Requirements Module: The Basics

Space Systems Engineering, version 1.0

Module Purpose: Requirements - The Basics

◆ Establish the role of good requirements in project success.

- Requirements capture the understanding of what is to be done.

◆ Establish the significance of good requirements development.

- Poor requirements are the single biggest problem for projects.

- The later a problem is discovered the more costly it is to recover from.

◆ Describe the different types of requirements.

◆ Establish how requirements are distributed — allocation, flow-down and derived.

◆ Define and understand the value of requirements traceability.

◆ Recognize that system decomposition creates new interfaces that must be defined and owned.

The Importance of Requirements

♦ Requirements problems are the single biggest cause of project problems.

♦ Requirements define what is to be done, how well and under what constraints - get the requirements wrong and the design and hardware will be wrong.

♦ Requirements drive…

  Cost - Design - Schedules - Skills required - Verification plans - Operational procedures - *everything*

♦ *It is amazing how many teams begin to solve a problem before there is agreement on what the problem is.* Requirements and their associated constraints and assumptions quantify the problem to be solved - they establish how project success will be determined.
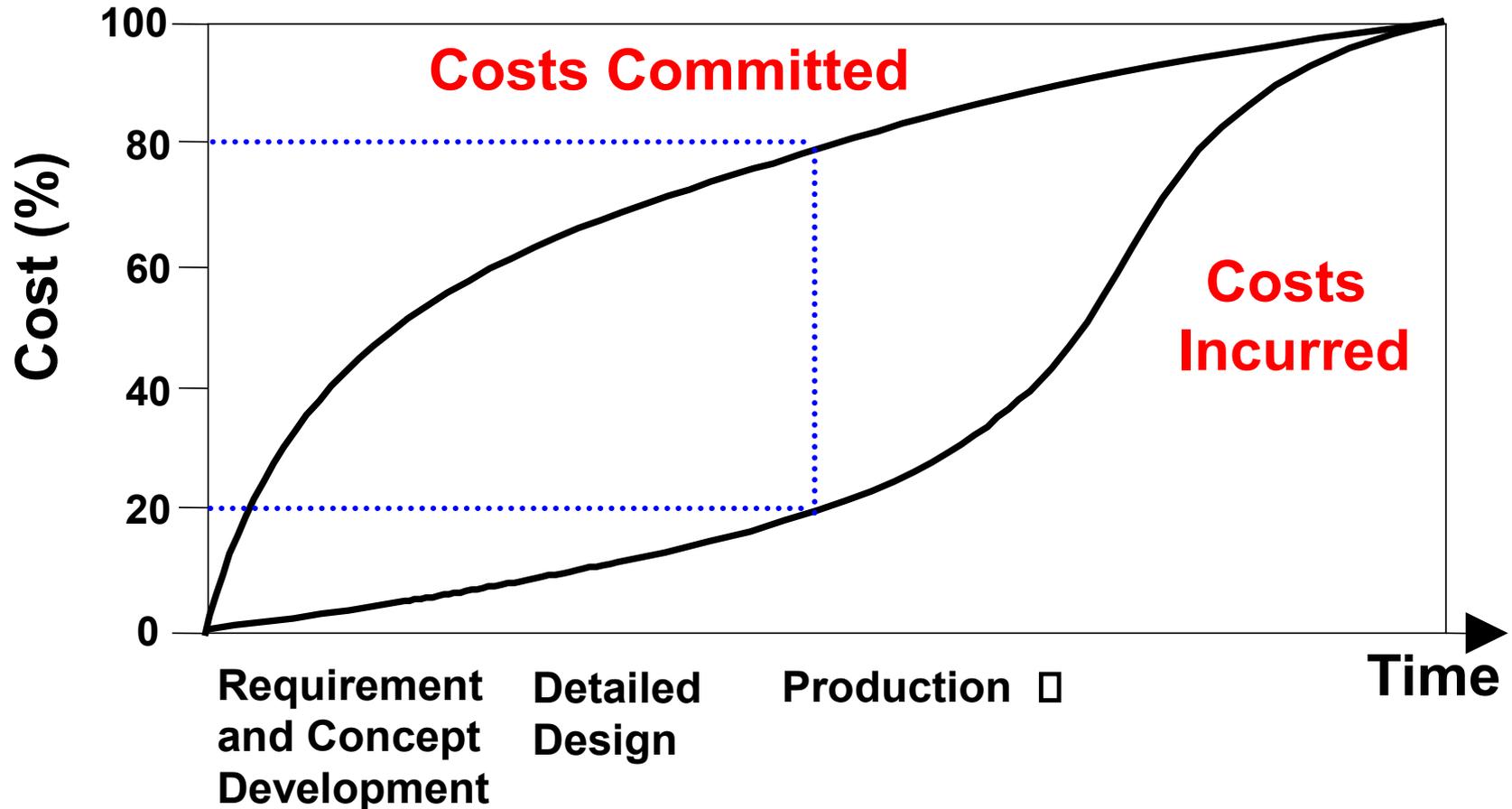
What is a Requirement?

