Challenging the role of Quality Engineering in NASA projects

Maximizing Our Value and Achieving Industry Alignment

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SAFETY and MISSION ASSURANCE DIRECTORATE
Code 300

DEFENSE

Lawmakers 'mystified' after NASA scales back Mars collection program

The space agency's cut could "cost hundreds of jobs and a decade of lost science," the bipartisan group says.

The Perseverance rover will characterize Mars' geology and past climate, paving the way for human exploration of the Red Planet, and be the first mission to collect and cache Martian rock and regolith. | NASA via Getty Images

NASA cancels $450 million VIPER moon rover due to budget concerns

News By Brett Tingley published July 17, 2024

The agency plans to potentially reuse VIPER's scientific instruments and other hardware on future moon missions.

Comments (9)

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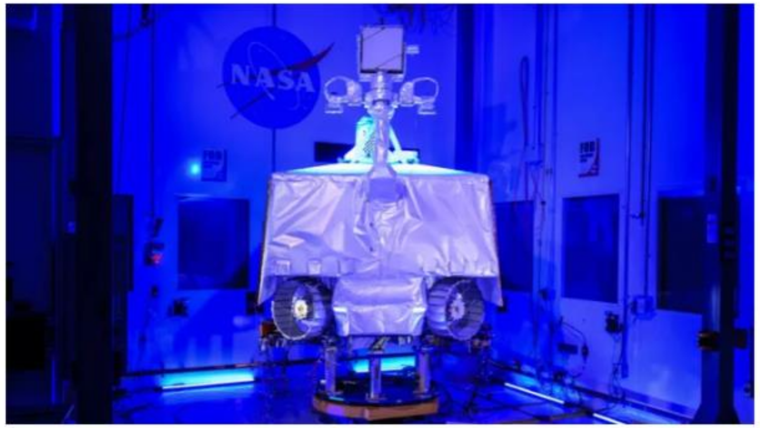

NASA's VIPER – short for the Volatiles Investigating Polar Exploration Rover – sits assembled inside the cleanroom at the agency's Johnson Space Center. (Image credit: NASA)

NASA has cancelled its VIPER moon rover program due to rising costs.

NASA reaffirms decision to cancel OSAM-1

Jeff Foust September 5, 2024

The OSAM-1 satellite servicing technology demonstration mission suffered significant cost and schedule overruns. Credit: NASA

Updated Sept. 6 with OSAM-1 RFI details.

WASHINGTON — NASA is proceeding with plans to shut down a satellite servicing mission at the end of the month after rejecting a proposal to revise the mission to meet a 2026 launch date.

Stellar Dispatch

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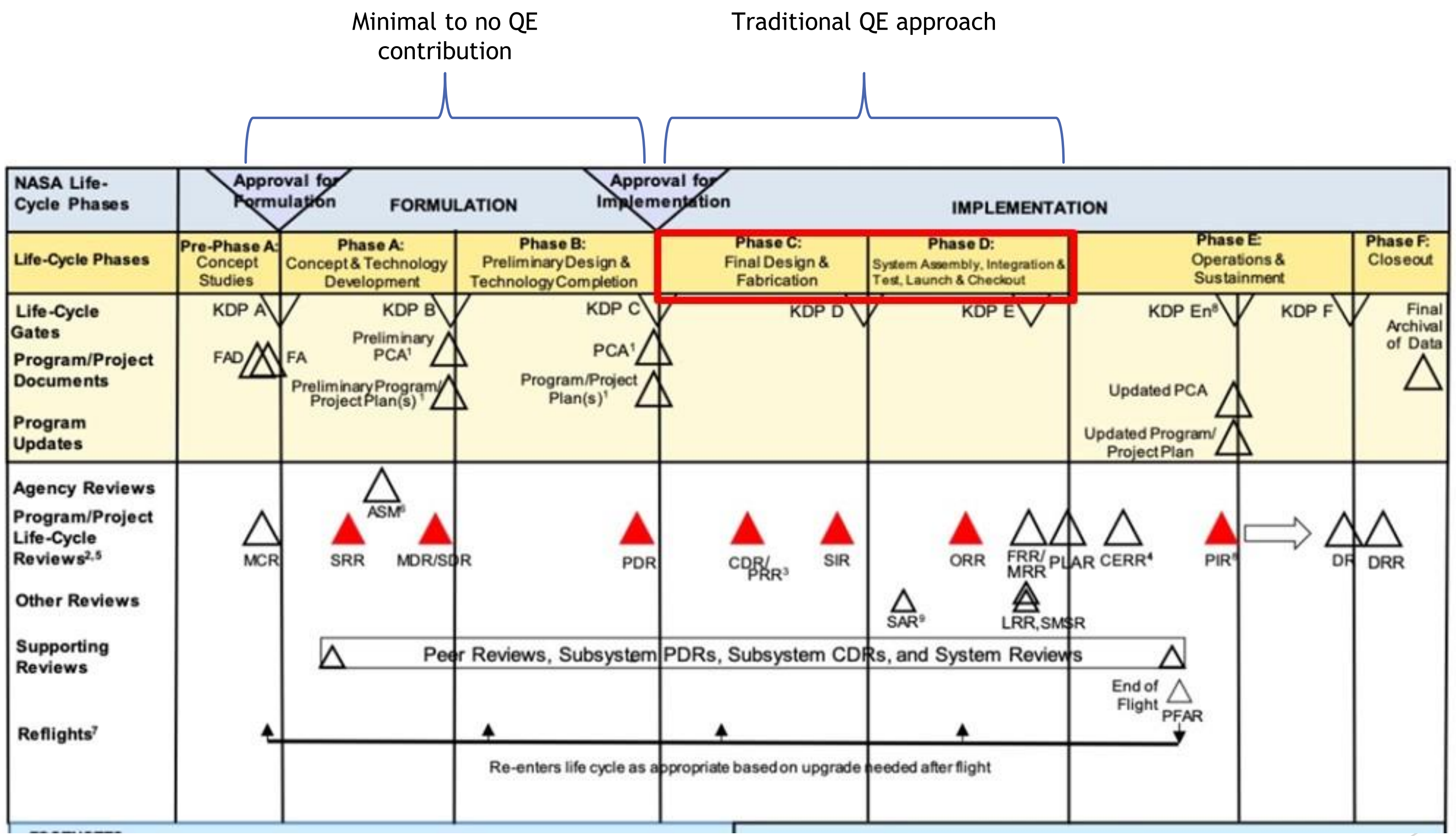
Historical Project Challenges

