National Aeronautics and Space Administration (NASA) Human Space Flight Industrial Base in the Post-Space Shuttle/Constellation Environment

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Executive Summary

From 1981 to 2011, the National Aeronautics and Space Administration (NASA) operated the Space Transportation System, commonly known as the Space Shuttle Program (Shuttle), with the world's first reusable spacecraft to carry humans into orbit. It transported satellites into space and serviced them, carried scientific experiments, and was used to build the International Space Station (ISS) and later carry astronauts to and from the station. In 2004, it was announced that the Shuttle would be retired, and 2010 was established as the retirement date.[1]

A year later in 2005, NASA was directed to "establish a program to develop a sustained human presence on the Moon, including a robust precursor program, to promote exploration, science, commerce, and United States preeminence in space, and as a stepping-stone to future exploration of Mars and other destinations."[2] This evolving program was referred to later as the Constellation program (CxP).

Due to a projected five-or-more year gap between the end of Shuttle and full production of CxP, NASA's Exploration Systems Mission Directorate approached the Bureau of Industry and Security's (BIS) Office of Technology Evaluation (OTE) in late 2009 to conduct an assessment on the ability of NASA's Shuttle-related human space flight (HSF) supply chain to maintain critical capabilities during the gap period. Unexpectedly, NASA was directed in early 2010 to "transition" from CxP to deep-space exploration (bypassing the Moon), and CxP-related funding was reduced to a few core components for deep-space projects, while funding for ISS was extended through 2020. The OTE assessment was therefore modified to include these changing factors.

NASA and OTE designed a survey to gather in-depth information on all parts of NASA's human space flight (HSF) supply chain and its ability to operate during the anticipated procurement gap, now between Shuttle/CxP and future deep-space exploration. OTE collected information covering 2007-2010 from 536 companies identified by NASA as Shuttle, CxP, and ISS program suppliers.

[1] This retirement date was later extended to 2011 when additional Shuttle missions were added.
[2] From the National Aeronautics and Space Administration Authorization Act of 2005.

The Shuttle retirement and CxP transition will impact future NASA HSF programs through a loss of unique skills, capabilities, products, and services by select suppliers. The assessment highlights and prioritizes immediate areas of concern for NASA, with focus on the 150 survey respondents that identified themselves as dependent on NASA. Within the group of 150 NASA-dependent companies, the 46 NASA-dependent companies that reported negative net profit margins for at least one year from 2007-2010 should be given particular attention. Without continued business opportunities, these companies have the highest potential of shutting down. Ongoing efforts to develop a deep-space exploration capsule and heavy-lift rocket capability are important first steps to maintaining capabilities, and should be viewed as the building blocks to spur a sustainable HSF supply chain.

The assessment also reveals many areas of opportunity for future NASA action, including: increasing communication and outreach with the HSF supply chain; coordinating efforts with regional, state, local, educational, and non-profit organizations and institutions; working with other U.S. Government agencies to address interdependency issues, find commonalities, and leverage mutual interests to support the industrial base; and directing more Federal Government research and development funds to smaller companies as well as diversifying the number of companies conducting NASA-related research and development.

For many NASA HSF suppliers, participating in NASA HSF programs and space missions is a point of national pride and enthusiasm. In fact, the vast majority of surveyed companies were willing to support future NASA HSF programs, despite the inconsistency of demand. Rapid action by NASA, in conjunction with other federal and state organizations, will ensure these companies and their skills and capabilities will be there when needed for the next great U.S. milestone into space.

I. Introduction

The National Aeronautics and Space Administration's (NASA) Exploration Systems Mission Directorate and the Bureau of Industry and Security's (BIS) Office of Technology Evaluation (OTE) initiated an industrial base assessment of NASA's human space flight supply chain, specifically suppliers participating in the Space Shuttle Program (Shuttle), the Shuttle's follow-up program Constellation (CxP), and the International Space Station (ISS).[3] NASA had concerns about the industrial base impacts resulting from the retirement of the Shuttle and the transition from CxP, and sought current, in-depth, multi-tier supplier information from BIS that would help NASA prioritize its funding allocations and program planning during the anticipated procurement gap.[4]

To formalize the project, BIS and NASA signed a joint Memorandum of Understanding (MOU), authorizing OTE to conduct a comprehensive survey and assessment of NASA's human space flight (HSF) suppliers. By working together, both agencies would be able to understand the behavior and composition of the supply chain, as well as identify key capabilities and labor skills deemed at risk of erosion during the post-Shuttle and CxP period. Furthermore, BIS and NASA suspected suppliers dependent on Shuttle and CxP contracts may also be suppliers to the U.S. Department of Defense (DOD) or other national security agencies, thus posing programmatic impacts across the U.S. Government (USG).

This final report will benefit NASA and other USG agencies that are involved in space activities, as well as the corresponding U.S. space industrial base community. With four years of complete data and a five-year sales projection, industry and government officials can use this report as a benchmark to better monitor trends and supplier performance in the HSF supply chain. This previously unavailable data highlights current and potential diminishing U.S. space-related manufacturing capabilities, technologies, and labor skills that can be used by decision makers to plan future actions to maintain and enhance the HSF supply chain.

[3] CxP was intended to return astronauts to the moon and build a lunar outpost, with the eventual goal of launching an expedition to Mars. The future of CxP had not yet been decided by the President and Congress upon OTE's initiation of the NASA Supply Chain Network survey assessment. OTE was later asked by NASA to delay the deployment of its industrial base survey to U.S. industry until the President had formally canceled the CxP.
[4] This procurement gap refers to the time between the Shuttle retirement and CxP transition and the implementation of a follow-up program.

Study Purpose

NASA faces industrial base challenges in the wake of the Shuttle retirement and CxP transition, including large-scale layoffs and facility closures across both industry and government, and a budget shortfall that did not allow for a NASA-owned, U.S.-based spacecraft to support ongoing missions to the ISS. While NASA had some insight into the potential impacts on prime contractors and their own facilities, it could not predict with precision the ramifications on suppliers at lower levels of the supply chain. OTE's survey instrument was designed to document both the immediate impacts of program terminations as well as the planning and support deemed necessary by suppliers to remain viable without a NASA-HSF mission to support. The intent was to be able to direct NASA attention to those deemed most impacted. The survey data collected includes production and service capabilities, sales figures, machinery and equipment by location and type, workforce statistics, research and development (R&D), capital expenditures, financial statements, and industry future outlook.

Study Authority

OTE has authority to conduct assessments and collect information from industry in support of the U.S. industrial base under Section 705 of the Defense Production Act of 1950, as amended, and Executive Order 12656. Accordingly, OTE is the focal point within DOC for industrial base and critical technology analyses. These assessments are normally undertaken at the request of the DOD, with one or more of the Armed Services participating, or with other federal agencies, such as NASA in this case.

OTE has conducted more than 50 assessments over the past 25 years within various industrial base programs. Assessments generally review in detail those industries facing employment, international competition, financial, production, investment, and foreign sourcing and dependencies challenges, as well as other issues affecting their ability to support defense and national security programs.

Study Methodology

To better understand the issues facing NASA, OTE held discussions with NASA and other government agencies across the U.S. space industrial base. These meetings were conducted with

experts from NASA headquarters and centers such as the Kennedy Space Flight Center, the Goddard Space Flight Center, and the Jet Propulsion Laboratory; DOD's Space Industrial Base Council (SIBC); and the Office of Space Commercialization in the National Oceanic and Atmospheric Administration (NOAA).[5] Additional consultations with other defense and intelligence community experts helped OTE appraise how Shuttle, CxP, and corresponding supplier networks are interwoven with national security procurement needs.

OTE also conducted site visits at several small- and medium-sized suppliers and organizations in California, Florida, and Alabama to learn how lower-tier companies were responding and adapting to the Shuttle and CxP transition. These site visits provided OTE greater insight into company-level issues, including human capital needs, unique production capabilities, and capital expenditures and R&D spending specific to NASA-HSF applications.

More than 1,200 HSF suppliers were initially identified by NASA to support the survey project. However, the number of viable survey respondents decreased due to companies submitting consolidated survey responses for multiple facilities, the removal of companies that provided items not deemed critical to HSF, business closures, and merger and acquisition activity.

OTE mailed letters to the identified NASA HSF suppliers in the summer of 2010 to initiate the data collection.[6] OTE provided respondents with 30 days to submit the completed survey to OTE, but extensions were granted in select instances. Respondents were allowed to provide either Business Unit/Division or Corporate Level/Whole Company information in multiple sections of the survey.

Survey Respondents

OTE received a total of 536 surveys from a combination of wholly-owned small-to-medium companies, the business units or divisions of large corporations, and a small number of universities. To better facilitate analysis, OTE applied sales-based "tiering" criteria to group the respondents by size: Tier 1 companies had 2009 total sales exceeding $200 million; Tier 2 companies had 2009 total sales of $25 to $200 million; and Tier 3 companies had 2009 total

[5] The SIBC is comprised of National Security Space (NSS) USG agencies. Its mission is to promote the health of the U.S. industrial base while assessing the industry's ability to meet the needs of the NSS community in the near and long term.

[6] A copy of the NASA Supply Chain Network survey document is in Appendix E.

sales less than $25 million.[7] Tier 1 companies tended to be prime contractors, while Tier 2 and 3 companies tended to be subcontractors and material suppliers. However, large, medium, and small size firms were represented in all three tiers, as were the small number of universities.

Study Findings

Chapter II: Company Profile of Survey Respondents:

- The 536 NASA HSF survey respondents participating in the assessment represent a broad mix of companies, business units/divisions, and universities ranging from 1 employee to more than 100,000, with total sales from $30,000 to $60 billion.
- There were 433 companies that knew which NASA HSF program they supported, and of those 136 supported all three - Shuttle, ISS, and CxP.
- Of the 17 primary business line categories, Manufacturing was the primary business line of 50 percent of respondents, followed by Distribution and R&D.
- California hosted 111 companies, or 21 percent of respondents, followed by Florida with 49 companies, or 9 percent of respondents.
- Fourteen percent of companies supplied products and services to NASA directly, 43 percent supplied to NASA both directly and indirectly, 33 percent supplied indirectly, and 10 percent were not sure how they supplied products and services to NASA.
- Of the 536 respondents, 411 supplied products and services to at least one specific NASA facility, center, or laboratory, while 193 respondents supplied to four or more and 44 respondents supplied to 10 or more.
- Seventy-five percent of survey respondents possess at least one professional, industry, and/or standards certification. A majority of Tier 3 companies, 62 percent, possess professional, industry, and/or standards certifications.
- Over 70 percent of all suppliers use supply chain management methodologies and systems.
- Overall, 28 percent or 150 of 536 NASA HSF survey respondents were dependent on NASA business, representing companies in Tier 1, Tier 2, and Tier 3.

[7] The specific sales level thresholds (Tiers 1-3) were established by OTE and do not adhere to the "tiering" or contract rubrics normally adopted in Federal Acquisition Regulations (FAR) or other USG contracting, which defines "tiering" based on point-to-point sales in the supply chain. OTE used a sales-based tiering system because of the complex and inter-related nature of the supply chain.

Chapter III: Products and Services:

- Eighty-seven percent of companies were able to identify the specific HSF program or element they supported, which reinforces the results from the Method of Sales to NASA data.
- All 536 survey respondents identified their participation in 18 product and service categories and an additional 306 subcategories. Approximately 60 percent of respondents selected the Services category, with NASA as the primary end-user followed by Commercial and then DOD end-users.
- Fifty-three percent of NASA HSF suppliers supported DOD end-users in at least one product and service category.

Chapter IV: NASA Supplier Sales

- While it differed by company, NASA-related sales represented only two percent of aggregate sales for all 536 survey respondents. This was mainly due to high non-NASA related sales of large Tier 1 companies.
- Aggregate NASA sales grew 29 percent from 2007-2010. Tier 1 respondents accounted for 93 percent of NASA sales, followed by Tier 2 at five percent and Tier 3 at two percent. Overall, NASA HSF sales were approximately double NASA non-HSF sales over the period.
- Tier 1 companies reported 52 percent of their HSF sales as Shuttle-related, with ISS and CxP counting for 25 percent and 23 percent, respectively. Tier 2 sales were equally distributed among the three NASA HSF programs. Tier 3 sales were 59 percent CxP-related, with Shuttle-related sales at 30 percent and ISS-related sales at 11 percent.
- Tier 3 companies, on average, had a larger percentage of NASA sales dedicated to HSF business than their Tier 1 and Tier 2 counterparts.
- HSF respondents were not optimistic about future ISS sales, with most companies not sure or expecting no change in ISS-related sales, while twice as many respondents anticipated a decrease than anticipated an increase in ISS-related sales.
- Approximately 73 percent of respondents' sales took place in the United States. Those respondents defining themselves as NASA-dependent have a smaller stake in the

international market, approximately seven percent, on average, than the survey population as a whole, approximately 25 percent.

- Only 82 respondents, 15 percent of the total, were able to report non-U.S. space-related sales from 2007-2010. Space-related exports constituted a small fraction of total declared non-U.S. sales – less than one percent. Japan, Italy, and the United Kingdom were the largest customers of space-related exports out of the 22 countries identified.
- Nine percent of survey respondents, 46 companies, indicated they had lost space-related export sales to foreign competitors, with Tier 2 companies representing the largest portion of affected NASA HSF suppliers. Seventy-eight percent of the 46 survey respondents reported Manufacturing as their primary business line, and 37 companies identified themselves as dependent on NASA-related business.
- The production capacity utilization rates for NASA-dependent companies fell from 67 percent in 2007 to 62 percent in 2009, recovering to 64 percent in 2010. These rates were lower than both the overall respondent capacity utilization rates, which decreased from 69 percent in 2007 to 67 percent in 2010, and the aerospace industry benchmark rates, which declined from 89 percent to 71 percent over the period.
- Fifty-two companies, almost all Tier 1, reported 48,623 specific machinery, tooling, and facilities, with 91 percent of the items reported as Government-Furnished Property (GFP). Eighty-six percent of the reported machinery, tooling, and facilities were used strictly to support the Shuttle, and 90 percent of all reported machinery, tooling, and facilities were listed as still in-use in 2010.
- With the Shuttle program completed, the majority of the GFP machines and tools will be processed by the General Services Administration (GSA) to be transferred, sold, scrapped, or donated. A small portion of the items are being evaluated for future HSF program use. The loss of items not in use, along with the skilled workforce to operate them, will lead to a significant decrease in the space industrial base's production capacity for the foreseeable future.
- The majority of respondent space-related sales were from non-NASA customers in the United States, including branches of the military, civilian agencies, government contractors, and commercial customers.

Chapter V: Employment

- Depending on the year, the 150 NASA dependent companies accounted for between 21-24 percent of total employment from 2007-2010, while those not dependent on NASA accounted for between 76-79 percent.
- From a company-specific perspective, 254 respondents experienced a decrease in employment, and 77 respondents experienced a decrease in employment of 25 percent or greater. The average decline per company among the 254 respondents was 19 percent from 2007-2010.
- Of the self-identified NASA-dependent companies, 60 reported a decline in employment of greater than or equal to 25 percent. The average employment decline per NASA-dependent company over the period was 20 percent. It is important to keep in mind that this data does not reflect the full impact of the Shuttle retirement and CxP transition due to the timing of the survey.
- Similar to the overall survey population, NASA-dependent companies indicated R&D Staff and Production Line Staff were the most difficult to hire and the most difficult to retain, with R&D Staff selected by the most companies in both categories. NASA-dependent respondents reported that Production Managers/Supervisors were more difficult to hire than respondents not dependent on NASA-related business.
- Technical Expertise, Engineering, and Experience were the top critical personnel skills and competencies listed by survey respondents, with almost 50 percent of all responses falling into these categories. R&D/Innovation and Technical Expertise were identified by the most NASA-dependent respondents as their unique skills and competencies.
- Nearly 40 percent of all respondents indicated they have personnel with formal qualifications/certifications necessary for doing business with NASA. Fifty-two percent of Tier 1 and 48 percent of Tier 2 respondents had personnel with such qualifications/certifications, with only 27 percent of Tier 3 respondents indicated the same.

Chapter VI: Research and Development

- Nearly half of NASA HSF suppliers conduct no R&D activities, as many are build-to-print companies, distributors, service providers, or resellers. When adjusted for outliers,

NASA-related R&D expenditures accounted for six percent of aggregate R&D outlays in 2010, or $757 million of $12 billion.

