# Risk Management
# What We Have Learned

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# So, what's new?

Experienced

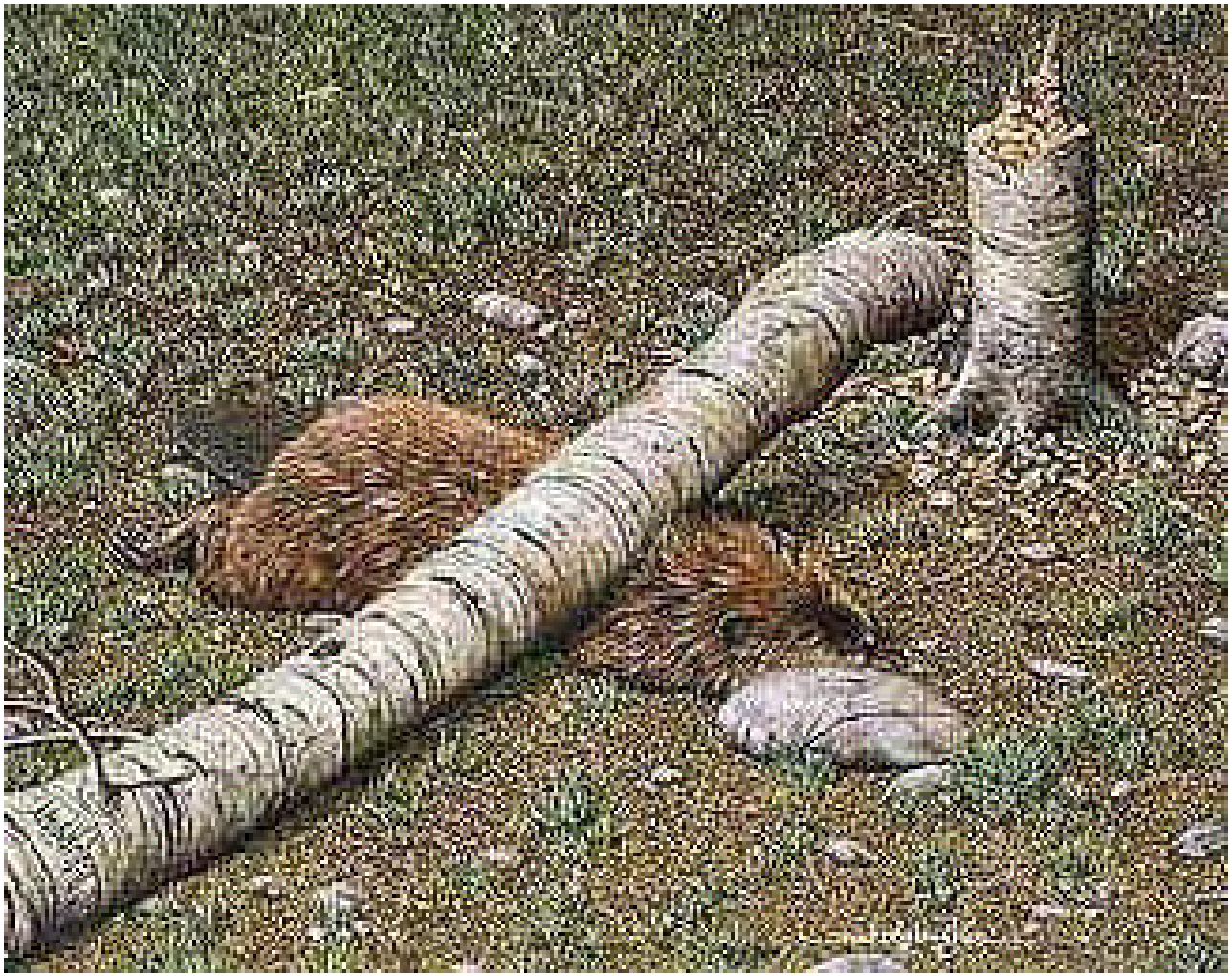
Project Manager

**Risk management??**

**I've always done that!!**

**What do they want me to do differently?**

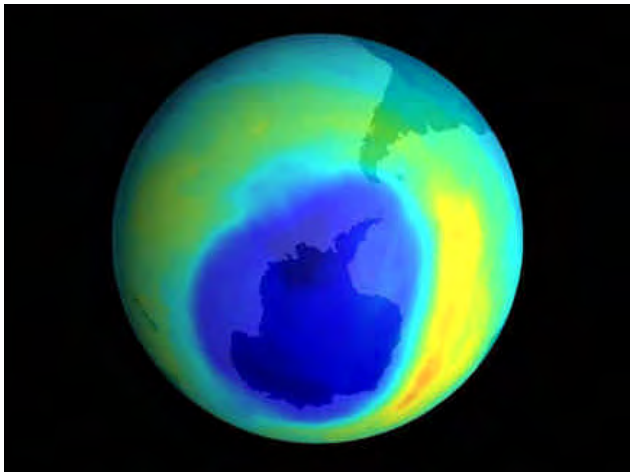
# Even Routine Tasks Have Some Risk*



*Note: No beavers were harmed in making this chart.

# Outline

- NASA Challenges
  - Mission-Related
  - Environment-Related
- Role of Risk Management in Meeting Those Challenges
  - Evaluation of Recent Results
  - Approach to Future Activity
- Summation



# The Big Picture

# Mission-Related Challenges

- 10- to 14-day weather and pollution forecasts; 10-year climate forecasts; 15-20 month El Nino forecasts; 12-month rain rate.
- Fly by of Pluto; study of Neptune; search for evidence of biological activity on Europa and Titan; advanced studies of Mars.
- An integrated understanding of space weather.
- Deep understanding of the role of gravity in complex chemical, biological, and physical processes.
- Safe, effective, and affordable long-duration human space flight.
- Self-sustaining life-support systems that enable humans to live and work in space and on other planets.
- Missions of exploration with human and robotic explorers.
- Greatly increased safety of launch vehicles; reduced payload cost; reduced travel time for planetary missions.
