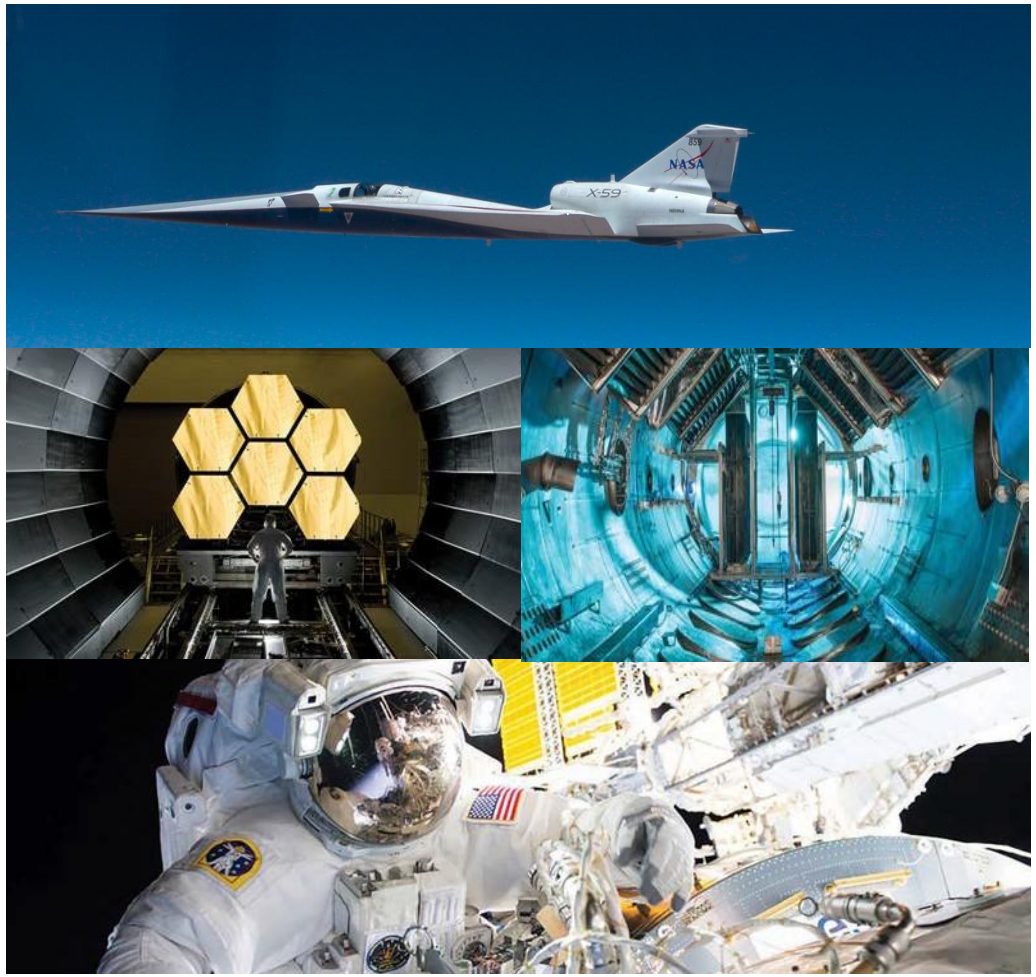


Adapting policy, procurement, and governance processes to enable digital and systems-based modernization

