# Req. Validation & Functional Decomposition for V&V Automation Testing

Lesson 5: Requirement Management

## Lesson Objectives

- To understand the following topics:
  - What is Requirements Management?
  - Why do requirements change?
  - Stable and Volatile Requirements
  - Requirements Classification
  - Baselining Requirements
  - Requirements Traceability
  - Types of Requirements Traceability
  - Requirement Traceability Matrix
  - Maintaining Requirement Traceability
  - Requirement Traceability Matrix – Simple Example

 

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- To understand the following topics:
  - Change Management
  - Change Request Management
  - Change Management Process
  - Define Requirement Creep
  - Why does Requirement Creep occur?
  - Measures to control Requirement Creep
  - Requirement Metrics
  - Summary
  - Review Questions

 

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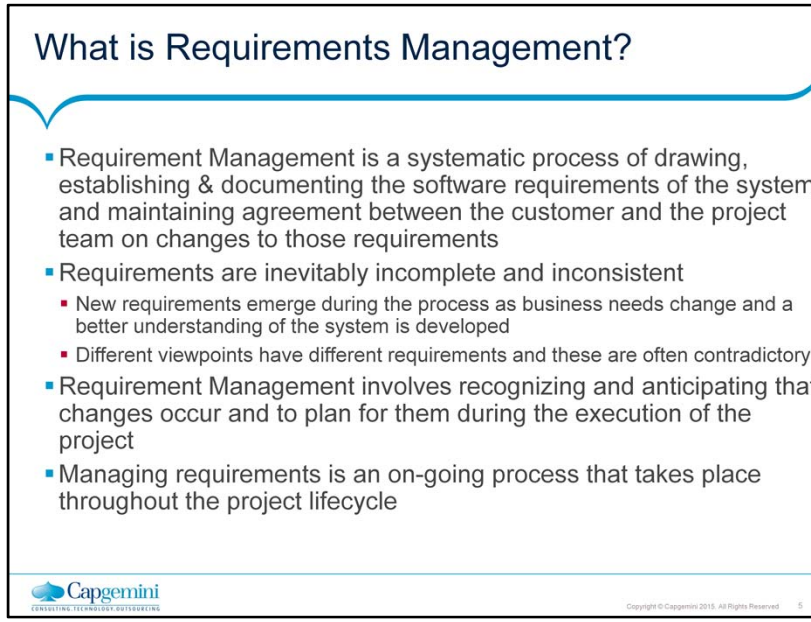
  - Review Questions




**Requirement Management – An Overview**

One of the major reason behind the software failures is the way the project team acquire, document, agree upon and change the product requirements. The classic problem areas include informal information gathering, implied functionality, inadequately defined requirements, and a casual change process

The purpose of **Requirements management** is to manage the requirements of a project and to identify inconsistencies between those requirements and the project's plans and work products. Requirements management practices include change management and traceability.

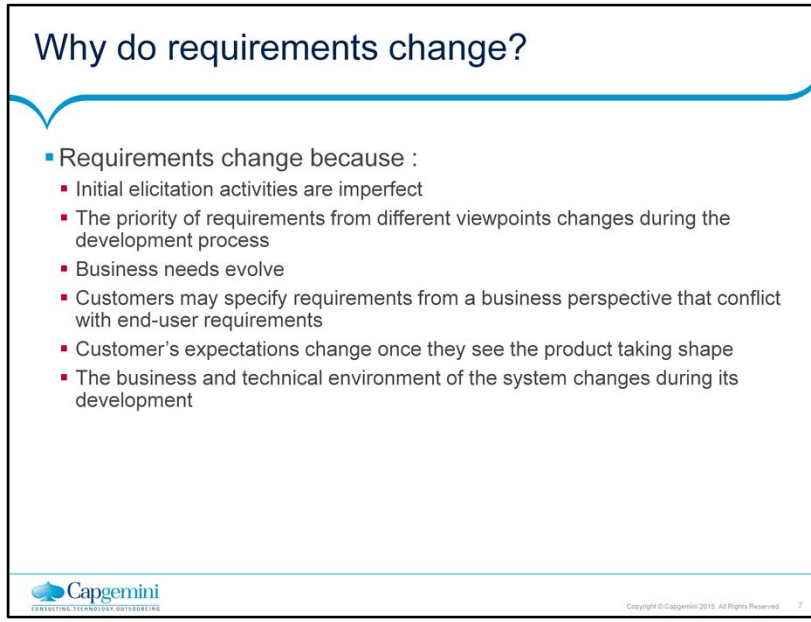
The effective requirement management process involves maintaining a clear declaration of the requirements along with appropriate attributes & traceability. Managing changing requirements throughout the software development life cycle is the key to developing a successful solution.

The effective requirement management process leads to a successful software development, one that meets customer's needs and is developed on time and within the budget.

## Why do requirements change?

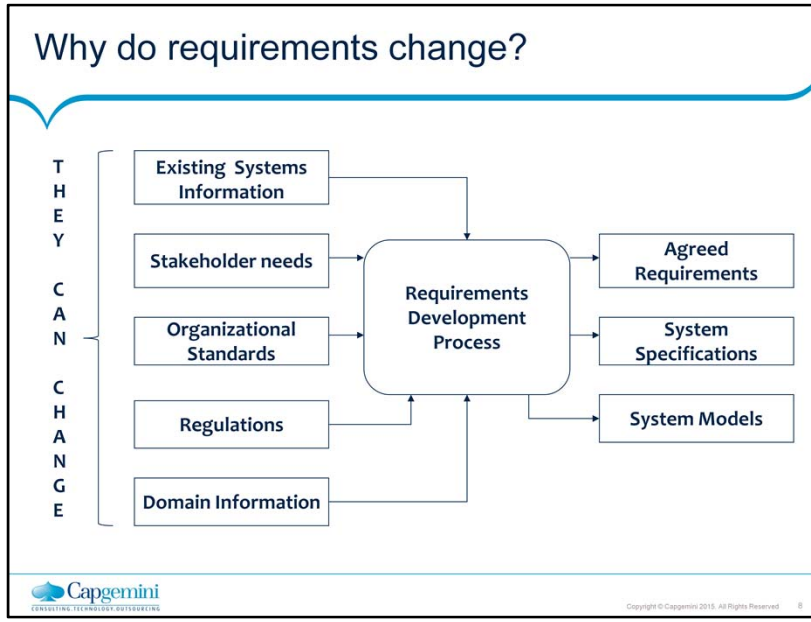
- Change in software development: as inevitable as difficult to control!