- Eighty-one companies reported NASA-related R&D expenditures, with 38 of those respondents dependent on NASA-related business. Six of the 81 respondents accounted for 75 percent of NASA-related R&D, with totals over $100 million each over the time period. Median R&D expenditures were just $174,250 in 2010 for the 81 respondents. NASA-dependent suppliers conducted between 63-66 percent of reported NASA-related R&D over 2007-2010, depending on the year.
- NASA-dependent companies reported higher R&D expenditures as a percentage of total sales on average than companies that were not dependent on NASA. The end of the Shuttle and CxP programs will impact R&D spending levels of these companies.
- From 2007-2010, 69 of 223 respondents received R&D funding from the Federal Government, with seven of the 69 respondents receiving 74 percent of the total Federally-funded dollars.
- On a per company basis, Internal/Self-Financed R&D funding was on average over 70 percent of total R&D funding, with Federal Government R&D funding representing approximately 16 percent.
- In 2010, for example, Tier 1 companies received the majority of Federal Government R&D funds, 93 percent of the approximately $5 billion in total Federal Government R&D funding, while Tier 2 received two percent and Tier 3 received five percent.
- NASA-dependent respondents relied on Federal Government-financed R&D funding, as it makes up 75 percent of their total R&D funding sources. On average, NASA-dependent suppliers allocated a much larger percentage of R&D staff in their workforce, 23 percent, than suppliers not dependent on NASA, 12 percent.

Chapter VII: Capital Expenditures

- Of those survey respondents that conducted NASA-related business, NASA-dependent HSF suppliers devoted 13 percent of their capital expenditures to their NASA business lines, while companies that were not dependent on NASA devoted one percent to NASA business. NASA-dependent companies directed a higher percentage of their capital

expenditures toward IT, Computers, and Software, while companies not dependent on NASA directed a higher percentage toward Machinery, Equipment, and Vehicles.

- NASA-dependent suppliers maintained relatively stable levels of capital expenditures, reducing capital expenditures only four percent from 2007-2010. The capital expenditures of companies not dependent on NASA decreased 33 percent over the same time period.
- The decline in NASA-related capital expenditures as a percentage of total sales was primarily due to the recession and the retirement of the Shuttle. The transition from CxP, which was not fully captured in the survey, is expected to drive expenditures down further in out years.

Chapter VIII: Supply Chain Relationships

- Mergers and Acquisitions (M&A) involving NASA HSF suppliers declined from 107 in 2007 to 39 in 2010, and largely mirrored broader impacts of the global economic downturn and tightening of available credit. Five M&A transactions took place in China.
- Thirty-two of the 536 respondents participated in a joint venture relationship from 2007-2010. There were 49 NASA-specific joint ventures, 34 of which were related to Shuttle, ISS, or CxP.
- Survey respondents reported 1,032 distinct U.S. competitors, 20 percent of which were surveyed in this effort. Not all competitors were related to the respondents' NASA-related business activities. There were four times as many California competitors, the most frequently identified state, as there were Florida competitors, the fifth most frequently identified state.
- There were 462 distinct non-U.S. companies identified as competitors by respondents. France, Germany, and the United Kingdom were the top reported locations of the non-U.S. competitors.
- There were 2,145 U.S. competitor and 711 non-U.S. competitor products and services mentioned corresponding to 16 of 18 broad categories, with Services and Spacecraft mentioned the most for both U.S. and non-U.S. competitors.
- Respondents reported 1,588 distinct U.S. suppliers, 20 percent of which were surveyed in this effort. California represented the largest concentration on U.S. suppliers.

- There were 311 distinct non-U.S. suppliers identified, concentrated mostly in Canada, Germany, Japan, and China.
- A total of 2,978 product and service mentions were reported from U.S. suppliers across all 18 broad categories, with Services and Spacecraft the two most frequently selected categories. Forty percent of the 1,588 distinct suppliers were identified as supplying products and services used for Shuttle, ISS, and CxP.
- For non-U.S. suppliers, there were 414 product and services mentions across 13 of 18 broad categories, with Services and Spacecraft the two largest categories. Twenty-nine percent of the 311 non-U.S. suppliers were identified as supplying products and services used for Shuttle, ISS, and CxP.

Chapter IX: Future Outlook for NASA Suppliers

- Survey respondents cited workforce reductions, loss of critical skills and competencies, and declining revenue as the three most prevalent consequences of the Shuttle retirement and CxP transition.
- At the time of the survey, half of respondents had a plan in place to preserve their current capabilities and workforce in the post-Shuttle, post-CxP environment. Many companies reported that they believed it was impossible to preserve these capabilities and their workforce.
- Many respondents reported that they planned to adjust their workforce, cancel capital expenditures, and diversify their customer base in reaction to the Shuttle retirement and CxP transition. Some respondents cited a lack of direction from NASA, the White House, and Congress as the reason they have made no plans.
- The majority of respondents planning to modify their business plans or product lines were already making modifications. These modifications included reducing workforce, halting facility renovations and capital purchases, and reducing dependence on customer bases that are unstable, e.g. NASA. Many suppliers cited commercial and military markets as possible customer alternatives.
- Only 20 percent of respondents indicated they participated in commercial, non-NASA HSF programs at the time of the survey. Some of the 80 percent that did not participate said they either made unsuccessful bids or had difficulty identifying opportunities.

Seventy-six percent of NASA-dependent respondents indicated they were not part of the commercial HSF supply chain. In contrast, 54 percent of total respondents and 69 percent of NASA-dependent respondents said they intended to participate in commercial, non-NASA HSF programs in the future.

- Sixteen percent or 86 NASA HSF suppliers stated that their business with other USG customers will be affected by the loss of Shuttle and CxP. Availability of products and services, program costs, workforce levels, and technology development were mentioned by respondents as areas that will be impacted. The Missile Defense Agency, the U.S. Army Space and Missile Defense Command, and the U.S. Air Force Space and Missile Systems Center, were as the most affected USG agencies.
- There is some compatibility between NASA-related products sold by respondents and non-NASA customers. Forty percent of respondents indicated their NASA-related products were nearly 100 percent compatible with non-NASA customers, and an additional 14 percent of companies noted having more than 50 percent compatibility. Conversely, 27 percent of respondents said their products had between 50 percent and zero percent compatibility with non-NASA customers. The remaining 19 percent of respondents were not sure about the compatibility of their NASA-related products.
- Of the 150 survey respondents that identified themselves as dependent on NASA, 31 percent indicated that their NASA-related products were nearly 100 percent compatible with non-NASA customers, with an additional 27 percent of companies having more than 50 percent compatibility. In contrast, 26 percent of NASA-dependent companies said they had between 50 and zero percent compatibility. The remaining 16 percent of NASA-dependent survey respondents were not sure about the compatibility of their NASA-related products.
- The vast majority of respondents received no guidance from either NASA or prime contractors on how to best respond to the Shuttle retirement and CxP transition.
- Most respondents are not interacting with regional, state, local, or non-profit economic development agencies/organizations to address the post-Shuttle, post-CxP environment. Many respondents were not aware of such agencies and organizations.

- The majority of respondents are willing to support future NASA HSF programs. Many stated they desired to continue working with NASA not just for the contracts, but for the personal fulfillment and national pride of working on HSF programs.
- Some survey respondents anticipate shifting away from the Aerospace and Defense market segments, while other respondents anticipate moving into the growing Healthcare and Energy market segments.
- The largest percent of respondents have taken and were planning to take action in modifying Capability/PP&E Investment and introducing Cost Reductions/Efficiency in order to improve competitiveness.
- Respondents indicated that Domestic Competition, Variability of Demand, and Foreign Competition were the three main issues affecting long-term industry viability. NASA-dependent companies identified Skills Retention rather than Foreign Competition as the third top issue.
- Respondents cited Export Control Reform and Tax Reform as the top two policy/regulatory issues for the USG to address in order to enhance the industry's competitiveness.

Chapter X: Supply Chain Dependency on NASA:

- Of the 536 total respondents, 150 NASA HSF suppliers representing all tiers identified themselves as dependent on NASA to maintain their core production, workforce, and technical capabilities and overall financial viability.
- Forty-six of the 150 NASA-dependent suppliers reported negative net profit margins for at least one year from 2007-2010, with some operating at a loss over multiple years.
- An additional 16 respondents did not identify themselves as dependent on NASA, but derived 25 percent or more of their total sales from sales to NASA and/or from sales to specific NASA programs.
- NASA-dependent companies operated in 14 of the 17 primary business lines, with Manufacturing, Professional Services, R&D, and Distribution as the most represented categories. Eighteen of the 27 survey respondents that identified their primary business line as R&D also identified themselves as dependent on NASA.

- NASA-dependent companies supported all three NASA HSF programs: 121 supported the Shuttle, 110 supported CxP, and 88 supported ISS.
- Sales to NASA as a percentage of aggregate sales were between 28-30 percent for NASA-dependent companies, as compared to six percent for non-NASA dependent companies. These percentages do not reflect the full impact of the Shuttle retirement and CxP transition, which occurred after the survey period.
- In general, suppliers that identified themselves as NASA-dependent had higher levels of excess production capacity than suppliers that were not dependent on NASA.
- The average current ratios, the ability to cover short-term liabilities, of NASA-dependent companies over the period were lower than those of companies that were not dependent on NASA, meaning they were less able to cover liabilities.
- NASA-dependent companies were slightly more likely than non-NASA dependent companies to be highly leveraged, or higher level of debt used to purchase assets.
- A significant portion of NASA-dependent suppliers anticipated increased total sales from 2011-2015. A large number of these companies were highly uncertain about how future NASA decisions would affect NASA-related sales. The majority of NASA-dependent respondents are unsure about their future NASA and ISS sales.
- The majority of NASA-dependent suppliers reporting negative net profit margins were Corporate/Whole Company level respondents, as compared to Business Unit/Division level respondents.
- The 150 NASA-dependent respondents participated in all 18 product and service categories, with Services, Spacecraft, and Propulsion Systems as the top three identified categories. A review of three- and four-digit product and service categories illustrated that NASA-dependent companies accounted for 62-100 percent of suppliers in various categories.
- Many NASA-dependent companies were reducing staff and diversifying to new business lines to counter loss of Shuttle- and CxP-related business. However, NASA's lack of direction, funding, and overall strategy were making it difficult for companies to preserve NASA HSF-related capabilities and skills.

Select Study Conclusions

While the report data, collected for the 2007-2010 period, ended before the full impact of the Shuttle retirement and CxP transition could be documented (Shuttle and CxP activity was still occurring in 2011), several conclusions can be drawn about the health of the NASA HSF supply chain and the potential implications of changes in NASA's HSF programs on the survey respondents.[8]

Overall State of NASA HSF Survey Respondents

The majority of NASA HSF survey respondents, 370 of 536, will not be negatively impacted by the Shuttle retirement and CxP transition. However, there are potential impacts on future NASA HSF programs through a loss of unique skills, capabilities, products, and services resident at these companies. Therefore, all providers of products and services that are deemed important for future HASA HSF missions should be reviewed, regardless of the company's financial health.

Of more immediate concern are the 150 NASA HSF companies that identified themselves as dependent on NASA and the additional 16 companies that proved to be dependent on NASA. These companies should be reviewed to determine the importance of their unique products and services, prioritized in three subsets: the 46 NASA-dependent companies operating at a loss; whole companies dependent on NASA; and the divisions and business units of larger corporations that make up the remaining NASA-dependent survey respondents.

As an alternative to a well-articulated short- to medium-term vision and strategic plan with the requisite funding for a broad-based HSF program, NASA could be more proactive in sustaining the varied portions of the HSF supply chain that would be the most difficult to reconstitute. Ongoing efforts to develop a deep-space capsule and heavy-lift rocket capability are important first steps, and should be viewed as the building blocks to spur the larger HSF supply chain.

[8] In-depth conclusions are discussed in Chapter XI.

Opportunities for Future NASA Action

While many NASA HSF respondents indicated they are trying or plan to try to shift into other, non-NASA space-related business areas to compensate for lost Shuttle and CxP business, there are barriers to entering other industries. Additionally, the majority of survey respondents believe there are too many space-related competitors, which pose a challenge to their future viability. This indicates an opportunity for NASA to get more involved in issues related to the sustainability of its HSF supply chain. The survey indicated several opportunities for NASA action, including:

- Increasing communication and outreach with the HSF supply chain;
- Coordinating efforts with regional, state, local, educational, and non-profit organizations and institutions;
- Working with other U.S. Government agencies to address interdependency issues, find commonalities, and leverage mutual interests to support the industrial base; and
- Directing more Federal Government R&D funds to lower tiers, and diversifying the number of companies conducting NASA-related R&D.

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Survey respondents, as well as NASA HSF companies interviewed during field visits, overwhelmingly expressed their willingness to participate in future NASA HSF programs. For many, it is not entirely a money-making exercise, but rather a point of national pride and enthusiasm to work on space missions, something which has not been identified in other OTE assessments of the U.S. industrial base. However, this corporate goodwill is not boundless, and will only go so far toward maintaining the vital elements of the HSF supply chain. NASA, in conjunction with other federal and state organizations, should consider rapid action to ensure a robust industrial supply chain and workforce will be there when needed for the next great U.S. milestone into space.

II. Company Profile of Survey Respondents

A. Survey Respondents and NASA Programs Supported

OTE received 536 completed surveys from companies that support NASA's human space flight (HSF) programs – the Space Shuttle program (Shuttle), the Constellation program (CxP), and the International Space Station (ISS). To better understand NASA's supply chain for these three programs, OTE categorized survey respondents as Tier 1, Tier 2, and Tier 3 companies based on declared 2009 total sales (see Figure II-1).[9] Tier 3 companies, identified as companies with total sales of less than $25 million, were 52 percent of surveyed NASA HSF suppliers and had a median employment level of 28 workers. Tier 2 companies represented 29 percent of the supply chain and had a median employment level of 238 workers, while Tier 1 companies represented 19 percent and had a median employment level of 1,460 workers.

Figure II-1: Survey Respondents by Tier

Tier	Total Sales Range (2009)	Number of Companies	Median U.S. Employees (2009)
1	> $200 Million	101	1,460
2	$25 – 200 Million	155	238
3	< $25 Million	280	28
Total		536	-

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Survey respondents were asked to identify the particular NASA HSF programs, NASA directorates, and other NASA activities they have supported since 2000. The largest segment, 57 percent indicated that they supported the Shuttle, with 14 percent of those respondents only selecting the Shuttle (see Figure II-2). This was followed by 35 percent of survey respondents that selected CxP. Overall, 87 percent of survey respondents had participated in at least one of NASA's HSF programs. Thirteen percent of survey respondents did not know the NASA program they supported, even though NASA had documentation indicating their program

[9] Total sales figures include NASA and non-NASA sales. Some companies provided Corporate Level/Whole Company sales figures, while other companies provided Business Unit/Division sales figures.

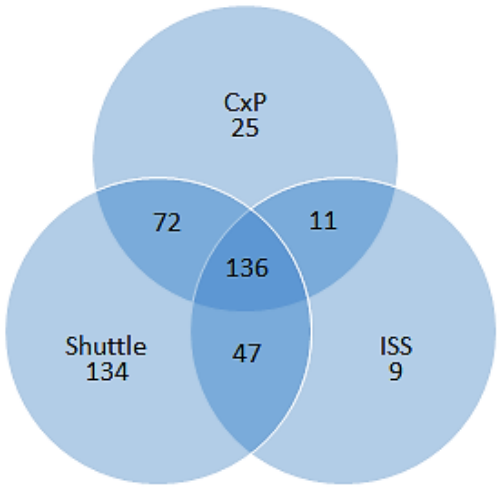
participation. This is likely because many of these companies sold their product and/or service to a third-party instead of directly to NASA.

Figure II-2: Company Participation in NASA Programs*	
Space Shuttle	57%
Constellation	35%
International Space Station	30%
Aeronautics Research Directorate (ARD)	5%
Science Mission Directorate (SMD)	11%
Other NASA	50%
*13% of respondents (71 of 536) did not know program/directorate supported	

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

There are a significant number of survey respondents that reported supporting more than one NASA HSF program. Of the 536 survey respondents, approximately half reported that they supported two or more NASA HSF programs, and 136 companies indicated they supported Shuttle, CxP, and ISS (see Figure II-3).[10] There were 103 survey respondents that did not indicate that they supported one or more of the NASA HSF programs. This indicates that the three NASA HSF programs share a significant portion of the supply chain.

