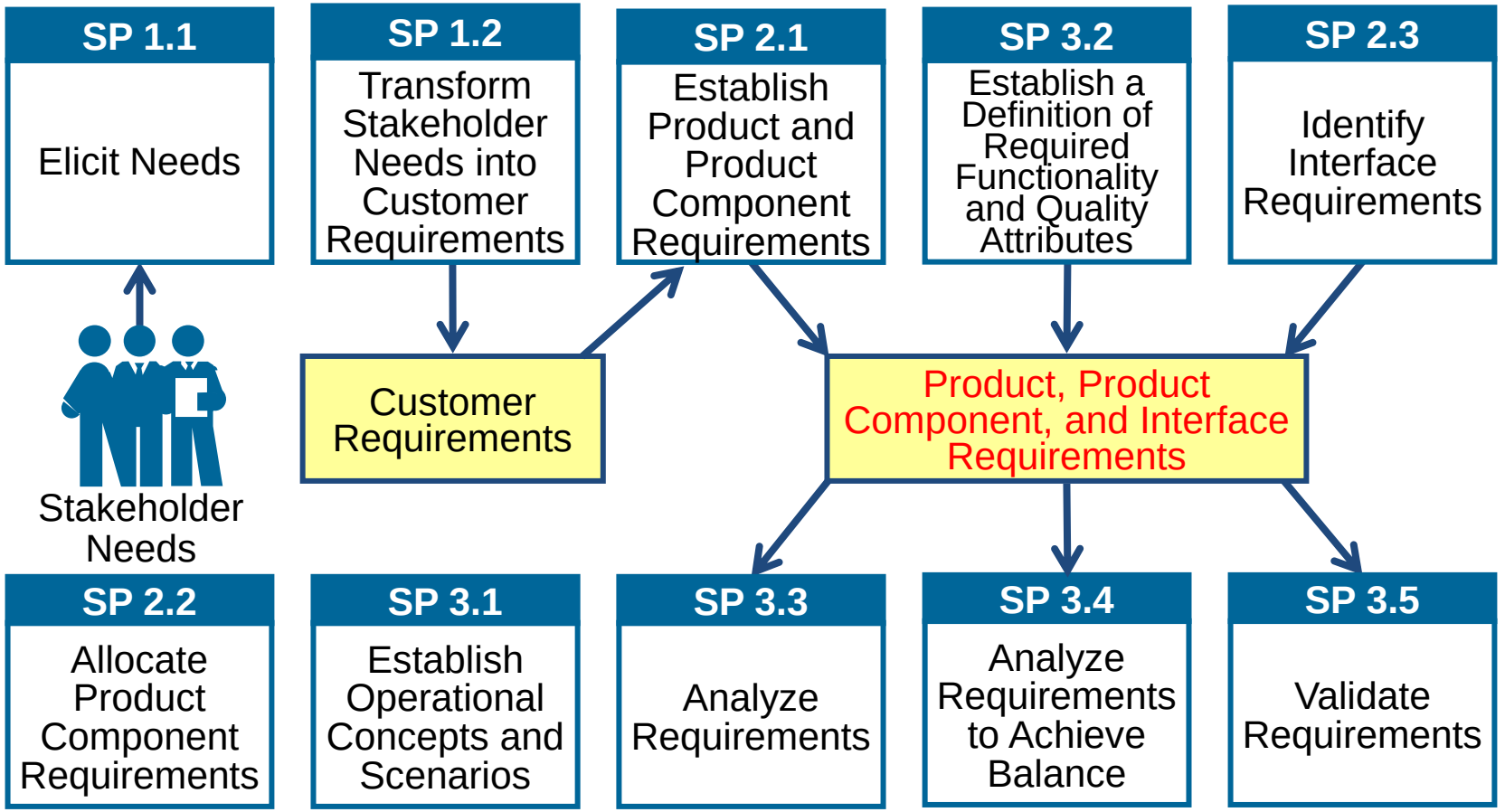
OWASP CycloneDX is a full-stack Bill of Materials (BOM) standard that provides advanced supply chain capabilities for **cyber risk reduction**.

The specification supports:

- Software Bill of Materials (SBOM)
- Software-as-a-Service Bill of Materials (SaaSBOM)
- Hardware Bill of Materials (HBOM)
- Machine Learning Bill of Materials (ML-BOM)
- Manufacturing Bill of Materials (MBOM)
- Operations Bill of Materials (OBOM)
- Vulnerability Disclosure Reports (VDR)
- Vulnerability Exploitability eXchange (VEX)

https://owasp.org/www-project-cyclonedx/

Requirements Development:
What other Work Products we need (in addition to the "Customer Requirements")



https://www.reqview.com/doc/iso-iec-ieee-29148-templates

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ISO/IEC/IEEE 29148 Requirements Specification Templates

Search

- GET STARTED
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ISO/IEC/IEEE 29148:2018 — *ISO/IEC/IEEE International Standard — Systems and software engineering — Life cycle processes — Requirements engineering* is the latest international standard describing requirements engineering processes for development of software and hardware products.
It obsoletes the well known standard for software requirements specifications: IEEE 830-1998 — *IEEE Recommended Practice for Software Requirements Specifications*.

Table of Contents

Requirements Specifications

You can reuse Document Templates for the following standard requirements specifications:

- **Business Requirements Specification (BRS)** describing business or mission requirements,
- **System Operational Concept (OpsCon)** describing stakeholder needs,
- **Stakeholder Requirements Specification (StRS)** describing stakeholder requirements,
- **System Requirements Specification (SyRS)** describing system requirements,
- **Software Requirements Specification (SRS)** describing software requirements.

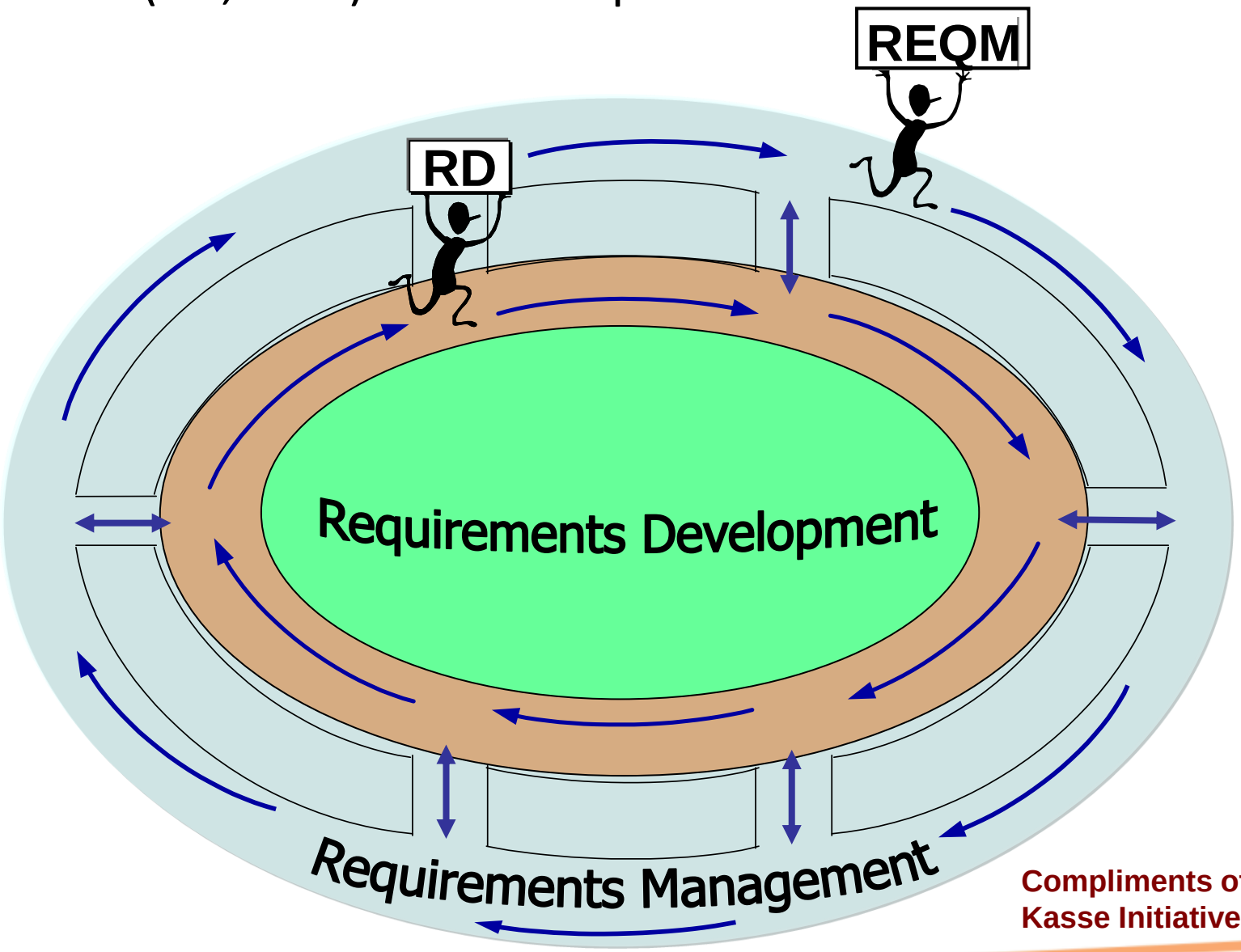
These Document Templates preserve structure of sections provided in the standard and define requirements attributes supporting the requirements process described in the standard.

Template Instructions

The standard provides detailed information about the requirements engineering process for software and system products and we strongly recommend it as the primary source of information for using the Document Templates in your projects.

If you create a new document from one of the templates above (see Requirements Projects > Set up Projects > Create Documents) then the application displays detailed guidance from the standard in the *Instructions* pane:

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

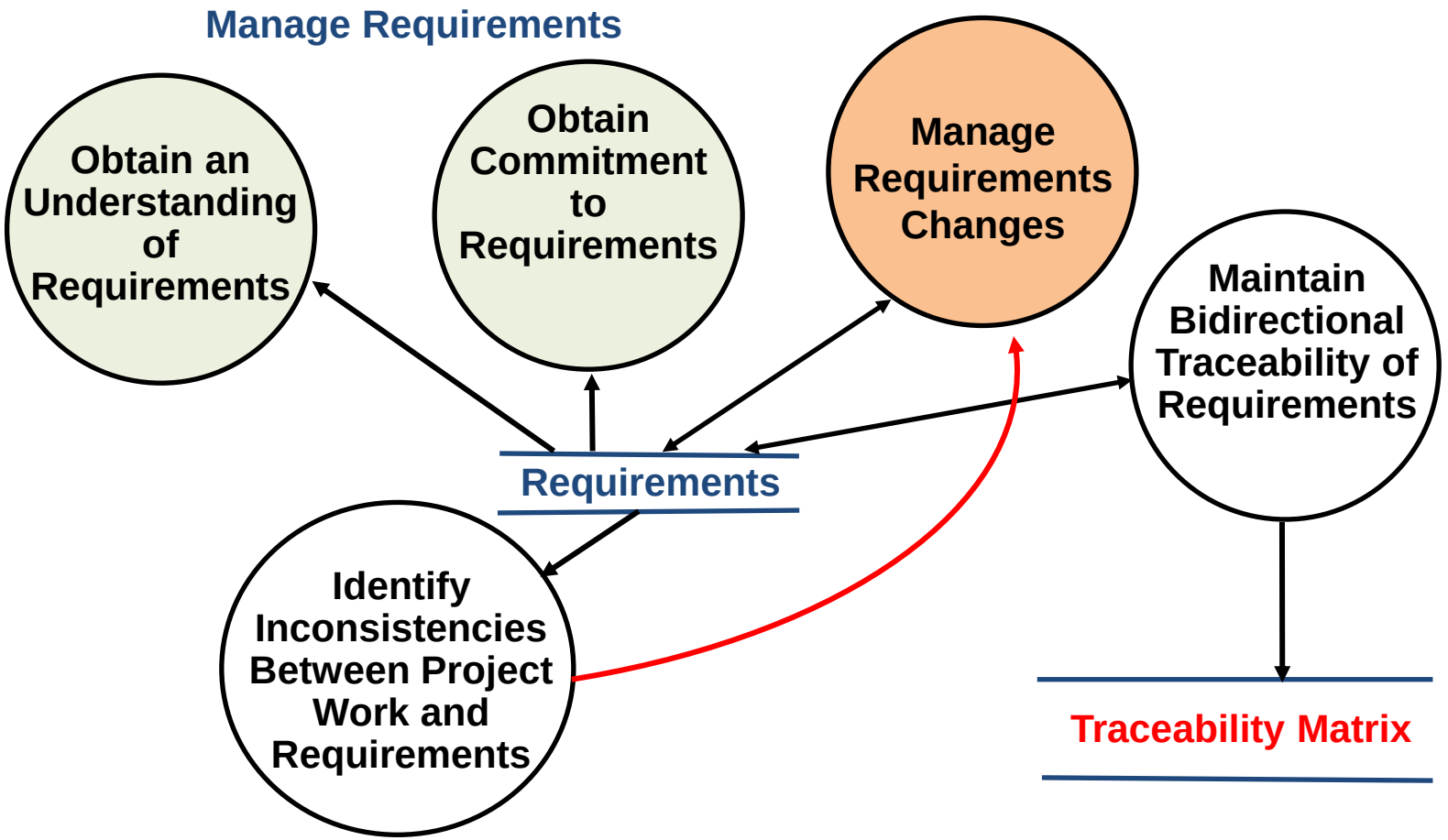
SP 1.1 Obtain an **Understanding** of Requirements

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



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???

