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A GenCorp Company

2011 Von Braun Symposium

Panel: Industry's Input For A Sustainable Exploration Program

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Vice President of Space and Launch Systems

Aerojet: A 70-Year Legacy of Demonstrated Safety and Reliability

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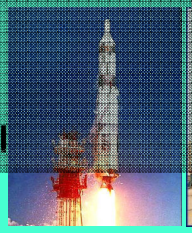
Launch – All Major U.S. Launch Vehicles

- Titan
- Delta
- Athena
- Atlas
- Taurus II

JATO & Aerobee



Titan I, II, III, and IV, Delta II

Large Liquids

Small Liquids:
Titan, Atlas, Athena, Pegasus, HAPS & Delta

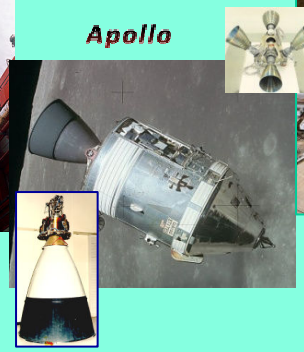
Monolithic Solids
Atlas V

Atlas V Solids
Taurus II AJ26
Heavy Lift

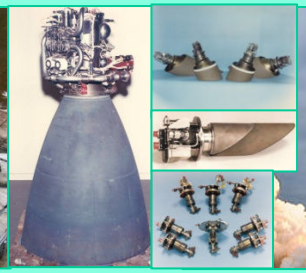
Human Space

- Apollo
- Shuttle
- Orion
- HTV / ATV
- Bigelow

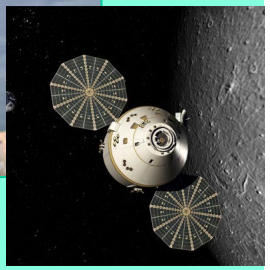
Titan II/Gemini



Apollo



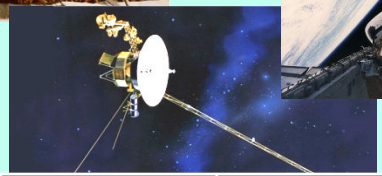
Space Shuttle



Orion

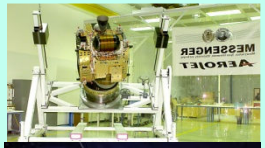
Satellites and Exploration

- All the Planets and Beyond
- Every Block of GPS
- Geosynchronous Satellites (~80% worldwide)
- Low Earth Orbit Imaging and Communications



Viking & Voyager

Magellan



MESSENGER & Cassini

AEHF

GPS IIF

1940	1950	1960	1970	1980	1990	2000	2010	2020

How Aerojet Is Supporting The Space Exploration Program

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- Orion – Propulsion supplier for crew module and service module liquid propulsion and for launch abort system jettison motor
- Space Launch System (SLS)
  - Advocacy for advanced booster competition
  - Reaction control propulsion
  - Plans to compete for advanced booster and expendable SSME and associated activities
- Space exploration architecture – Future opportunities
  - Electric propulsion for in-space tugs
  - Nuclear thermal propulsion for future manned missions
  - Lox methane systems for future Applications
  - Lox/H2 engines for departure/transfer stages
- Advocacy for overall program

Current State of US Propulsion Industrial Base

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- Aerojet has been actively engaged in a number of industrial base studies for both liquid and solid rocket propulsion

- Both the liquid and solid propulsion US industrial base are under stress and in a time of transition
  - Lack of sustainable propulsion research and development programs
  - Volatile /dynamic future market projections
  - Decreasing US propulsion cost competitiveness
  - Challenging workforce demographics
  - Areas of 2nd tier supply base challenged