Table Figure II-3: NASA HSF Program Participation



*434 companies indicated supporting at least one NASA HSF program

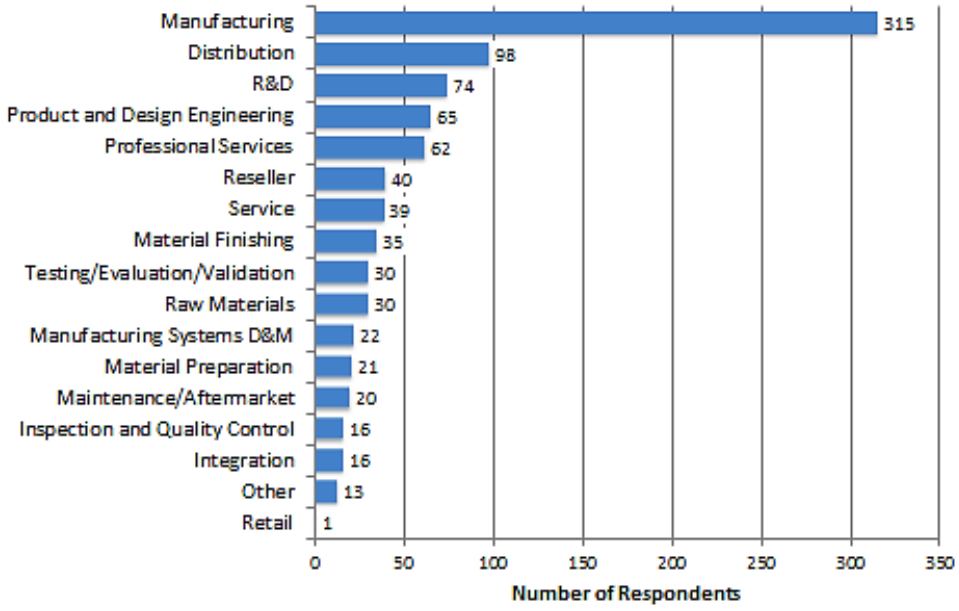
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[10] Survey respondent participation in NASA HSF programs was determined by examining companies that directly indicated program support, indicated they supported a part of a program, or listed program-specific sales.

B. Business Lines

To further profile the HSF supply chain, survey respondents were asked to identify and rank their company's three primary business lines based on total sales from a selection of 17 pre-identified business lines. The number of companies with a "manufacturing" business line far exceeded any other business line, with 315 out of 897 mentions; it accounted for 50 percent of respondent's top-ranked business lines by total sales. "Distribution" was the second most prevalent business line with 98 mentions, but was only selected by 16 percent of respondents as their top-ranked business line. The top-ranked business lines differ slightly in rank from the overall mentions of respondent business lines, as illustrated in Figures II-4 and II-5. The breakout of top-ranked business lines was similar across Tier 1, Tier 2, and Tier 3.[11]

Figure II-4: Respondent Primary Business Lines by Total Sales



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[11] See Appendix A for a breakout of top-ranked business lines by tier.

Figure II-5: Top-Ranked Business Lines	
Business Line	% of 536 Companies
Manufacturing	50%
Distribution	16%
Professional Services	7%
R&D	5%
Service	4%
Raw Materials	4%
Reseller	3%
Material Finishing	3%
Product and Design Engineering	3%
Manufacturing Systems D&M	2%
Material Preparation	1%
Testing/Evaluation/Validation	1%
Inspection and Quality Control	1%
Maintenance/Aftermarket	1%
Integration	0.2%
Retail	0.2%

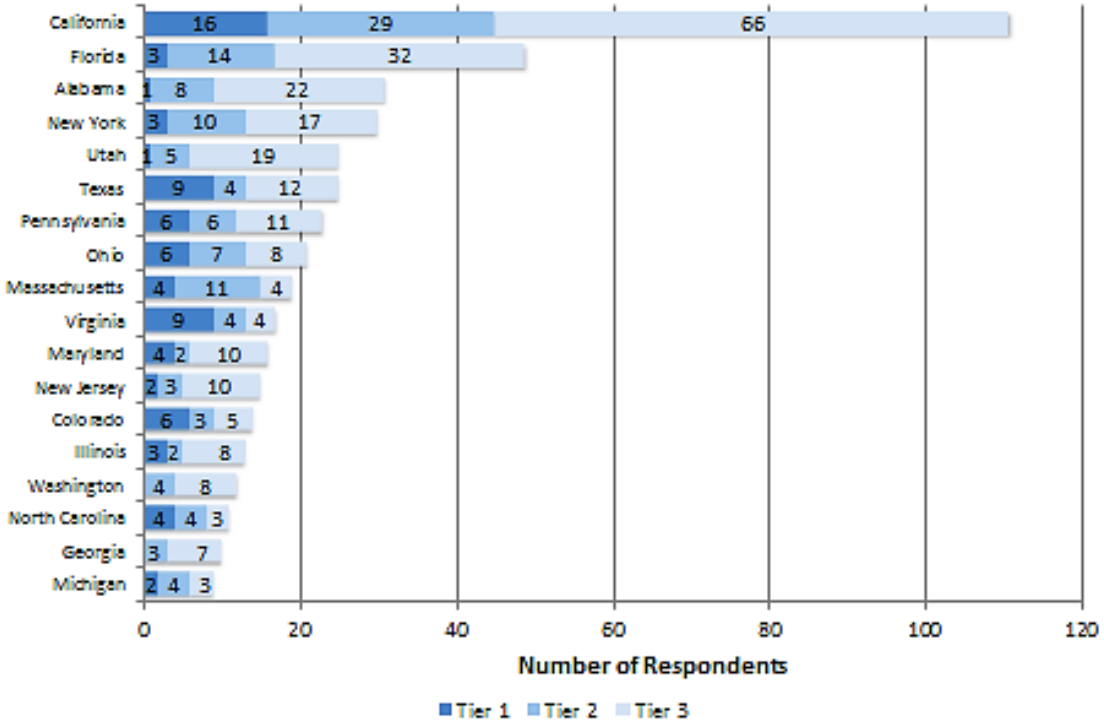
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

C. Company Locations

Overall, 96 percent of survey respondents or 514 companies were headquartered in the United States. These companies operated in 40 states, the District of Columbia, and Puerto Rico. While many NASA activities occur in Florida and Texas, California contained the most survey respondents with 21 percent (see Figure II-6).[12] When evaluated by tier, 16 percent of Tier 1 suppliers, 19 percent of Tier 2 suppliers, and 24 percent of all Tier 3 suppliers were located in California. Florida, with nine percent of respondents, had the second most NASA HSF suppliers.

[12] The Other category includes the following states: New Hampshire, Connecticut, Wisconsin, Minnesota, South Carolina, Arizona, Missouri, Arkansas, Rhode Island, Oregon, Idaho, New Mexico, West Virginia, Tennessee, Mississippi, Louisiana, Iowa, and Oklahoma. It also includes the District of Columbia, and Puerto Rico.

Figure II-6: Top U.S. Headquarter Locations of 536 Survey Respondents

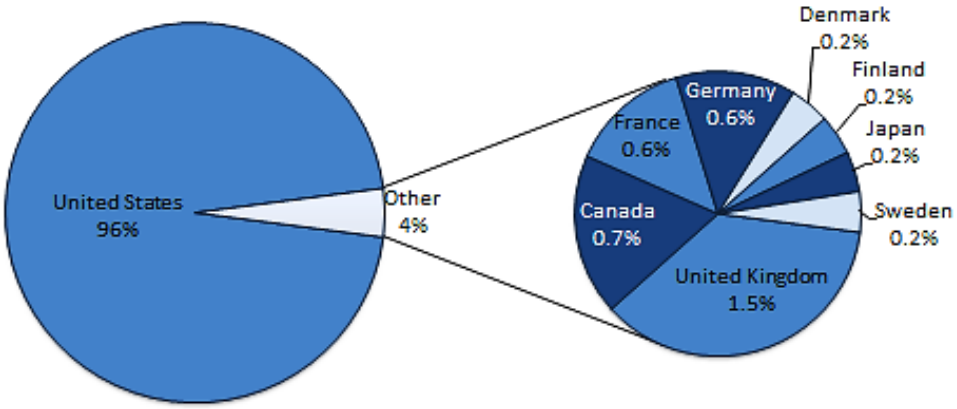


Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The remaining four percent of survey respondents or 22 companies were headquartered outside of the United States, with the leading countries being the United Kingdom, Canada, France, and Germany (see Figure II-7). Tier 2 had the largest number of companies with non-U.S. headquarters.[13]

[13] See Appendix A for a breakdown of non-U.S. headquarters by tier.

Figure II-7: Company Headquarters by Country



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

D. Company Certifications and Supply Chain Management Practices

In general, NASA officials are familiar with the professional, industry, and standards certifications held by Tier 1 and some Tier 2 companies. Survey respondents were asked to identify their certifications in order to enhance NASA's knowledge of the quantity and diversity of certifications held by companies across all tiers of the supply chain.[14] Seventy-five percent of NASA HSF respondents have at least one certification, and 19 percent have four or more.

The International Organization for Standardization (ISO) 9001 was the leading mention with 65 percent of survey respondents holding this certificate (see Figure II-8). SAE AS9100, an aerospace quality assurance management standard, had the second most mentions with 34 percent of respondents. It is important to note that, overall, 62 percent of Tier 3 respondents maintain at least one certification, indicating that there are small companies in the lower tiers that have some of the same certifications as larger companies in the higher tiers.[15]

[14] Survey respondents were provided with a pre-populated list of 17 certifications. A full listing of certification descriptions can be found in Appendix B, and a breakout of the "NADCAP," "AMS", "NCLS," and "Other" certifications can be found in Appendix A.
[15] Personnel-specific qualifications/certifications are discussed in Chapter V.

Figure II-8: Professional, Industry, and Standards Certifications				
Certification	Tier 1 (101 Companies)	Tier 2 (155 Companies)	Tier 3 (280 Companies)	Total
ISO 9001	86%	82%	48%	65%
SAE AS9100	48%	45%	23%	34%
ISO 14000	30%	18%	4%	13%
NADCAP	21%	14%	7%	12%
ISO 9000	22%	12%	5%	10%
MIL-STD-45662 A	10%	15%	8%	10%
J-STD-001DS	13%	13%	3%	8%
MIL-Q-9858	10%	11%	5%	8%
ANSI/ASQC Z1.4	6%	11%	5%	6%
ANSI/ISO/IEC 17025	12%	10%	3%	6%
AMS	8%	8%	3%	5%
ANSI/ESD S20.20	11%	5%	2%	4%
ISO 10012-1	5%	7%	1%	4%
ISO TS16948	6%	5%	4%	3%
SAE AS9003	2%	5%	1%	2%
DoD 5000	3%	2%	0.4%	1%
NCLS	3%	2%	0.4%	1%
Other	26%	24%	13%	18%

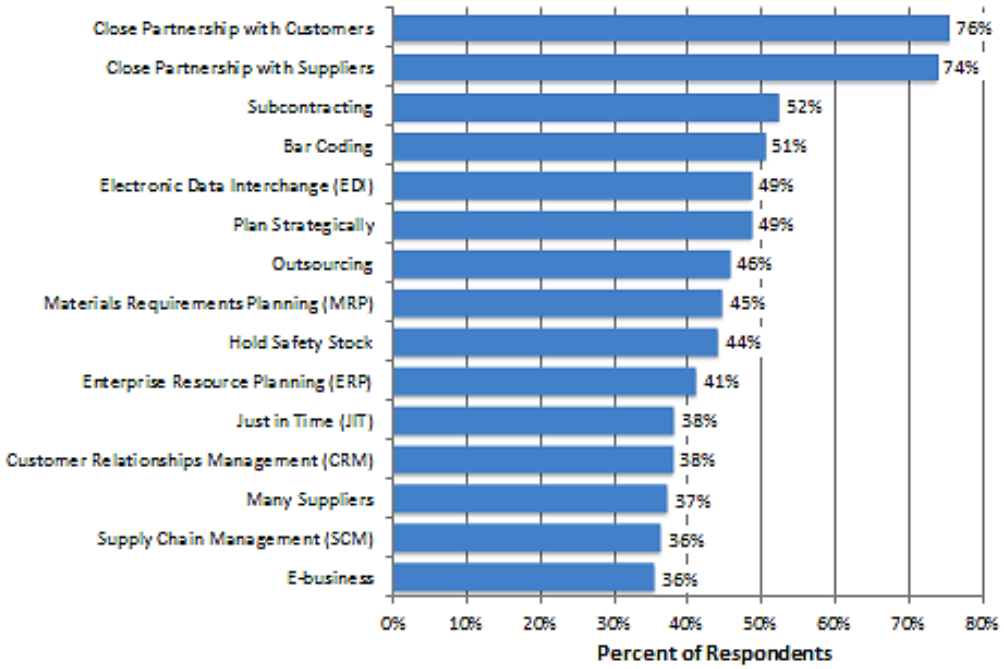
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

For current and future HSF programs, NASA was interested in learning about the practices, methodologies, and systems used by companies to manage their supply chains, particularly in the lower tiers. Survey respondents were provided with a list of 31 supply chain management practices, as well as the opportunity to identify additional practices not captured.[16]

More than 70 percent of NASA HSF suppliers identified "close partnerships with customers" and "close partnerships with suppliers" as supply chain management practices (see Figure II-9). Additionally, over half of survey respondents used "subcontracting" and "bar coding" in maintaining supply chains, and 46 percent of respondents used "outsourcing" of their supply chains. In contrast, 27 percent of companies use "Radio Frequency Identification (RFID)" or "Third Party Logistics (TPL)", while only seven percent of respondents use "network centric manufacturing."[17]

[16] A full list of supply chain management practices can be found in the OTE survey in Appendix E.
[17] See Appendix A for a breakdown of supply chain management practices, methodologies, and systems by tier.

Figure II-9: Leading Supply Chain Management Practices, Methodologies, and Systems



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

E. Method of Sale to NASA

Survey respondents were asked to identify the method by which they sell their products or services to NASA. A small percentage of NASA HSF suppliers (14 percent) sell directly to NASA. Most of the companies (43 percent) sold both directly and indirectly (see Figure II-10). Tier 1 reported the largest percentage of suppliers that sold both directly and indirectly to NASA (52 percent), while Tier 2 and Tier 3 reported larger percentages of indirect/third-party sales than Tier 1 companies. Ten percent of survey respondents did not know how their products and services were eventually sold to NASA.

Figure II-10: Method of Sale to NASA

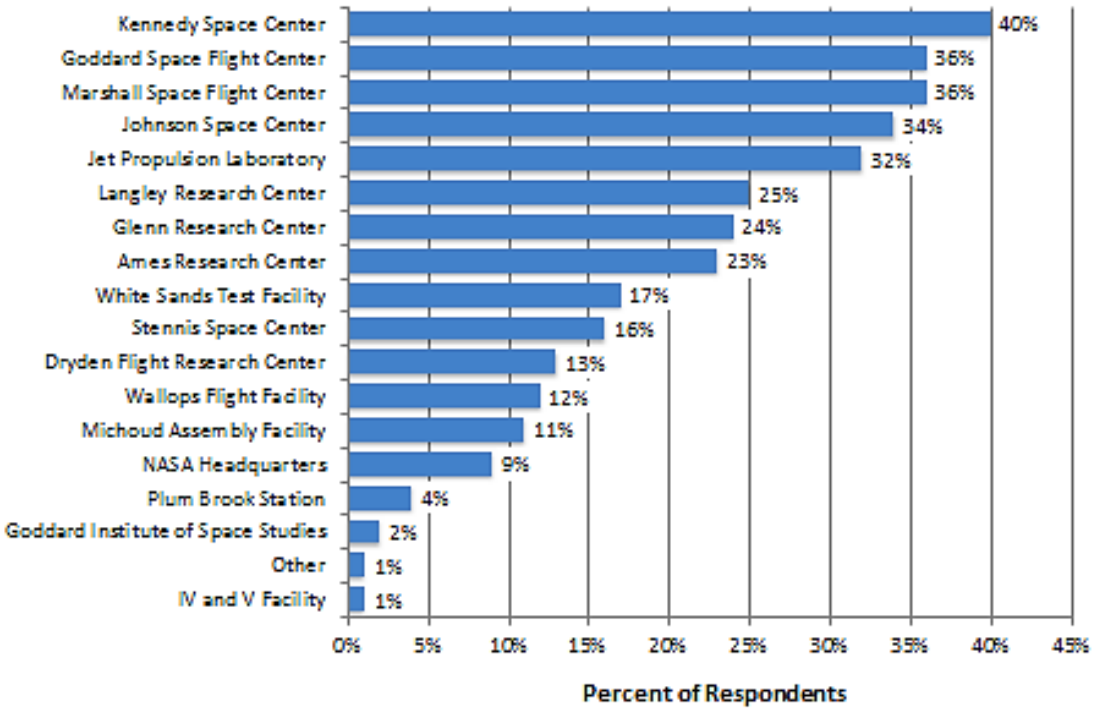
Method	Tier 1 (101 Companies)	Tier 2 (155 Companies)	Tier 3 (280 Companies)	Total
Direct to NASA	15%	13%	14%	14%
Both Direct and Indirect	52%	42%	40%	43%
Indirect/Third-Party	21%	35%	36%	33%
Not Sure	12%	10%	10%	10%

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

F. NASA Customers

OTE asked survey respondents to identify the NASA facilities, centers, and/or laboratories which they have served in any production or service capacity since 2007; 411 companies indicated they supported at least one NASA customer. Kennedy Space Center was the most widely supported facility, with 40 percent of NASA HSF suppliers identifying that location (see Figure II-11). Goddard Space Flight Center, Marshall Space Flight Center, Johnson Space Center, and the Jet Propulsion Laboratory were supported by roughly the same percentage of companies (ranging between 32-36 percent each). These leading NASA customers remained consistent from Tier 1 to Tier 3.[18] Overall, 145 survey respondents noted that they supported five or more NASA locations, and 44 respondents supported 10 or more NASA locations.

