Applying Validation Techniques Across the System Life Cycle

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Did we meet the customer’s needs?

• How do you know if your system meets the customer’s operational mission?

• The typical Systems Engineering process satisfies the tasks for each of the life-cycle phases, but…
  – Did we build the right product?
  – Do we know what the product does?
  – Do we know how the customer will use the product?
  – Do we know the operational mission of the product?
**Understanding Validation**

- Requirements for the Diesel Fuel Dispensing System
  - Design a diesel fuel dispensing system.
  - Include a nozzle length of at least 4 inches.
  - Dispense fuel into a tank that is between 6 inches and 6 feet from ground level.
  - An operator shall be able to dispense fuel
  - The system shall reside at the customer’s facility.
Understanding Validation

• But, here’s what the customer wanted…

• What is the price of delivering a product without proper validation?
  – Reputation
  – Rework
  – Schedule Delays
  – Loss of Follow-on Orders
Operational and Support Implementation System (OASIS)

OASIS Provides:
- Flight Planning
- Weather Graphics
- Upgrades to Flight Service Stations

Awarded by FAA in 1997
- COTS HW
- COTS\NDI Software
- One B-Spec
Who Defines the Mission?

- Multiple FAA Customer Interfaces
  - Program Office
  - Requirements Group
  - Security Organization
  - Test and Verification Team
  - National Airspace System Operations
  - Engineering & Installation
  - End Users
    - Flight Service Specialists
    - Flight Service Supervisors
    - Flight Service Maintenance

Who validates OASIS?
What Happened?

- Original procurement strategy was a COTS/NDI lease service with minimal development.

- Additional Human Factors Team and Functional requirements resulted in increased development and test necessitating a modified COTS/NDI based software solution.
OASIS Life Cycles

System Architecting
- CONOPs
- System Architecture
- B-Spec
- IRDs
- SRR

Requirements Analysis
- Design Reviews
- ICDs

System Design

System Development
- Peer Reviews
- Code & Unit Test
- Integration Test
- TRR
- Formal Test Procedures
- Customer (Test) Witness and Approval

System Verification & Test

Contractual Compliance

PTRs/No Acceptance!

User Validation
- Users 1st exposure
- Operational Testing

Full User Participation
Partial User Participation
No User Participation

Partially or fully implementing validation techniques across the system life-cycle is crucial for ensuring the success of any project.
Changes

- The OASIS Program utilized concepts from the CMMI® Validation Process Area.
  
  “The purpose of Validation is to demonstrate that a product or product component fulfills its intended use when placed in its intended environment.”

- Increased user involvement (and buy-in…) during:
  - Chalk Talks
    - Task Description Development and Approval
  - Technical Exchange Meetings
  - User Assessment Tests
Chalk Talks

- Informal Conduct – free exchange of ideas
- Empowered team of customers
- Defined Stakeholder Matrix
- Issues discussed and resolutions brainstormed
- Results form basis of a Task Description
- Active participation by every stakeholder
Task Descriptions (TDs)

- TD Development included:
  - Background Information
  - Concept of Operations
  - Subsystem Changes
  - Messages
  - User and External Interfaces
  - Implementation Notes
  - Affected Documentation
  - Security Considerations
- Peer Review by all stakeholders
- Stakeholder approval
  - Validates mission, requirements, and high-level design
Technical Exchange Meetings (TEMs)

- TEMs held informally throughout development effort
  - Database
  - Hardware
  - Interfaces
  - Test
  - Training
  - Security
- Validating implementation approaches, revisiting:
  - Are we building the right product?
  - Do we know what the product is supposed to do?
  - Do we know how the customer will use the product?
  - Do we know the operational mission of the product?
User Assessment Tests

- Users at development facility – “Hands On”
- Preceded by Verification and Regression Testing held with FAA Test and Verification Team
- Users validate true operational scenarios prior to site installation
- Users granted full access to development staff
  – Reducing requirement interpretation issues
OASIS Program Background

Chalk Talks
- CONOPs
- Issues Identified
- Brainstorming
- Basis for TD

Task Description Development
- TD Drafted
- Peer Review
- TD Approval
- Included in B-Spec

System Development
- Peer Reviews
- Code & Unit Test
- Integration Test
- Prototyping
- TEMs
- TD Updates

System Verification & Test
- On-going review of TD Test Procedures
- On-going TRR
- Verification Test
- Regression Test
- User Assessment Test

Contractual Compliance

Acceptance!

User Validation
- Users have been involved since requirement definition
- Operational issues surfaced during System Verification & Test

Users have been involved: Full User Participation, Partial User Participation, No User Participation
Results

- Reduced cycle time of requirement development to deployment
- User buy-in of end product
  - They were a major part of development team
- Significant reduction in Problem Tracking Reports
- Increased Customer’s trust in relationship
- User Acceptance
- Fully operational system, as user expected
  - Currently deployed in 16 Flight Service Stations
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