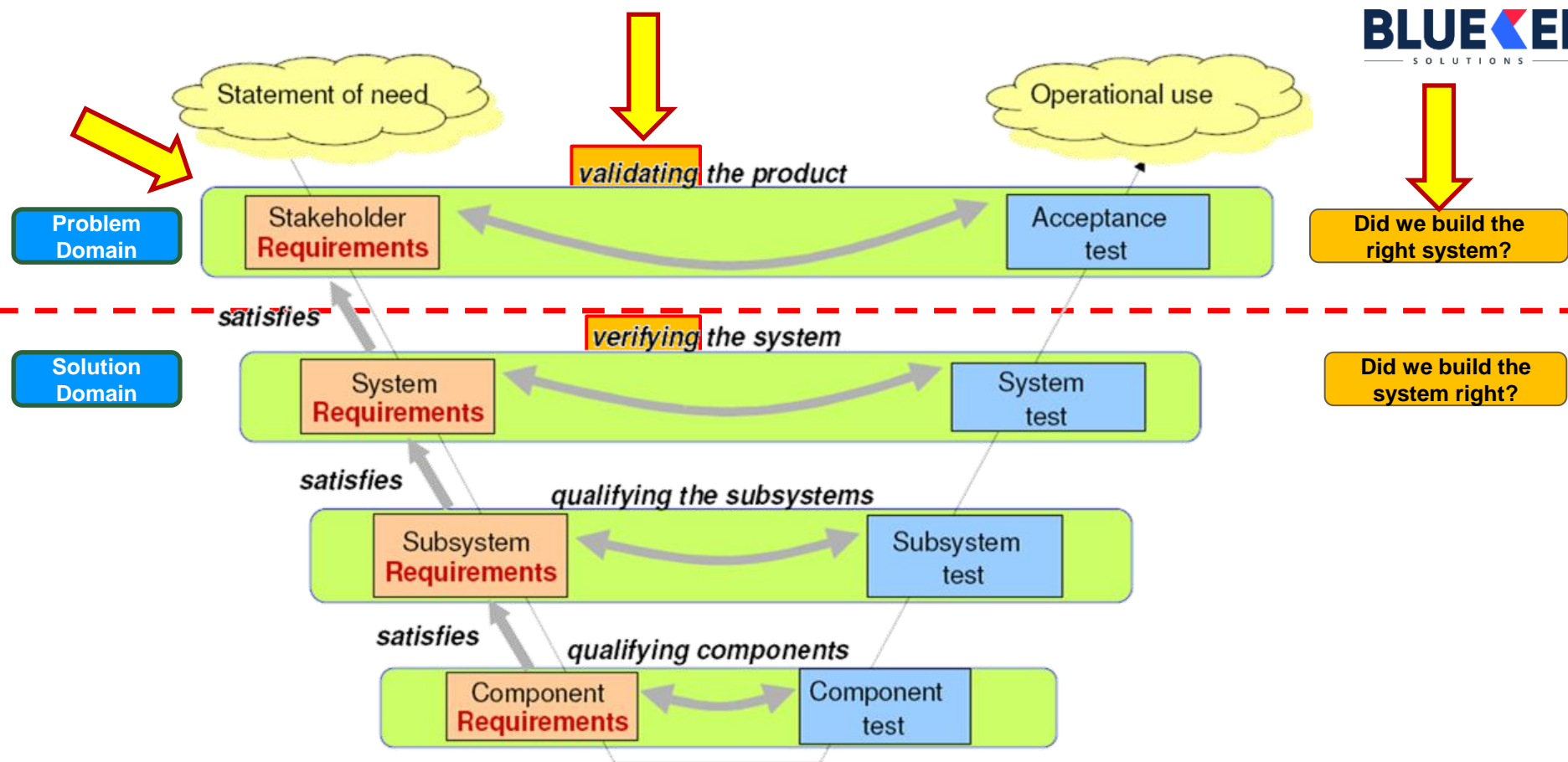


Module 2

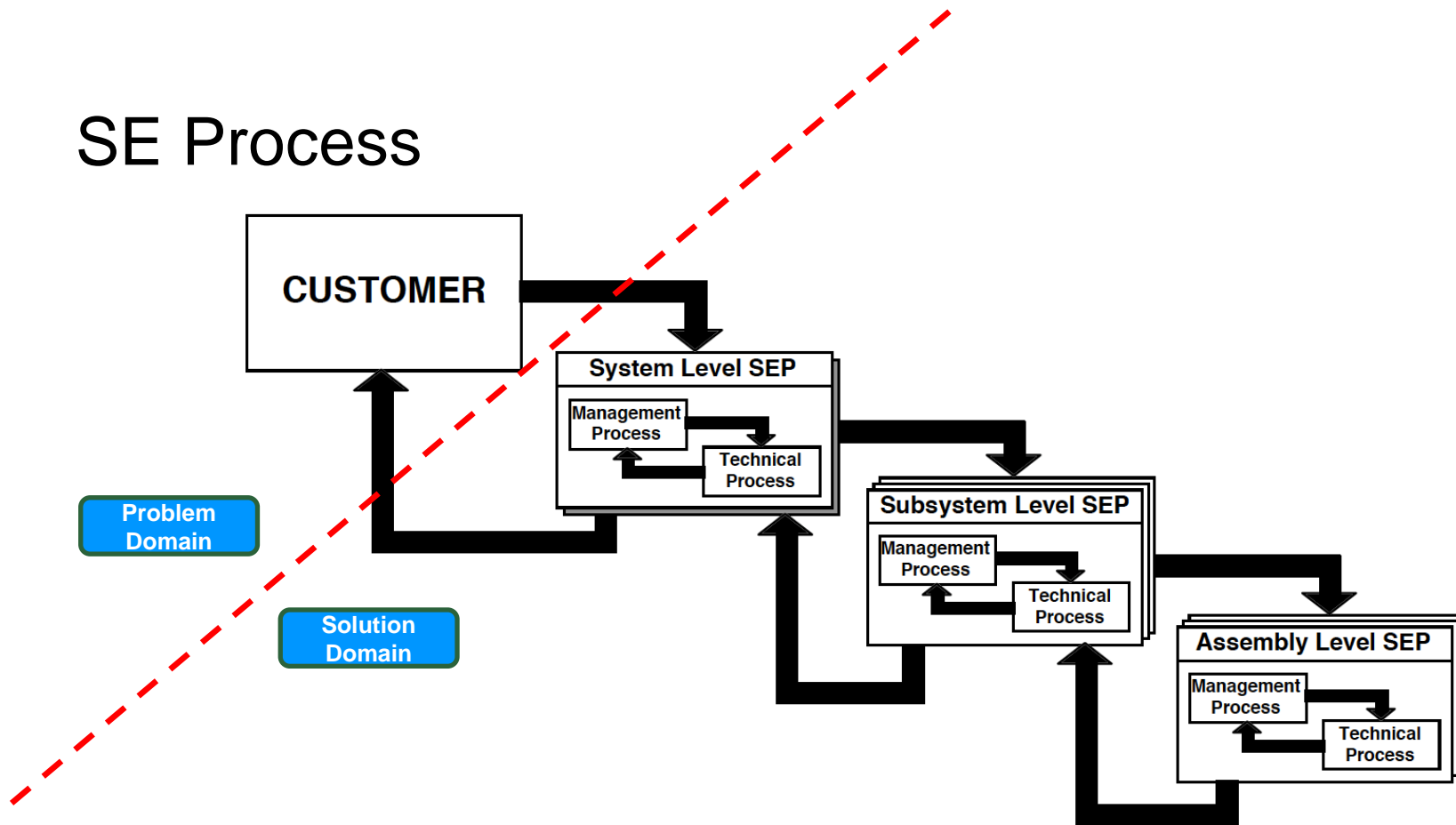
Stakeholder Needs and Requirements Definition

Agenda

- Purpose of the Process
- Requirements Elicitation
- Operational Analysis
- Stakeholders and Needs
- Context Diagram
- Stakeholder Needs to Stakeholder Requirements



SE Process



Lockheed Martin Corporation

Purpose of the Process

Stakeholder Needs and Requirements Definition Process

The purpose of the Stakeholder Needs and Requirements Definition process is to define the stakeholder needs and requirements for a system that can provide the capabilities needed by users and other stakeholders in a defined environment.

(INCOSE Systems Engineering Handbook, v5)

Who is a **Stakeholder**?

