REQUIREMENTS ENGINEERING

Developing & Managing Requirements

Requirements Engineering
Department of CS&E

Objectives

- To understand the different processes in the realm of

‘Requirements Engineering’.

- To see the challenges in requirements development and the importance of getting requirements right in an IT project.
- To understand the different techniques used in different phases and processes of requirements development and management.

REQUIREMENT

What is a

‘Requireme

nt’?

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What is a ‘Requirement’?

- *“A condition or capability to which a system must conform.”*

It can be any one of the following:

- A capability needed by a customer or user to solve a problem or achieve an objective.
- A capability that must be met or possessed by a system to satisfy a contract, standard, specification, regulation, or other formally imposed document.
- A restriction imposed by a stakeholder.

From Needs to Requirements

PROBLEM
DOMAIN

Requirement Categories (1)

- Functional Requirements
- Non Functional Requirements (NFRs)
  - Performance
  - Security
  - Logging

– Reliability

Requirement Categories (2)

- Functional Requirements
- Technical Requirements
- Operational Requirements
- Transitional Requirements

Why do we need requirements?

- Project scoping
- Cost estimating
- Budgeting
- Project scheduling
- Software design
- Software testing

- Documentation and training manuals

Why is it important to get the requirements right?

Why is it important to get the requirements right?

Requirements	1
Design	3 – 6
Coding	10
Development Testing	15 – 40
Acceptance Testing	30 – 70
Operations	40 – 100

What are the factors that cause projects to be challenged?

Lack of User Input	12.8%
Incomplete Requirements	12.3%
Changing Requirements	11.8%
Lack of Executive Support	7.5%
Technology Incompetence	7.0%
Lack of Resources	6.4%
Unrealistic Expectations	5.9%
Unclear Objectives	5.3%
Unrealistic Time Frames	3.7%
Other	23.0%

Why projects are impaired and ultimately cancelled?

Incomplete Requirements	13.1%
Lack of User Involvement	12.4%
Lack of Resources	10.6%
Unrealistic Expectations	9.9%
Lack of Executive Support	9.3%
Changing Requirements	8.7%
Lack of Planning	8.1%
Didn’t need it any longer	7.5%
Lack of IT Management	4.3%
Technology Illiteracy	9.9%

Characteristics of a Good Requirement

- Correct
- Clear
  - Understandable
- Unambiguous
- Testable (Verifiable)
- Feasible
- Independent
- Atomic
- Necessary
- Implementation-free
- Consistent
- Complete
  - Non-redundant

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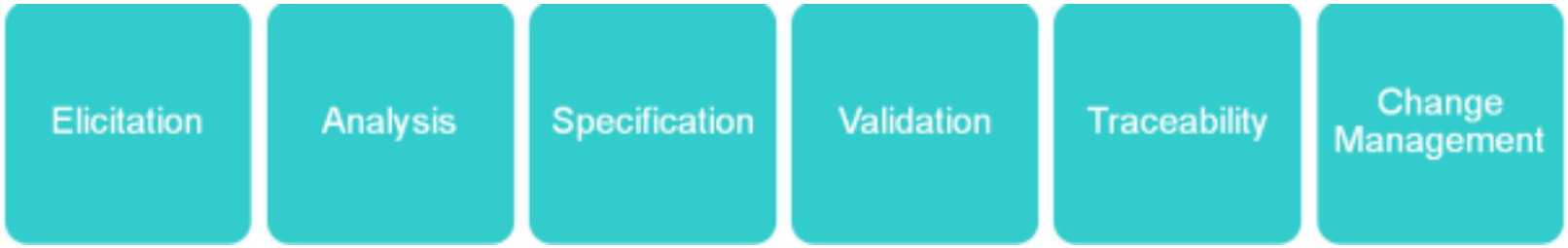
Requirements Engineering

Requirements Development



Requirements Development

REQUIREMENTS ELICITATION

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What is Requirements Elicitation?

What is Requirements Elicitation?

- The process of discovering the requirements for a system by communication with customers, system

users and others who have a stake in the system development.

So how do we elicit requirements?

- Identify relevant requirements sources.
- Ask them appropriate questions to understand their needs.
- Look for implications, inconsistencies, and unresolved issues in gathered information.

- Confirm your understanding of requirements with the users.
- Synthesize appropriate statements of the requirements.

