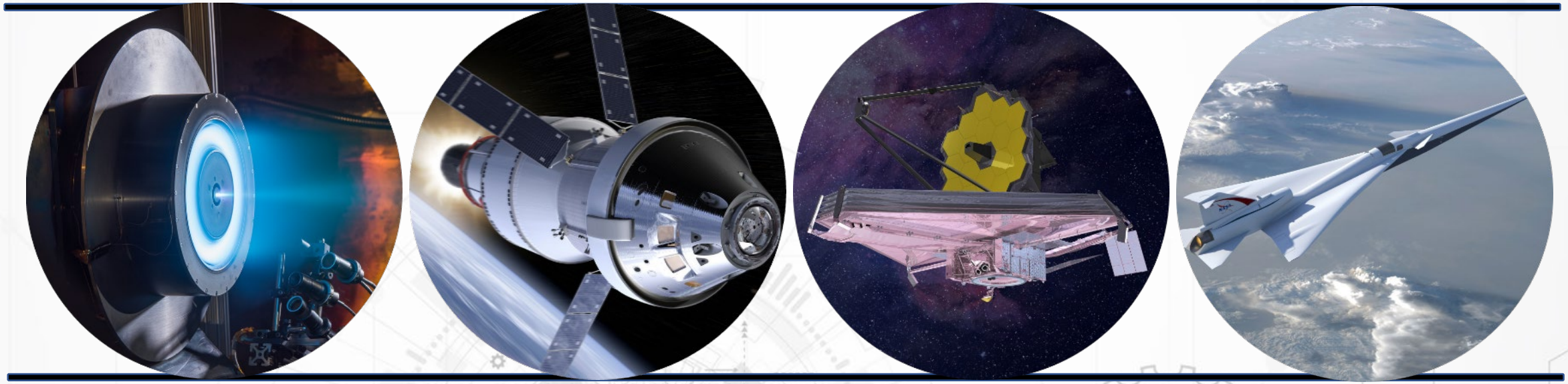
Office of the Chief Technologist

National Aeronautics and Space Administration



An Update to the NASA Advisory Council

Technology, Innovation and Engineering Committee Meeting

Al Conde - Strategic Integration Office Lead

29 OCTOBER 2019

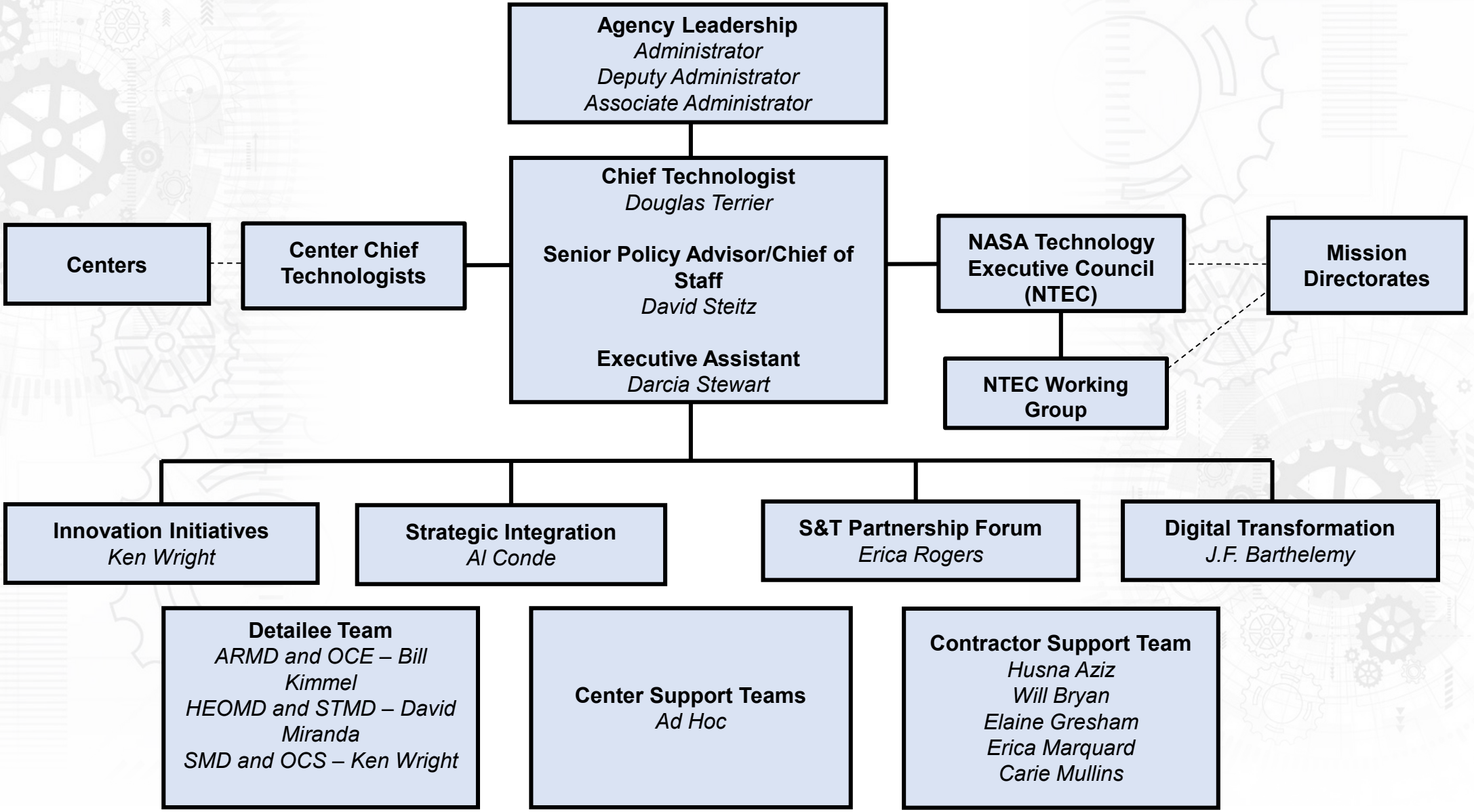
Agenda

National Aeronautics and Space Administration

- Strategic Technology Integration Framework Overview & Status
- 2020 NASA Technology Taxonomy Overview

Our Office

National Aeronautics and Space Administration



NASA Technology Portfolio FY2017

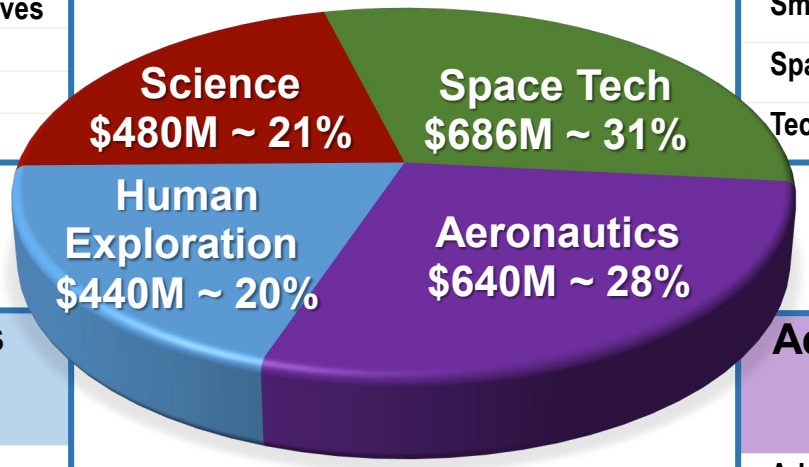
National Aeronautics and Space Administration

Science Mission Directorate ~ $480M

- Advanced Component Technology
- Advanced Information Systems Technology
- Astrophysics Research and Analysis
- Europa Technology
- Heliophysics - Tech and Instrument Development for Science
- In-Space Validation of Earth Science Technologies
- Instrument Incubator
- Maturation of Instruments for Solar System Exploration
- Nancy Grace Roman Technology Fellowships
- Planetary Instrument Concepts for Adv of Solar Sys Objectives
- Planetary Science and Tech Through Analog Research
- Strategic Astrophysics Technology
- + Mission-Directed Technology