Stakeholder Definition

- Individual or organization having a right, share, claim, or interest in a system or in its possession of characteristics that meet their needs and expectations (ISO/IEC/IEEE 15288:2015)
- An individual, team, or organization (or classes thereof) with interests in, or concerns relative to, a system. (TOGAF)
- A stakeholder in an organization is (by definition) any group or individual who can affect or is affected by the achievement of the organization's objectives. (*'Strategic Management: A Stakeholder Approach'*, Freeman 1984)

Source : www.jamasoftware.com

What is the difference between **Need** and **Requirement**?

Need

A need may be defined as:

- A necessity
- An overall desire or want
- A wish for something that is lacking

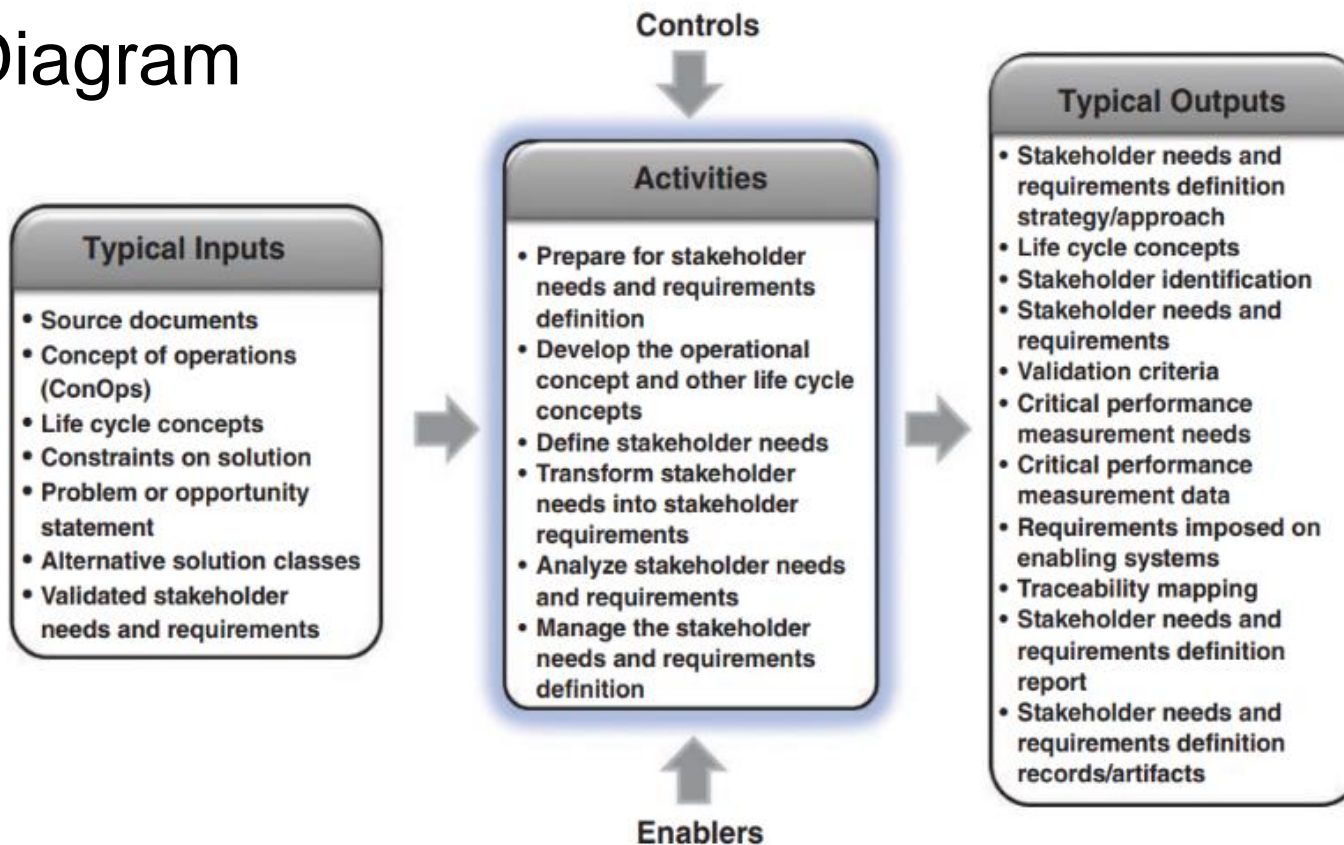
Needs exist in the minds of people, and they are often expressed in **fuzzy** or **general (ambiguous)** terms.

Need: Something that is wanted or expected
Requirement: A formal structured statement

Requirement

A requirement is “a statement that *identifies a system, product or process characteristic or constraint*, which is *unambiguous, clear, unique, consistent, stand-alone (not grouped), and verifiable*, and is deemed *necessary* for stakeholder acceptability.” (INCOSE 2010)

IPO Diagram



Source: INCOSE SE Handbook v5

Major Activities

- Determine Stakeholders
- Elicit Stakeholder Needs
- Transform Stakeholder Needs into Stakeholder Requirements
- Determine the need for any enabling systems, products, or services
- Define Validation Criteria

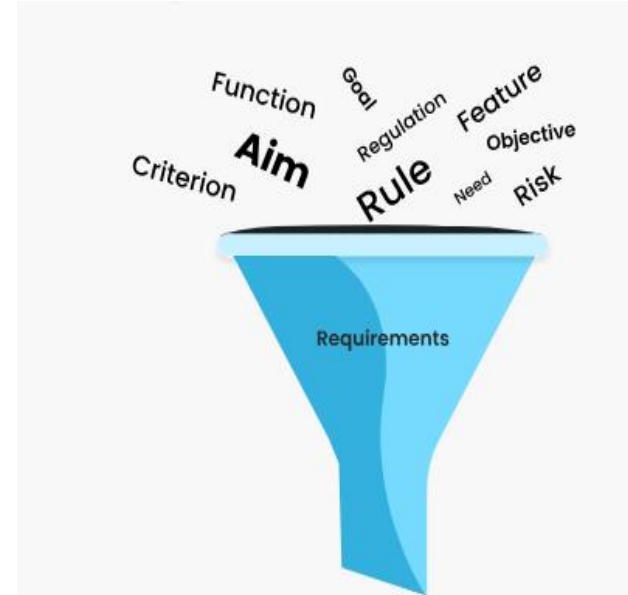
Major Artifacts

- Stakeholder Requirements Document
- Stakeholder Needs / Requirements elicitation reports
- Stakeholder Requirements Justification Documents
- Traceability Report between stakeholder needs and requirements

Requirements Elicitation

Requirements Elicitation

- Starting Point: Need Statement
 - Self Generated OR Given by Customer
- Purpose of Requirements Elicitation
 - Identify Stakeholders
 - Gather Stakeholder Needs and Requirements
- Useful Skills
 - Systems Thinking
 - Domain Expertise

