• Requirement 15 (Section 3.2.1.1) “The Center Directors or designees shall establish and maintain a process, to include activities, requirements, guidelines, and documentation, for the definition of stakeholder expectations for the applicable WBS model.”
Suddenly There Is A Heated Argument!

Why?

Far Side cartoon of two cavemen arguing removed due to copyright restrictions.
Stakeholder Expectation Definition
Purpose and Importance

• The Stakeholder Expectation Definition Process is used to:
  – Identify who Stakeholders are (for all phases of the project)
  – Identify how the product is intended to be used by the stakeholders
  – Elicit and define stakeholder expectations (including use cases, scenarios, operational concepts) in ways we can measure (validate) the appropriateness of our system when completed.

• Result is the foundation from which the system is designed and the product realized.
Who is a Stakeholder?

- A group or an individual who is affected by or is in some way accountable for the outcome of an undertaking

- Stakeholders can be classified as:
  - **Customers** – An organization or individual that has requested a product and will receive the product to be delivered. Examples:
    - An end user of the product
    - The acquiring agent for the end user
    - The requestor of the work product from a technical effort
  - **Other interested parties** who provide broad overarching constraints within which the customers’ needs must be achieved, or who have influence on success of the system. Examples:
    - Those affected by the resulting product
    - Those affected by the manner in which the product is realized or used
    - Those who have a responsibility for providing life-cycle support services (e.g. design, manufacturing, operations, maintenance)
## Example Technical Stakeholders

<table>
<thead>
<tr>
<th>Relative to Org</th>
<th>Stakeholder</th>
<th>Typical Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External</strong></td>
<td>Customer</td>
<td>Expected level of product quality, delivered on time, affordable, life cycle support &amp; services</td>
</tr>
<tr>
<td></td>
<td>Subcontractors/vendors</td>
<td>Well defined requirements</td>
</tr>
<tr>
<td></td>
<td>Local, State, National Public</td>
<td>Products must not contaminate the environment</td>
</tr>
<tr>
<td><strong>Internal</strong></td>
<td>Org Management</td>
<td>Internal Commitments met (cost, schedule), good status provided, compliance with org policies, directives and procedures</td>
</tr>
<tr>
<td></td>
<td>PM</td>
<td>Expected technical work products delivered on time and can be used for decision making</td>
</tr>
<tr>
<td></td>
<td>Technical Team members</td>
<td>clear tasks, job security, rewards, teamwork</td>
</tr>
<tr>
<td></td>
<td>Functional Organizations (e.g., test)</td>
<td>Test support products available, clear test requirements, recognition for project help</td>
</tr>
</tbody>
</table>
Stakeholders are Everywhere . . .

- Capabilities
- Functions
- Priorities
- Reliability
- Maintainability
- Supportability
- Producibility
- Operations
- Maintenance
- Logistics

System Performance
- System Availability
- Technical Effectiveness
- Process Efficiency

System Effectiveness

Affordable Operational Effectiveness

Life Cycle Cost/Total Ownership Cost
The Vision for Space Exploration: Foundations for Exploration

- Complete the International Space Station
- Safely fly the Space Shuttle until 2010
- Develop & fly the Crew Exploration Vehicle no later than 2014
- Return to the Moon no later than 2020
- Extend human presence across the solar system & beyond
- Implement a sustained & affordable human & robotic program
- Promote international & commercial participation in Exploration

**NASA Authorization Act of 2005**

The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations.
Stakeholder Expectations Definition Guidance – Concept of Operations

- One of the major outputs for capturing stakeholder expectations is the Concept of Operations or “ConOps”
- The ConOps is an important component in capturing expectations, forming requirements and developing the architecture of a project
- Should be addressed early in the project
- Thinking through the ConOps and use cases often reveals requirements and design functions that might be otherwise overlooked
Constellation ConOps for Mission to ISS

Docked for ~ 6 Months

SM Expended

Landing

Continue Missions

ISS DRM

DRM = Design Reference Mission

Source: CxP 70007 Cx Design Reference Missions
Design Reference Missions
Mission Key Driving Requirements

- Altair performs LOI 1,000 m/s (3,281 ft/s) (Propellant load for 950 m/s)
- Altair TLI injected control mass 45 t (99,200 lbm)
- EDS performs TLI 3,175 m/s (10,417 ft/s)
- Areas-I Delivered mass 23.6 t (52,070 lbm) 4 days LEO loiter
- Descent ΔV 2,030 m/s (6,660 ft/s) L1/2/L2 descent engine restartable/throttleable
- Sizing: Altair ΔV for LOI L100 m/s (3,281 ft/s)
- 3-burn LOI 1-5 days Altair LLO loiter
- Orion
  - Orion TLI control mass 20,185 kg (44,500 lbm)
- EVO up to 241 km (150 mm), minimum 222 km, LEO attitude = Gravity gradient
- -20x185 km (-11x100 km), 2s

Ascent 1,881 m/s (6,171 ft/s)
- 100 kg (220 lbm) pressurized return payload TBD hrs post lunar ascent

Image by MIT OpenCourseWare.
Concept of Operations Developed at Lower Decomposition Levels

Orion Low Impact Docking System (LIDS)
Example of Constellation Stakeholder Expectation MOEs

- Ability to transport six crew members to/from the ISS.
- Ability to deliver four crew members to the lunar surface and return them to Earth.
- Ability to deliver six crew members to the surface of Mars and return them to Earth.
Shakeholder Expectations

Definition

Discussion

• How do we identify what the stakeholders really want?

• How do we prevent stakeholders from designing the system?
Stakeholder Expectations Definition - Best Practice Process Flow Diagram

Input

From Project
- Initial customer expectations
- Other stakeholder expectations

From Design Solution Definition (recursive loop) and Requirements Management and Interface Management processes
- Customer flowdown requirements

Activities

1. Establish list of stakeholders
2. Elicit stakeholder expectations
3. Establish operations concept and support strategies
4. Define stakeholder expectations in acceptable statements
5. Analyze expectation statements for measures of effectiveness
6. Validate that defined expectation statements reflect bidirectional traceability
7. Obtain stakeholder commitments to the validated set of expectations
8. Baseline stakeholder expectations

Output

To Technical Requirements Definition and Requirements Management and Interface Management processes
- Validated stakeholder expectations

To Technical Requirements Definition and Configuration Management processes
- Operations concept
- Enabling product support strategies
- Measures of effectiveness
Interrelationships Among the System Design Processes

Legend:
- Stakeholder Expectations Definition
- Technical Requirements Definition
- Logical Decomposition
- Design Solution Definition
- Decision Analysis

SP-2007-6105, Figure 4.0-1
What are the Benefits of the Stakeholder Expectations Process?

• Build a system that meets customers’ expectations
  – Operators requirements
  – Support from Congress and public

• Build a system that can be tested, operated and maintained

• Ensure Stakeholder commitments are obtained and realized.
Stakeholder Expectations Definition - Summary

- Stakeholders can be classified as customers or other interested parties who affect the product.
- Stakeholder Expectations can be captured in a Concept of Operations or “ConOps” and with Measures of Effectiveness (MOEs).
- Stakeholders should be involved throughout the product lifecycle.
- Stakeholder expectations can be found in multiple layers of the product decomposition.
16.842 Fundamentals of Systems Engineering
Fall 2009

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