Space Technology ~ $686M

- Centennial Challenges
- Center Innovation Fund
- Flight Opportunities
- Game Changing Development
- NASA Innovative Advanced Concepts
- SBIR/STTR
- Small Spacecraft Technology
- Space Tech Research Grants
- Technology Demonstration Missions



Human Exploration and Operations Mission Directorate ~ $440M

- Advanced Exploration Systems
- Space Life and Physical Sciences Research
  - Human Research Program
  - Life and Physical Sciences
- Space Communications and Navigation

Aeronautics Research Mission Directorate ~ $640M

- Advanced Air Vehicles
- Airspace Operations and Safety
- Integrated Aviation Systems
- Transformative Aeronautics Concepts

Recent Milestones

National Aeronautics and Space Administration

- March 14, 2019 – NASA Technology Executive Council Convened
  - Proceed with Framework Plan
- Sept 2019 –
  - First round of Strategic data gathered from MDs
  - TechPort Configured to Accept Framework Data

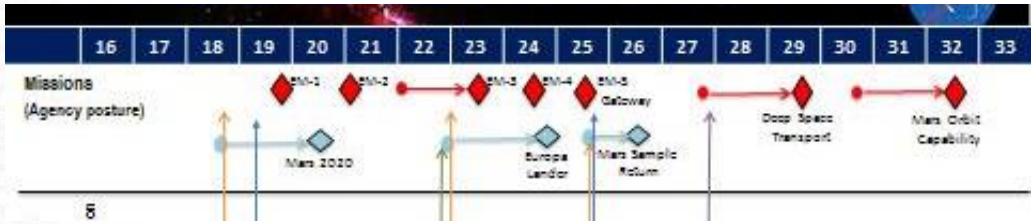
Technology Integration Framework

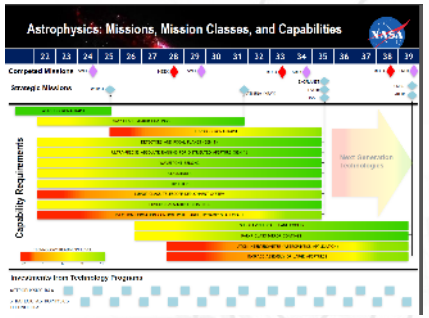
National Aeronautics and Space Administration

National policy, agency-level strategic plans or other activities that drive missions.

Examples: National Space Council, agency strategic plan, decadal surveys, Exploration Mission

Mission/ Outcomes "Why"





Technical Challenges "What"

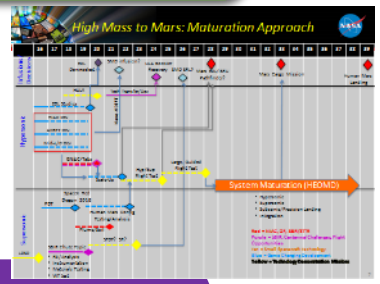
100 m landing footprint, challenging terrains like Europa

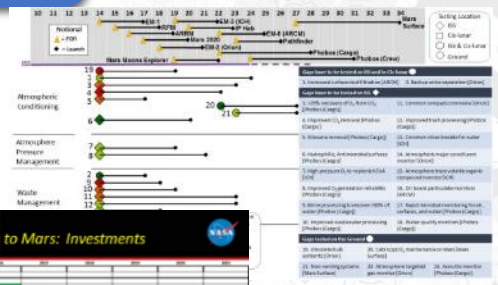
ECLSS 98% Air and Water Loop Closure

Fast Transit Deep Space Transportation

~5 MT to Surface Lander Capability

Strategy for Development "How"





Technology Investment "When"

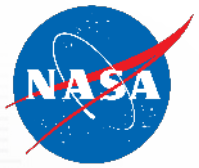
Why Needed

National Aeronautics and Space Administration

- Technology Portfolio Represents over 10% of Agency's budget
- Elevate the visibility of Agency Strategic Technology Development Portfolio
- Informed by Mission Driven Needs – the "Why"
- Tighter coupling between needs and technology investment
  - Easy to communicate benefits to stakeholders
  - Supports strategic thinking and planning about technology investments
- Aligns technology investments to future missions needs
  - Promotes cross-agency collaboration to accomplish Agency goals
  - Facilitates partnerships across the Agency, OGAs and commercial