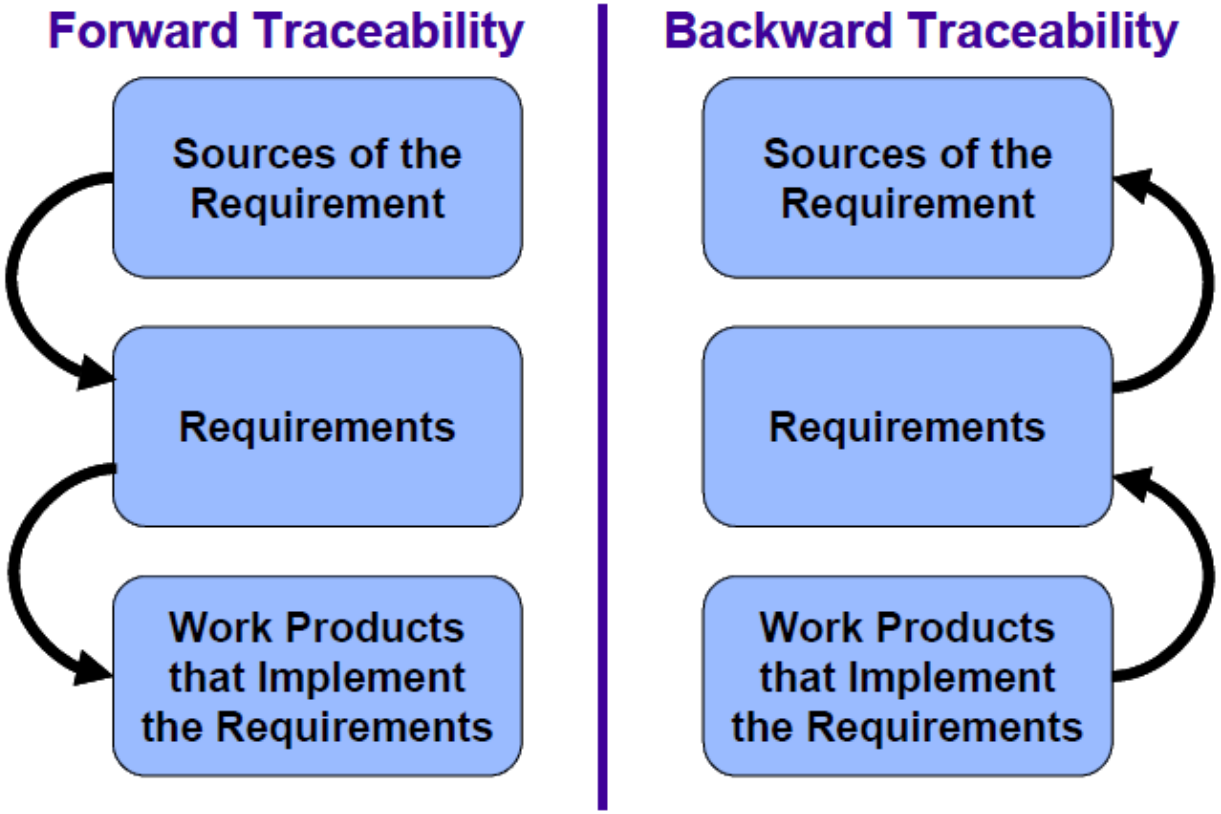


Figure 1: Bidirectional (Forward & Backward) Traceability

Benefits:

Analyze the impact of a change

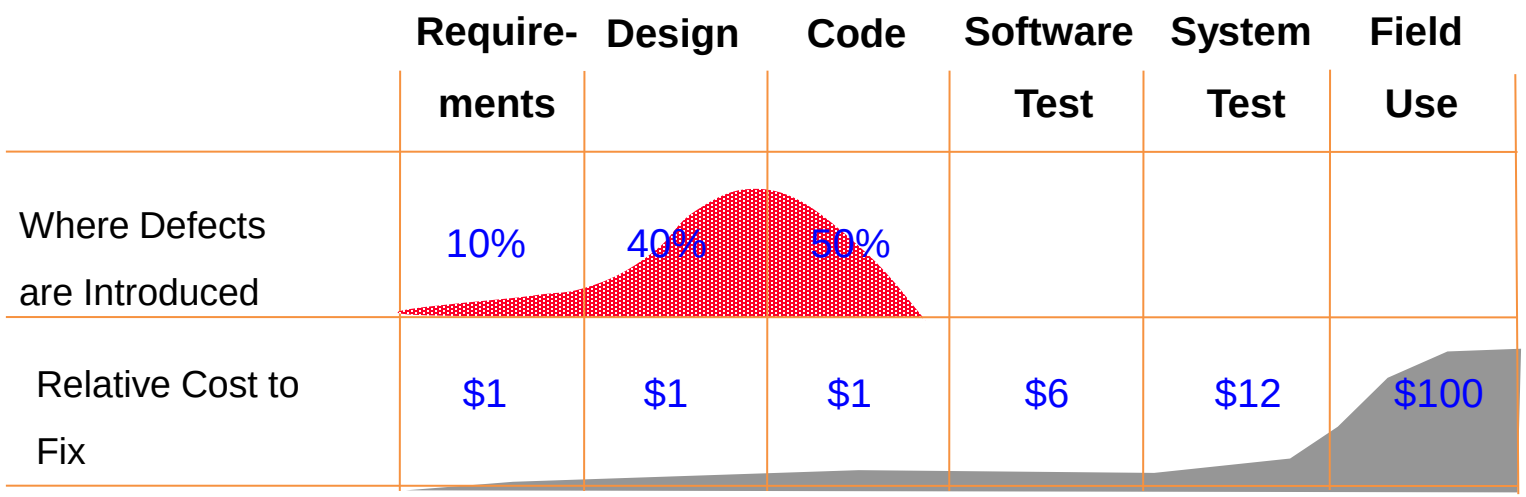
- All **work products affected** by a changed requirement
- All **requirements affected** by a change or defect in a work product

Assess current status of the requirements and the project

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

Remember:

Defects - Insertion Pattern & Cost of Removal



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

Sampling the Generic Practices

GP 2.2: Plan the process

Establish and maintain the plan for performing the requirements management process.

Elaboration for Requirements Management

This plan for performing the requirements management process can be part of (or referenced by) the project plan as described in the Project Planning process area.

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 2.5: Train People

Train the people performing or supporting the requirements management process as needed.

Elaboration for Requirements Management

Examples of training topics include the following:

- Application domain
- Requirements definition, analysis, review, and management
- Requirements management tools
- Configuration management
- Negotiation and conflict resolution

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.

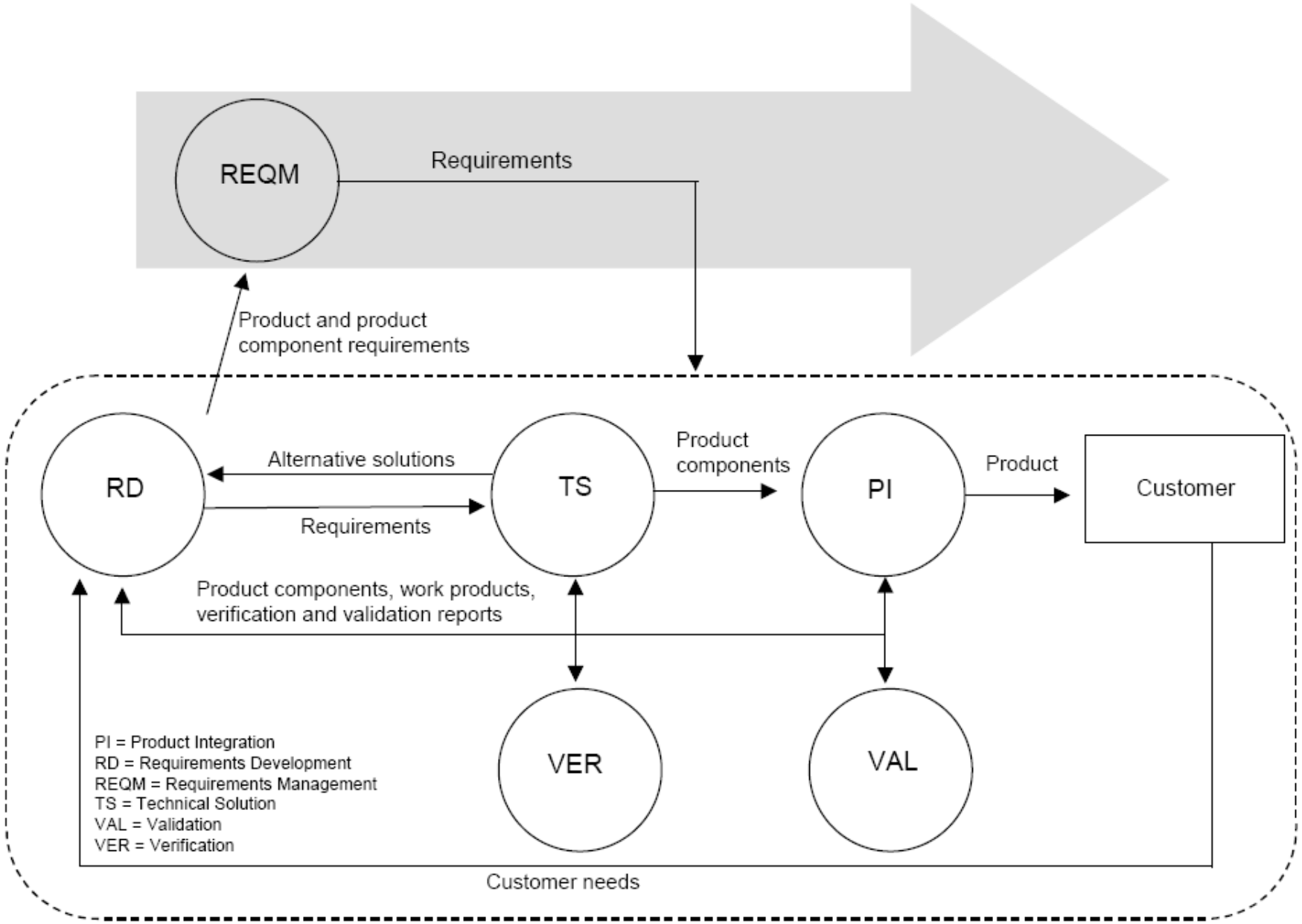
Elaboration for Requirements Management

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 **(e.g., the RACI matrix!)**.

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**

Where Requirements Development stands in the model?



CMMI V2.0 – V3.0 [Next Generation CMMI]

REQUIREMENTS DEVELOPMENT AND MANAGEMENT (RDM)

- Combined REQM (ML2) and RD (ML3)
- New approach to ML and indicators
- Adapted to Agile organizations
- Process areas >>> **Practice** areas

CMMI V2.0 REQUIREMENTS DEVELOPMENT AND MANAGEMENT (RDM)

Level 1

- RDM 1.1 Record requirements

Level 2

- RDM 2.1 Elicit stakeholder needs, expectations, constraints, and interfaces or connections. (RD SP 1.1)
- RDM 2.2 Transform stakeholder needs, expectations, constraints, and interfaces or connections into prioritized customer requirements. (RD SP 1,1, 3.2)
- RDM 2.3 Develop an understanding with the requirements providers on the meaning of the requirements. (REQM SP 1.1.)
- RDM 2.4 Obtain commitment from project participants that they can implement the requirements. (REQM SP 1.2)
- RDM 2.5 Develop, record, and maintain bidirectional traceability among requirements and activities or work products. (REQM SP 1.4)
- RDM 2.6 Ensure that plans and activities or work products remain consistent with requirements. (REQM SP 1.4)

Level 3

- RDM 3.1 Develop and keep requirements updated for the solution and its components. (RD SP 2.1)
- RDM 3.2 Develop operational concepts and scenarios. (RD SP 3.1, 3.2)
- RDM 3.3 Allocate the requirements to be implemented. (RD SP2.2)
- RDM 3.4 Identify, develop, and keep updated interface or connection requirements. (RD SP 2.3)
- RDM 3.5 Ensure that requirements are necessary and sufficient. (RD SP 3.3)
- RDM 3.6 Balance stakeholder needs and constraints. (RD SP 3.4)
- RDM 3.7 Validate requirements to ensure the resulting solution will perform as intended in the target environment. (RD SP 3.5)

Project Management PAs (overview)

Requirements management (REQM)

- SG1: Manage requirements

ML3: Requirements Development

- SG 1 Develop Customer Requirements
- SG 2 Develop Product Requirements
- SG 3 Analyze and Validate 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.