Fifteen Years Of Decline In US Spacelift

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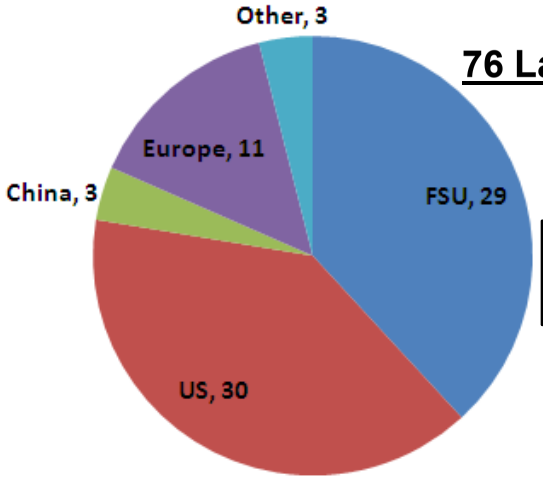
Total Space Launches

1995

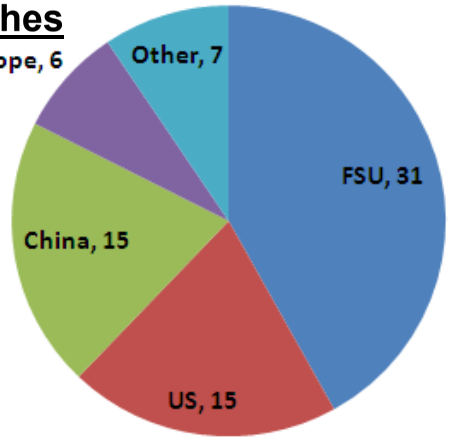
76 Launches



- US declined by half
- China reached parity with US
- FSU steady and dominant

2010

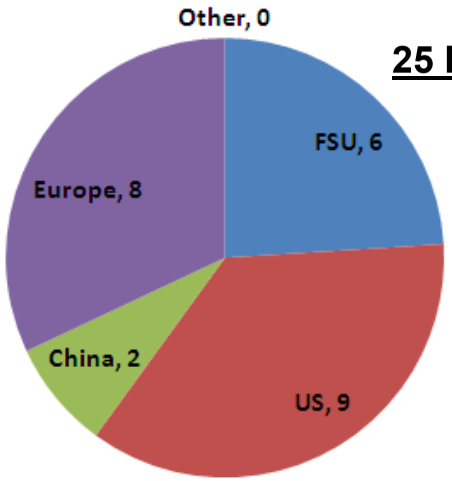
74 Launches



Commercial Space Launches

1995

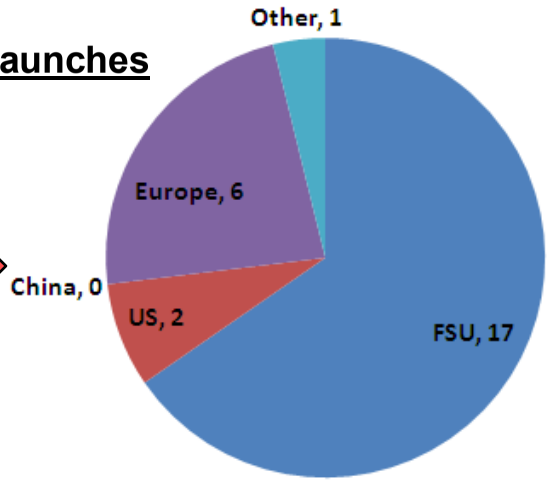
25 Launches



- FSU dominant and growing
- Europe growing (dual manifests)
- US No longer competitive
- New entrant: India

2010

26 Launches



Drastic Decline of US Launch Market Share in Last Two Decades

A Balance of Programs (R&D Through Production) is Required to Maintain Critical Infrastructure

