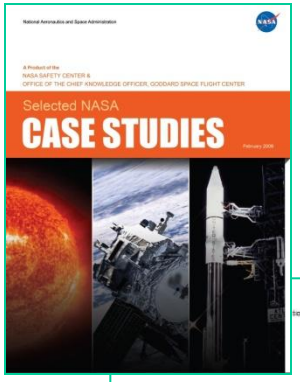
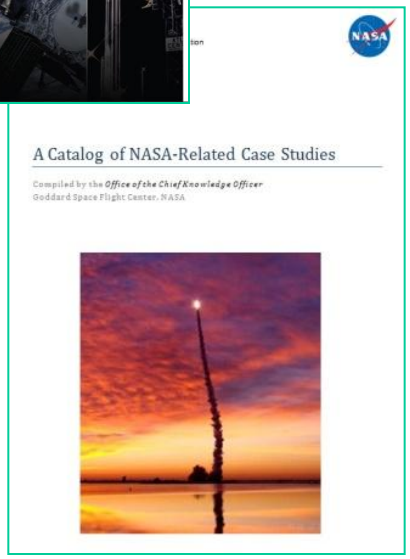
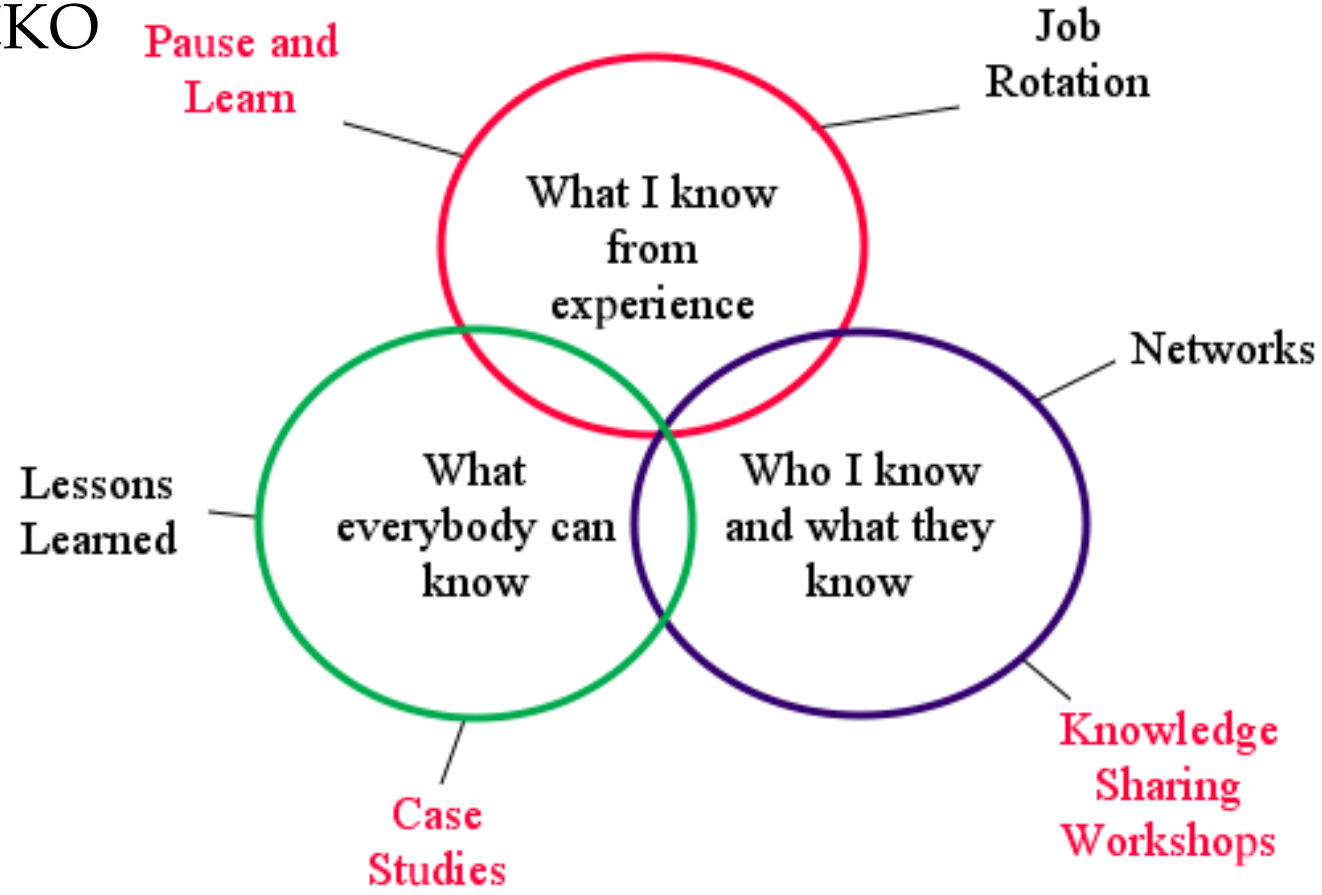
Learning with Case Studies