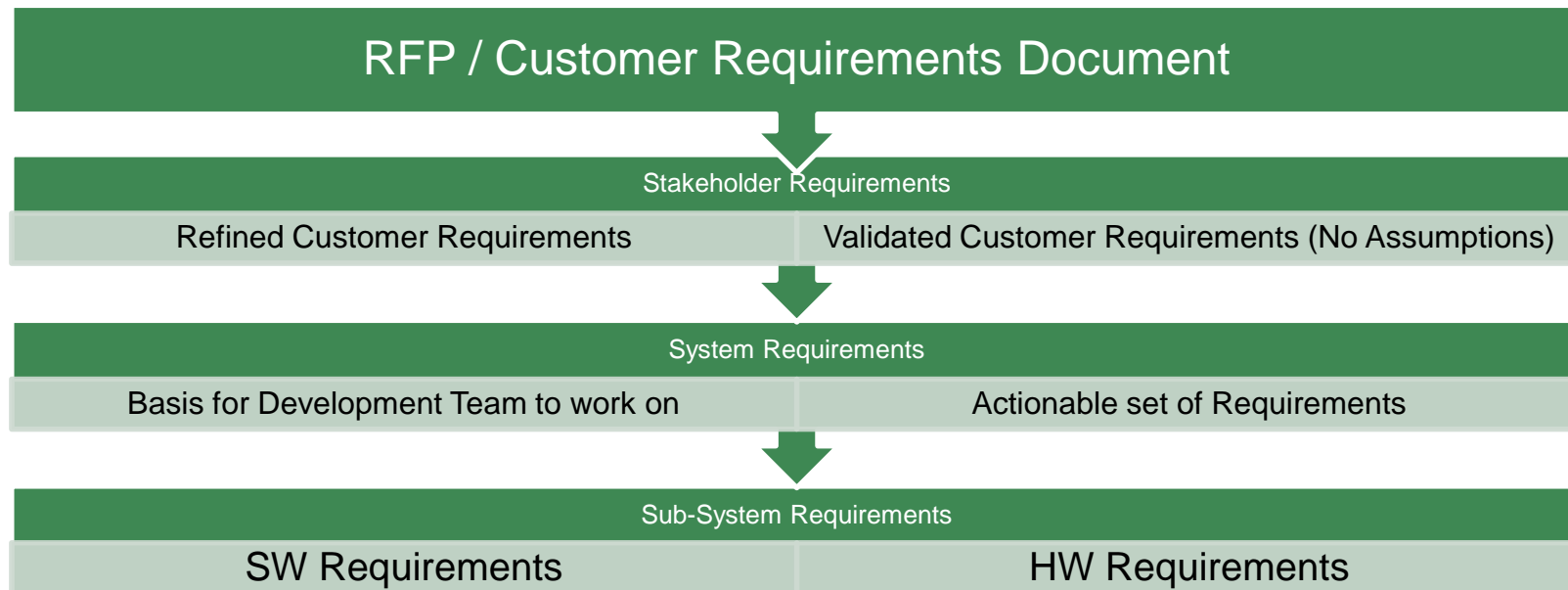


Challenges of Successful Requirements Elicitation

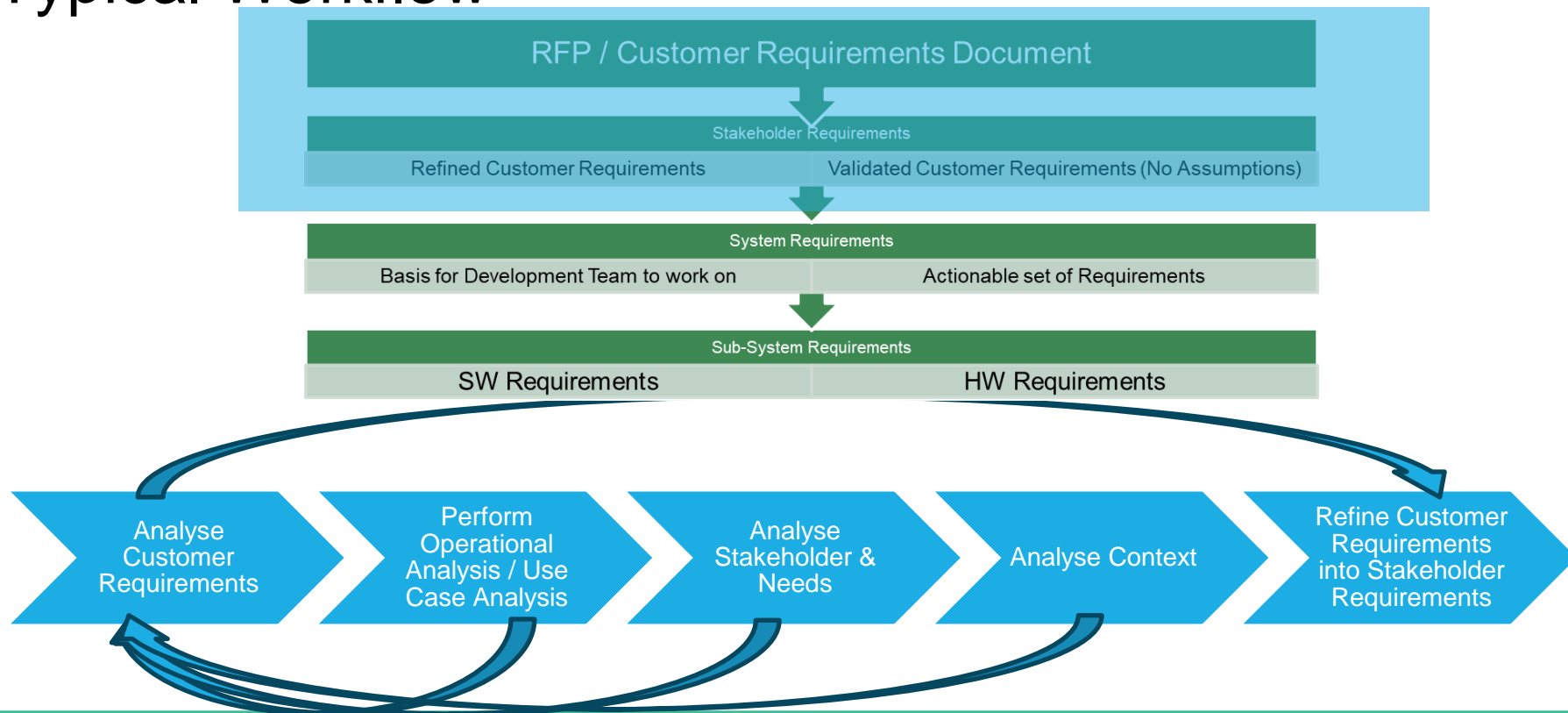
- Finding the right stakeholders
- Uncovering the best insights
- Documenting the requirements
- Planning for change
- Understanding System Context

Source : www.jamasoftware.com

Typical Elicitation Workflow



Typical Workflow



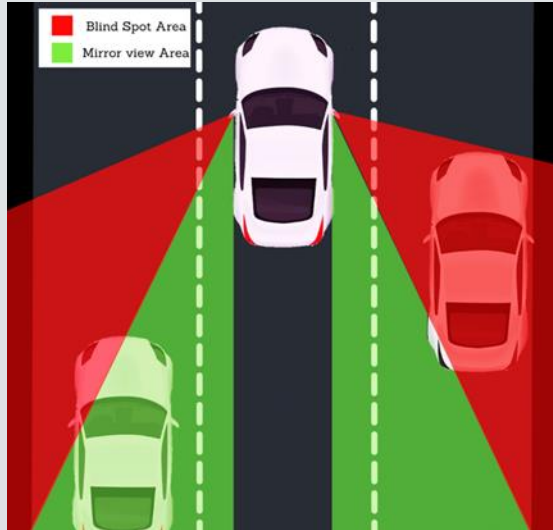
Team Exercise - Background

EcoIndia is a leading EV company specializing in passenger vehicles. They wish to add a new feature of “***Blind Spot Warning System***” to their upcoming Sedan Platform.

EcoIndia has initiated a RFP, and shared a High level Requirements Document. Your team has been tasked to conceive and develop this Feature.

Background

- Your SOI (System of Interest) : ***Blind Spot Detection (BSD)***



Elicitation Workflow

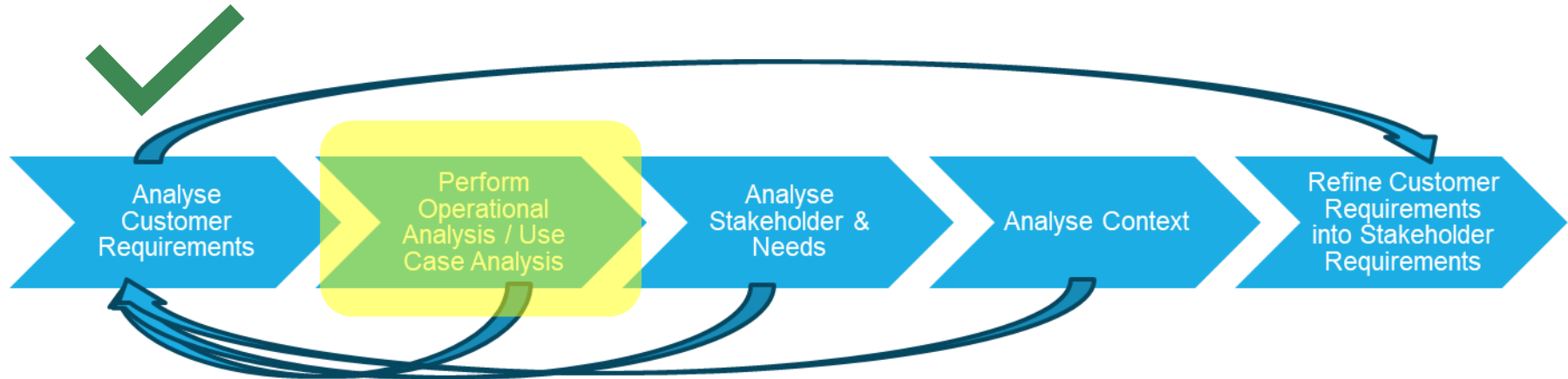


Exercise 2.1

- Read the HLD
- Discuss as a group
 - Do you have any questions for the Customer?
 - What assumptions are you making?

