МУК 2020/2021:
Модели за управление на качеството на софтуера и ИТ услуги
(Увод в подобряване на процесите - PI, CMMI)

Quality Management Models:
Intro to Process Improvement (PI)

PART 3: Maturity Level 2+

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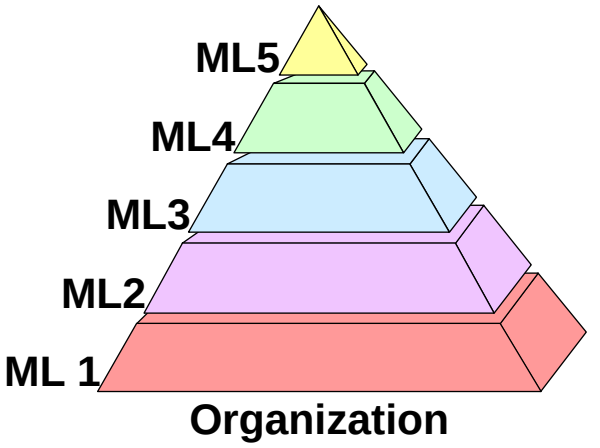
Remember: CMMI Representations

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

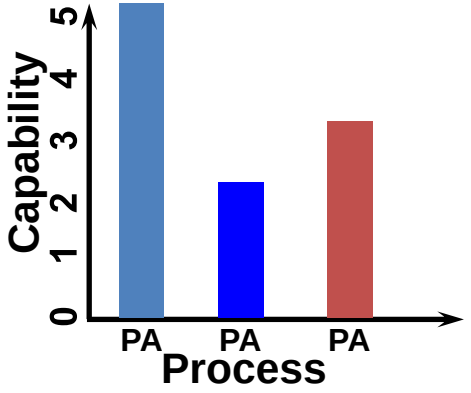
Organizational Innovation & Deployment (OID)
Causal Analysis and Resolution (CAR)

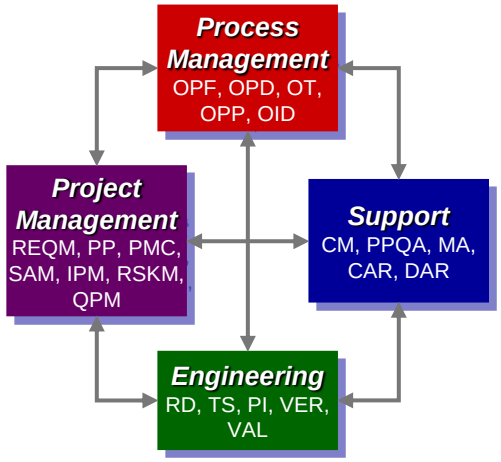
Organizational Process Performance (OPP)
Quantitative Project Management (QPM)

Requirements Development (RD)
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 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)

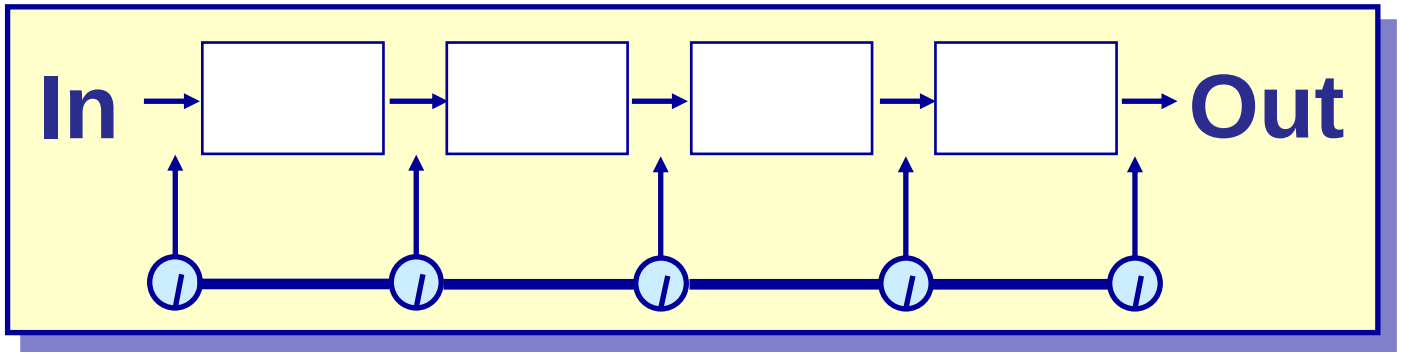
Continuous





Remember:
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)

ML2: Requirements management (REQM)

- **SG1: Manage requirements**

+ ML3: Requirements Development (RD)

- **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

Supplier Agreement Management (SAM)