- Greatly increased aircraft safety; reduced aircraft emissions (pollutants and noise); reduced travel time.

# Environment-Related Challenges

- **The nature of NASA's business (using cutting edge technology to do things that have never been done before) injects uncertainty and creates inherent risk.**
- **The aerospace environment is harsh and unforgiving.**
- **NASA mission systems are highly complex and tightly coupled.**
- **All NASA programs face difficult schedule and cost constraints.**

- ***Risks constantly threaten NASA programs. Success depends on identifying, understanding, and controlling risk in all that we do.***
- ***Effective Risk Management is the essence of good Project Management.***

# RM: Asking the Right Questions

Project Manager and team

- What can go wrong with our project?
- How likely is it to go wrong?
- What would be the consequences if something does go wrong?
- What can we do to prevent things from going wrong, or at least reduce the probability or severity of the consequences?
- How soon do we need to act?

# ISS Risk Summary Card
# ISS Program Risk Management


***DEFINITIONS:***

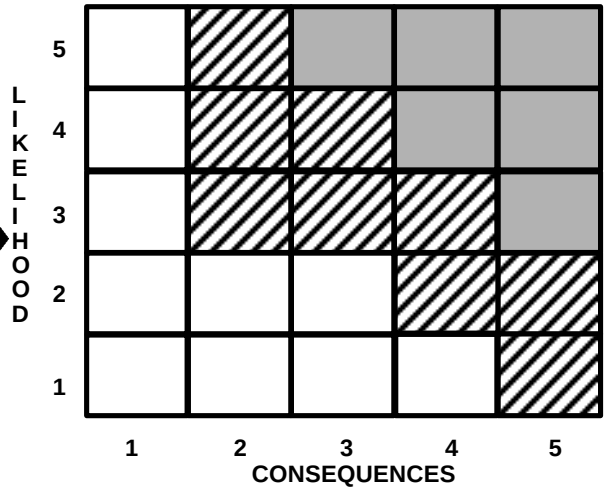
**RISK MANAGEMENT:** An organized, systematic decision-making process that efficiently identifies risks, assesses or analyzes risks, and effectively reduces or eliminates risks to achieving program goals.