APPEL Master's Forum 20
April 21, 2011
Edward Rogers, CKO

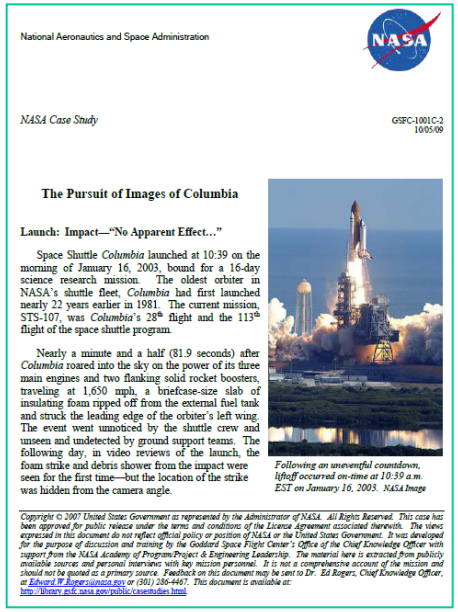






Origins of Case Studies

"A case study is best understood as a narrative, based on actual events, that creates an opportunity for conversation, problem analysis, and virtual decision-making about a particular project or issue."



National Aeronautics and Space Administration

NASA Case Study GSFC-1001C-2 10/05/09

The Pursuit of Images of Columbia

Launch: Impact—"No Apparent Effect…"

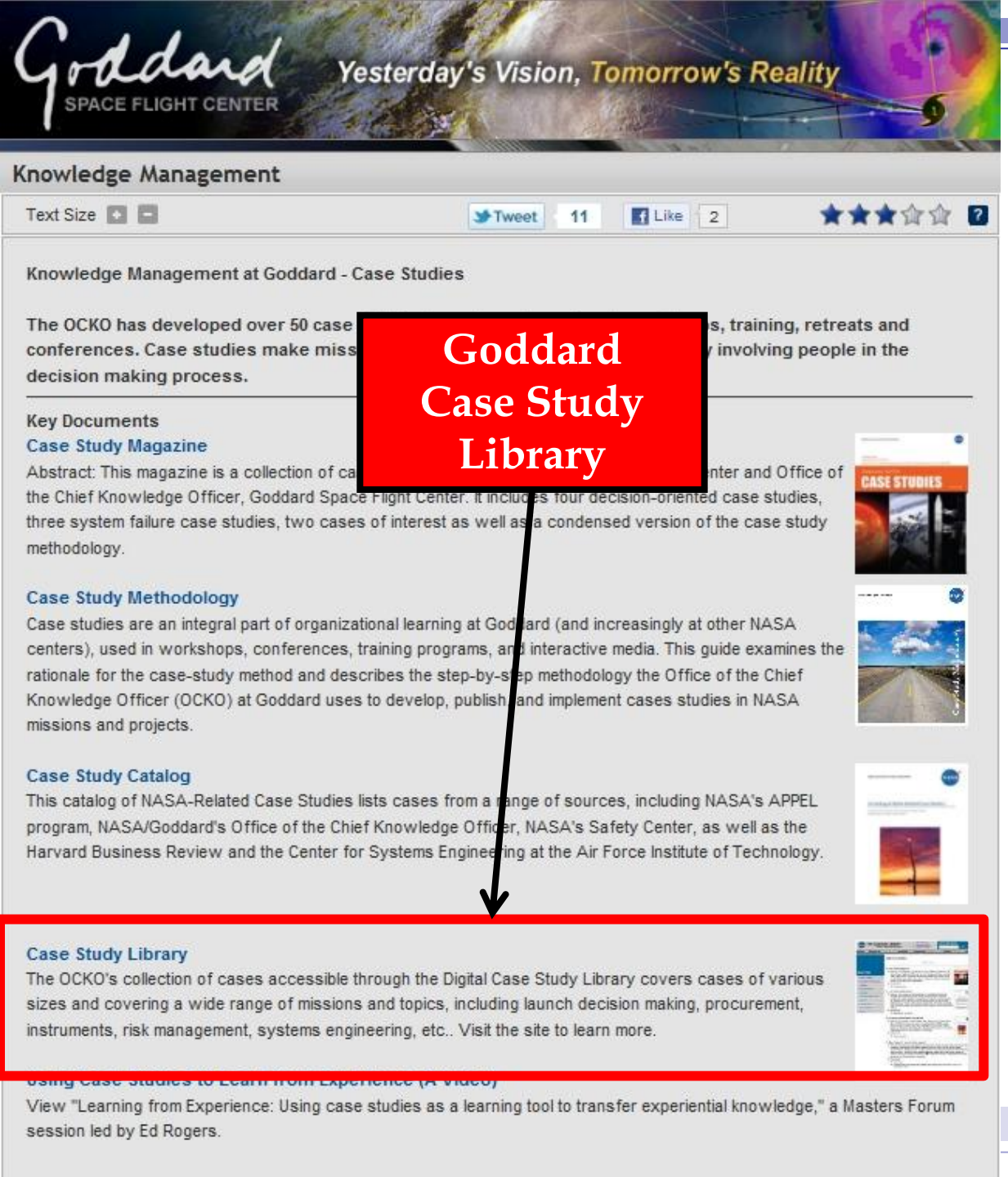
Space Shuttle *Columbia* launched at 10:39 on the morning of January 16, 2003, bound for a 16-day science research mission. The oldest orbiter in NASA's shuttle fleet, *Columbia* had first launched nearly 22 years earlier in 1981. The current mission, STS-107, was *Columbia*'s 28th flight and the 113th flight of the space shuttle program.