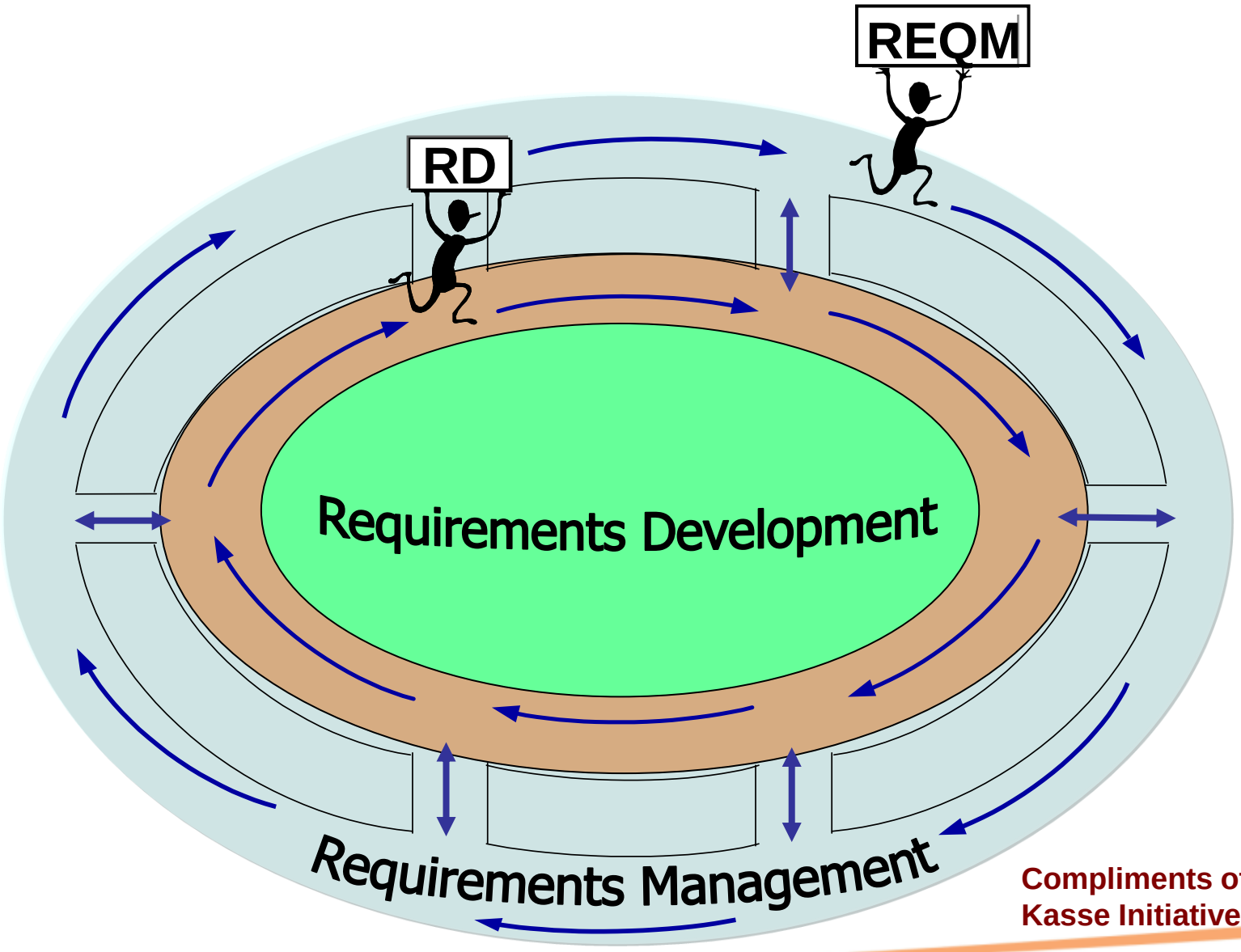
- SG 1: Establish Supplier Agreements
- SG 2: Satisfy Supplier Agreements

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

Requirements Management and Requirements Development



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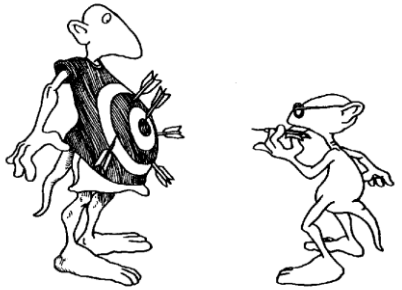
ML3: Requirements Development

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

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

GOALS



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.

Importance of Requirements Development

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

Establish solid **foundation** for downstream activities

Benefits of Proper Requirements Development

Development team and customer share the same vision of what is to be developed, tested and supported

