

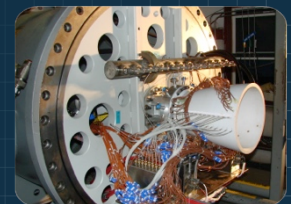


NATIONAL INSTITUTE FOR ROCKET PROPULSION SYSTEMS

US Rocket Propulsion Industrial Base Health Metrics

AIAA, Space 2013
San Diego, CA

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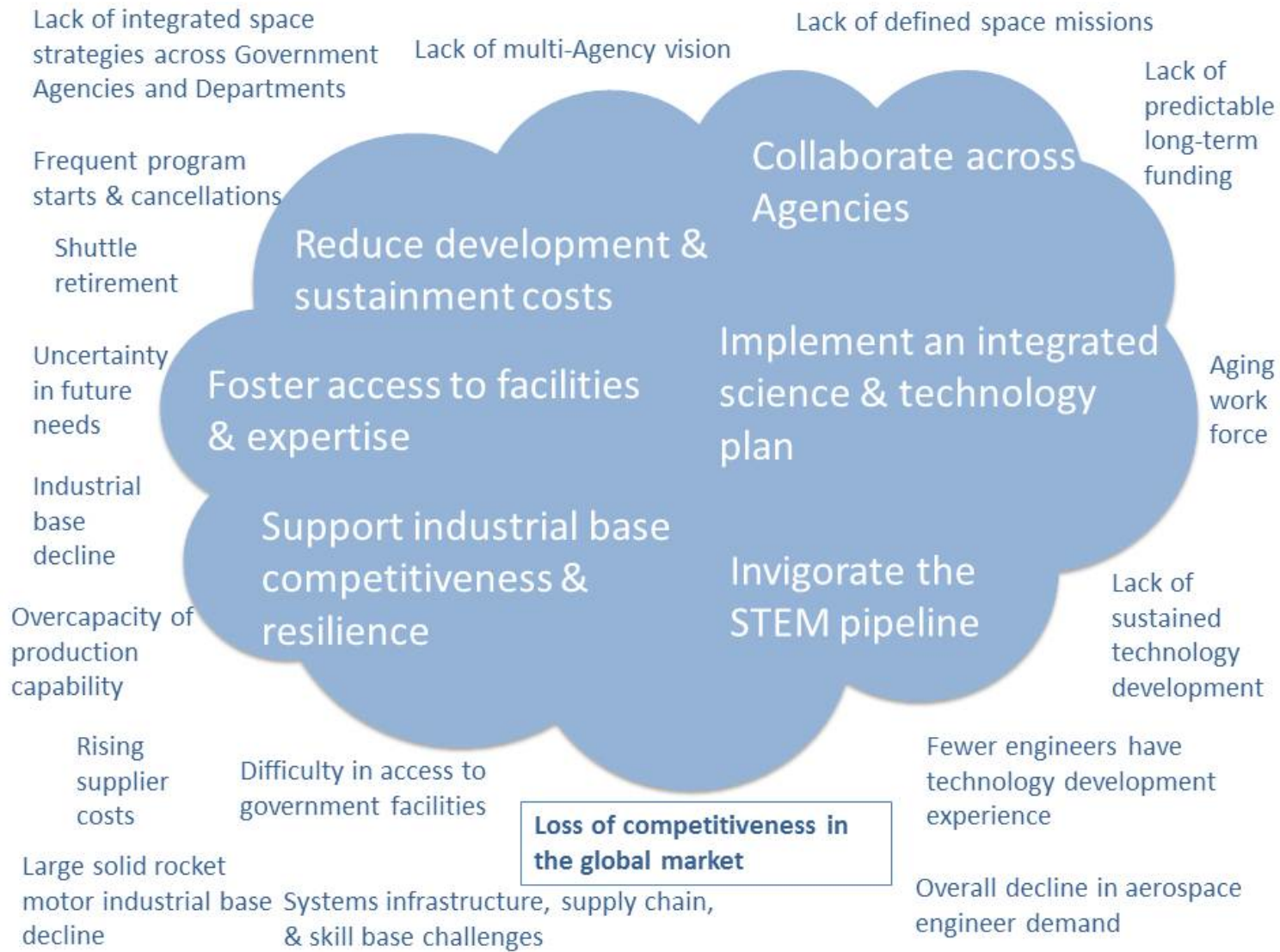


NIRPS: Where we started

- Widespread recognition of the problem
- September 16, 2011 NIRPS authorization letter signed by NASA Administrator Bolden
- Established MSFC as NASA lead, in cooperation with USAF, NRO
- Briefed Space Transportation Association on October 12, 2011 re. needs, policy guidance, & plans



Derivation of the Grand Challenges



Why RPIB Metrics

- To Improve the “health” of the RPIB, we need to understand
 - The current condition of the RPIB
 - How this compares to past history
 - The trend of RPIB health
- This drives the need for a concise set of “metrics”
 - Analogous to the basic data a physician uses to determine the state of health of his patients
 - Easy to measure and collect
 - The trend is often more useful than the actual data point
 - Can be used to focus on problem areas and develop preventative measures

Definition of RPIB

- The nation's capability to conceive, design, develop, manufacture, test, and support missions using liquid rocket engines and solid rocket motors that are critical to its national security, economic health and growth, and future scientific needs.
- The RPIB encompasses US government, academic, and commercial (including industry primes and their supplier base) research, development, test, evaluation, and manufacturing capabilities and facilities.
- The RPIB includes the skilled workforce, related intellectual property, engineering and support services, and supply chain operations and management. This definition touches the five main segments of the U.S. RPIB as categorized by the USG: defense, intelligence community, civil government, academia, and commercial sector.

