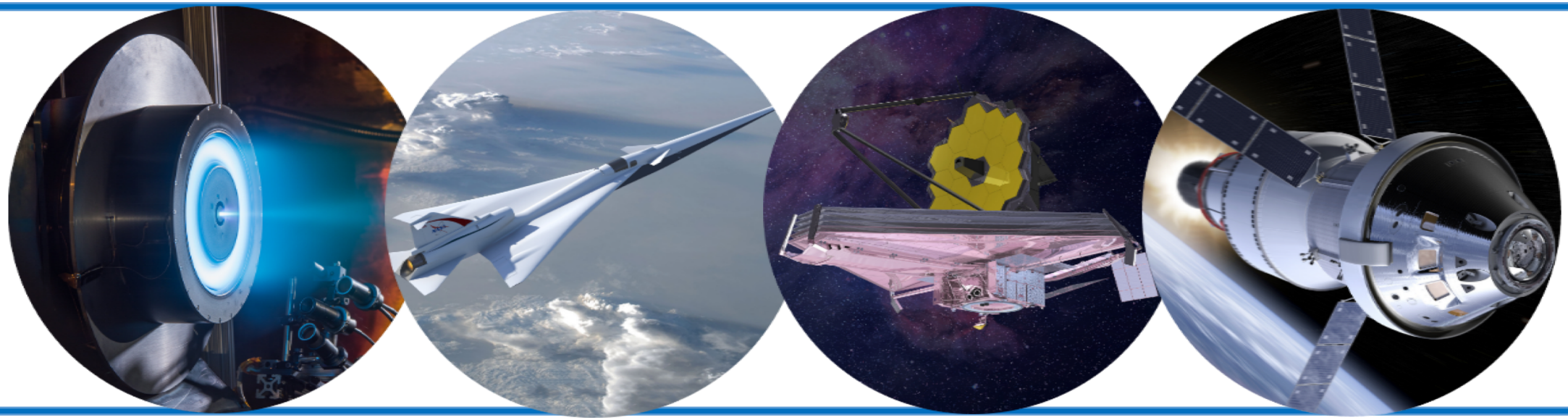
Office of the Chief Technologist

National Aeronautics and Space Administration



An Update to the NASA Advisory Council

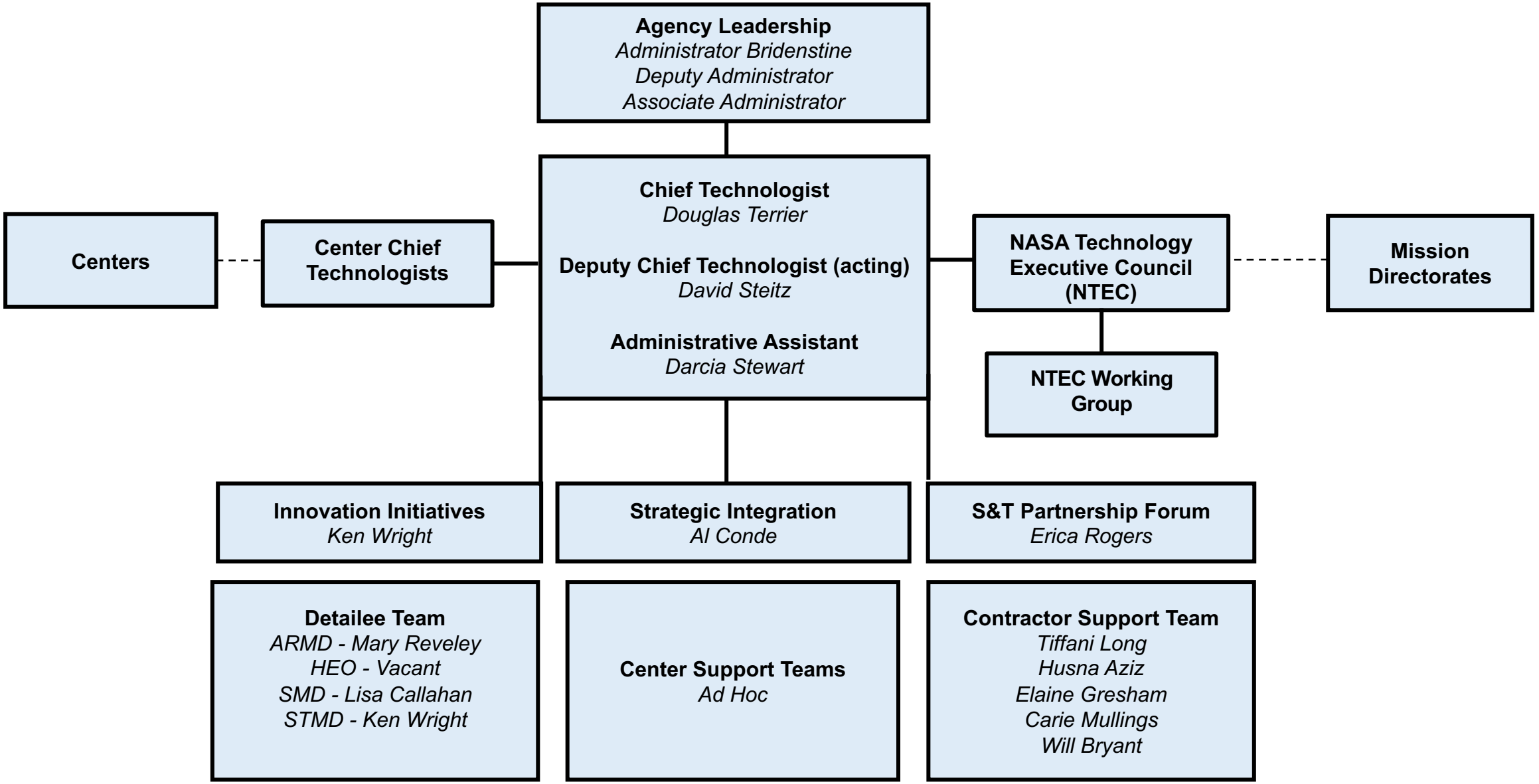
December 2018

Dr. Douglas Terrier

NASA Chief Technologist

Office of the Chief Technologist

National Aeronautics and Space Administration



Key OCT Initiatives

National Aeronautics and Space Administration

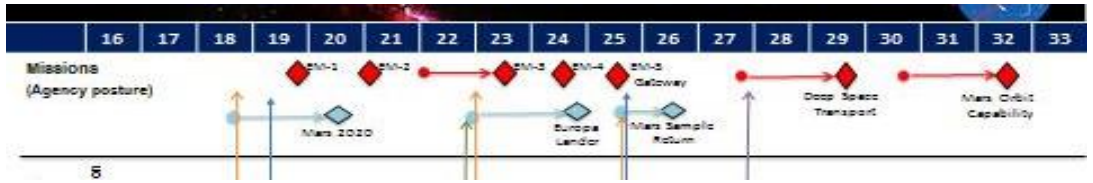
- Technology Integration Framework
  - Integrated agency technology plan derived from mission needs
  - Developed in collaboration with Mission Directorates
- Innovation Framework
  - Integrate agency-wide innovation initiatives and expand ecosystem
  - Partnered with National Academy of Sciences
- Science &Technology Partnership
  - Collaboration of USAF, NRO, NASA, DARPA, NRL, OSD, NOAA, et al.
  - Identify common technology needs and develop collaborative plans
- Technology Studies
  - Portfolio management outside, Leveraging outside investment, Technology infusion, Critical technology for Human Space Flight, $350B space, Disruptive technology
- Digital Transformation Study

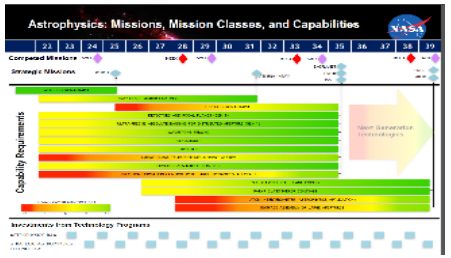
Technology Integration Framework

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"

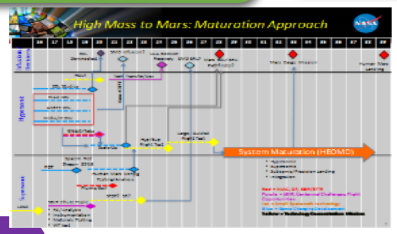
100 m landing footprint, challenging terrains like Europa

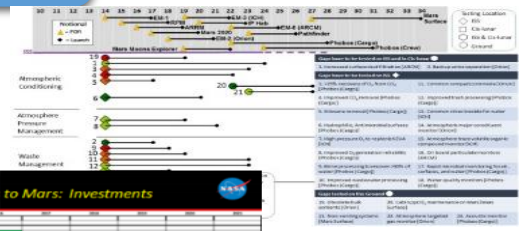
Nuclear Propulsion

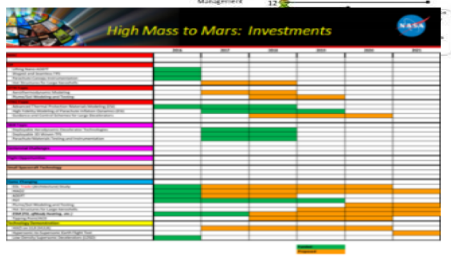
Fast Transit Deep Space Transportation

~5 MT to Surface Lander Capability

Strategy for Development "How"







Technology Investment "When"

Technology Integration Update

National Aeronautics and Space Administration

- Framework concept of four steps developed December 2017
- Proof of concept with data from the Mission Directorates completed August 2018
- Plan to use TechPort for TIF database
- The TIF will be presented for approval at the next NASA Technology Executive Council (NTEC) meeting