Requirements are easily traceable to/from downstream work products

Acceptance by customer of downstream products is easy & swift

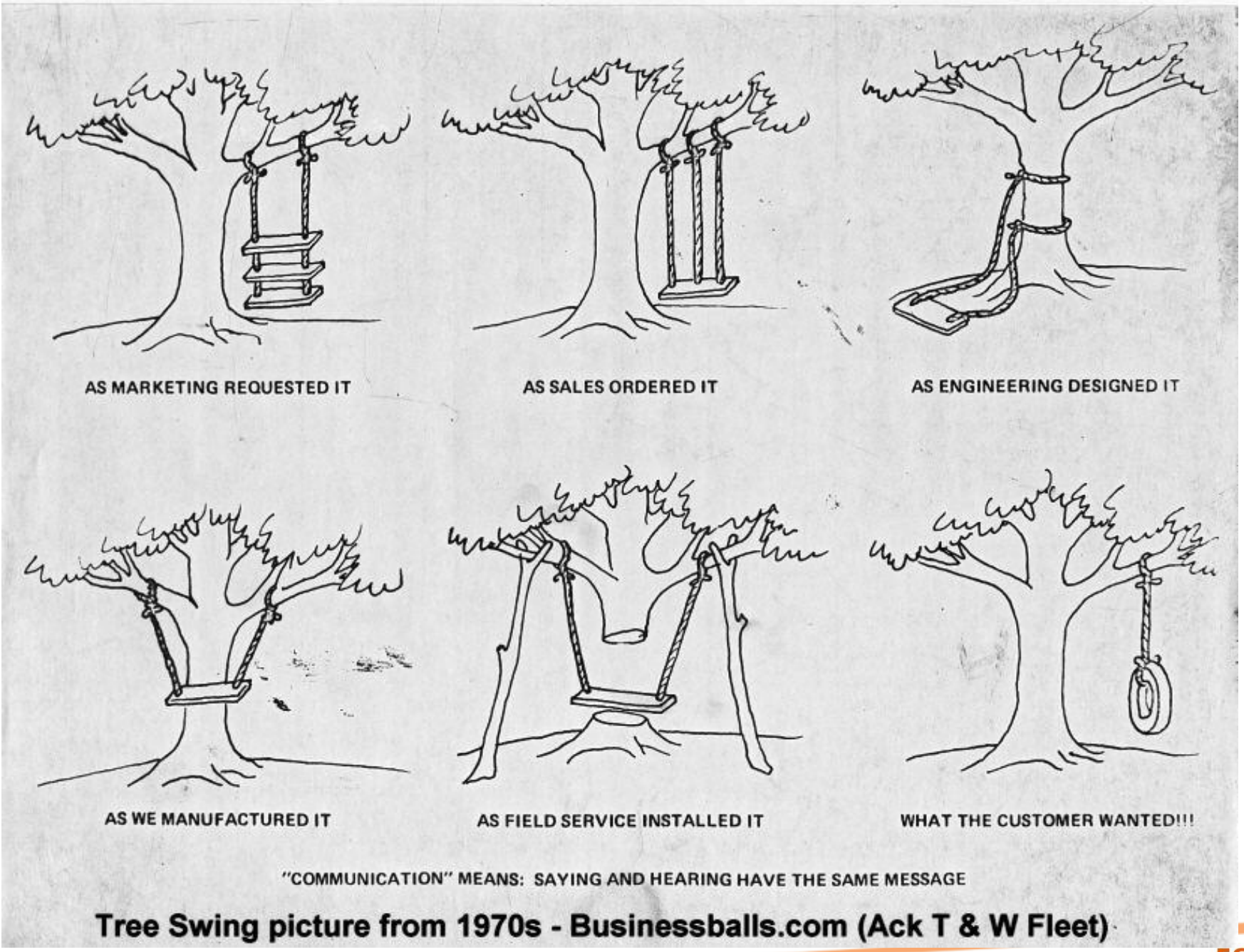
Low risk of increased costs to meet customer needs and expectations

Remember:

Defects - Insertion Pattern & Cost of Removal

	Require-ments	Design	Code	Software Test	System Test	Field Use
Where Defects are Introduced	10%	40%	50%			
Relative Cost to Fix	$1	$1	$1	$6	$12	$100

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


AS MARKETING REQUESTED IT
AS SALES ORDERED IT
AS ENGINEERING DESIGNED IT
AS WE MANUFACTURED IT
AS FIELD SERVICE INSTALLED IT
WHAT THE CUSTOMER WANTED!!!
"COMMUNICATION" MEANS: SAYING AND HEARING HAVE THE SAME MESSAGE
Tree Swing picture from 1970s - Businessballs.com (Ack T & W Fleet)

Terminology

Allocated Requirement - 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. Derived requirements can also arise during analysis and design of components of the product or system. (See also "product requirements.")

Terminology II

Customer Requirement - 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 - 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.

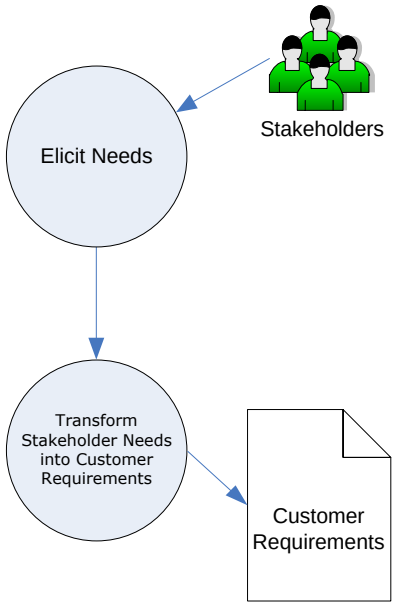
SG 1 Develop Customer Requirements

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

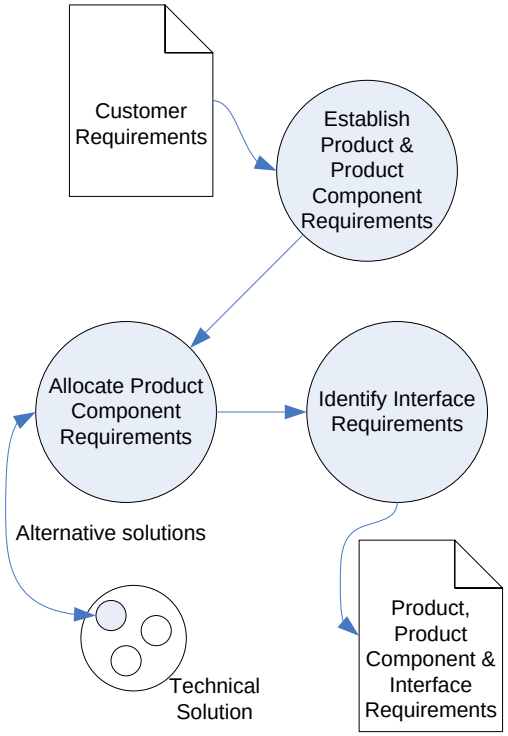
Establish and maintain product and product component requirements, which are based on the customer requirements.