> ***"Stable requirements are the holy grail of software development."***
> ***(McConnell, 1993)***




**Why do Requirements change?**

1. Our understanding of the problem improved.
2. The problem being solved changed.
3. We failed to ask the right people the right questions at the right time.
4. We failed to create or follow a process to help manage change.
5. The users changed their minds or their perceptions.
6. The external environment changed.


Why do requirements change?
THEY CAN CHANGE
Existing Systems Information
Stakeholder needs
Organizational Standards
Regulations
Domain Information
Requirements Development Process
Agreed Requirements
System Specifications
System Models
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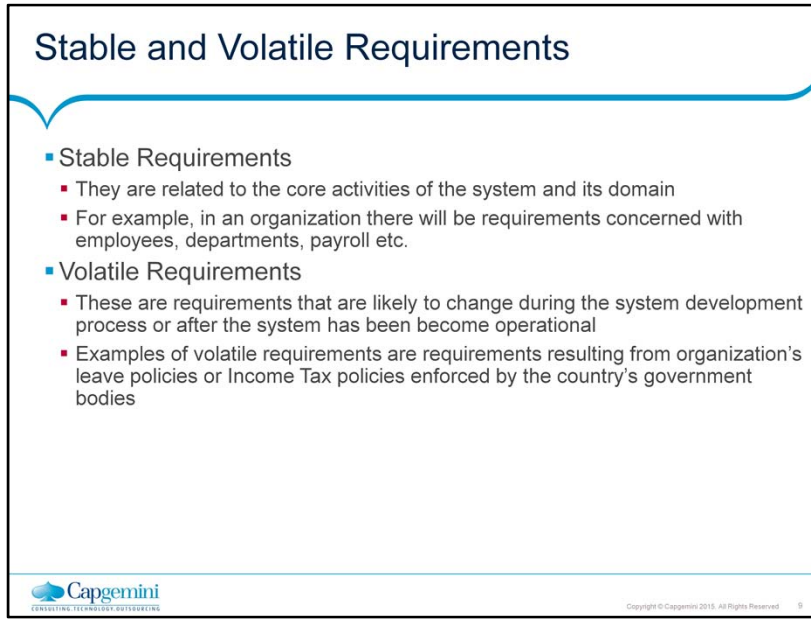
Stable and Volatile Requirements
Stable Requirements
They are related to the core activities of the system and its domain
For example, in an organization there will be requirements concerned with employees, departments, payroll etc.
Volatile Requirements
These are requirements that are likely to change during the system development process or after the system has been become operational
Examples of volatile requirements are requirements resulting from organization's leave policies or Income Tax policies enforced by the country's government bodies
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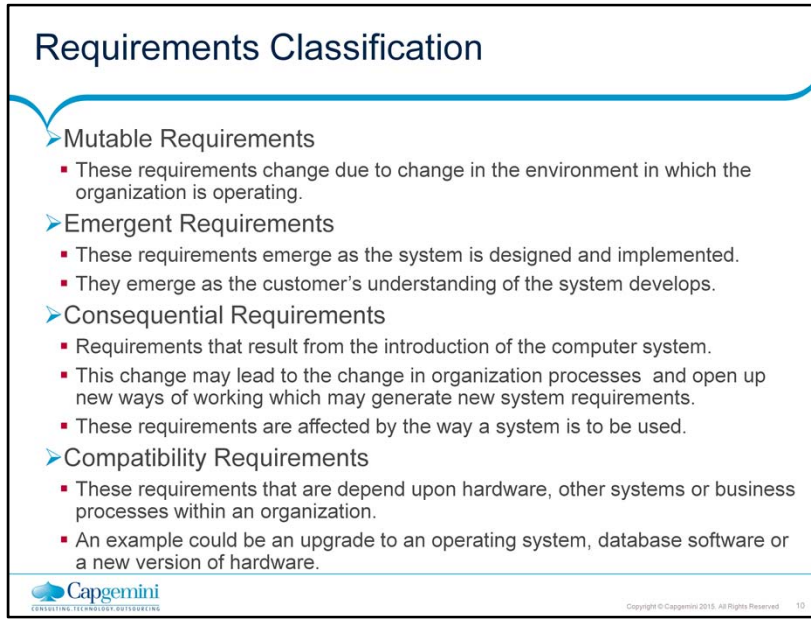
Requirements Classification
Mutable Requirements
These requirements change due to change in the environment in which the organization is operating.
Emergent Requirements
These requirements emerge as the system is designed and implemented.
They emerge as the customer's understanding of the system develops.
Consequential Requirements
Requirements that result from the introduction of the computer system.
This change may lead to the change in organization processes and open up new ways of working which may generate new system requirements.
These requirements are affected by the way a system is to be used.
Compatibility Requirements
These requirements that are depend upon hardware, other systems or business processes within an organization.
An example could be an upgrade to an operating system, database software or a new version of hardware.
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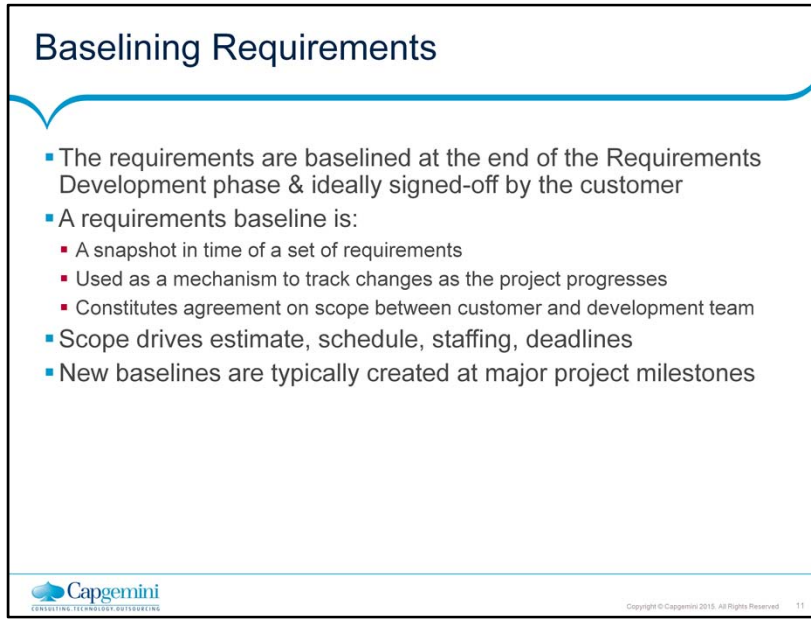
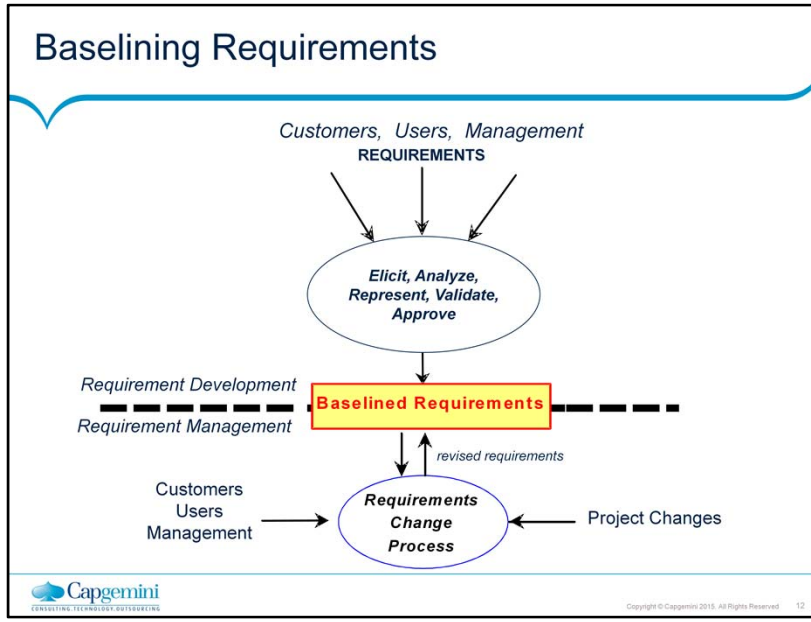