- Rollout of the TIF is contingent on obtaining support from the Mission Directorate AA's

	Mission Directorate			
Framework Step	ARMD	HEOMD	SMD	STMD
1. Goals/Objectives	✓	✓	✓	✓
2. Quantifiable Technical Objectives /Challenges	✓	✓ Some Programs	✓ Most Programs	✓ Most Programs
3. Strategy for Development	✓	× Some gaps	× Some gaps	× Some gaps
4. Technology Investment	✓	✓	✓	✓

Inter-Agency Science & Tech Forum

National Aeronautics and Space Administration

S&T Partnership Goals
- Leverage synergies
- Influence agency portfolios

S&T Partnership Objectives
- Facilitate synergistic collaborations
- Strategize technical solutions
- Maintain awareness of S&T investments
- Identify impediments and solutions

The USAF, NASA, and NRO are aggressively collaborating to find enterprise synergistic S&T solutions to benefit the Nation.

AFRL, AFOSR, NRL, AF SMC, OUSD, DARPA, NOAA

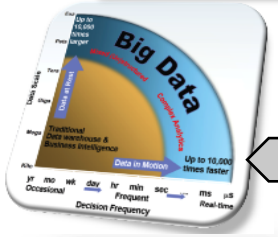
Affiliate government partners dependent on the S&T topic area

Established in 2015

Strategic forum established to identify synergistic efforts and technologies.

Focus on key pervasive and game-changing technologies across government space

Identified and prioritized S&T collaboration topic areas



1. Small Sat Technology

2. Big Data Analytics

3. In-Space Assembly

4. Cybersecurity

2017-2018 Accomplishments

- Transitioned Topic 1
- Conducted multiple interagency technical exchanges on Topics 3 and 4
- Topic 3
  - Delivered interagency whitepaper describing value proposition, strategic plan, current investments /planning, & concept summaries
  - Defined dictionary of terms, and defined and categorized capability areas
  - Performed capability gap analysis to determine interagency partnering recommendations
  - Topic 3 Industry Open Forum in Nov 2018

Inter-Agency Science & Tech Update

National Aeronautics and Space Administration

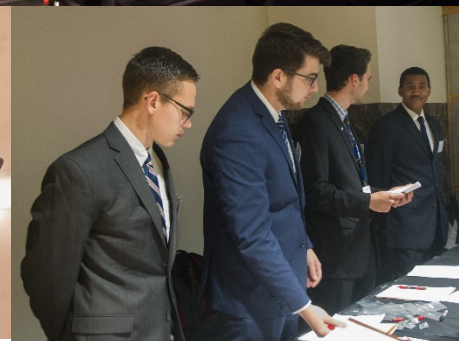
The USAF, NASA, and NRO are aggressively collaborating to find enterprise synergistic S&T solutions to benefit the Nation.

