Applying Validation Techniques Across the System Life Cycle

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Did we meet the customer's needs?

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- 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.
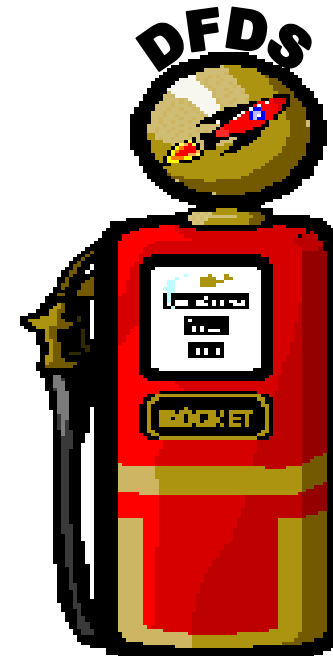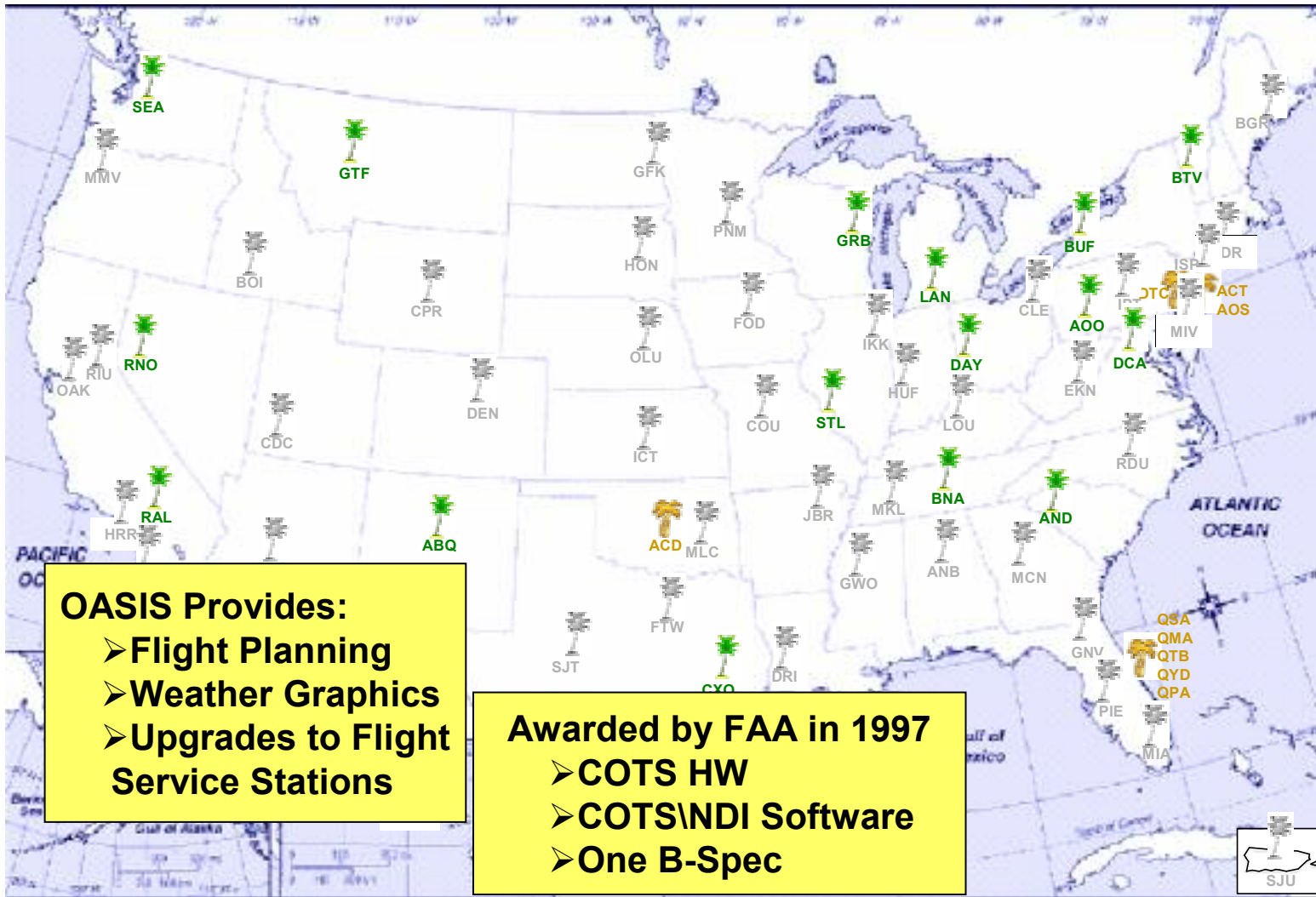
Understanding Validation

- 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)

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Map of the United States showing OASIS implementation sites:

Locations: SEA, MMV, GTF, GFK, BGR, BTV, PNM, GRB, BUF, DR, HON, ISP, DTC, ACT, AOS, BOI, LAN, CLE, MIV, CPR, AOO, DCA, FOD, IKK, DAY, RNO, OLU, EKN, RIU, OAK, HUF, DEN, COU, STL, LOU, RDU, CDC, ICT, JBR, MKL, BNA, AND, RAL, HRR, ABQ, ACD, MLC, GWO, ANB, MCN, ATLANTIC OCEAN, PACIFIC OCEAN, FTW, SJT, CXO, DRI, GNV, QSA, QMA, QTB, QYD, QPA, PIE, MIA, SJU

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

Awarded by FAA in 1997
- ➤ COTS HW
- ➤ COTS\NDI Software
- ➤ One B-Spec

Operational (16)   Support (9)   Non-OASIS AFSSs (45)

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Who Defines the Mission?

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- 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
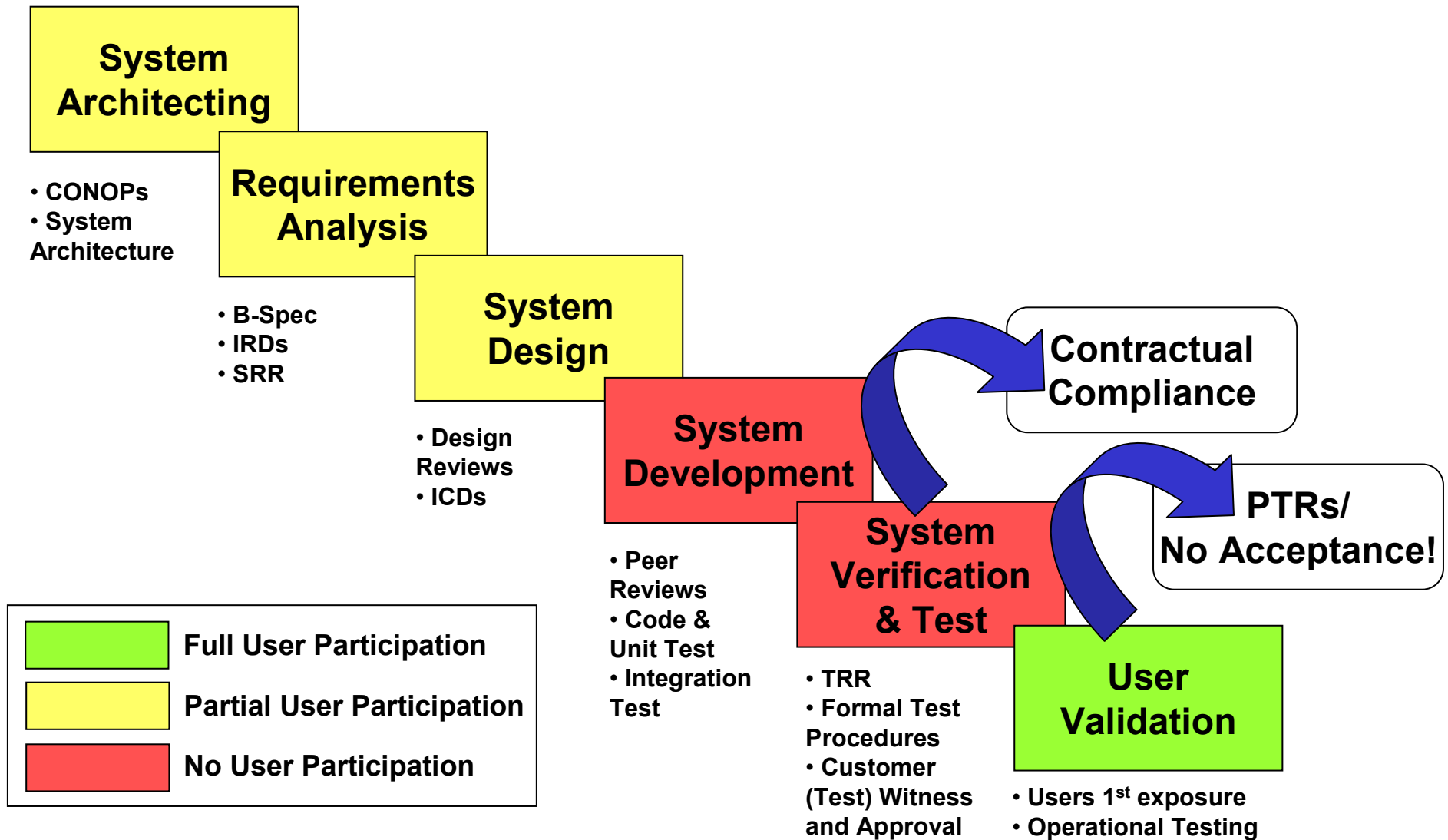   - Flight Service Maintenance

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

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System Architecting

- CONOPs
- System Architecture

Requirements Analysis

- B-Spec
- IRDs
- SRR

System Design

- Design Reviews
- ICDs

System Development

- Peer Reviews
- Code & Unit Test
- Integration Test

Contractual Compliance

System Verification & Test

- TRR
- Formal Test Procedures
- Customer (Test) Witness and Approval

PTRs/ No Acceptance!