Nearly a minute and a half (81.9 seconds) after *Columbia* roared into the sky on the power of its three main engines and two flanking solid rocket boosters, traveling at 1,650 mph, a briefcase-size slab of insulating foam ripped off from the external fuel tank and struck the leading edge of the orbiter's left wing. The event went unnoticed by the shuttle crew and unseen and undetected by ground support teams. The following day, in video reviews of the launch, the foam strike and debris shower from the impact were seen for the first time—but the location of the strike was hidden from the camera angle.

Following an uneventful countdown, liftoff occurred on-time at 10:39 a.m. EST on January 16, 2003. NASA Image

Different Types of Cases

"The form the case takes is not as important as whether it causes learning to happen. Make the case form fit the learning function that is required."



Case Library

Cases belong in a collection; they can be misused in isolation as single points of learning.

Cases Used for Training

NASA Case Study in Project Management

The GENESIS Project

This is a one-hour session structured as follows:

Time	Activity
7 minutes	Read the case exercise individually
8 minutes	Discuss the cases with small group (3-4)
30 minutes	Panel members comment on the decision
15 minutes	Panel members answer audience questio

It is calendar year 2000. NASA has just experienced two Mars mission f and is grappling with the balance between risk and reward in implement cost missions.

The GENESIS Mission

The Genesis Project was proposed and selected as the fifth in NASA's series of Discove missions to be executed in the PI mode. The purpose of the mission is to collect sample wind and return them to Earth. Professor Don Burnett of the California Institute of Tech (CIT) is the principal investigator and project team leader. The Jet Propulsion Laborat is the managing agency and provides the science canister. Los Alamos National Laborat (LANL) provides the electrostatic concentrator for the science canister and the Electron Monitors. Lockheed Martin Aeronautics (LMA) is the industrial partner and provides th spacecraft and Sample Return Capsule (SRC). JPL and LMA will conduct mission oper Genesis is an immediate development successor to the Stardust mission which used a sl

Decision-Based Case Study Used in Road to Mission Success

NASA Case Study

Launching the *Vasa*

Laid down in 1626, a lot rode on the men who were building the Swedish gunship *Vasa* and those who would sail her. It had been a calamitous decade for the Swedish Navy during which 12 of Sweden's largest warships had been captured, wrecked, or scuttled. A violent storm in 1625 destroyed 10 of those, prompting the impetuous King Gustav II Adolf to order four new ships. Further losses dramatically increased the King's impatience with his shipbuilders.