Purpose of Technology Framework

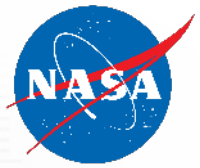
National Aeronautics and Space Administration



- MD to develop and maintain a Practical Strategic Technology Investment Plan
- MD Users Identify Strategic Capability Needs
  - Elevates MD awareness of their strategic needs
  - Focuses Developers on MD needs
  - Facilitates MD Prioritization at Capability Level
- Strategic vs Tactical
  - Provides structured approach before a flight program is authorized
  - Significant reduction in Flight Program Risk
- Communication
  - Facilitates collaboration & partnering
  - Encourages User and developers to communicate
  - Contributes to refining and efficiency of Strategy development
  - Centers can better apply their IRAD funds for strategic benefit
  - Shows individuals how they are part of something bigger then their project

Framework Status as of 4Q19

National Aeronautics and Space Administration



- ✓Developed high level Strategic Technology Integration Framework
- ✓Modification of TechPort
- ✓Working with MDs to fill gaps and overcome challenges to implementation

Framework End-State with current data

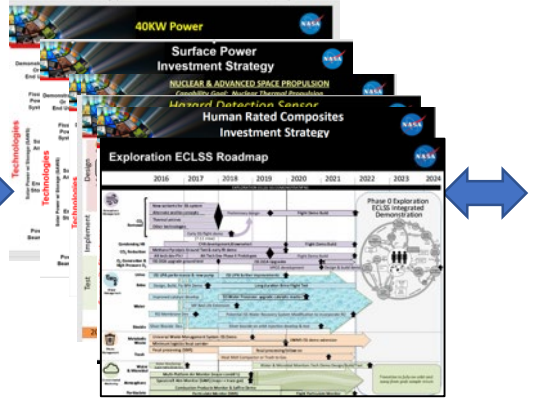
Step 1
NASA Strategic Goals

~33

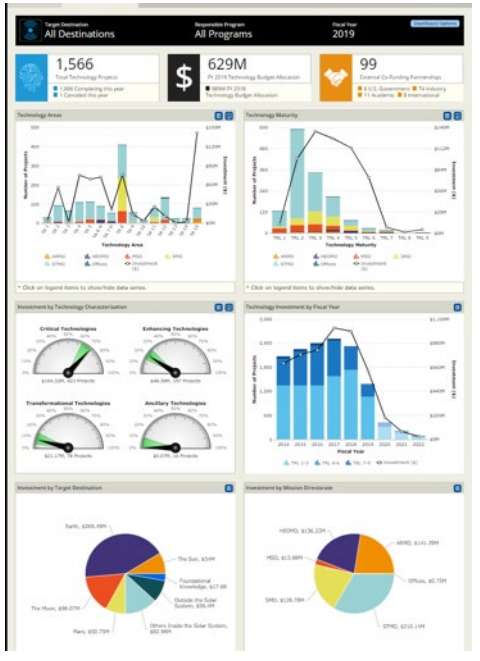
- Efficient, safe Air Transportation
- Innovation in Commercial Supersonic Aircraft
- Ultra-Efficient Subsonic Transports
- Safe, Quiet and Affordable Vertical Lift Air Vehicles
- In-Time System-Wide Safety Assurance
- Assured Autonomy for Aviation Transformation
- How is the global Earth system changing?
- Understanding what drives the constant change we observe on our sun?
- Expand Capabilities Through Robotic Exploration and Discovery
- Enable Humans to Live and Work in Space and on Planetary Surfaces
- Increase Access to Planetary Surfaces
- Enable Safe and Efficient Transportation Into and Through Space
- Long-duration crewed missions beyond low Earth orbit
- Conduct Human Exploration in Deep Space, Including to the Surface of the Moon

Step 2
Identify Strategic
Technical Challenges
~15+ TBD

Step 3
Develop
Investment
Strategies
~2 + TBD



Step 4
Strategic Technology
Investments
~ 23+TBD/1500



A goal without a plan is just a wish”