Operational Analysis

Elicitation Workflow



Use Cases

A **use case** captures a contract between the stakeholders of a system about its behavior.

It describes the system's behavior under various conditions as it responds to a request from one of the **stakeholders, called the primary actor**.

Description of a Use Case

- **Use case name:** a unique name for this use case
- **Scenario:** the instance of the use case being documented
- **Triggering Event:** the business event that initiates or triggers this use case
- **Brief Description:** a one or two sentence description of the results of the use case
- **Related use case:** any included use cases, or use cases that “include” this one
- **Stakeholders:** other persons, other than the actors, who have an interest in the results or successful completion of this use case
- **Precondition:** The state of the system before the use case begins
- **Postcondition:** the state of the system at the successful completion of the use case
- **Flow of activities:** a step by step sequence of the actions by the actor and the system internal to the use case
- **Exception conditions:** any exception conditions that cause the system not to follow the expected flow of activities or that cause the use case to terminate abnormally

Source Systems Analysis and Design in a Changing World, seventh edition

Operational Scenarios

- Description of an **imagined sequence of events** that includes the interaction of the product or service with its environment and users, as well as interaction among its product or service components. (ISO/IEC 2011)
- A **set of actions or functions** representing the dynamic of exchanges between the functions allowing the system to achieve a mission or a service. (Created for SEBoK)
- Stories which describe the **expected utilization of the future system** in terms of actions. (Created for SEBoK)

Buying an SUV



Source: www.cardekho.com

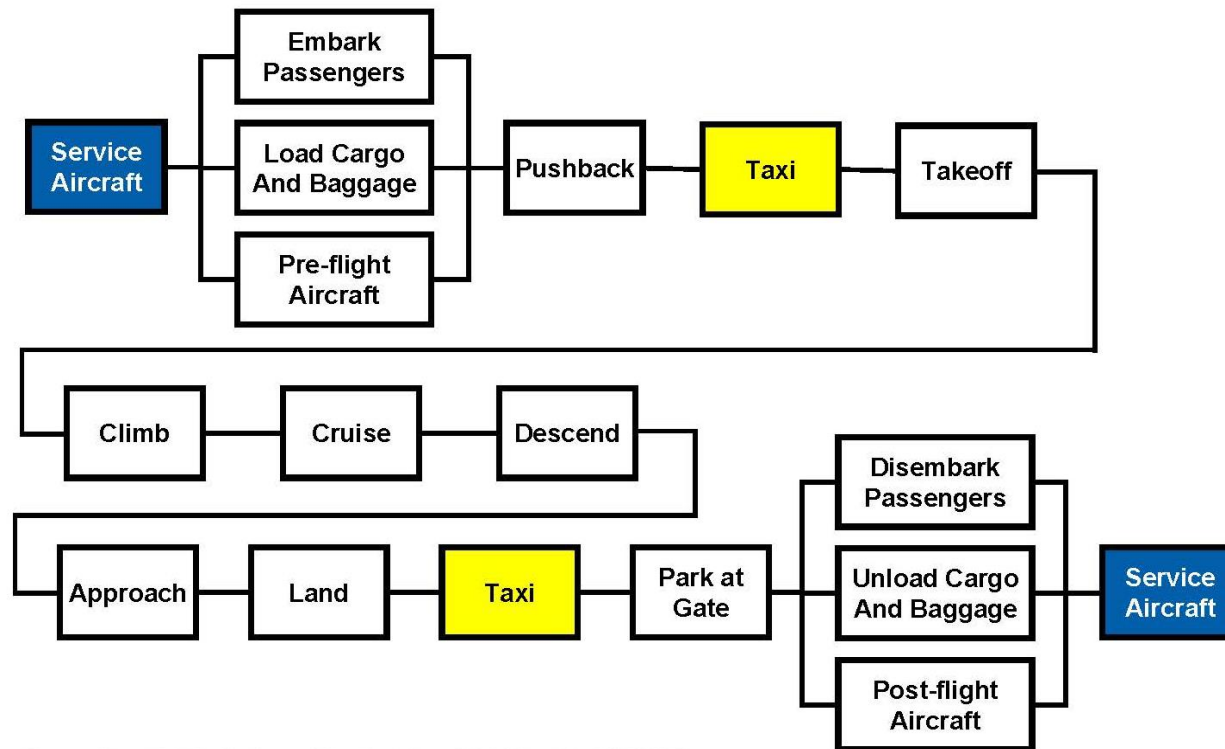
Operational Scenarios for a **Smart Phone**

- ✓ Daily Communication
- ✓ Internet Browsing
- ✓ Navigation and Travel
- ✓ Media Consumption
- ✓ Photography and Videography
- ✓ Productivity and Work
- ✓ Connectivity and Networking
- ✓ Customization and Personalization
- ✓ Emergency Situations
- ✓ Health and Fitness
- ✓ Security and Authentication
- ✓ Gaming and Entertainment

Concept of Operations (ConOps)

- The concept of operations defines at a conceptual level how the system actually operates when it delivers value.
- ConOps is a formal document that employs users' terminology to describe the rationale, uses, capabilities, and benefits of a system

ConOps – Commercial Aircraft



Source: van Gaasbeek, 2008



ConOps: Going to Work (physically)

Get Ready <i>(for the day)</i>				
Get Set <i>(for going to office)</i>				
Go <i>(from home to office)</i>				
Get Unset <i>(reach desk)</i>				
Get Unready <i>(settle at desk; get ready to work)</i>				



ConOps: what could go wrong?

Get Ready <i>(for the day)</i>				
Get Set <i>(for going to office)</i>				
Go <i>(from home to office)</i>				
Get Unset <i>(reach desk)</i>				
Get Unready <i>(settle at desk; get ready to work)</i>				

What are the benefits of ConOps

- Enables success on the left side of the V
- Effective stakeholder identification and requirements elicitation
- Enables early, high-level understanding of the System of Interest
- Bridges the gaps between various stakeholders
- Ensures requirements and designs are aligned with end-user expectations

Exercise 2.2

For your BSD(SOI),

1. Identify a few **Operational Scenarios / Use Cases**
(Stories which describe the expected utilization of the future system)
2. Create a **ConOps** for any **one** Operational Scenario
(As a Block Diagram, List, or Ready - Set - Go Framework)
3. Identify and list **stakeholders** that are involved in the **ConOps**