**Baselining Requirements**

Usually projects start with unclear requirements and expectations. Lack of base lined requirements can result in chaos with lots of requirements changes resulting in requirements and scope creeps. Baselines can also help in acceptance testing and prototyping efforts. Baselines are especially valuable in fixed price contracts.

A baseline is all about getting to a common base agreement between stakeholders. It essentially involves setting the right expectations including responsibilities, risks, assumptions, deliverable and approaches. Once an agreement is reached; it could be put in source control to manage the base line going forward.



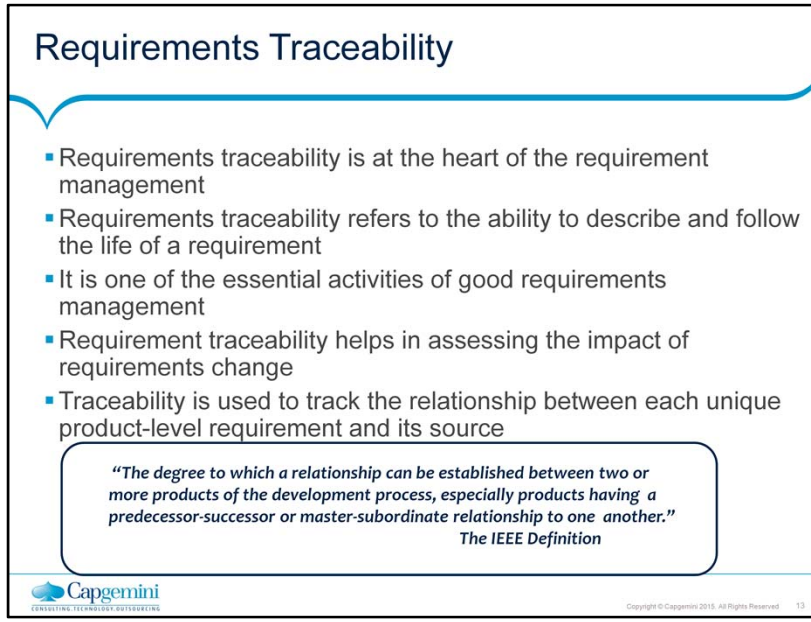

**Baselining Requirements**

Once sufficient requirements have been discovered and documented as an analyst you maybe required to help facilitate the planning of releases / versions.

Firstly you ensure that the requirements or features have been prioritized by the customer. This may require some diplomacy if you have a number of stakeholders with different priorities. This prioritization process is crucial and any conflicts must be resolved before starting development work where possible.

Secondly you will need to work with the development team to help them estimate the duration and risk of each requirement. Once completed you will be prepared to facilitate the discussion to start baseline planning.

The features that make up each version should be derived through a balance of priority value (determined by the project customer), effort required (determined by the development team) and perceived risk (determined by the development team).
Baselined requirements are the start point for Requirements Management.




**Requirement Traceability**

Requirements traceability is concerned with documenting the life of a requirement. It should be possible to trace back to the origin of each requirement and every change made to the requirement should therefore be documented in order to achieve traceability. Even the use of the requirement after the implemented features have been deployed and used should be traceable.

Requirements come from different sources, like the business person ordering the product, the marketing manager and the actual user. These people all have different requirements on the product. Using requirements traceability an implemented feature can be traced back to the person, or group, that wanted it during the requirements elicitation. This can be used during the development process to prioritize the requirement, determining how valuable the requirement is to a specific user. It can also be used after the deployment when user studies show that a feature is not used, to see why it was required in the first place.