◆ Statement of some THING you want or need
OR
A characteristic of some THING you want or need

◆ A requirement is also…

  • A *Contractually Binding* Statement

  • Documentation of *Problem Space*

  • The *Means* We Use to Communicate

Mutual Understanding

The Importance of Getting the Requirements Right

Requirement and concept development commit costs before they are incurred.

Chart: Cost (%) vs Time. Y-axis "Cost (%)" marked 0, 20, 40, 60, 80, 100. Upper curve labeled "Costs Committed" (reaching 80% by the Production phase). Lower curve labeled "Costs Incurred" (reaching 20% by the Production phase). X-axis "Time" with phases: Requirement and Concept Development, Detailed Design, Production.

Requirements Development
Is the Most Important Step!

♦ Requirements are distributed from the broad mission scope into the architecture that defines the project

♦ Requirements bound the scope of the problems to be solved so we know when we have done well enough

♦ A hierarchy of <u>traceable</u> requirements ensures that the project is building only what is required, i.e., no frivolous activities

♦ A hierarchy of <u>negotiated</u> requirements ensures a balanced system design

♦ Requirements are the basis for the project's verification and validation efforts

  • Poorly written or unverifiable requirements are trouble!

Requirements Traceability and Hierarchy

◆ Once mission level requirements have been decomposed to lower levels, traceability identifies the relationship between requirements.