Recent Event Nov 6, 2018 @ NASA HQ, Washington, DC

Open Forum: Information Exchange for Market Analysis of Commercial In-Space Assembly Activities

Purpose

To understand current state of commercial investments in in-space assembly related systems and capability developments and how they may fit with the in-space assembly capability needs of any of the partners.



Open Forum Highlights

- More than 70 representatives from commercial/FFRDC and government participated in the Open Forum
  - 22 companies/FFRDCs represented
  - 4 government agencies represented
- 146 views via livestream from 10 different countries
- Interagency S&T Team conducted 12 one-on-one sessions with commercial participants

Open Forum Deliverables

- Collected commercial participant capability gap data to fold into interagency capability assessment
- Open Forum data will be analyzed, summarized, and reported in interagency white paper and in public paper
- Provide government – commercial bridging activities that follow from S&T interagency partnering recommendations

Innovation Framework

National Aeronautics and Space Administration

National R&D Priorities
Space Council Directives
NASA Strategic Plan

Outcomes "Why"

Innovation culture essential to achieving NASA's missions

- Innovative Technologies
- Innovative workforce
- Innovative partnering
- Innovative business
- Others….

- Diverse workforce, diverse ideas
- Ability to partner and adopt
- Freedom and award workforce innovation
- Path to incorporate new ideas
- Communication share knowledge

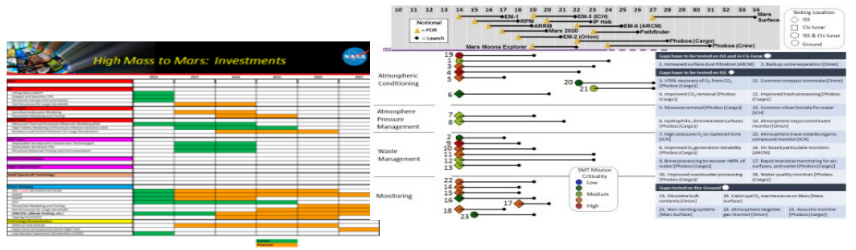
Address Barriers ?

Required Characteristics "What"

Innovation Initiatives "How"

NIAC	SAAs	NARI	NASA Tournament Lab	NASA @work	OHC Culture Strategy
CIF	PPPs	Centennial Challenge	CoECI	LaRC Fast Track to Market	STMD BIG Ideas
Early Career Initiative	Innovation Awards	Human Health Risk	Innovational Portal	Flight Opportunities	OCE Tech Fellows

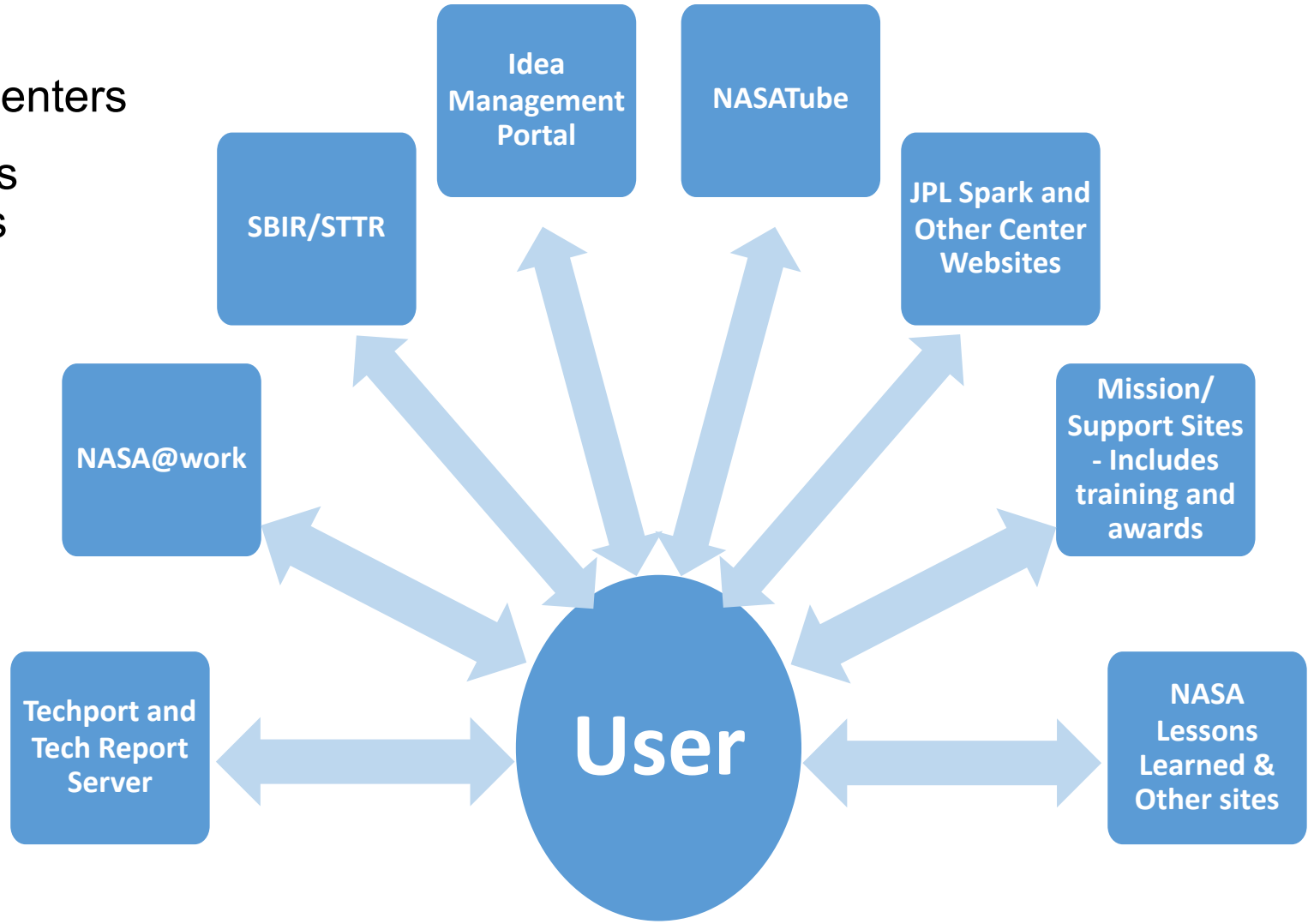
Innovation Plans "When"