## Types of Requirements Traceability

- Forward traceability
  - This traceability is used to validate whether the project is evolving in the desired direction and for the right product
  - It ensures that each requirement is implemented in the product and that each requirement is tested thoroughly
  - This traceability maps requirements to test cases
- Backward or reverse traceability
  - This traceability is used to validate that the product development is on the correct path of its development
  - The objective behind this type of traceability is to ensure that the scope of the project is not expanding due to additional code, design elements or other tasks that are not specified in the requirements
  - It maps test cases to requirements
- Bi-directional traceability
  - This traceability ensures that all requirements are covered by test cases

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## Requirement Traceability Matrix

- The classic way to perform traceability is by constructing a traceability matrix
- Traceability Matrix is a table containing requirements of a project and their relation to the engineering work products
- It ensures completeness in translating requirements to the delivered work products
- Advantages
  - Ensures completeness of testing against requirements
  - Facilitates the impact analysis of the requirements change on all the related work products
  - Enables scope analysis for regression testing
  - Helps judging requirements stability from a customer
  - Helps to analyze Requirements creep

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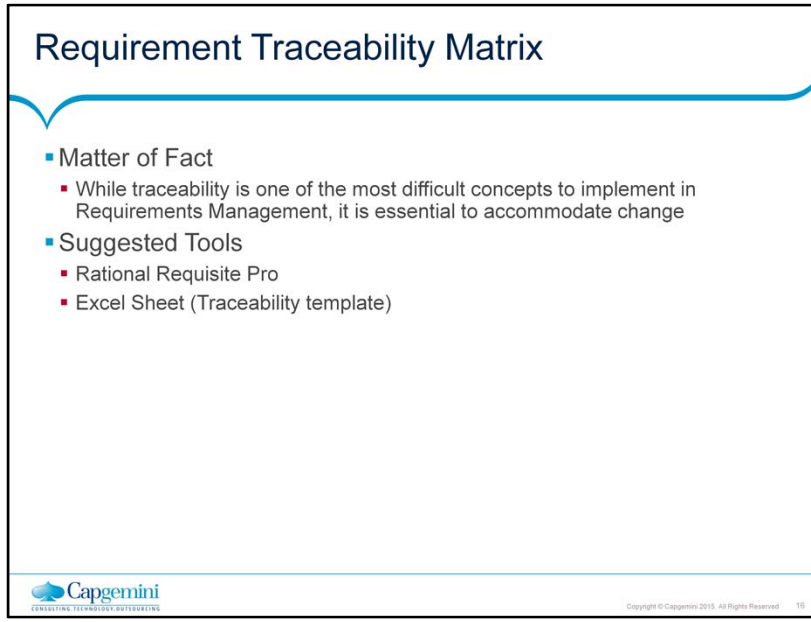
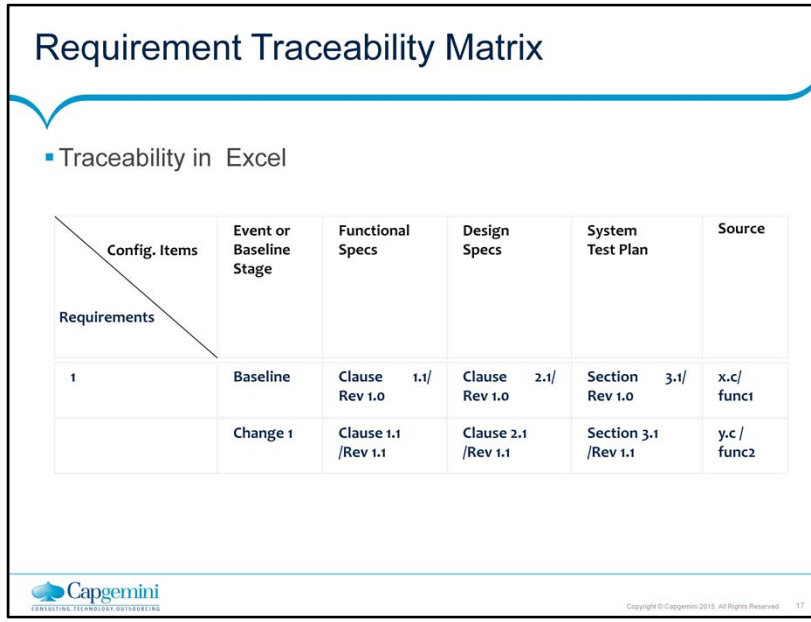
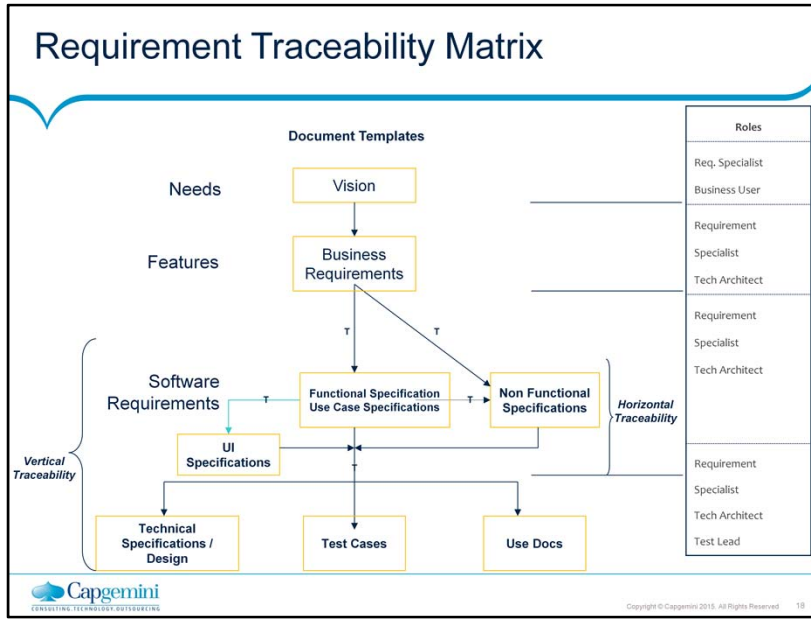



Traceability looks very simple in theory, but is in fact very difficult to implement. Typically tools are used to manage requirements traceability.




Traceability as a general term is the "ability to chronologically interrelate the uniquely identifiable entities in a way that matters." The word *chronology* here reflects the use the term in the context of tracking food from farm to shop, or drugs from factory to mouth. What matters in requirements management is not a *temporal* evolution so much as a *structural* evolution: a trace of where requirements are derived from, how they are satisfied, how they are tested, and what impact will result if they are changed.