Make It Longer!

First ordered as a small, traditional ship, after numerous change orders from the King it was increased in both size and armament. A 111-foot keel was laid down, but almost immediately work stopped as the King learned that rival Denmark was building a larger ship with two gun decks, a new innovation. The *Vasa*'s keel was ordered to be increased to 135 feet and the ship was now to include two enclosed gun decks.

No one in Sweden had ever built such a ship, and with the King making constant and ever-louder demands for both larger dimensions and faster delivery, there was no time for plans to be engineered. It was decided that scaling up the 111-foot keel, rather than laying a 135-foot keel, would save time.

This case was developed by the Goddard Knowledge Management Office with support from the NASA Academy of Program/Project & Engineering Leadership (APPEL. http://www.appel.nasa.gov) for the purpose of discussion and training. The material here is extracted from publicly available sources. It is not a comprehensive account of the mission and should not be quoted as primary source. Feedback on this case document may be sent to Edward.W.Rogers@nasa.gov or (301) 286-4467.

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NASA Case Study in Project Management

GOES-N: Long and Winding Road to Launch

Operating as a two-satellite constellation 22,000 miles above Earth's equator, the GOES (Geostationary Operational Environmental Satellite) observatories provided continuous

generation of GOES spacecraft, would be the most advanced meteorological observation satellite in space.

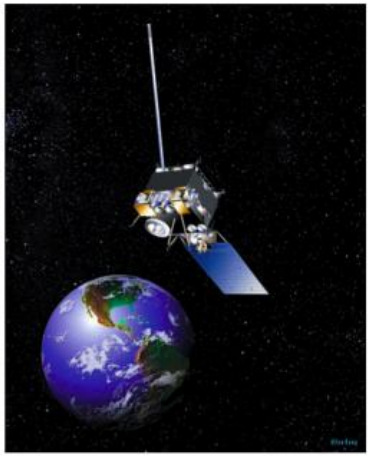

Figure 1. Artist's depiction of GOES overlooking Earth.

N into orbit, prove to be d to launch was es of unfortunate ightning strikes in e rocket, launch- alification issues, echnician strikes. ES-N sat on the nd waiting, riding delays and resets managers wrestled ues.

of 2005, Ken s manager for t help but wonder, As a systems er said, "you are making sure you thing possible to l mission right up f launch—testing, g, and validating le times. Then you vehicle fairing and say, 'Let's go!' You expect some unexpected er that will delay you a day or so on the pad, or a shuttle mission might few days. But nobody plans upfront to sit on the launch pad for a

N team facing a host of technical and programmatic issues and project uling commitments…with the original launch date of December 2004 ar-view mirror and the 2005 hurricane season approaching…the central n have an observatory and launch vehicle sat too long on the pad?

