

Mission Success Starts With YOU

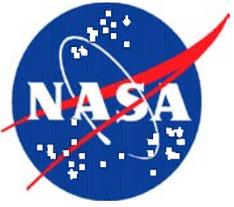
# Supplier Process Control Training Program

**Process  
Control**



across the board!

Copyright 2013, California Institute of Technology  
Government sponsorship acknowledged



Mission Success Starts With YOU

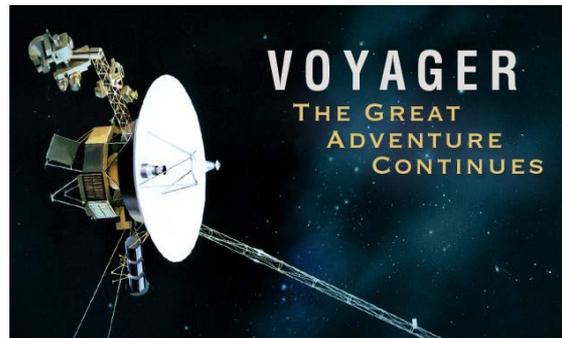
## *Why are we here?*

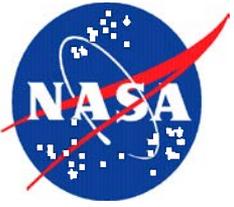
✓ **THANK YOU** for your efforts in supporting NASA's Programs

✓ **Knowledge Sharing**

- Awareness of process control and process quality for our continued mutual success
- Provide useful tools to allow you to better control processes and improve process quality
- Communicate lessons learned and industry best practices

*“Our Future Depends on the Integrity of the Products We Produce Today”*



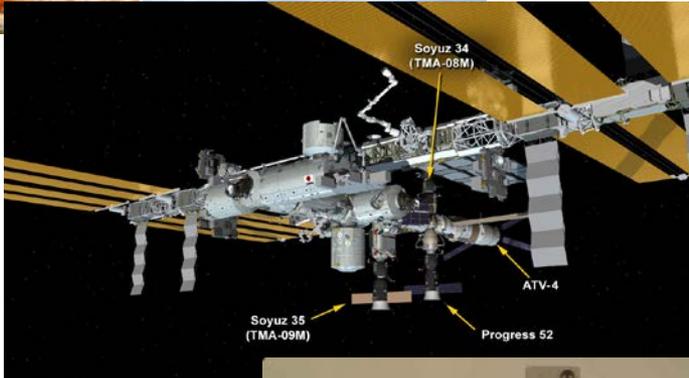


Mission Success Starts With YOU

# NASA's Vision



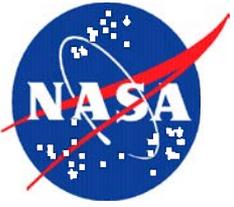
*To Improve Life Here*



*To Extend Life There*



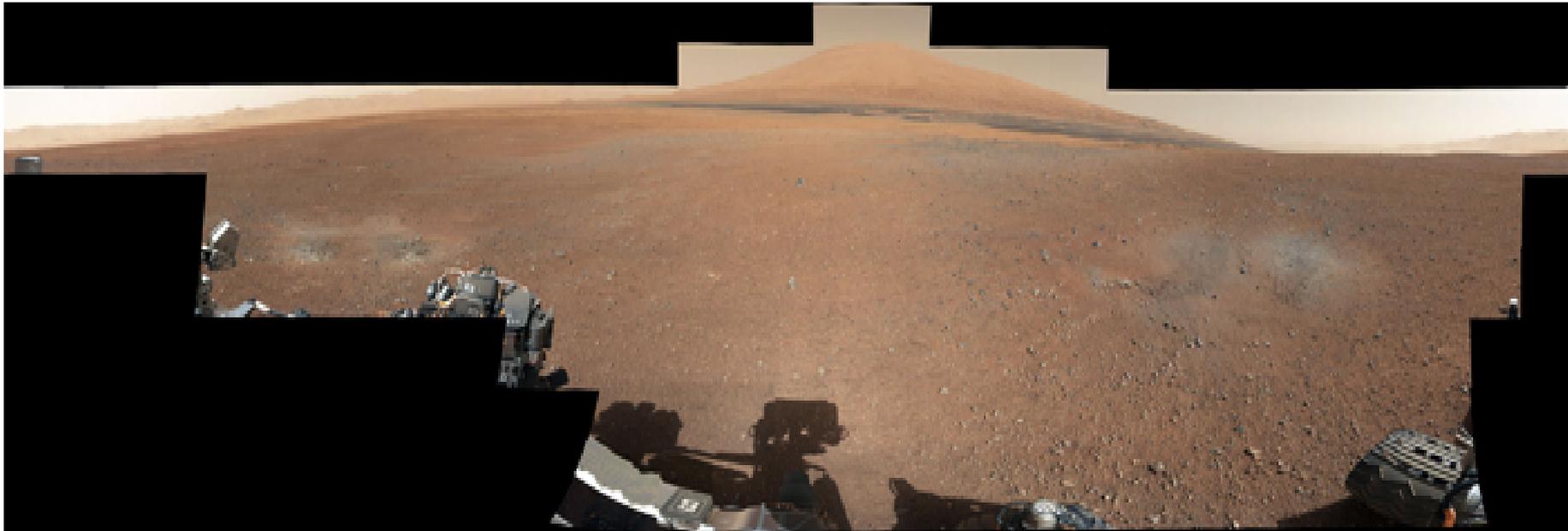
*To Find Life Beyond*

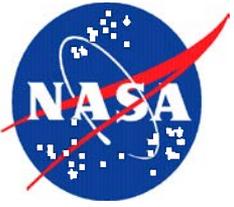


Mission Success Starts With YOU

# ***About the SPCT Program***

- The objective of SPCT is to provide increased assurance that suppliers will deliver conforming products by proactively providing process control training in potential areas of high risk, areas of particular interest and/or concern to the industry, and supplier process control operations.