Requirements Elicitation Problems

- Problems of Scope
  - The requirements may address too little or too much information
- Problems of Understanding
  - Wrong/ different understanding of the requirements within and between groups
- Problems of Volatility
  - Changing nature of requirements

Problems of Scope

1. The boundary of the system is ill-defined 2. Unnecessary design information may be given

Problems of Understanding

- Users have incomplete understanding of their needs.
- Users have poor understanding of computer capabilities and limitations.
- Analysts have poor knowledge of problem domain.
- User and analyst speak different languages.
- Ease of omitting “obvious” information.
- Conflicting views of different users.
- Requirements are often vague and un-testable, e.g., “user friendly” and “robust”.

Problems of Volatility

- Requirements evolve over time

Challenges of Requirements Elicitation

- “Yes, but…” syndrome

- Stems from human nature and the users' inability to experience the software as they might experience a physical device.

- The Undiscovered Ruins
  - The more you find, the more you realize still remain.
- "User and Developer" syndrome
  - Reflects the profound difference between the two, making communication difficult.
- "Living with the sins of your predecessors" syndrome – No trust between the groups based on previous interactions and earlier experiences.

Requirements Elicitation Techniques

- Questionnaire
- Interviewing
- Requirements Workshops

- Brain storming
- Use cases
- Role Playing
- Prototyping
- Story boards

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REQUIREMENTS ANALYSIS

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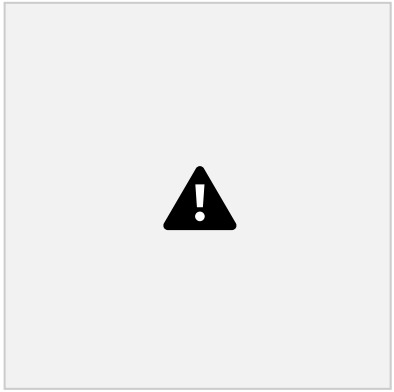
What is Requirements Analysis?



What is Requirements Analysis?

- The process of breaking down user requirements into their components and studying these to develop a

set of system requirements.

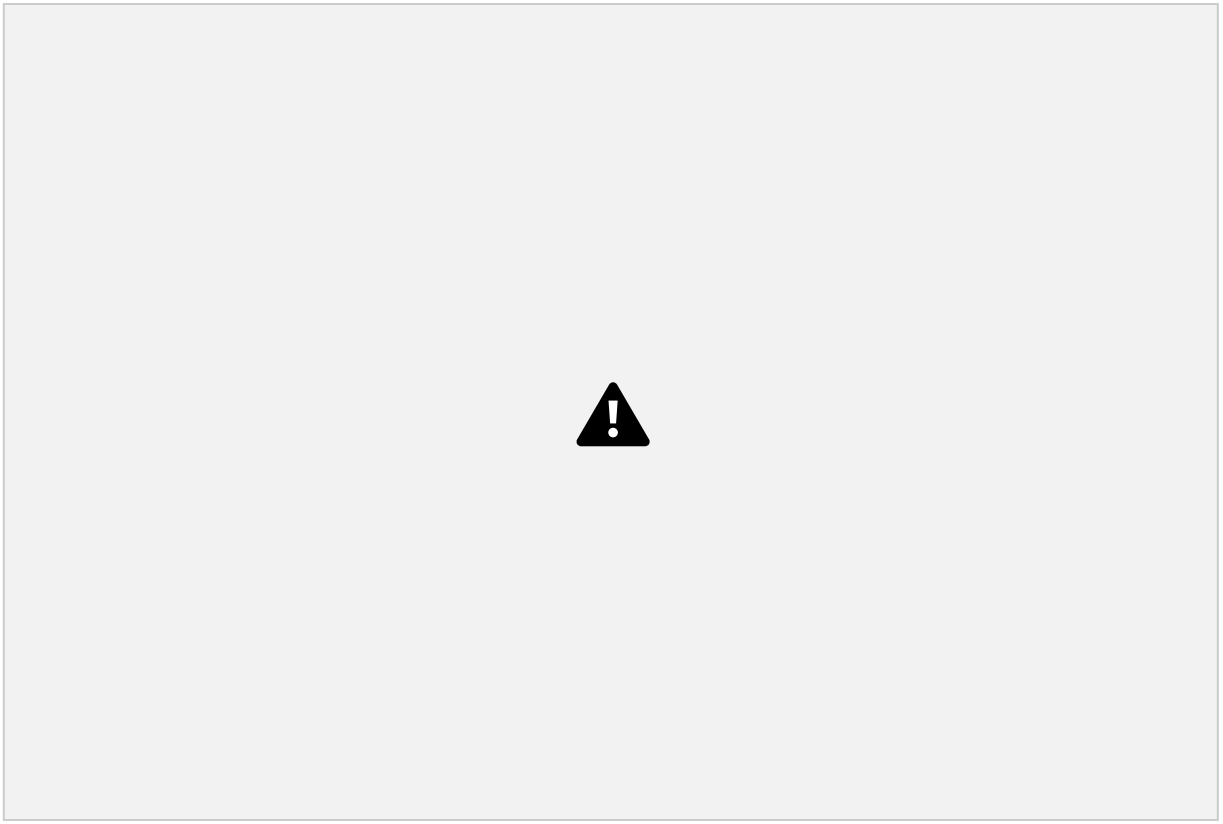
The three major goals of this process are:

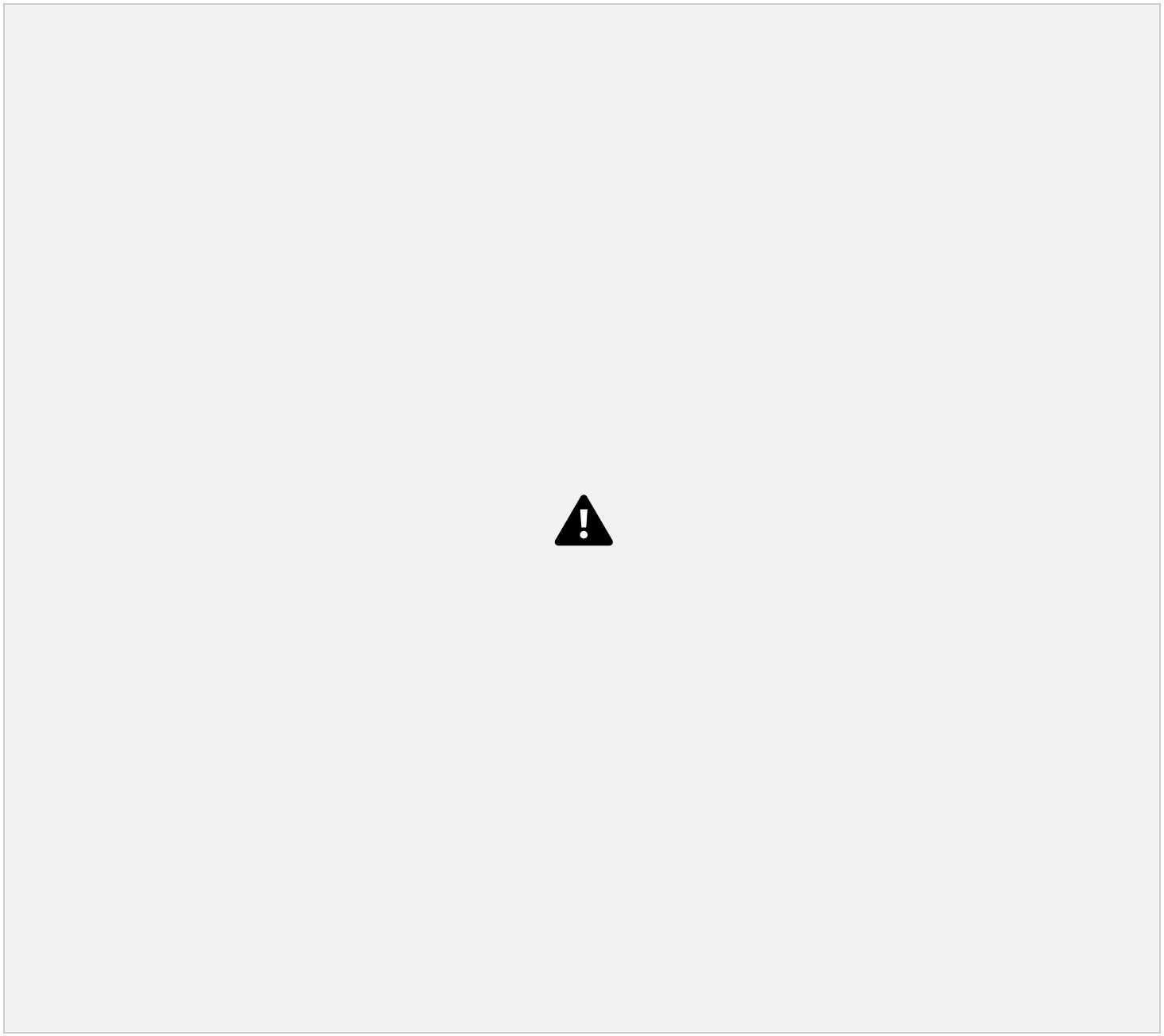
- Achieve agreement among developers and customers.
- Provide a basis for design.
- Provide a basis for Verification and Validation (V&V)

