Carnegie Mellon
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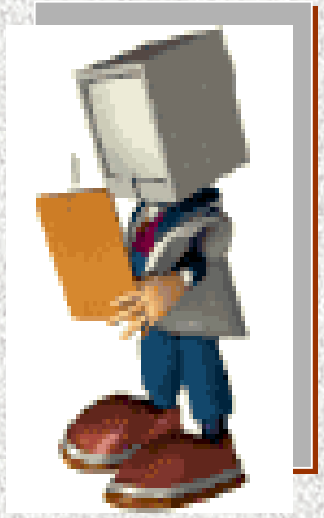
Why Isn't Someone Coding Yet (WISCY)?



Avoiding Ineffective Requirements

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Presented at the SEPG, May 2004, in Orlando, Florida

Agenda

- Requirements and Their Impacts
- Basic Requirements Definitions
- Comparison to Capability Maturity Model Integration® (CMMI®) Designations
- Requirements Development and Management

Didn't We Solve the Requirements Problem?[1]

- Sample of approximately 428 CMM-Based Assessments for Internal Process Improvement (CBA-IPI)
- Analyzed data from 1997 through August 2001
- Of the assessments conducted, only 33 percent fully satisfied the Requirements Management KPA

[Crosstalk, April 2002]

Didn't We Solve the Requirements Problem?[2]

"[Disciplines for **performance-based contracting** to be successful] start with requirements definitions, and that takes a skill set.. . . . It's a very difficult process to get a good set of requirements. There are not a ton of folks who are really good at that and you have to apply that very early in the process. **That is the first discipline**."

--Ed Meagher, Acting CIO, Veteran's Administration

[Government Computer News, 2003]

Requirements and Their Impact

As Requirements Go, So Goes the Project

What is a Requirement?

- **Standard Definition**
  - Something that the product must do or a quality that the product must have
- **More Ways to Characterize**
  - Something you discover BEFORE YOU START TO BUILD YOUR PRODUCT

    --Robertson and Robertson *(1999)*
  - Agreement reached between the customer and the developers on what the system will do

Requirements: A Project Foundation[1]

- **Quality Foundation**
  - **The greatest control on software quality can be exercised during requirements phases.**

  [Stevens, 1999]

  - ***"Quality is conformance to requirements"***

  [Philip Crosby, 2000]

  - ***"Quality is conformance to requirements. Everything else is bull...."***

  [Forsha, 1992]

Requirements: A Project Foundation²

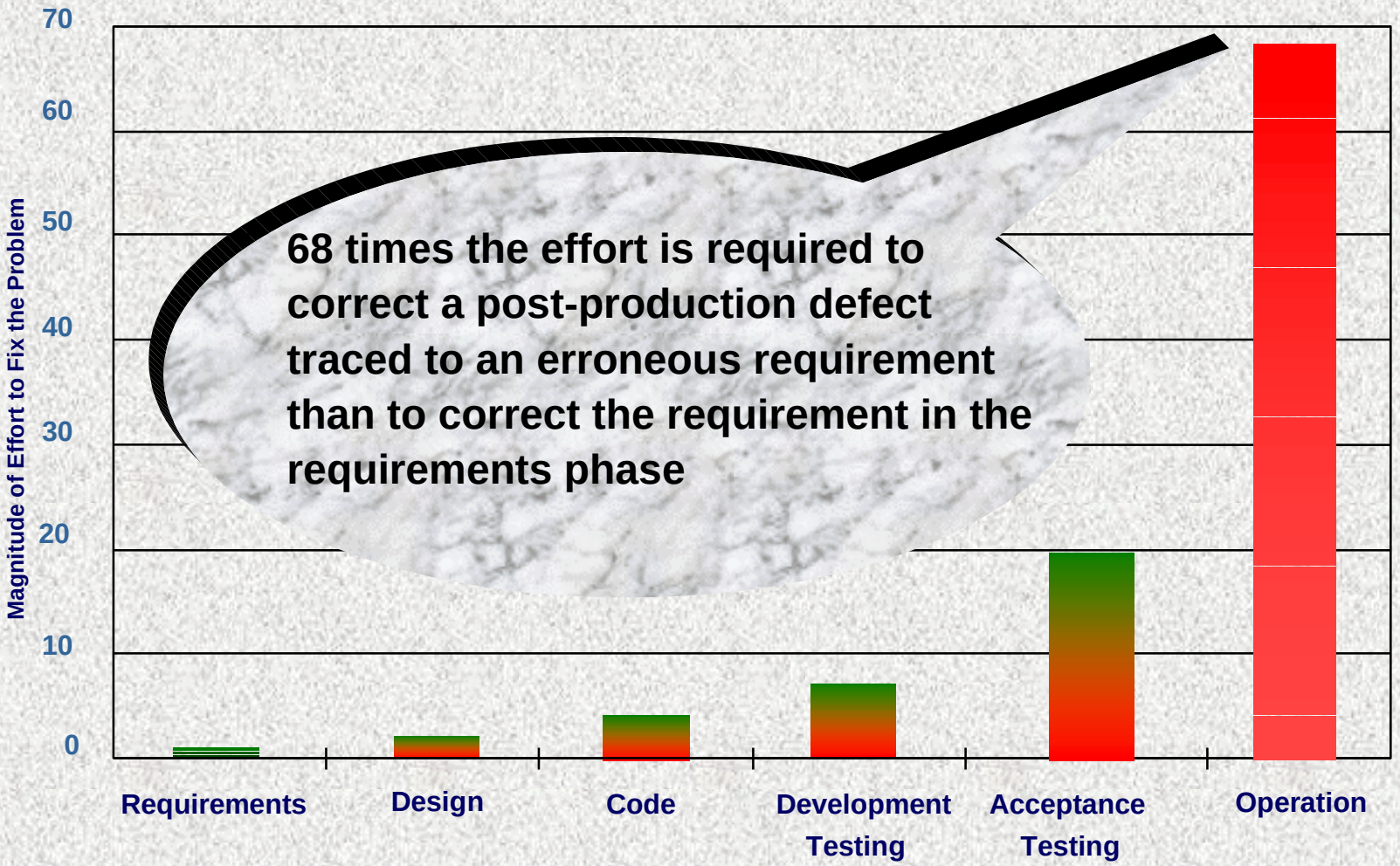
- Planning Foundation
  - Clear and concise communication to all the team members
  - Alive and active throughout the lifecycle
  - Solution must reflect requirements
- ROI Foundation
  - BASIS FOR EFFORT ESTIMATES and thus cost and profit