Innovation Framework Update

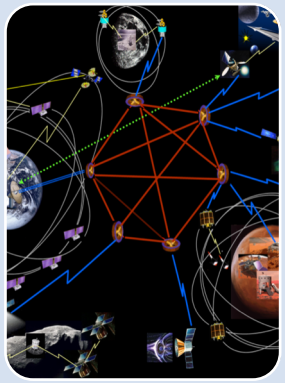
National Aeronautics and Space Administration

- Identified barriers and examined solution initiatives across agency
- Reenergized innovation initiatives at Centers
- Developed cloud-based tool that allows users to leverage innovation resources across the Agency
- Conducted “Meetings of Experts” and workshop with National Academies
- Incorporating outcomes of workshop:
  - Career Management
  - Portfolio Management
  - Program Management
  - Enablers and Impediments
  - Communication
- Developing community of practice

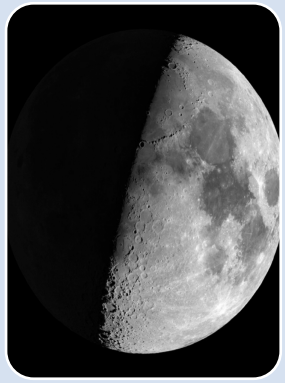


Technology Studies

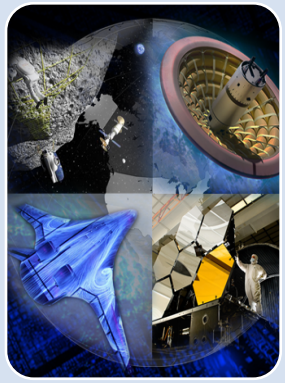
National Aeronautics and Space Administration



Lessons Learned in Technology Portfolio Management from Outside of NASA

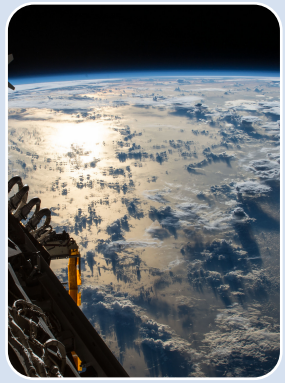


Leveraging OGA and Industry Technology Advances for NASA Missions

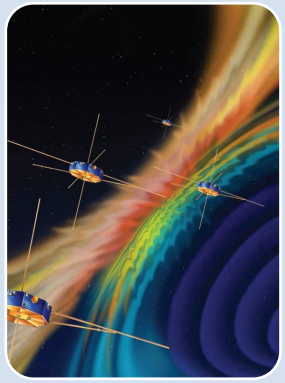


Technology Infusion: Over the Valley of Death

Review of Advance-ment of Critical Technology for Human Exploration



Behind the $300 Billion Global Space Industry



Emerging and Disruptive Technology Study

Digital Transformation

National Aeronautics and Space Administration

Objective:

In response to the APMC directions, the *NASA Digital Transformation (DT) Team* assesses the state of DT at NASA and, where needed, formulates strategy and top level implementation framework to better leverage evolving digital technologies and transform activities, processes, competencies, capabilities, and/or products, to advance Agency missions.

Timeline:

Year	2018								2019			
Month	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
DT Vision												
External Inventory												
Internal Inventory												
Analysis												
Recommendations												
Communication and reporting												

Fully leveraging digital technologies to transform NASA's processes, capabilities and products **to maximize mission success.**