Stakeholders & Needs

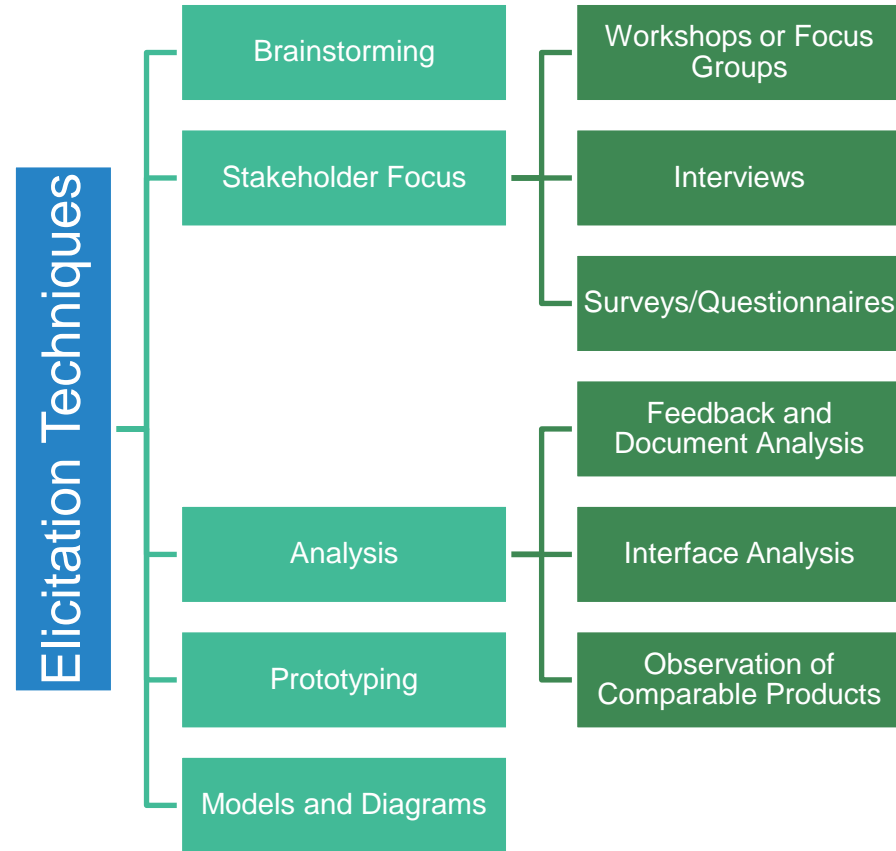
Elicitation Workflow



Identifying Stakeholders

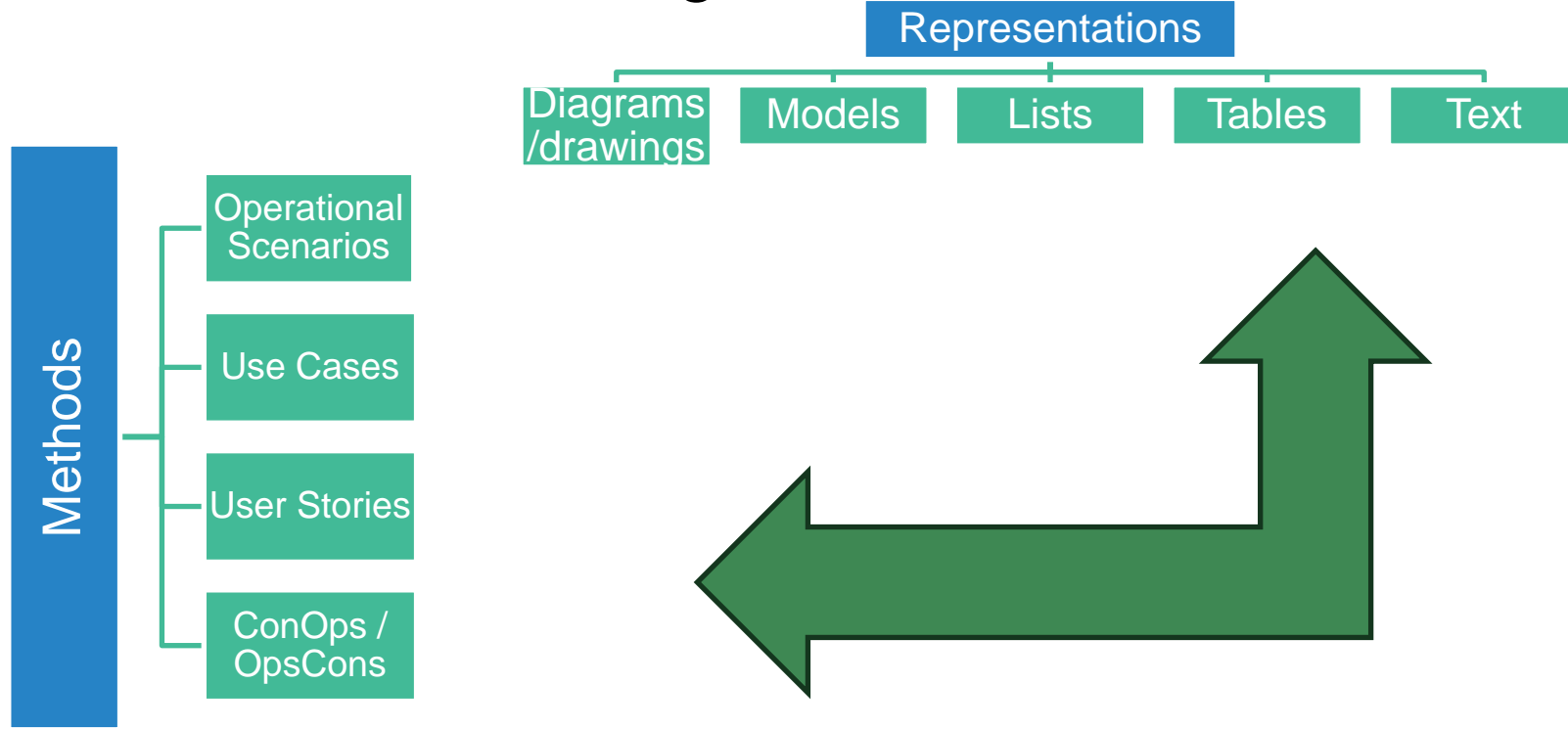
- Think about the entire life-cycle of the system
 - Different stakeholders during different life-cycle stages
- Think about “A day in the life of the system”
- Consider breaking down broad categories of stakeholders
 - Categories of ‘Users’
 - Nature of Interest in project/system
 - “Friendly” Stakeholders; Beneficiaries (interested in project/system success)
 - “Neutral” Stakeholders (don’t care, but critical for success)
 - “Unfriendly” Stakeholders (interest in project/system failure)
 - Lifecycle Stage
 - Internal (Solution Domain)
 - External (Problem Domain)

Needs Elicitation Techniques



Source : INCOSE Needs and Requirements Manual

Forms of Documenting Elicitation Outcomes

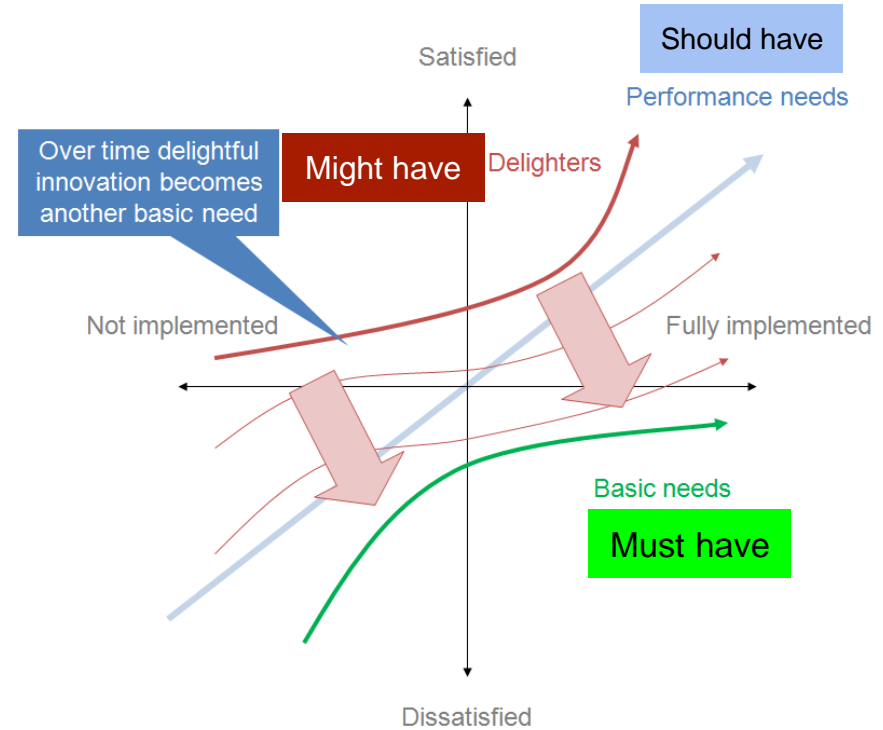


Needs characterization (Kano Model)

Must have: Its presence is absolutely essential, and I would regret its absence.

Should have: I would be satisfied by its presence, and I would regret its absence.

