

Requirements Development and Requirements Management.
CMMI Engineering Process Areas

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Legend:

RM: Requirements Management

RD: Requirements Development

Difference in objectives of RM and RD:

The purpose of RM is to “**manage**” the requirements of the project's products and product components whereas that of *RD* is to “**produce**” customer, product, and product component requirements. RM **identifies** inconsistencies between requirements and project's plans/work products, whereas *RD* **analyzes** the customer, product and product component requirements.

RM and RD stakeholders:

RM and RD stakeholders are customers, end users, developers, producers, testers, suppliers, marketers, maintainers, disposal personnel, and others who may be affected by, or may affect, the product/process.

Difference in Base and Advance practices.

RM does not have advance practices built on the base practices, *but RD has 2 cases.*

- A. *In RD,SP1.1-1(base practice) we have “collect stakeholder needs” and in RD 1.1-2,(advance practice built on base practice),we have “elicit needs” which is relatively more proactive. Thus RD 1.1-2 is included in the staged model and **it** subsumes RD.SP1.1-1(base practice)*

Elaboration:

Requirements Elicitation includes:

1. *Problems Of Scope.*
2. *Problems of understanding.*
3. *Problems of volatility.*

System engineers must approach the RD gathering activity in an organized manner like:

1. *Assess the business and technical feasibility for the proposed system.*
2. *Identify people who can specify requirements and understand their Organizational basis.*
3. *Define the technical environment (e.g., computing architecture, operating System, telecommunications needs) into which the system or product will be placed.*
4. *Identify "domain constraints" (i.e., characteristics of the business environment) that limit the functionality or performance of the system or product to be built.*

5. *Define one or more requirement elicitation methods (e.g., interviews, focus groups, and team meetings).*
6. *Solicit participation from many people so that requirements are defined from different points of view; be sure to identify the rationale for each requirement that is recorded.*
7. *Identify ambiguous requirements as candidates for prototyping for functional, behavioral and performance modeling.*
8. *Create usage scenarios to help customers/users better identify key requirements.*

B. *In RD,SP3.5-1 (base practice) we have “validate requirements” and in RD 3.5-2,(advance practice built on base practice),we have “validate requirements with comprehensive methods” which is relatively more detail.Thus RD 3.5-2 is included in the staged model and it subsumes RD.SP3.5-1(base practice)*

Elaboration:

The work products produced as a consequence of RD are validated to ensure that all system requirements have been stated unambiguously; that inconsistencies, omissions, and errors have been detected and corrected; and that the work products conform to the standards established for the process, the project, and the product. Following checklist can be useful.

1. *Is the requirement bounded in quantitative terms?*
2. *Is the requirement testable? If so, can we specify tests validation criterion?*
3. *Have requirements associated with system performance, behavior, and operational characteristics been clearly stated? What requirements appear to be implicit?*
4. *Are requirements stated clearly? Can they be misinterpreted?*

RM defines process for collecting and defining Customer requirements, Project management requirements and process specific requirements, necessary to be satisfied by the organization. This checklist may help RM activity:

1. Has the final statement of requirements been checked against the original source?
2. What other requirements relate to this requirement? Are they clearly noted via cross-reference matrix or other mechanism? Does the requirement violate any domain constraints?
3. Is the requirement traceable to any system model that has been created?
4. Is the requirement traceable to overall system/product objectives?
5. Is the system specification structured in a way that leads to easy understanding, easy reference, and easy translation into more technical work products?
6. Has an index for the specification been created?
7. Is the source (e.g., a person, a regulation, a document) of the requirement identified?
8. RM ensures reduction of costly rework, or customer rejection by establishing the criteria for the acceptance of requirements to see that requirements are clear, complete, consistent with each other, uniquely identified, implementable, verifiable and traceable.

In RD, requirement analysis is used to understand, define and select the requirements at all levels from competing alternatives. RD normally follows RM in a logical sequence by

Collection and coordination of stakeholder needs and development of the life-cycle requirements of the product. It analyses, validates and communicates customer needs, expectations and constraints to obtain detail satisfaction and acceptance criterion from customer. RD ensures identification and refinement of requirements due to design decisions, planning decisions and subsequent corrective actions in the product's life cycle. The processes of RD will generate product and product-component requirements that will also be managed by the RM processes.

Use cases can help to elicit and express requirements by answering the following:

- 1. What main tasks or functions are performed by the actor?*
- 2. What systems information will the actor acquire, produce or change?*
- 3. Will the actor have to inform the system about changes in the external environment?*
- 4. What information does the actor desire from the system?*
- 5. Does the actor wish to be informed about unexpected changes?*

RM process area expects a common understanding to be developed between the project stakeholders from the customer's side and software development organization. Project related requirements from process areas like RD, technical solutions, Product integration, verification and validation (testing) shall be created when these process areas are enacted. These evolving project and process requirements changes may “**dynamically and often recursively**” affect all other engineering process areas. Functional and non functional requirements review by SME (Subject matter expert) ensures consistency between the RM document, project planning, WBS, work products and products components to ensure smooth implementation of the design and coding activities. RM takes care of managing the requirements developed in the RD stage and subsequent stages of the life cycle by handling requirement changes and sign-offs in an organized manner. As and when RD changes the requirements, RM manages and controls the requirement changes and assesses its impact on other work products and the phases of the life cycle. RM process ensures that requirements are reviewed by an agreed SPOC (Single point of Contact) from the customer, after necessary review on functional, non functional and technical specifications. The requirements are decomposed for clarity and systematically negotiated without keeping any TBD (to be decided) factors. This ensures that misunderstanding, misconception and assumptions in the documents are resolve at an early stage of life cycle. This prevents them to be converted into risk in later phases of the life cycle.