The slide here depicts a typical way in which requirements can be traced using Excel.




The first step is to establish your requirements structure and the relationship of different requirements types to each other.
Based on this structure, you need to set up traceability links between all associated requirements or other project elements.

1. Trace top-level requirements to detailed requirements
2. Trace requirements to design
3. Trace requirements to test procedures
4. Trace requirements to user documentation plans

## Requirement Traceability Matrix

| Sr. No | Requirement Type | Traced to Requirement |
|---|---|---|
| 1 | Functional Requirement | Business Requirements |
| 2 | Non Functional Requirements | Business Requirements |
| 3 | Non Functional Requirements | Functional Requirement |
| 4 | Use Case Requirement | Business Requirements |
| 5 | UI Specifications | Use Case Requirement |
| 6 | Design Requirements | Functional Requirements |
| 7 | Design Requirements | Non-Functional Requirements |
| 8 | Design Requirements | Use Case Requirements |

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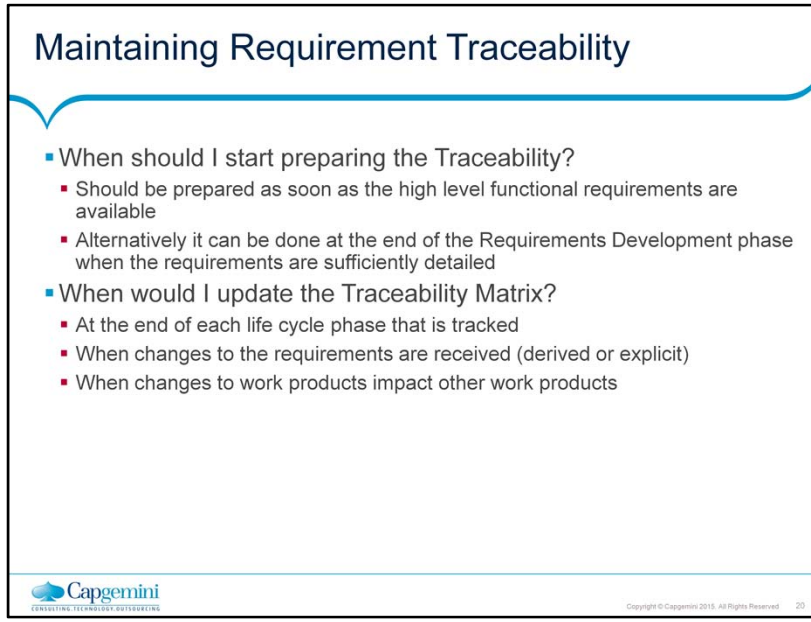


Traceability needs to be on the radar right from the beginning. Ideally we should create the Traceability Matrix by the end of Requirements Development, and update it at the end of each subsequent phase and whenever there are changes in requirements.

# Requirement Traceability Matrix – Simple Example

- Let's understand the concept of Requirement Traceability Matrix through a simple example of "FlyWithMe" Airways Web Application
- We will use the following business requirement & technical design requirement to understand the requirement traceability matrix
- Simple Business Requirement Document (BRD)

| BR ID | Application/Module/Component Name | Roles Involved | Requirement Description |
|---|---|---|---|
| BR_1 | Login Module | Customer | A customer need to login to the FlyWithMe Airways Website to avail the facility of Web Check-in |

- Simple Technical Design Document (TDD)

| TDR ID | Application/Module/Component Name | Requirement Description |
|---|---|---|
| TDR_16 | Login Module | User ID should not be left blank |
| TDR_09 | Login Module | Password should contain at least 1 alphanumeric value |
| TDR_29 | Login Module | User should be able to login to the website upon entering valid User ID and Password |

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# Requirement Traceability Matrix – Simple Example

- Step 1: On the basis of Business Requirement Document (BRD) and Technical Requirement Document (TDD), testers start writing test cases

| Test Case ID | Test Condition | Test Steps | Test Data | Expected Result |
|---|---|---|---|---|
| TC_1 | To validate that user should be able to login to the airways website successfully with valid User ID and Password | Go to Login Page | http://www.FlyWithMe.com/Login.aspx | Login Successful |
| | | Enter User ID | User1 | |
| | | Enter Password | fly@123 | |
| | | Click on Login button | | |

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# Requirement Traceability Matrix – Simple Example

- Step 2: Identify the Technical Requirement that this test case is verifying. For our test case, the technical requirement is TDR_29 is being verified.

| Test Case ID | TDR ID | Test Condition | Test Steps | Test Data | Expected Result |
|---|---|---|---|---|---|
| TC_1 | TDR_29 | To validate that user should be able to login to the airways website successfully with valid User ID and Password | Go to Login Page | http://www.FlyWithMe.com/Login.aspx | Login Successful |
| | | | Enter User ID | User1 | |
| | | | Enter Password | fly@123 | |
| | | | Click on Login button | | |

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# Requirement Traceability Matrix – Simple Example

- Step 3: Identify the Business Requirement for which this TDR (Technical Requirement-TDR_29) is defined

| Test Case ID | TDR ID | BR ID | Test Condition | Test Steps | Test Data | Expected Result |
|---|---|---|---|---|---|---|
| TC_1 | TDR_29 | BR_1 | To validate that user should be able to login to the airways website successfully with valid User ID and Password | Go to Login Page | http://www.FlyWithMe.com/Login.aspx | Login Successful |
| | | | | Enter User ID | User1 | |
| | | | | Enter Password | fly@123 | |
| | | | | Click on Login button | | |

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## Requirement Traceability Matrix – Simple Example

- Step 4: We need to perform above process for all the test Cases. Later Extract the First 3 Columns from your Test Suite. RTM is Ready.