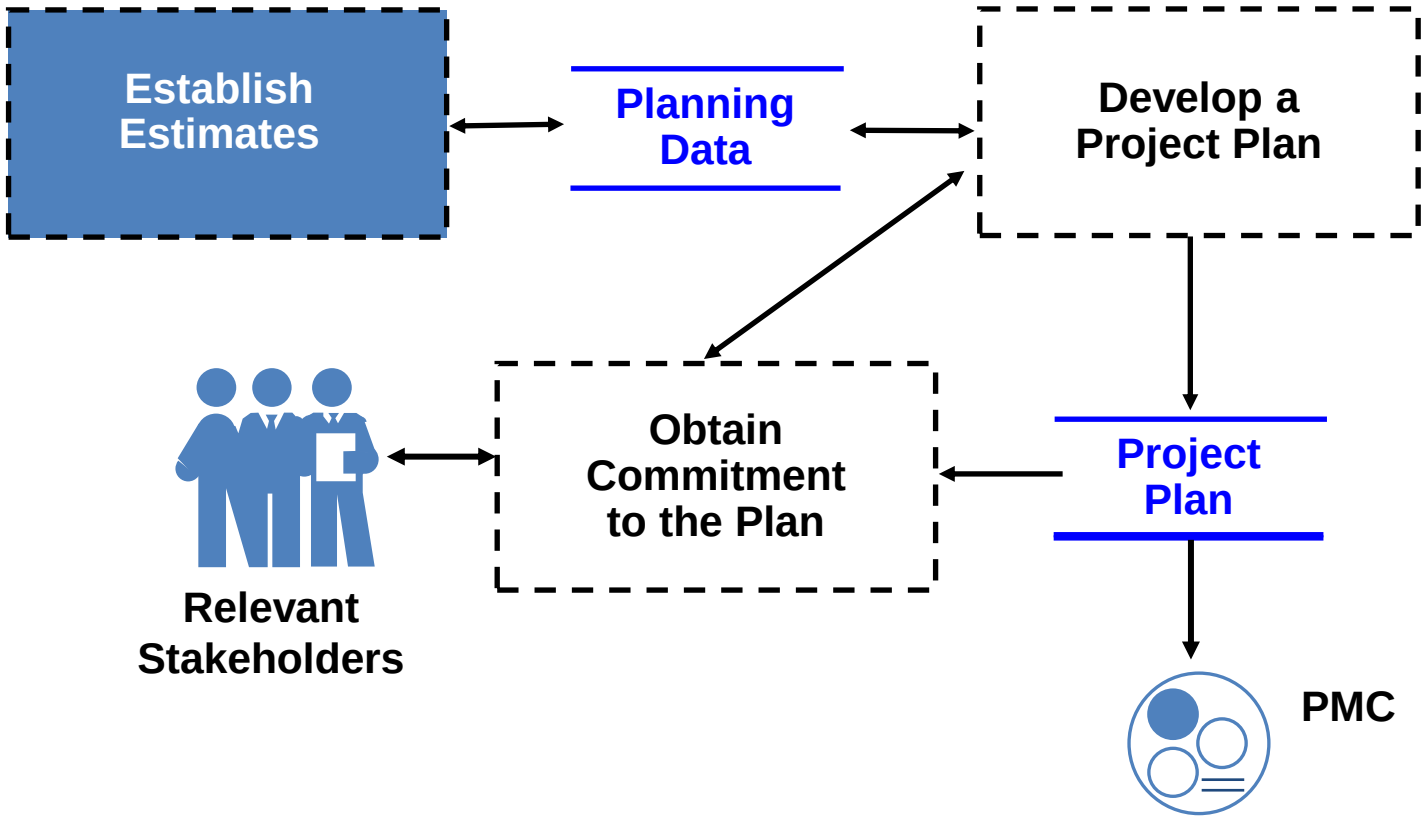
Program

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

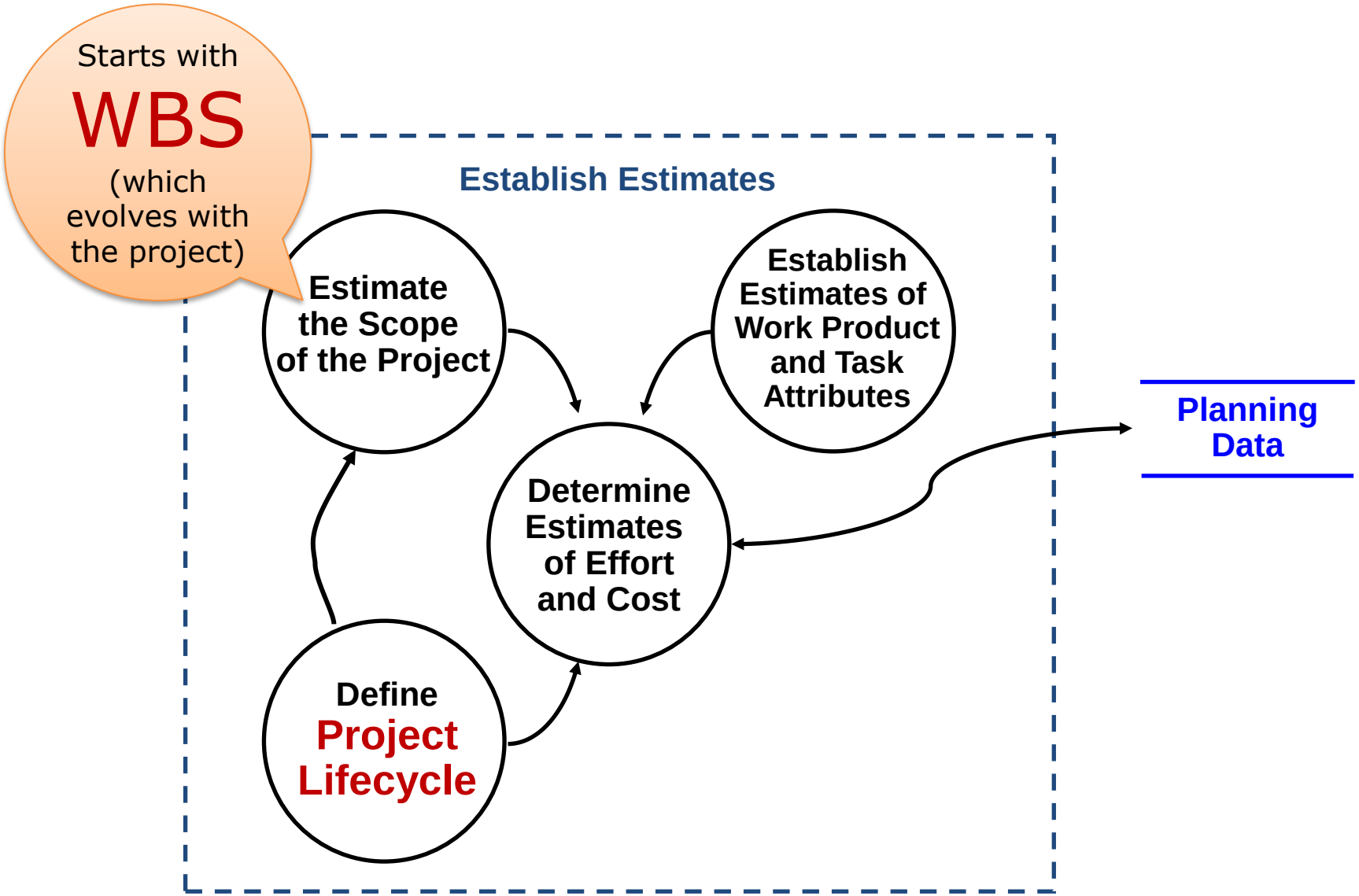
Work breakdown structure (WBS)

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

Project Planning Context -1



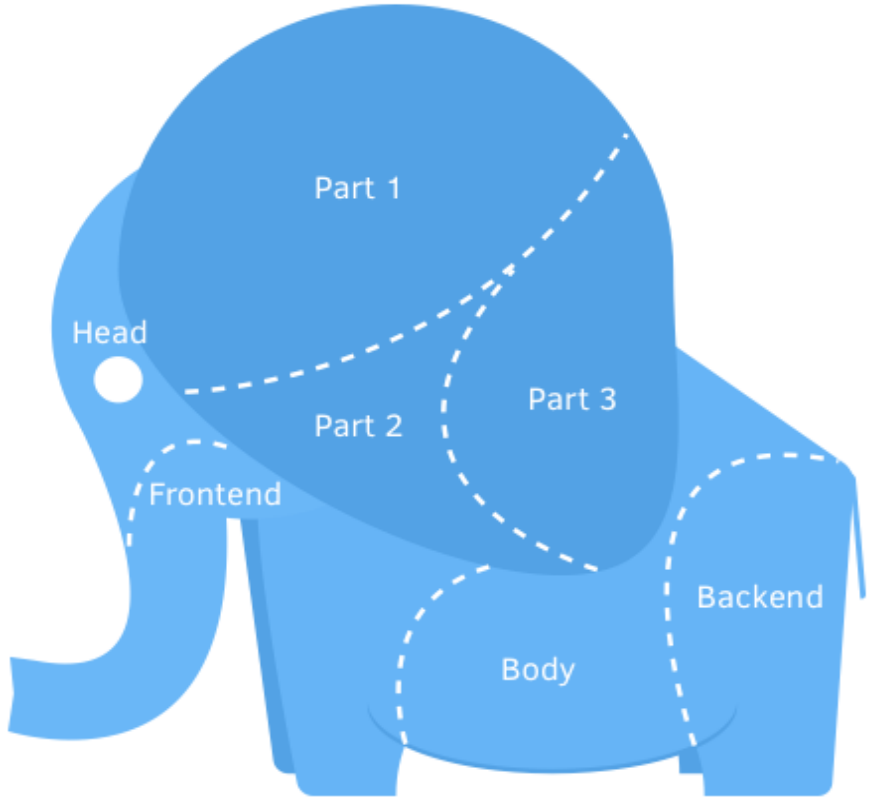
Project Planning Context -2



PP example 1:

Work Breakdown: Planning the “What”

How do you eat an elephant?



What is in WBS - example

Research

Survey users
- create questionnaire
- find users
- analyze results

Competition research
- make the list
- analyze
- document key points

Gather requirements
- interview marketing department
- interview sales department
- get content

Design

Information architecture
- Create interaction map
- Create sitemap
- Plan content
- Copywriting
- Discussion and review

Visual design
- Choose color palette
- Decide on typography
- Create comps
- Asset production

Development

Front-end
- Set layout
- Write HTML
- Write CSS
- Responsiveness
- Header
- Footer

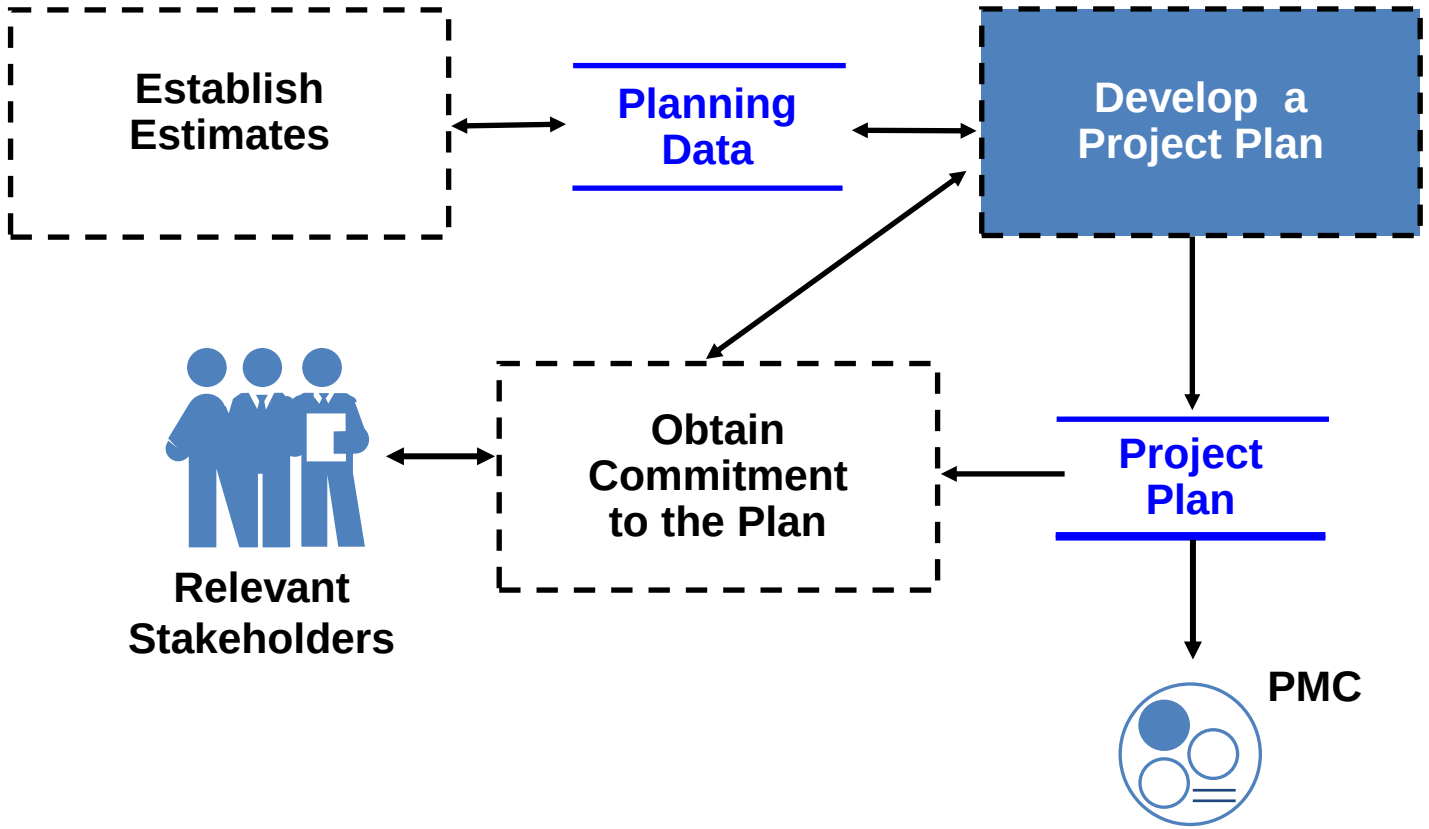
Back-end
- Set integrations
- Create admin area
- Log-in
- Cookies
- Security

Review

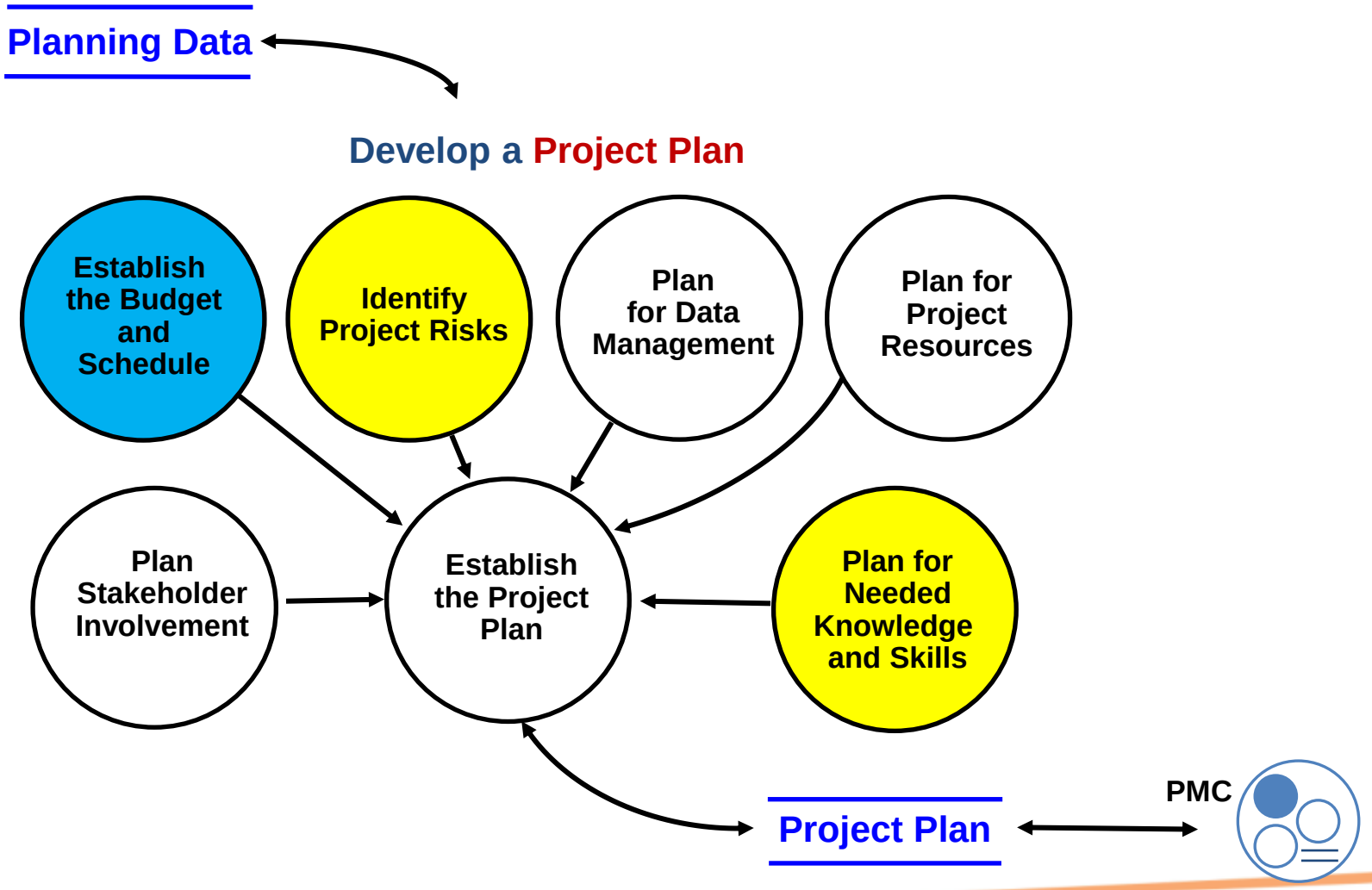
Test
- A/B tests
- Usability
- Test back-end