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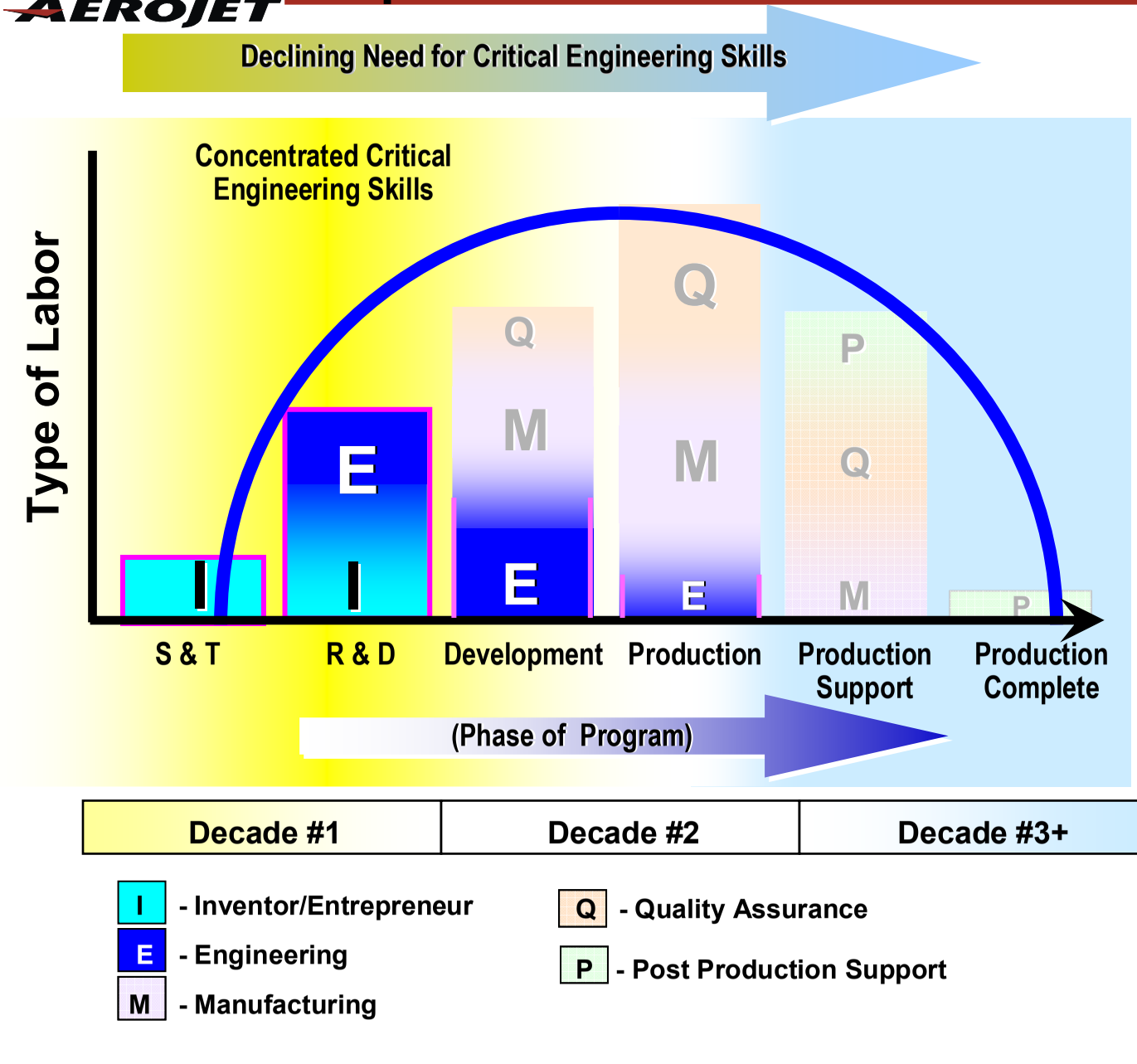

- Product life-cycle dictates current engineering skill mix
- Production programs are primarily maintaining quality and manufacturing skills
- Need for critical engineering skills decreases as programs mature

