NASA's Independent Verification and Validation (IV&V) Program

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www.nasa.gov/centers/ivv

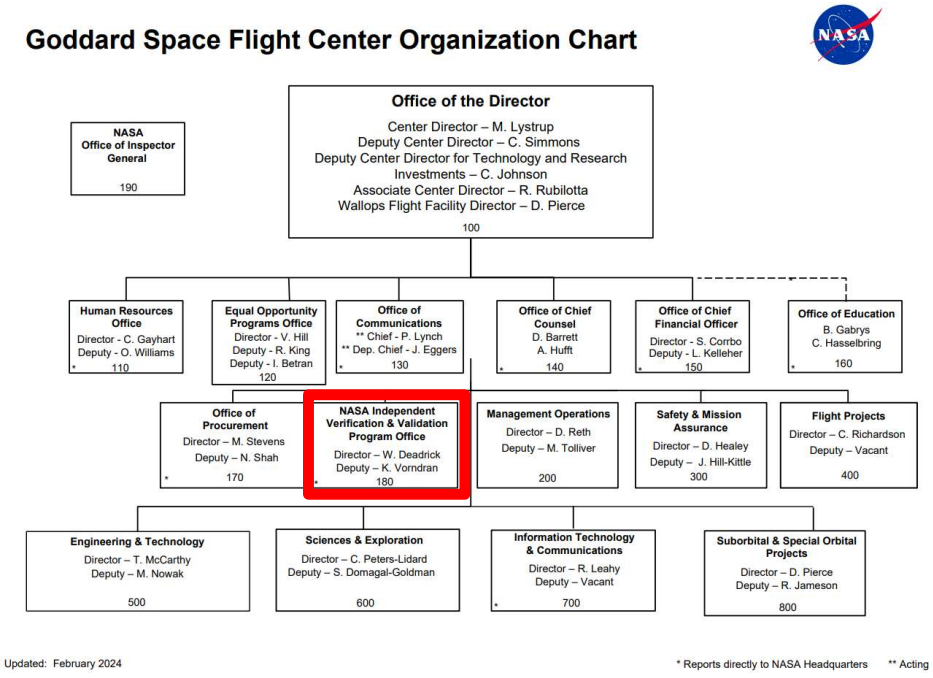
History of the NASA IV&V Program

NASA's Independent Verification and Validation (IV&V) Program: established in 1993, driven by recommendation after Space Shuttle Challenger accident.

- IV&V is responsible for providing a systems engineering function that is focused on partnering with missions to improve reliability, find defects earlier, reduce cost, and reduce risk related to safety- and mission-critical software.
- Founded under the NASA Office of Safety and Mission Assurance (OSMA) as a direct result of recommendations made by the National Research Council (NRC) and the Report of the Presidential Commission on the Space Shuttle Challenger disaster.
- Based at the Katherine Johnson IV&V (KJIV&V) Facility in Fairmont, WV, the NASA IV&V Program is the IV&V provider for NASA missions.

Where does the IV&V Program fit within NASA?

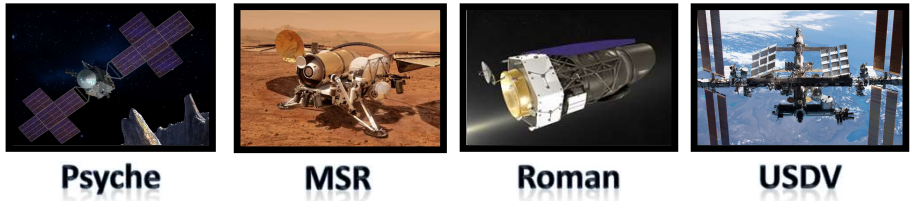
- IV&V receives functional guidance and direction from OSMA
- The KJIV&V Facility is a GSFC facility, and all IV&V employees are GSFC Code 180



Which NASA projects receive IV&V?

- NASA established IV&V as a requirement in NPR 7150.2, *NASA Software Engineering Requirements.* Per NPR 7150.2, IV&V is required on the following:
  - a. Category 1 projects as defined in NPR 7120.5.
  - b. Category 2 projects as defined in NPR 7120.5, that have Class A or Class B payload risk classification per NPR 8705.4, Risk Classification for NASA Payloads.
  - c. Projects selected explicitly by the Mission Directorate Associate Administrator (MDAA) to have software IV&V.