| Test Case ID | TDR ID | BR ID |
|---|---|---|
| TC_1 | TDR_29 | BR_1 |

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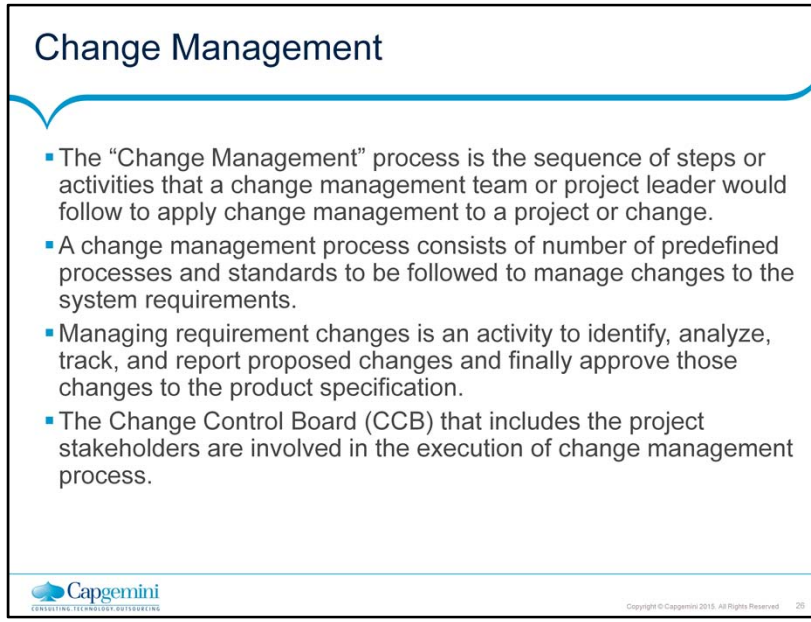
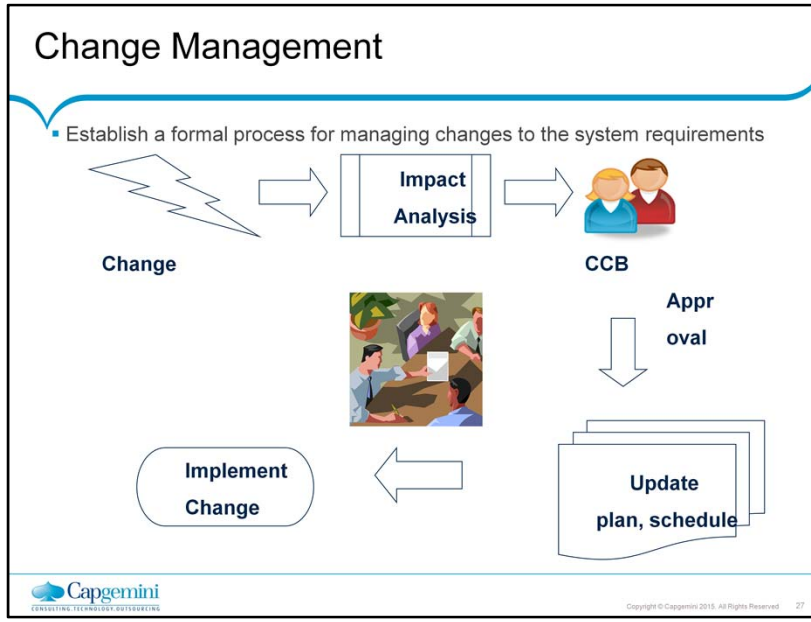
**Note** - All the formats/templates used in RTM example are sample templates to maintain the simplicity of the example. They are not standard templates that are used in projects in IGATE.



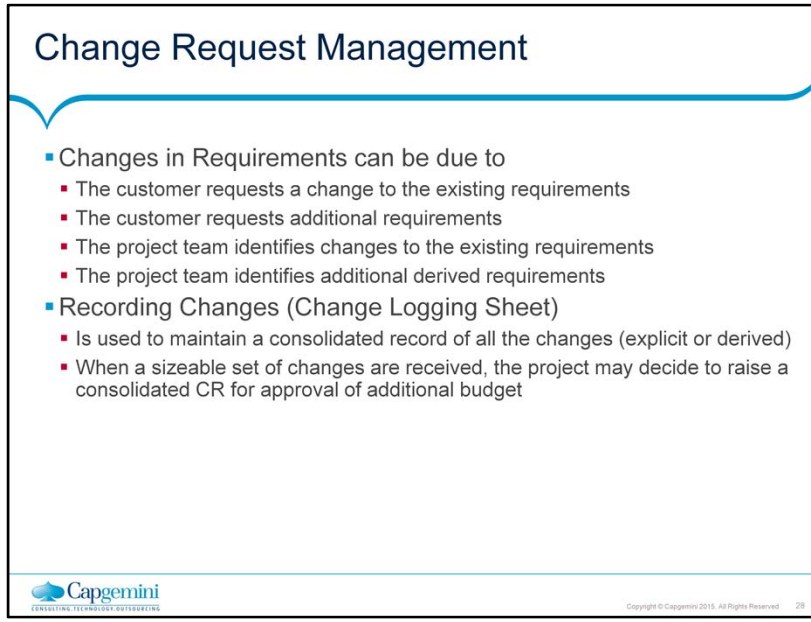

## Change Management

Managing requirement changes is an activity to identify, analyze, track, and report proposed changes and finally approve those changes to the product specification. As project develops, requirements may change or increase to accommodate changes in the project scope or design. When there is a request to add a new feature to the product, to enhance an existing specification due to a defect or failure or to adopt the changes in the various organization level or statutory and legal policies, a change request is created to modify the existing requirement specification. Those changes to the requirements can impact the project overall cost, resources allocated, and schedule planned for the delivery.

A change management process consists of number of predefined processes and standards to be followed to manage changes to the system requirements.




A typical change management process is illustrated here and explained further on the next slide. Key thing to remembers is that a structured process has to be followed before deciding to go ahead with the change.