Present to the client
- Arrange a meeting
- Prepare documentation
- Present
- Gather feedback
- Evaluate next steps

Project Planning Context -3



Project Planning Context -4



PP example 2:
Project Timeline: Planning the “When”

- **deadline-driven planning**
- **quality-driven planning**

Quality-Driven Planning

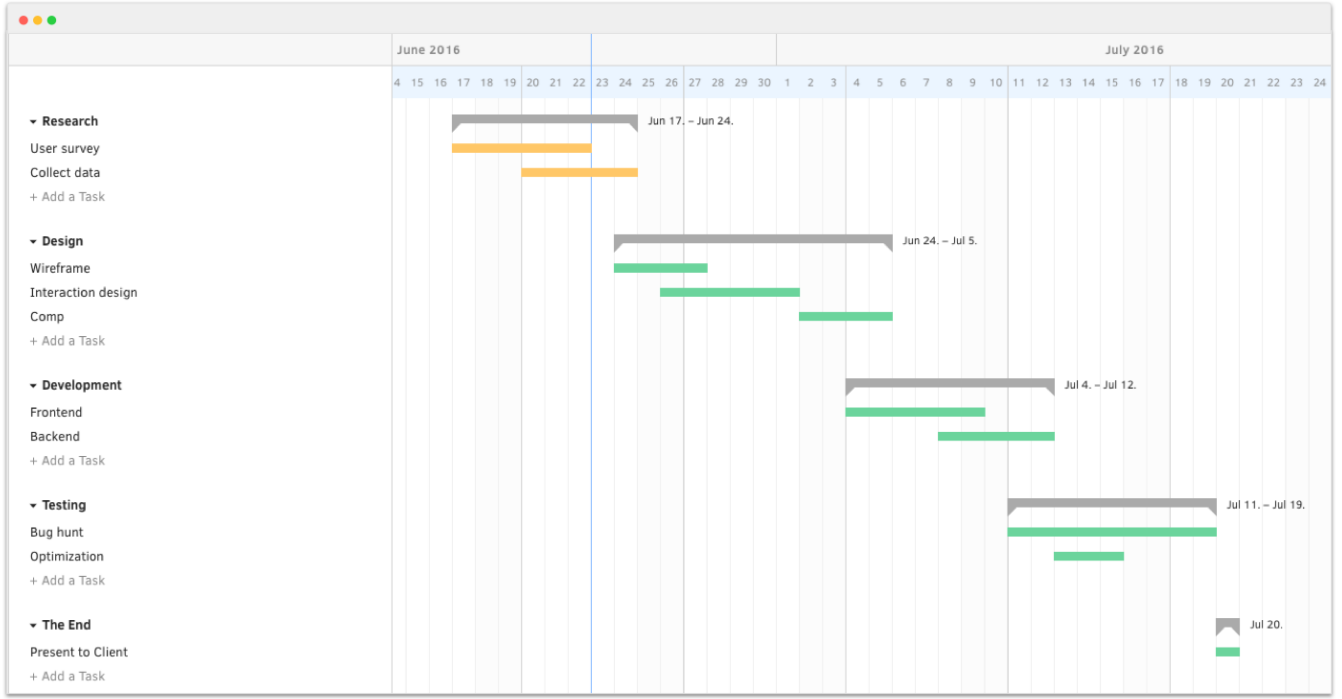
Step 1
Estimate how long you need for the first activity.

Step 2
Move on to the next activity.

Step 3
Give each task as much time as you need to finish it properly.

Step 4
If you need more time for some task, shift other tasks as well so you don't risk crunch time.

Step 5
The end date of the last task is your deadline.



Step 7
Adjust dates until you come up with a realistic timeline within time constraints.

Step 6
If you end up having to start "yesterday", decide what activities can be finished more quickly.

Step 5
Do so until you come to project's first activity.

Step 4
See what goes before that and repeat.

Step 3
Estimate how much time you need for that and set start and end date for that task.

Step 2
See what's the immediate previous thing before the deadline.

Step 1
Set the project deadline.

Deadline-Driven Planning

PP example 3:
Task Assignment: Planning the "Who"

Responsibility Assignment Matrix (RACI).

RACI matrix defines four roles a person can have on a task:

•**Responsible** - owns the task, works on it, and their duty is to see it gets completed

•**Accountable** - must approve the work and sign-off before it can be completed

•**Consulted** - has the necessary information without which a task can't be completed

•**Informed** - needs to know the final outcome, but doesn't need to be consulted

PP example 4:
Automate Planning

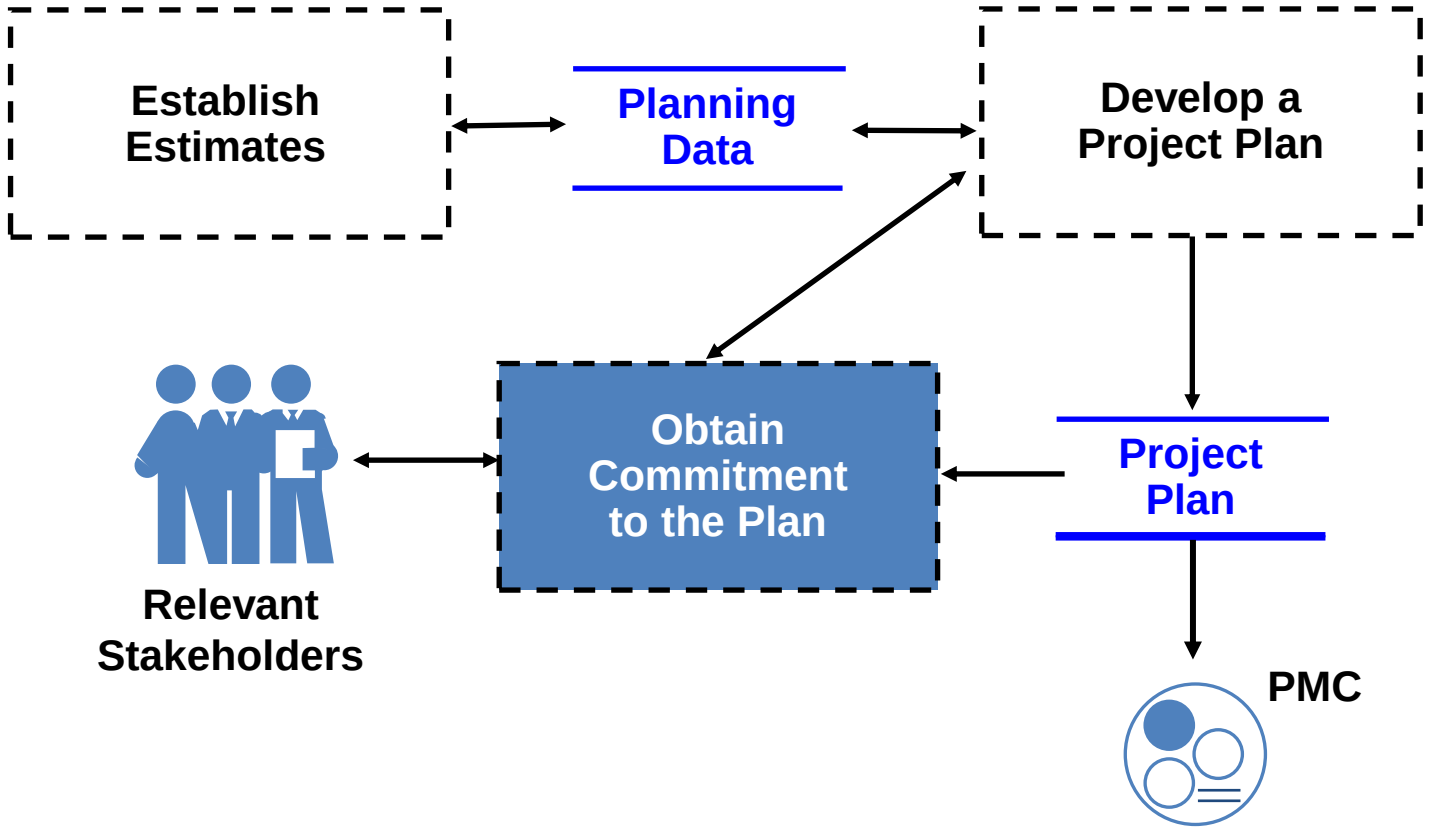
Once you've planned one dev project, you've planned them all

Recurring tasks
common tasks that you create often, like every day, week, or month
define them once, set how often they should be created

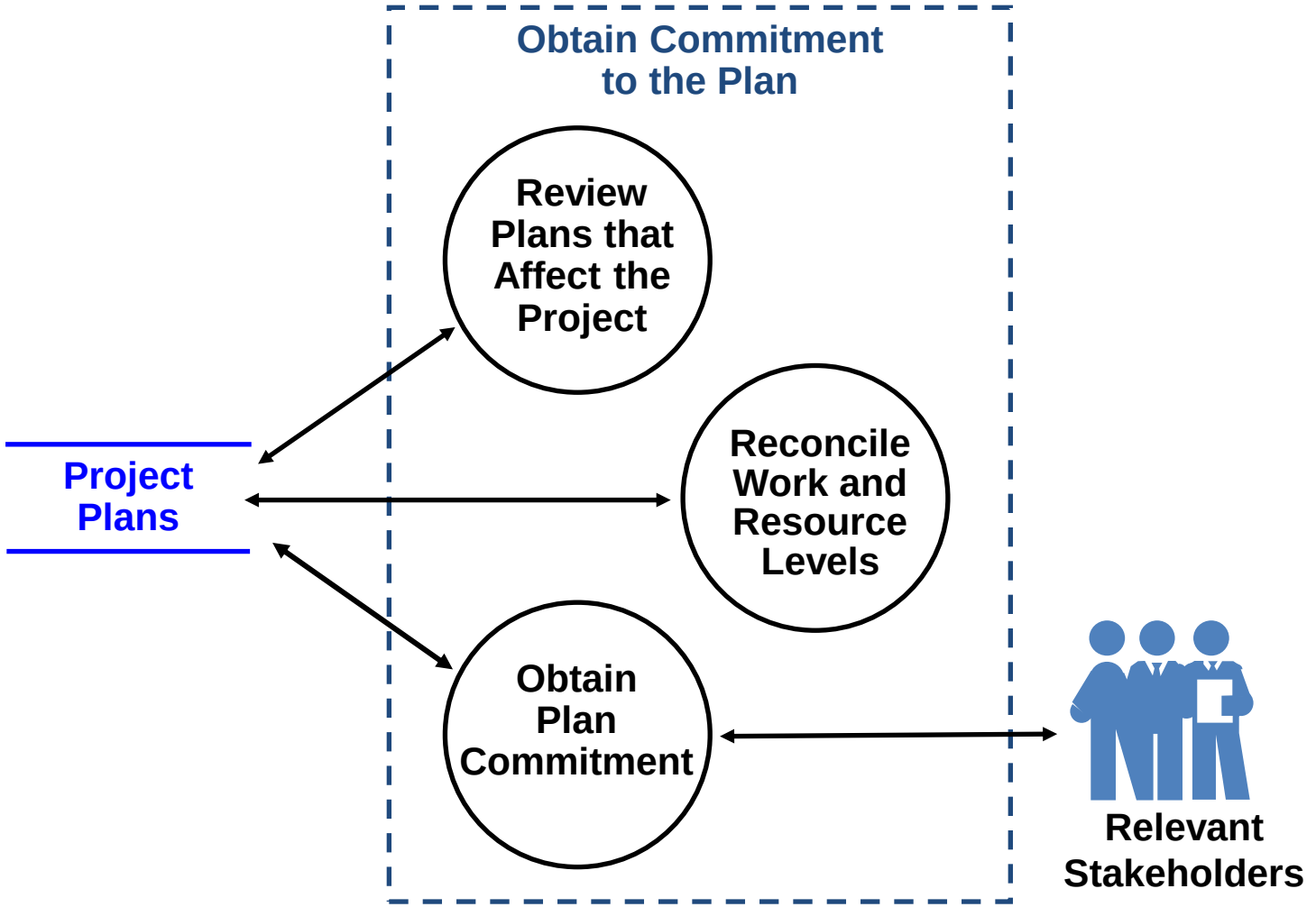
Here are some tasks you can put on auto-pilot:

- Daily standup meeting
- Monthly progress meeting
- Client meeting
- Review contracts with lawyer
- Check team performance every week
- Create a projects report every Monday
- Perform backup each week
- Check unpaid invoices
- Pay office bills
- Invoice work at the end of the month
- Contact an old client to keep in touch

Project Planning Context -5



Project Planning Context -6



Project Planning “takeaways”:

- 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:

- 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?