Mission Success Starts With YOU

# NASA's New Direction

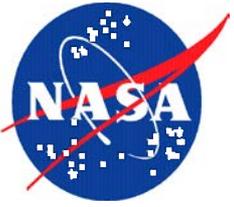
The end of the space shuttle program does not mean the end of NASA, or even of NASA sending humans into space.

## Exploration

NASA is designing and building the capabilities to send humans to explore the solar system, working toward a goal of landing humans on Mars. We will build the [Multi-Purpose Crew Vehicle](#),

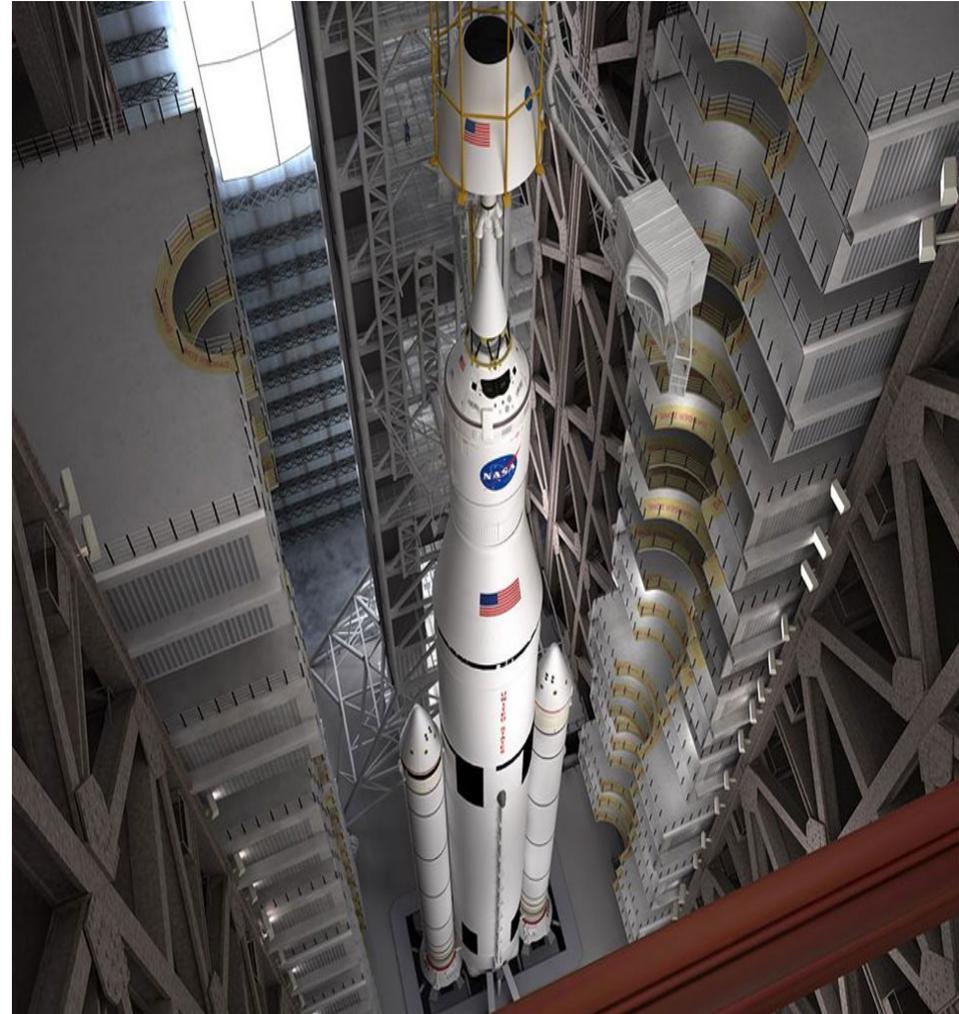
NASA announced the [heavy-lift Space Launch System](#) that will carry us out of low Earth orbit. We are developing the [technologies](#) we will need for human exploration of the solar system, including solar electric propulsion, refueling depots in orbit, radiation protection and high-reliability life support systems.

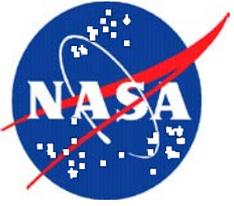




# NASA's Space Launch System

- ❑ NASA is developing the SLS and Orion spacecraft to provide an entirely new capability for human exploration beyond low-Earth orbit.
- ❑ New flexibility to launch spacecraft for crew and cargo missions, including to an asteroid and Mars.
- ❑ The next milestone is for NASA to grant the program authority to move from formulation to implementation.
- ❑ There are several external NASA stakeholders and organizations -- including Congress, the Office of Management and Budget, and the public.





# Multipurpose Crew Vehicle

## ❑ Launch Abort System

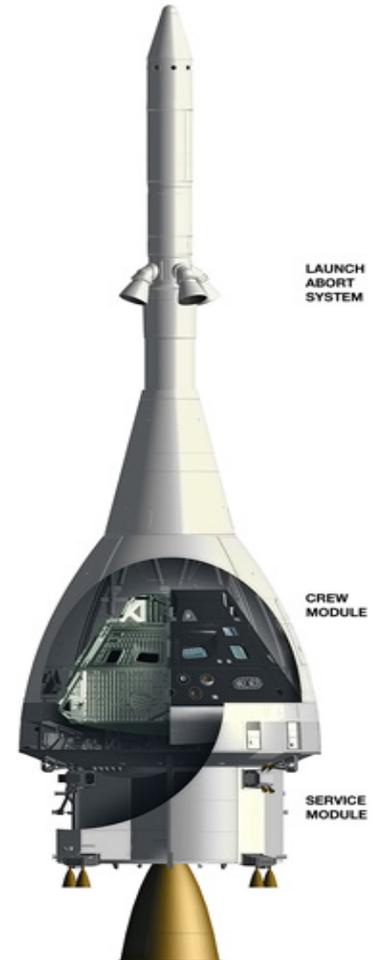
The launch abort system (LAS), activates within milliseconds to propel the crew module to safety in the event of an emergency during launch or climb to orbit.

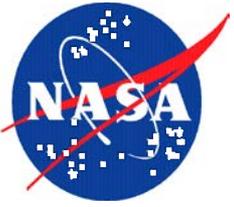
## ❑ Crew Module

The crew module is the transportation capsule that provides a safe habitat for the crew, provides storage for consumables and research instruments.

