Lessons Learned For Cx PRACA

Constellation Program Problem Reporting, Analysis & Corrective Action Process & System

CONSTELLATION

The Presidential Commission on the Space Shuttle Challenger Accident Report

FINDINGS

- ***Problem reporting requirements are not concise and fail to get critical information to the proper levels of management.***
- ***Little or no trend analysis was performed on O-ring erosion and blow-by problems.***
- ***Five weeks after the 51-L accident, the criticality of the Solid Rocket Motor field joint was still not properly documented in the problem reporting system at Marshall.***

(June 6, 1986 p.152, p161)

CAIB Report Finding

F7.4-9

NASA information databases such as The Problem Reporting and Corrective Action and the Web Program Compliance Assurance and Status System are marginally effective decision tools

F7.4-11

The Space Shuttle Program has a wealth of data tucked away in multiple databases without a convenient way to integrate and use the data for management, engineering, or safety decisions.

F6.1-10

NASA failed to adequately perform trend analysis on foam losses. This greatly hampered the agency's ability to make informed decisions about foam losses.

Other Lessons Learned

- Lesson Learned Shuttle, ISS, Orbiter
- Experiences during RTF after Challenger and Columbia
  - Significant cost incurred attempting to locate & capture H/W and S\W life-cycle failure history
  - Multiple databases with little or no access and no common terminology
  - Significant cost incurred in trying to trend, (data-mining by several multiple organizations, produced marginal results)
  - Multiple instances of innovative ways to not report problems
    (i.e. “in-family” vs “out of family” ; reporting start at ATP and then only at highest level assembly.)

How the Cx PRACA Requirements Respond

- *Defines PRACA PROCESS first then identifies tool needed*
- *Requires a Single Tool for Managing the PRACA Data & Process*
  - *Allowing data to be collected in different tools significantly complicates the process.*
- *Clearly defines the Scope of PRACA Applicability and What "Problems" Must Be Reported*
  - *The PRACA requirements specify those items to which the PRACA reporting and management process applies.*
- *Clearly defines when the PRACA Process and Requirements become Applicable*
  - *The PRACA requirements define the point in time during HW/SW development that reporting and managing problems is required.*
- *Clearly defines Ownership and Responsibility for Managing the PRACA Process, Including Disposition Authority*
  - *Although all "problems" should be reported, not all problems warrant NASA disposition approval; those that do may warrant approval at different levels.*

Critical Success Factors

- Support, involvement and ownership by Program and Project Management
- Important aspects for success of closed-loop corrective action systems:
  - Enforce Accountability (NASA and Contractors)
  - Require thorough analysis and approval before deviating or allowing deviation from requirements
  - CxP PRACA is a Process, not a Database. The database is intended to support the tactical implementation of the process.*
  - Rigorous training on process and/or CxP PRACA Module
  - Ensure communication (NASA ←→ NASA || Contractor ←→ NASA).
  - Ensure appropriate resources through the life of the program
- Understanding of economic case as well as technical (safety) case for requirements.

**CxP PRACA is a process, supported by a single information gathering data module which will be integrated with a single CxP Information System, providing interoperability, import and export capability making the CxP PRACA a more effective and user friendly technical and management tool.*

Key Lessons Learned

CXPRACA DATA SYSTEM

Software System Key Requirements

- **Process**
  - Single, centralized data set
  - Expanded definition of the types of captured problems (e.g., non-conformances)
- **System**
  - Tactical support for analysis and investigation
  - Workflow support
  - Highly modifiable, especially with respect to data collected and workflow
  - Interoperability with related systems (e.g., Parts list, PRACA, FMEA/CIL, Hazards, GMIP, CRADLE, etc.)
  - Attachments (any number, any size, any type)
  - Cross-platform, Cross-browser

Broad System Solutions/Issues

- **Paper->Digital = New capability and options = Process changes**
- **Should collect low-level non-conformances**
  - What seems like a small problem when looked at from a trending perspective may be a large issue.
- **Manage hardware, software, process problems together**
  - Creates environment for analysis across all problems.
  - The line between software and hardware is blurry and process connects to both.
- **Adaptable for future technology**
  - Protect the data, the software will change
- **Open standards, focus on web services and interoperability**

Links to Relevant Data

- **One linked PRACA data set across centers**
  - Across Centers and workgroups
  - Linking dependencies in work process steps
  - Tying together related problems and parts
- **Access from and to multiple related systems,**
- **Attaching, accessing relevant files, e.g., diagrams, spreadsheets, telemetry**

Searching

- **Flexible & powerful searching within the system**
- **Types of Search**
  - Keyword (Google style)
    - Records which mention Newton
  - **Filtering** (most valuable for quality)
    - **Every record ever entered pertaining to part SB00001, sorted by criticality and date entered**
  - Suggestive Filtering
    - All records matching a set combination of fields in an opened record, automatically provided for review.
  - Relational Filtering
    - Comprehensive results utilizing correlated links between related problems
  - Integrated system supported search
    - Every record pertaining to a part included on the official flight manifest

Validation and entry

- **Providing definition of fields and code values in context with their use.**
  - Clickable field titles with definition provided.
  - Value definition lists
- **Validate data on entry against authoritative source**
  - Part numbers checked against Product Data Structure
  - Invalid entrees stored but marked for evaluation
- **Codes and Trending data need to be consistent and reliable**
  - When possible have codes managed in an authorities, sharable source
  - Ensure consideration has been made for evolution of coding schemes (merging values, splitting values up)
  - Valuable for closed records to maintain original coding but function in searches based on up to date coding schemes.