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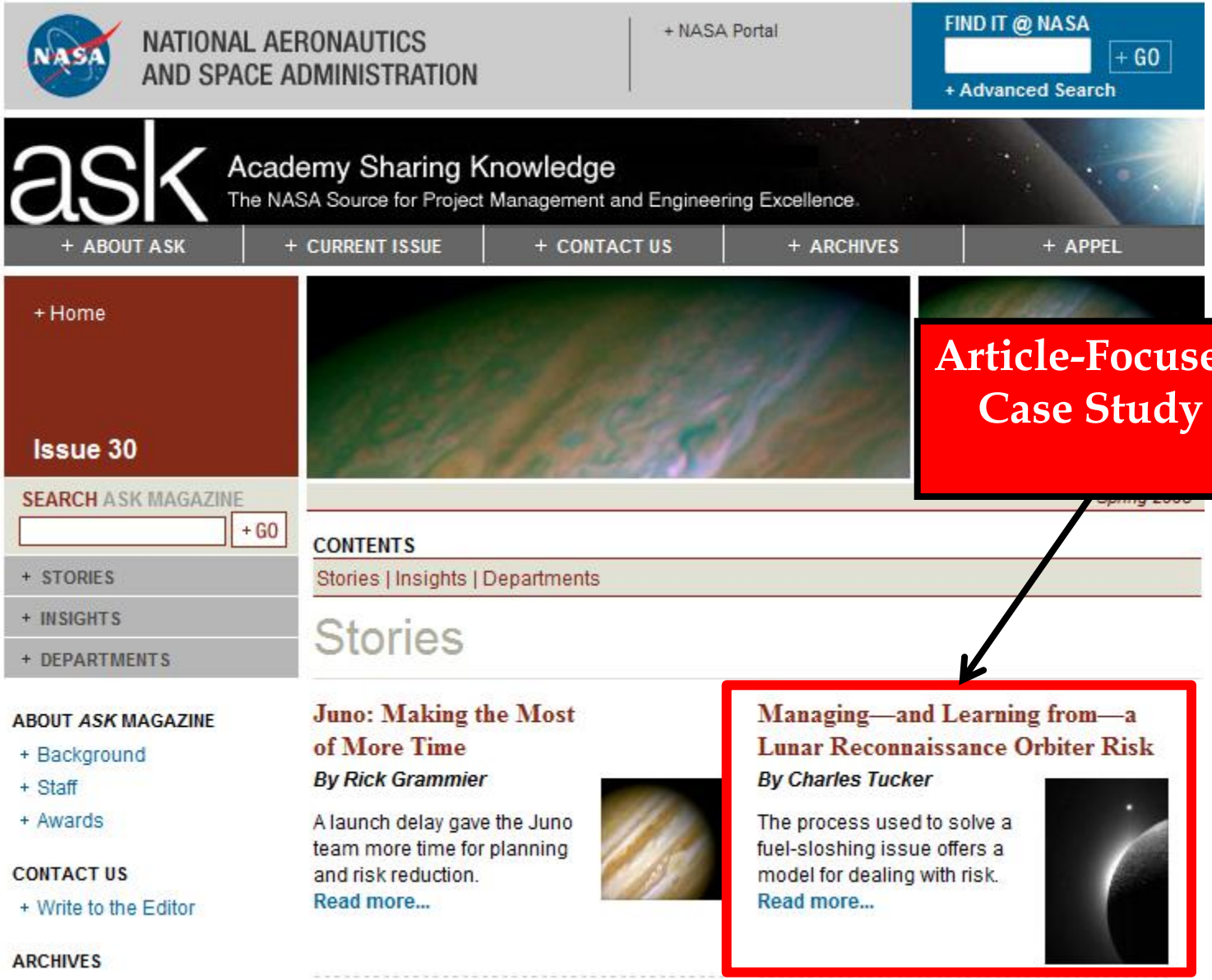
Decision-Based Case Study Used APPEL Courses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Case Studies

Knowledge Sharing Case Study

Case studies illustrate the kinds of decisions and dilemmas managers face every day, and as such provide an effective learning tool for project management. Due to the dynamic and complex environment of projects, a great deal of project management knowledge is tacit and hard to formalize. A case study captures the complex nature of a project and identifies key decision points, allowing the reader an inside look at the project from a practitioner's point of view.

Some of these Case studies require Flash to work.
+ Download it here.
Make sure to **Uncheck** the Yahoo Toolbar installer.

Redesigning COBE

The Cosmic Background Explorer (COBE) satellite was slated to launch on the Space Shuttle in 1989, but the loss of the *Challenger* on January 28, 1986 changed everything. The COBE team was forced back to the drawing board: it had to find a new way to get COBE into orbit.

+ Go to Case Study

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PBMA Process Based Mission Assurance Knowledge Management System

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Help

OSMA Safety Message Resource Page

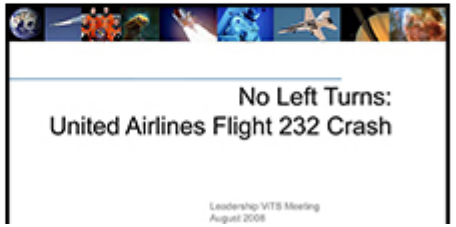
I am pleased to introduce my new OSMA safety message archive. This page contains my OSMA ViTS safety presentation along with a case study and [illegible]edia. These stories are written as summaries of system [illegible]hich I believe we can all learn. While many of these cases are [illegible]ed, each has certain aspects that are applicable to NASA. I [illegible] to disseminate these to your organizations as a tool to [illegible]ssion on the causes of system failures. Henry Petroski, author of "To Engineer is Human: The Role of Failure in Successful Design," argues that engineers must strive to anticipate the ways in which a design might fail, and these case studies are an excellent way of highlighting many of these failure modes.