Size of the Problem

- 40 – 60% of errors in systems have been traced back to the requirements and analysis phase
- 70 – 85% of total revisions can be attributed to requirements errors

[Leffingwell, 1997]

Doing It Over . . .



[Boehm, 1981]

Requirements Development

Traditional Requirements Categories

- Business
- User
- Functional
- Non-functional

Requirement Type - Business

Meaning:

- What the organization hopes to achieve
- The business benefits that the product will offer

Eliciting the Business Requirements:

- How will this project (product) improve the business or organization?
- What will you be able to do that you cannot do now?

Requirement Type - User

Meaning

- What the user requires to complete tasks
- Business rules, data representation requirements, logical models, and acceptance criteria that user will employ

Eliciting the User Requirement

- Tasks that need to be accomplished?
- Required business rules?
- Deciding if the new system/product is working?

Requirement Type - Functional

Meaning

- What software system should do
- What it does to have effect on outside domain

Documenting the Functional Requirement

Functional Requirement FR#
Priority: ***(Select High if must have, Medium if Important but not Critical, Low if Nice to Have)***
Description:
Related User Requirements UR#
Input information:
Output information:

Requirement Type – Non-Functional

Meaning

- Standards
- Regulations
- Constraints
- Interfaces
- Quality attributes that affect how the system must perform

Examples

- Enterprise Standards
- Government Regulations
- Platform
- Legacy Interfaces
- Usability
- Performance
- Scalability
- Security
- Flexibility
- Portability

Successful Requirements Development

- Place high emphasis on requirements -
  - *About 15% of the project life should be spent on requirements development activities before any final deliverable is built.*

    [Rubin, 1999]
- Use a variety of methods for obtaining requirements
  - Unstructured interviews –no particular format
  - Structured interviews – specific questions and format
  - Observation – view and record user actions
  - Brainstorming – facilitated or non-facilitated group elicitation
- Devise a consistent method for describing requirements

Elements of a Good Requirement

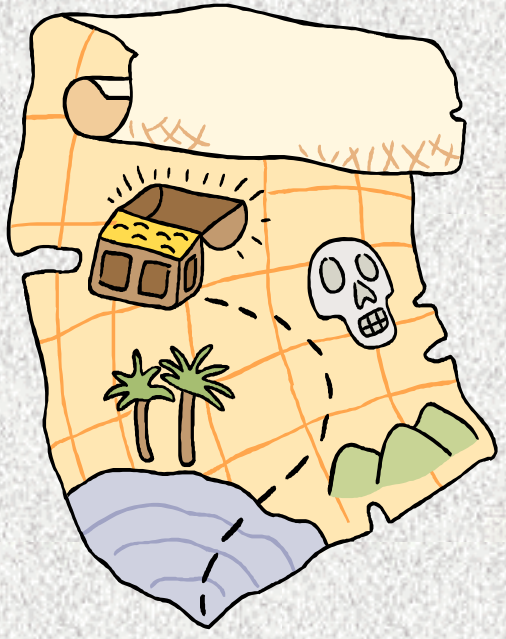
- Necessary
- Verifiable
- Feasible
- Clear and concise
- Complete
- Consistent
- Traceable
- No implementation bias

[Kar and Bailey, 1996]

Structure of a Requirement

- Keep sentences and paragraphs short
- Use active voice
- Use complete sentences with proper grammar, spelling and punctuation
- Use consistent wording
- Reduce ambiguity by avoiding vague and subjective terms
- Avoid comparative words and ambiguous language; quantify statement

Comparison to Capability Maturity Model Integration® (CMMI®) Designations



Model Overview[1]

- Capability Maturity Model (CMM®)
  - Philosophy that quality processes enable quality products
  - Essential elements of effective processes for one or more bodies of knowledge
  - First CMM released in 1991 and targeted Software Engineering (SW-CMM)
  - Other discipline-specific CMMs created, e.g:
    - Systems Engineering
    - Integrated Product and Process Development
    - Supplier Sourcing
    - Others . . .

