Recovery from Mission Failure

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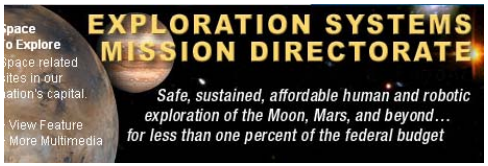
http://appel.nasa.gov

NASA Missions, Programs and Projects

Mission Directorates

Aeronautics Research

Exploration Systems



Space Operations

Science

Programs

Projects

NASA's Stakeholders

Public

White House

Congress

Why Projects Fail: 1992 Jack Lee Study

Factors that Drive Program Costs and Technical Risks

- Inadequate Phase B definition (i.e., before Preliminary Design Review)
- Unrealistic dependence on unproven technology
- Annual funding instability
- Complex organizational structure, including multiple unclear interfaces
- Cost estimates that are often misused
- Scope additions due to “requirements creep”
- Schedule slips
- Acquisition strategy that does not promote cost containment

“7 Deadly Sins”

1. Vague roles, accountability, and delegated authority.
2. Team leaders in over their heads / ineffective.
3. Poor acquisition planning with poorly incentivized / structured contracts. (Or contractors doing the wrong work.)
4. The defined scope is not doable within available resources.
5. Structures don’t support efficient systems engineering.
6. Ineffective risk management process.
7. Broken project team context.

Review Boards and Experts

Challenger "… signals of potential danger … were repeatedly normalized … at the intersection of the social and technical …. "Normalization of Deviance." (Diane Vaughn)

Hubble "A leadership failure was the root cause." (Lew Allen)

Mars Climate Orbiter "Communications failure was the root cause." (Noel Hinners)

Columbia "In our view, the NASA organizational culture had as much to do with this accident as the foam. Organizational culture refers to the basic values, norms, beliefs, and practices that characterize the functioning of an institution." (Doug Osheroff)

PMI "… ultimately projects fail or succeed on the basis of the individuals assigned to the project team, the culture and the leadership." (Eleanor Haupt)

Technical expertise and process excellence are necessary but not sufficient for success.

Learning from Failure

Responses to Failures	Examples
Standards and policies	Revised procedures and requirements for project management; revised governance model
Communications	Procedures to encourage dissenting opinions; case studies on lessons learned; senior leadership focus on communications
Training and development	NASA Academy (individual training, team support, organizational learning)
Technical excellence	NASA Engineering and Safety Center; NASA Safety Center; technical authority

Evolution of the NASA Academy

Challenger accident → Precursor to NASA Academy established

1986

NASA: Human error caused loss of Mars orbiter

November 10, 1999
Web posted at: 4:27 p.m. EST (2127 GMT)

In this story:

Report Summary
Signs of trouble came early
Will Polar Lander be safe?
RELATED STORIES, SITES

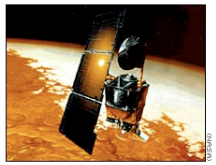


Illustration of the Mars Climate Orbiter

Metric mishap caused loss of NASA orbiter

September 30, 1999
Web posted at: 4:21 p.m. EDT (2021 GMT)

In this story:

Metric system used by NASA for many years
Error points to nation's conversion lag
RELATED STORIES, SITES

NASA's Climate Orbiter was lost September 23, 1999

Mars failures → Team support and knowledge sharing initiated

1999

Columbia accident → Increased focus on teams, organizational learning, communication, technical excellence

2003

"NASA's current organization…has not demonstrated the characteristics of a learning organization."
Columbia Accident Investigation Board Report

Closing Thought

"A large organization can emphasize to its engineers that talking and thinking about failure are not signs of pessimism, but are ways to keep the principal goal — the obviation of failure — in the forefront. Success is best achieved by being fully aware of what can go wrong in a design — and designing against its happening."

Dr. Henry Petroski, Duke University

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