Bryan O'Connor
Chief, Safety and Mission Assurance

System Failure Case Study

August 2008 - Expect the Unexpected

Detailed inspection throughout the lifetime of a safety-critical part is absolutely essential. The tail mounted engine on the DC-10 aircraft for United Airlines Flight 232 had left the manufacturing foundry with undetected microscopic defects. However, when establishing



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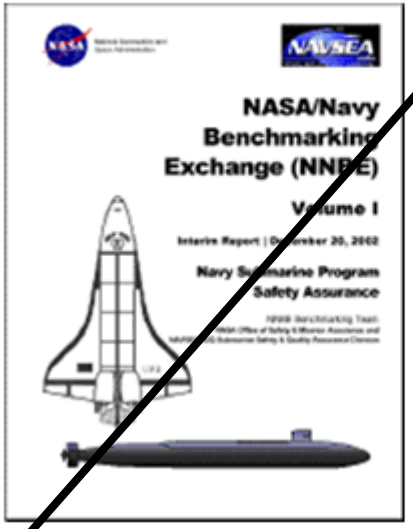


+ Case Studies

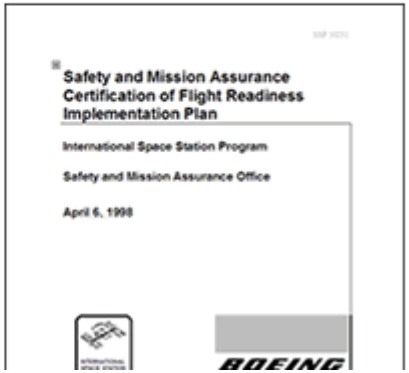
A view into how other NASA Project Managers have implemented assurance processes.

Descriptions of Safety, Mission Assurance, and Risk Management processes employed on past and present NASA programs that are based on NASA SRQ&MA Independent Assessments.

Project Management Case Study for SMA

r knowledge to become NASA-wide knowledge.

Best Practices are solicited from the Center Directors. These are proven program documents that Project Managers, Facility Managers, Developers, etc. can build upon and tailor for their projects. Library contains over 300 plans, processes, procedure documents, handbooks, manuals, tools and techniques. Scope ranges from overall high level documents such as systems safety plans to lower level documents addressing fastener integrity.


Safety and Mission Assurance
Certification of Flight Readiness
Implementation Plan

International Space Station Program

Safety and Mission Assurance Office

April 6, 1998

BOEING

Case Study Best Practice

The Case Study

National Aeronautics and Space Administration

NASA Ca[...] GSFC-1001C-2 10/05/09

The Pursuit of Images of Columbia

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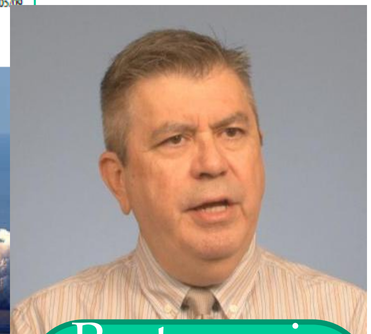


Protagonist

Participants

Facilitator

Rodney Rocha – The Pursuit of Images of Columbia
Interview of 9/22/2010 – Transcript

Video Clips

[...] that is next time, I would not be alone, I would make sure that our group, in our case the Debris Assessment team, of which there was over 30 people, that I take all of them or some of them or a sizable group with me to management. That way it does not appear that there is a single person with this concern, an alarmist or a chicken little or whatever.

I was able to actually put that in practice with STS-400 that's the hypothetical launch on the rescue of the HST maintenance mission. That maintenance mission occurred very successfully, no problems, in May 2009. But before that the Engineering Director at Johnson Space Center put me in charge of the "what if" mission, what if we had to rescue them with another orbiter. We ran into some obstacles there. Some management, flight directors, and mission managers not believing there was any hazardous, very hazardous aspects of this. We learned it was very out of the box. So, when we communicated these, I made sure I took my group with me, the specialists in different fields that we had to look at different technical aspects. We were concerned. We had to come up with new math models and techniques of looking at these and managing the risks. But to communicate these and get an okay to proceed, I took a group. So I'd say take your group, take your experts. Make sure you know what you're talking about. Now, there can be the possibility like in the Columbia mission where the evidence is weak. If you have the evidence, take it, if you have high uncertainty, low technical confidence, communicate that fact and try to be on the side of conservatism.