**RISK:** A Program "Risk" is any circumstance or situation that poses a threat to: crew or vehicle safety, Program controlled cost; Program controlled schedule; or major mission objectives, and for which an acceptable resolution is deemed unlikely without a focused management effort.

| *What is the likelihood the situation or circumstance will happen?* | | |
|---|---|---|
| ***Level*** | ***Probability*** | ***. . . or - the current process . . .*** |
| 5 | Very High | cannot prevent this event, no alternate approaches or processes are available. |
| 4 | High | cannot prevent this event, but a different approach or process might. |
| 3 | Moderate | may prevent this event, but additional actions will be required. |
| 2 | Low | is usually sufficient to prevent this type of event. |
| 1 | Very Low | is sufficient to prevent this event. |

Likelihood

## ISS Risk Matrix




***LEGEND***

- High - Implement new process(es) or change baseline plan(s)
- Med - Aggressively manage; consider alternative process
- Low - Monitor

| *Given the event occurs, what is the magnitude of the impact to the ISS Program? . . .* | | | | | |
|---|---|---|---|---|---|
| ***Level →*** | **1** | **2** | **3** | **4** | **5** |
| Technical | Minimal or No Impact | Mod. Reduction, Same Approach Retained | Mod. Reduction, But Workarounds Available | Major Reduction, But Workarounds Available | Unacceptable, No Alternatives Exist |
| Schedule | Minimal or No Impact | Additional Activities Required. Able to Meet Need Dates | Level 2 Milestone Slip of ≤ 1 Month. | Level 2 Milestone Slip of >1 Month, or Program Critical Path Impacted | Cannot Achieve Major Program Milestone |
| Cost | Minimal Impact of < $100K | Budget Increase between $100K and $1 Mil. | Budget Increase between $1 Mil and $10 Mil. | Budget Increase between $10 Mil and $50 Mil. | Budget Increase of > $50 Mil. |

Consequences

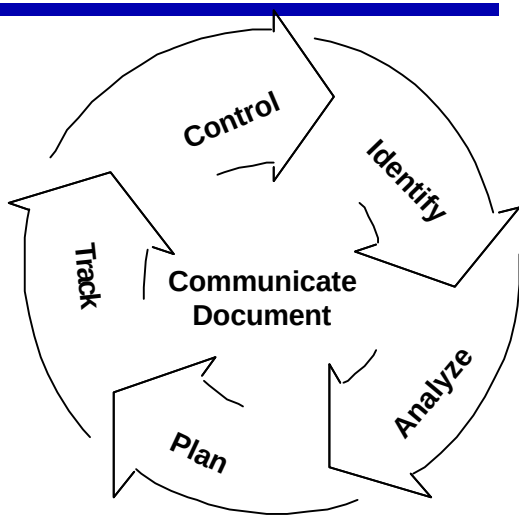
***QUESTIONS ABOUT RISK MANAGEMENT?***

Call: The Space Station Program Risk Managers:
Fred Kuo (NASA) 281-244-7674
Peter Smoot (Boeing) 281-336-4567
or refer to ISSP-JPD-306 Rev. A July 1998.

**NOTE:** Technical includes everything that is not cost and schedule: e.g., safety, operations, programmatic.

# RM Process and Tools Provide Answers

- **Lessons Learned Information System (LLIS)**
- **Fault Tree Analysis (FTA)**
- **Failure Modes and Effects Analysis (FMEA)**
- **Probabilistic Risk Assessment (PRA)**




**What can go wrong?**

**What can we do?**

| | IDENTIFY | ANALYZE | PLAN | TRACK | CONTROL |
|---|---|---|---|---|---|
| LLIS | X | | X | | |
| FTA | X | X | | X | |
| FMEA | X | X | | | |
| PRA | X | X | | X | |

**Likelihood, severity, timeframe, priority?**

**Is it getting better or worse?**

NASA Lessons Learned - Netscape

File Edit View Go Communicator Help

Back Forward Reload Home Search Netscape Print Security Stop

Bookmarks Location: http://llis.nasa.gov/ What's Related

# Welcome To The NASA Lessons Learned Resource

## What is the Lessons Learned Information System?

The purpose of the NASA Lessons Learned Information System (LLIS) is to collect and make available for use by all who may derive benefit from the experiences of others, the **lessons learned** from more than forty years in the aeronautics and space business. Both government and industry have long recognized the need to document and apply the knowledge gained from past experience to current and future projects in order to avoid the repetition of past failures and mishaps. Through the LLIS, NASA seeks to facilitate the early incorporation of safety, reliability, maintainability, and quality into the design of flight and ground support hardware, software, facilities, and procedures.