History of Characterizing the RPIB and health

- Over the past decade over 40 studies have examined the RPIB, either as the primary subject or a subset of a larger set such as the aerospace industry, launch vehicles, etc.
- Most of these studies were qualitative and relied on anecdotal data
- Data summarized and analyzed by the authors
Doreswamy, R., and Fry, E., "A Review of Propulsion Industrial Base Studies and an Introduction to the National Institute of Rocket Propulsion Systems," 48th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, The American Institute of Aeronautics and Astronautics, Atlanta, GA, 2012
- More data driven studies have been performed by the US Department of Commerce (DoC) for NASA and the USAF
 - Human Space Flight Industrial base (2010, report 2012) was a NASA sponsored and focused study
 - US Space Industry "Deep Dive" (2012-present), Sponsored by NASA and USAF, examined the entire US Space Industry
- DoC surveys were extensive, and time consuming for the recipients
 - Not exclusively RPIB focused
 - Expensive to execute
 - Need extensive data analysis to understand and interpret data
- Need exists for an RPIB survey and metric

RPIB Survey: Goals and Focus Areas

- Goals
 - Develop metrics that are a good indicators of the state of health of the propulsion industrial base
 - Minimize burden on respondents to the survey
 - Understand the dependence of non US suppliers for critical items
 - Understand any “at-risk” or single source suppliers
 - Protect any sensitive data
- Focus Areas
 - Human Capital
 - Production, Research and Sales (PR&S)
 - Supply Chain

RPIB Survey: Development and Distribution

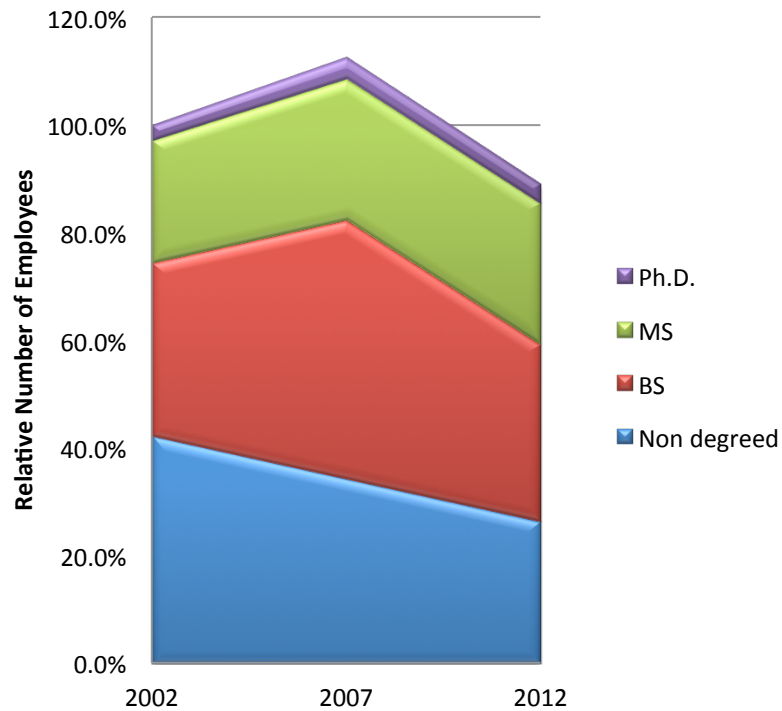
- Development
 - Small, inclusive team developed the survey questions
 - USG, Academia, Large and small private sector
 - Focused on unique and high value metrics
 - Identified concerns of potential respondents
 - Protection data
 - Ease of response
 - Ability to conduct periodic surveys
 - The Academic Community is developing unique metrics for their area, will be discussed next month
 - Due to industry consolidation, most data is only available from 2002 or later
- Distribution
 - NASA Request for Information (RFI) was used to collect data
 - Allows all interested parties to respond
 - Survey available on FedBizOpps website
 - Publicized at NIRPS Planning team meetings and other outreach activities