U.S. Rocket Engine Development History

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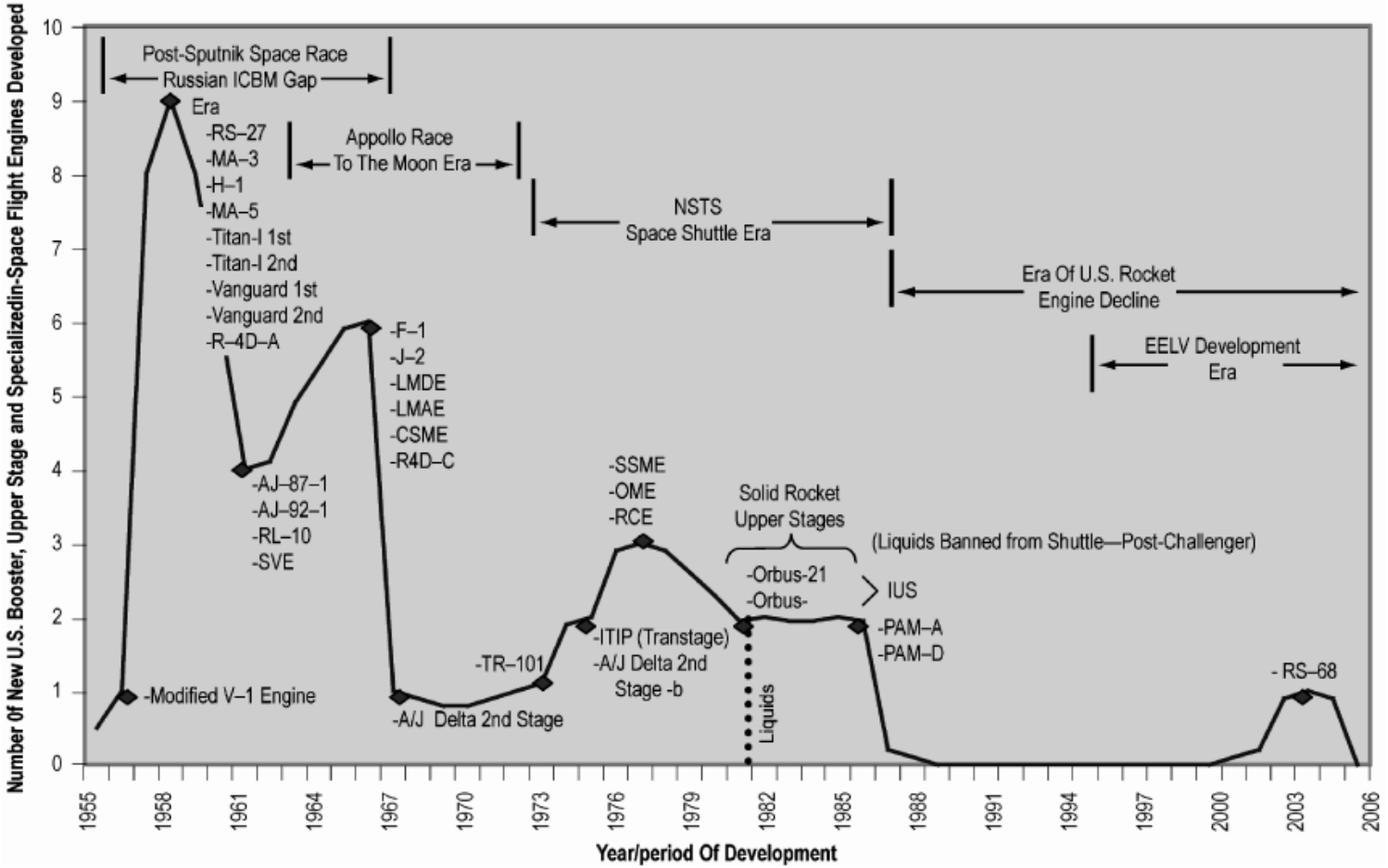

Fig. 2 U.S. rocket engine developments from 1955–2005.