## ❑ Service Module

The service module supports the crew module from launch through separation prior to reentry.

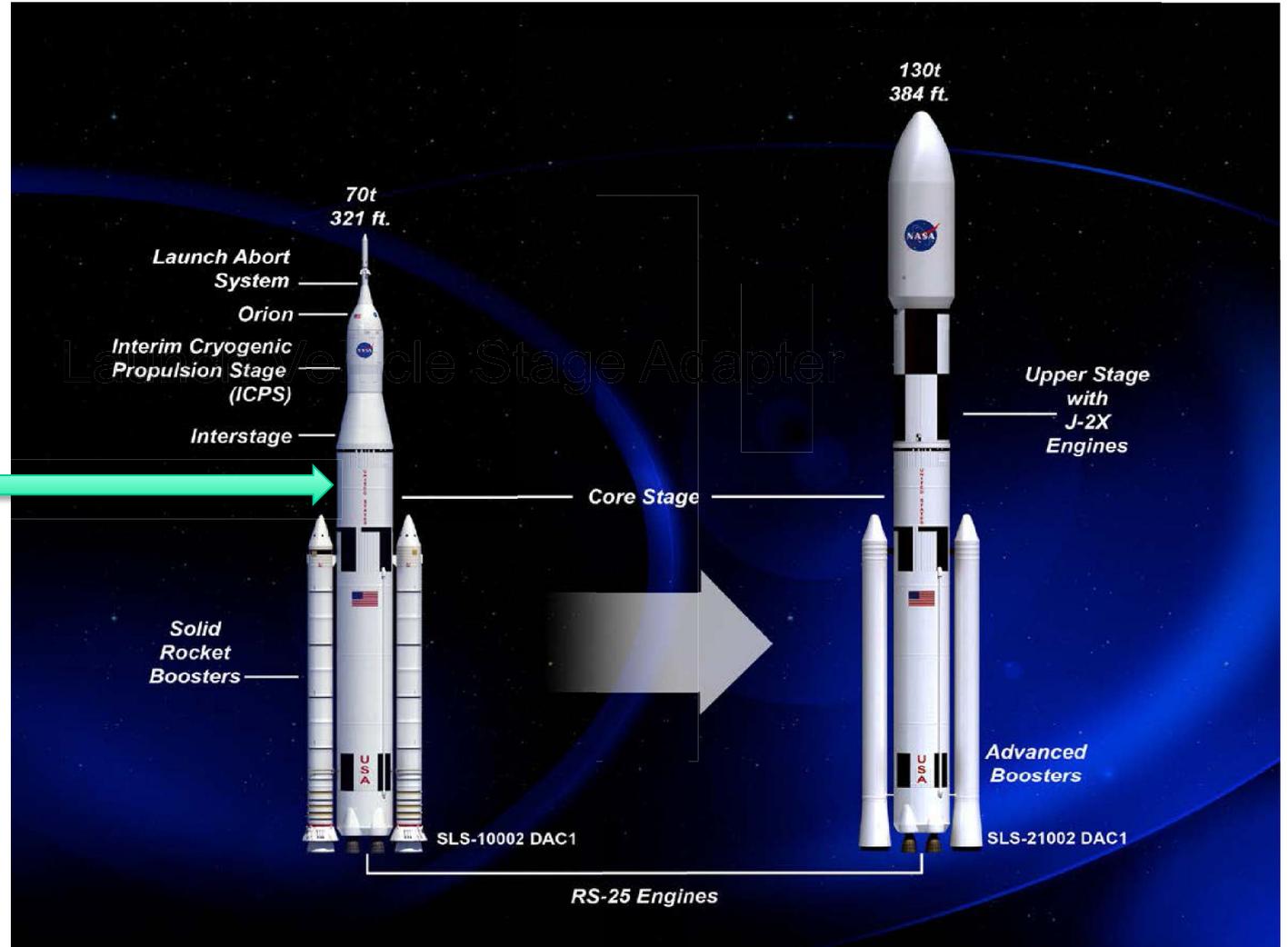


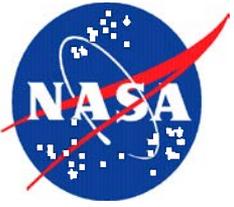


Mission Success Starts With YOU

# NASA's Space Launch System

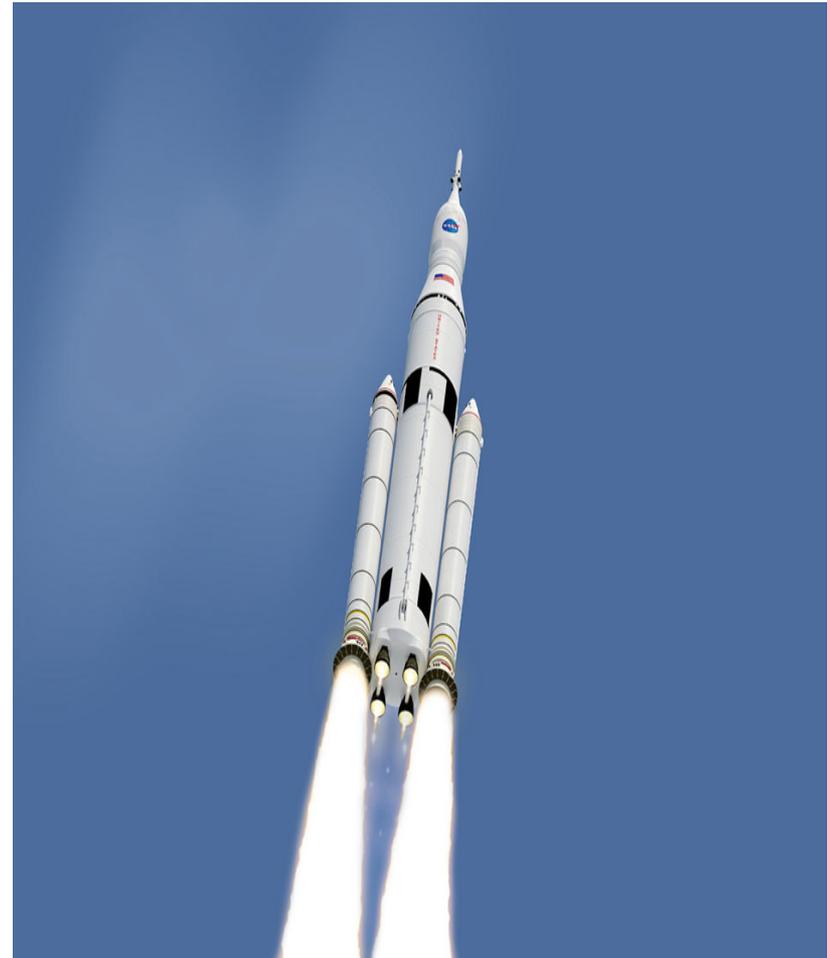
Space Shuttle  
Height is:  
184.2 ft.