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

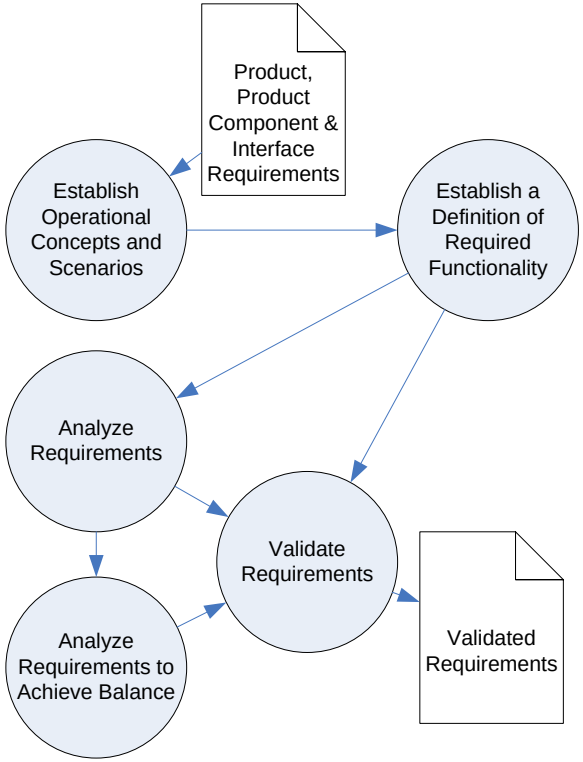
Analyze requirements to ensure that they are necessary and sufficient.

SP 3.4 Analyze Requirements to Achieve Balance

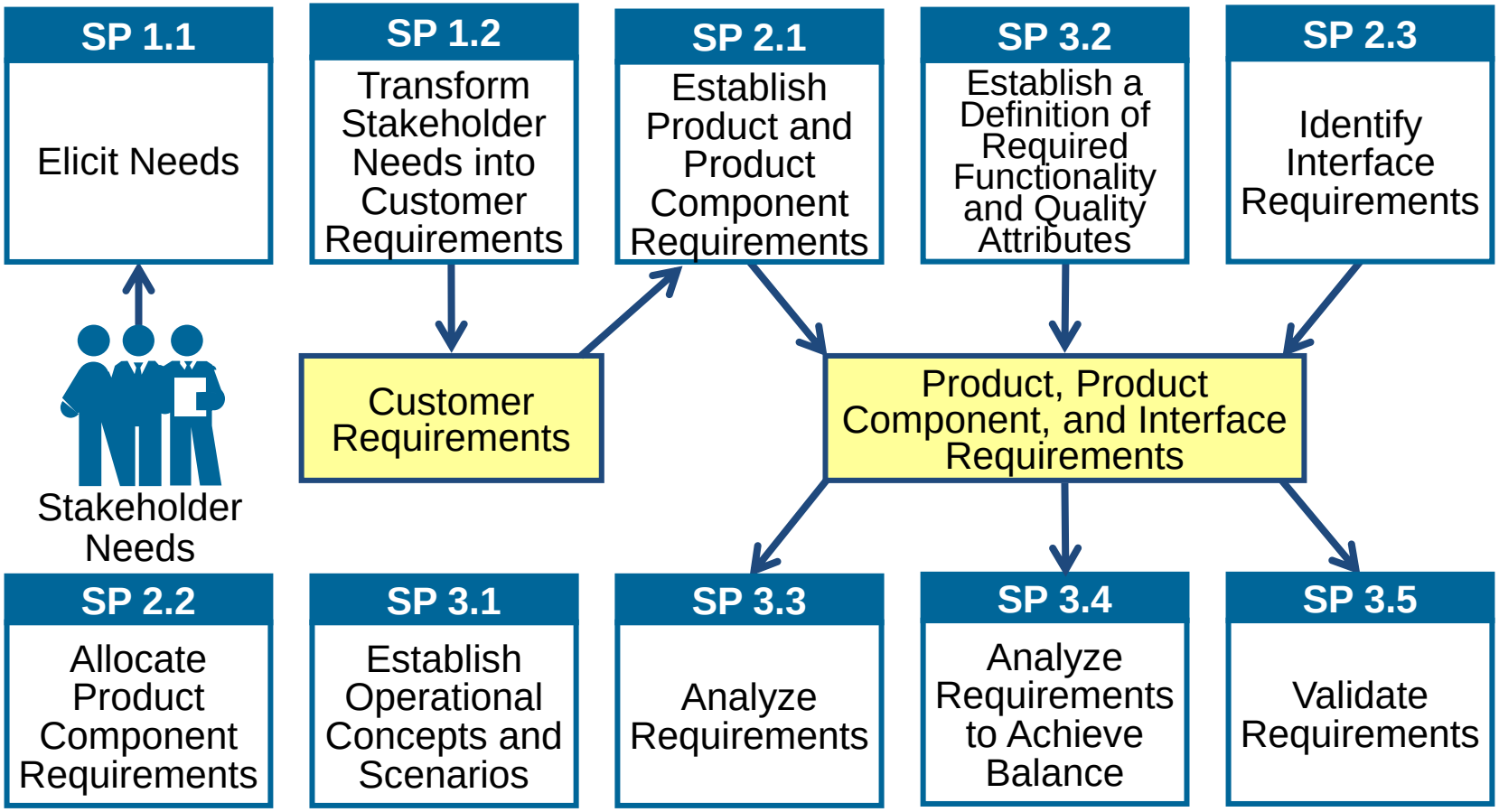
Analyze requirements to balance stakeholder needs and constraints.