Change Request Management
Changes in Requirements can be due to
The customer requests a change to the existing requirements
The customer requests additional requirements
The project team identifies changes to the existing requirements
The project team identifies additional derived requirements
Recording Changes (Change Logging Sheet)
Is used to maintain a consolidated record of all the changes (explicit or derived)
When a sizeable set of changes are received, the project may decide to raise a consolidated CR for approval of additional budget
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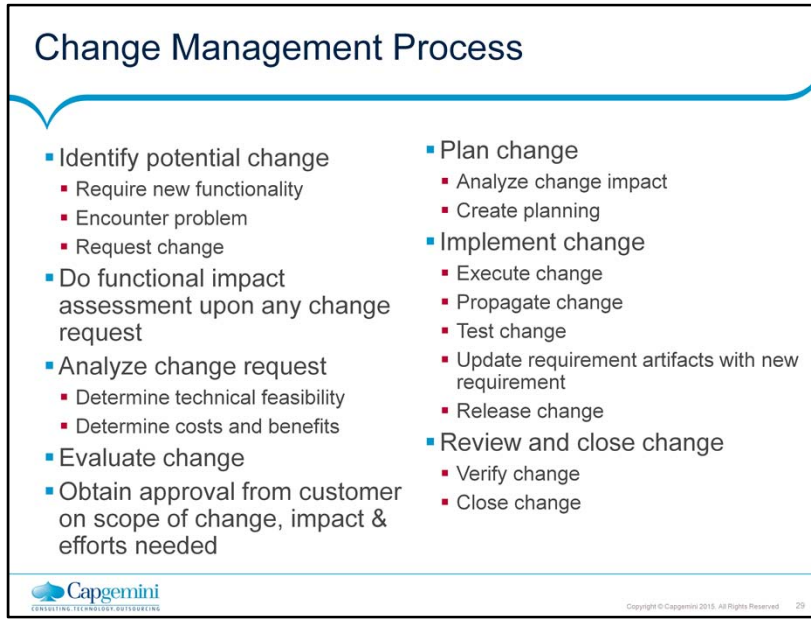



There are six main activities, which jointly form the change management process. They are: Identify potential change, Analyze change request, Evaluate change, Plan change, Implement change and Review and close change.

1. **Identify potential change:** The change in requirements is identified. This could come from an analysis of the requirements, new customer needs, or operational problems with the system. The change may be initiated by a customer/user, business analyst or any other stakeholder involved in defining the requirement.

2. **Analyze change request :** The proposed changes are analyzed. This includes how many other requirements and system components are affected by the change. The analysis are also carried out to understand approximate cost in terms of money, efforts & timer to successfully implement the change in the product and overall impact on the project schedule.

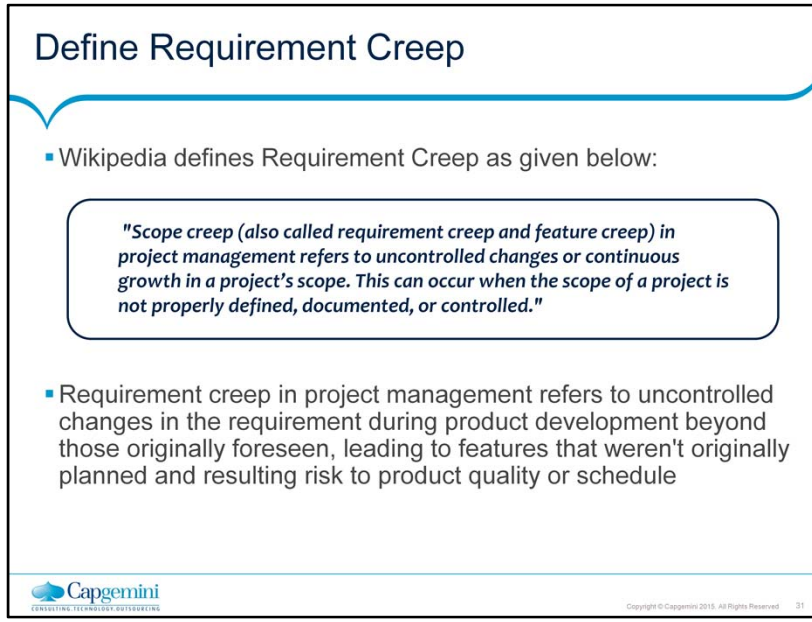
3. **Evaluate Change :** On the basis of change request analysis, the Change Control Board (CCB) decides whether to implement or not the change. This decision will be based on factors such as : the severity of the changes, cost versus benefit etc.

4. **Plan Change :** The first step in managing change is building awareness around the need for change and creating a desire among employees. If the CCB decides that the change is to be implemented, it is communicated to any stakeholders e.g. user/customer, project manager, project team etc. that are affected by that change. The change management team must develop a plan for successful implementation of the change. A key part of the change control process is to carry out an impact analysis of the proposed new or modified requirement. The impact analysis involves estimating the time, effort and cost of implementing the change and any other requirements that are affected by the change are also considered.a

5. **Implement Change :** The change is implemented. The information about the new change implementation is then passed on to all of the people involved in the process and the ones affected by the change. It is also very important to verify that the new change that is introduced in the system is tested for its successful implementation. A set of amendments to the requirements document or a new document version is produced.

6. **Review and close changes :** The implementation team must determine the success of the change based on execution of the post implementation test plan and success criteria identified in the Change Request. If the change was not completed successfully as planned or is incomplete, the implementer must determine if the change should be reversed. The change will be closed off if the changes are successfully implemented. The benchmarks for a successful change are given below:

    - The change was implemented in accordance with the implementation plan
    - The change was implemented within the planned implementation timeframe
    - The change did not cause unplanned customer impact
    - The change met anticipated objectives defined in the Change Request
    - The change did not result in a system/application outage due to the execution of the back out plan


Define Requirement Creep
Wikipedia defines Requirement Creep as given below:
"Scope creep (also called requirement creep and feature creep) in project management refers to uncontrolled changes or continuous growth in a project's scope. This can occur when the scope of a project is not properly defined, documented, or controlled."
Requirement creep in project management refers to uncontrolled changes in the requirement during product development beyond those originally foreseen, leading to features that weren't originally planned and resulting risk to product quality or schedule
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## Define Requirement Creep

- Even when there is a clearly defined project scope, one must be aware that Requirement creep can still occur during project development.
- Requirement creep can originate from several sources and is a leading cause of project failure when handled poorly.
- Requirement creep tends to occur when new features are added to product design that have already been approved without providing equivalent increase in the budget, time and resources.
- Additional requirements needed to achieve the new objectives can overwhelm the capacity of the resources allocated to the project resulting into project missing deadlines, budgets or complete failure.
- Therefore, preventing requirement creep and managing requirement creep is the key to successful project management.

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## Why does Requirement Creep occur?