Ref: Sackheim, AIAA-23257-7531, Journal of Propulsion and Power, Nov. – Dec. 2006

There have been no competitive LRE developments for over 3 decades

Engine Development Cycle is At Risk if Aging Workforce is Not Replenished

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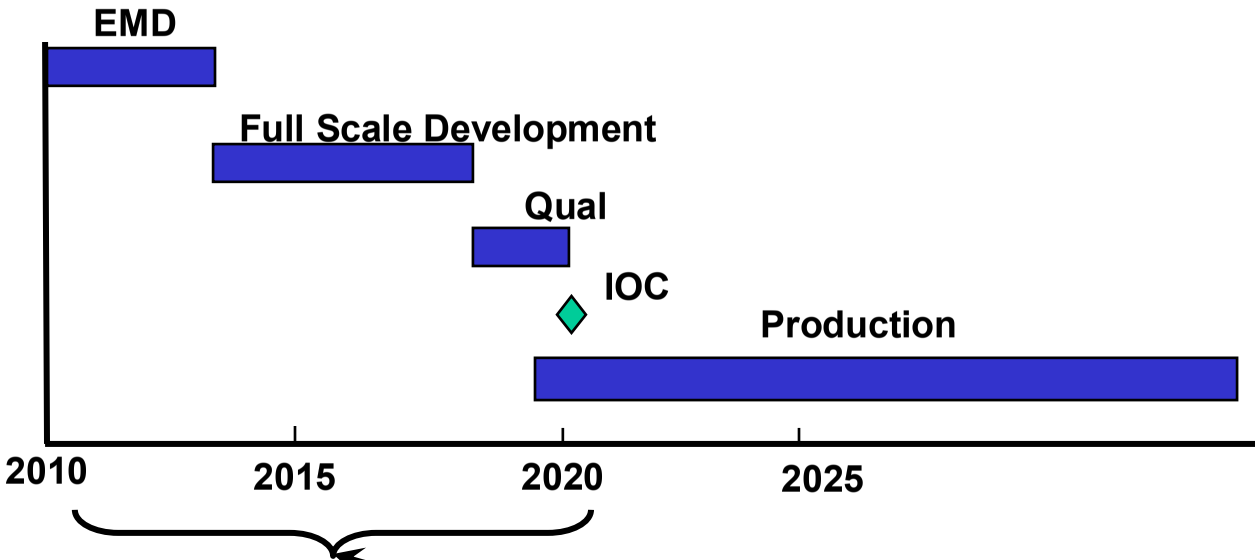
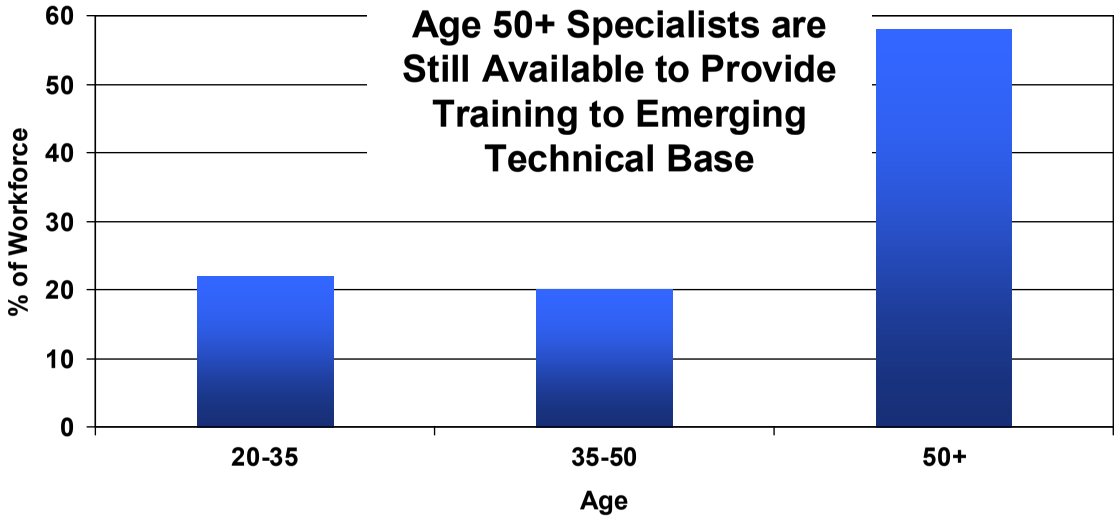