Robert Hubbard
Deputy for Chief Engineer Management

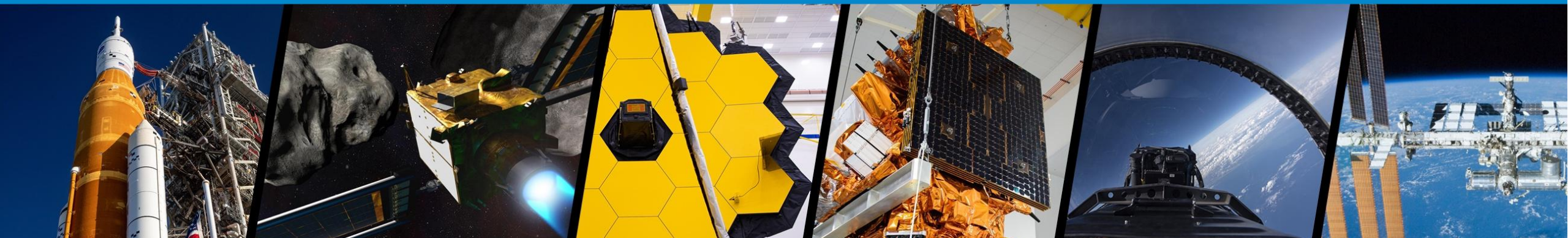
NASA Office of the Chief Engineer

October 27, 2026

Systems Engineering Leadership Across the Agency

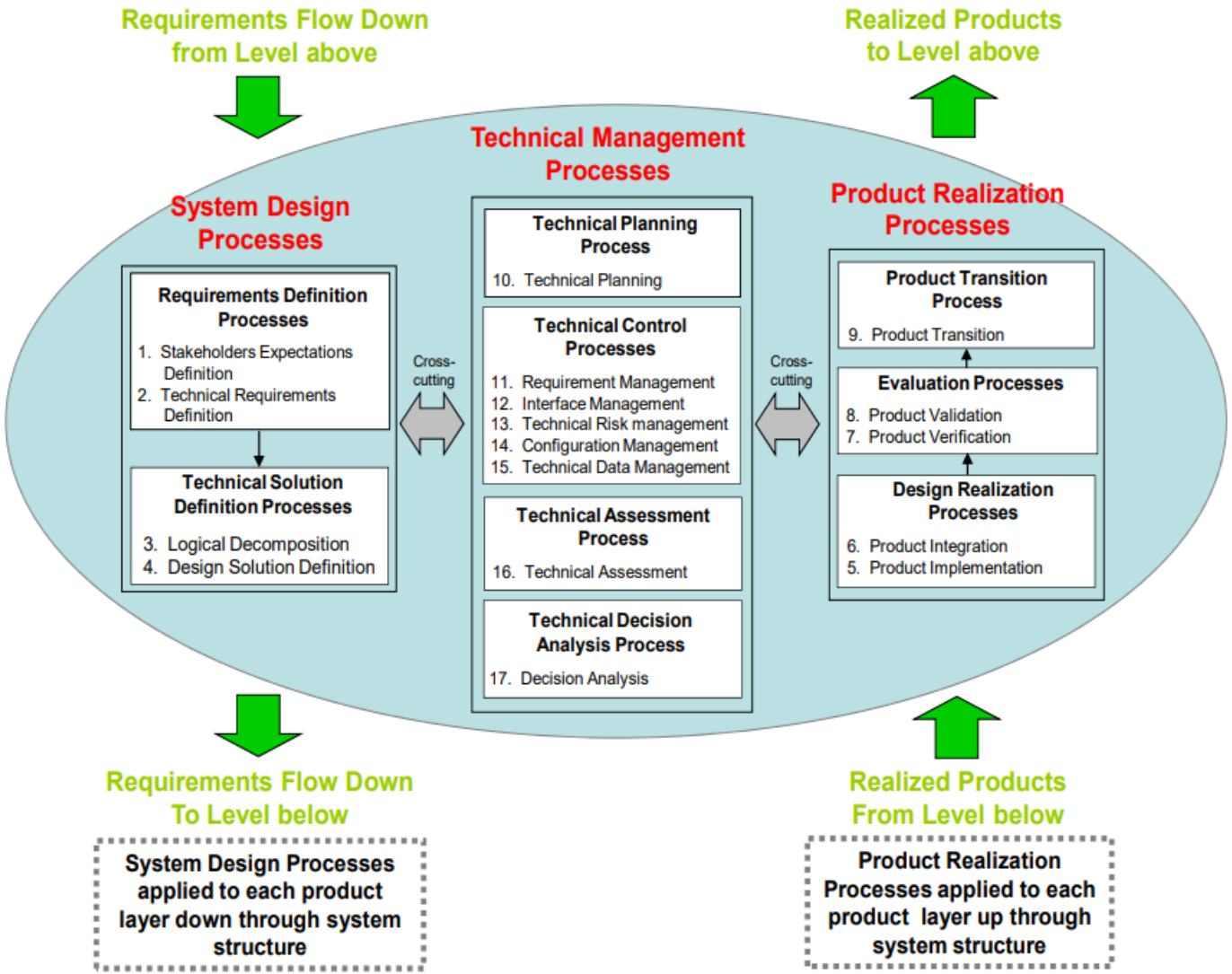
- Systems Engineering (SE) varies program-to-program and center-to-center but follows consistent guidance

