"10 Golden Questions"
for
Concept Exploration
&
Development

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Customer Success Is Our Mission

Overview

- Definitions
- 10 “Golden Questions”
- Apply to Audience Examples
- Summary
- Q & A

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Definitions

- Concept Exploration
- CONOPS
- Systems Engineering Life Cycle
- System, Product, Component
- Concurrent Engineering
- Failure Modes and Effects Analysis (FMEA)

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1. Who are the SYSTEM stakeholders?
2. What are the SYSTEM goals/objectives?
   a) User/Maintainer/Sustainer
      1) Operations, Support.
      2) Mission scenarios.
      3) Production, sustainment, supply chain.
      4) Life cycle needs for growth/improvement (P^3I)
   b) Enterprise stakeholder goals, objectives and constraints?
3. What is the market for this SYSTEM?
   a. Where?
   b. When?
   c. Why?
   d. How funded?

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4. What are the external constraints the SYSTEM must satisfy?
5. What is the operating and support concept for the SYSTEM ?
   a. Major states, modes, transitions
   b. Environments
      1) Operating & Maintaining
      2) Storage & Shipping/Transportation
   c. Measures of Effectiveness
   d. Life Cycle Cost, CAIV & Cost of Ownership
   e. Maintenance levels & supply chain

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6. What is the SYSTEM architecture context?
   a. People
   b. Facilities
   c. Support equipment (tools & testers)
   d. Manufacturing process capabilities
   e. Training
   f. Products (knowledge, goods, services)
7. What are the man-machine interface criteria to be satisfied by the SYSTEM ?
   a. Operators & Maintainers
   b. Market-driven standards (ISO, ANSI, etc.)

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8. What are the key SYSTEM attributes?
   a. Four (4) types of attributes, or 'requirements':
      1) Performance
      2) Environmental
      3) Interface
      4) Design Constraints
   b. Format of 'requirements':
      1) Value, Relation, Units
      2) Method of Verification (IADTS)

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9. What are the SYSTEM functions (behaviors) that will satisfy the SYSTEM attributes?
   - Derive from System Context
   - Compatible with System CONOPS
   - Help "allocate" System-level requirement

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10 What happens if the SYSTEM fails to satisfy or perform as defined by 1-9?

a. Potential "effects of failure" (qualitative, worst case; mission success, users, maintainers, by-standers)
   1) Severity
   2) Likelihood of occurrence

b. What should be done to control or mitigate the potential for those SYSTEM failures?
   1) Design
   2) Manufacturing
   3) Training
   4) Usage limitations or advisories

Questions 1-10 are **repeated** using **PRODUCT** or **COMPONENT**.

Questions from the Audience!!

Summary

- Customers often want more than they will tell us, or even understand that they want it.
- Ask questions to find out what is most important (to all the stakeholders).
- Think of the life cycle, the user & those who must support and sustain the system:
  - Product Development
  - Product's in-service life
- Systems have several layers in their architectures, think it through from multiple perspectives.
- Ask "what if it fails to ------?!" Often!!!!

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Biography

Dr. Surber is an INCOSE Certified Systems Engineering Professional, and has worked as a pilot, engineer and manager in avionics systems and heavy equipment engineering for over 30 years with three large defense contractors and a large, commercial corporation. He is an experienced senior pilot, flight examiner/ instructor, human factors engineer, systems safety engineer, and military accident investigator. He has accumulated over 5,000 hours of flight and simulator time in 17 types of military and commercial aircraft; holds a pilot rating in single and multi-engine aircraft; and, is a rated parachutist. In 1998 he retired after 29 years of military service with the United States Air Force, and with the Army National Guard and Reserve in various armor, mechanized infantry, aviation and military intelligence units. He is a Principal Systems Engineer for Raytheon, where he works on the V-22 Osprey program, and supports process improvements as a Raytheon Six Sigma Specialist. Dr. Surber has been a member of INCOSE since 1998, and is currently Past-President for the INCOSE Crossroads of America chapter in Region IV.

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Abstract

- Project engineers and development teams must be able to quickly understand the customer's need. There are many tools, methods, and processes suggested for conducting "Concept Exploration" and "Concept Development". The author believes that there are "10 golden questions" which get the requirements elicitation done right. They apply to any Product (knowledge, good or service), system, or organizational structure. The "10 Questions" go a bit further than grammar school's: "who, what, where, when, why, and how." Interaction with the customer/user illumines a key aspect of the system solution, "How does failure affect customer satisfaction?" Asking, "What if the product, (seen at its various levels of decomposition such as, "system/product/component"), FAILS to satisfy these 'requirements'?", leads the designer to a better system solution. These answers take one to the next important discovery, answering, "how do we achieve mitigation and control of any critical failure modes and their effects on mission success, (through design, manufacturing, materials, and training)."
- This is the true purpose of the systems engineering lifecycle.