Model Overview[2]

- Issues with multiple models
  - Hampered ability to focus improvements where multiple disciplines present
  - More costly in terms of training, appraisals, and improvement activities when applied within an organization
- Solution
  - An integration of three source models
  - Addresses multiple disciplines
  - Integrates training, appraisal support, and improvement activities

Model Overview[3]

- Capability Maturity Model Integration® (CMMI®)
  - Cohesive set of integrated models for organizations already using other CMMs, as well as by those new to the CMM concept
  - Consistent and compatible with the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 15504 Technical Report for Software Process Assessment
  - More information at http://www.sei.cmu.edu/cmmi/

CMMI® and Requirements[1]

- Two principal process areas (PA)
  - Maturity Level 2 – Requirements Management
  - Maturity Level 3 - Requirements Development
- New Purpose of Requirements Development PA - produce and analyze:
  - Customer requirements
  - Product requirements
  - Product-component requirements
  - Derived requirements

CMMI and Requirements^2

- **Customer requirements**
  - An understanding of what will satisfy stakeholders
  - Transformed stakeholder needs, expectations, constraints, and interfaces
  - May be stated in technical or non-technical terms
  - May also provide specific design requirements

CMMI and Requirements[3]

- Product requirements – a work product delivered to the customer
  - More detailed and precise sets of requirements
  - Expressed in technical terms or parameters
    - Functionality, including actions, sequence, inputs, and outputs
    - Qualities it must possess
    - Constraints that the system and its development must satisfy

[CMMI, Software Engineering Institute, 2003]

CMMI and Requirements[4]

- **Product-component requirements – lower level components of the product**
  - **Example - a car engine and a piston are product components of a car (the product)**
  - **Allocated from product requirements**
  - **Complete specification, including fit, form, function, performance, and any other requirement**
  - **Sufficiently technical for use in the design of the product component**

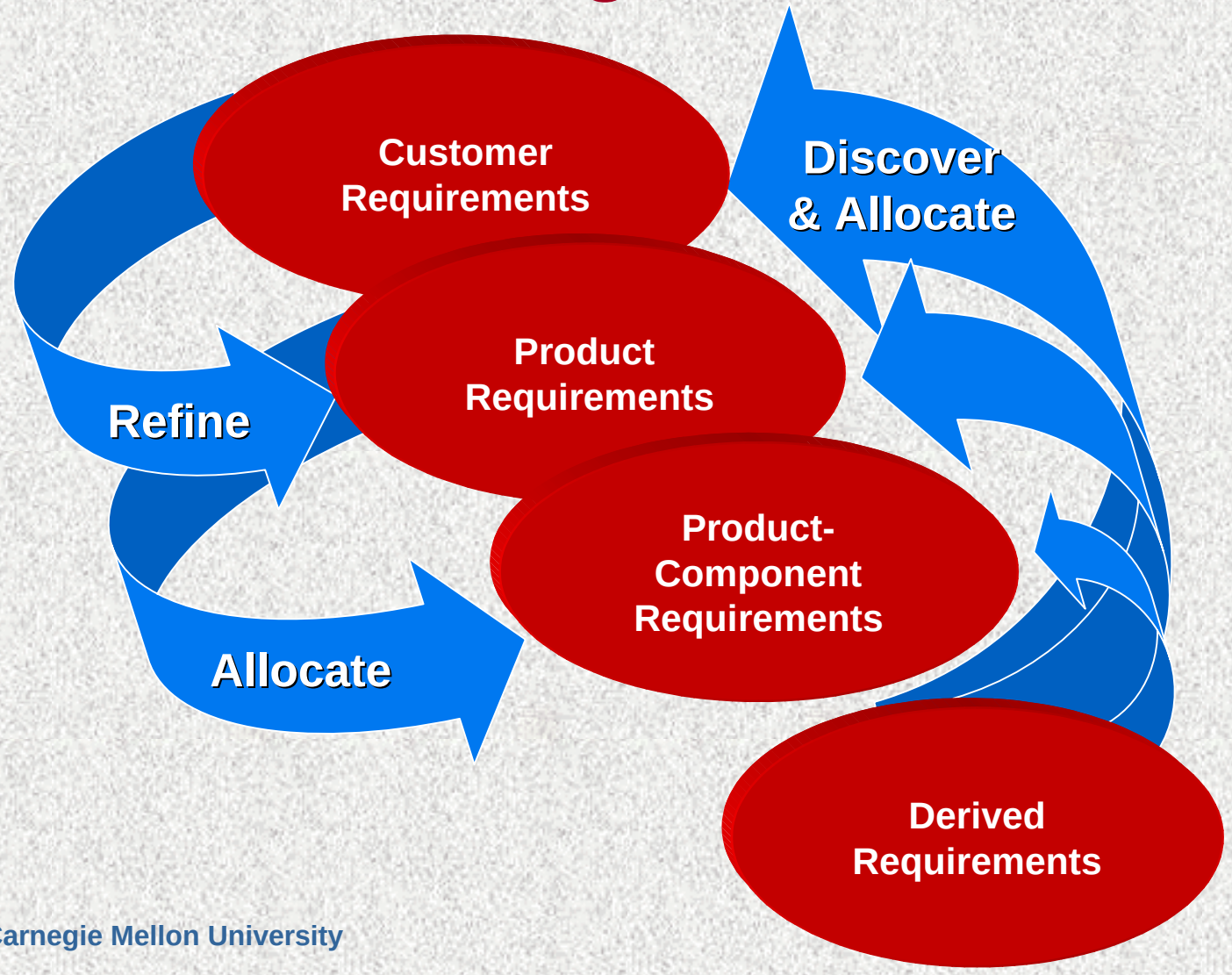
CMMI and Requirements[5]