Figure II-11: Survey Respondents Supporting NASA Customers



*Based on 536 survey respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

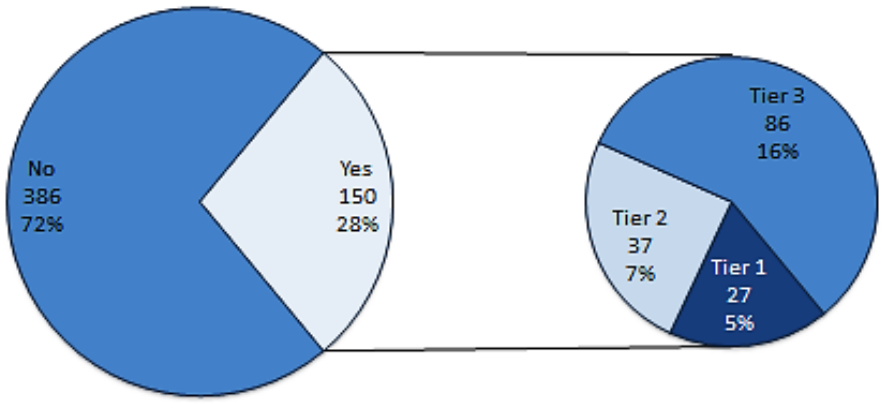
[18] See Appendix A for a breakdown of respondents supporting NASA customers by tier.

G. Dependency on NASA-Related Business

Survey respondents were asked to identify if they were dependent on NASA-related business and to explain their answer. OTE did not provide a definition of dependency due to the diverse makeup and characteristics of the HSF respondents. In their responses, suppliers said they determined dependency a number of ways, including by the percentage of their total sales to NASA, number of employees dedicated to NASA projects, dependency on NASA-related technology, and the focus of their corporate/division/unit business model.

Overall, 28 percent or 150 of respondents said they were dependent on NASA-related business (see Figure II-12). From a tier perspective, Tier 3 had the largest number of companies dependent on NASA-related business, 86, followed by 37 Tier 2 and 27 Tier 1 companies. Chapter X provides further analysis and insight on these 150 NASA-dependent companies.

Figure II-12: Is Your Company Dependent on NASA-Related Business?



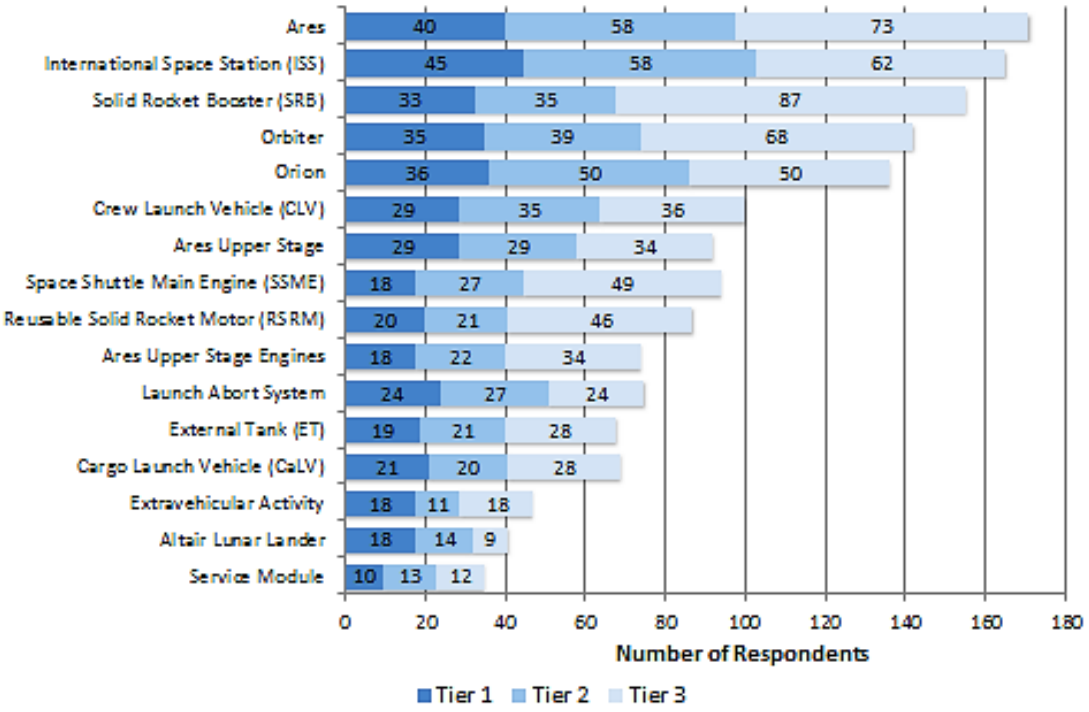
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

III. Products and Services

A. Participation in NASA HSF Program Elements

Survey respondents were asked to identify which of the 16 specific elements of the three human space flight (HSF) programs they supported – the Space Shuttle (Shuttle), Constellation (CxP), and the International Space Station (ISS). Of the 536 survey respondents, 87 percent were able to identify the specific NASA HSF program elements they supported. The majority of these companies were Tier 3 suppliers, consisting of almost 50 percent of total respondents. The Ares, ISS, and Solid Rocket Booster program elements were the predominant program elements supported by respondents, followed by Orbitor and Orion (see Figure III-1).

Figure III-1: Participation in Human Space Flight Program Elements



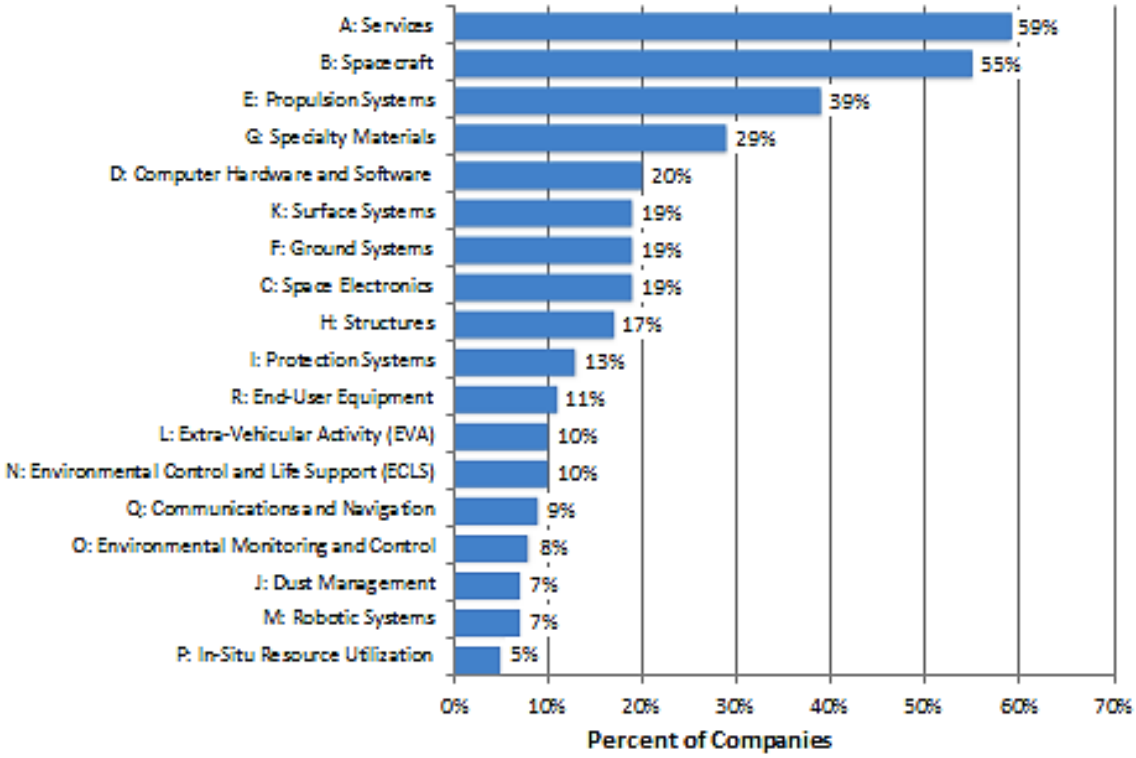
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

B. Product and Service List Breakdown

OTE provided a list of 18 product and service categories for NASA HSF suppliers, including Services, Propulsion Systems, Space Electronics, and Environmental Monitoring and Control

(see Figure III-2).[19] This list was included to determine the specific products and services supplied by respondents and to allow for segmentation of the different aspects of the supply chain. The 18 product and service categories from the Technical Element Detail (TED) list were broken down further into an additional 306 subcategories to provide further detail for analysis.[20] Additionally, survey respondents were asked if NASA, DOD, and/or commercial entities were the end-users for each product, service, and subcategory selected.

Figure III-2: Participation in 18 Product and Service Categories

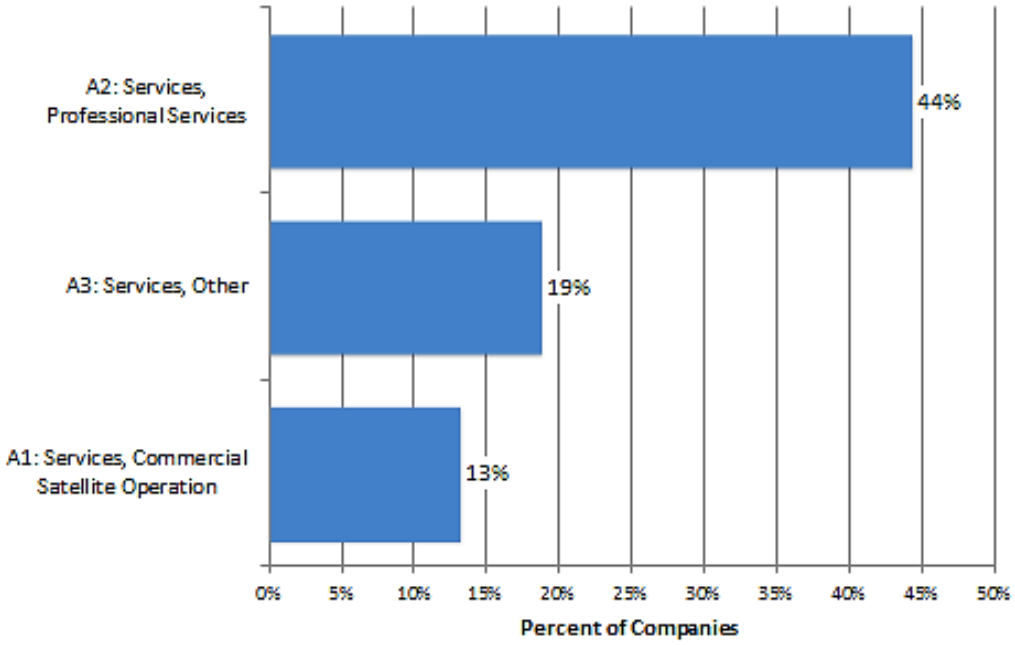


Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Approximately 60 percent of respondents selected the Services category, which included commercial satellite operation services, professional services, and other services (see Figure III-3). These subcategories were futher broken down to include systems engineering, product assurance, testing, and space medicine. NASA was the primary end-user identified of the Services category, followed by commercial and then DOD end-users.

[19] The complete list of products and services can be found in the OTE survey in Appendix E.
[20] Charts detailing the subcategory breakouts for each of the product and service categories can be found in Appendix A.

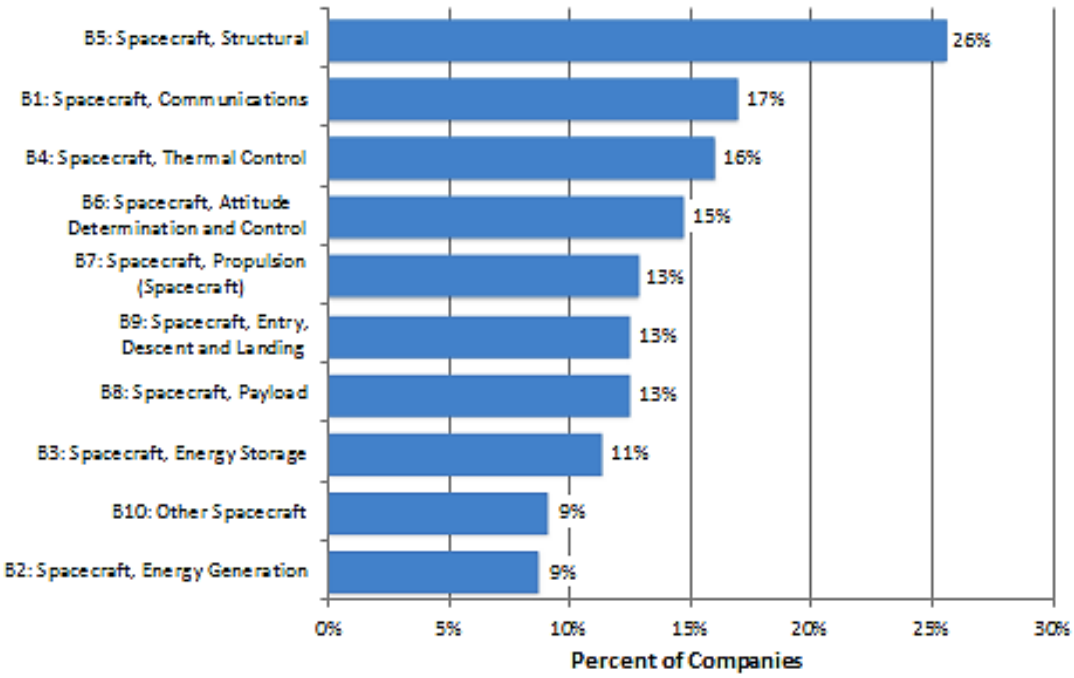
Figure III-3: Participation in Product and Service Categories: Services A.1-A.3



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The second most prominent product and service category selected was the Spacecraft category, with 55 percent of all survey respondents selecting items in this category. The Spacecraft category consisted of various subcategories, including communications, energy storage, thermal control, and payload (see Figure III-4). Products from this category were primarily sold to NASA and DOD customers, with slightly fewer commercial end-users.