Process Model

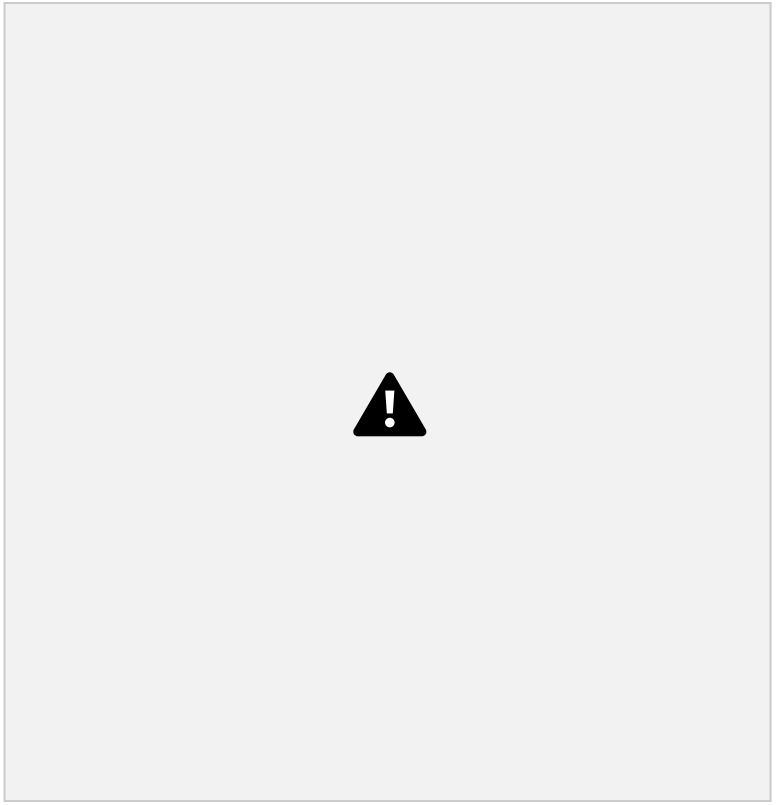
- Work Flow Diagramming
- Model Flow Chart Diagramming
- Customer Event Diagramming
- Use Case Diagramming
- Activity Diagrams
- Decision Trees

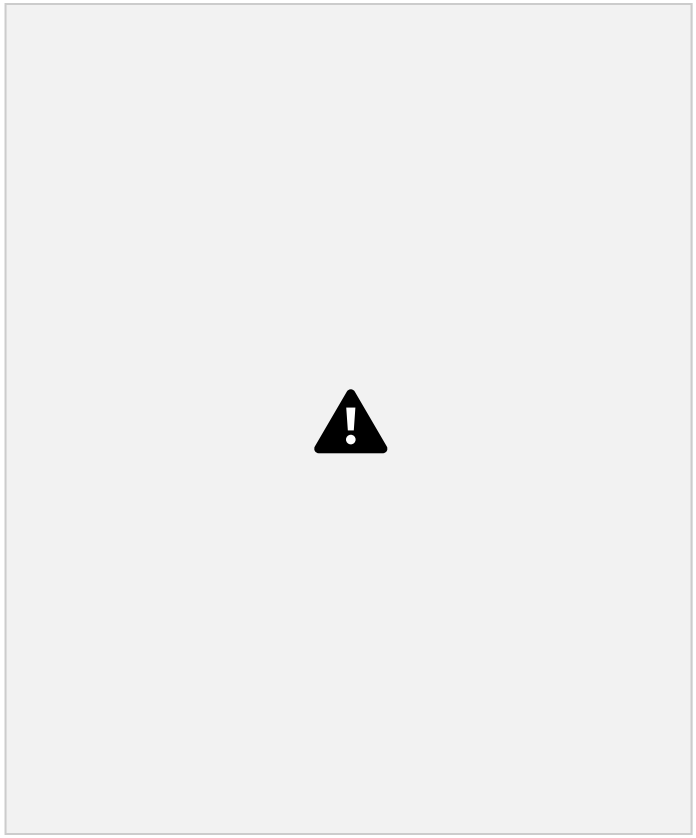
Process Modeling (Sample diagrams)