## Connect to the NASA Lessons Learned Information System

### International Space Partners Lessons Learned services:

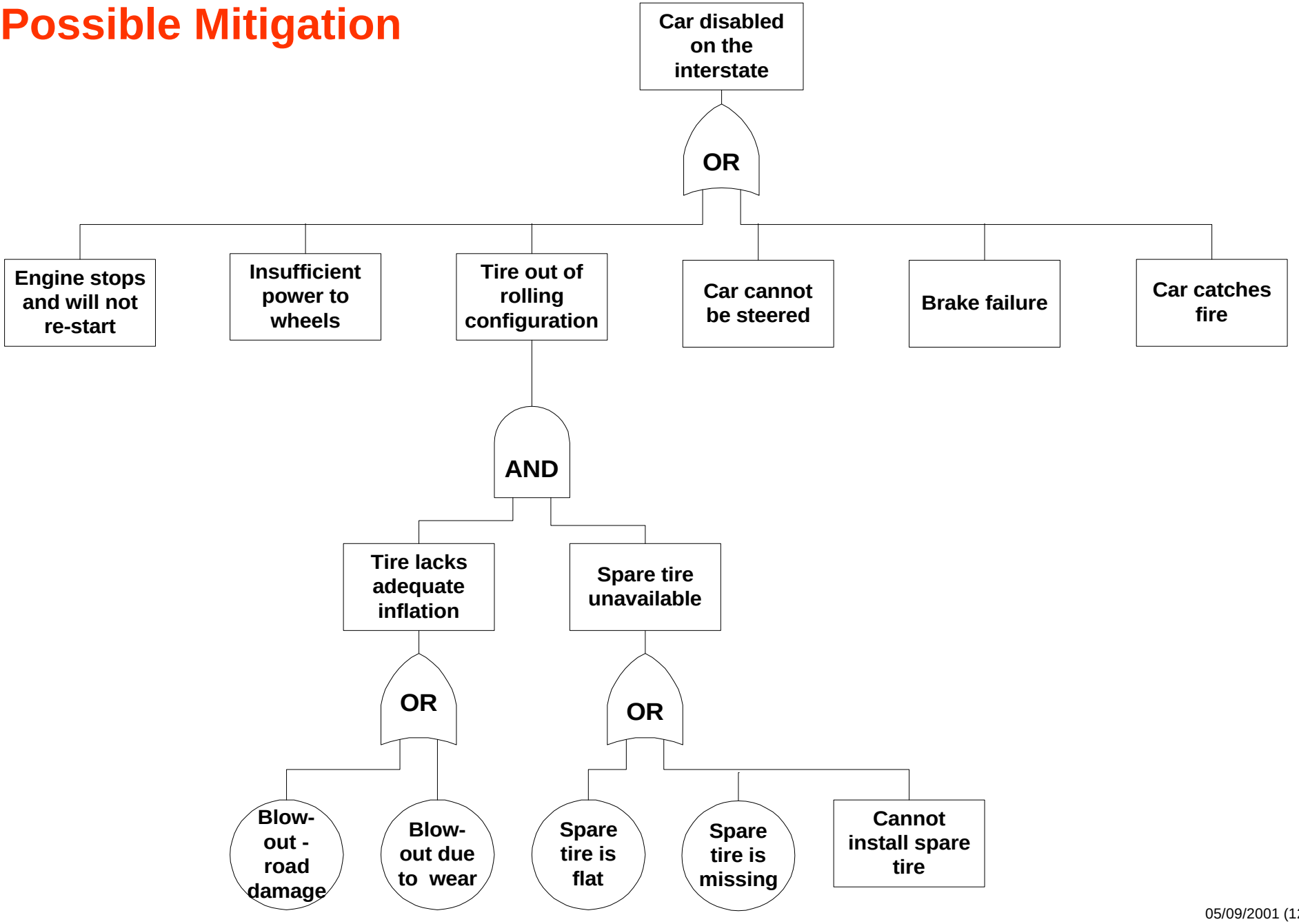
- International Safety Lessons Learned (ISLL) Information System