National Aeronautics and Space Administration

Teaching Note for NASA Case Study GSFC-1001T-3 Rev. 12/06/2010

Teaching Note

In this Teaching Note

- Case Synopsis, Overview, Purpose of the case
- Thoughts on Steering Conversation and Discussion Questions
- Columbia Post-script and Video Clips
- Appendix A: Alternative Email Communications
- Appendix B: Rodney Rocha Video Transcript: *Why didn't they listen?*
- Appendix C: Rodney Rocha Video Transcript: *How would I do it differently?*
- Appendix D: Rodney Rocha Video Transcript: *What Did I Learn?*
- Appendix E: Additional Resources

Alternative One

It is absolutely essential—critical in fact—that we get clearer, definitive photos of the wing and body underside of Columbia. I cannot overstate my concern. Without better images, we simply will not be able to even bound the problem and attempt thermal, trajectory, and structural analyses.

This is not my view alone. All the DAT meeting participants—Boeing, USA, NASA ES2 and ES3, KSC—concur on the need to obtain those images as soon as possible. The answers we might get from better pictures of the impact area could range from acceptable to not-acceptable to horrible [...]

Exercise Handout

Thank you for your urgent attention to this request.

Alternative Two

Since the Crater math modeling evaluation by Boeing over the weekend, my concern over the possible extent of damage and penetration of the Thermal Protection System has grown. Without knowing more about where the foam actually hit, and seeing the result of the impact, we won't be able to address the problem. At this time, we just don't know what we are dealing with, and without clearer images, we can't know.

The only way to get better, even definitive, pictures is to seek outside assistance. Can we petition for assistance outside the agency? I would even advocate begging if that's what it takes. We're asking Frank Benz with Ralph Roe or Ron Dittemore to take the lead on this. (By the way, despite the agency's tendency toward insularity in these types of matters, you probably recall that this would not be the first time we sought just such help—in the '80s we went outside for assistance when we had missing tile concerns.)

My professional judgment about the need for definitive pictures is shared by other engineers. We can't afford not to err way on the side of caution.

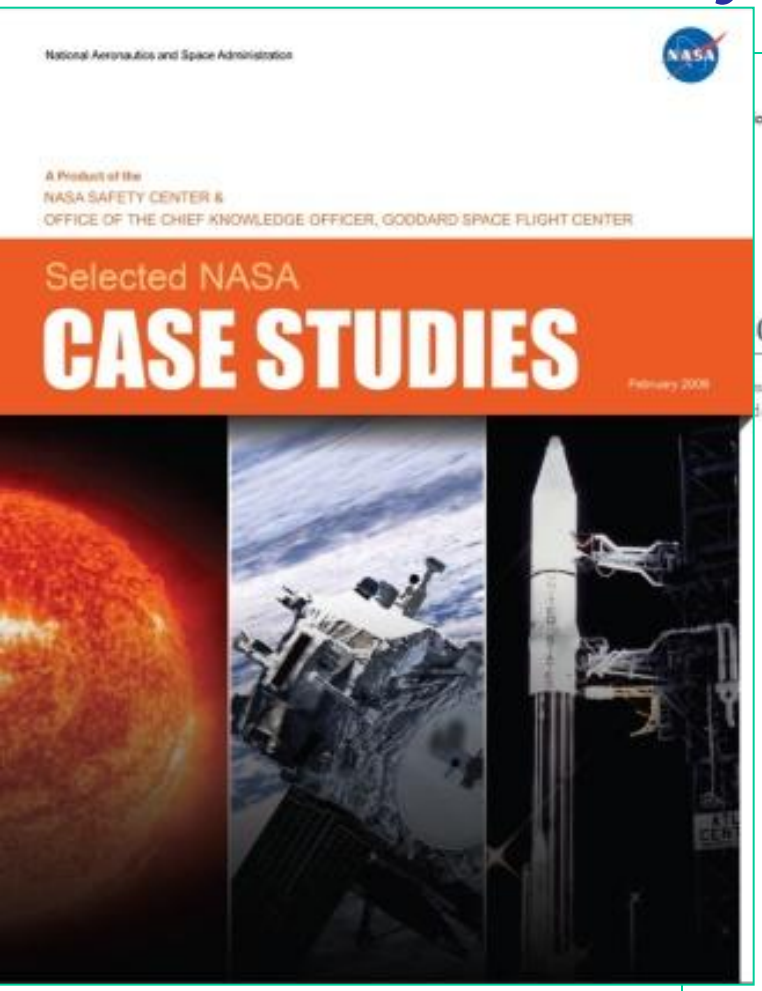
I hope you'll give this your immediate consideration.