  - SE practices exist on the entire NASA portfolio of programs, projects, and activities (from very large to very small) across all mission directorates
  - SE practices at NASA must mesh with many external partners (from very large to very small) as well as the cultures and guiding principles at each NASA Center
  - SE leadership exists in varying parts of the organization by people with varying titles
    - SE for a program/project might be led by a Chief Engineer, Lead Systems Engineer, Mission/Program Systems Engineer, etc.
    - SE organizations, on programs large enough to have them, are similar but are tailored to best meet program needs, Mission Directorate needs, and lead Center practices



SE Application at NASA

- Documentation is consistent across all programs
  - NPR 7123.1 NASA Systems Engineering Processes and Requirements, tailored appropriately per application
  - NASA/SP-6105, the NASA SE Handbook, contains guidance on good SE practices to be used as a companion to NPR 7123.1
  - NASA-HDBK-1009, the NASA Model Based SE (MBSE) Modeling Handbook
- ***Consistent guidance ensures SE application and practices are similar across all programs***



The Systems Engineering Engine (NPR 7123.1)

NASA SE Across the Agency

- Frontline systems engineers are embedded directly in NASA's missions and programs, not managed from a central office
  - Technical Fellow: discipline direction, credibility, judgment, and agency-level continuity
  - SE Technical Discipline Team: NASA Engineering and Safety Center's ~50 core experts give discipline-level pattern recognition and cross-center reach back
  - SE Communities of Practice sit under that umbrella: Model Based SE, Agile, Configuration/Data Management, Mass Properties, standards, lessons learned, and security
  - SE Agency Leadership (SEAL) Team: Center SE leaders who manage, protect, and advocate for the frontline, and clear bureaucracy from the mission path
  - Tools and AI are practitioner-owned, not a one-size-fits-all enterprise model
  - Tools are funded by the missions and programs that need them, and used by the frontline that owns them

How NASA SE Drives Mission Success

- The NASA SE product is not paperwork.
  - ➢ It is a closed technical case: the right owner, the right evidence, the right decision point, and residual-risk logic that holds under pressure
  - ➢ The mission objective is what must be met for mission success; critical seam is where failure hides across organizations, providers, software, ground, ops, and safety authority
  - ➢ Closure evidence ties test, analysis, model, and inspection to the mission claim; the decision point is the date and forum where the decision must stand up
- Evidence over theater, verification pulled left: the closure case is defined early, before design inertia or schedule pressure locks in weak assumptions.



The frontline execution loop: see friction, collect evidence, close the decision with accountable experts. Reuse the lesson: TDT, Communities of Practice, and Technical Interchange Meetings push it outward across every center and mission.

SE Enables Evolving Commercialization and Acquisition Intent

2006 — CCRS



Credit: NASA · https://www.nasa.gov/history/history-publications-and-resources/oral-histories/c3po/

CRS (COTS Origins)

Pure Space Act Agreement mode: NASA funds milestones, industry owns the design. NASA acts as standards author, not integrator — the precedent for every commercial model that followed.

2011 — CCP



Credit: NASA · https://www.nasa.gov/humans-in-space/commercial-space/commercial-crew-program/commercial-crew-program-overview/

Commercial Crew Program

SAA evolves into hybrid FAR/SAA certification. NASA becomes sufficiency gatekeeper — hazard reports and certification products replace design ownership as the insight mechanism.

HLS

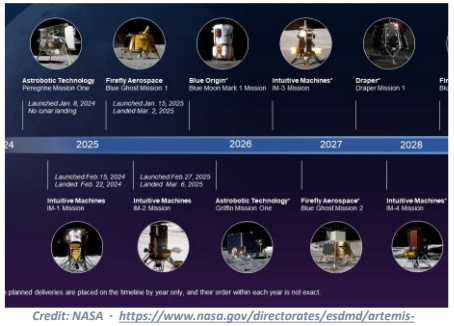


Credit: NASA · https://www.nasa.gov/humans-in-space/commercial-space/

Human Landing System

Service acquisition at the highest consequence tier: crewed lunar descent. Insight concentrated on the genuinely novel — cryo transfer, GN&C — not re-litigated heritage.