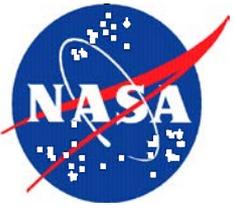




# NASA SLS Progress

- ❑ In 2012, the SLS Program completed a combined system requirements and system definition review.
- ❑ The SLS was ready to move from concept to design. All element-level preliminary design reviews for the SLS core stage, boosters, engines and spacecraft and payload integration have been completed successfully.
- ❑ "In two short years from the first announcement, the Space Launch System, validates the detailed design and integration of the system.
- ❑ The initial 70-metric-ton version of SLS will stand 321 feet tall, provide 8.4 million pounds of thrust at liftoff, and carry 154,000 pounds of payload.
- ❑ The SLS will be modified to a 130-metric-ton version, which will be capable of lifting 286,000 pounds.
- ❑ The rocket is scheduled for its first mission, Exploration Mission 1, in 2017. A crewed flight in 2021.



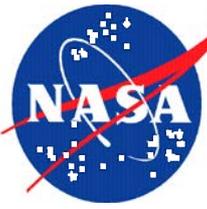


Mission Success Starts With YOU

# NASA's Commercial Crew Transport

- NASA is supporting the development of these capabilities through its Commercial Crew Integrated Capability (CCiCap) initiative
- Participating Organizations:
  - Boeing
  - Sierra Nevada
  - Space X
- NASA is exercising and funding additional milestones for these next generation space transportation systems.
- Commercial partners are on-track developing innovative, new space systems that can safely, reliably and affordably transport astronauts and end the gap in U.S. human spaceflight capabilities.