◆ Knowing the source and dependencies between requirements is valuable since if a requirement changes, traceability can be used to determine the implications of that change.
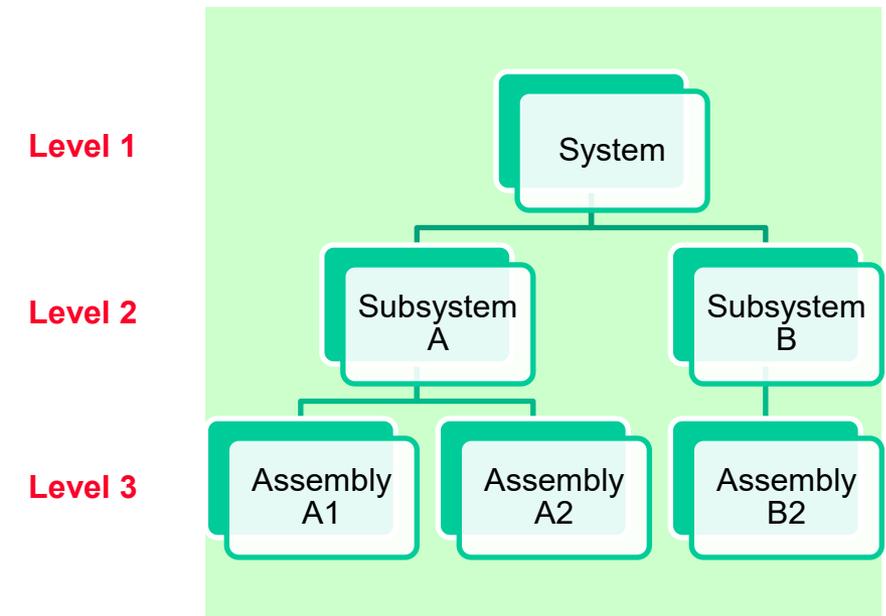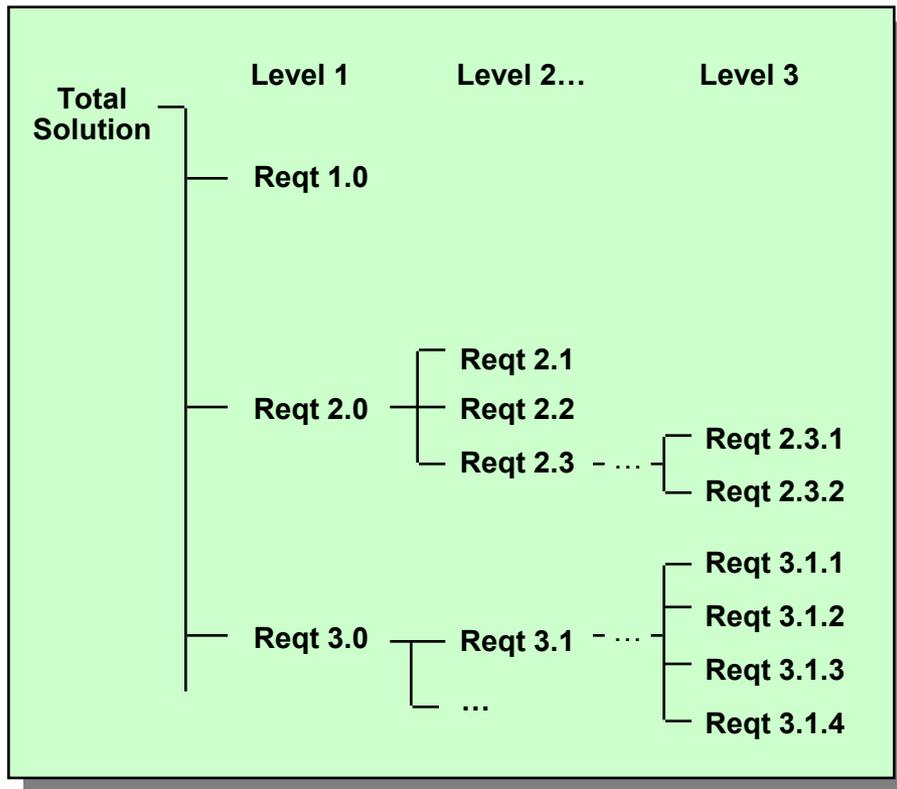
Types of Requirements

♦ <u>Functional</u> - Requirements which define ***what*** an item *must do*.

- The system shall provide communications between the ground and the spacecraft.

♦ <u>Performance</u> - Requirements which define and quantify ***how well*** an item must accomplish a particular function.

- Provide communications over what range, with what data rate and how often

♦ <u>Constraints</u> - Requirements that capture operational, environmental, safety or regulatory constraints.

- The communications system shall use X-band frequencies.

- The communications system shall operate with a base plate temperature of at least -30 C and at most 40 C.

- The maximum RF power density shall be less than 10 watts/m^2

- Design standards (e.g., metric units, programming language, etc.)

♦ <u>Verification</u> - Requirements capture how confidence will be established that the system will perform in its intended environment.

- All performance and functional requirements shall be met while the system is in a vacuum chamber with 2.5 Kwatts/m^2 of visible light illuminating the z-side.

Module Summary: Requirements — The Basics

♦ Requirements define the problem to be solved and establish the terms by which mission success will be measured.

♦ Requirements problems are the single biggest problem on development projects so care in creating good requirements always pays off.

♦ The later a problem is discovered the more costly it is to recover from.

♦ Requirements are distributed within the system architecture via flow-down, allocation and derivation.

♦ Requirements traceability is a technique of tracking the source and connections between requirements. It is used to assess the consequences of potential requirements changes.

♦ When a system is decomposed into smaller segments, interfaces are created that must be defined and managed.