### Other US Government Lessons Learned services:

- Air Force Knowledge Management (the Official Site for Air Force Lessons Learned)
- Center for Army Lessons Learned (CALL)
- Navy Combined Automated Lessons Learned
- US Department of Energy Lessons Learned

Document: Done

# FTA Provides a Top-Down View to Identify Risks and Possible Mitigation



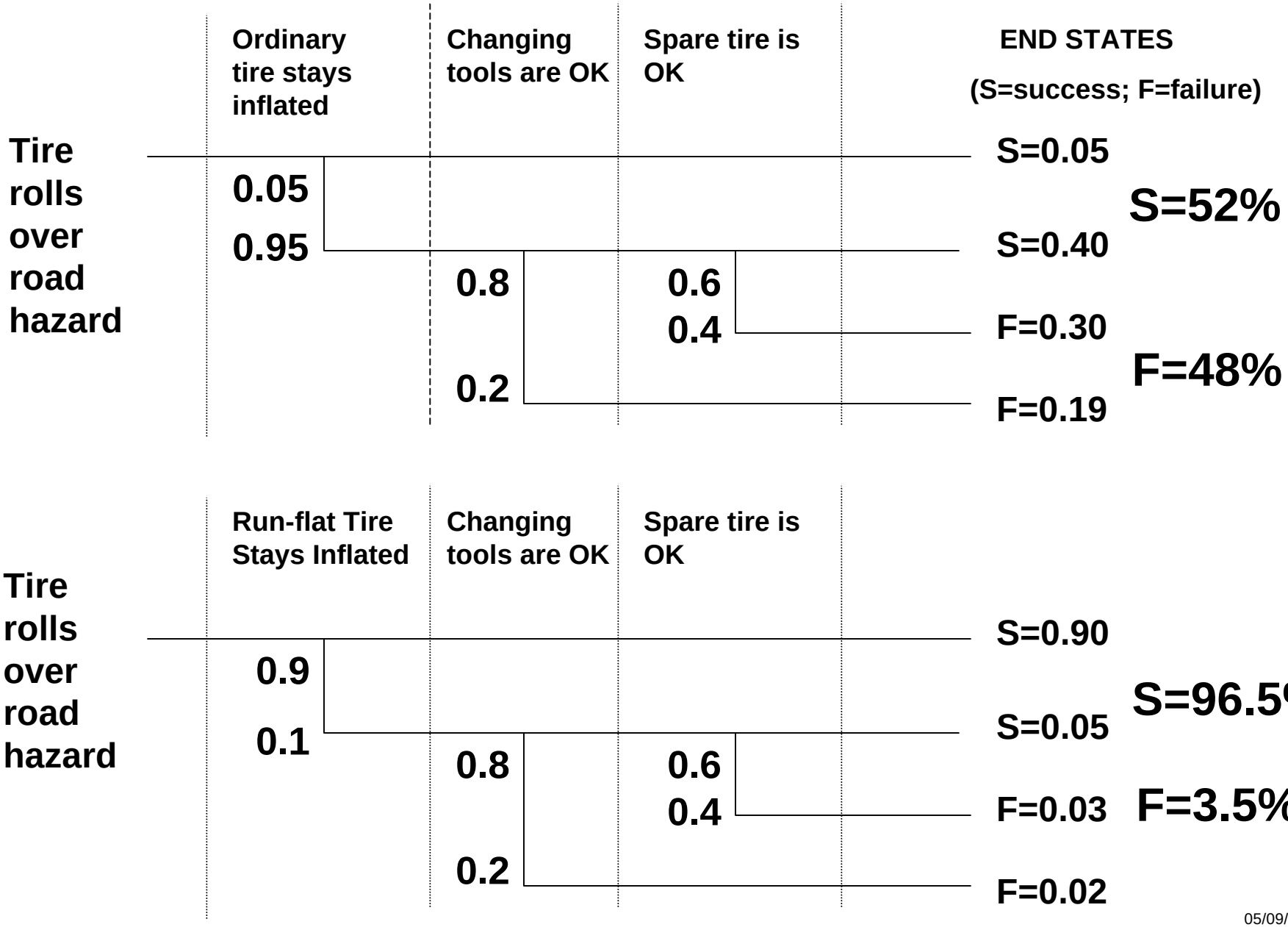
# FMECA- A Bottoms-Up View to Design, Manufacture, Operations