# Process Control Issues Know No Boundaries

Mission Success Starts With YOU

## *NEW Projects Being Launched*

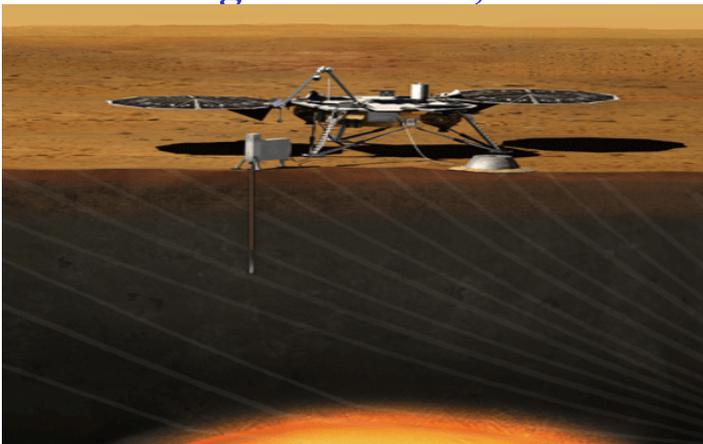
IRIS – June, 2013



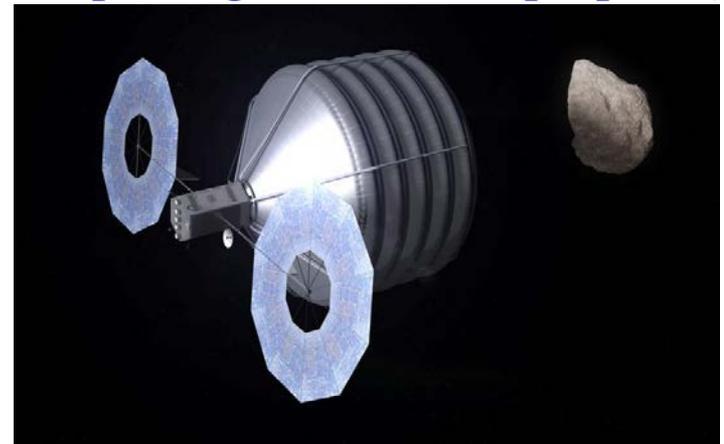
MAVEN – Late 2013

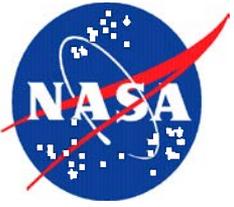


InSight – March, 2016



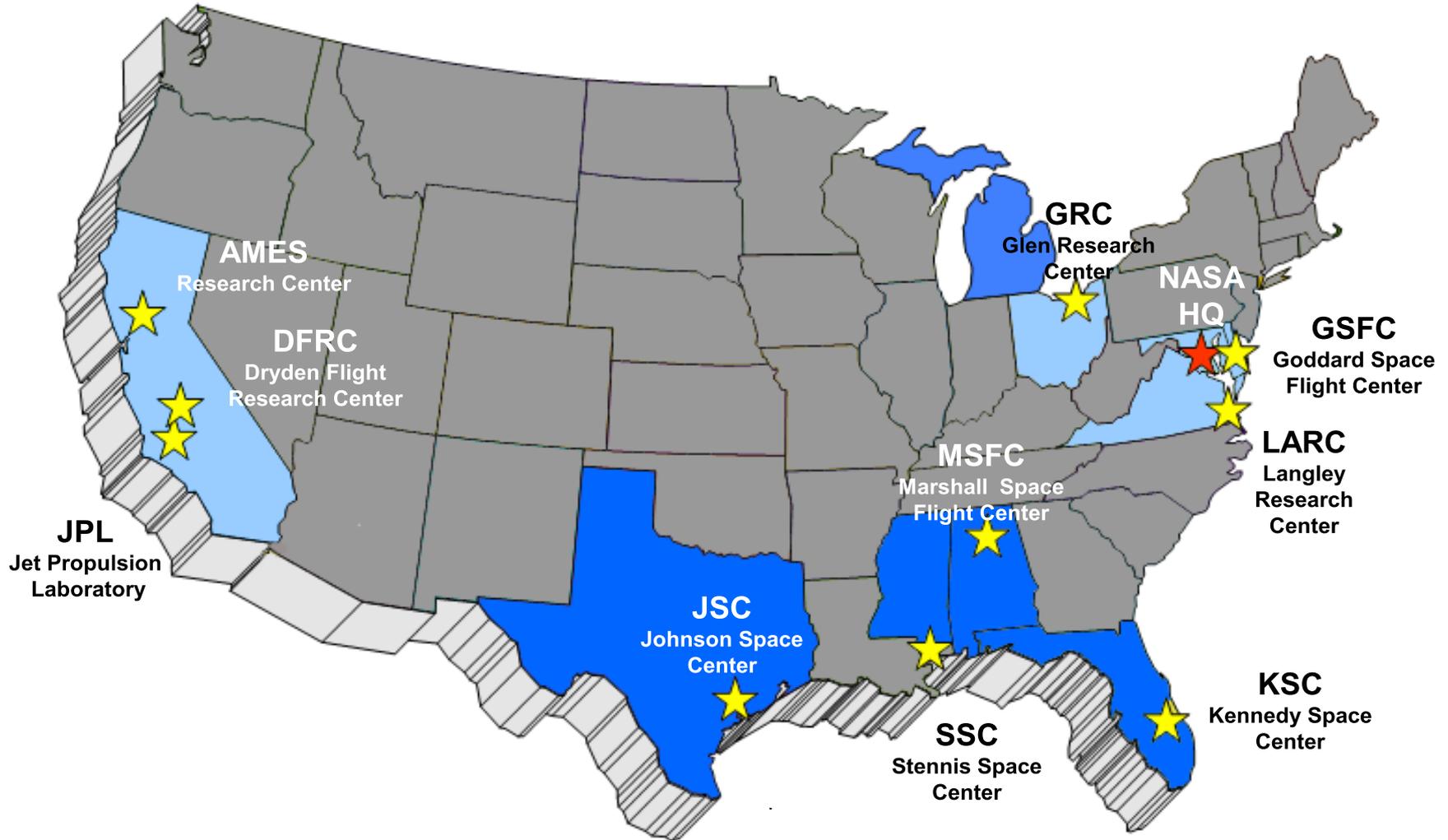
Capturing an Asteroid (proposed)