RPIB Survey: Human Capital

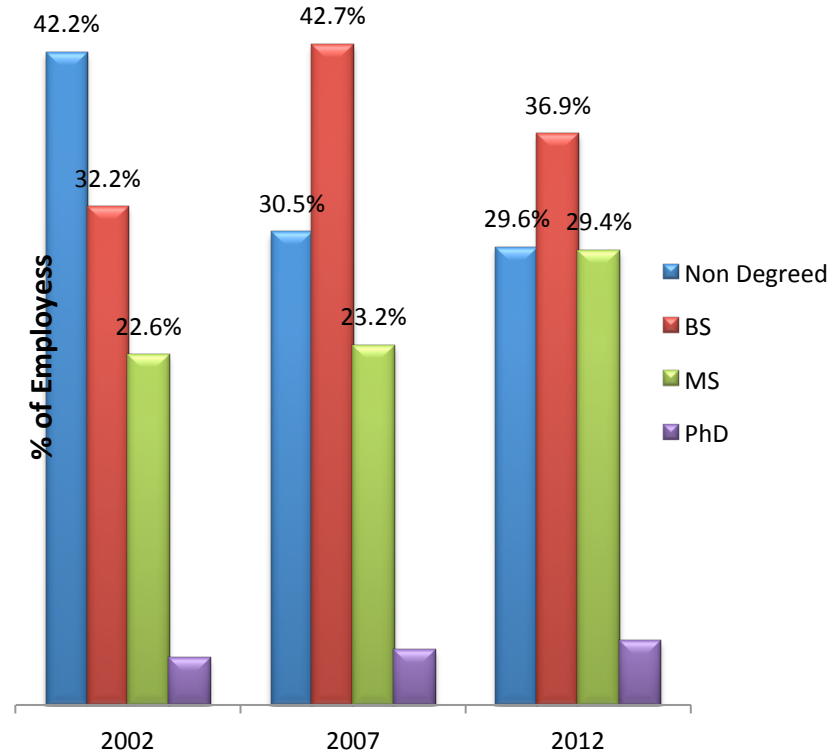
- Please provide a breakdown of number of degreed (broken out by BS, MS and PhD) and number of non-degreed STEM (Science, Technical Engineering and Mathematics) employees for Rocket Propulsion Systems (RPS) versus years of experience, in 5 year increments, as of 1 October 2002, 2007, and 2012. Please provide age demographics as well.
- Average number of job offers from your company or organization received and accepted by STEM graduates for RPS positions
- Retention rates for STEM hires (years of service) of record 1 October 2002 and 2007