Age Distribution in Aerospace & Defense*



Workforce is Available NOW to Support New Development

Aerojet Demographics Reflect U.S. Aerospace & Defense Workforce Issues

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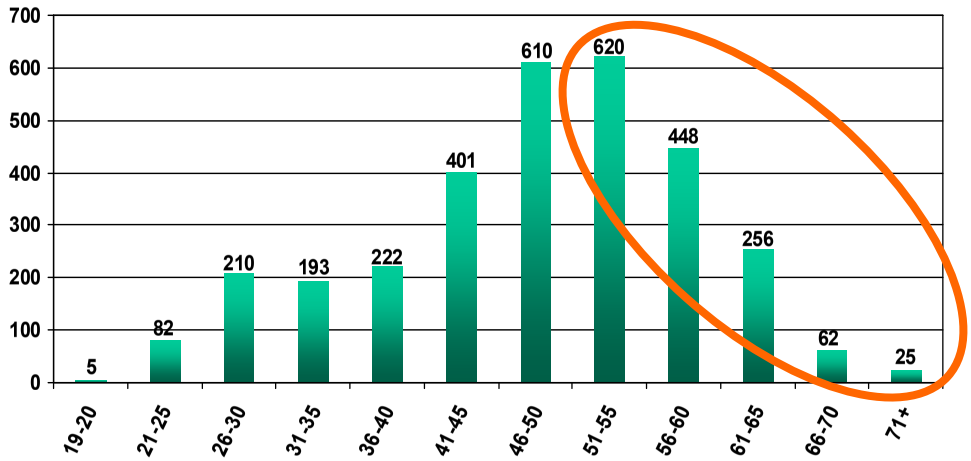
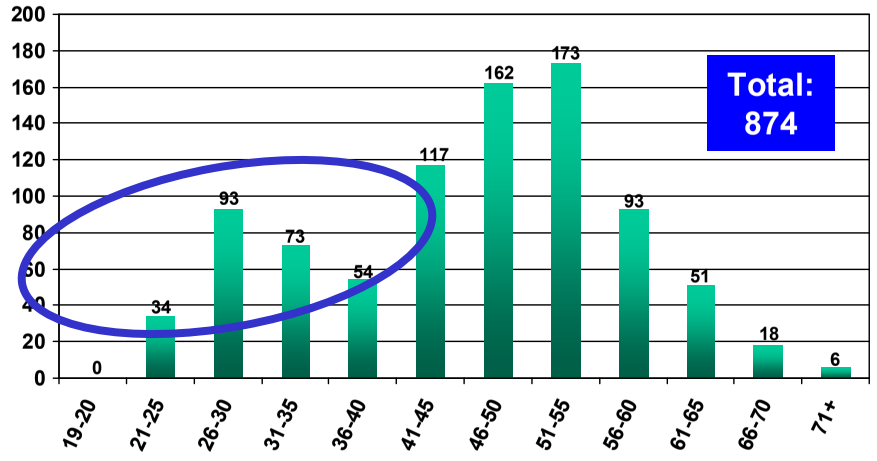
All Employees By Age



Age Distribution for Engineers



Almost half within 5 years of retirement eligibility

Recent focus on new grads is paying of

Cross Training and Agile Business model is aiding in both attracting and retaining

Approximately 30% of Workforce is Composed of Engineers & Scientists

Ideas For Improving Exploration Program Affordability And Sustainability

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- Competition wherever possible – proven method to drive innovation and reduce cost
- Continue to redefine government/industry business model for future business environment
- Don’t wait on in-space architecture investments….Improvements here can translate back to reduced overall architecture and mission costs
- Seek areas of commonality with other users to help share in development and infrastructure costs
- Encourage innovation and risk taking to attract and retain the new generation of aerospace workers