SP 3.5 Validate Requirements

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



Requirements Development
Sampling of Work Products

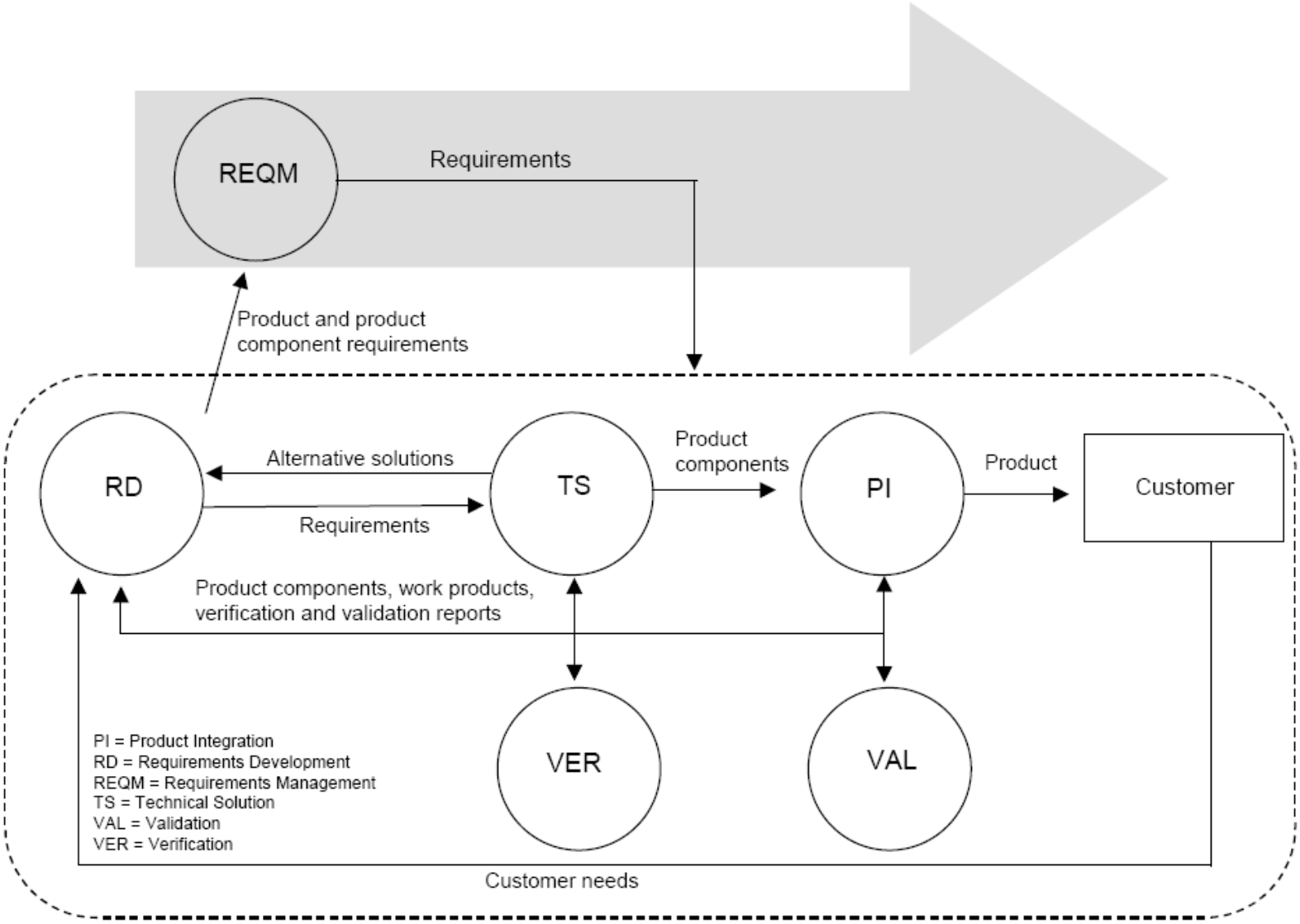


How Requirements Development interacts with other Process Areas

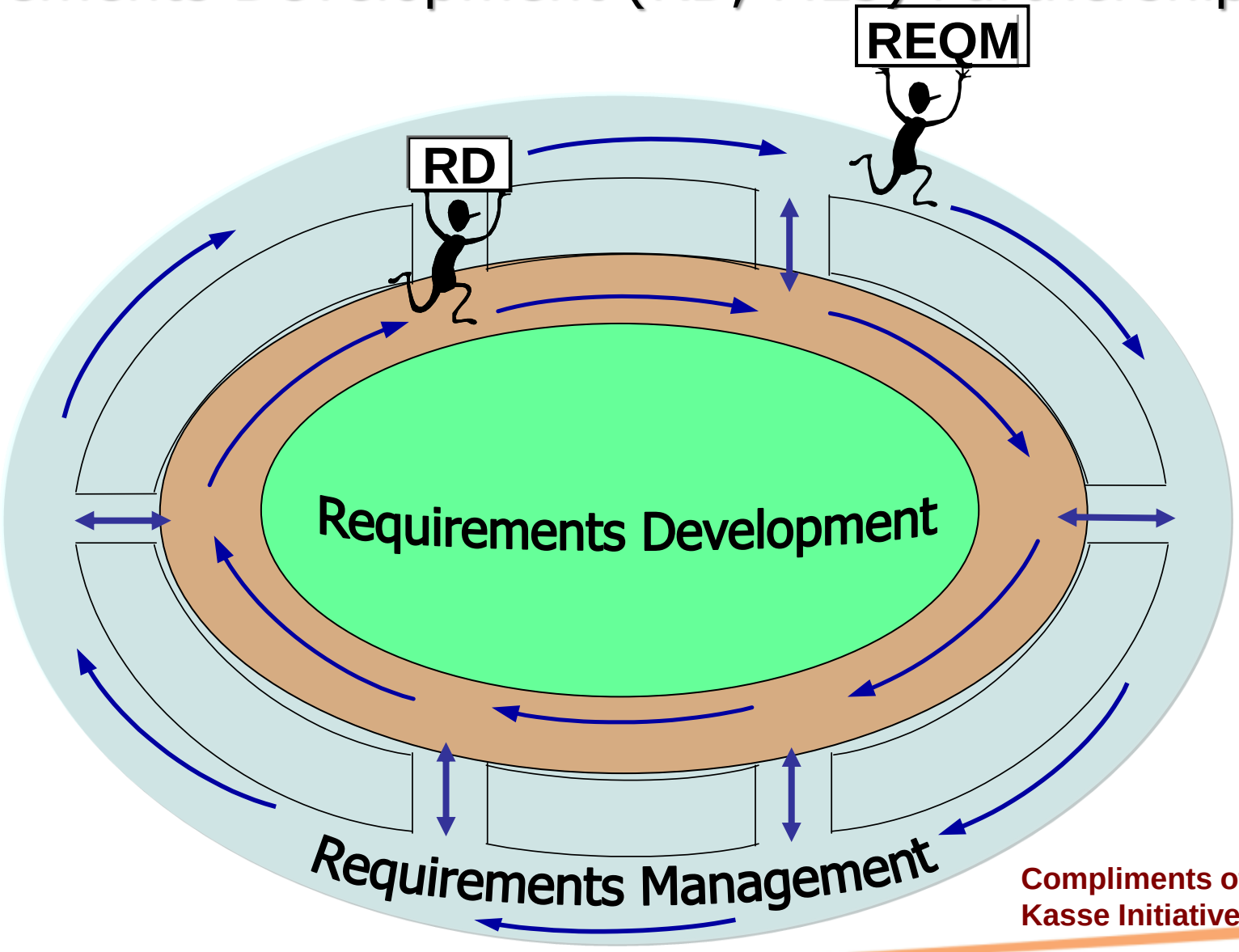
- Who does RD depend upon?
  - Requirements Management (ML2:REQM) for managing requirements
  - Technical Solution (ML3:TS) for development of alternative solutions and identification of product components
  - Risk Management (ML3:RSKM) for identification and management of requirements risks
- Who depends on RD?
  - Requirements Management (ML2:REQM) takes requirements from RD
  - Product Integration (ML3:PI) takes interface requirements
  - Verification & Validation (ML3: VER & VAL)

Where Requirements Development stands in the model?

- **Maturity level 3**
- **Engineering** process area



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



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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