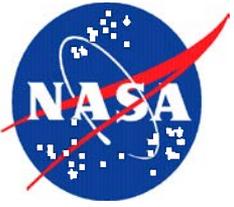




Mission Success Starts With YOU

# NASA Center Locations





# Five Elements of a Process



## Variables affecting a Process:

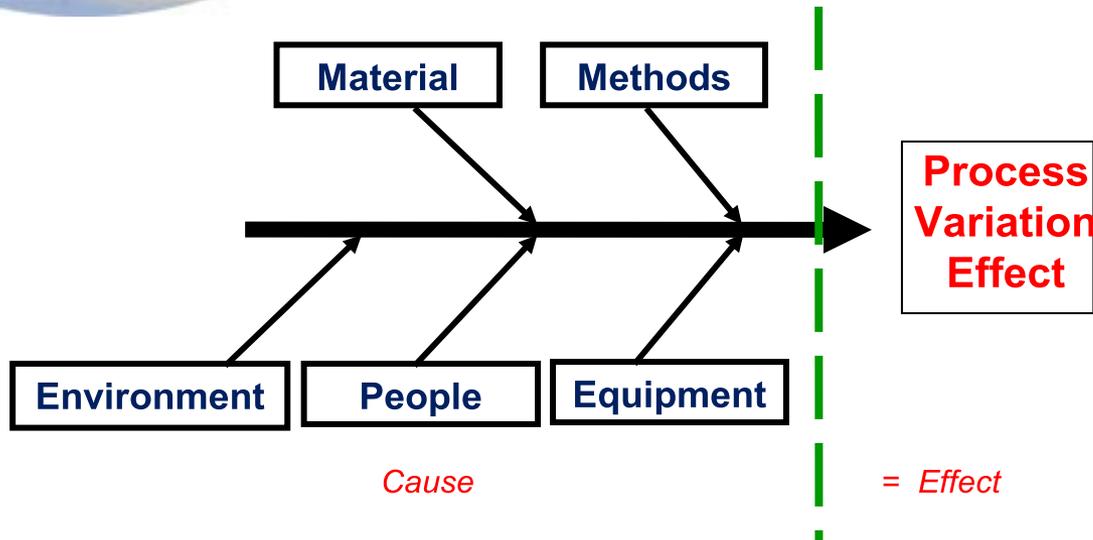
Element 1: PEOPLE

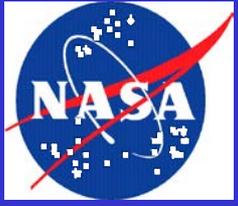
Element 2: METHODS

Element 3: EQUIPMENT

Element 4: MATERIAL

Element 5: ENVIRONMENT

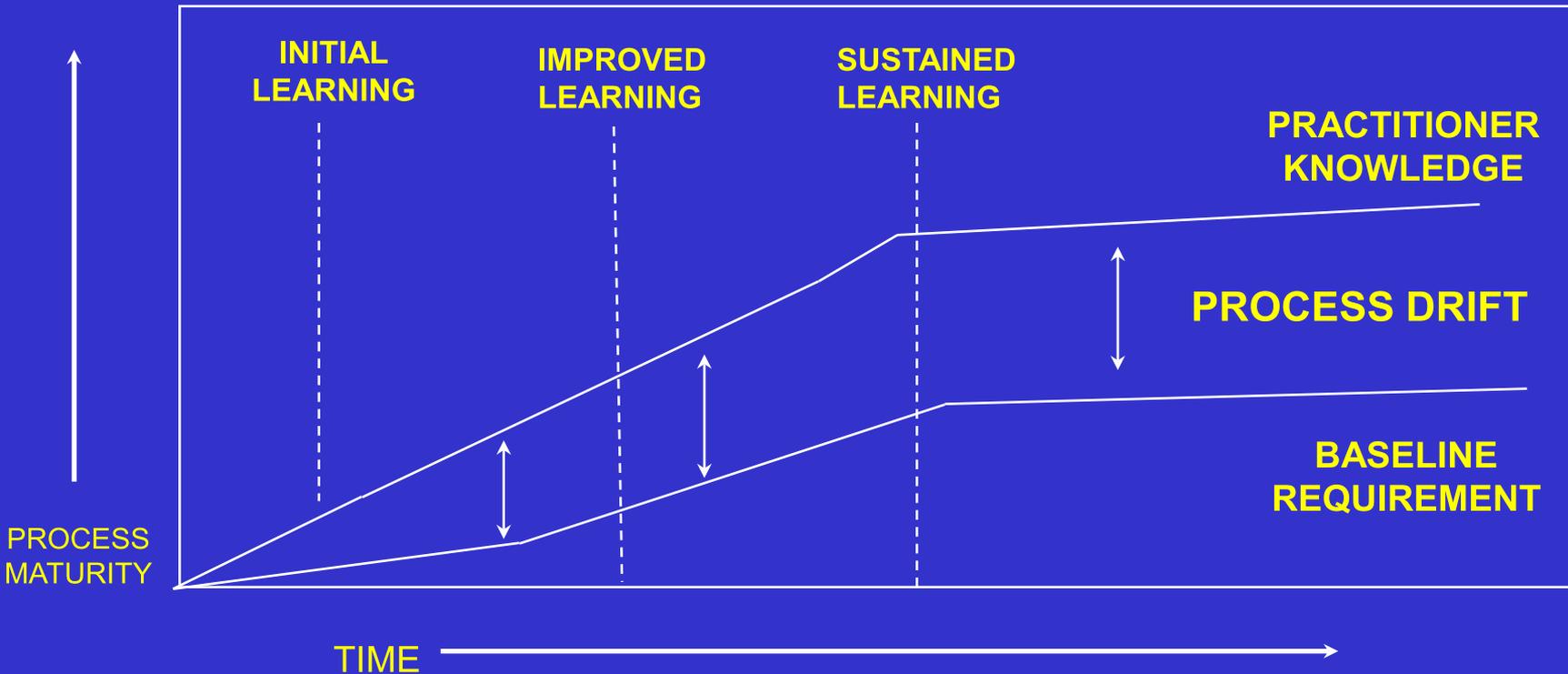




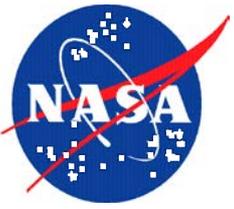
Mission Success Starts With YOU

# Process Drift

*Traditional Audit Systems Don't Protect Against Drift*



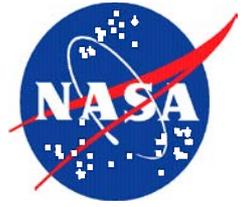
*Need To Leverage Practitioners Knowledge*



### What caused ISS astronaut's helmet leak?

- On July 16, ESA astronaut Luca Parmitano and NASA astronaut Chris Cassidy went outside the space station to make preparations for the arrival of a Russian module destined for the ISS in 2014.
- Originally, the spacewalk was supposed to last for six and a half hours, but was cut short after an hour and half when water began leaking inside Parmitano's helmet. In the zero-gravity [environment](#), the water droplets clung to Parmitano's face and head and interfered with his vision and hearing.
- The space suit cooling system holds about 1 gallon of water, [according to the Associated Press](#), while the bag of drinking water astronauts carry contains just about a quarter of a gallon. there's some speculation that the suit's cooling system could be at fault.



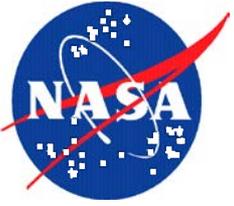


### What caused ISS astronaut's helmet leak?

In the back of the helmet's neck hole, slightly to the left side of the body, there's a slit in the rim that allows air to go through, Cassidy said [in the video](#). This port links to the ventilation system, which blows air over the astronaut's face. Somehow, water leaked out and made its way through that slit and into the helmet, where it began to collect in a kind of hard white plastic lining behind Parmitano's head, soaking his hair. Soon, the water began to spill over the white plastic and float inside the helmet, raising the risk of drowning in the suit.

"The board's investigation will run parallel with the engineering analysis already underway," The mishap investigation board will look more broadly at past operations and maintenance, quality assurance, aspects of flight control and other organizational factors."