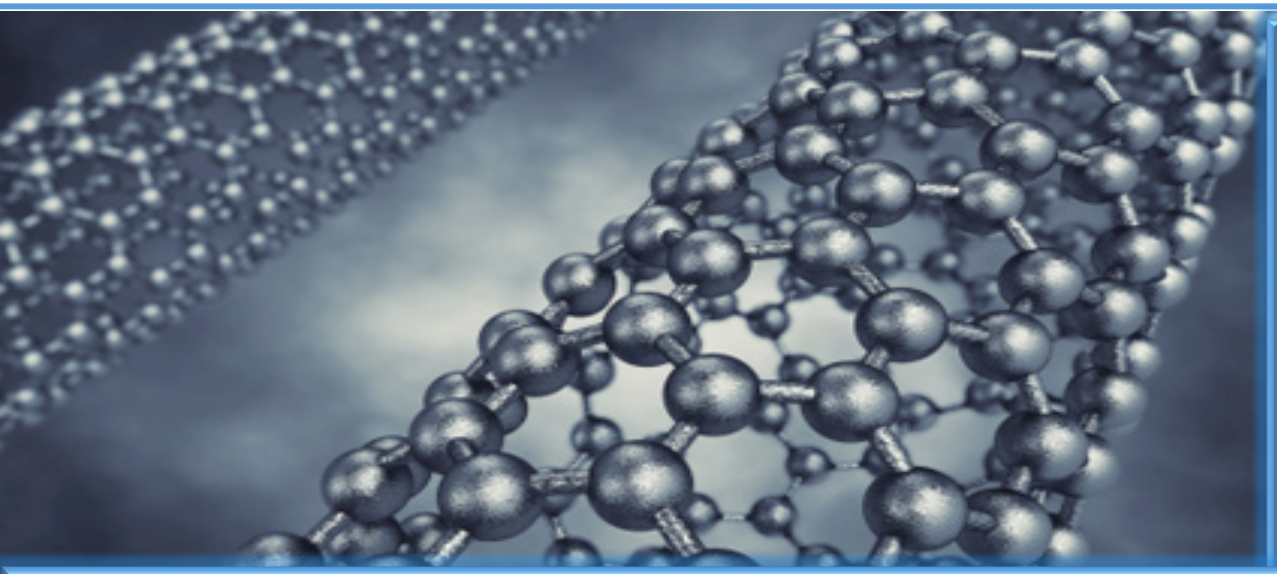
Digital Transformation Update

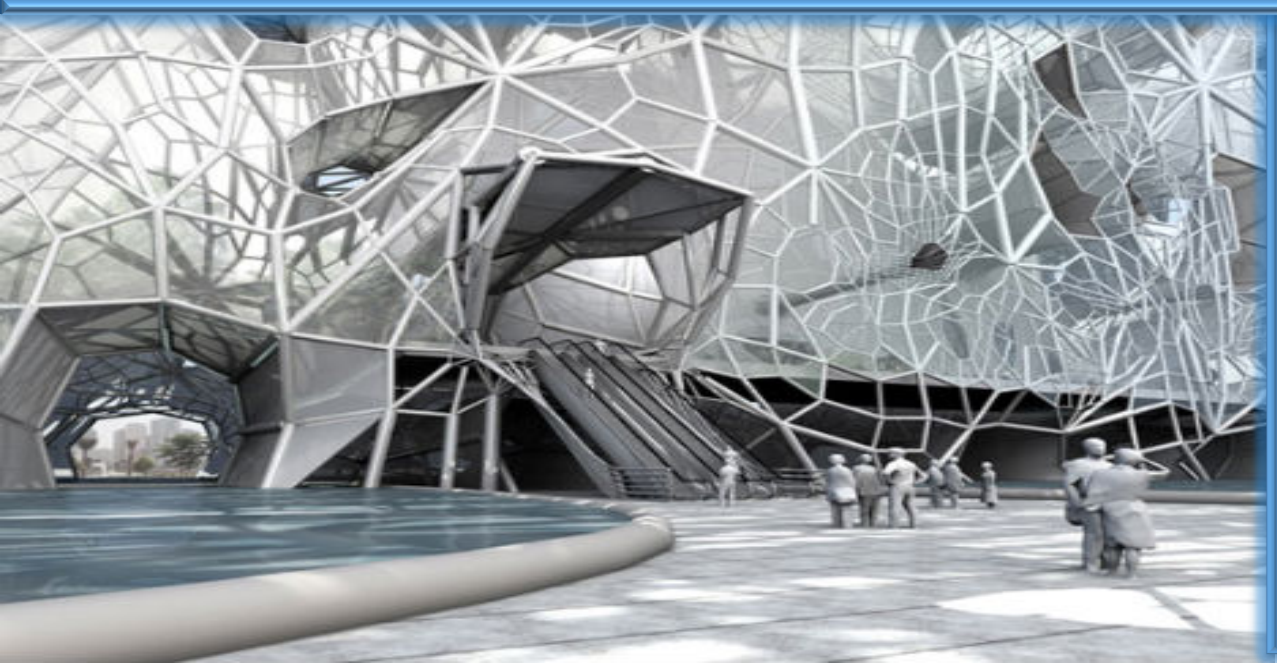
National Aeronautics and Space Administration

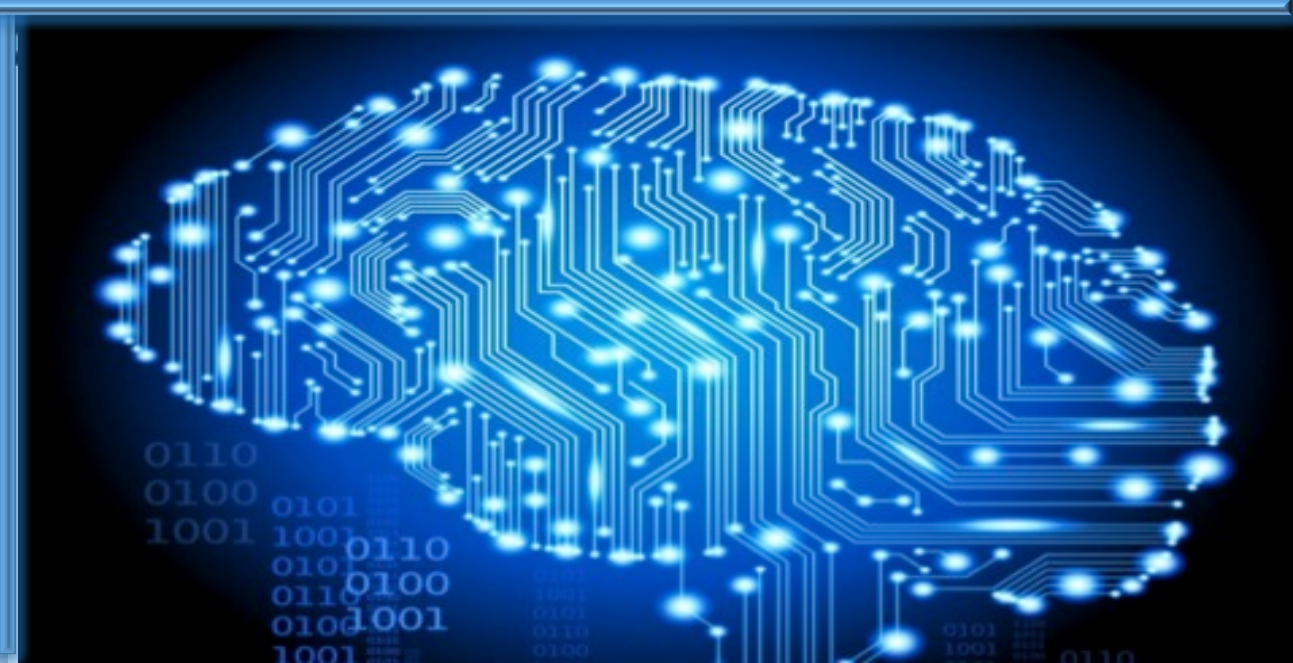
- Engaged all NASA Centers and every HQ organization
- Engaged multiple outside organizations to understand their transformation journey
  - Boeing, Lockheed-Martin, Space X, Ford Motor Company
  - IBM, Google, Netflix
  - Coursera, Georgia Tech
  - FAA, OSD, GSA
- Captured over 180 success stories of NASA DT applications
- Identified more than 240 opportunities for further application of DT at NASA
- Every DT technology we track is being experimented with at NASA, somewhere
- Process automation, data integration, are MBSE promising DT directions being explored
- Currently extracting findings and recommendations
- Developing an overall strategy implementation framework and, if needed, policies.