- Derived requirements – discovered and/or implied
  - Not explicitly stated but inferred from:
    - Customer requirements
    - Contextual requirements (e.g., applicable standards, laws, policies, common practices, and management decisions)
    - Contractual commitments such as data rights for delivered commercial off-the-shelf (COTS), and non-developmental items (NDIs); terms and condition, delivery dates, and milestones with exit criteria

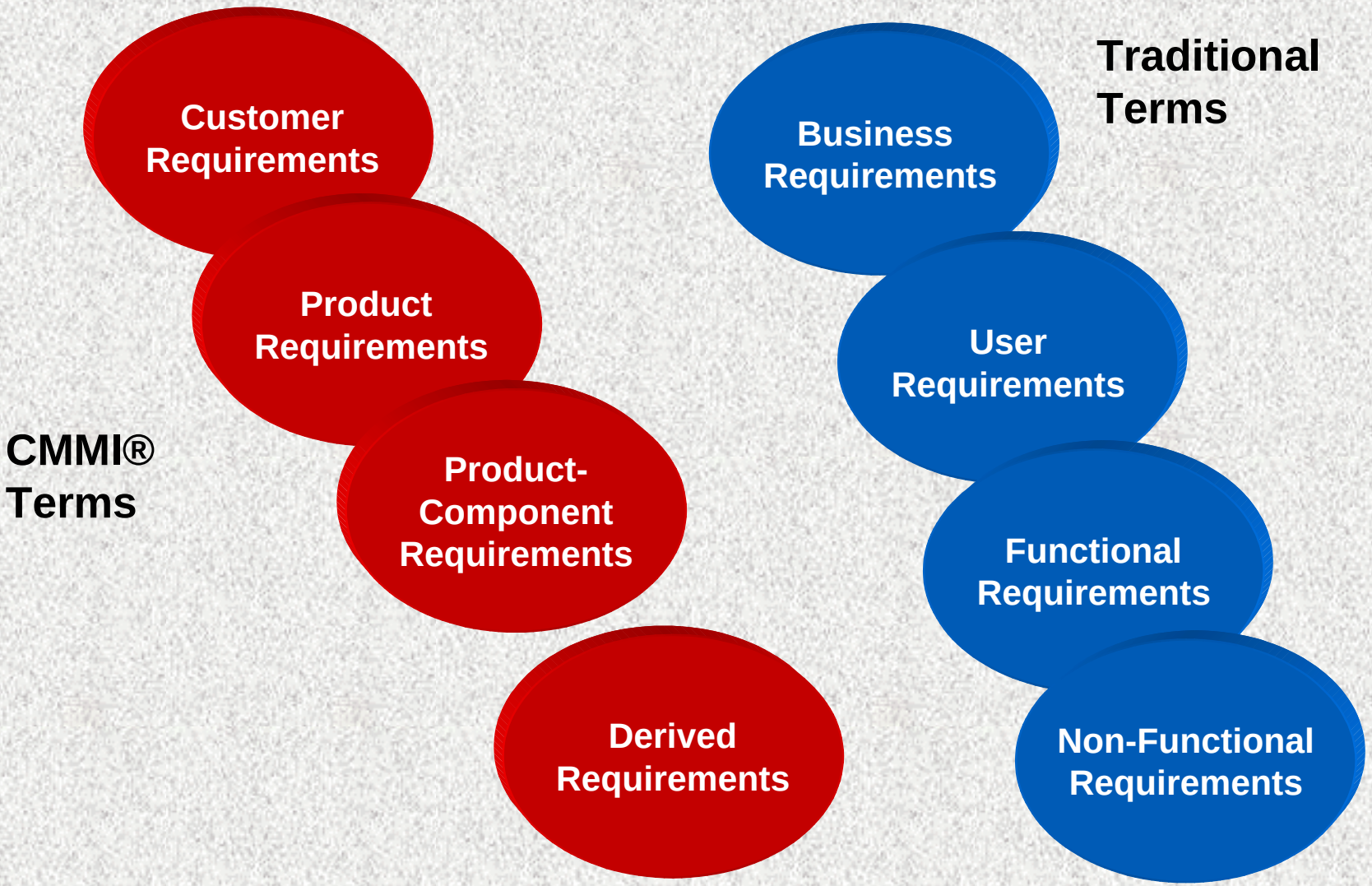
CMMI and Requirements[6]