RPIB Survey: Human Capital

**Total RPS Employment
GFY 2002 Total=100%**

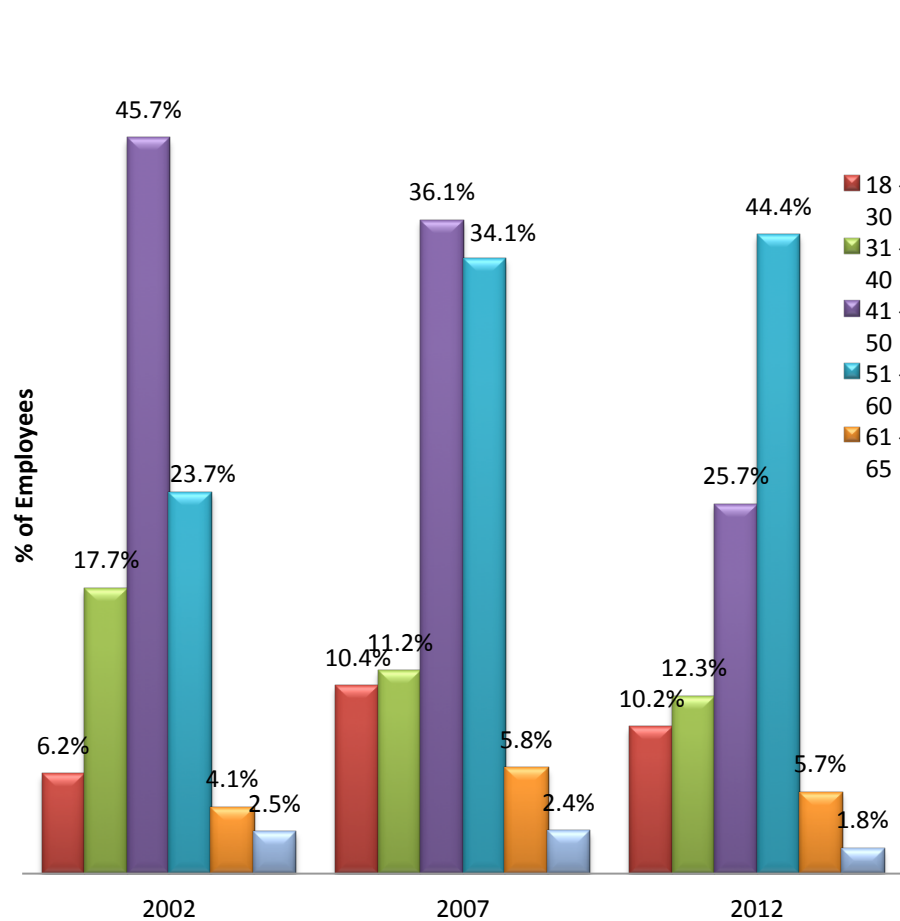


RPS Education Demographics

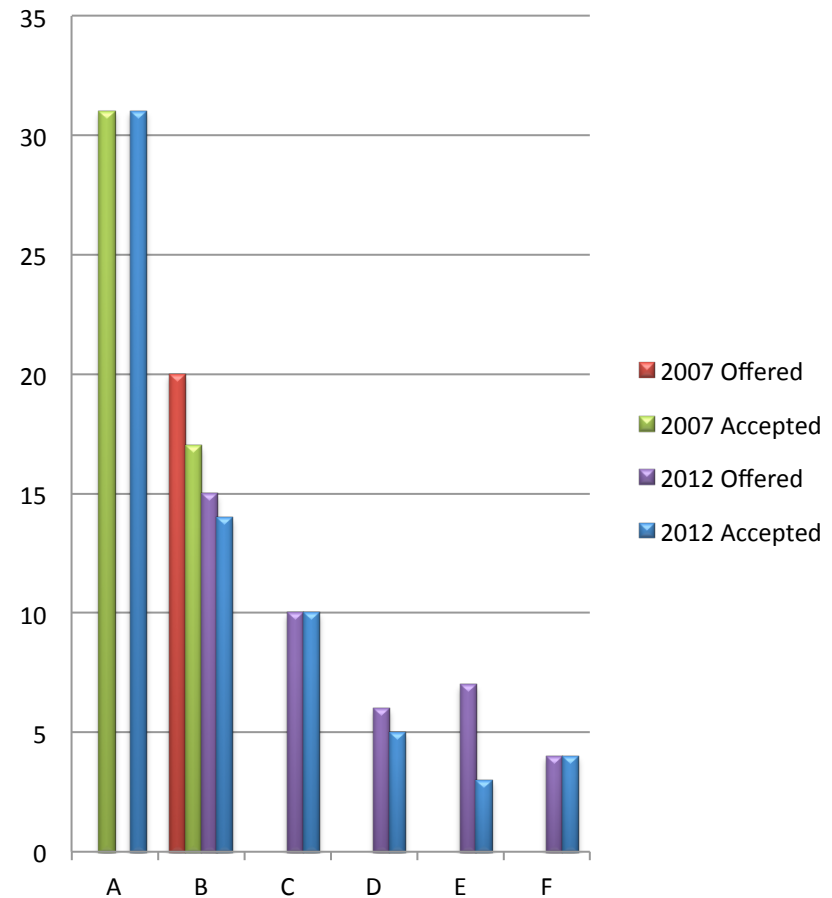


RPIB Survey: Human Capital

RPS Age Demographics



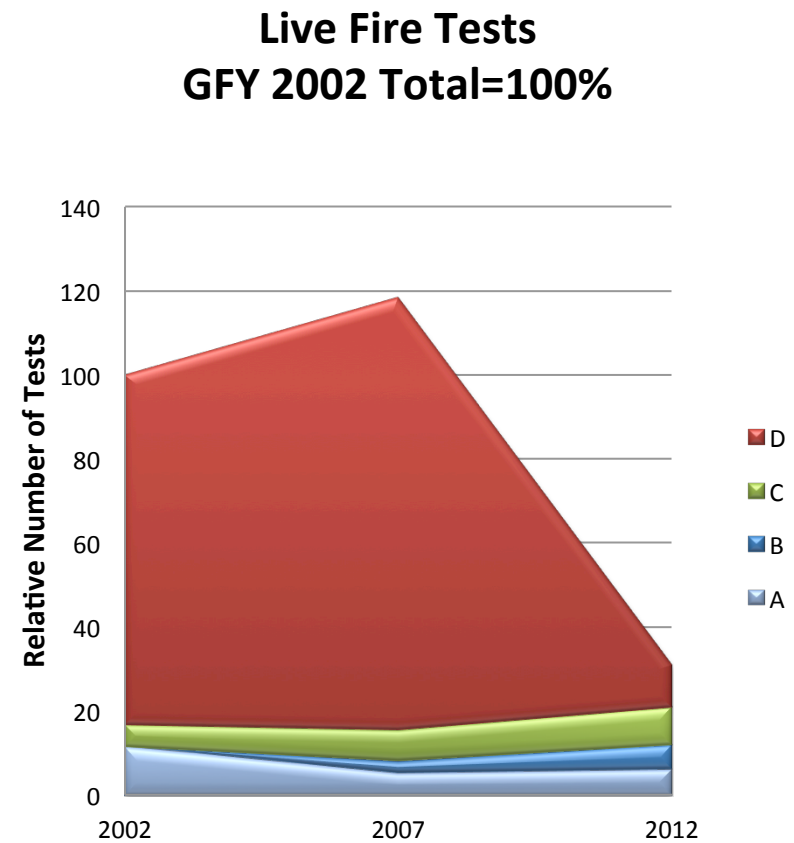
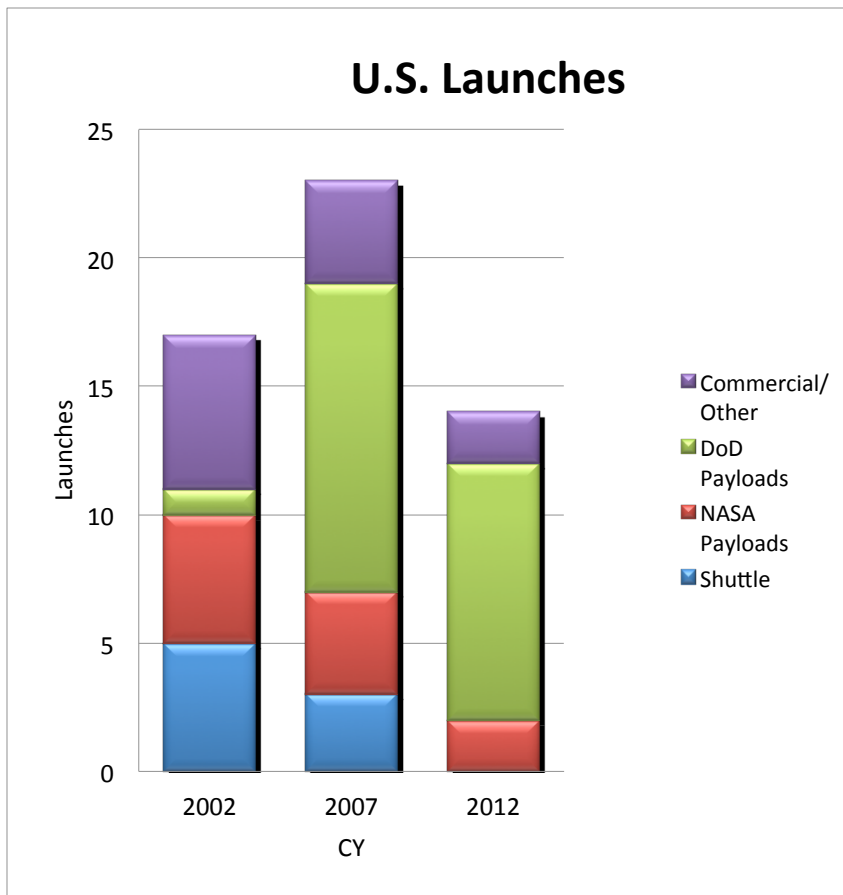
RPS Industry Jobs



RPIB Survey: Production Research and Sales (PR&S)

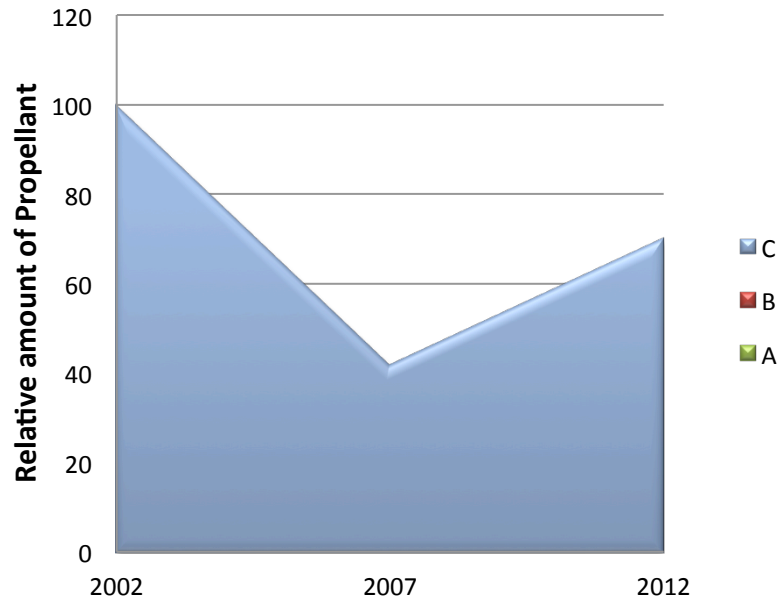
- For the periods Government Fiscal Year (1OCT-31SEPT) GFY02, GFY07 and GFY12, please provide:
 - The number of rocket engine/motor live fire tests conducted, broken down by liquid, solid, or other.
 - Total pounds of solid propellant or storable liquids or cryogenics produced for use development programs (including Independent Research and Development (IR&D))
 - Total pounds of solid propellant or storable liquids or cryogenics produced for production motors.
 - Number of Development motors or Liquid Rocket Engines (LREs) produced.
 - Number of production motors or LREs delivered.
 - The IR&D (in \$'s) devoted to RPS by your company or organization.
 - IR&D devoted to Rocket Propulsion Systems (RPS) as a % of total sales.
 - The externally funded R&D value (in \$'s) for RPS for your organization.
 - Total RPS sales (\$M)