CLPS

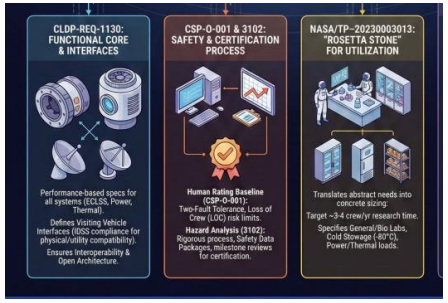


Credit: NASA · https://www.nasa.gov/directorates/esdmd/artemis-campaign-development-division/human-landing-system-program/

Comm'l. Lunar Payload Services

Insight calibrated to Class D risk posture: NASA doesn't own the lander design but owns the sufficiency threshold for what counts as ready — the sufficiency-gatekeeper model applied to uncrewed delivery.

CLDP



Credit: NASA · https://www.nasa.gov/humans-in-space/commercial-space/

Comm'l. LEO Destinations

CLDP-REQ-1130 tailors requirements to the destination's actual risk class instead of importing ISS heritage wholesale — the most mature expression yet of insight scaled to novelty.

The NASA Engineering and Safety Center and its SE Technical Discipline Team have been the constant thread across this timeline — supporting formulation, judging the technical adequacy of provider responses, and driving risk identification. Institutional subject matter expertise and continuity provide efficient engagement of lessons learned and decision velocity.

SE Enables the Administration Commercialization and Acquisition Intent

2019



Credit: NASA/Joel Kowsky · https://www.nasa.gov/image-article/starliner-to-the-stars/

Starliner CFT

Uncrewed demonstration of Starliner's ability to reach, dock with, and safely return from the ISS. MET timer error resulted in insertion and thruster issues. SE TDT co-led the investigation and lessons learned.

Artemis I

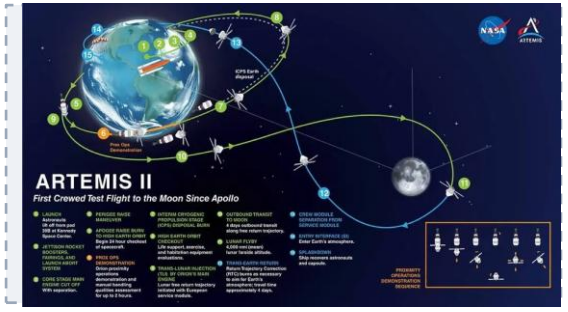


Credit: NASA · https://www.nasa.gov/centers-and-facilities/nesc/nesc-assists-in-heatshield-investigation/

Orion, SLS and EGS

Uncrewed full-stack test of SLS/Orion beyond the Moon and back, ahead of crew. Same SE TDT personnel led evaluation of primary critical events across mission, resulting in updates to TLYF emulator logic.

Artemis II

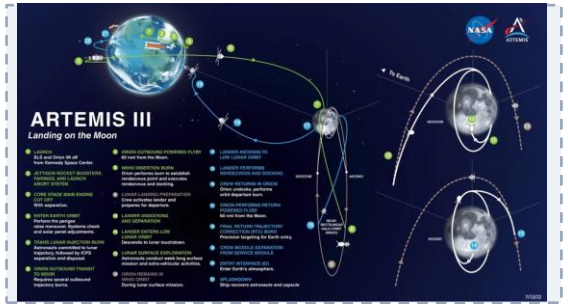


Credit: NASA/Cory Huston · https://www.nasa.gov/image-detail/amf-ksc-20230622-ph-csh01_0012/

Orion, SLS, EGS, and Crew

First crewed test of Orion/SLS on a lunar flyby trajectory, validating life support, navigation, and comms with astronauts aboard. Same SE TDT personnel led independent evaluation of expanded critical events related to crew on board.