- Project Management Approach
- Contract Types and Incentives
- Supplier Selection and Performance
- Technology Maturity

- Regardless of proximate cause, does our function reflect on what our contribution to these cancellations or challenges was?
- Is Quality Engineering part of the solution or part of the problem?

Traditional QE Approach



Traditional QE Approach – The Why

- Technology is often not mature, PI and PM focus on proof of concept and TRL. Projects don't see how Quality Engineering can offer value.

- Quality Engineering = Inspection
  - … verification of compliance and document preparation

- Can we do more?

How about our industry QE counterparts?

- In the aerospace and defense industries, inspections are left to inspectors!
- Quality engineers have a significantly more expanded role that oversees continuous improvement activities and are accountable for implementation of process improvements to reduce both waste and risk.
- Examples include:
  - Involvement and management of Advanced Product Quality Planning activities
    - Participation in design and process FMEAs
    - Development of inspections based on FMEA risk
    - Management of FAIR
  - Oversight and <u>accountability</u> for process improvement initiatives (reduce scrap, rework, development and use of SPC)
  - Risk based supplier oversight using objective monitoring metrics

Can we follow the industry's example?

- Most common arguments against it are:
  - We build one of a kind *"stuff"*
  - All our missions fly, how can you say we are not successful and/or efficient?
- Wrong!
  - All processes can be measured

1 mission

Tens of subsystems

- Antennas
- LIDAR
- Robot arms
- Power Units
- Tools
- Structures
- ....

Hundreds of Processes

- Welding
- Soldering
- Handling
- Installation
- Machining
- Harnesses
- PCBs

Thousands of **repetitive tasks** contributing to cost and schedule that can be measured and improved

Our suppliers are constantly working on process efficiencies for similar work. Should we do the same?