Antoine de Saint-Exupéry

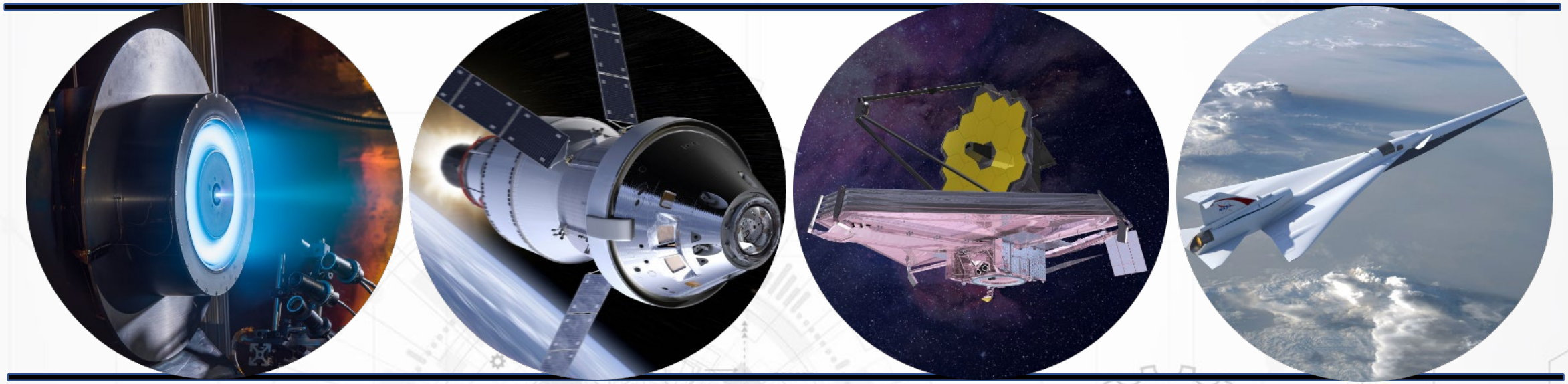
Going Forward

National Aeronautics and Space Administration

- Complete upload of 1st cycle MD Strategic Framework data into TechPort
- Standardize MD Strategic Technology reporting across Agency
- Technology focused APMC Early 2020 CY

Office of the Chief Technologist

National Aeronautics and Space Administration



The 2020 NASA Technology Taxonomy

David J. Miranda (Senior Technologist, Office of the Chief Technologist, NASA Headquarters)
Al Conde (Strategic Integration Lead, Office of the Chief Technologist, NASA Headquarters)
Douglas A. Terrier (Chief Technologist, Office of the Chief Technologist, NASA Headquarters)

Outline

National Aeronautics and Space Administration

- Introduction
- History (2010-2015)
- 2020 Development, Review, and Disposition
- 2020 Content and Changes from 2015
- 2020 Roll-Out

Introduction

National Aeronautics and Space Administration

- To manage and communicate NASA's extensive and diverse technology portfolio (in aeronautics, science, and space), the agency uses the **2020 NASA Technology Taxonomy**
  - The Taxonomy identifies, organizes, and communicates the technology areas that NASA advances to achieve its goals
  - It is a common technology discipline-based communication tool composed of 17 technical discipline based taxonomies that provide a breakdown for each area

TX01: Propulsion Systems
TX02: Flight Computing & Avionics
TX03: Aerospace Power and Energy Storage
TX04: Robotic Systems
TX05: Communications, Navigation, & Orbital Debris Tracking & Characterization Systems
TX06: Human Health, Life Support, & Habitation Systems
TX07: Exploration Destination Systems
TX08: Sensors & Instruments
TX09: Entry, Descent, & Landing
TX10: Autonomous Systems
TX11: Software, Modeling, Simulation, & Information Processing
TX12: Manufacturing, Materials, & Structures
TX13: Ground, Test, and Surface Systems
TX14: Thermal Management Systems
TX15: Flight Vehicle Systems
TX16: Air Traffic Management & Range Tracking Systems
TX17: Guidance, Navigation, & Control

History

- In **2010**, NASA identified 14 Space Technology Areas, as part of the draft technology roadmaps
- In **2012**, after internal and external reviews, the final version was released
- In **2015**, in response to changing needs, tech advancements, and recommended improvements an update was released with 15 areas to include aeronautics