Future Technology

National Aeronautics and Space Administration





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What Is Different About The Future

Scope of Innovation

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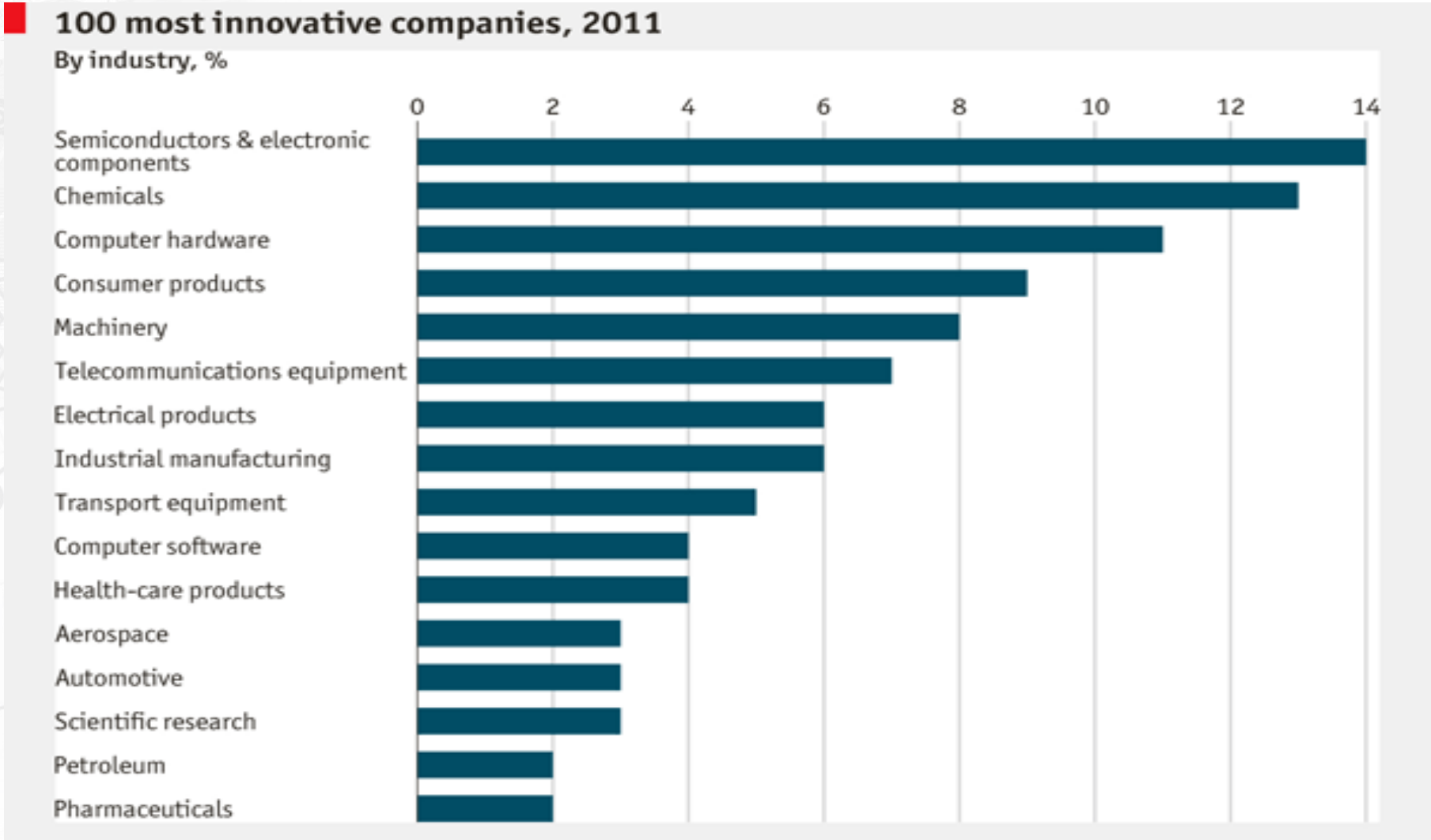
Innovation is driving business across economic sectors