- Derived requirements (cont.)
  - Factors arise as part of:
    - Selected architecture
    - Design decisions
    - Developer's unique business considerations
  - May also address the cost and performance of other life-cycle phases and other non-technical requirements
    - Training requirements
    - Site requirements
    - Deployment schedules

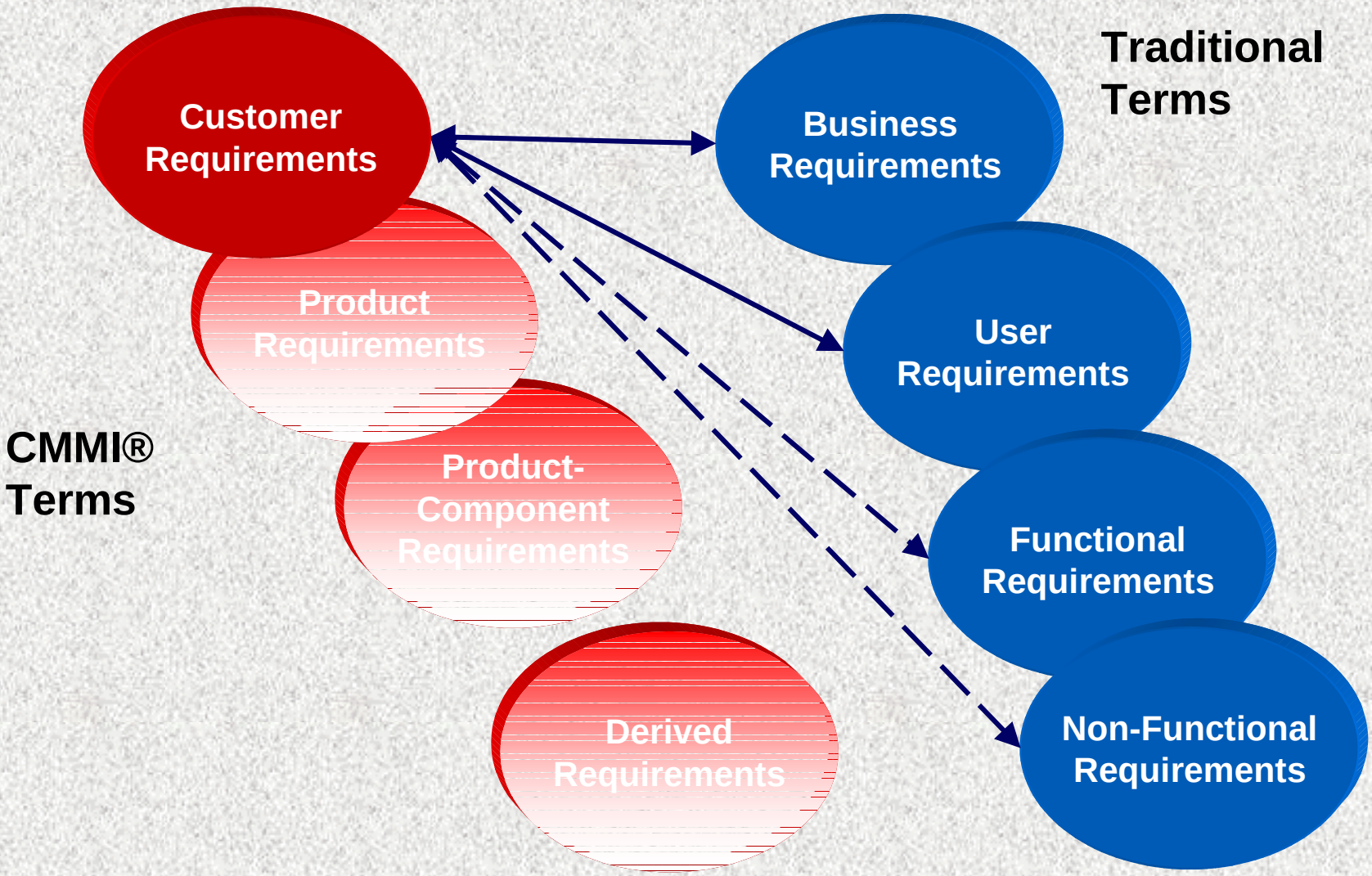
Relating CMMI Requirements Categories



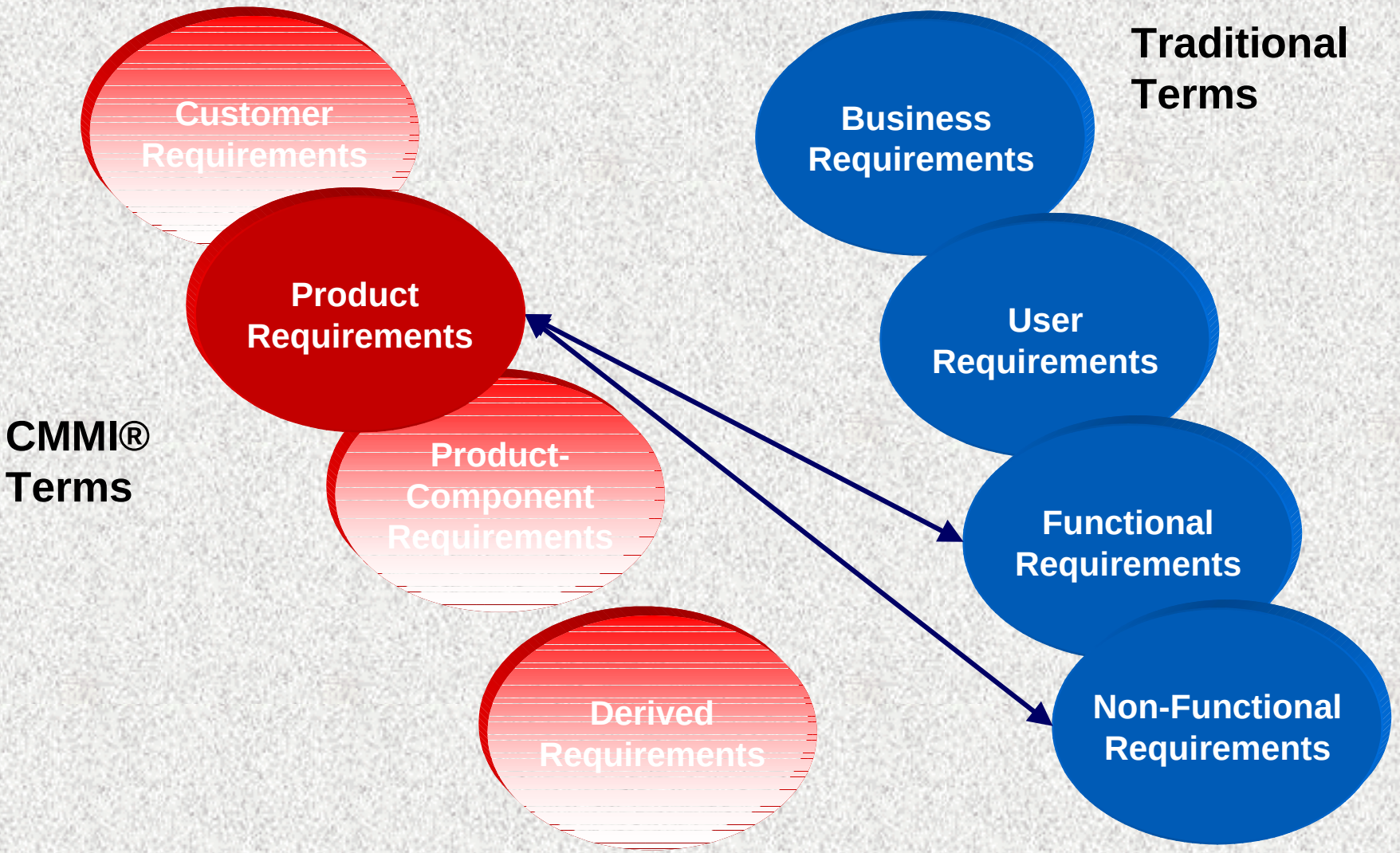
Relating Two Schemas - 1



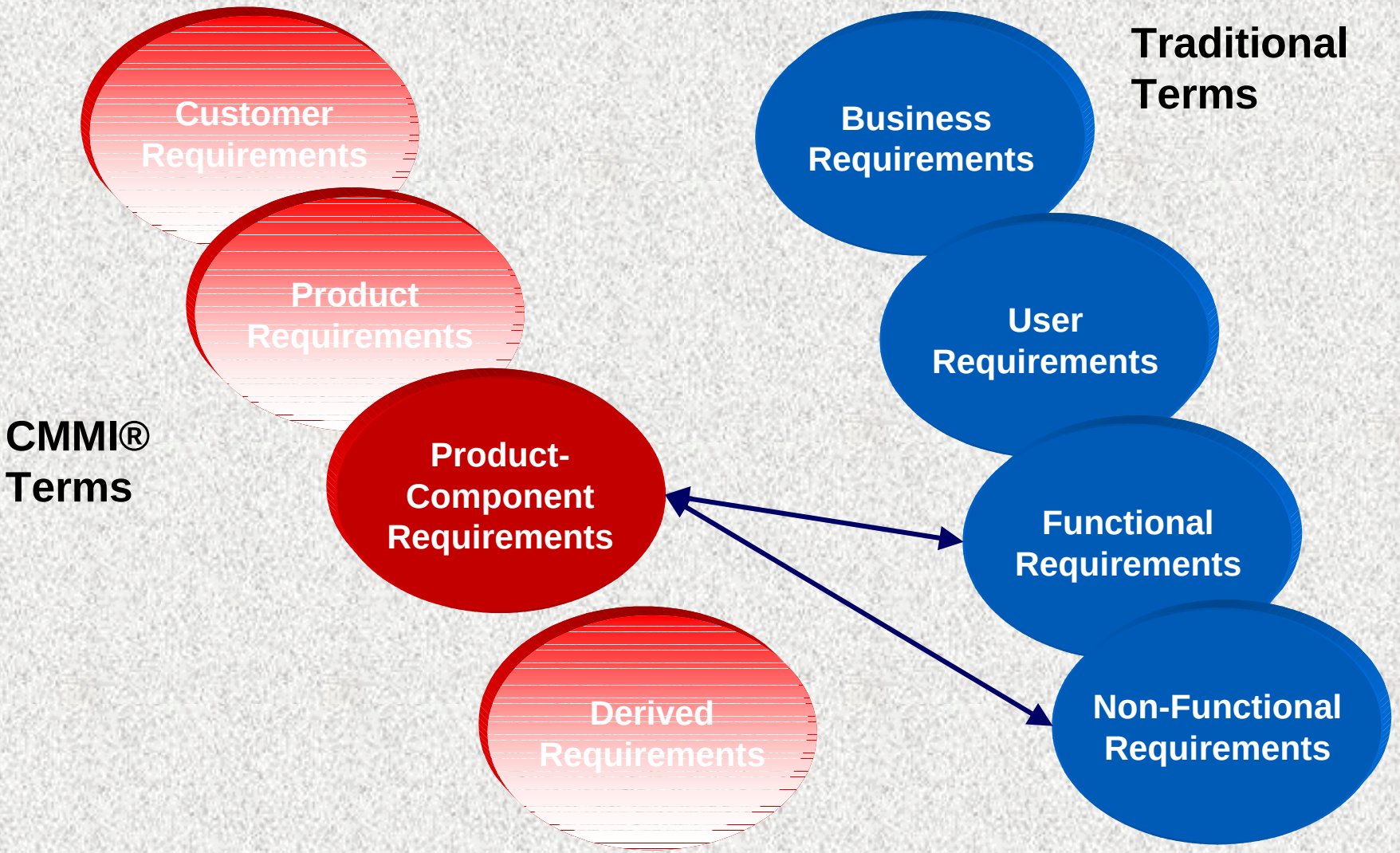
Relating Two Schemas - 2



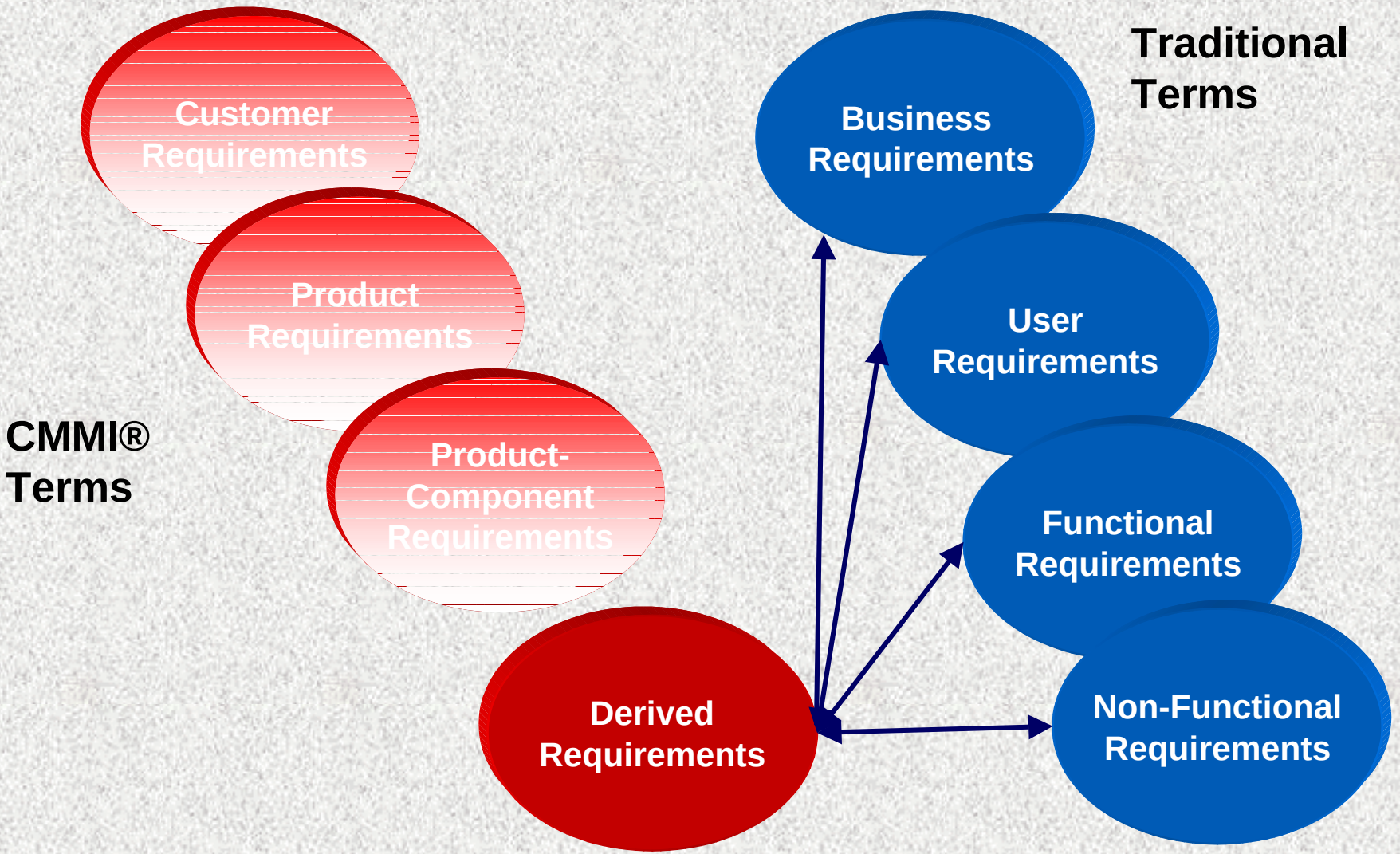
Relating Two Schemas - 3



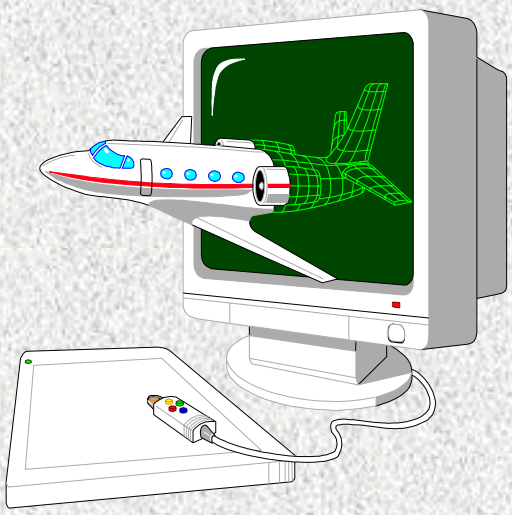
Relating Two Schemas - 4



Relating Two Schemas - 5



Implementing Requirements Management



Requirements Management Processes[1]

- Change Control
- Version Control
- Requirements Tracing
- Requirements Status
- Requirements Measures

Requirements Management Processes[2]

- Change Control Processes – controlling and authorizing changes
  - Documentation and baseline of requirements
  - Submission and documentation of changes
  - Impact analysis and negotiation with stakeholders
  - Change Control Board Infrastructure
  - Update and recording of disposition of change request

Requirements Management Processes[3]