Figure III-4: Participation in Product and Service Categories: Spacecraft B.1-B.10

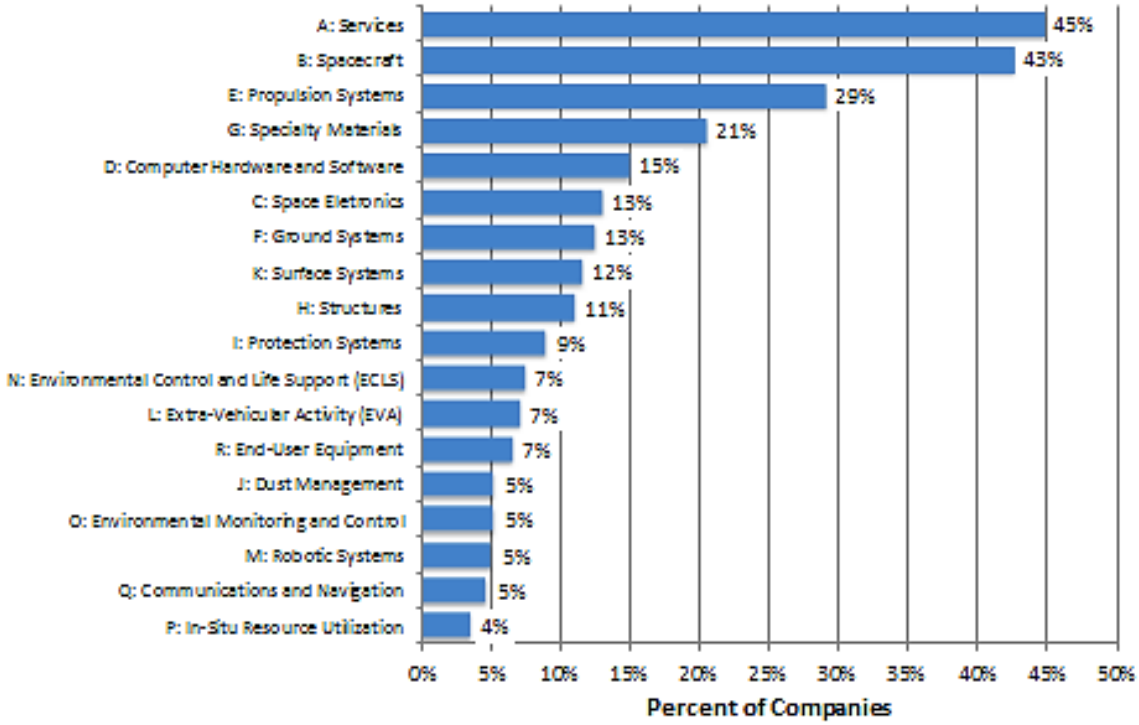


Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Overall, the leading product and service categories selected by NASA HSF suppliers for NASA end-users were Services, Spacecraft, and Propulsion Systems (see Figure III-5). These are the same three leading product and service categories NASA HSF suppliers sold to DOD and Commercial end-users.[21] Of note, Fifty-three percent of NASA HSF suppliers supported DOD end-users in at least one product and service category.

[21] Charts detailing the subcategory breakouts for each of the product and service categories sold to DOD and Commercial end-users can be found in Appendix A.

Figure III-5: Participation in Product and Service Categories for NASA End-Users



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

IV. NASA Supplier Sales

OTE asked survey respondents to report U.S. and non-U.S. sales information with breakouts for Government and Non-Government sales for 2007-2010, and to project sales in these areas for 2011-2015. Companies also provided NASA sales information, including data for human space flight (HSF) and non-HSF programs, and a percentage breakout for Space Shuttle (Shuttle), International Space Station (ISS), and Constellation (CxP) sales.[22] OTE then applied the tiering system explained in Chapter II to further analyze respondent data.

Of the 536 survey respondents, 188 companies declared their sales information at the Business Unit/Division level, while 348 HSF suppliers reported their sales data at the Corporate/Whole Company level.[23]

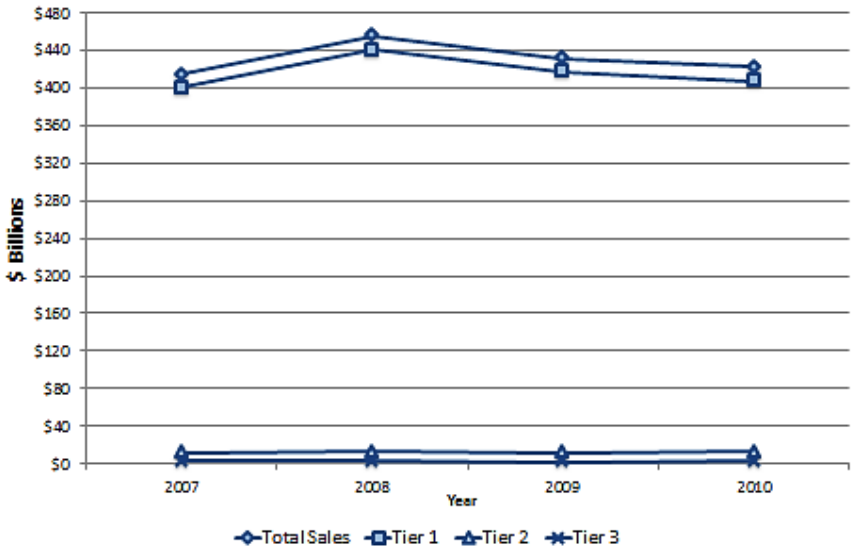
A. Total Company Sales Including NASA Sales

From 2007-2010, survey respondents conducted over $1.7 trillion in total sales (including a small percentage of NASA sales) reporting an average of $431 billion in sales annually. Sales peaked at $455 billion in 2008, falling five percent the following year. Revenues declined even further in 2010, approaching parity with 2007 levels (see Figure IV-1). Tier 1 sales constituted the vast majority of reported sales – $400-440 billion annually. Tier 2 sales were between $12 and $13 billion per year, while Tier 3 sales were approximately $2 billion per year.

[22] A number of survey respondents indicated they did not know the breakout of their sales because they either did not track sales by program, sold to someone who sold to NASA, or sold to NASA but did not know the specific programs in which their products and services were used.

[23] Respondent "Source of Sales Data" designations for Section 6.a sometimes differed from source designations reported in other questions. This was because NASA suppliers, in particular Tier 1 companies, reported their sales information on a NASA or space-affiliated enterprise basis but reported other data, such as their balance sheet data, at a Corporate/Whole Company level.

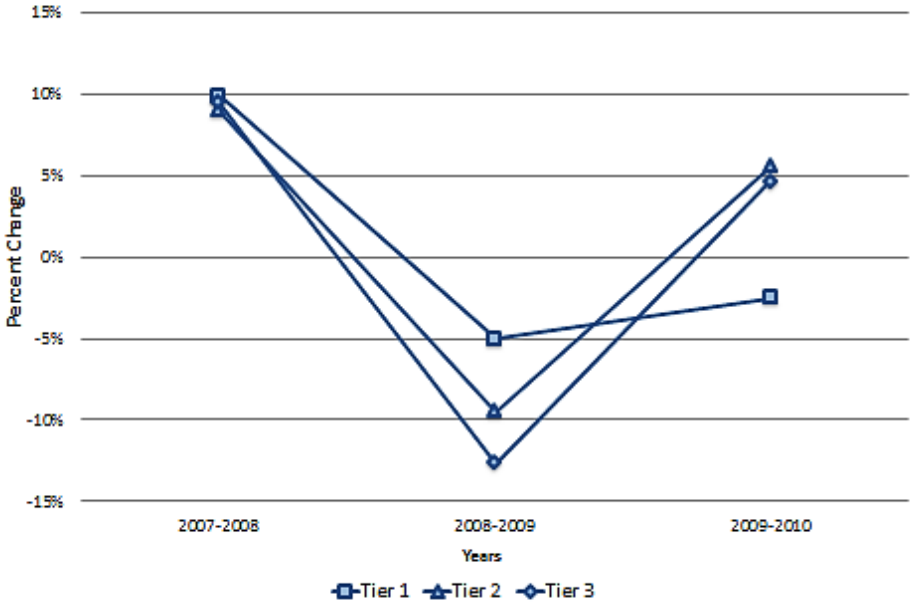
Figure IV-1: Total Sales, All Customers (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Looking at the year-to-year percent change, each tier experienced similar percentage growth in sales from 2007-2008 (see Figure IV-2). All tiers experienced decreases from 2008-2009, though Tier 1 respondent sales did not drop as much as those in Tiers 2 and 3. However, respondents in Tiers 2 and 3 had higher percent increases in sales from 2009 to 2010 than Tier 1 respondents. This is understandable, as Tier 2 and 3 companies have smaller sales numbers than Tier 1 companies, and therefore experience larger percent increases and decreases.

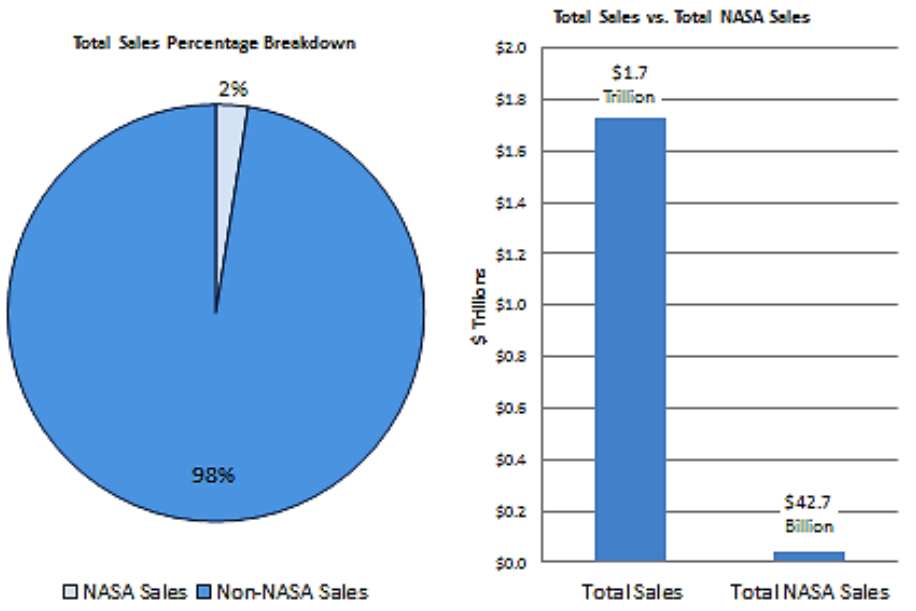
Figure IV-2: Tier Percent Change (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The 2008-2009 global recession and corresponding decreases in Non-Government demand were largely responsible for the drop in respondent aggregate sales data. Moreover, with NASA-related sales representing slightly more than two percent of the $1.7 trillion of combined sales over the 4-year period, it could be inferred that the Shuttle retirement and CxP transition had little impact on overall aggregate sales, at least through 2010 (see Figure IV-3). However, it is important to note that Tier 1 companies made up 96 percent of the aggregate sales, masking any impact the program terminations had on smaller companies in the lower tiers or on Tier 1 Business Units/Divisions dedicated to NASA programs, which make up 81 percent of survey respondents.

Figure IV-3: Total Sales vs. Total NASA Sales (2007-2010)



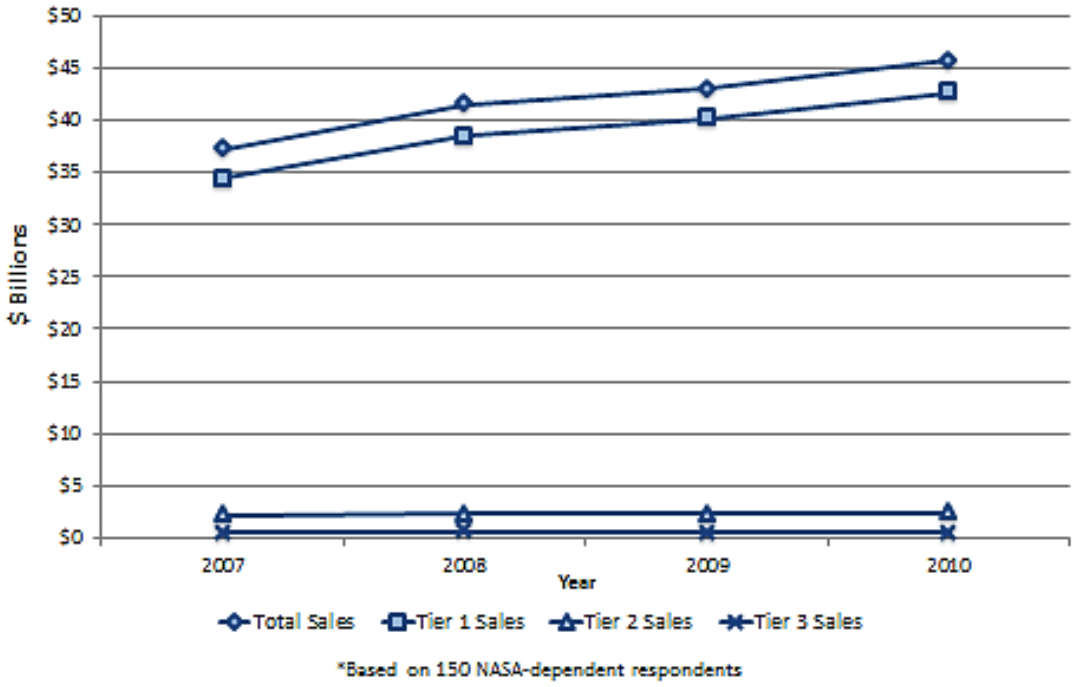
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The 150 survey respondents that identified themselves as dependent on NASA conducted over $167 billion in total sales from 2007-2010, reporting an average of $41 billion in sales annually.[24] Unlike the total survey sample, aggregate sales of NASA-dependent respondents did not decline after 2008 but continued to increase (see Figure IV-4). Tier 1 sales constituted the vast majority of reported sales for NASA-dependent respondents – $34-43 billion in sales

[24] See Chapter X for further discussion of NASA-dependent survey respondents.

annually. Tiers 2 and 3 sales were approximately $2.5 billion per year. NASA-dependent companies in all three tiers experienced a total sales increase over the four-year period.

Figure IV-4: Total Sales for NASA-Dependent Respondents, All Customers (2007-2010)



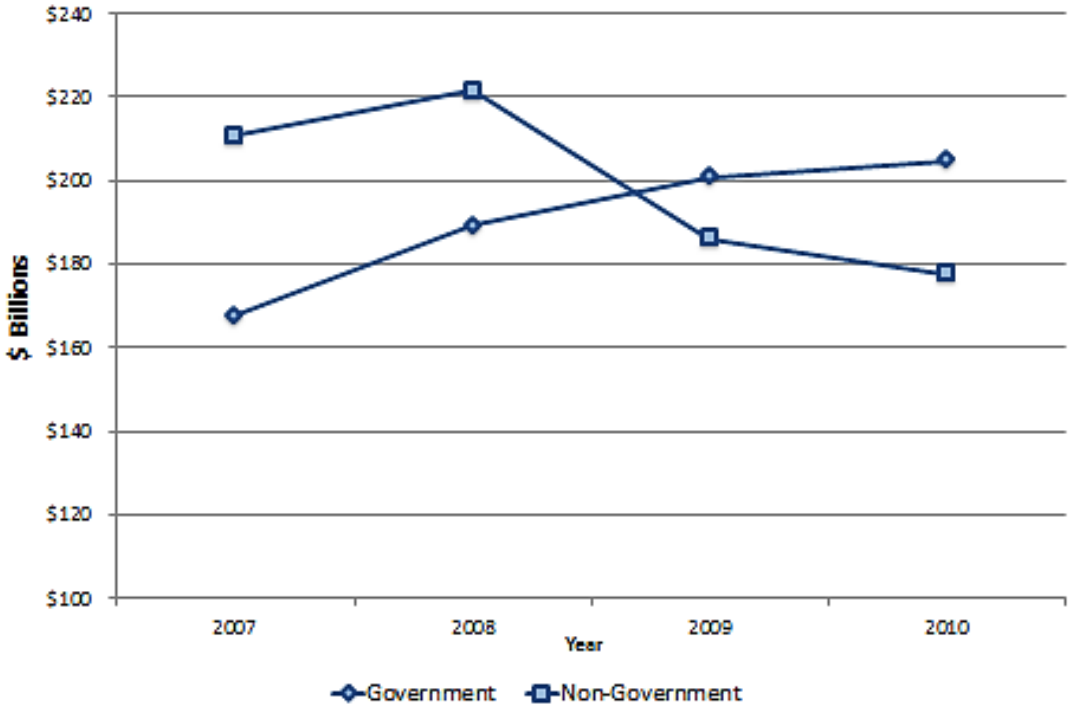
*Based on 150 NASA-dependent respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

B. Government/Non-Government Sales

Most NASA HSF suppliers sold to both Government and Non-Government customers. Before 2009, aggregate Non-Government sales surpassed Government sales by a margin greater than $30 billion. In 2009, aggregate Government sales eclipsed Non-Government sales, and the trend continued in 2010 when Government sales were approximately $20 billion higher. Sales to the Government rose 22 percent from 2007-2010, growing nearly seven percent on average each year, compared to the 16 percent decline in Non-Government sales over the period (See Figure IV-5).