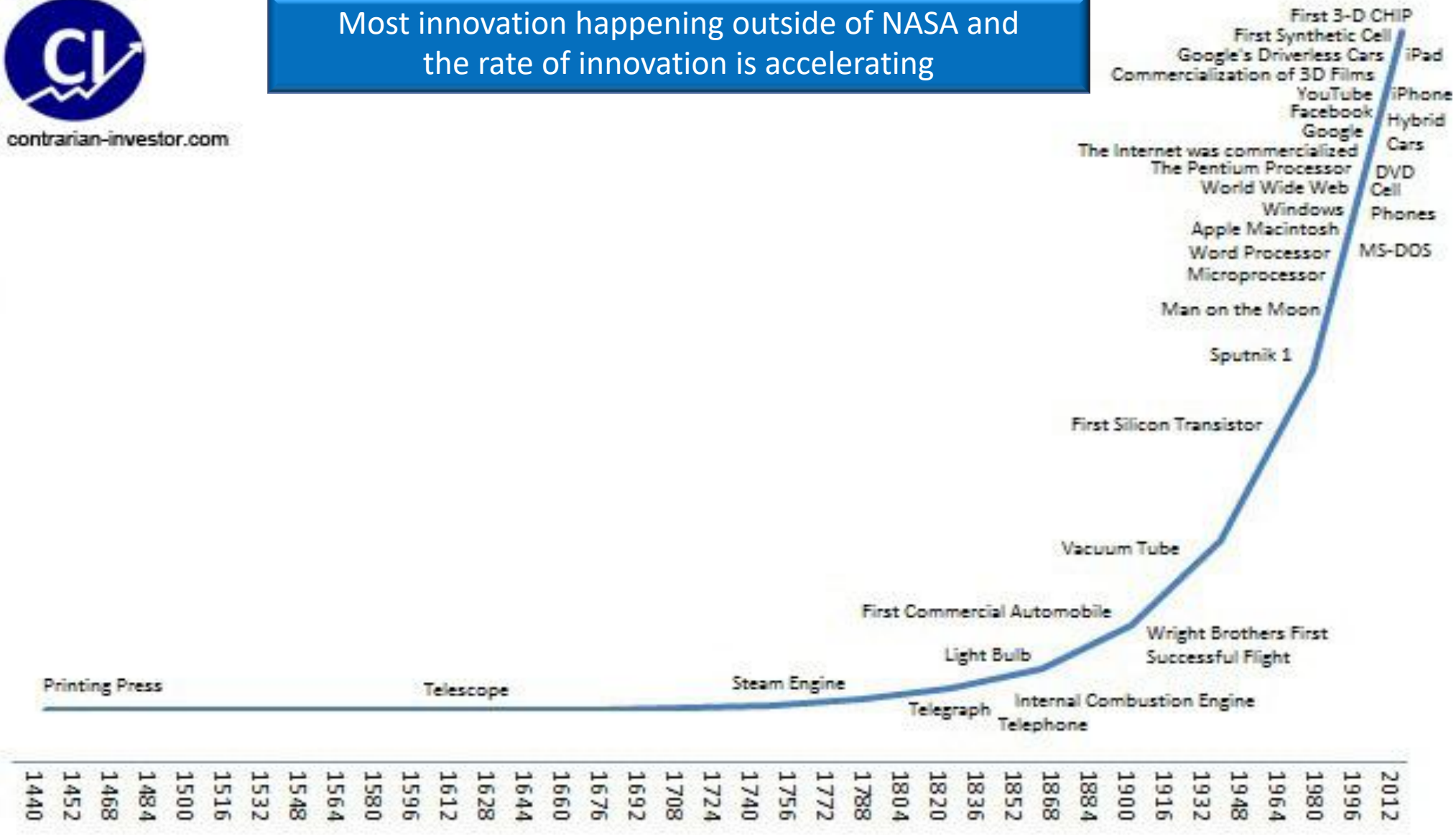


Source: Thomson Reuters

Accelerating Innovation

National Aeronautics and Space Administration

Most innovation happening outside of NASA and the rate of innovation is accelerating



Speed of Adoption

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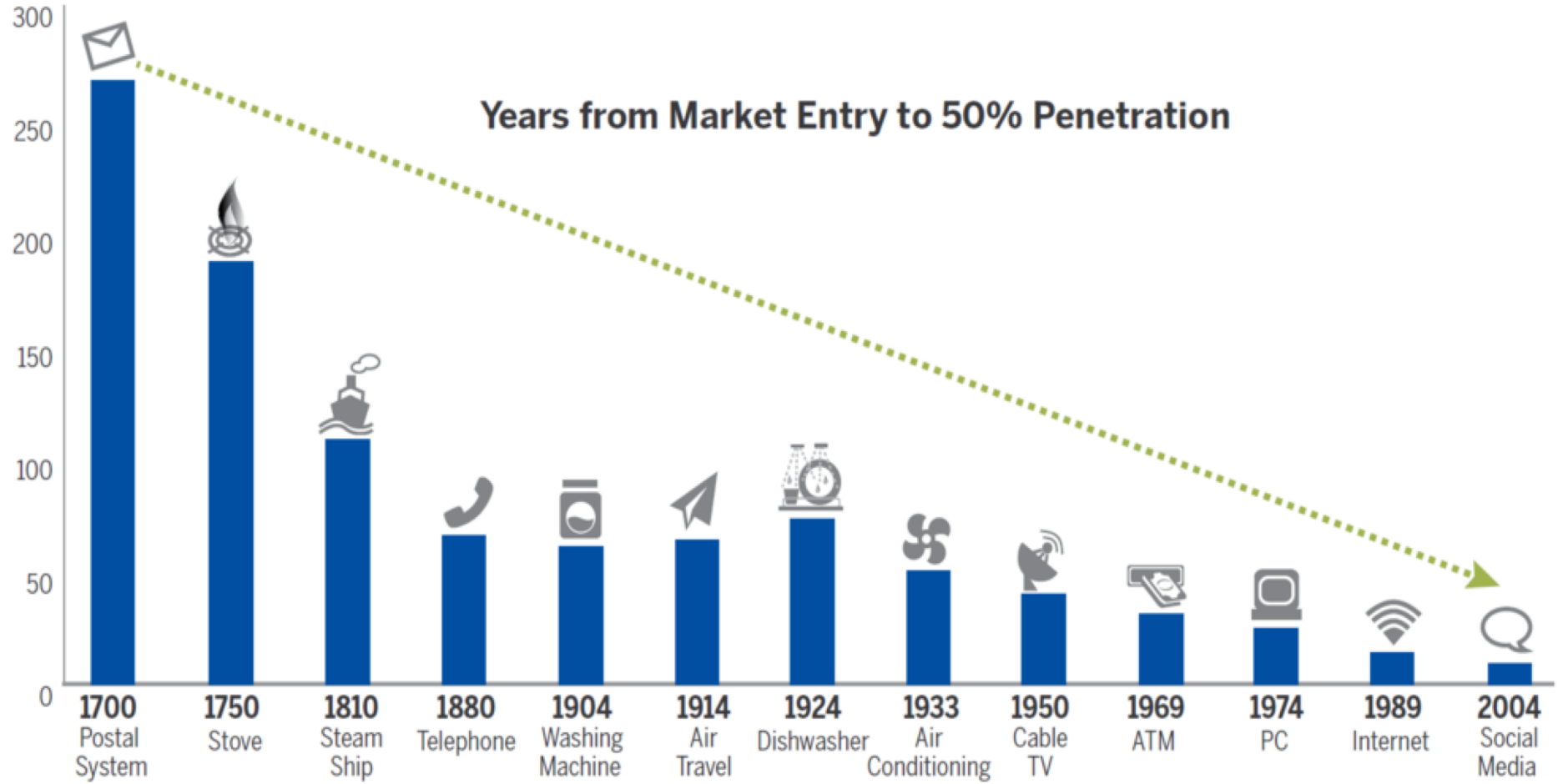
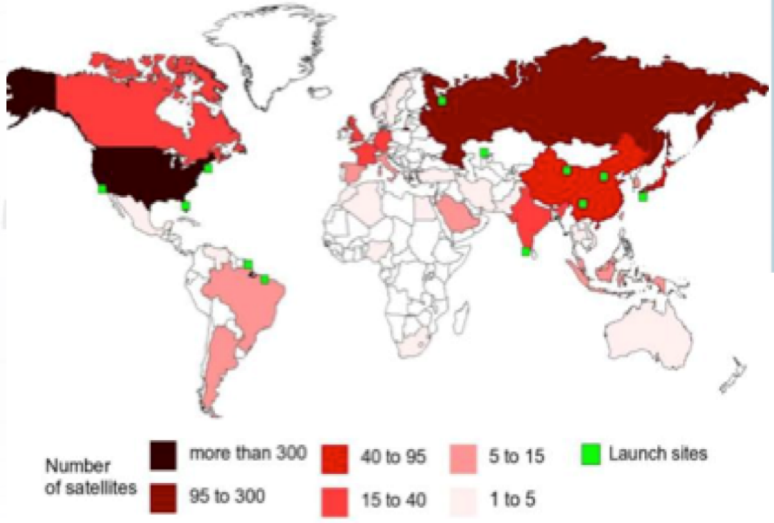