Sampling the Generic Practices

GP 2.2: Plan the Process

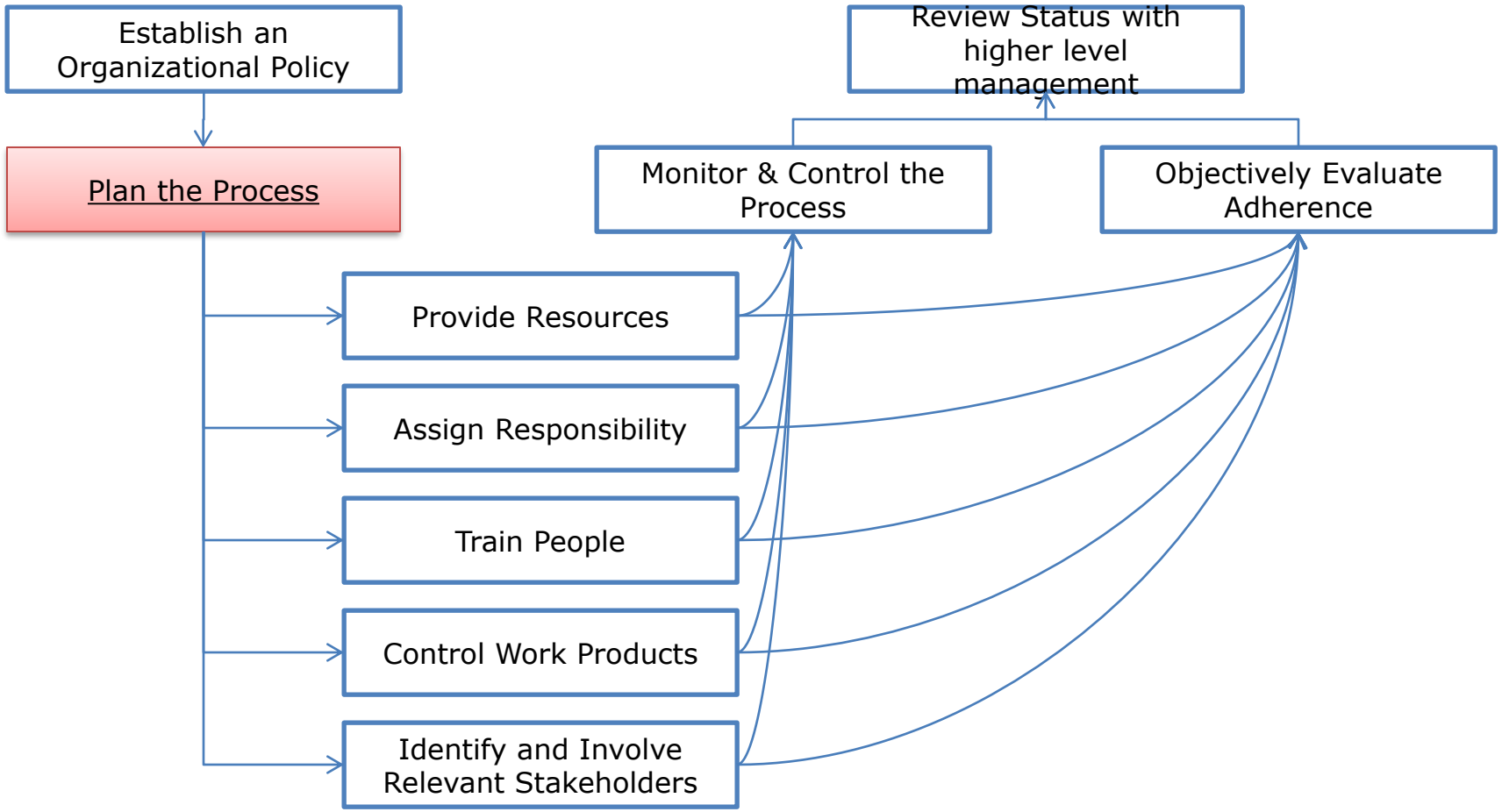
Establish and maintain the plan for performing the project planning process.

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

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 - Gantt Chart

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

Internet | Protected M

Step 1. List all activities in the plan

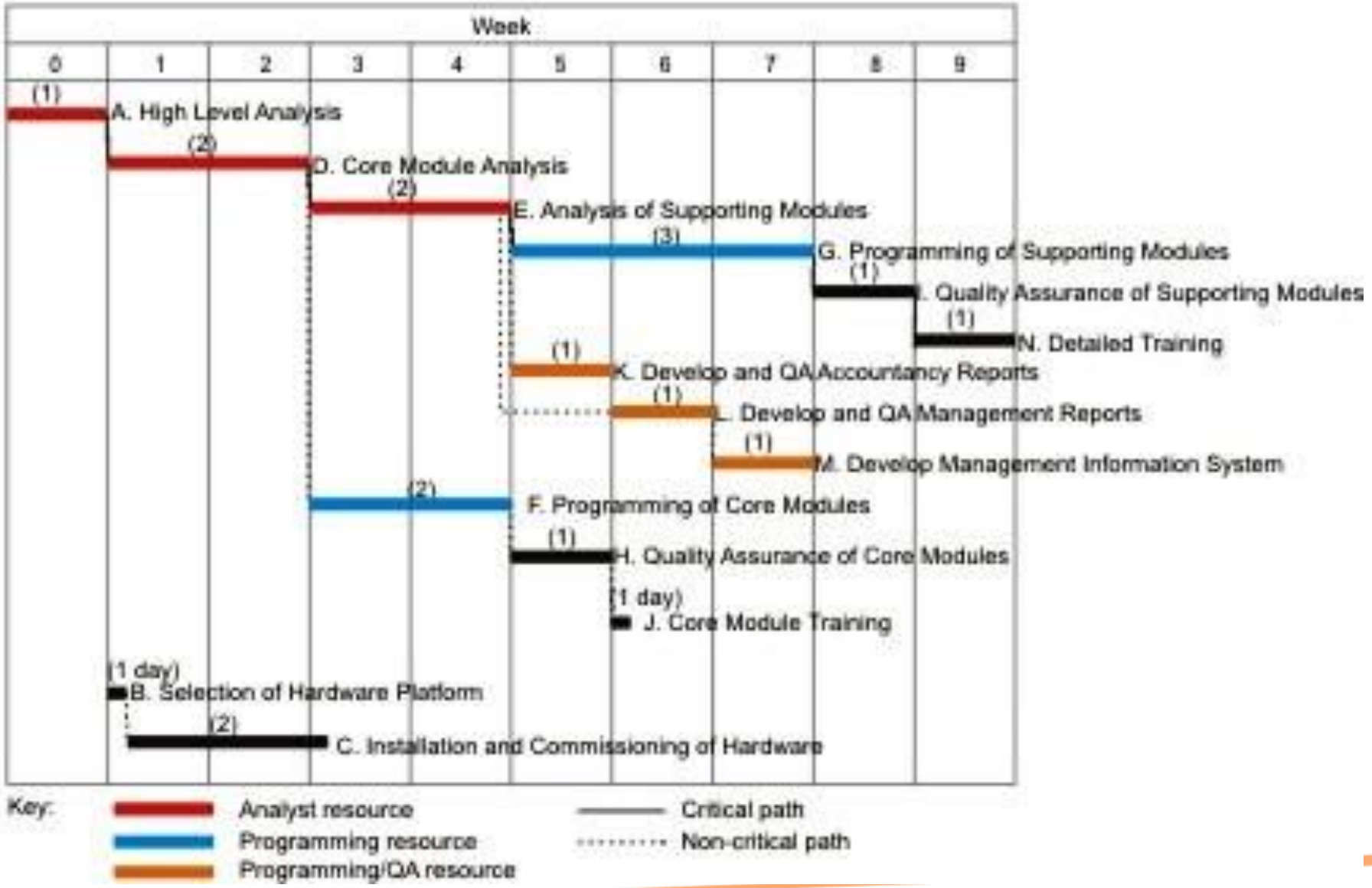
Sequential and parallel activities

Courtesy to www.mindtools.com

SW Project Plan – example 2 - Gantt Chart

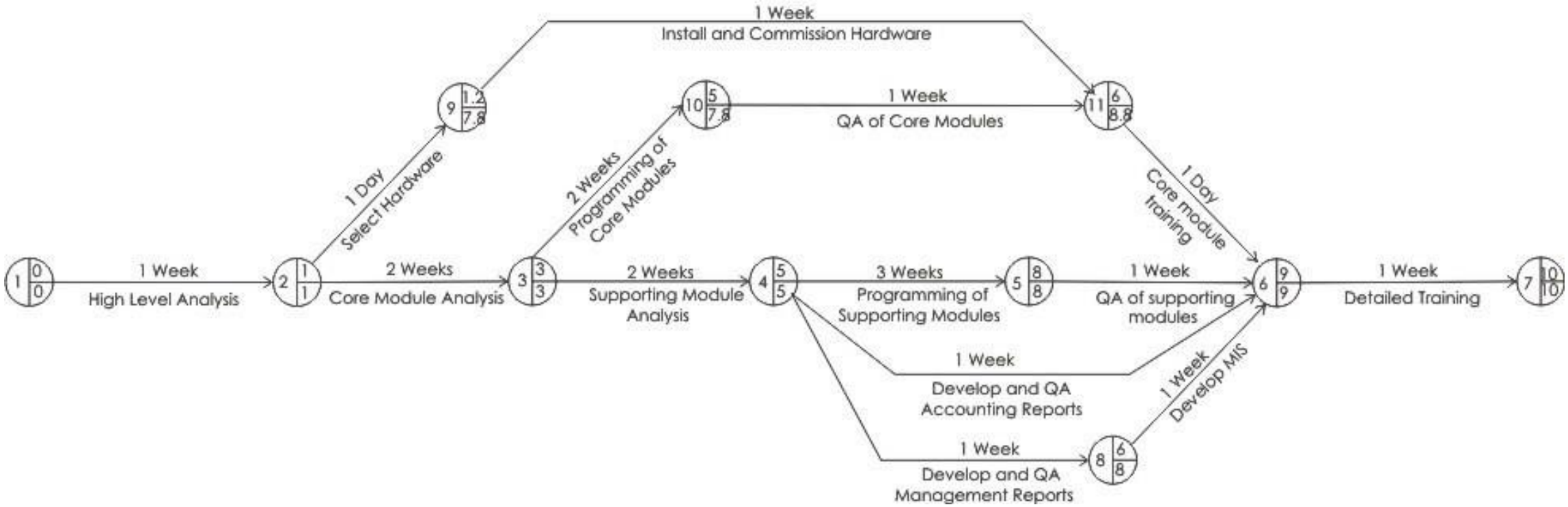
Courtesy to www.mindtools.com

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



SW Project Plan – example 4 - Critical Path Analysis

Figure 5: Critical Path Analysis for Example Computer Project



Courtesy to 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

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**.

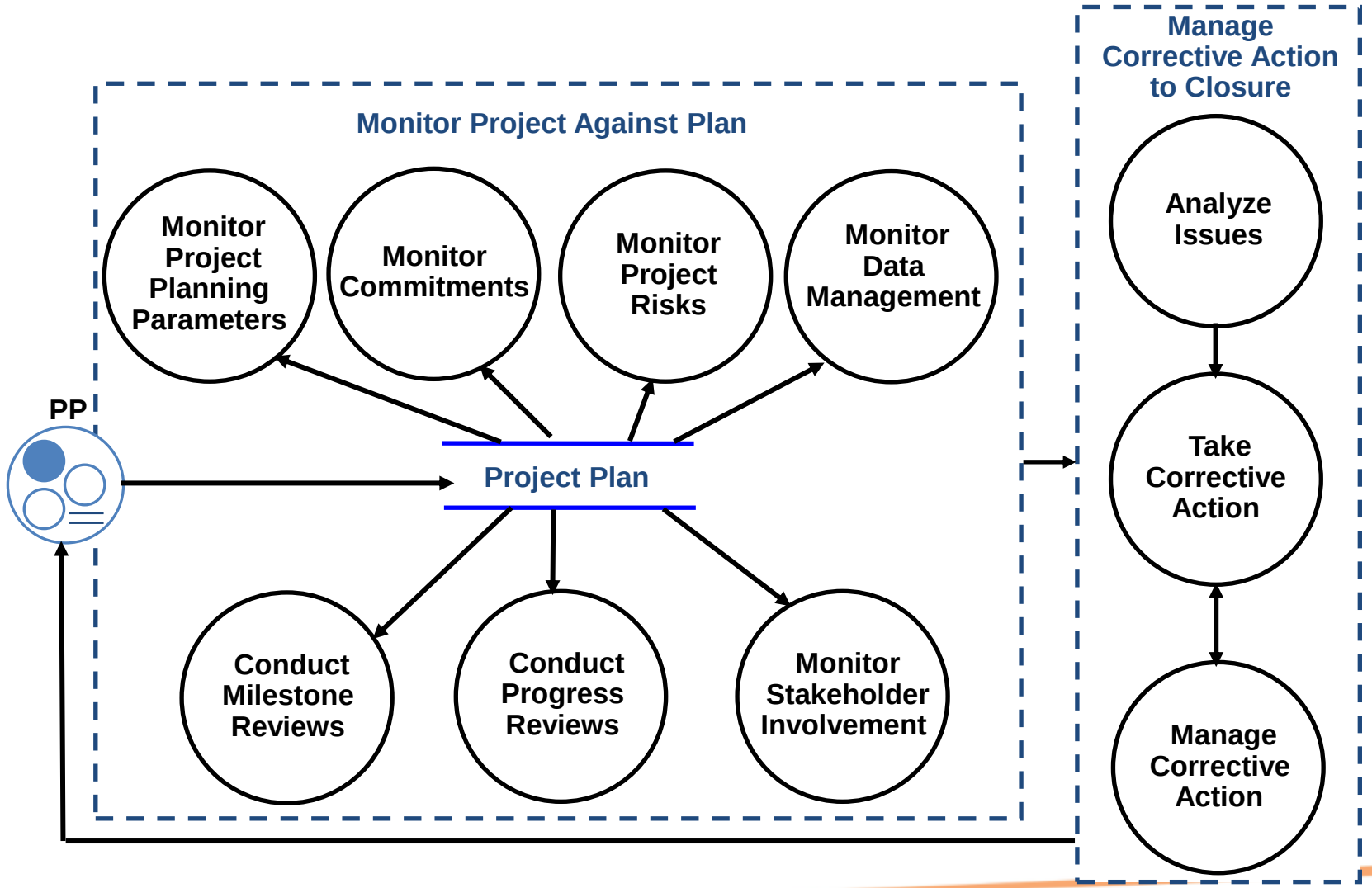
Data needed for management decisions are **not available** when needed.

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



SG 1: Monitor Project Against Plan

SP 1.1 "Monitor Project Planning Parameters" – This practice monitors progress against the parameters established in the project plan (e.g., schedule, cost, expended effort, and resources).