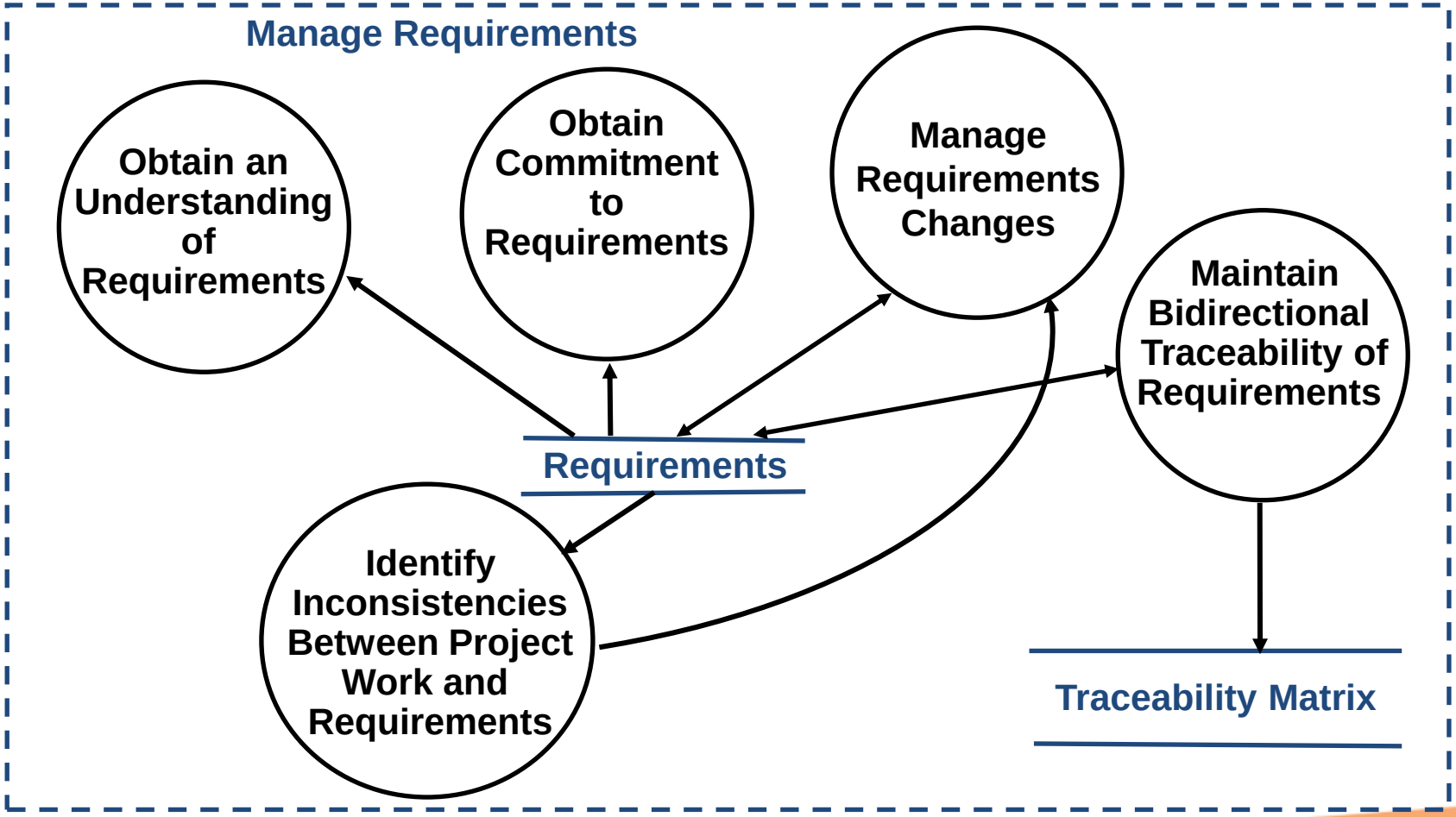
SP 1.2 Obtain **Commitment** to Requirements

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 - 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 2.5: 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**

Remember:
Why do we need bidirectional traceability???