- In a Computerworld survey of 160 I.T. professionals, 80% reported requirements creep either “always” or “frequently”.
- There are a number of reasons for requirement creep, and the following are a few of the most common:
- Poor requirement analysis
  - The customers are not sure enough about what they want from the system and they end up stating vague requirements
- Not involving customers early though
  - This refers to having false confidence that you know exactly what the customers expect from the system
  - It is very important to involve customers in the requirement analysis as well as design phase
- Insufficient detailing on the complexity of the project
  - Many projects runs into problems because they are executed for the first time and there is no enough detailed information available on what to expect from the project and how to implement the same in a standard manner

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## Why does Requirement Creep occur?

- Lack of change control
  - You can expect requirement creep in most projects, therefore it is important to design a process to manage these changes
- Gold Plating
  - This term is given to the practice of exceeding the scope of a project in the belief that a value is being added
  - As a team proceeds through the various phases of a project, frequently one or more of the team members will strive to improve or perfect the product
  - These changes inevitably consume time and budget and are not guaranteed to increase customer satisfaction
- Unwillingness to say no to a client
  - The project team's or an individual's desire to please the customer and reluctance to say "no" can also lead to requirement creep
- One little change won't matter
  - There can be a situation when customers ask for a change, if proper and required impact analysis of the change is not performed then it can give a false impression of change being manageable which can fit into current schedule and cost

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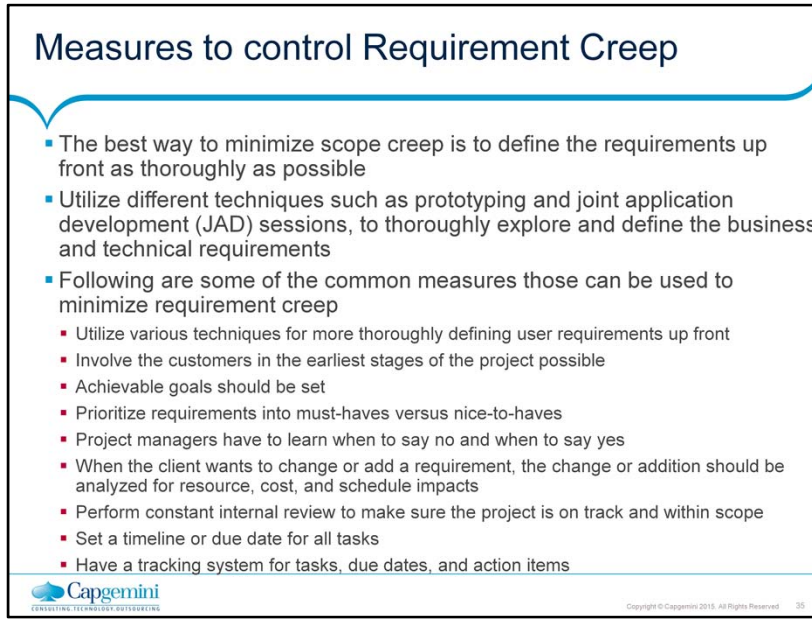
Measures to control Requirement Creep
The best way to minimize scope creep is to define the requirements up front as thoroughly as possible
Utilize different techniques such as prototyping and joint application development (JAD) sessions, to thoroughly explore and define the business and technical requirements
Following are some of the common measures those can be used to minimize requirement creep
Utilize various techniques for more thoroughly defining user requirements up front
Involve the customers in the earliest stages of the project possible
Achievable goals should be set
Prioritize requirements into must-haves versus nice-to-haves
Project managers have to learn when to say no and when to say yes
When the client wants to change or add a requirement, the change or addition should be analyzed for resource, cost, and schedule impacts
Perform constant internal review to make sure the project is on track and within scope
Set a timeline or due date for all tasks
Have a tracking system for tasks, due dates, and action items
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## Requirement Metrics

| Process | Sub Process | Objective | Metrics |
|---|---|---|---|
| Requirements Development | Elicitation | 1. Minimize the scope creep<br>2. Increase requirements stability | 1. Requirements Creep Index (RCI)<br>2. Requirements Stability Index (RSI) |
| | Elicitation | 1. Increase requirements elicitation | 1. Elicitation Efficiency (EEI) |
| Requirements Management | Query Resolution | 1. Increase query resolution<br>2. Decrease time for closing a query | 1. Query Resolution Index (QRI)<br>2. Average Query Turnaround Time (QTAT) |

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# Requirement Metrics

| Metrics | Overview | Calculation |
|---|---|---|
| **Requirements Creep Index (RCI)** | A measure of scope creep over gathered requirements | ((Effort due to scope creep)*100)/(Approved efforts in person days as approved by customer) |
| **Requirements Stability Index (RSI)** | A measure of frequency of change in baselined requirements over project lifecycle | (N - \|C\|)/N, where,<br><br>N = Number of requirements identified and approved for the project.<br>C = Number of suggested changes in requirement because of issues at any time in the project's phase. |
| **Elicitation Efficiency (EEI)** | A measure of the efficiency of elicitation process | Use of a template for calculating EEI |
| **Query Resolution Index (QRI)** | | Total number of Queries Resolved / Total number of Queries |
| **Average Query Turnaround Time (QTAT)** | Time taken to resolve a functional query | Σ(End date – Star date) of all queries / Total number of closed queries for the reporting period |

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## Summary

- In this lesson, you have learnt:
  - What is Requirements Management?
  - Why do requirements change?
  - Stable and Volatile Requirements
  - Requirements Classification
  - Baselining Requirements
  - Requirements Traceability
  - Requirement Traceability Matrix
  - Maintaining Requirement Traceability
  - Change Management
  - Requirement Creep


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## Review Question

- Question 1: Volatile Requirements are likely to change during the system development process or after the system has been become operational.
  - True/ False
- Question 2: The requirements are baselined at the beginning of the Requirements Development phase & ideally signed-off by the development team.
  - True/ False
- Question 3: _____ is a measure of frequency of change in baselined requirements over project lifecycle.
- Question 4: _____ requirements are the requirements that are depend upon hardware, other systems or business processes within an organization.

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## Review Question

- Question 5: Which of the following requirement traceability is used to validate whether the project is evolving in the desired direction and for the right product?
  - Option 1: Forward traceability
  - Option 2: Backward traceability
  - Option 3: Bi-directional traceability
  - Option 4: All of the above

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