SP 1.2 "Monitor Commitments" - Monitoring emphasizes identifying commitments that have not been satisfied or are at significant risk of not being satisfied and evaluating the impacts of these unsatisfied commitments.

SP 1.3 "Monitor Project Risks" - Monitoring project risks involves periodically reviewing the project's documented risks in light of the current status and circumstances.

SP 1.4 "Monitor Data Management" - Monitoring data management involves periodically reviewing data management activities against their description in the project plan.

SP 1.5 "Monitor Stakeholder Involvement" - Monitoring stakeholder involvement includes periodically reviewing the status of stakeholder involvement and identifying and documenting significant issues and their impacts.

SP 1.6 "Conduct Progress Reviews" - This specific practice is distinct from conduct milestone reviews, which focuses on reviews at major project milestones and phase boundaries. Conducting progress reviews involves regularly communicating status on assigned activities and work products to relevant stakeholders and reviewing the results of collecting and analyzing measures for controlling the project.

SP 1.7 "Conduct Milestone Reviews" - Milestone reviews are conducted at meaningful points in the project's schedule and include reviewing the commitments, plan, status, and risks of the project.

SG 2: Manage Corrective Action to Closure

SP 2.1 "Analyze Issues" - Analyzing issues involves gathering issues for analysis and analyzing them to determine the need for corrective action. Corrective action criteria are established in project planning.

SP 2.2 "Take Corrective Action" - Corrective actions are taken as necessary when issues are identified or when progress differs significantly from what was planned.

SP 2.3 "Manage Corrective Action" - Managing corrective action includes monitoring corrective actions for completion, analyzing the results of corrective actions to determine the effectiveness of the corrective action, and determining and documenting appropriate actions to correct deviations from planned results of corrective actions.

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)


YOU ARE BEING
MONITORED
VIA 9GAG.COM

Example: How PP and PMC work in SCRUM

What is Scrum?

Scrum (n): A **framework** within which people can address complex adaptive problems, while productively and creatively delivering products of the highest possible value.

- *Developers like it*
- *It's fast, easy, and fun*

"Go Fast! Make your mistakes quickly so you can discover problems and fix them quickly."

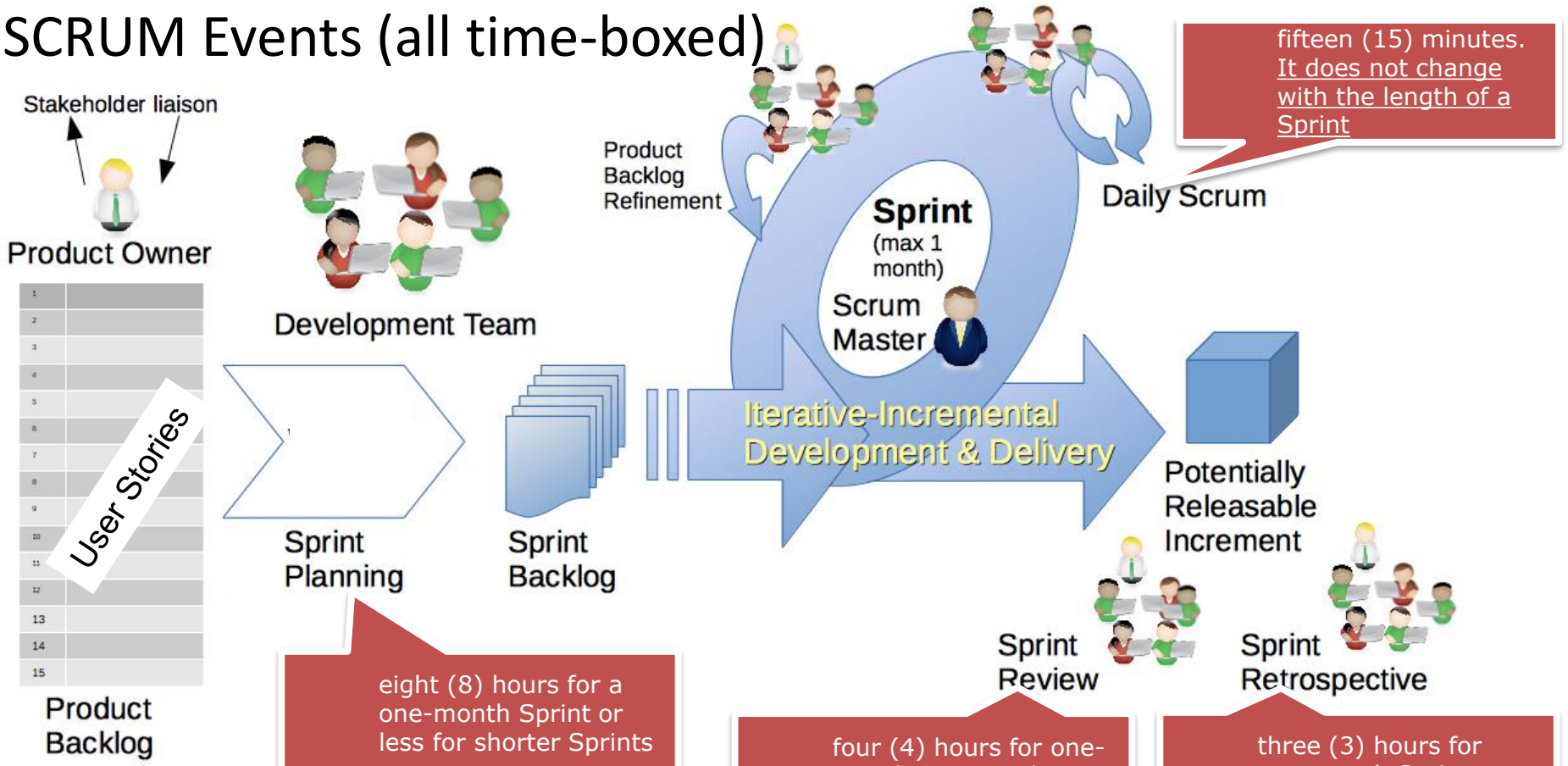
History of Scrum for SW Development

In rugby football, a scrum refers to a tight-packed formation of players with their heads down who attempt to gain possession of the ball.

Jeff Sutherland and Ken Schwaber codified Scrum in 1995 in order to present it at the Oopsla conference in Austin, Texas (US) and published the paper "SCRUM Software Development Process".

Event	Inspection	Adaptation
Sprint Planning	• Product Backlog • (Commitments Retrospective) • (Definition of Done)	• Sprint Goal • Forecast • Sprint Backlog
Daily Scrum	• Progress toward Sprint Goal	• Sprint Backlog • Daily Plan
Sprint Review	• Product Increment • Product Backlog (Release) • Market-business conditions	• Product Backlog
Sprint Retrospective	• Team & collaboration • Technology & engineering • Definition of Done	• Actionable improvements

SCRUM Events (all time-boxed)



Daily Scrum

The Daily Scrum is held at the same time and place each day to reduce complexity.
The Scrum Master ensures/teaches how the Development Team conducts the meeting in 15 min. Development Team is responsible for conducting the Daily Scrum.

What did I do **yesterday** that helped the Development Team meet the Sprint Goal?

What **will I do today** to help the Development Team meet the Sprint Goal?

Blockers: Do I see any impediment that prevents me or the Development Team from meeting the Sprint Goal?

The Development Team or team members often meet immediately after the Daily Scrum for detailed discussions.

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

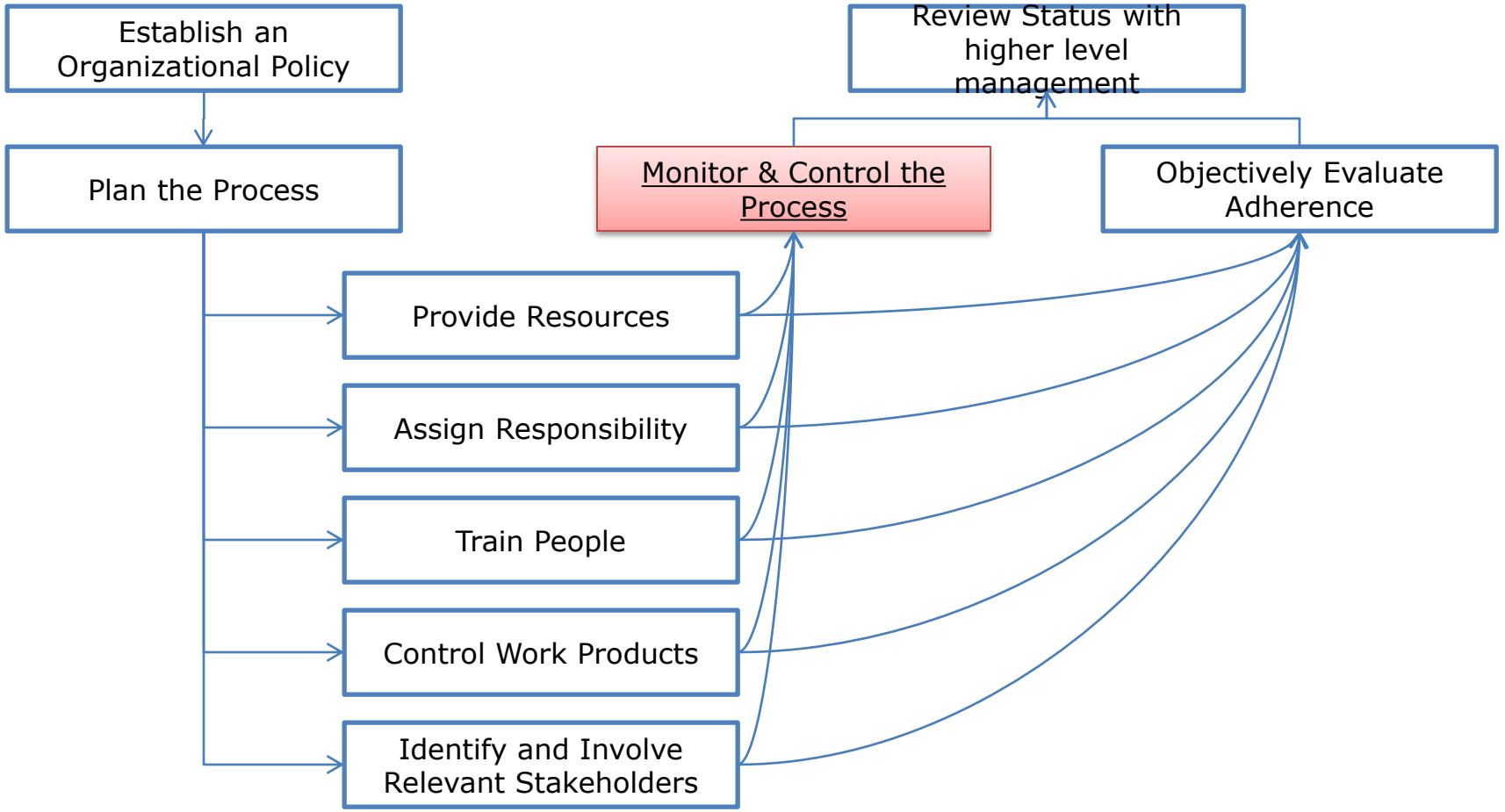
Monitor and control the project monitoring and control process against the plan for performing the process and take appropriate corrective action.

Elaboration for Project Monitoring and Control

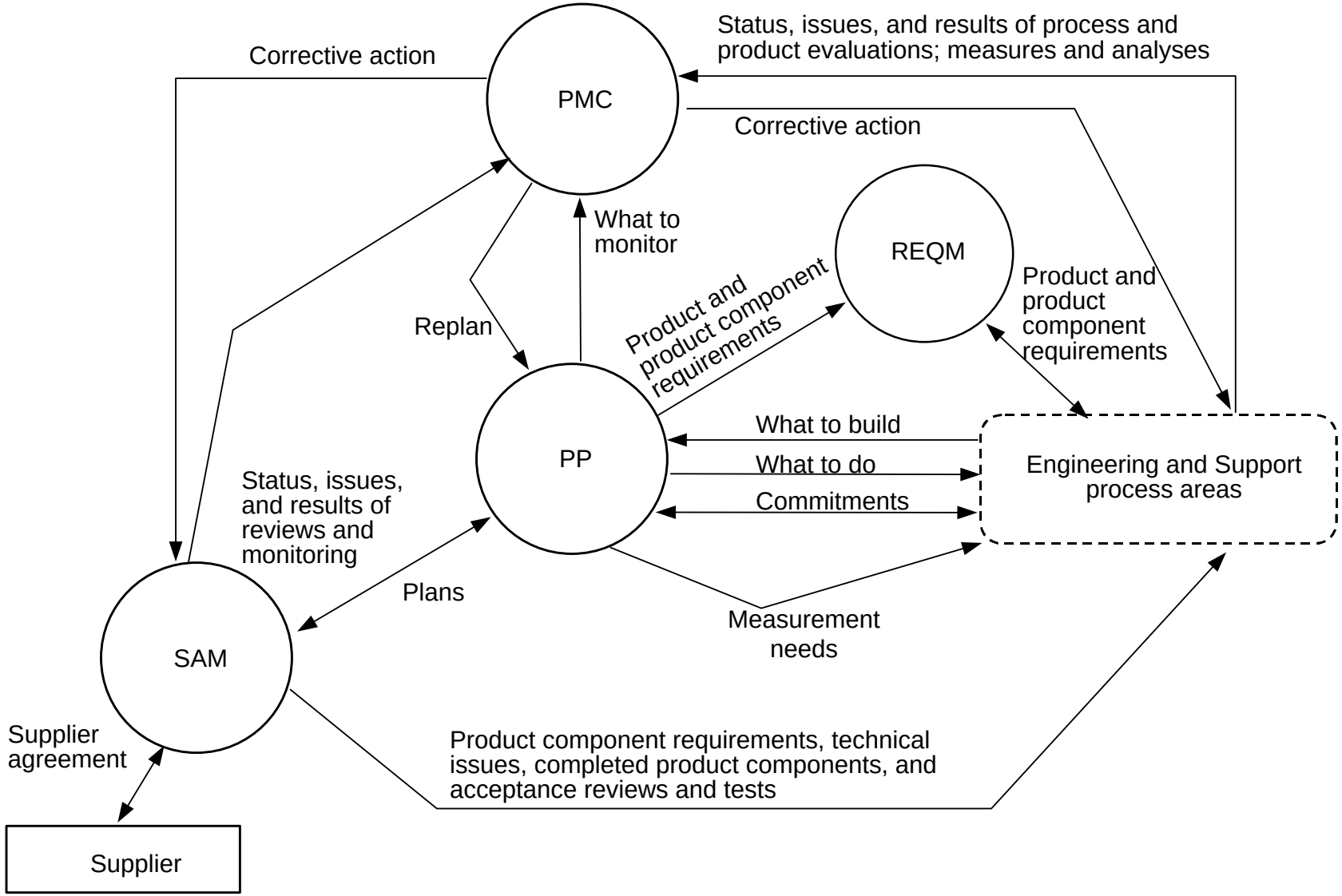
Examples of measures and work products used in monitoring and controlling include the following:

- 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



PMC = Project Monitoring and Control
PP = Project Planning
REQM = Requirements Management
SAM = Supplier Agreement Management

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.