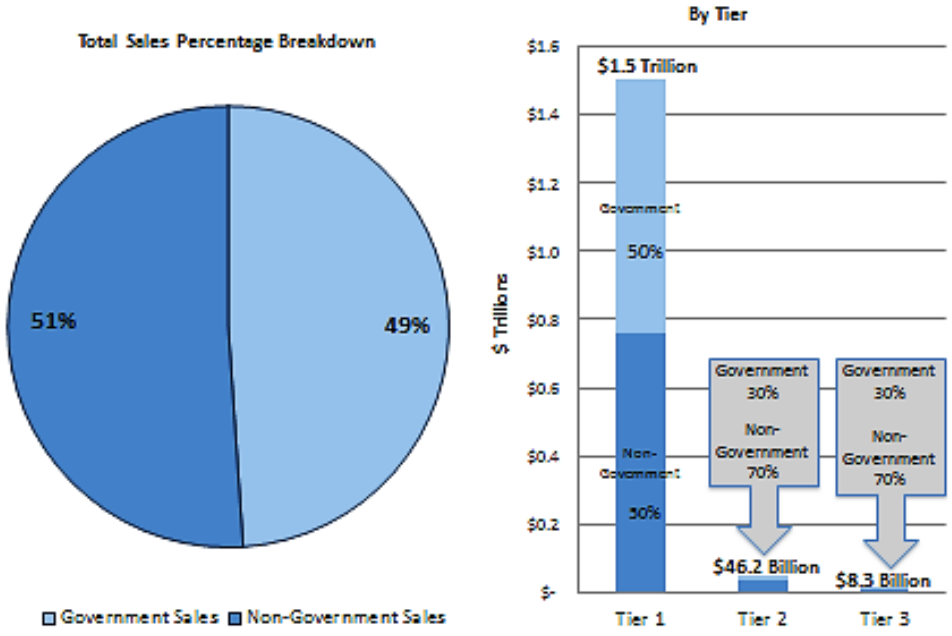
Figure IV-5: Government vs. Non-Government Sales (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

From a tier perspective, Tier 1 companies had an equal percentage of aggregate sales to Government and Non-Government entities from 2007-2010 (see Figure IV-6). Tier 2 and Tier 3 respondents, however, exhibited a greater reliance on Non-Government work, with only 30 percent of their aggregate sales attributed to Government customers. A portion of this reliance may be due to some companies not having enough visibility to report on Government sales.

Figure IV-6: Government vs. Non-Government Total Sales (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The reliance of Tier 2 and 3 suppliers on Non-Government customers helps to explain financial difficulties they may have faced during the recession and resulting viability concerns.[25] The rise of Government sales may have strengthened the financial position of Tier 1 NASA HSF suppliers in the wake of the recession. However, as the lower tiers do not perform much direct business for the public sector, at least when compared to Tier 1 proportions, the decline in Non-Government sales after 2008 placed downward pressure on their financial positions.

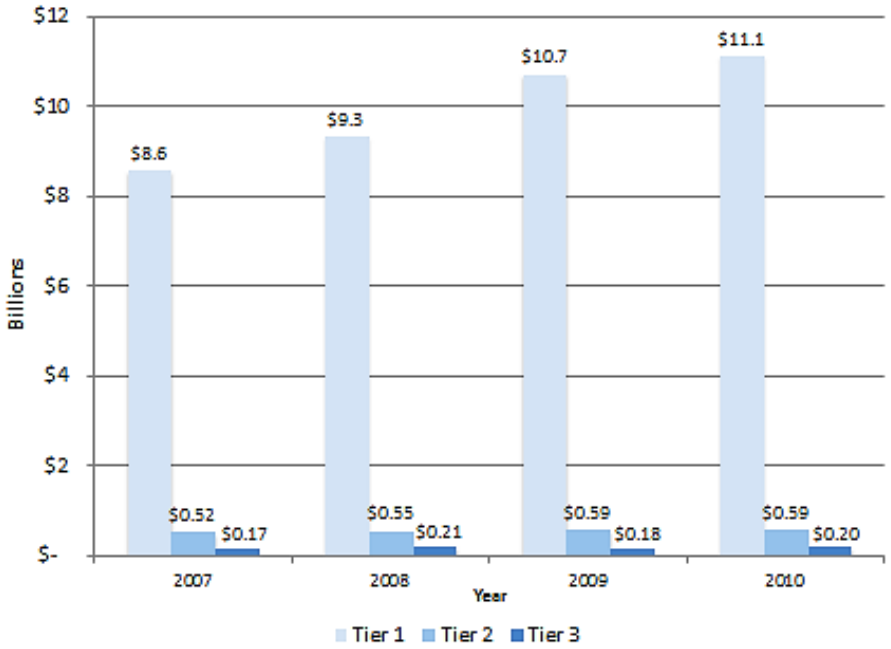
Projections for 2011-2015 sales highlighted survey respondent uncertainty about the future of the market. The majority of respondents said they either were "not sure" about their company's future sales trends, or anticipated "no change" for both Government and Non-Government sales in the U.S. and elsewhere over the five-year period.[26] However, survey respondents were more likely to anticipate an increase in both Government and Non-Government sales than to project a decrease in sales.

[25] A more detailed discussion of the financial difficulties faced by NASA-dependent survey respondents can be found in Chapter X.
[26] Graphs on survey respondent aggregate sales projections can be found in Appendix A.

C. NASA Sales

To help distinguish NASA-based revenues from those generated from other customers, OTE asked respondents to disclose their overall NASA sales for 2007-2010. During the period, aggregate NASA sales grew by 29 percent, from $9.2 billion in 2007 to $11.9 billion in 2010. The vast majority of NASA sales were attributed to Tier 1 survey respondents, who recorded a 30 percent increase during the period. Tier 1 companies also exhibited the most growth in NASA business over the four-year period when compared to Tiers 2 and 3 (see Figure IV-7). Nevertheless, Tiers 2 and 3 exhibited double digit growth.

Figure IV-7: NASA Sales by Tier (2007-2010)



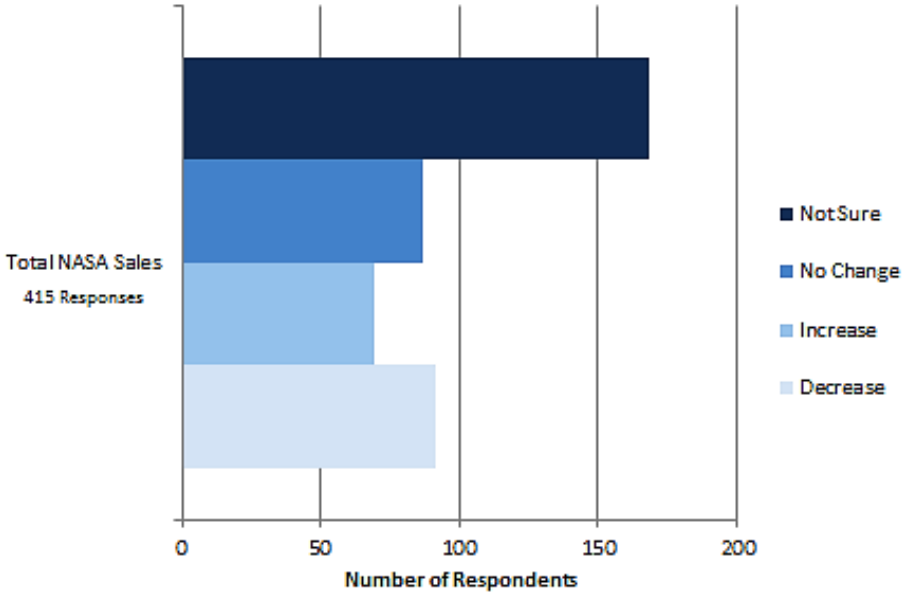
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Sixteen survey respondents derived 90 percent or more of their total sales from NASA in at least one year from 2007-2010; six respondents derived 90 percent or more of their total sales from NASA in all four years. These companies represented all tiers, though most of these respondents were Tier 3 companies. In addition, four of these 16 companies did not identify themselves as dependent on NASA-related sales.

Despite the growth in NASA sales since 2007, companies expressed uncertainty regarding NASA sales for 2011-2015. Of the 415 respondents that projected NASA sales, 40 percent were

"Not Sure" about their future NASA sales trends (see Figure IV-8). This lack of certainty, combined with the 91 companies who anticipated a "Decrease," indicates a significant portion of NASA HSF suppliers, 259 or 62 percent of the 415 responses, are not confident about their future NASA-related business. The CxP transition and the lack of a definitive plan for HSF likely contributed to their uncertainty.

Figure IV-8: Future NASA Sales Projection (2011-2015)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

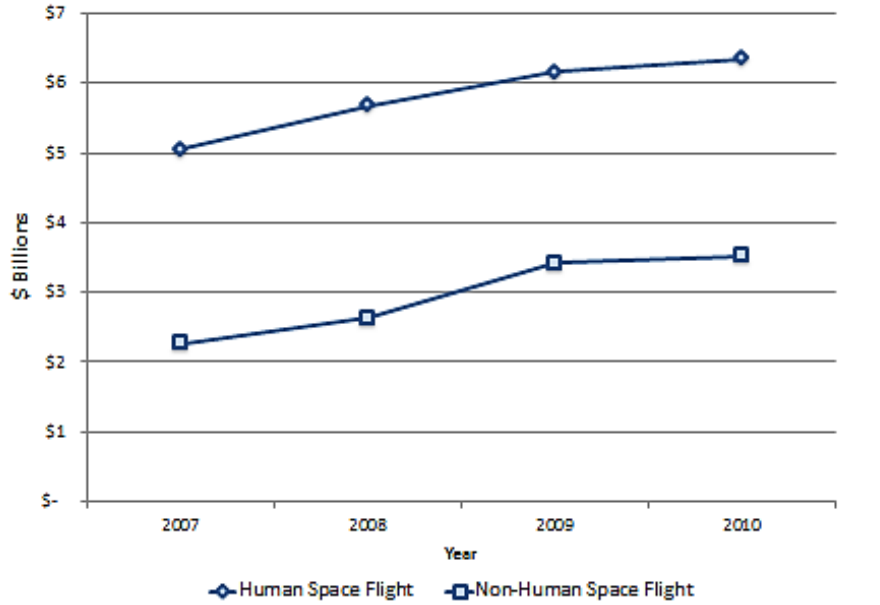
D. HSF Sales - Shuttle, ISS, and CxP

Survey respondents were asked to report their NASA-affiliated HSF and non-HSF sales in 2007-2010. They also submitted details of their program-specific HSF sales, including break-outs of their Shuttle, CxP, and ISS sales.[27]

Overall, survey respondents had a larger amount of HSF program sales than non-HSF program sales (see Figure IV-9). Aggregate HSF sales represented 66 percent of total NASA sales, $23.2 billion of $35.1 billion, in 2007-2010. Following the trend of respondents' Government sales, both NASA HSF and non-HSF program sales increased in the period, at 26 percent and 55 percent, respectively.

[27] Respondents were selected to participate in the survey based on previous sales to NASA HSF programs.

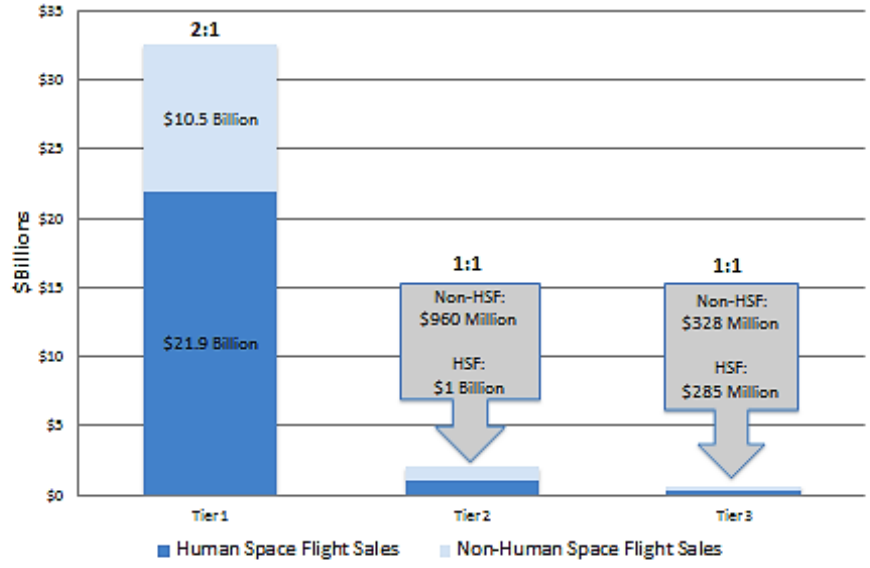
Figure IV-9: NASA Human and Non-Human Space Flight Sales (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

During the period, Tier 1 NASA HSF suppliers sold $21.9 billion in products and services for HSF programs and $10.5 billion for non-HSF programs, representing roughly a 2:1 proportional relationship (see Figure IV-10). For Tier 2 and Tier 3 suppliers, the sales ratios were closer to 1:1.

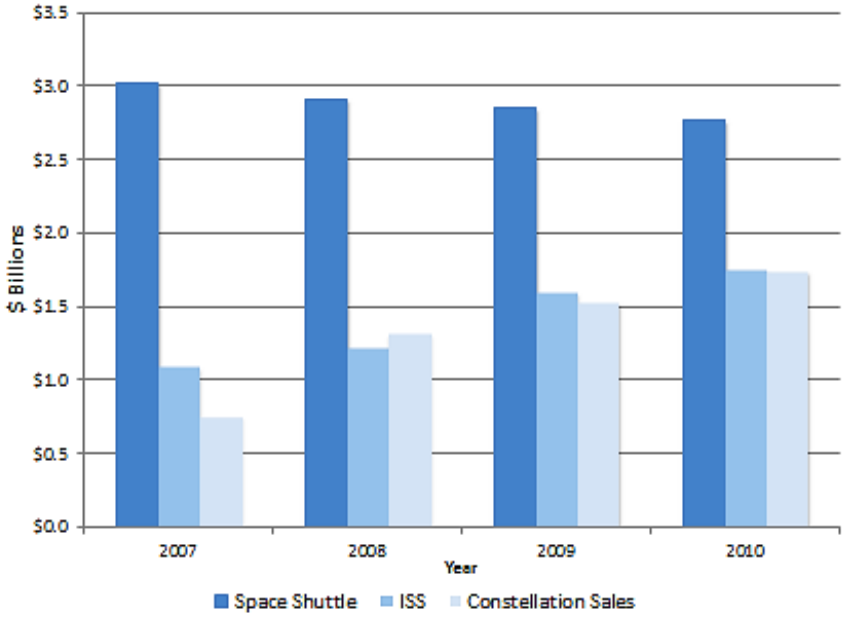
Figure IV-10: NASA Human to Non-Human Space Flight Sales by Tier (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Of the $22.6 billion reported in specific HSF-program sales by all tiers, 51 percent was Shuttle-related, while ISS and CxP represented 25 percent and 24 percent, respectively.[28] In the aggregate, respondent HSF sales increased over the period largely due to rising sales from CxP and ISS program business. CxP and ISS sales increased by 134 and 62 percent, respectively, while Shuttle sales decreased by eight percent over the period.[29] For many HSF respondents, sales of CxP and ISS-related products and services helped reduce, at least temporarily, the deleterious effects of the planned Shuttle retirement (see Figure IV-11).