- Version Control Processes – ensuring correct version availability
  - Configuration management of requirements repository
  - Version maintenance and history throughout iterations
  - Designated read, write, delete and update permissions
  - Check In-Check out capability
  - Labeling and annotation schemas

Requirements Management Processes[4]

- Requirements Tracing Processes – forward and backward requirements audit trail
  - Bidirectional linking to system elements
  - Capture of allocation rationale, accountability, and test/validation
  - Identification of inconsistencies
  - Capabilities to view/trace links
  - Verification of requirements
  - History of requirements changes

[Kean, 1998]

Requirements Management Processes[5]

- Requirements Status Processes – status of activity on requirements
  - Categories for status, e.g., proposed, approved, implemented, verified, deleted, and/or rejected
  - Methods of tracking
  - Escalation standards

Requirements Management Processes[6]

- Requirements Measures – metrics for requirements activities and status
  - Requirements change requests – status, number, age
  - Number of requirements in a particular status category
  - Time spent on traceability and other requirements activities

[Weigers, 2001]

Requirements Management Tools

- **Database-centric**
  - Store all requirements, attributes, and traceability information in database
  - Examples are Caliber-RM, DOORS/ERS, RTM Workshop
- **Document-centric**
  - Treats word processing document as primary requirements container
  - May provide link to database or allow user to identify text as requirement
  - Examples are Requireit and RequisitePro

Managing Customer Expectations

A Bill of Rights and a Bill of Responsibilities

Origin and Importance

- Developed by Karl E. Weigers for his book, Software Requirements
- Delineates what customer should expect from project team
- Clarifies what customer needs to commit to providing to project team

Customer Bill of Rights

- Expect analysts to speak your language.
- Expect analysts to learn about your business and your objectives.
- Expect analysts to structure the information you present during requirements capture into a written software requirement specification.
- Have developers explain all work products created from the requirements process.
- Expect developers to treat you with respect and to maintain a collaborative and professional attitude throughout your interactions.
- Have developers provide you with ideas and alternatives both for your requirements and for implementation of the product.
- Describe characteristics of the product that will make it easy and enjoyable to use.
- Be presented with opportunities to adjust your requirements to permit reuse of existing software components.
- Be given good-faith estimates of cost, impacts, and trade-offs when you request a change in the requirements.
- Receive a system that meets your functional and quality needs, to the extent that those needs have been communicated to the developers and agreed upon.

Customer Bill of Responsibilities

- Educate analysts about your business and define business jargon.
- Spend the time it takes to provide requirements, clarify them, and iteratively flesh them out.
- Be specific and precise when providing input about the system's requirements.
- Make timely decisions about requirements when requested to do so.
- Respect a developer's assessment of the cost and feasibility of requirements.
- Set priorities for individual requirements, system features, or use cases
- Review requirements documents and prototypes.
- Communicate changes to the project requirements as soon as you know about them.
- Follow the development organization's defined process for requesting requirements changes.
- Respect the processes the developers use for requirements engineering.

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