SAM Practices:

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

Supplier selection based on evaluation?

Criteria for evaluation established/documented?

Criteria for evaluation of proposals?

Agreement with supplier documented?

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 documented?

Next: Supporting PAs ML2:

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

Supporting Process Areas, ML2 (overview)

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.

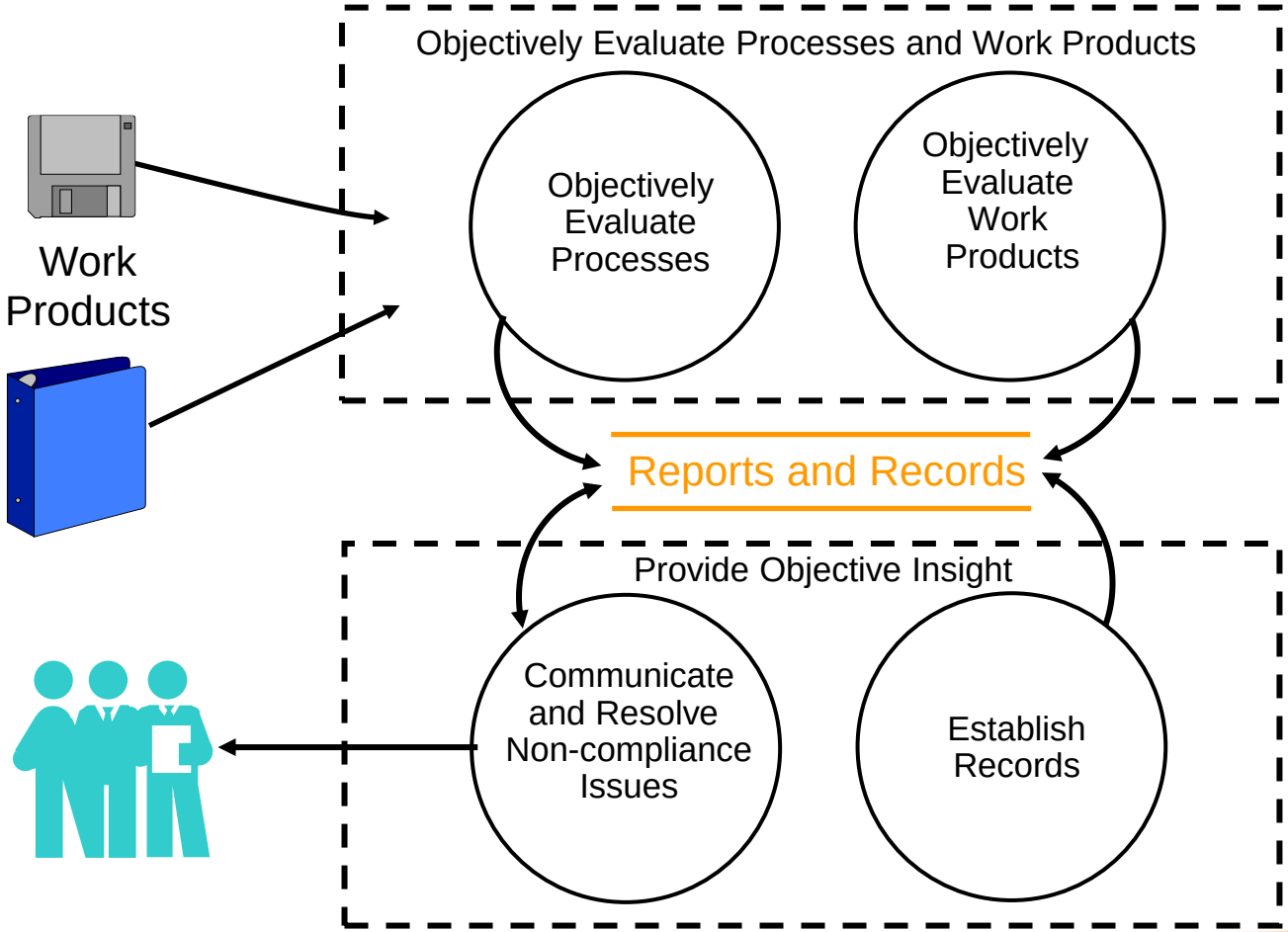
Process and Product Quality Assurance (PPQA)

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.

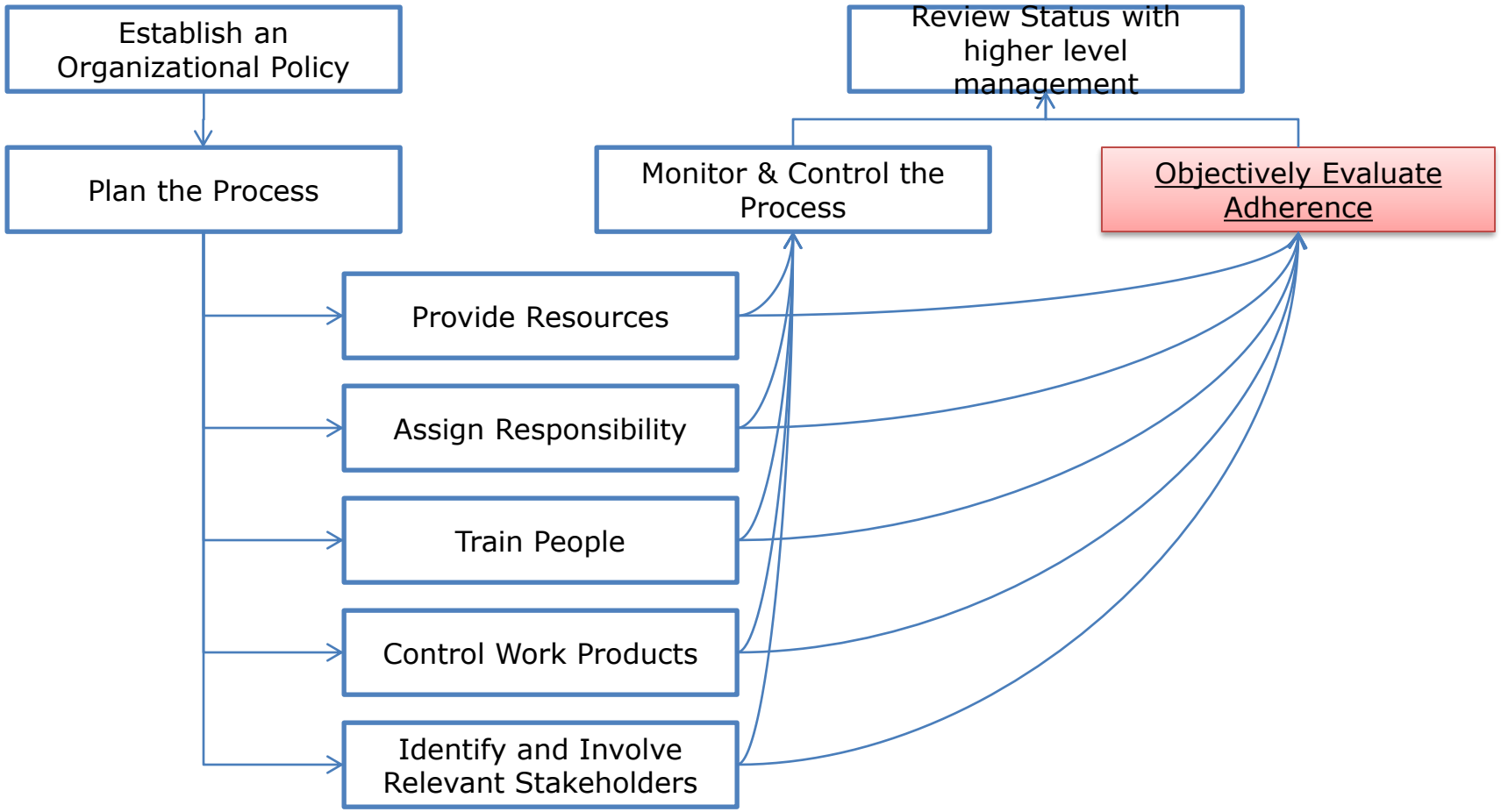
Process and Product Quality Assurance - Context



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?



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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

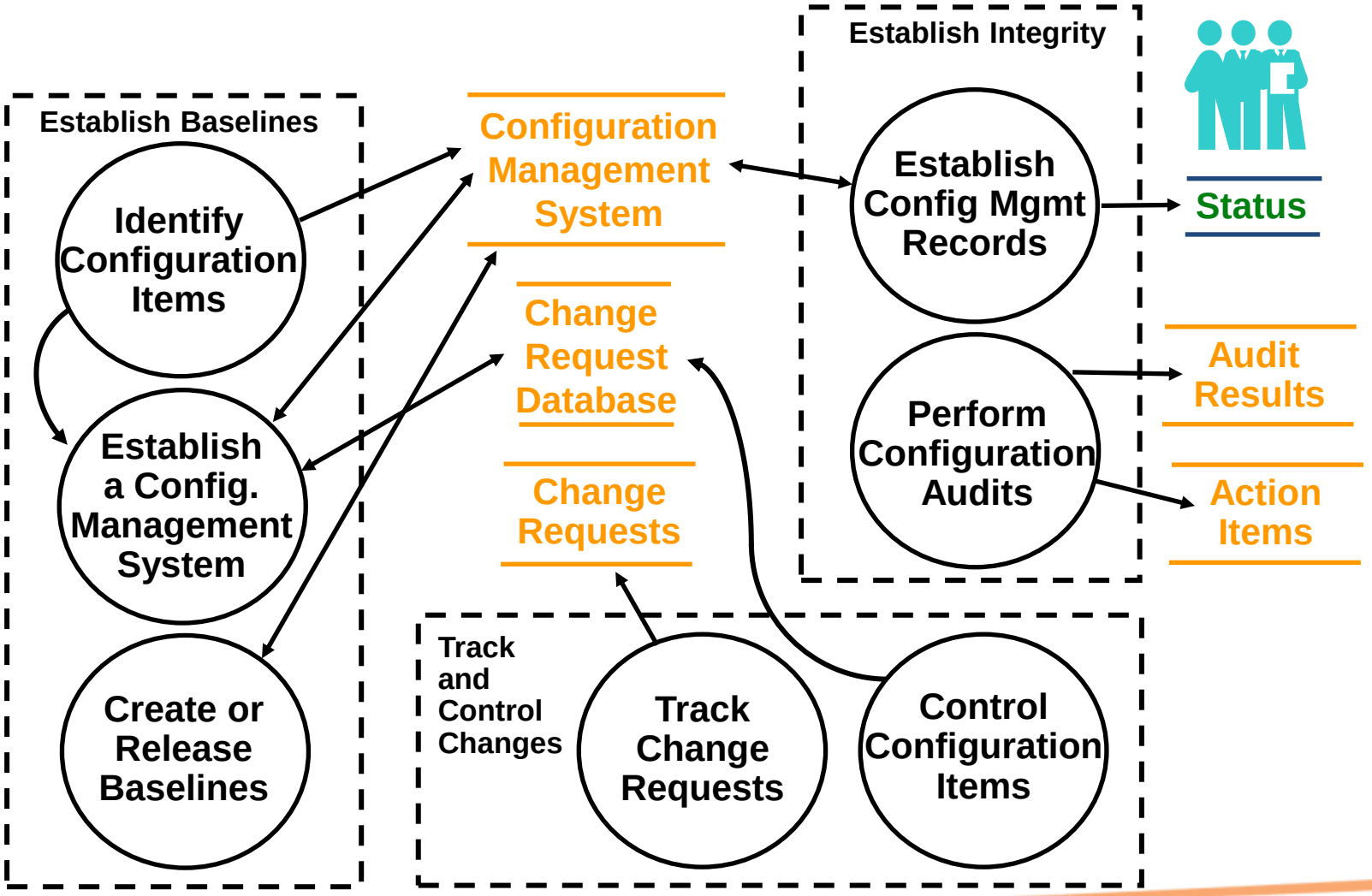
Past product releases can be rebuilt

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.

Example

The Explosion of the Ariane 5

On June 4, 1996 an unmanned Ariane 5 rocket launched by the European Space Agency exploded just forty seconds after its lift-off from Kourou, French Guiana. The rocket was on its first voyage, after a decade of development costing **$7 billion**. The destroyed rocket and its cargo were valued at **$500 million**.

A board of inquiry investigated the causes of the explosion and in two weeks issued a report. It turned out that the cause of the failure was a software error in the inertial reference system.