Figure IV-11: Space Shuttle, ISS, and Constellation Sales (2007-2010)

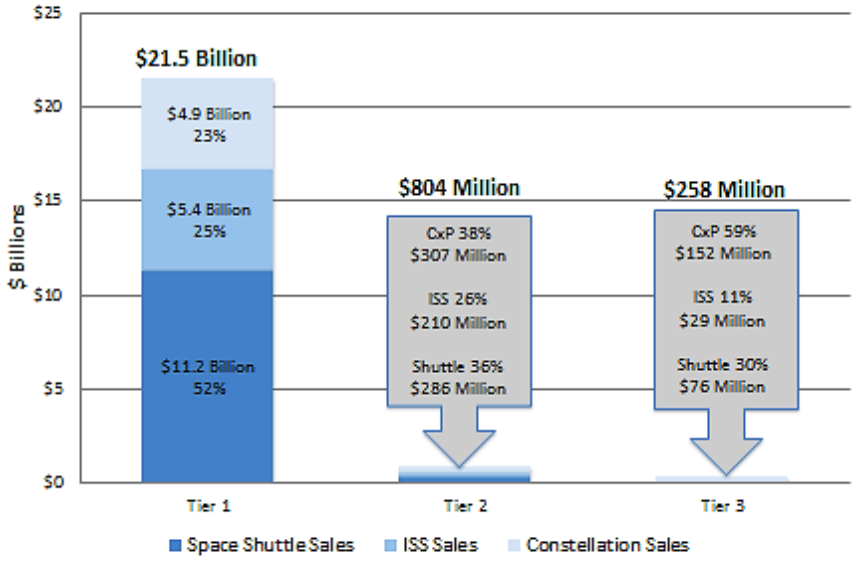


Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Based on their aggregate HSF sales in the period, Tier 1 NASA HSF suppliers were more oriented towards Shuttle-based business than ISS or CxP. Tier 1 companies recorded 52 percent of their HSF sales as Shuttle-affiliated, while ISS and CxP program-based sales accounted for 25 percent and 23 percent, respectively (See Figure IV-12). Sales of Tier 2 and Tier 3 respondents did not exhibit the same proportions. Tier 2 HSF program sales were nearly equally distributed among the three programs, while Tier 3 HSF sales were more heavily drawn from CxP business (59 percent of aggregate period HSF derived revenues) than either ISS or Shuttle business.

[28] It is important to note that there is a $600 million gap between the reported specific HSF-program sales and the reported overall NASA HSF sales. This gap is largely attributed to some respondents' lack of visibility into the actual end-use application of the parts and components sold to NASA.
[29] Some Shuttle contracts remained in place well into 2010.

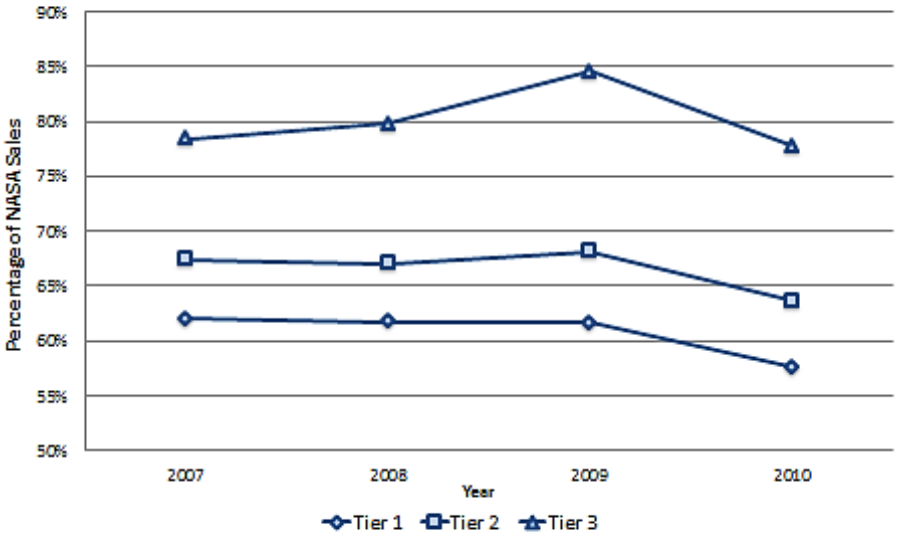
Figure IV-12: NASA HSF Program Sales Breakdown by Tier (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

From an individual survey respondent perspective, the proportion of respondent HSF sales to NASA-derived sales is rather distinct. For those respondents that reported HSF sales, data showed the average Tier 3 company had a larger percentage of NASA sales dedicated to HSF business than its more diversified Tier 1 and Tier 2 counterparts (see Figure IV-13).

Figure IV-13: HSF Sales as a Percentage of NASA Sales, Respondent Average (2007-2010)

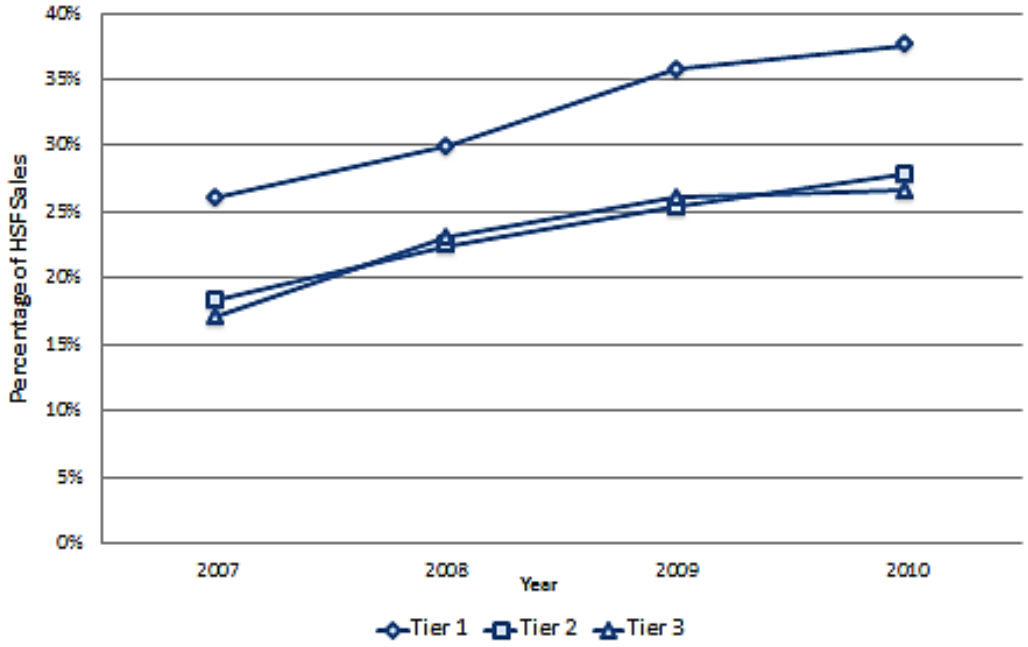


*Based on 42-44 Tier 1, 61-68 Tier 2, and 85-100 Tier 3 respondents that reported HSF sales depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Each respondent capable of estimating their NASA program sales allocations provided the percentage of HSF sales corresponding to Shuttle, CxP, and ISS programs. The percentage of HSF sales for CxP increased substantially over the period for all three tiers (see Figure IV-14). It is important to note that due to the timing of the announcement, these figures do not reflect the impact of the CxP transition.

Figure IV-14: Constellation Sales as a Percentage of HSF Sales, Respondent Average (2007-2010)

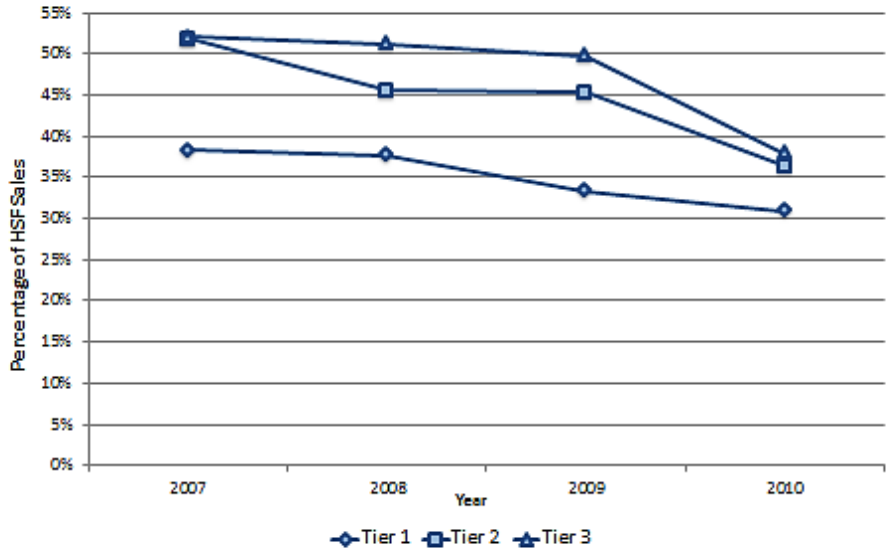


*Based on 45 Tier 1, 74 Tier 2, and 108 Tier 3 respondents that reported HSF sales

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

While the CxP sales as a percentage of HSF sales increased over the period, Shuttle sales as a percentage of HSF sales decreased for companies across all tiers (see Figure IV-15). This is understandable, considering the planned retirement of the Shuttle was announced in 2004. Shuttle program activity continued into 2011, when the last Shuttle mission occurred, which accounts for the existence of Shuttle sales in 2010.

Figure IV-15: Space Shuttle Sales as a Percentage of HSF Sales, Respondent Average (2007-2010)

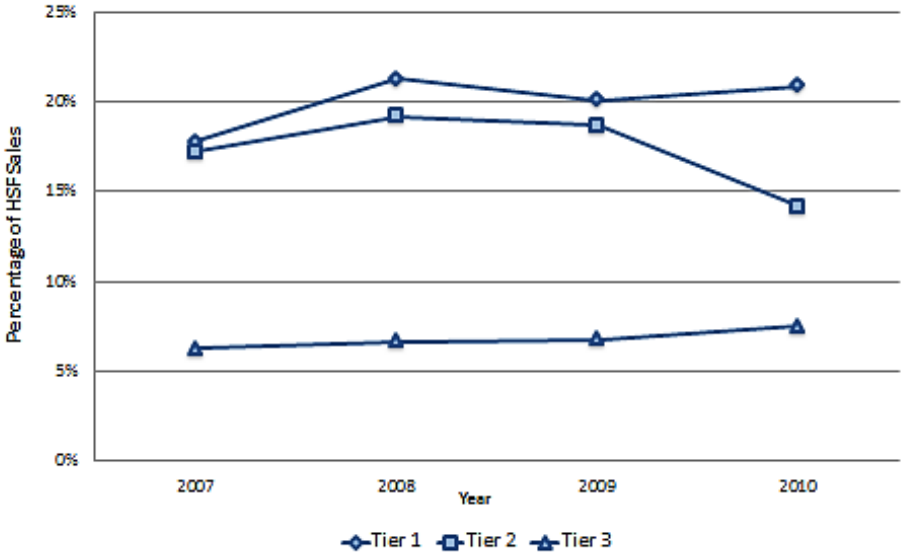


*Based on 45 Tier 1, 74 Tier 2, and 108 Tier 3 respondents that reported HSF sales

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

As a percentage of HSF sales, the respondent averages of ISS sales were the smallest of all HSF programs. ISS sales of Tier 3 respondents rose slightly, while Tier 2 respondents experienced an overall decline (see Figure IV-16). Tier 1 companies, who had the highest ISS sales as a percentage of HSF sales, experienced fluctuating but overall growth.

Figure IV-16: ISS Sales as a Percentage of HSF Sales, Respondent Average (2007-2010)

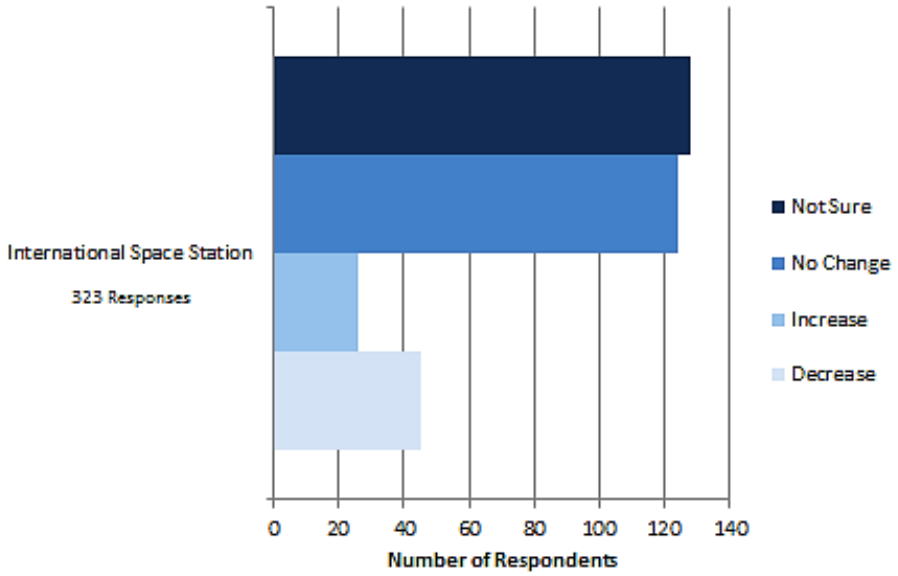


*Based on 45 Tier 1, 74 Tier 2, and 108 Tier 3 respondents that reported HSF sales

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Looking forward to 2011-2015, ISS has taken on increased importance to many of the companies, with Shuttle and CxP both cancelled. However, when asked to project future ISS sales, approximately the same numbers of survey respondents were either "Not Sure" or projected "No Change" (see Figure IV-17).[30] In addition, almost twice as many respondents anticipated a decrease than anticipated an increase in ISS sales in the future.

Figure IV-17: Future ISS Sales Projection (2011-2015)



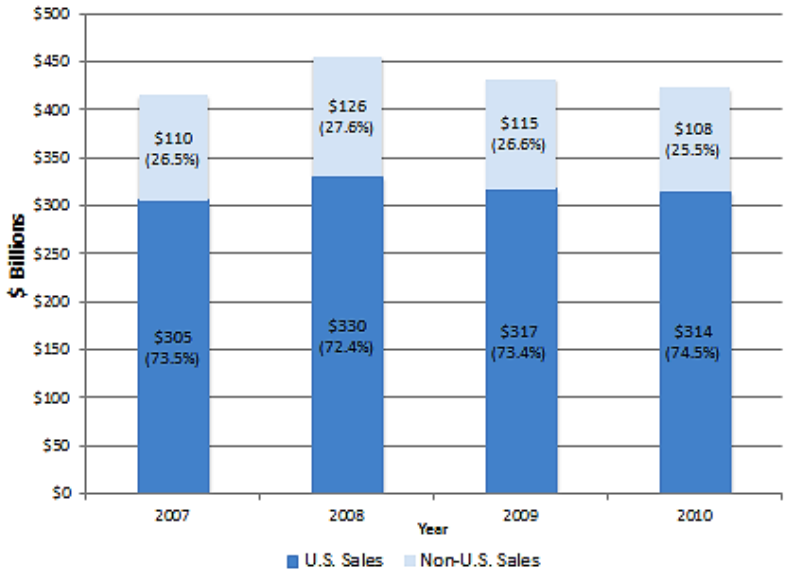
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

E. Non-U.S. Sales

More than half of survey respondents, 56-58 percent depending on the reporting year, had non-U.S. sales/exports over the period.[31] The non-U.S. sales of these respondents consisted of all products and services, including space-related items. Overall, approximately a quarter of aggregate total sales were due to non-U.S. sales (See Figure IV-18).

[30] At the time of the survey, ISS was the only NASA HSF program continuing beyond 2011.
[31] Non-U.S. is defined as anything outside of the 50 states, Puerto Rico, the District of Columbia, the island of Guam, the Trust Territories, and the U.S. Virgin Islands.

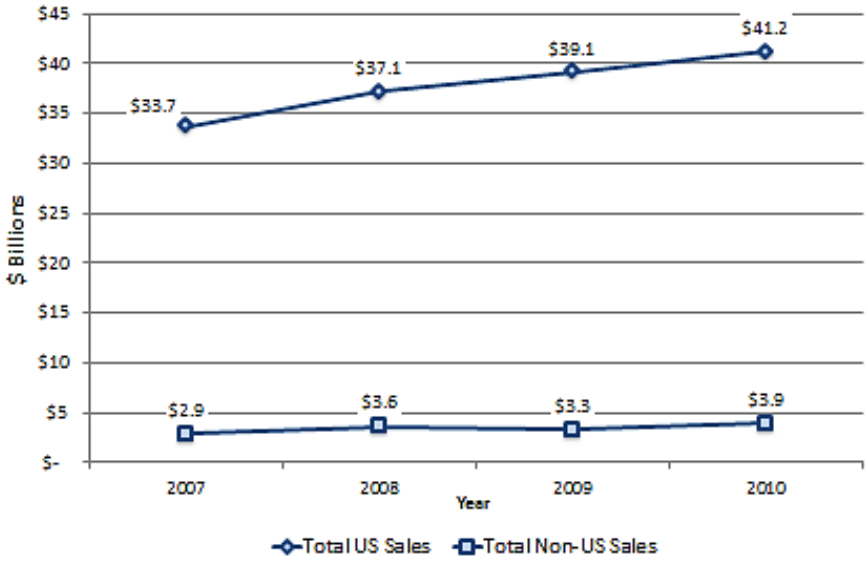
Figure IV-18: U.S. and Non-U.S. Sales, All Customers (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Of the 150 NASA-dependent respondents, 67 had non-U.S. sales between 2007 and 2010. While the non-U.S. sales of these NASA HSF suppliers experienced an overall increase, they were only 7.7-8.8 percent of their total sales (see Figure IV-19). This means NASA-dependent respondents have a smaller stake in the international market than the survey population as a whole.