IV&V is strategically applied within NASA as an engineering capability that is proven to identify defects earlier, thereby reducing development costs, and promoting mission success



NASA IV&V Approach: Guiding principles to enable mission success

- **Full Lifecycle –** Starts near System Requirements Review (SRR) continues to/beyond launch.
- **In Phase –** Services provided in-line with system/software development life cycle (SDLC) phase. Enables timely consideration/incorporation IV&V issues, risks, and assurance results.
- **Mission Oriented –** IV&V strives to be a partner in mission success. Projects = key stakeholders. IV&V cannot be successful without project buy in.
- **Product Focused –** Not process or compliance focused. IV&V focuses on system/software products essential to fulfilling mission goals and objectives (i.e., Level 1 requirements).
- **Capability Based –** Keep "big picture" in view when assessing the software details. Software functionality is evaluated within the context of the system capabilities they support.
- **Risk Driven –** IV&V dynamically adapts, focuses assurance activities where evidence indicates risk to safety/mission critical software.

Why Have IV&V?: Observed Benefits

- **Increased Safety and Dependability –** Greater confidence that delivered products are error free and meet user needs. Many IV&V-identified defects threaten loss of mission or loss of crew if not resolved.
- **Reduced Risk to Safety and Mission Critical Software –** Increased likelihood high-risk errors are detected early, allowing time for the development team to evolve a comprehensive solution rather than a forced makeshift fix to accommodate deadlines.
- **Greater Management Insight –** Increased insight throughout the software development lifecycle through independent perspectives and objective evidence.
- **Increased Confidence –** IV&V generates empirical evidence as a complement to identified issues and risk which equate to greater confidence in the delivered software.
- **Reduced Development Cost –** IV&V reduces development rework, thereby reducing total program and project costs, for a positive return on investment.
- **Increased Knowledge Transfer –** Improves communication across project teams and cross-project transfer of system and software engineering best practices.

IV&V Program Capabilities

- **System and Software Assurance**
  - Full Lifecycle IV&V
  - Independent Assessments
- **Safety and Mission Assurance (SMA) Support**
  - Common support infrastructure for assuring core Software Assurance functions across the Agency, including support for Commercial Crew Program (CCP)
- **Mission Protection Services (MPS) and Engineering Services**
  - Cybersecurity Assessment team, Threat/Risk Assessment, Vulnerability Assessment, CyberLab, Model Based Mission Assurance (MBMA)

IV&V Program Capabilities

- **Jon McBride Software Testing And Research (JSTAR) Laboratory**
  - Digital Twin Factory, Independent Test Capability (ITC), Simulation, Testing, Automation, Virtualization
- **Partnerships, Collaboration, and Leadership**
  - MDA, International IV&V WG, WVANG, DOE, OSMA, FBI, NOAA, DOD/Army, CCSDS, OCIO, OCE
- **STEM Engagement**
  - Internship program, educator workshops, student workshops, STEM competitions, student opportunities
  - In coordination with the agency, NASA IV&V provides STEM engagement opportunities across WV

JON McBRIDE JSTAR SOFTWARE TESTING & RESEARCH LABORATORY

PHASE PSYCHE HARDWARE ABSTRACTION SIMULATION ENVIRONMENT

ARISTOTLE ADVANCED RISK REDUCTION INTEGRATED SOFTWARE TEST & OPERATIONS TRI-PROGRAM LIGHTWEIGHT ENVIRONMENT

WISP RST DIGITAL TWIN

Summary – IV&V:

- …is driven by mission success and partnerships, not compliance or standards adherence. IV&V is focused on collaboration and strategically tailors the services provided to the unique needs of each mission.
- …continues to adapt as systems and software development approaches evolve and as new procurement and partnership structures, including increased commercialization, are leveraged by the Agency.
- …continually employs technology advancements to most efficiently and effectively identify software defects and mitigate software and security risk.
- …provides Mission Protection Services (MPS) as an integral component in safeguarding NASA's missions, seamlessly integrating results-driven cybersecurity assessments into the IV&V process.
- …develops and provides its engineers and customers with industry leading high-fidelity digital twins that condense the entire flight system to run standard computing hardware providing cost effective, and powerful, testing capabilities that enable testing beyond what can be performed on standard hardware testbeds.
- …is a proven agency capability that improves system and software reliability, finds defects earlier, reduces development cost, improves spacecraft resiliency, and reduces operational risk related to the safety- and mission-critical software.