RPIB Survey: Human Capital

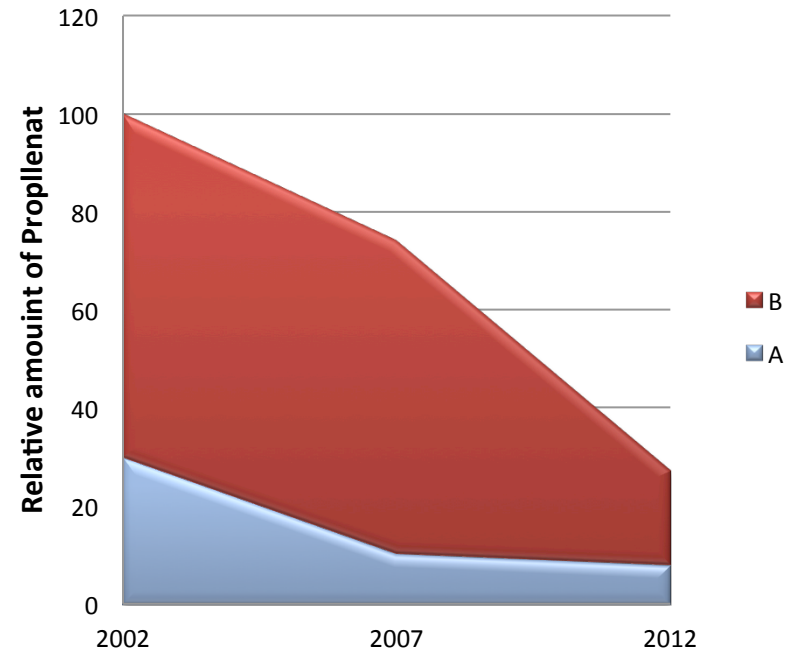


RPIB Survey: Human Capital

**Propellant Produced: IR&D and
Funded Research
GFY 2002 Total=100%**

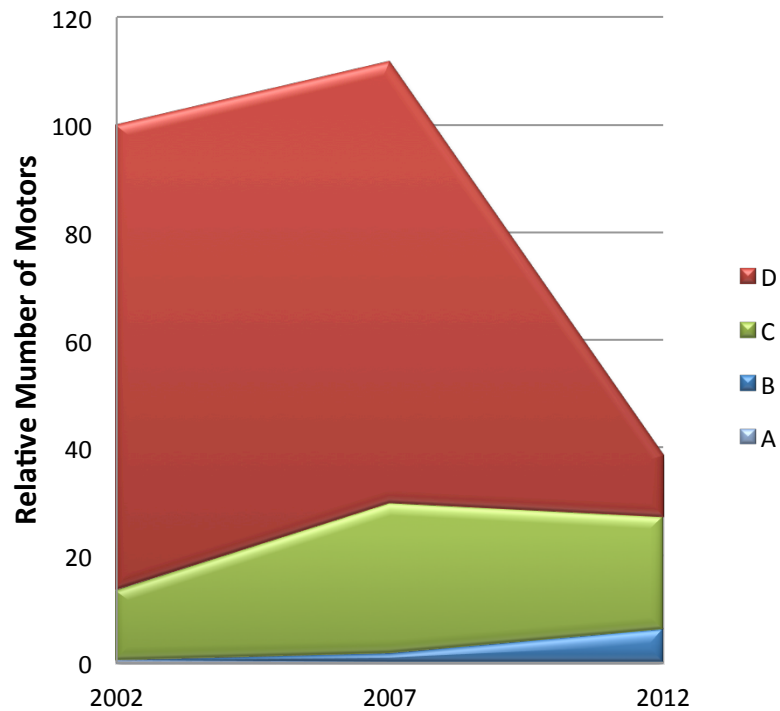


**Propellant Produced: Production
Motors
GFY 2002 Total=100%**

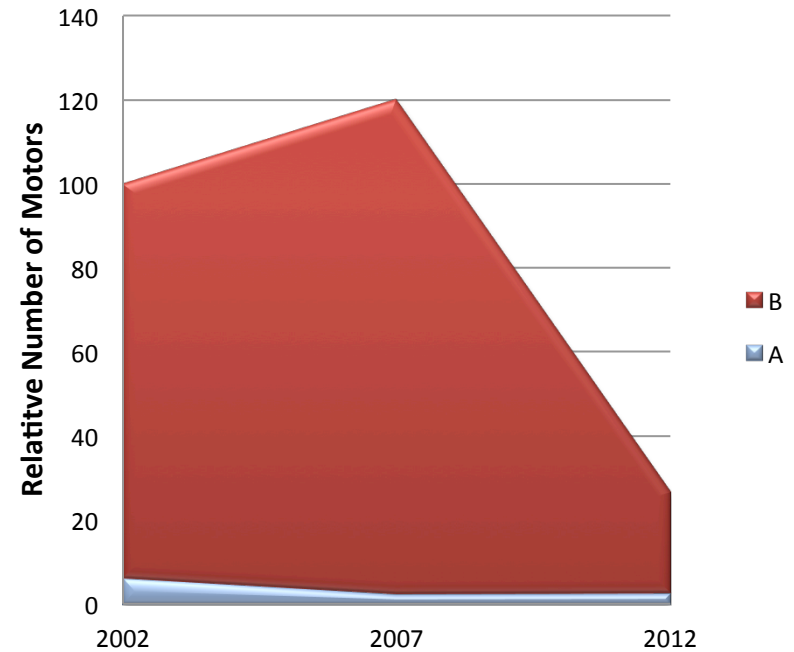


RPIB Survey: Human Capital

Development Motors
GFY 2002 Total =100%

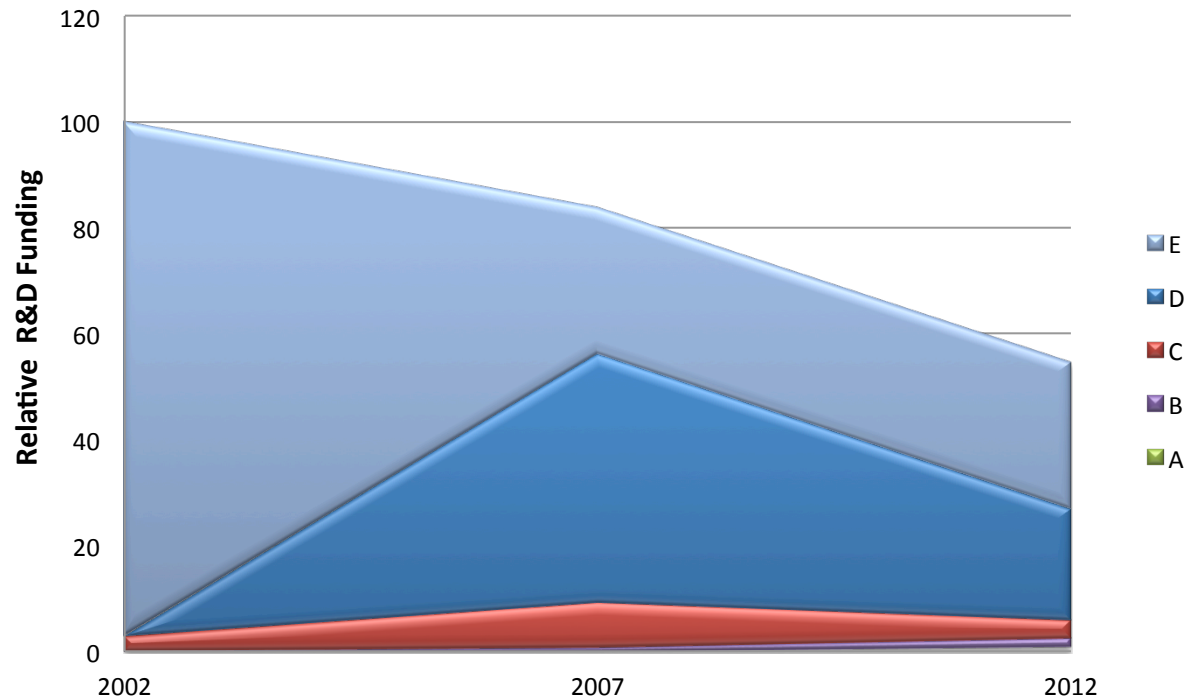


Production Motors Delivered
GFY 2002 Total=100%



RPIB Survey: Human Capital

Company Funded Research and Development:
GFY 2002 Total=100%

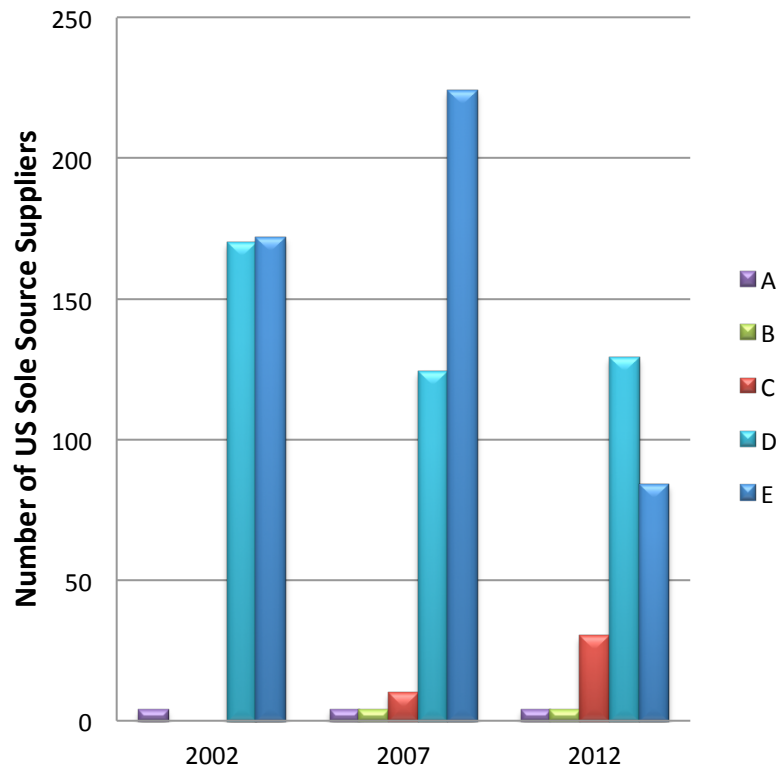


RPIB Survey: Supply Chain

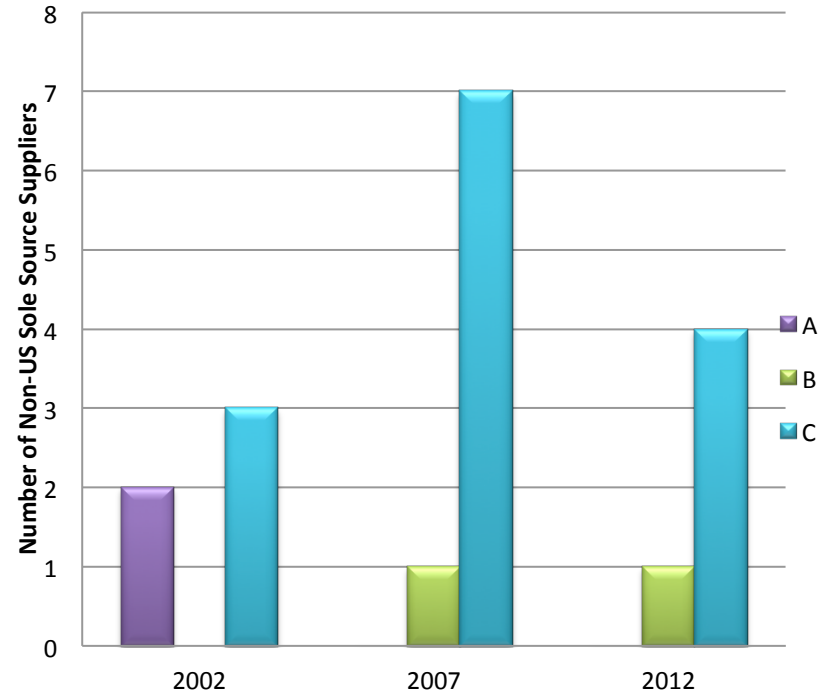
- Do you have an active supply chain management system in place for your lower-tier RPS vendors (tier 2 and 3, not just first level suppliers)?
- How many sole or single source suppliers did/do you have for GFY 2002, 2007, and 2012? Of these, how many are US and how many are non-US? If non-US, please identify country.
- Identify the percentage of non-US components used in your RPS products (treat each part, ingredient, circuit board, etc. equally as a single component).