Artemis III and IV…



Credit: NASA · https://www.nasa.gov/image-detail/2-astros-flag-lander-2/

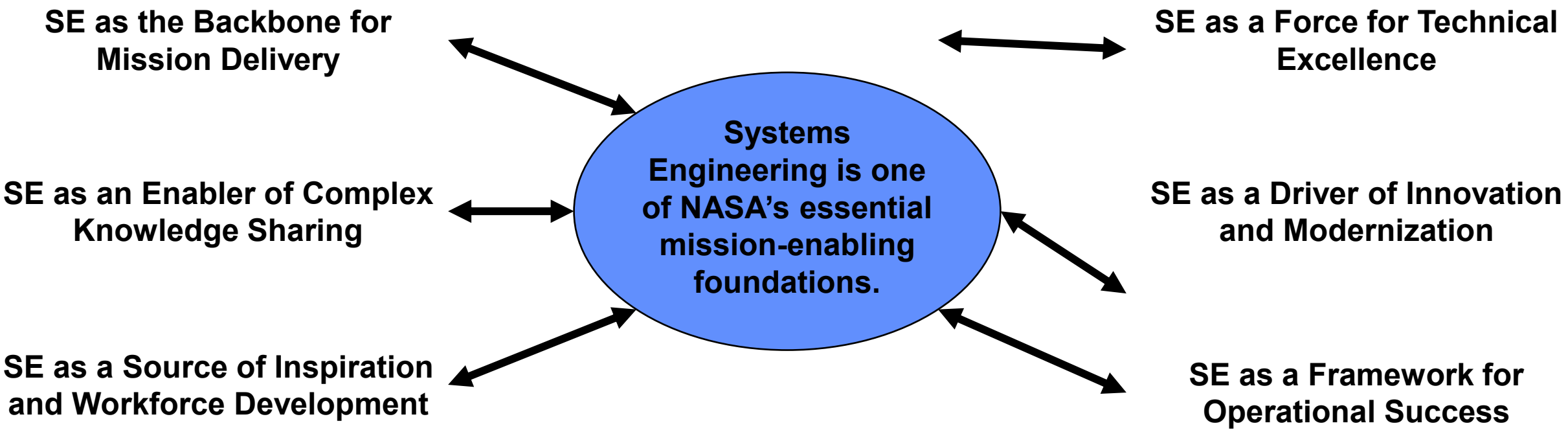
Orion, SLS, EGS, Crew and HLS

Crewed Orion rendezvous and docking with commercial HLS landers in Earth orbit, validating the architecture ahead of an eventual lunar landing. Expanded look at critical events for Artemis III TLYF in preparation for Artemis IV and Boots on Moon.

Independence matters less than having already seen the failure mode elsewhere in the experience base. That combination — a Subject Matter Expert with no stake in this program, but scar tissue from a dozen others — is what's genuinely hard to replicate, and it's what NASA Engineering and Safety Center's Systems Engineering Technical Discipline Team provides to NASA's Missions and Programs that can't be found anywhere else in the world.

Recognizing Excellence in Systems Engineering at NASA

- NASA teams and organizations are increasingly employing well-defined, proven processes and practices to develop, manage, and integrate increasingly complex systems.
- The successful application of these principles is a challenge that requires not only knowledge of SE but also artful implementation that may apply SE in new ways to meet the unique needs of the Agency.



Systems Engineering Capability Advancements

- Advanced agile systems engineering by forming a multi-center Community of Practice focused on improving agility, reducing unnecessary process overhead, and building on prior digital engineering successes.

- Modernized design and construction standards by converting them into an enterprise-ready database structure, improving cross-agency alignment, mapping efficiency, and standards quality for multiple programs.

- Expanded NASA's digital engineering capability through agency-wide engagement, award-winning MBSE achievements, extensive DE training, broad adoption of SysML/MBSE tools, and identification of future gaps and risks requiring sustained commitment and resources.

- Strengthened mission resilience and protection through space sustainability policy development, cybersecurity standards support, anomaly response activities, and expanded system security engineering training and integration.

- Enhanced systems engineering workforce development using SME and leadership inputs, updated competency models, structured development pathways, and expanded experiential, community, and formal learning opportunities.

Key Workforce Feedback and Improvement Priorities

- Strengthen industry–academia collaboration to align training and research with systems engineering practices and lifecycle rigor
- Need clearer decision thresholds and reduced elevation of low-risk decisions.
- Delegate authority for reversible work and define roles for Centers of Excellence.
- Modernize systems engineering tools and streamline document-heavy integration processes.
- Advance machine-readable integration environments to accelerate technical convergence and reduce rework across programs and cross-program interfaces.
- Adopt principle-based, tailorable frameworks
- Streamline approvals/exception pathways tied to systems engineering evidence
- Modernize hiring/workforce practices for rapid redeployment
- Update acquisition policy for calibrated insight + provider standards

Summary

- The Systems Engineering community at NASA is skilled, engaged, and integrated both internally and with external partners
- Focus areas for the future are broad but include:
  - Digital Engineering
  - Cybersecurity
  - Space Sustainability
  - Agility
  - Workforce Development
- The future demands an agile approach with engineers who think and operate at a systems level



Thank You!