User Validation

- Users 1st exposure
- Operational Testing

Full User Participation
Partial User Participation
No User Participation

Changes

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- 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)

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- 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)
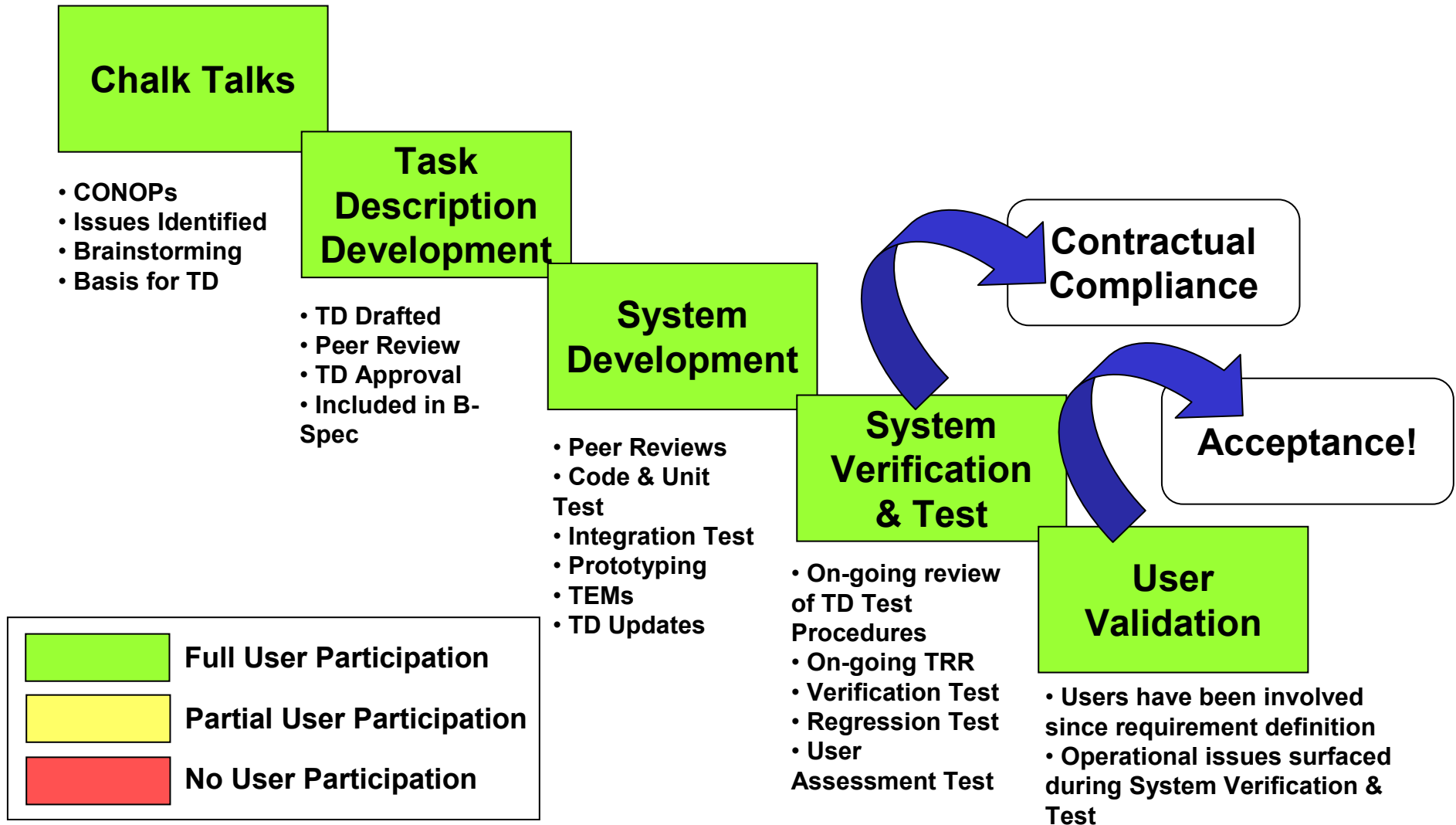
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- TEMs held informally throughout development effort
  - Database
  - Hardware
  - Interfaces
  - Test
  - Training
  - Security
- Validating implementation approaches, revisiting:
  - Are we building the right product?
  - Do we know what the product 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

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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

🟩	**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

Contact Information

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