- For the years GFY2002, 2007, and 2012, how many sub-tier suppliers left the market? How many entered the market? How many re-qualifications occurred because of a supplier change or process change? Provide data for your company or organization only.
- Are your production capabilities dependent on a stockpile of material? If so, what stockpiled material? Are there plans to develop a capability to produce the material?
- How dependent is your sub-tier supply base on revenues from the rocket propulsion market? Identify vendors where RPS revenues are >50% of their revenue portfolio.
- If data is not available for any of these, please indicate what's missing.

RPIB Survey: Human Capital

U.S. Sole Source Suppliers



Non-U.S. Sole Source Suppliers



Observations

- Initial look at the survey responses indicates the beginning of stability in key RPIB metrics
 - Company R&D investment is stabilizing, even as launch rates and other indicators tend down
 - New entrants to the RPIB are beginning to make positive impacts on the industrial base, although they are still a small part
 - US Government is stabilizing space launch demand and rates, tactical systems demand is also steady
 - NASA's Commercial Crew/Cargo programs are encouraging new entrants
- While these are all positive signs, more data is needed to see if the industry is in a stable mode
- Industry consolidation is traditional suppliers is continuing with the formation of Aerojet Rocketdyne and these impacts are still not clear
- Some data was not tracked or had a very small sample size to be useful
 - Employee Retention Rates
 - Dependency of suppliers on Rocket Propulsion Systems
 - Overall Company Sales

Areas for Improvement/Next Steps

- Redesign survey to include items normally tracked by industry and clarify language to make survey responses easier to complete
- Remove questions on metrics that were not useful
- Expand outreach to non traditional entrants, small business and other government organizations
- Validate data with data from Department of Commerce surveys
- Incorporate results from academic metrics activities
- Automate survey responses using a secure website
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Summary

- The team has developed a good useful set of metrics
 - Low burden to respond
 - Provides a good “health check”
- Work remains to be done
 - Improve survey
 - Expand outreach
 - Validate data with DoC data

Questions?

NIRPS

National Institute for
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<http://nirps.msfc.nasa.gov/home>