Might have: I would be satisfied by its presence, but I would not regret its absence



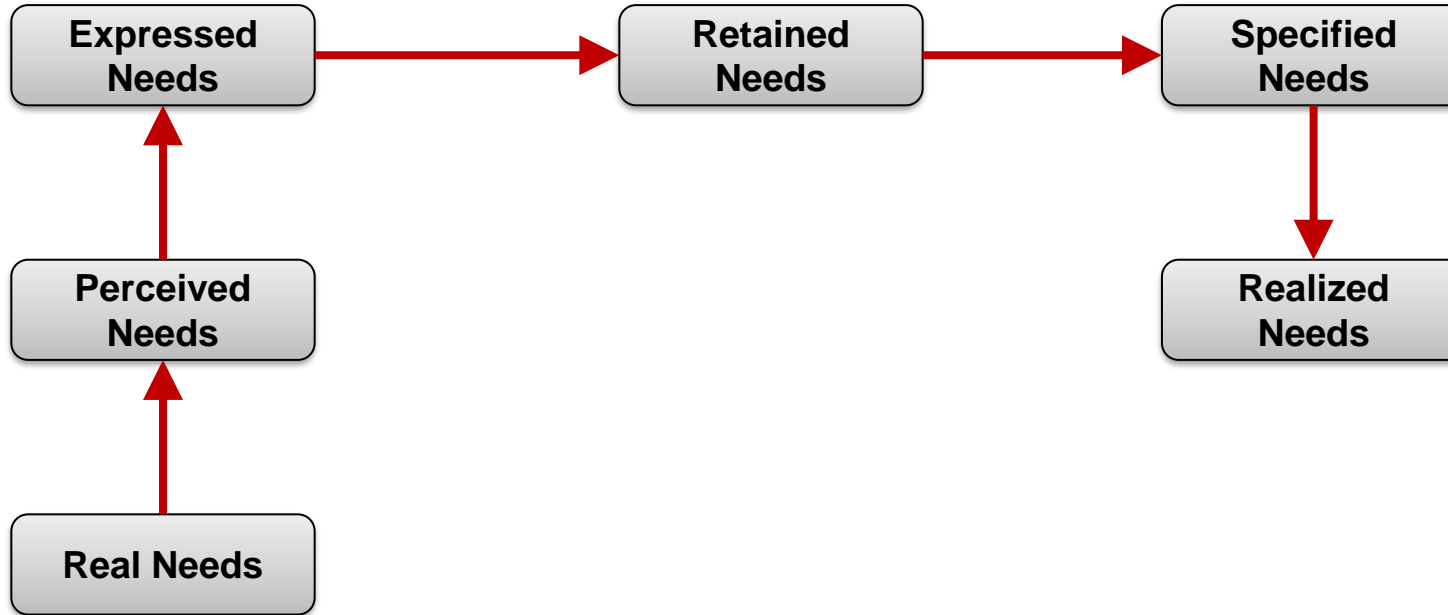
By Craigwbrown - Own work, CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=23262780>

Open Discussion : Evolution of Needs



What is the importance of the Kano model in Requirements Elicitation?

Types of Needs



Best Practice

- From stakeholders (particularly customers / end-user), elicit Needs; NOT Requirements
- Customers / end-users will typically want a solution
- Ask them about their problems
- A system that satisfies elicited requirements need not solve the problem!

Exercise 2.3

For your BSD(SOI):

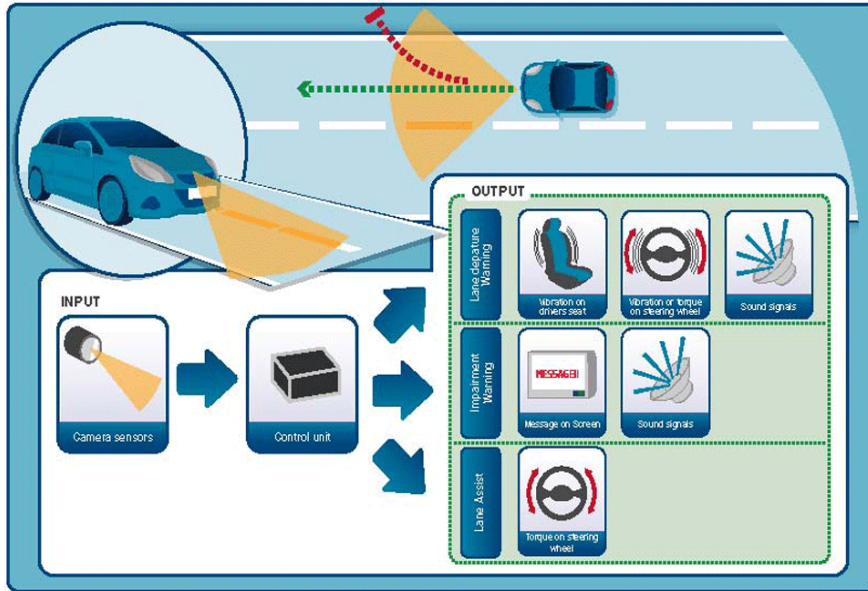
1. Identify various **Stakeholders**
2. Identify a few **Needs** that each Stakeholder may have
(i.e., stakeholder responses to the question “What do you expect from the SOI”?)

Use sheet ‘**Ex 2.3– STK**’ and ‘**Ex. 2.3 STK Needs**’ in ‘**Requirements Worksheet**’

[use Operational Scenarios and ConOps Exercise as a reference]

Open Discussion

LDW Lane Departure Warning / **LA** Lane Assist / **IW** Impairment Warning



- What are some challenges which Could be identified for LDW ?
- What will be your “needs” for LDW ?
- What solutions are you thinking?

Categories of Elicitation Problems

1. Problems of Scope
2. Problems of Understanding
3. Problems of Volatility
4. Problems of Resistance (non-cooperation)

Source: Christel and Kang, 1992; Saiedian and Dale, 1999

1. Problems of Scope

- Gathered requirements may provide too little or too much information
- Unnecessary design information may be given
- Boundary of the system may be ill-defined

2. Problems of Understanding

- Stakeholders have incomplete understanding of their needs
- Stakeholders have incomplete understanding of technologies and capabilities (of the system of interest)
- Obvious information can be omitted
- Stakeholders may have conflicting views
- Needs are vague and untestable
- Use of imprecise terminology, sentence structure

3. Problems of Volatility

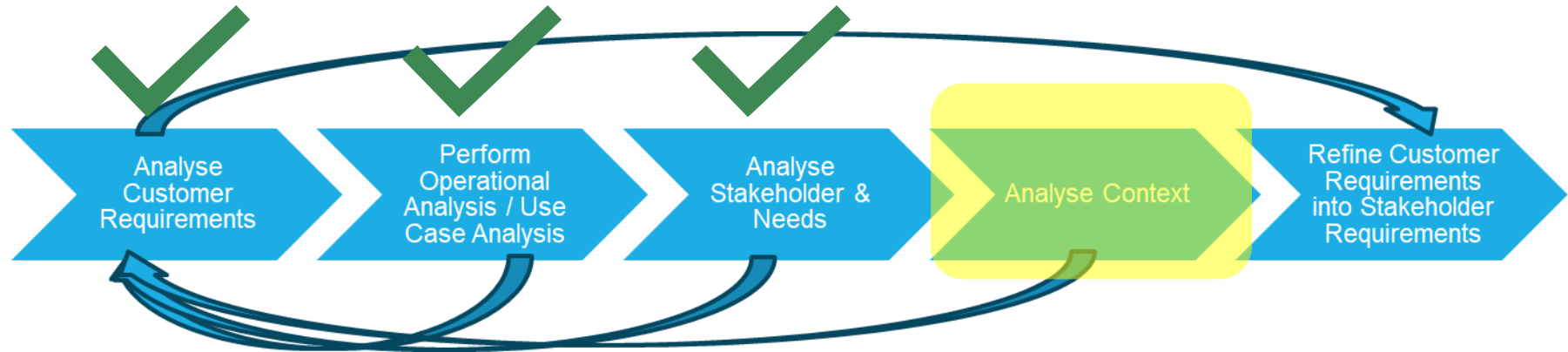
- Stakeholder needs evolve over time
- Stakeholders' awareness / knowledge of their needs may increase during development activities
- If new / modified requirements are not addressed, the system may not be acceptable

4. Problems of Resistance

- Time Resistance
 - Person does not have the time to meet
- Overload Resistance
 - Person wants more information than what you provide
- Silence Resistance
 - Person does not react or respond to questions
- Impracticality Resistance
 - Person states that what you are stating will not work in the real world
- Compliance Resistance
 - Person agrees with everything you say

