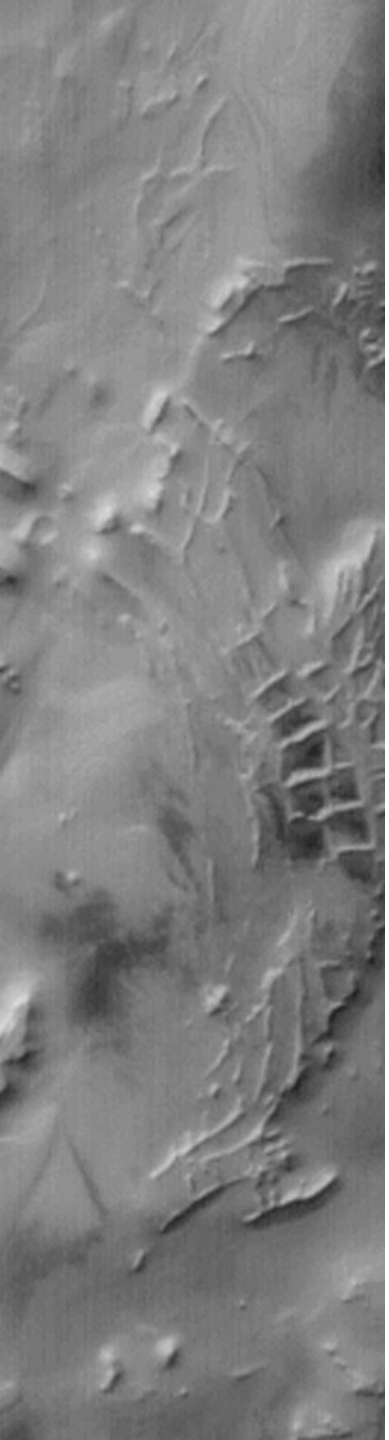

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Assuring that Lessons Learned Critical to Mission Success Get Used

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Lessons Learned as a "Contact Sport"

- Military: after action reports and lessons learned have immediate utility
- A formal lessons learned process is a hallmark of a mature engineering organization
  1. High risk missions, often never flown before, often one-of-a-kind spacecraft or facilities
  2. Repeated mistakes, or violation of known best practices, pose a risk that is potentially avoidable
     - *NASA "has not demonstrated the characteristics of a 'learning organization'." Investigators observed mistakes being repeated and lessons from the past apparently being relearned."* –CAIB report, page 11
     - *"An expert is someone who knows some of the worst mistakes that can be made in his subject, and how to avoid them."* -Werner Karl Heisenberg
     - *"Fools say that they learn by experience, I prefer to profit by others' experience."* -Otto von Bismarck
     - *"Why - I learnt what one ought not to do, and that is always something."* - The Duke of Wellington describing the failed Dutch campaign of 1794
     - *"The business of transferring lessons learned is best done as a 'contact sport'"* - Joe Nieberding (NASA Glenn Research Center, retired)

Dissemination & Assuring Use

- NASA Lesson Learned Information System (LLIS) is a searchable repository of over 1800 lessons learned
  - Lessons Learned Committee at each NASA Field Center obtains content from recent project incidents and enters lessons into the LLIS
- The actual use of lessons learned is difficult to assess or to ensure
  - Metrics on website visits/downloads provide limited insight
  - LLIS must compete with many information sources
- NASA has struggled to respond to criticisms of its lesson learned dissemination efforts
- Repeated criticism that LLIS is only used on an ad hoc basis
  - 2002 GAO report: NASA not assuring that lessons get used
  - 2004 Diaz report: “Managers do not use the LLIS when making decisions.”
  - 2011 NASA OIG audit: project managers are not using lessons learned
- How do you ensure that the appropriate person reads a lesson learned at the proper project milestone when the information is needed?

Assuring Use: (1) Targeted Distribution

- Answer: Assuring lessons learned use requires (1) pushing information to individuals, (2) systematic status assessment by each project, and (2) capture in NASA Center-wide procedures/training
- JPL recently implemented a 3-pronged approach to assuring that lesson learned get used:
- **(1) Targeted Distribution.** JPL LLC Chair reviews newly published LLIS entries and forwards them to appropriate JPL subject matter experts
  - Recipient is more receptive of a personalized e-mail that forwards pre-screened information, and is more likely to read and apply it
  - Downside of this method is that it only goes to one person (unless forwarded), and the information arrives at an arbitrary time rather than at a key decision point
  - Also, lessons learned summaries are periodically sent to JPL Mission Assurance Managers and Project System Engineers

Assuring Use: (2) Project Self-Assessment

- **(2) Project Self-Assessment.** At major project milestones, JPL flight projects self-audit their "compliance" with lessons learned
  - Mars Exploration Rover project audited compliance with 364 JPL & GSFC lessons
  - Juno tracked compliance with 5 specific "high risk" lessons learned
  - Kepler project reviewed compliance with all (over 1100) NASA lessons
- A coordinator determines a lesson's applicability to the project, evaluates its compliance status, and proposes a plan of action.
  - NASA policy previously (2002) required projects to perform this review iteratively at major project milestones
  - Provides objective evidence of systematic application of lessons learned
  - Such detailed review may not be cost-effective for smaller projects
  - Closed-loop when the project takes corrective action, but project action is not tied to NASA Center procedures and training

Assuring Use: (3) “Infusion”

- **(3) Infusion of Lessons Learned into Center Business Practices.** *Infuse* lessons into NASA Center procedures and training such that the project need not depend on the right person reading a lesson at the appropriate project milestone
- Attempts to infuse lessons into low level procedures not successful
- Infusion into JPL core standards: cross-reference lessons to specific paragraphs in the JPL *Design Principles* (DPs) and *Flight Project Practices* (FPPs).
  - Constitute comprehensive list of “things JPL projects should always do”
  - JPL projects are audited for compliance with DPs and FPPs
  - Objective 1: Infuse lessons learned, achieving a closed-loop lessons learned process
  - Objective 2: Provide additional rationale for the requirements in the DPs and FPPs
  - JPL Engineering Board vetted the (521) cross-references

Assuring Use: (3) “Infusion” (Cont.)

- Example Paragraph: DP Para. 4.2.5.5. “Positive margins shall be demonstrated, for both of the following cases, with the application of a factor of safety of ___ for thermally-induced loading over the qualification/protoflight temperature range, and the application of a factor of safety of ___ over the allowable flight temperature range.”

  NEN #2038, “To Bond or to Bolt, That is the Question”: “Evaluate thermal stresses and stress relief early in the design phase of hardware, but particularly where adhesive bonding will be used for joining spacecraft fittings.”

  - Hot links are be added to latest DP and FPP revisions
  - Projects complete a DP and FPP compliance matrix (subject to waiver)
  - Process escape: new lessons learned are not yet cross-referenced, but FPP requires projects to review lessons learned that are not yet incorporated
- 3-pronged methodology assures merely that lesson learned recommendations are not ignored