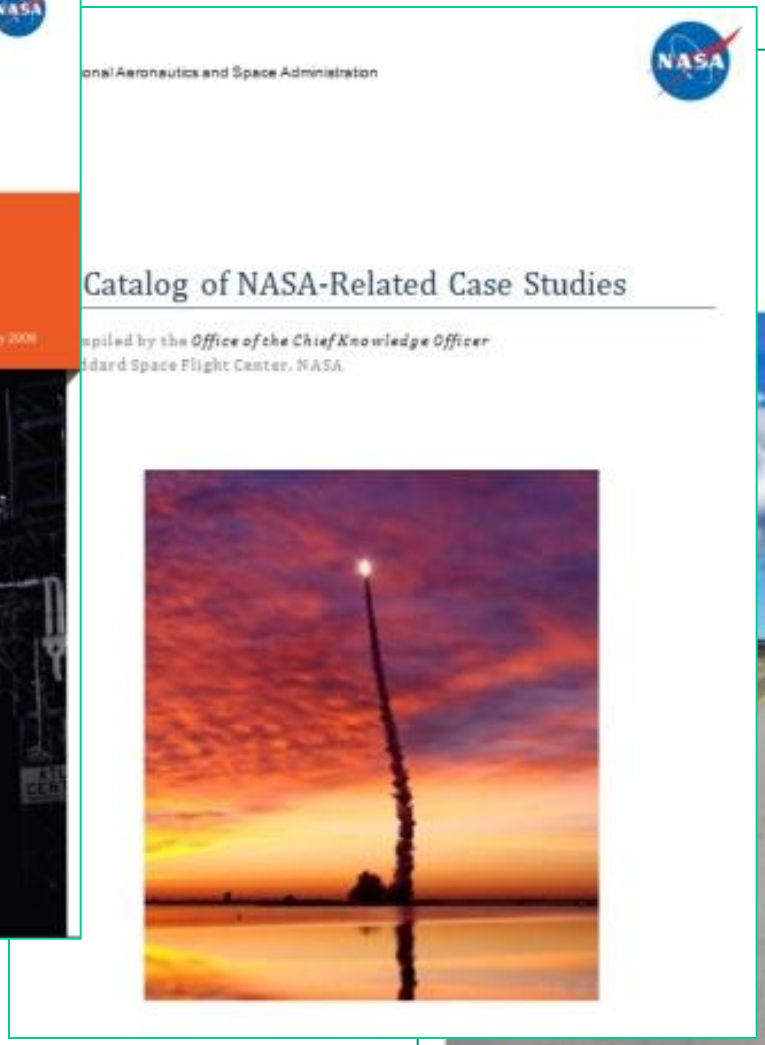
Case Development Process

"We write the case but the story is not ours. It is someone else's story we are using to teach."

Stories are meant to be told (and listened to.) Case are meant to be discussed and debated.

Case Study Resources Available





Case Studies Links

- OCKO / GSFC Case Studies
  http://www.nasa.gov/centers/goddard/about/organizations/OCKO/casestudies/index.html
- APPEL Case Studies
  http://www.nasa.gov/offices/oce/appel/knowledge/publications/case_studies.html
- NSC System Failure Case Studies
  http://nsc.nasa.gov/KnowledgeManagement/SFCS.aspx
- NSC Cases of Interest
  http://nsc.nasa.gov/KnowledgeManagement/CasesOfInterest.aspx
- JSC Case Studies
  http://knowledge.jsc.nasa.gov/index.cfm?Event=CaseStudies

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