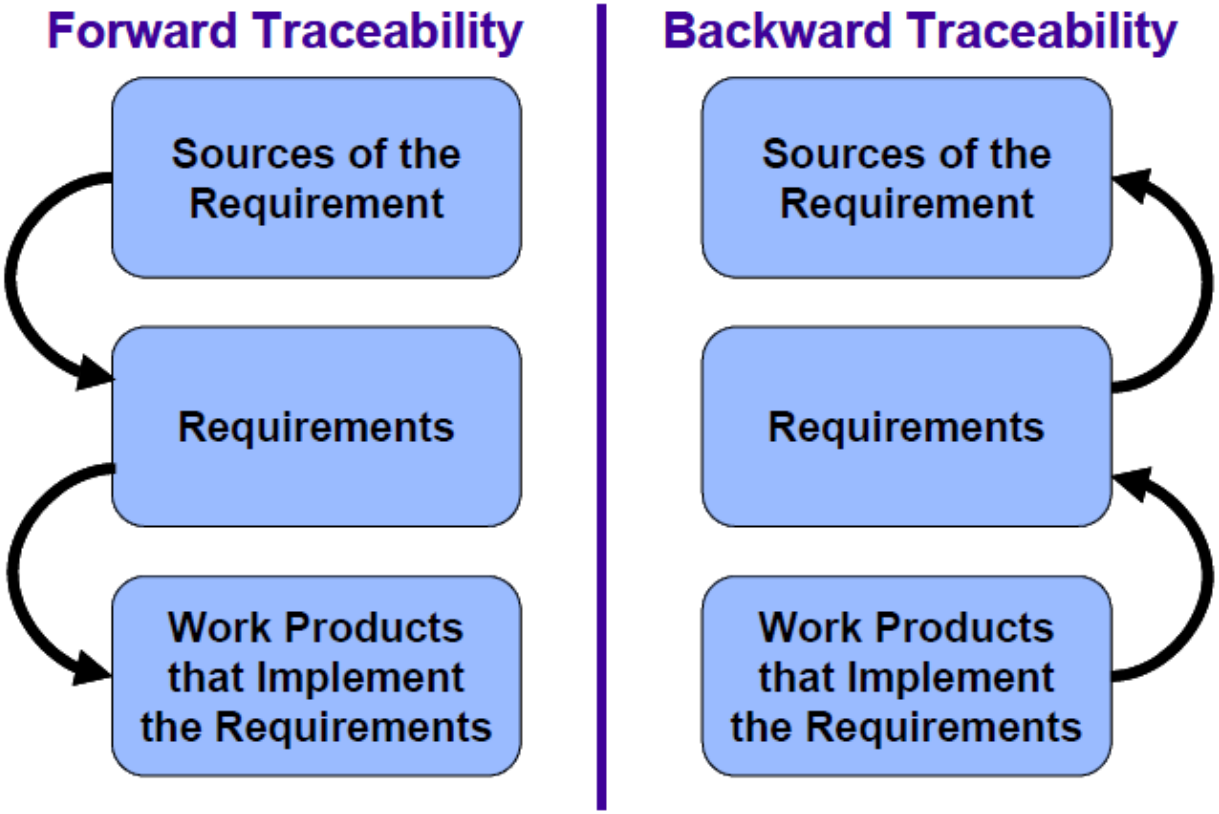


Figure 1: Bidirectional (Forward & Backward) Traceability

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)

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 2.10: 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**.

CMMI V2.0 [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

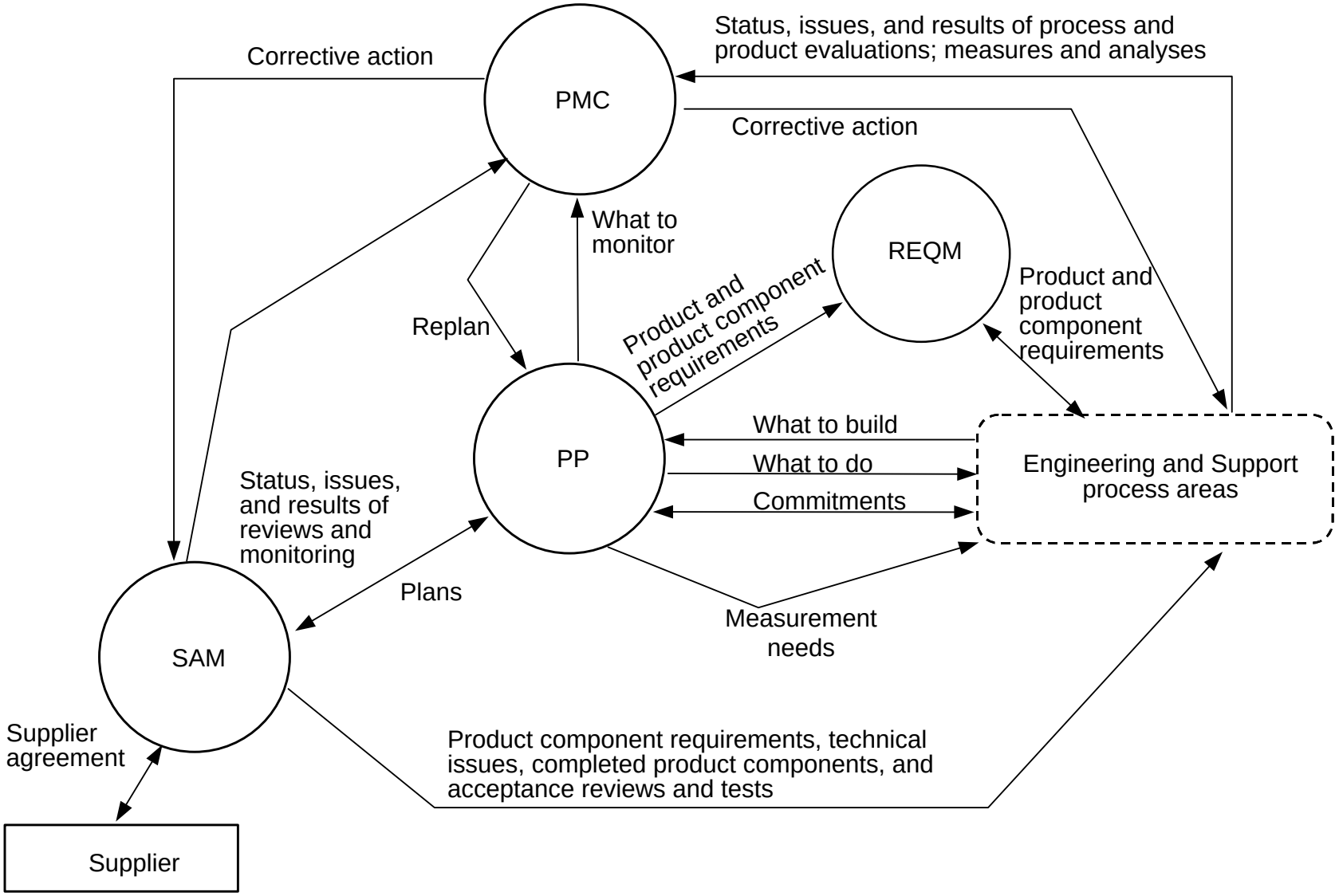
- RDM 1.1 Record requirements

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)



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.

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/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?