Context Diagram

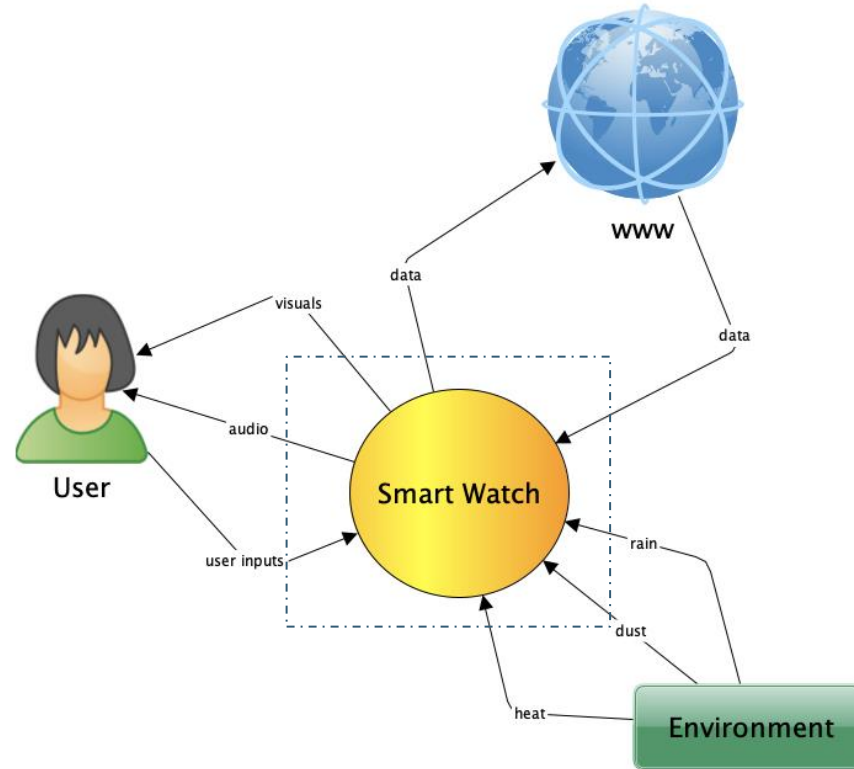
Elicitation Workflow



Context Analysis

- The circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood.
 - Oxford Dictionary
- Describes the system relationships and environment, resolved around a selected system-of-interest.
 - (Flood and Carson 1993) SEBoK
- Diagram defining the highest-level view of a system in its environment.
 - (Flood and Carson 1993) SEBoK

Context Diagram – Smartwatch [Example]



Context Diagram

- Also known as “External Systems Diagram”
- Identifies / defines:
 - System scope/boundary
 - Interactions with external environment / systems / entities
 - External events and external inputs to which the system must respond
 - Data / information to be produced by the system
 - External data / information required by the system

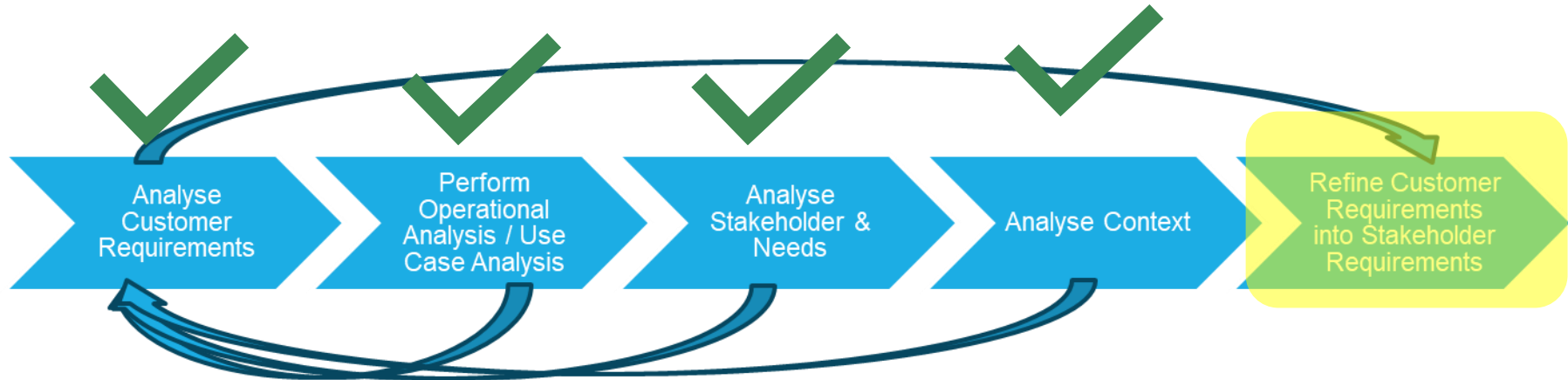
Exercise 2.4

For your **Blind Spot Detection System (SOL)**:

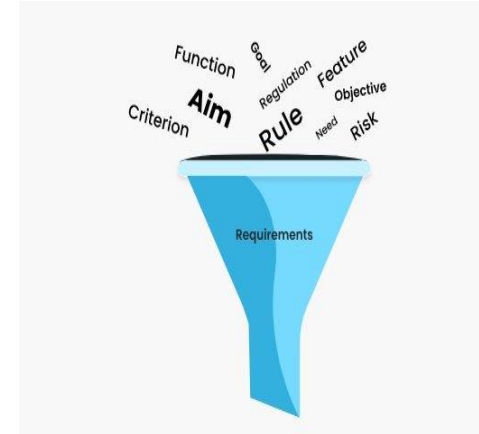
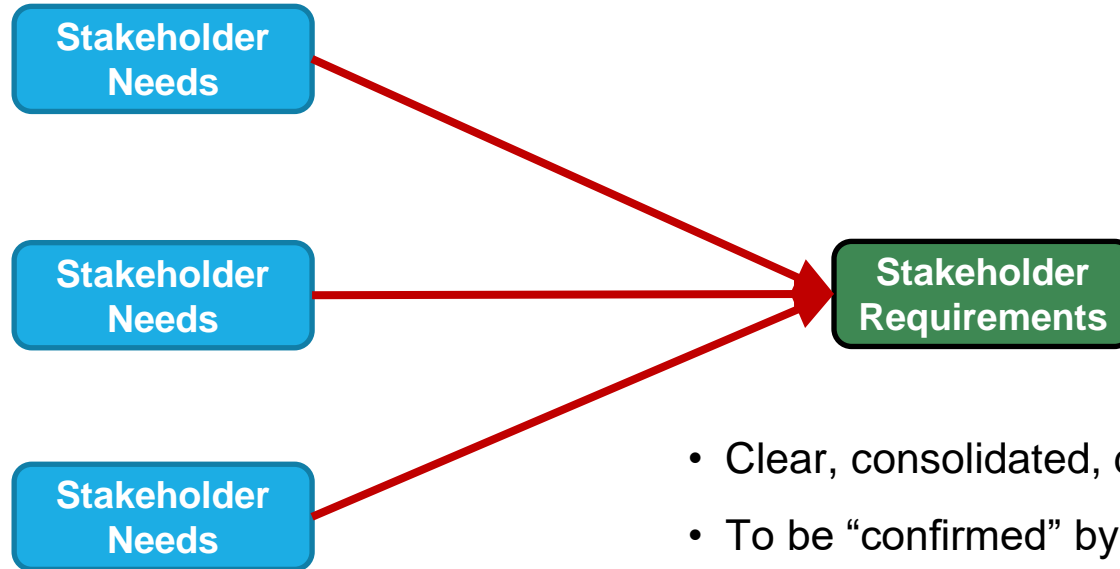
- Give a **name**
- Draw a **Context Diagram**
 - ☐ Identify external entities
 - ☐ Draw arrows indicating the direction of flow of data / information
 - ☐ Label the arrows
- Go back to HLD, and see if any interface requirements are missing