Process Modeling (Sample diagrams)





Logical Data Model

- Entity Relationship Diagramming
- Data Normalization/ De-Normalization

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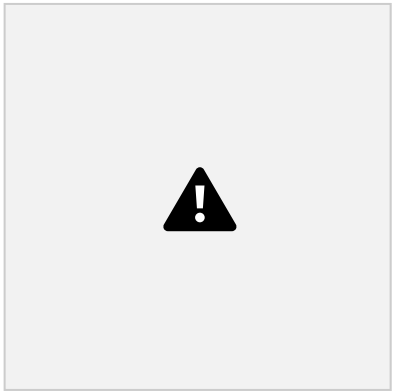
REQUIREMENTS SPECIFICATION

What is Requirements Specification?



What is Requirements Specification?

- *"Complete description of the behavior of the system to be developed.*

- Requirements document is a reference document. •

Contract between stakeholders

- Must be maintained over the life of the project

Software Requirement Specification

Objectives

- Establish agreement between stakeholders
- Firm foundation for design
- Reduce development effort
- Provide a basis for estimating cost and schedule
- Reduce rework effort and cost of quality
- Provide a baseline for validation and verification
- Facilitate transfer
- Serve as a basis for enhancement

SRS Document

- Known as ‘Black-box specification’
- Concentrates on
  - ‘What’ needs to be done
  - Carefully avoids the ‘how to do’ aspects
- Serves as a contract

Issues SRS writer must address

- Functionality

- External Interfaces
- Performance
- Attributes
- Design Constraints

Specification Principles

- Separate functionality from implementation
- Develop model of desired behavior of the system
- Establish the context in which software operates

Define the environment in which system operates

The following are NOT included in a SRS:

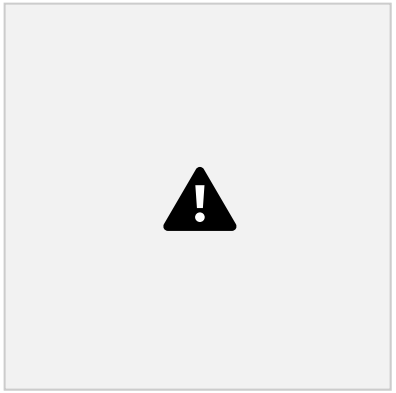
- Project Requirements: Cost, delivery schedules, staffing, reporting procedures
- Design Solutions
- Product Assurance Plan: Quality Assurance plans, Configuration Management procedures, Verification & Validation procedures

Requirements Development

REQUIREMENTS VERIFICATION & VALIDATION

What is Requirements Verification &

Validation?



What is Requirements Verification?

- Proving that each requirement has been satisfied •

Can be done by logical argument, inspection, modeling, simulation, analysis, expert review, test, demonstration

What is Requirements Validation?

- Ensuring that the set of requirements is correct, complete & consistent.
- Ensuring that a model can be created that satisfies the requirements.

- Ensuring that a real-world solution can be built and tested to prove that it satisfies the requirements.

Requirements V & V: Objectives

- Certify that the requirements document is an acceptable description of the system to be implemented
- Check requirements document for:
  - Correctness, completeness and consistency
  - Conformance to standards
  - Requirement conflicts

- Technical errors
- Ambiguous requirements

Requirements: Analysis & Validation

- Analysis works with raw requirements as elicited from the system stakeholders.
  - "Have we got the right requirements?" is the key question to be answered at this stage.
- Validation works with final draft of the requirements document i.e. with negotiated and agreed requirements.
  - "Have we got the requirements right?" is the key question to be answered at this stage.