RD achieves the establishment of the customer requirements wrt the life-cycle phases and product attributes (e.g., safety, reliability, maintainability, usability, accuracy etc) as shown below in Barry Boehm's Product Characteristic chart.

Difference table for RM and RD process area:

RM	RD
1.Deals with communication between requirements analysts and customer. RM is customer management oriented.	Deals with communication between PM, domain and functional architect, designer and his team. In object oriented domain, it relates to defining services.
2.RM process defines a clear and explicit understanding of all the project activities executed by the SW development organization. This is also agreed by the customer SPOC, and PM communicates various technical/ non technical aspects of the requirements to his team members.	RD collects stakeholder needs, expectations, constraints, formulating product and product-component requirements, and analyzing and validating them. For customer needs be clearly identified and understood at every stage , an iterative process is used throughout the project life cycle.
3.RM manages the activities emerging out of RD and other PA in the life cycle. Several process activities shall get added to the project plan (eg. Staff training, review requirements, test equipments, interfaces, integration environments, documentation requirements, prototyping needs etc) at various phases of SDLC.	RD proactively elicits customer requirements by the way of technology demonstrations, Interface and technology working groups, project reviews, questionnaires, interviews, brainstorming, simulating operational scenarios and walkthroughs, business case analysis, end-user task analysis, prototypes, models, market surveys, beta testing and reverse engineering.
4.Bi-directional requirements traceability is maintained using matrix format which helps in managing control of requirement changes by using CRL(Change request log) and version control process (configuration management) and its impact on project planning, design, WBS, coding and the testing activities is logged.	Sometimes there are several iterations of refinements in the architecture (product or product components) and thus in the detail design and so on due to variation of: -Design Constraints and Technological limitations, risks, - Cost, effort, time and schedules -Implied needs by the customer and uncontrolled factors introduced by the developer's unique business considerations, regulations, and laws.
5.GP 2.3 RM uses requirements tracking tools, traceability tools and bi-directional matrix to manage requirement changes	GP 2.3 RD uses requirements specification tools, simulators, modeling/ prototyping tools , scenario definition and management tools.
6.GP 2.5 RM training includes: Application domain, Requirements definition, analysis, review ,Configuration management and RM tools, Negotiation and conflict resolution	GP 2.5 Examples of TD training includes : Application domain, Requirements definition, analysis and requirements elicitation, Requirements specification, modeling and tracking
7.GP 2.6 RM deliverables placed under configuration management are requirements and requirements traceability matrix.	GP 2.6 RD deliverables placed under configuration management are customer requirements, functional architecture, product and product-component requirements and Interface requirements.

<p>8.GP 2.9 Work products reviewed include requirements and requirements traceability matrix.</p>	<p>Work products reviewed include product and product-component requirements, Interface requirements and functional architecture.</p>
<p>9. There is 1 goal (5 specific practices with 2 base practices) for RM: a) Manage Requirements</p>	<p>There are 3 goals(10 specific practices) ie a) Develop Customer Requirements b) Develop Product Requirements c) Analyze and Validate Requirements</p>
<p>10. RM does not have any advance practice built on the base practice.</p>	<p>RD has 2 advance practices built on base practices.</p>
<p><u>11. Typical RM work products are:</u></p> <p>For successful RM implementation, we have the following work products.</p> <ol style="list-style-type: none"> 1. Criterion for evaluation and acceptance of requirements with results of analyses against criteria.(SP1.1-1) 2. An agreed to set of documented requirements (complete, consistent, verifiable, traceable, unique and appropriate to implement) with commitments(SP1.1-1) .This can be in a document called URS(User requirements specification) 3. Requirements Impact assessments (SP 1.2-2). 4. Requirements status in requirements database with decision statements.(SP1.3-1) 5. Requirements Traceability Matrix and tracking system procedures. (SP 1.4-2) 6. Documentation of inconsistencies including sources conditions and rationales and the follow-up corrective actions. (SP 1.5-1) 7. Corrective actions 	<p><u>Typical RD work products are:</u></p> <p>For successful RD implementation, we have the following work products.</p> <ol style="list-style-type: none"> 1. Customer requirements(SP 1.2-1) 2. Customer constraints on conduct of verification and validation. (SP 1.2-1) 3. Derived requirements and relationships amongst them.(SP 2.1-1 and SP2.2-1) 4. Product requirements and product component requirements(SP 2.1-1) 5. Requirements allocation sheet and provisional requirement allocations(SP2.2-1) 6. Design constraints(SP2.2-1) 7. Interface Requirements(SP2.3-1) 8. Operational and disposal concepts(SP3.1-1) 9. Product installation, operational, maintenance and support concept(SP3.1-1) 10. Use cases, activity diagrams, OOAD, services identified and timeline scenarios. (SP3.1-1& SP 3.2-1) 11. Functional architecture(SP 3.2-1)