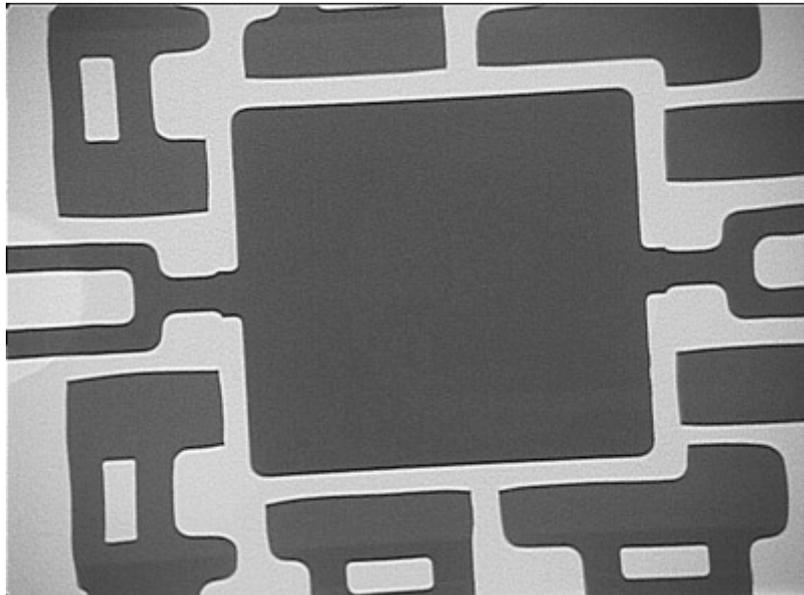
# Lessons Learned

Mission Success Starts With YOU

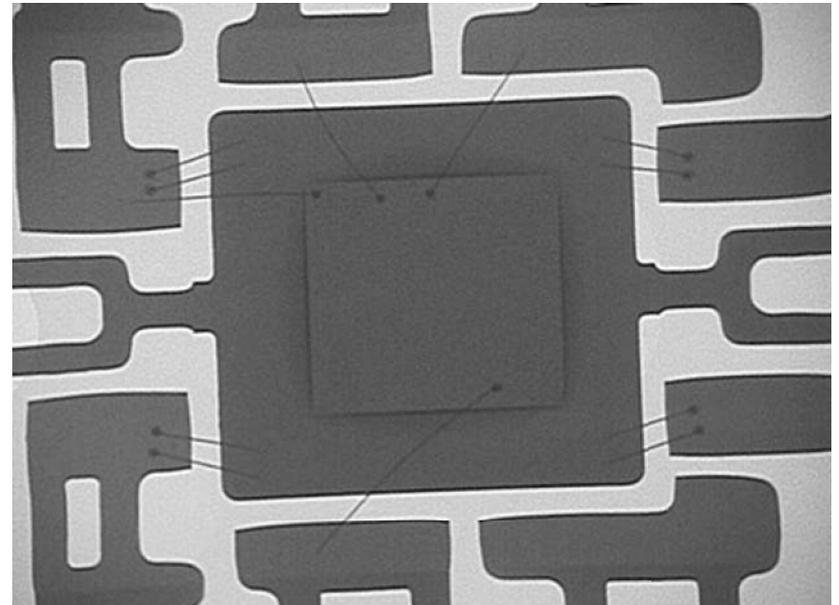
## Counterfeit Parts lead to Mission failure

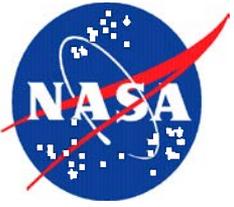
- X-ray image of dummy part with no die inside and no wires
- Outside packaging made to appear authentic

Dummy  
Part



Authentic  
Part



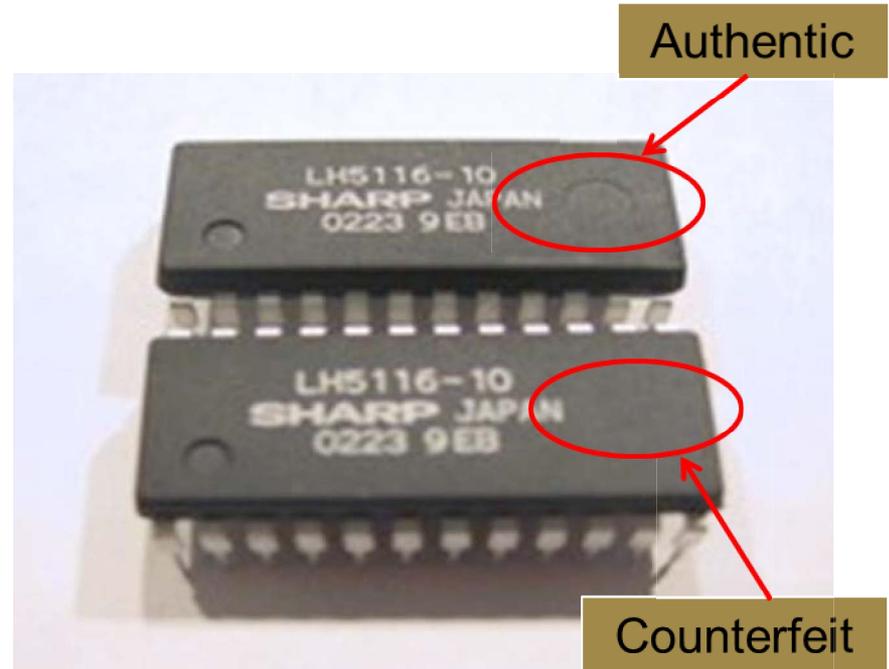


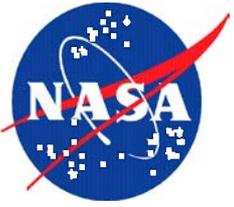
# Lessons Learned

Mission Success Starts With YOU

## Counterfeit Parts lead to Mission failure

- The indents to the lower left look similar
  - Middle right indent is not apparent on the bottom part
  - Counterfeiters sand down the parts to remove original markings
- They re-surface parts with a process called “blacktopping”
    - Grayish to black substance
    - This often fills indents, they should not be filled





# Counterfeit Parts Mitigation Plan

## SAE International Standards-Counterfeit Avoidance, Detection, Mitigation and Disposition

1. OEMS/Users of Electronics: **AS5553**

2. OEMS/Users of Materiel (other than electronics): **AS6174**

3. Independent Distributors/Brokers of Electronics: **AS6081**

4. Authorized Distributors of Electronics: **AS6496**

5. Test Laboratories of Electronics: **AS6171**

G-19 Committee

G-19 CI - Continuous Improvement Subcommittee  
(AS5553A: Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition)

G-19 D - Independent Distributor Subcommittee  
(AS6081: Counterfeit Electronic Parts: Avoidance, Detection, Mitigation, and Disposition; Independent Distribution)

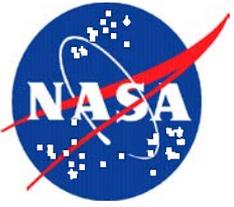
G-19 AD - Authorized Distributor Counterfeit Mitigation Subcommittee  
(AS6496: Counterfeit Electronic Parts Counterfeit Mitigation AD's)