Stakeholder Needs to Stakeholder Requirements

Elicitation Workflow

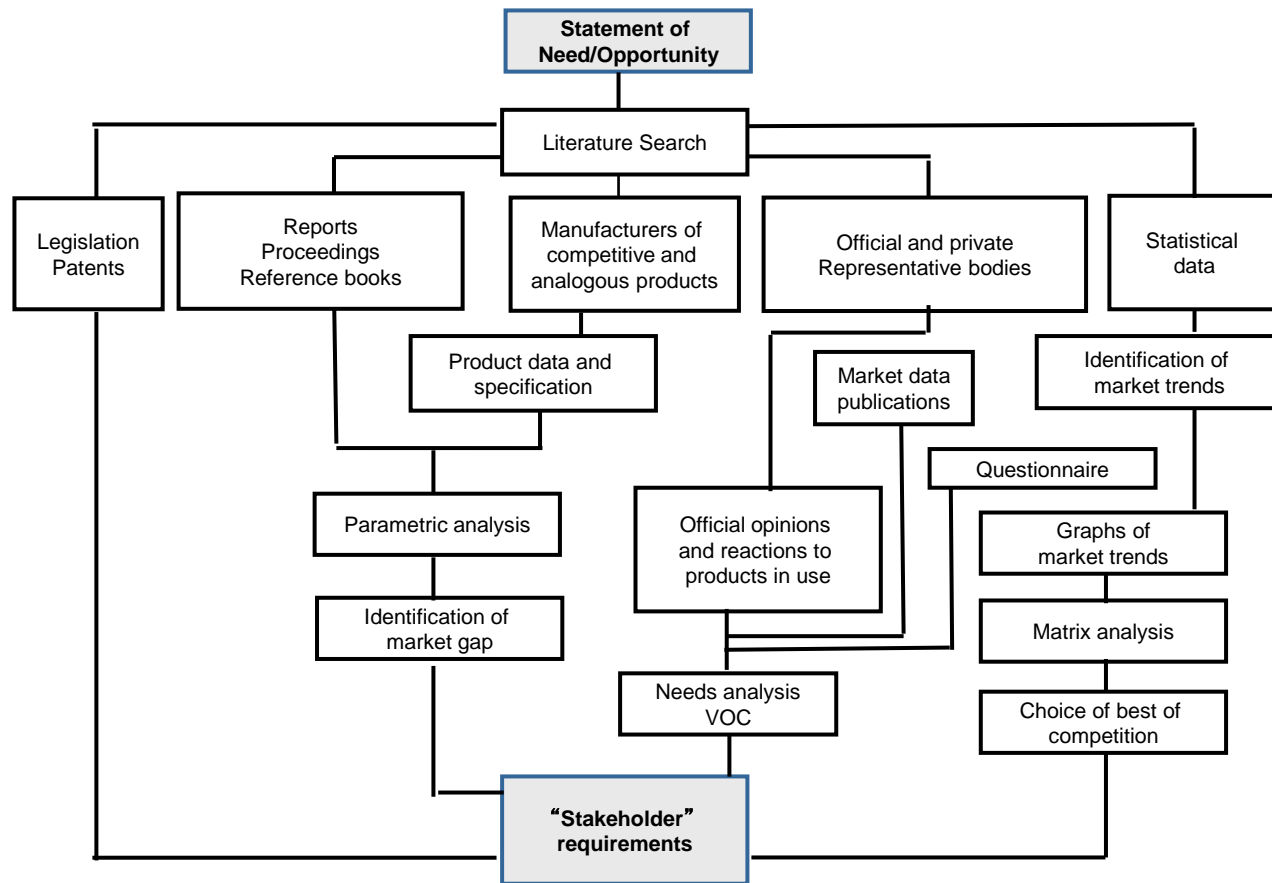


Needs to Requirements



- Clear, consolidated, documented set of statements
- To be “confirmed” by the respective stakeholders
- Will be the basis for “System **Validation**”

Stakeholder Requirements



Transforming Needs to Requirements

- **System Validation is based on Stakeholder Requirements**
- Additional interactions with the Stakeholders will be needed
- Ask “Why”; try to get to the ‘Real Needs’; document the ‘What’, not ‘How’
- Some stakeholder needs may give rise to multiple stakeholder requirements
- Requirements must be ‘Testable’ - must be able to prove that they are met
- Confirm with the Stakeholder that the ‘proof’ will be acceptable
- Resolve any issues related to considering the full list of ‘Stakeholder Requirements’ as one set.

Requirements Engineering Effort (thus far)



Potential Stakeholders across the System Lifecycle

Lifecycle Stage	Potential Stakeholders
Define	Paying customer, sponsor, project team, project manager, procurement, research and development, suppliers, regulating authorities, public, marketing, end users, operators, compliance office, regulators, owners of enabling systems, owners of external systems, Approving Authorities
Develop	Project team, subject matter experts (SMEs), system architects, design engineers, suppliers, procurement, etc.
Produce	Production organization, process engineers, quality control, production verification, product acceptance, supply chain
Integrate, Verify, and Validate	Test engineers, system integration engineers, system verification engineers, system validation engineers, operators/users, owners of enabling systems, facility personnel, contracting, Approving Authorities, regulators, safety personnel, security personnel
Operate	Transporters, installers, users, operators, safety engineers, security engineers, owners of external systems, IT, regulators, quality, mission assurance
Sustain/Maintain	Customer/technical support, replacement part providers, service technicians, trainers, IT, quality engineer, inspectors, CM, those conducting post development system verification and system validation activities.
Dismantle/Dispose	Operators, waste management, regulators, public

What we
got from
ConOps /
UseCases

Source : INCOSE Needs and Requirements Manual

Typical Stakeholders' Perspectives & Concerns (1)

Stakeholders	Example Perspectives/Concerns
Customer/Sponsors (those providing resources or have requested the system)	Cost, schedule, resources to develop Cost and resources to operate and maintain - lifecycle costs Whether the system will meet their needs Quality Risks ROI
Customers (those that will buy and use a consumer product)	Features/capabilities (functions) Cost/schedule User interface / user experience Whether the system will meet their real-world expectations Performance: speed, accuracy, precision Safety, Security Quality: reliability, maintainability, updateability, lifecycle costs
Users/operators (those using or interacting with the operational system)	Features/capabilities, functionality Whether the system will meet their real-world expectations User interface, user experience, usability, operability Performance: speed, accuracy, precision Quality: availability, reliability, robustness Safety, Security Operating environment

Typical Stakeholders' Perspectives & Concerns (2)

Marketing	<p>Capabilities, features, performance, and quality better than their competitors</p> <p>Providing a product that consumers need, want, and will buy</p> <p>Making customers happy, increasing market share</p>
Project management	<p>Understanding the stakeholder needs and stakeholder-owned system requirements</p> <p>Feasibility of what is being asked for</p> <p>Drivers and constraints</p> <p>Enabling systems (hardware, SE tools, networks)</p> <p>Schedule/budget</p> <p>Available resources and personnel</p> <p>Risks</p> <p>Compliance with standards and regulations</p>
Contractors, Suppliers, Vendors	<p>Understanding what the customer real-world expectations are</p> <p>Understanding what the deliverables are</p> <p>Understanding what the customers measures are</p> <p>Understanding what is necessary for acceptance</p> <p>Schedule and budget</p> <p>Profits</p> <p>Keeping their customers happy</p>

Typical Stakeholders' Perspectives & Concerns (3)

Developers/Engineering	<p>Understanding the stakeholder needs and stakeholder-owned system requirements</p> <p>Feasibility of what is being asked for</p> <p>Drivers and constraints</p> <p>External system interactions</p> <p>Enabling systems (hardware, SE tools, networks)</p> <p>Schedule/budget</p> <p>Operating Environment</p> <p>measures (what will make customers happy and accept the SOI)</p>
Production Engineers	<p>Timeliness and quality of the design output specifications</p> <p>Ability to produce quality products - repeatably, at the needed rate and yield</p> <p>Changes/updates needed to the existing manufacturing capability</p> <p>Feasibility in what they are being asked to do</p> <p>Cost and Schedule</p>
Integrators, verifiers, validators	<p>Quality of the built or coded system (built/coded) in accordance with the design output specifications</p> <p>A realized, integrated system that can be verified to meet the design input requirements and validated to meet the set of needs</p> <p>Testability of the system</p> <p>Infrastructure to enable integration, system verification, and system validation (hardware/software)</p> <p>Access to test points to get needed data</p>

Typical Stakeholders' Perspectives & Concerns (4)

Maintainers/Technical support	Installation and setup Maintainability Tools needed to maintain and repair Logistics of spare parts Shipping and storage Reliability, failure rate, time to repair Configuration management
Facility personnel	Operating environment Support services Enabling systems Safety, Security
Regulators and government	Compliance with standards and regulations Consumer safety
Information Technology (IT)	IT hardware (Networks, servers, workstations) Application support software Security
Disposers	Use of hazardous materials Safety Environmental impacts Reusability of parts and materials
The public at large	Safety and security Environmental impacts

Exercise 2.5

- Convert the Stakeholder Needs to Stakeholder Requirements [Sheet..]
- Discuss and share the requirements that were not existing or changed from HLD.

Exercise 2.6

- As an internal stakeholder (i.e. BSD Design Team), what stakeholder needs/requirements would you provide to the Vehicle-level Systems Engineering Team?
- How would these requirements change from vehicle-to-vehicle

The End