## Tire FMECA with Reevaluation of Risks

| Part Name/ Part Number | Potential Failure Modes | Causes (failure mechanism) | Effects | Risk Priority Rating | | | | Recommended Corrective Action | Improved Rating | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Sev* | Freq | Det | RPN | | Sev* | Freq | Det | RPN |
| Cord | Fiber separation | 1. Weak precursor material | Ply failure | 4 | 3 | 8 | 96 | Incoming inspection | 4 | 1 | 8 | 3 |
| | | 2. Handling damage | Ply failure | 4 | 3 | 8 | 96 | Increase process controls during mfg | 4 | 2 | 2 | 16 |
| | | 3. Cumulative fatigue | Ply failure | 4 | 2 | 8 | 64 | Monitor tire life | 4 | 2 | 2 | 16 |
| Ply | Delamin-ation | 1. Dirt or grease | Loss of side wall integrity | 7 | 3 | 8 | 168 | Toluene wipe down during layup | 7 | 1 | 1 | 7 |
| | | 2. Twisted plys | Loss of side wall integrity | 7 | 2 | 6 | 84 | Automatic ply alignment | 7 | 1 | 1 | 7 |
| | | 3. Poor bond pressure | Loss of side wall integrity | 7 | 2 | 8 | 144 | Redundant tensioning system | 7 | 1 | 1 | 7 |
| Carcass | Disinte-gration | 1. Poor tire alignment | Vehicle loss | 9 | 2 | 9 | 162 | Planned periodic maintenance | 9 | 1 | 1 | 9 |
| | | 2. Tire hits curb | Vehicle loss | 9 | 2 | 9 | 162 | Driver training | 9 | 1 | 1 | 9 |

*Severity ratings 8 to 10 request special effort in design improvement regardless of RPN rating

# PRA Supports Design Decisions



# Failures, Lessons, and Improvements

- **The NASA Administrator chartered the NASA Integrated Action Team to assess findings from failure reports and determine Agencywide actions for improvement.**
  - **Mars Climate Orbiter Mishap Investigation**
  - **NASA FBC (Faster, Better, Cheaper) Assessment**
  - **Shuttle Independent Assessment of Recent Failures**
  - **Mars Program Independent Assessment**
- **Recommendations emerged along five themes:**
  - **Developing & Supporting Exceptional People & Teams**
  - **Delivering Technology on Time**
  - **Understanding & Controlling Risk**
  - **Ensuring Formulation Rigor and Implementation Discipline**
  - **Improving Communication**

# Accepting Risk Makes Missions Possible

- **Prudent mission risk that does not compromise safety considerations must remain the hallmark of NASA's endeavors --**
  - **To enhance performance that achieves challenging mission objectives.**
  - **To vigorously pursue cost and schedule improvements.**

    **(Note: Lack of thorough planning and departure from sound practice are not considered prudent.)**
- **Mission risk must be objectively assessed, appropriately mitigated, and consciously accepted on a case-by-case basis by the team with customers.**
  - **Mission risk profile and balance of scope and resources must be continuously evaluated (adequate reserves and margins must accommodate mission risk).**
  - **Management and stakeholders must be part of the mission risk acceptance process.**
  - **The mission risk acceptance process is the same regardless of mission although degree of acceptable risk will vary greatly, depending on mission unique considerations. One size does not fit all.**

# Summary

- NASA's mission is inherently risky. Success depends on identifying, understanding, and controlling risk in all that we do.
- Using a structured risk management process with risk identification and analysis tools provides excellent data for making decisions.
- By analyzing failures, we learn how to improve for the future.
- Acceptance of prudent mission risk is the hallmark of NASA's approach, while fully attending to safety considerations