Source: Asymco

Growing Space Industry

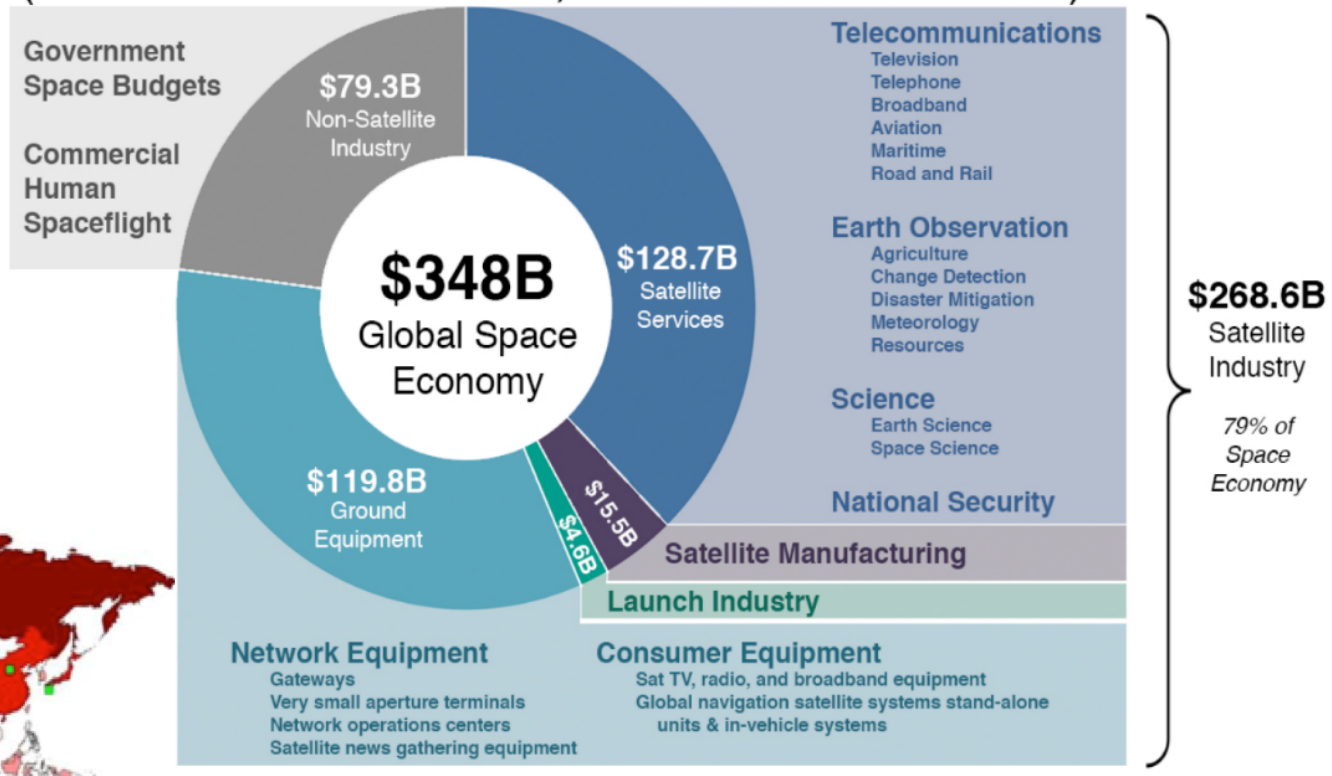
National Aeronautics and Space Administration

Growing International Participation



The Satellite Industry in Context

(2017 revenues worldwide, in billions of U.S. dollars)



Commercial Space Industry

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Disruptive Technologies

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Re-usable launch vehicles

Small satellites

In-situ Resource Utilization

On-orbit servicing and assembly