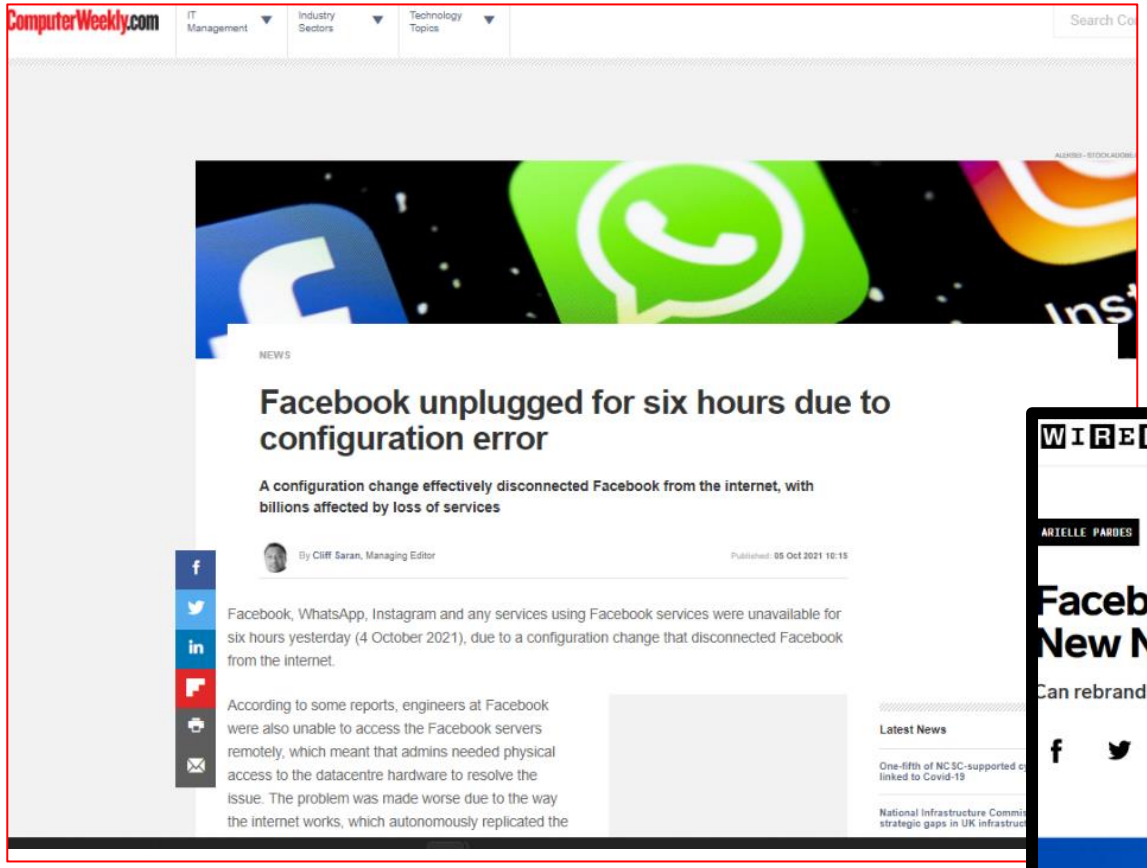
Specifically a **64 bit floating point number** relating to the horizontal velocity of the rocket with respect to the platform was converted to a **16 bit signed integer**.

The number was larger than 32,767, the largest integer storeable in a 16 bit signed integer, and thus the conversion failed.

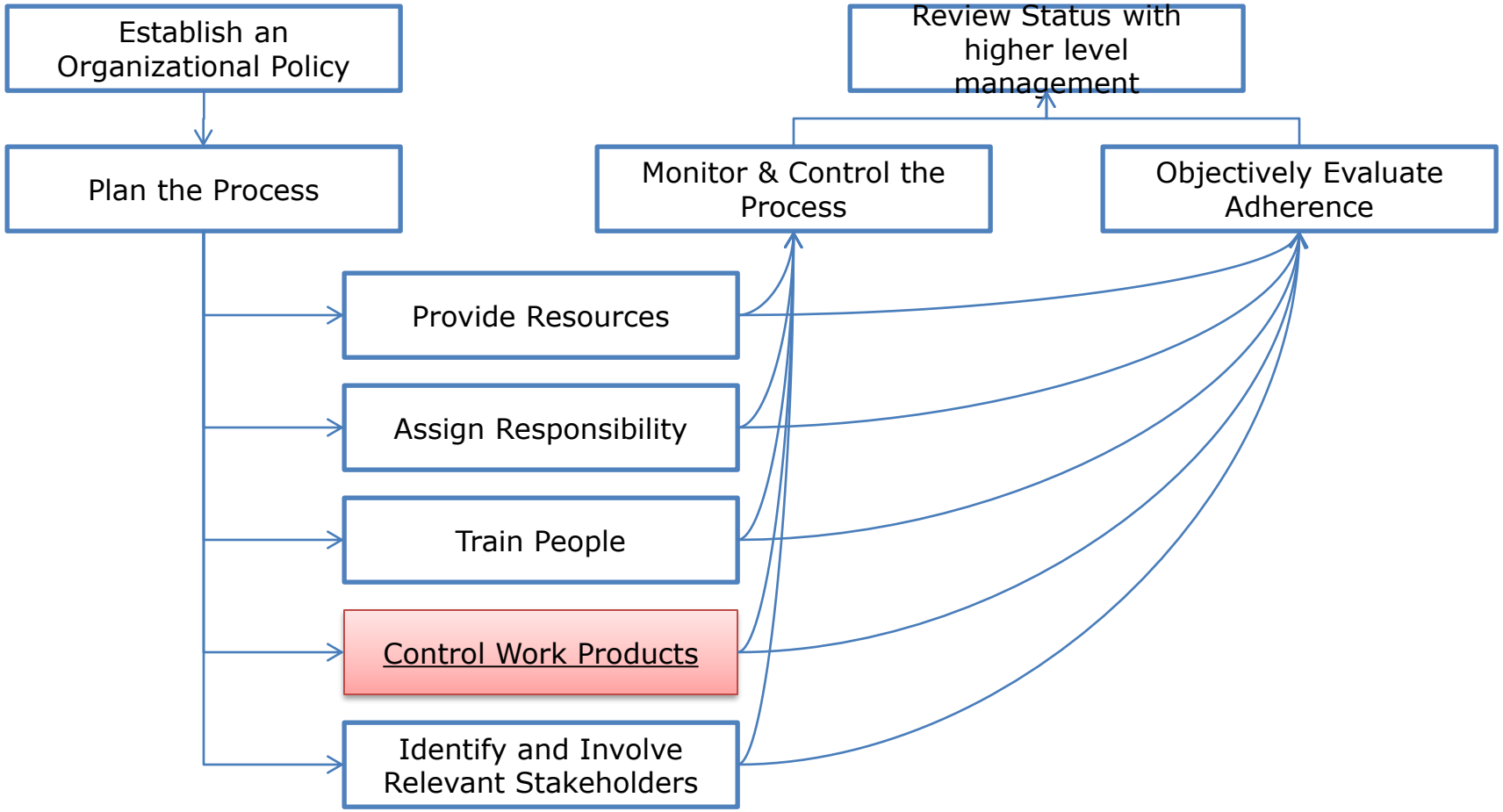
Example (2)

05 October 2021

https://www.computerweekly.com/news/252507717/Facebook-unplugged-for-six-hours-due-to-configuration-error



How CM relates to Generic Practices?



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Supporting PAs (overview)

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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.

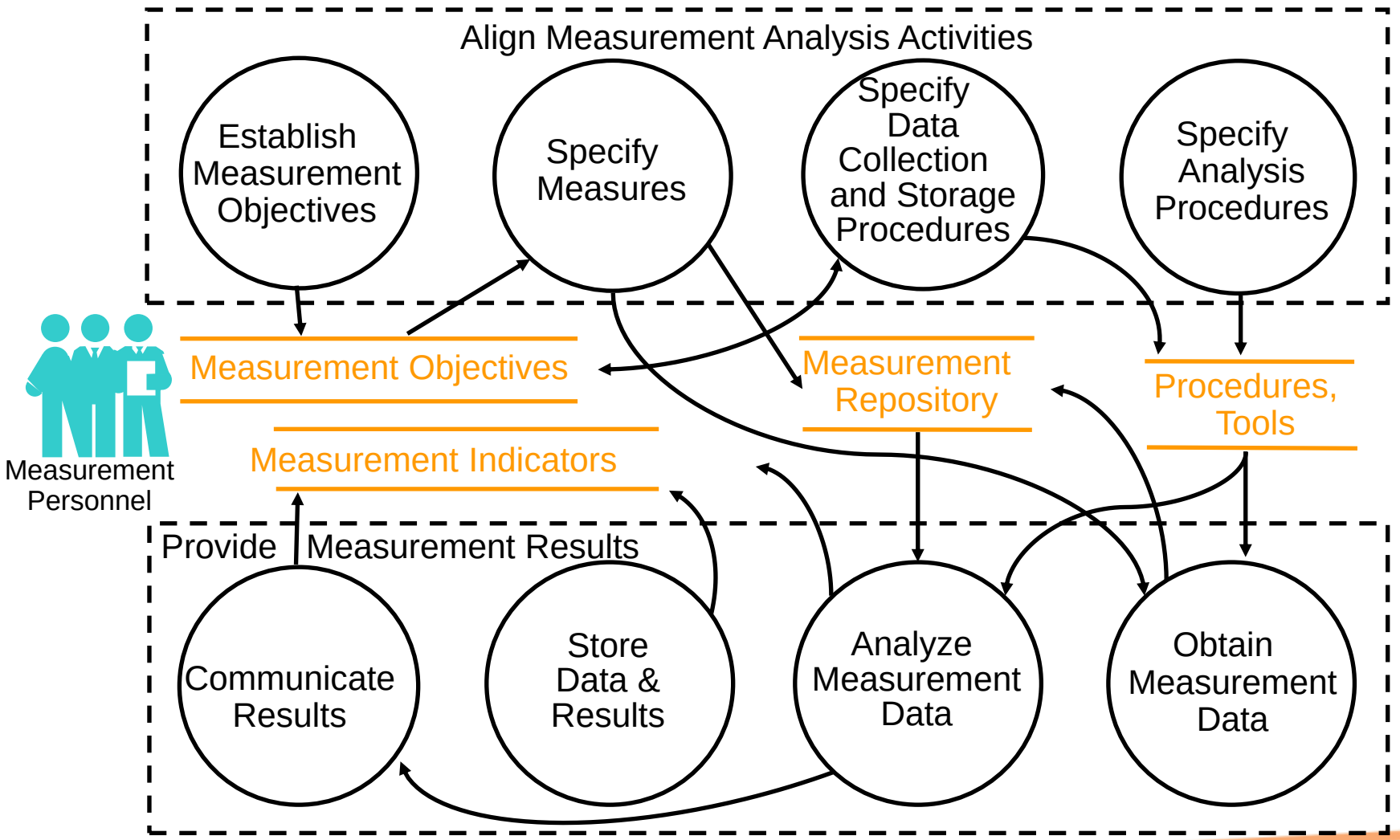
Measurement and Analysis

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)

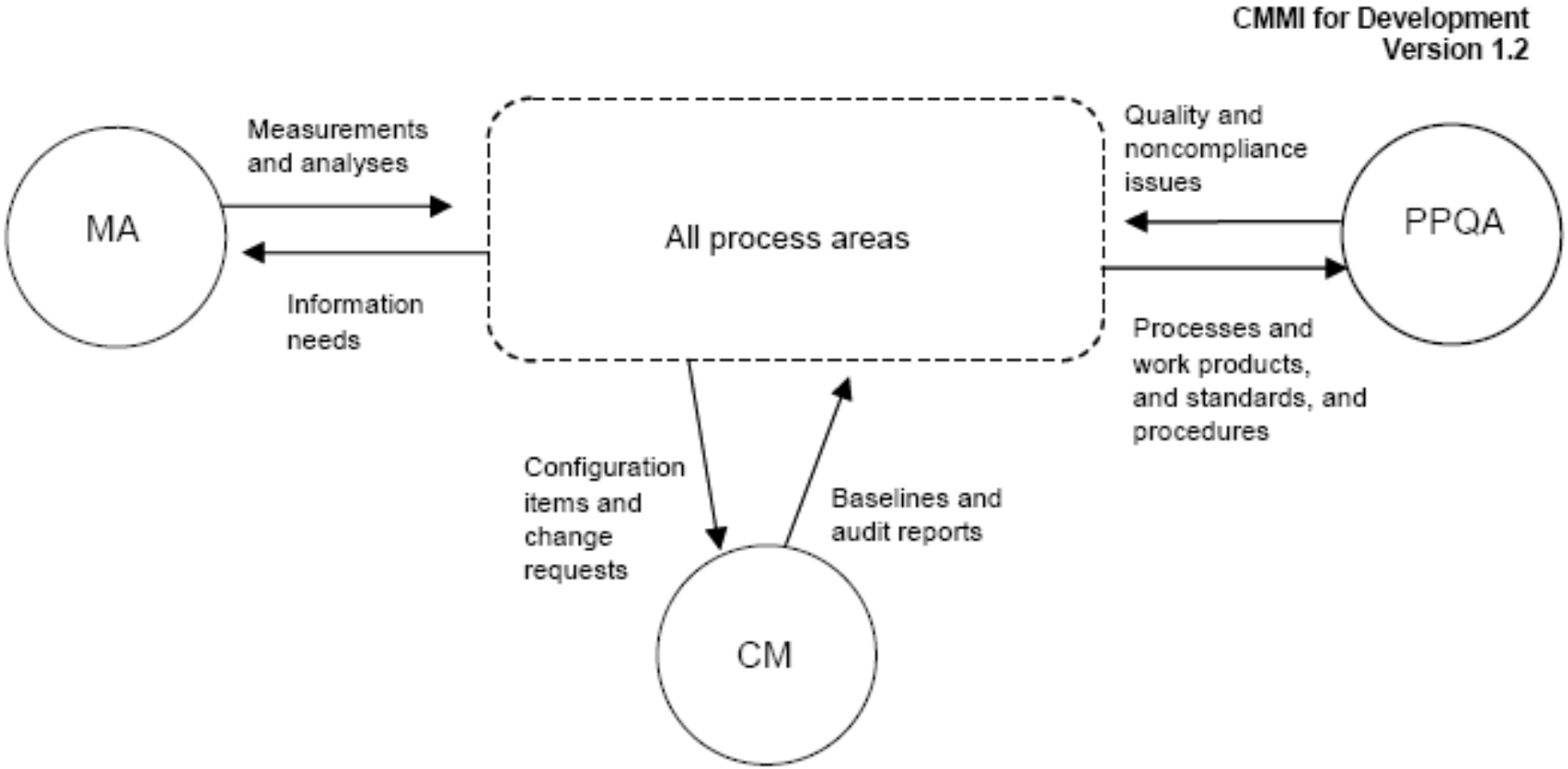
1. Completion of milestones for the project planning activities compared to the plan **(estimates versus actuals)**
2. Work completed, effort expended, and funds expended in the project planning activities compared to the plan
3. **Number of revisions to the project plans**
4. Cost, schedule, and effort 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 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)

Summary: How support process areas fit?



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

Remember

A model IS NOT a process.

The model shows WHAT TO DO, NOT HOW TO do it or WHO does it.

Life Cycle Relationships