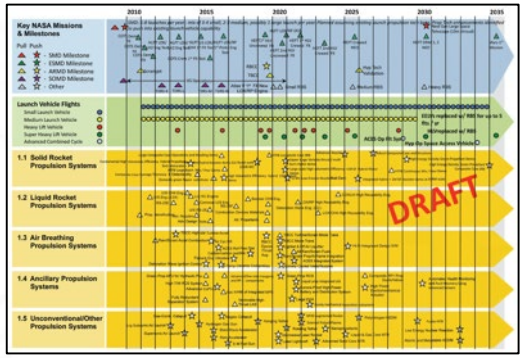
History

National Aeronautics and Space Administration

- The 2010-2015 Technology Roadmaps were composed of two key features: Technology Roadmaps and the Technology Area Breakdown Structure (TABS)
- TABS was a taxonomical structure identifying the technology areas that NASA is involved in and identified in the roadmaps

2012 Space Technology Roadmaps & Technology Area Breakdown Structure

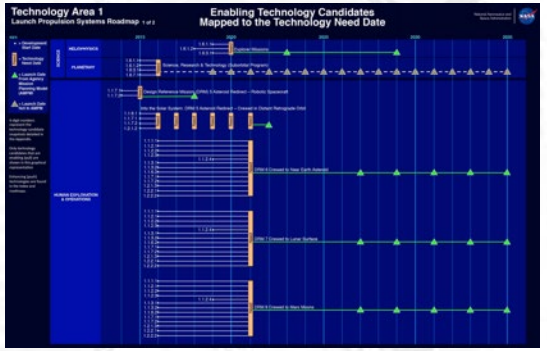
Technology Area Breakdown Structure (TABS)



Sample Roadmap

2015 NASA Technology Roadmaps & Technology Area Breakdown Structure

Technology Area Breakdown Structure (TABS)



Sample Roadmap

2020 Development

National Aeronautics and Space Administration

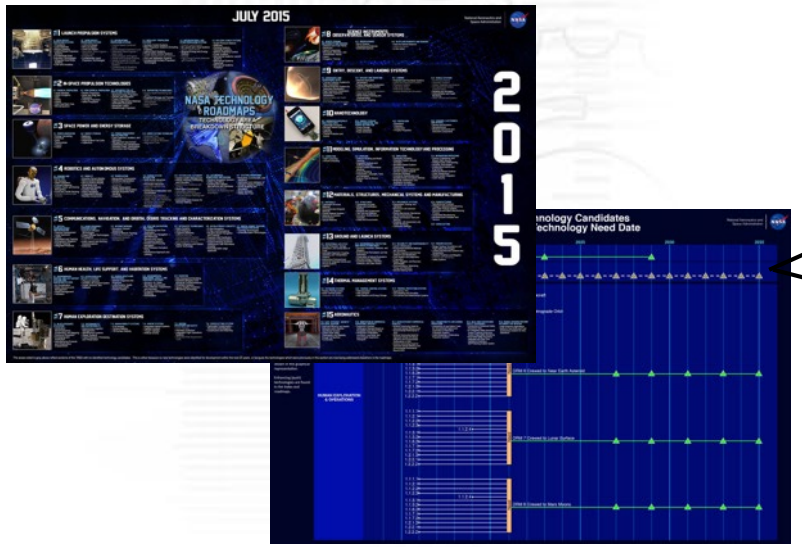
- In mid-2017 NASA decided to take a critical look at the Technology Roadmaps and TABS
  - An Internal survey was sent across agency to understand how these tools were being used
    - 79% indicated that their organizations had created their own roadmaps
    - Respondents found TABS useful for defining and grouping technology investments