G-19 DR - Distributor Risk Characterization Subcommittee  
(ARP6178: Counterfeit Electronic Parts; Tool for Risk Assessment of Distributors)

G-19 A - Test Laboratory Standards Development Subcommittee  
(AS6171: Test Methods Standard; Counterfeit Electronic Parts)

G-19 C - Standards Compliance Verification Subcommittee  
(AS6462: AS5553, Verification Criteria  
AS6301: AS6081 Verification Criteria)

G-19 T - Definitions Task Group  
(AIR6273: Terms and Definitions - Counterfeit Parts)



## What YOU Can Do...

*What YOU can do to ensure the United States maintains a leadership role in Space Science programs:*



**PREVENT**



Audits, Risk Management,  
Continuous Process Improvement,  
Process Mapping, Statistics

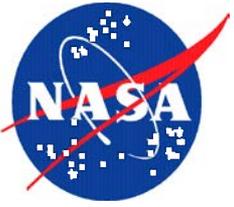
• **REACT, or** 

Problem Solving, Fishbone, 5 W's,  
Root Cause and Corrective Actions,  
Gap Analysis

• **DO NOTHING** 

Rework, Scrap,  
Customer Complaint





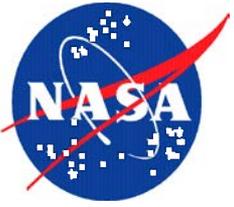
The challenge is to control processes in order to avoid degradation of product quality.

*Some* of the tools that are effective in controlling processes, minimizing variation and possibly preventing escapes are :

- ✓ *Identify Key Characteristics in the Planning & Design phases*
- ✓ *Failure Modes and Effects Analysis (FMEA)*
- ✓ *Risk and Mitigation*

General Types of Key Characteristics

- ✓ Mission
- ✓ Operational
- ✓ Product
- ✓ Process



## Failure Modes & Effects Analysis (FMEA)

---

1. **Design FMEA** - examines the *functions* of a component, subsystem or main system.

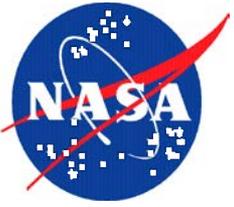
*Potential Failures: incorrect material choice, inappropriate specifications.*

Example: *Air Bag (excessive air bag inflator force).*

2. **Process FMEA** - examines the *processes* used to make a component, subsystem, or main system.

*Potential Failures: operator assembling part incorrectly.*

Example: *Incorrect installation of pneumatic lines to landing gear.*



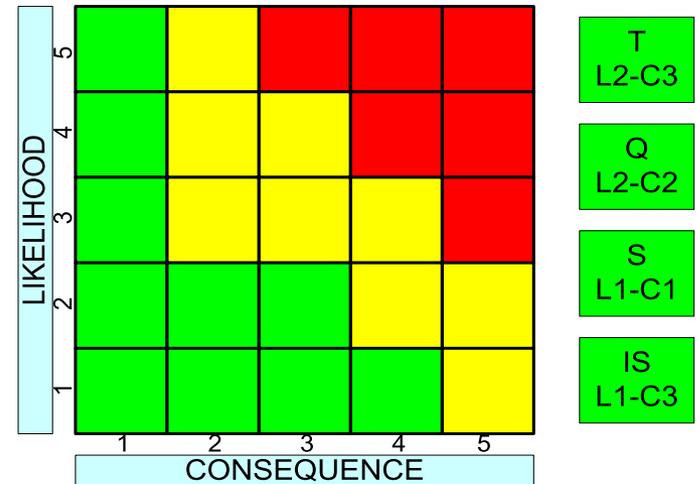
# Risk and Mitigation

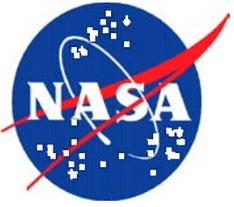
## Managing Risk

- ✓ Identify risk
- ✓ Analyze, determine likelihood and impact (use Risk Matrix), and prioritize risks
- ✓ Develop and implement risk mitigation or acceptance plan during the program/project formulation phase
- ✓ Included in the program/project plans
- ✓ Assure that risk information is communicated at all project/program levels

## Mitigating Risk

- ✓ Conduct Risk Reviews
- ✓ Training programs
- ✓ Mandatory inspection points
- ✓ Regular monitoring of risks (trends and metrics)





## When Implementing Process Control...

**Do the procedures need to be changed? If so, establish:**

*New process baselines*

*Statistical Process Control charts*

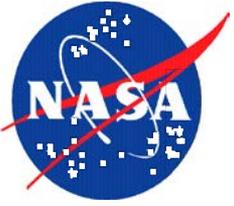
*Updated Procedures*

**Were the project design goals met?**

*What were the defect reductions?*

*Were risks areas minimized or mitigated?*

*Are the process outputs stable?*



# Summary

---

## Maintain Open Dialog

- Performance Issues, Technical, Scheduling, Support
- Requirements (Design, Quality, Configuration and Processing)

## Communicate Importance of Supplier Products

## Promulgate Lessons Learned

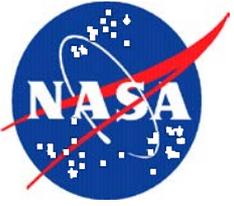
- What works and what doesn't
- Shared Experiences

## Report Failures and Damage

- Timely notification of anomaly issues/ discrepancies

## Emphasis on strict control of all processes

- Design Engineering Authorization
- Customer Authorization



Mission Success Starts With YOU

# CONTACTS

**Tony Gutierrez**  
Quality Initiatives Program  
NASA - Jet Propulsion Laboratory  
(818) 393-7387  
[Tony.Gutierrez@jpl.nasa.gov](mailto:Tony.Gutierrez@jpl.nasa.gov)

**Brian Hughitt**  
Manager, Agency Quality Program  
NASA Headquarters Office of Safety & Mission Assurance  
(202) 358-3104  
[brian.hughitt-1@nasa.gov](mailto:brian.hughitt-1@nasa.gov)

**Thank you!**  
**Questions?**