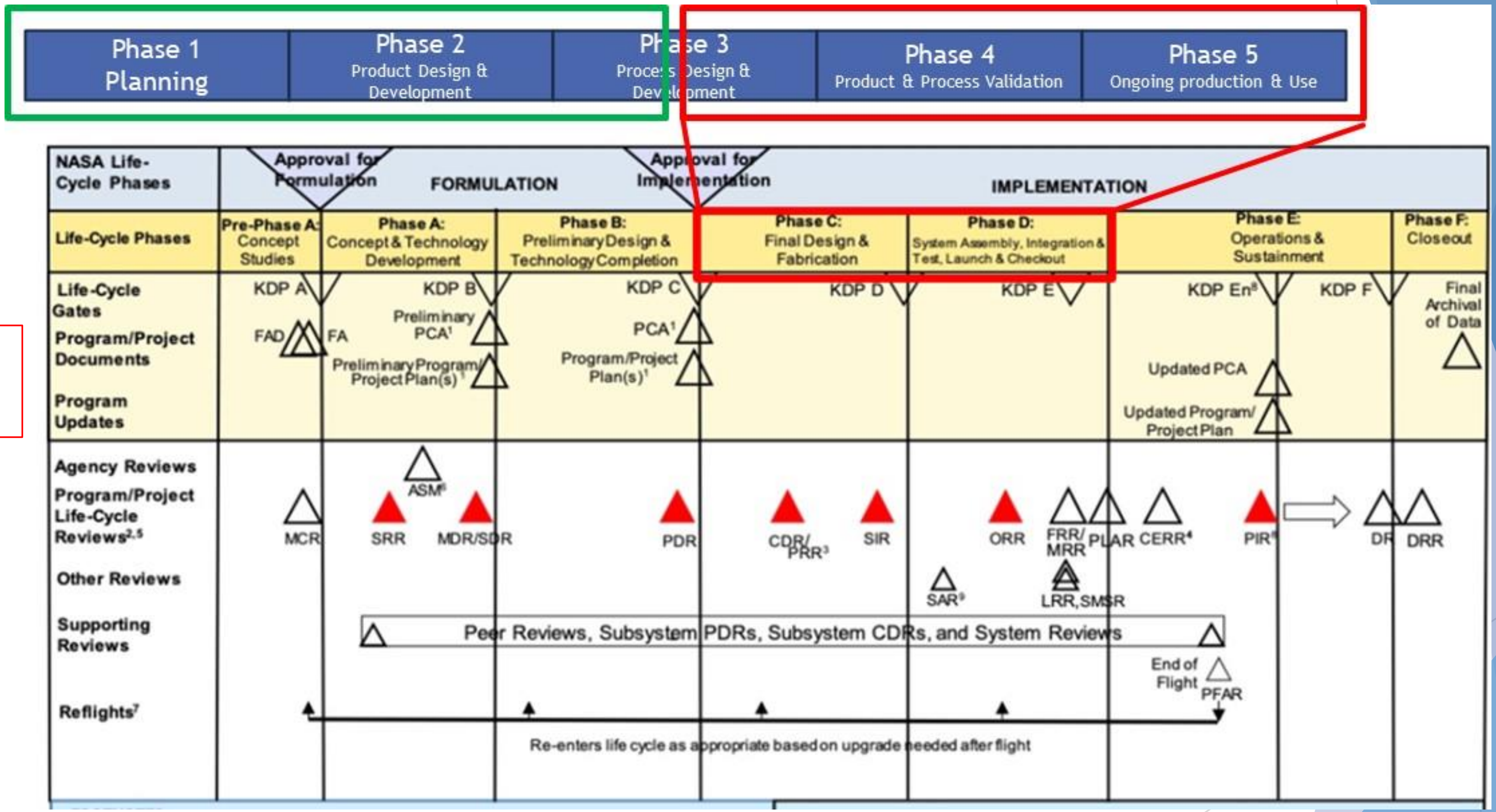
Maximizing Our Value Proposition Achieving Industry Alignment

- Embrace Advanced Product Quality Planning principles for both in-house and out of house
- Measurement of our in-house capability for doing things right the first time
- Highlight the value proposition of Quality Engineering

Advanced Product Quality Planning

APQP Phases

NASA Life Cycle Phases



Advanced Product Quality Planning
How Can We Use It?

- Risk Assessment and Reduction for Suppliers
  - More primes are flowing APQP (AS9145) as a contract deliverable to their suppliers
  - NASA should consider doing the same

- In-House Development
  - Introduce APQP elements during development of new “technologies” to reduce downstream risk

Evaluation of Our In-House Capabilities A GSFC Case Study

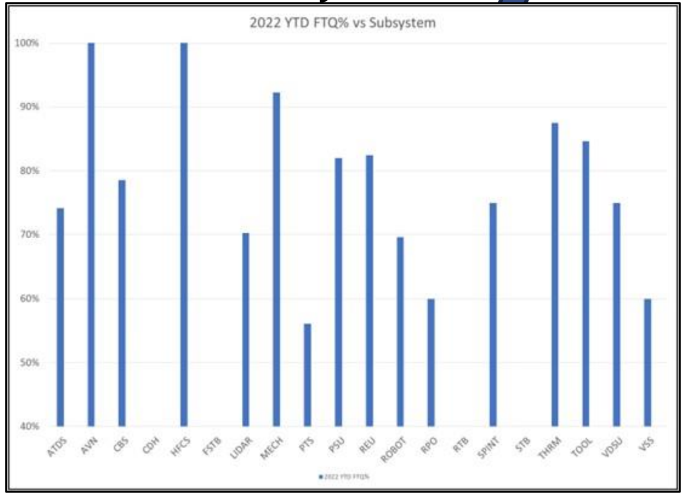
- While most of projects' manufacturing activities are performed by off site suppliers, there is significant volume of work taking place at GSFC.
- Examples include:
  - Assemblies of Instruments, Mechanisms and Electromechanical Equipment such as Advance tool drive systems, LIDARs, Propellant Transfer Systems
  - Mechanical structures with operations like welding, installation of propellant lines, soldering EEE/thermal HW, PCB assembly and functional testing.
- When issues occur during building of hardware, approach is reactive (fix and move on), with no measuring of execution efficiency or continuous improvement mindset.