2020 Development

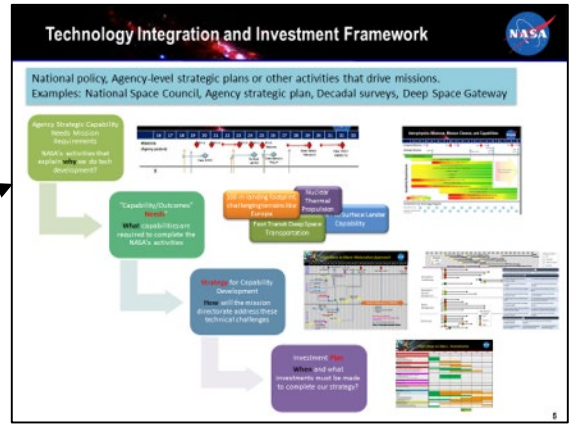
National Aeronautics and Space Administration

- The Office of the Chief Technologist (OCT) made two key decisions:
  - Roadmaps to be retired and replaced by a Strategic Technology Investment Framework (STIF)
  - TABS to be retained and refocused as a technical discipline driven technology taxonomy

2015 NASA Technology Roadmaps & Technology Area Breakdown Structure



NASA Mission Directorate Strategic Technology Frameworks



2020 NASA Technology Taxonomy

2020 Development

National Aeronautics and Space Administration

- OCT tasked the NASA Center Technology Council (CTC) to revise and refocus the 2015 TABS
  - By late 2018, with input from OCT leadership, the full CTC, Mission Directorate representatives, and subject matter experts, TABS was revised into the 2020 Taxonomy

2020 Review and Disposition

National Aeronautics and Space Administration

- In 2019, a review of the draft taxonomy was conducted in two phases, an internal and a public review
  - Internal NASA Review (March 5 – March 22)
  - Public Review (May 21 – July 5)

1,277 total comments
568 comments in Internal Review
709 comments in Public Review

- All comments were individually reviewed and dispositioned by NASA subject matter experts in the areas related to the taxonomy areas (Tech Fellows, Principal Technologists, System Capability Leaders, and other Agency technical experts)
  - These SMEs will serve in an enduring role as Agency resources for the technical areas described

2015 vs 2020 Comparison

National Aeronautics and Space Administration

2015	2020
TA 1 Launch Propulsion Systems	TX01 Propulsion Systems
TA 2 In-Space Propulsion Technologies	
New	TX02 Flight Computing and Avionics
TA 3 Space Power and Energy Storage	TX03 Aerospace Power and Energy Storage
TA 4 Robotics and Autonomous Systems	TX04 Robotic Systems
	TX10 Autonomous Systems
TA 5 Communications, Navigation, and Orbital Debris Tracking and Characterization Systems	TX05 Communications, Navigation, and Orbital Debris Tracking and Characterization
TA 6 Human Health, Life Support, and Habitation Systems	TX06 Human Health, Life Support, and Habitation
TA 7 Human Exploration Destination Systems	TX07 Exploration Destination Systems
TA 8 Science Instruments, Observatories, and Sensor Systems	TX08 Sensors and Instruments
TA 9 Entry, Descent, and Landing Systems	TX09 Entry, Descent, and Landing
TA 11 Modeling, Simulation, Information Technology, and Processing	TX11 Software, Modeling, Simulation, and Information Processing
TA 10 Nanotechnology	TX12 Manufacturing, Materials, and Structures
TA 12 Materials, Structures, Mechanical Systems, and Manufacturing	
TA 13 Ground and Launch Systems	TX13 Ground, Test, and Surface Systems
TA 14 Thermal Management Systems	TX14 Thermal Management Systems
TA 15 Aeronautics	TX15 Flight Vehicle Systems
	TX16 Air Traffic Management and Range Control Systems
New	TX17 Guidance, Navigation, and Control

Roll-Out

National Aeronautics and Space Administration

- Since **December 2018** OCT has been working with stakeholders to develop a roll-out plan
- In early **October 2019** the 2020 NASA Technology Taxonomy officially replaced the 2015 Technology Area Breakdown Structure
  - That same month OCT began a roll-out campaign to get the word out on the Taxonomy to the entire NASA ecosystem (Centers, Other Government Agencies, Industry, Academia, International Partners, Public)