Requirements V & V: Inputs &

Outputs

Requirements

Document

Organisational Knowledge

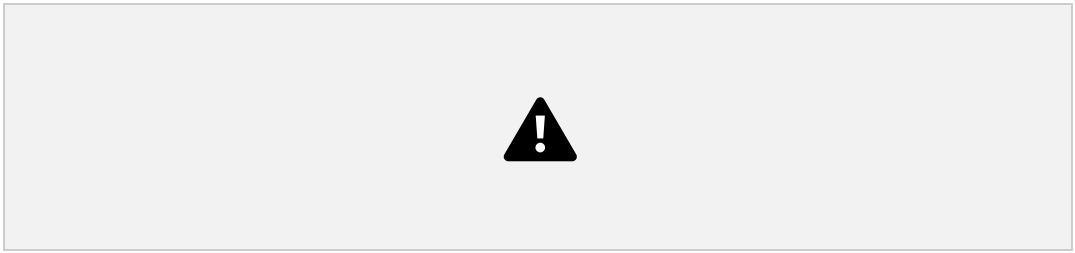
Organisational Standards

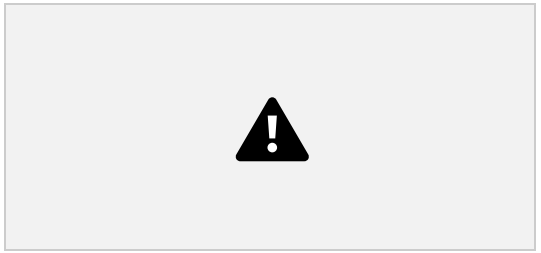
Requirements V & V

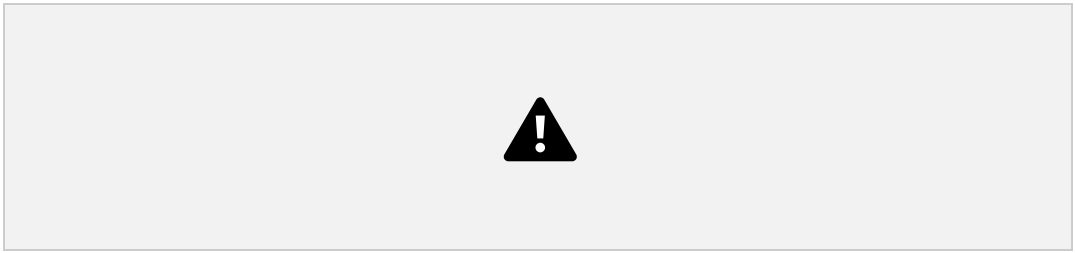
List of problems

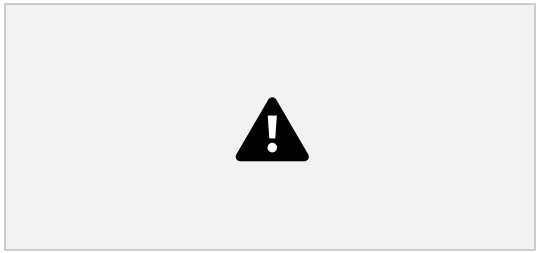
Agreed actions

Requirements Management

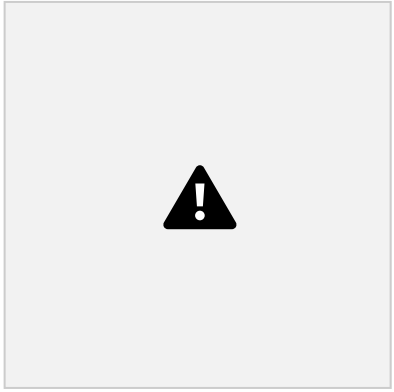








What is Requirements Management?