Evaluation of Our In-House Capabilities
A GSFC Case Study

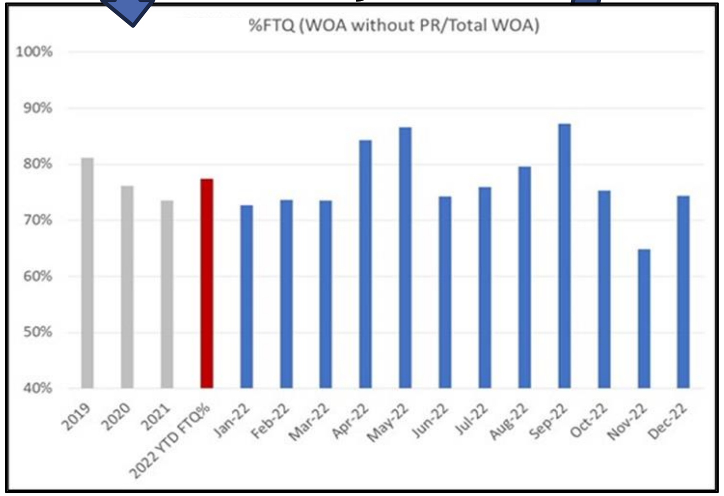
- What to monitor?
  - Traditional manufacturing metrics are scrap, rework, first pass yield/quality based on quantities produced, $ value of components or labor rates.
  - Performance at NASA not measured in $, but mostly in schedule adherence
  - Considering the differences between traditional manufacturing and NASA prototype projects, an alternative metric was developed.
- FTQ measures the ability to execute a task from beg to end as planned, without raising a nonconformance
  - For any time frame (month, year)
  - First Time Quality (FTQ) = #compliant WOA/total #WOA
  - Metric is normalized, so performance can be compared regardless of work volume and at any level of the organization
    - Subsystems within a project or between projects
    - Comparison of projects within same mission class, build phase, project or Center's aggregate year over year performance

Evaluation of Our In-House Capabilities A GSFC Case Study - Benefits

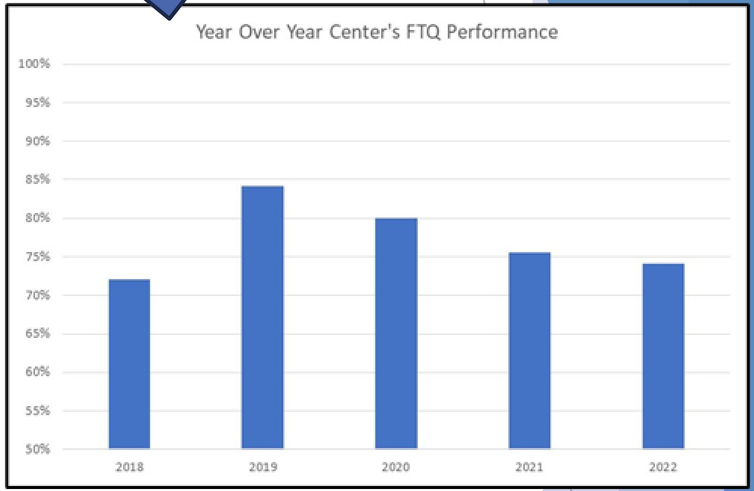
Subsystem



Project



Center



- **Risk Reduction**
  - Low FTQ (more WOA with nonconformances), higher risk some will be incorrectly dispositioned. Metric provides measurable improvements
- **Lessons Learned**
  - Do we incorporate lessons learned during development phase, or do we repeat same mistakes during flight? FTQ comparison vs build phase
  - What can project X or subsystem Y learn from a project or subsystem that is performing better? Metric can help us identify best practice
- **Schedule**
  - Reduction of delays by reducing repetitive errors, more personnel available for value added tasks
  - Cost reduction from reducing rework/scrap. Year over year improvements can be captured
- **Risk Based Audit Compliance**
  - Metric can be used to identify high risk areas to direct internal audit activities
  - Center can use cross project data to identify institutional opportunities for improvement (personnel training, facilities, tools)

Value Of Quality Engineering - ROI

- Quality Engineers are terrible salespeople. We focus too much on the bad news!
  - We are shareholders of success. Not the police

- Use continuous improvement activities to highlight the value we bring to a project. Cost savings/avoidance are everywhere:
  - Identification and elimination of systemic nonconformances
  - Monitor performance and adjust oversight
  - Research and implement new inspections methods

- Translate your cost savings activities into $ or hours. Make your customer look good