Roll-Out Products

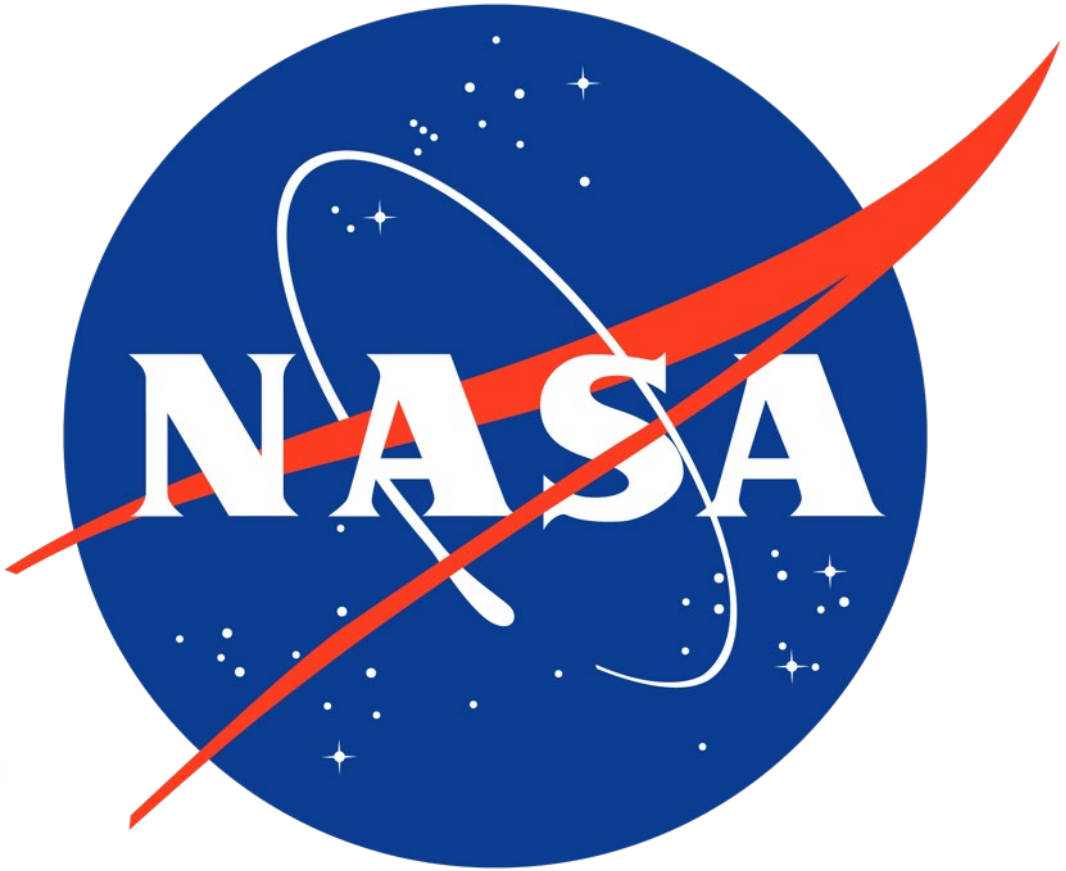
- **Presentation / Webinar:** Guided walkthrough that explains the history, what changed, and what's coming
- **Poster:** Easy reference for all 3 levels of the Taxonomy
- **OCT Taxonomy Website:** Official home of the Taxonomy w/ links to digital versions of all materials.

- **TechPort:** Searchable Taxonomy, all projects will automatically be updated from the TABS system
- **@NASA_Technology & NASA@Work Challenge:** Internal & external crowdsourcing challenges that encourage hands-on use of the Taxonomy and its 17 areas
- **Brochure/ Cards:** High level overview of 2020 Taxonomy with link to full version online
- **…more**

Conclusion

National Aeronautics and Space Administration

- The 2020 NASA Technology Taxonomy was created to manage and communicate the broad scope of NASA's technology development activities
  - Past iterations (2010, 2012, 2015) have served as valuable tools for identifying, organizing, and communicating the technology areas that NASA advances in order to achieve future space missions and aeronautics activities
- The Taxonomy will continue to be key to NASA's ability to manage and communicate its technology development efforts for years to come
- Visit https://www.nasa.gov/offices/oct/home/taxonomy to download a copy of the Taxonomy
- Visit https://techport.nasa.gov to see the Taxonomy applied to NASA's technology investments


NASA