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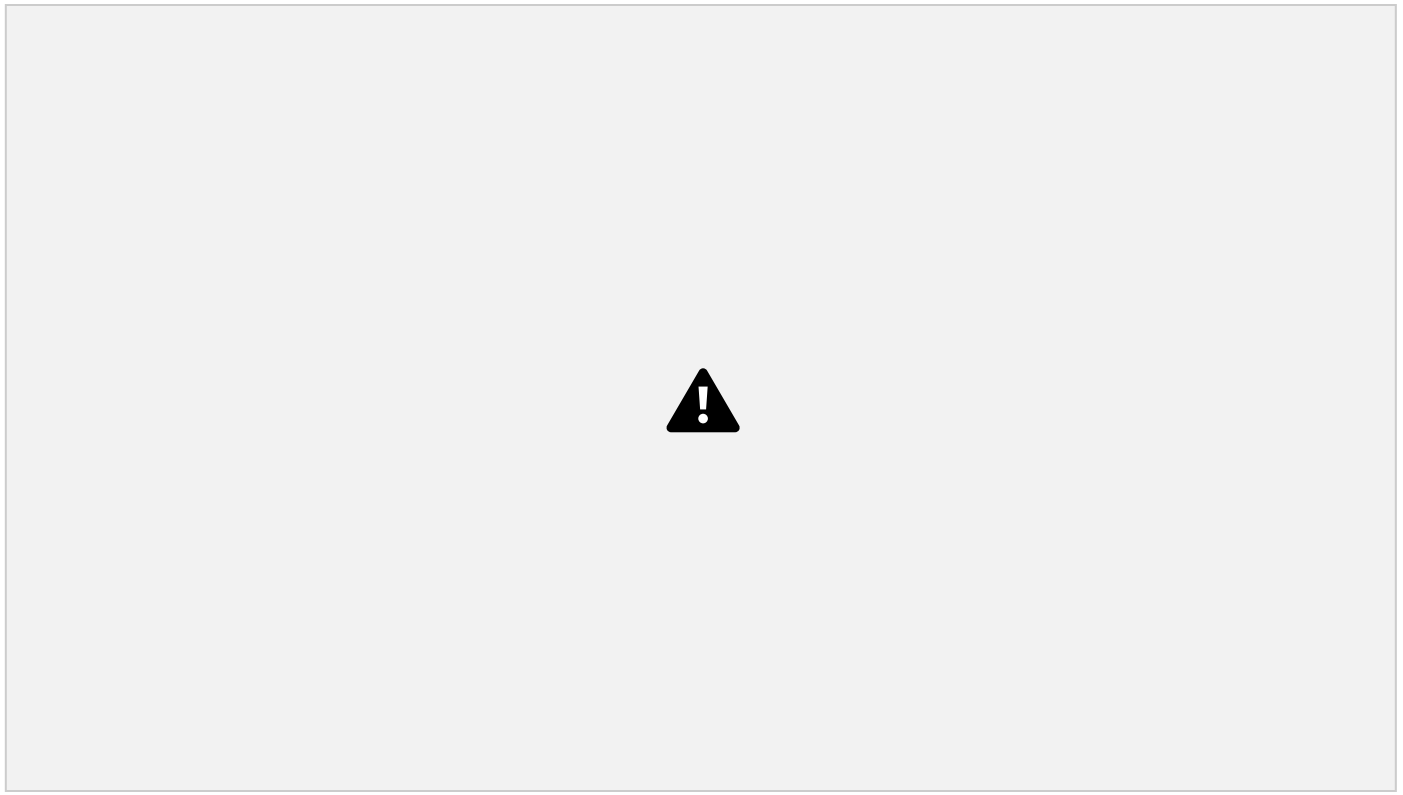

Requirements Management: Key Activities

- Understand relationships among key stakeholders

and involve them

- Identify change in requirements
- Managing & controlling requirements changes • Identify and track requirements attributes • Trace requirements

Requirements Management Plan

- A component of Project Management Plan • Details the plans and processes for managing requirements through out the entire project life cycle.

Requirements
Management Plan

Requirement Management Metrics

- To measure and improve effectiveness of the requirements processes.

Typical metrics collected:

- Number of Requirement defects

- Requirement Review efforts
- Changes raised

Requirements Traceability

- *'The ability to describe and follow the life of a requirement, in both forwards and backwards direction (i.e. from its origins, through its development and specification, to its subsequent deployment and use, and through all periods of on-going refinement and iteration in any of these phases'*

  - To ensure the object of the requirements conforms to the requirements by associating each requirement with the object via the traceability matrix.
  - Concerned with documenting the life of a requirement.

- To find the origin of each requirement and track every change which was made to this requirement

Requirements Change Management

- Process to manage changes in requirements (over the entire project life cycle)
- Key elements:
  - Change Process
  - Change Tracking System