Figure IV-19: Total Sales to U.S. and Non-U.S. Customers for NASA-Dependent Suppliers (2007-2010)*



* Based on 148 NASA-dependent respondents.

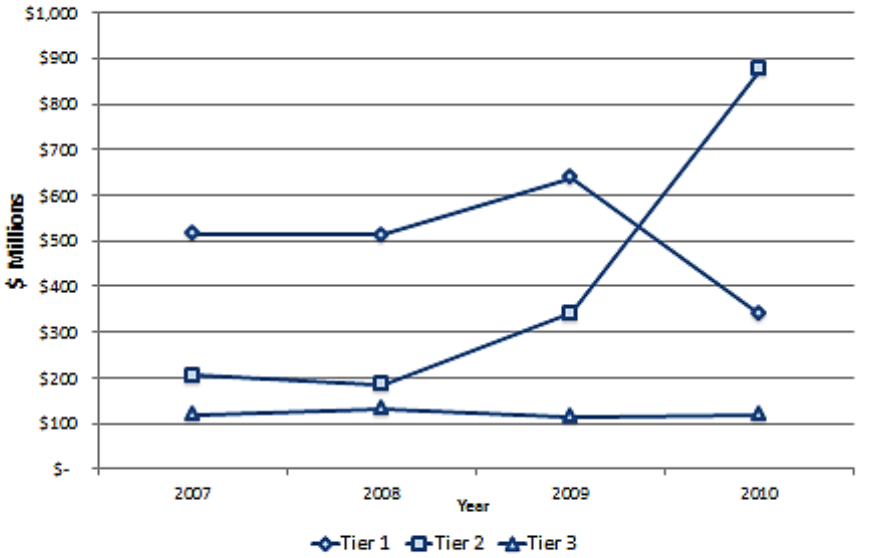
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

In addition to reporting their overall non-U.S. sales, NASA HSF suppliers were asked to record their space-related export sales from 2007-2010 by country and corresponding dollar value.[32] Of the 323 respondents who had non-U.S. sales at least once during the period, 25 percent reported space-related exports. The exports reported by these respondents constituted a small fraction of the total non-U.S. sales declared by suppliers – less than one percent in any given year.

Trends in the export of space-related goods and services contrasted with the direction of total non-U.S. sales, in both the aggregate and across the tiers. Space-related exports grew 59 percent over the period from $841 million to $1.3 billion, while aggregate non-U.S. sales fell two percent from $110 billion to $108 billion.

The 34 percent decline in Tier 1 space-related exports over the period far exceeded the two percent drop in total Tier 1 exports (see Figure IV-20). Tier 2 space-related exports climbed over 300 percent in the period and far outpaced their overall non-U.S. sales gains of merely one percent.[33] Tier 3 space-related export sales remained steady, growing just one percent from 2007-2010, which was less than Tier 3's overall non-U.S. sale gains of 13 percent.

Figure IV-20: Space-Related Export Sales (2007-2010)



* Based on 68-73 responses that reported space-related export sales, depending on the year.

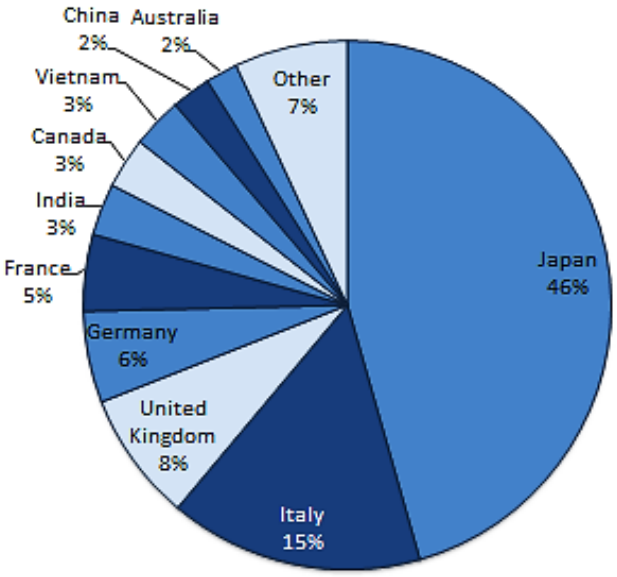
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[32] No more than 10 countries could be reported by each respondent. Therefore, in select instances, respondents were not able to document all of their space-related exports.

[33] Tier 2 gains in 2010 were due to one company with $698 million in export sales.

Nearly half of all reported space-related exports by dollar value were destined for Japan (see Figure IV-21). Italy was the second largest foreign consumer of respondents' space-related products and services, representing 14 percent. A total of 22 countries were identified as purchasers of U.S. space-related exports from 2007-2010.

Figure IV-21: U.S. Space-Related Export Sales by Country (2007-2010)*



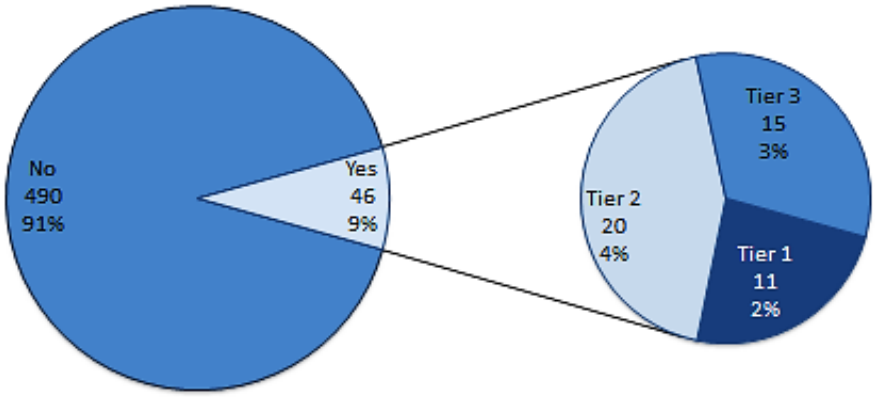
* Based on total U.S. dollar value of export sales of 82 respondents.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

F. Impacts of Export Controls

The impacts of U.S. export controls can vary between industrial base segments and throughout supply chains. To better determine the financial impacts associated with export controls, survey respondents were asked if they had lost space-related export sales opportunities to non-U.S. competitors because of U.S. export controls. Data showed nine percent of respondents indicated they had lost space-related export sales to foreign competitors (see Figure IV-22). While losses were reported in all tiers, Tier 2 companies represented the largest portion of affected NASA HSF suppliers.

Figure IV-22: Have You Lost Export Sales Opportunities of Space-Related Products or Services to Non-U.S. Competitors Because of U.S. Export Controls?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Some survey respondents attributed their lost sales to non-U.S. customers insisting on ITAR-free space-related products and services. One Tier 1 company said, "We have international aerospace customers serviced by our foreign affiliates whose contracts specify that no American export controlled product will be considered." Additional comments highlighted that the ITAR-free issue affects all tiers. For example, one Tier 2 company stated, "Many foreign commercial satellite manufacturers dictate an 'ITAR-free' product be offered for any given application." Similarly, a Tier 3 company said, "Foreign customers did not give our company the opportunity to quote on the items once they determined that export controls would apply. It was easier [for them] to pursue non-U.S. products."

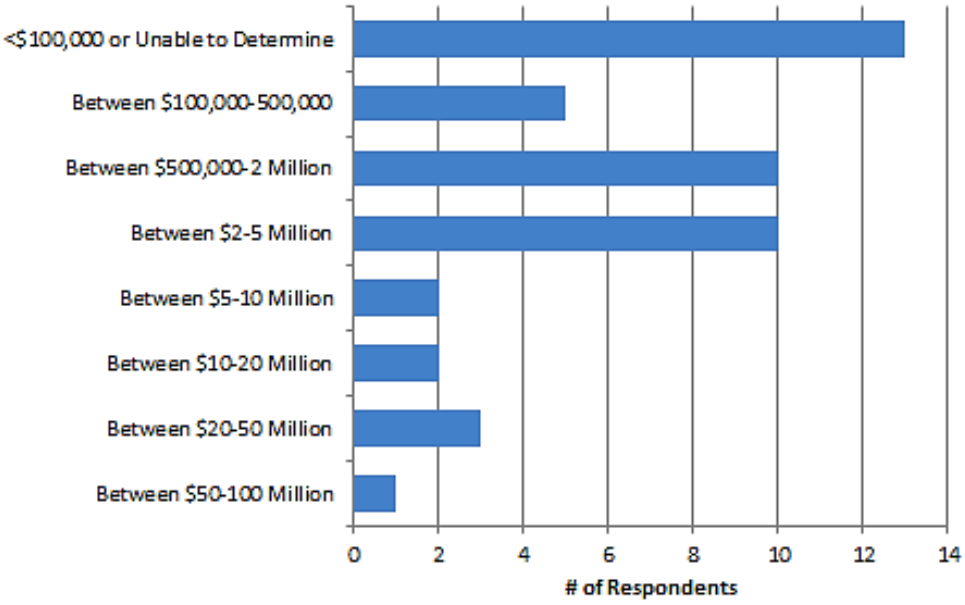
NASA HSF suppliers were also asked if they had stopped exporting their space-related products or services because of past experiences with export license denials, conditions, or extended delays. Less than two percent of respondents responded "Yes," most of which were Tier 1 companies.[34]

[34] A chart of survey respondents that stopped exporting their space-related products or services because of past experiences with export license denials, conditions, or extended delays can be found in Appendix A.

These respondents cited various reasons for not participating in the export markets for space-related goods. A Tier 3 company said, "Other than Canada, we elect not to promote sales of space-related products outside the U.S. When international customers ask for quotes, we advise them of the potential cost and delays associated with ITAR orders, and they lose interest."[35] Another Tier 3 company stated, "The cost of doing this business outweighs the profit for a company as small as ours. It makes the product too expensive." A Tier 2 company said, "We generally do not consider selling our products and services abroad, because in most cases the time required to obtain a license precludes timely submission of bids."

The 46 respondents who reported lost space-related export sales due to U.S. export controls also provided the approximate dollar value of the lost sales incurred during 2007-2010. The vast majority of lost space-related export sales fell between $100,000 and $5 million, though in select instances respondents reported lost space-related export sales between $5-50 million (see Figure IV-23). Seventy-eight percent declared Manufacturing as their primary business line, while 37 percent identified themselves as dependent on NASA business.

Figure IV-23: Total Lost Export Sales Opportunities (2007-2010)*



* As a percentage of 46 companies who lost sales opportunities due to export controls.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[35] ITAR stands for International Traffic in Arms Regulations.

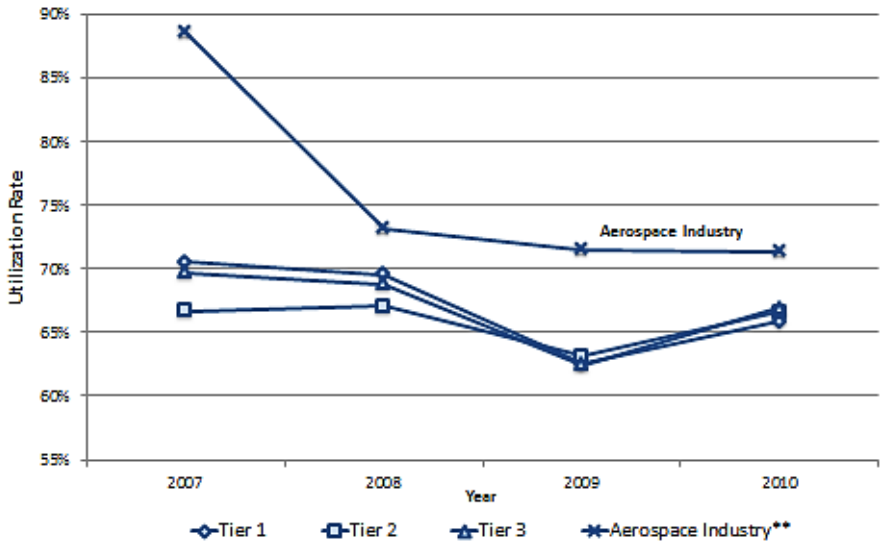
G. Capacity Utilization Rates

Another way to better understand industry health and competitiveness is to review the annual capacity utilization rate of survey respondents' operations. Companies provided their average production capacity utilization rates for 2007-2010 based on a seven day-a-week, three eight-hour shift production schedule. Out of the 536 companies that were surveyed, 340 listed a production capacity utilization rate for at least one year. Averaging across all tiers, capacity utilization decreased over the four-year time span from 69 percent in 2007 to 67 percent in 2010 (see Figure IV-24).

Between 2008 and 2009, every tier experienced a decline in capacity utilization rates, with Tier 1 companies experiencing the largest overall decrease. This was similar for the general trend in U.S. industry as the national average for capacity utilization rate dropped from 71 percent to 62 percent. The survey respondents rebounded slightly based on 2010 data, although not returning to 2007 levels. Overall, the NASA HSF survey respondents' capacity utilization rates are lower than those of the related Aerospace and Miscellaneous Transportation Equipment Manufacturing industry, which had a rate of 89 percent in the fourth quarter of 2007 and 71 percent in the fourth quarter of 2010.[36]

[36] The Federal Reserve, http://www.federalreserve.gov/releases/g17/revisions/Current/DefaultRev.htm, Accessed 21 October 2011.

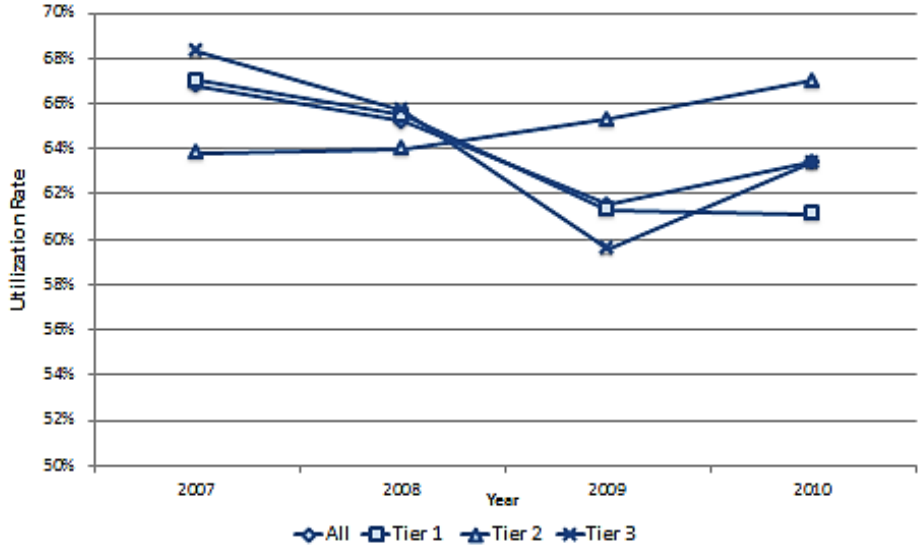
Figure IV-24: Average Production Capacity Utilization Rate*



*Based on 335-340 respondents that reported production capacity utilization depending on the year
**Aerospace Industry data, for Quarter 4 of each year, obtained from The Federal Reserve
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The companies that indicated they were dependent upon NASA followed the same trend as the survey population for capacity utilization rates, although they exhibited lower annual rates. The utilization rates of NASA-dependent companies fell from 67 percent in 2007 to 62 percent in 2009, recovering to 64 percent in 2010. Of the three tiers, only the Tier 2 NASA-dependent respondents did not experience a drop in the average capacity utilization rate (see Figure IV-25).

Figure IV-25: Average Production Capacity Utilization Rate for NASA-Dependent Respondents*



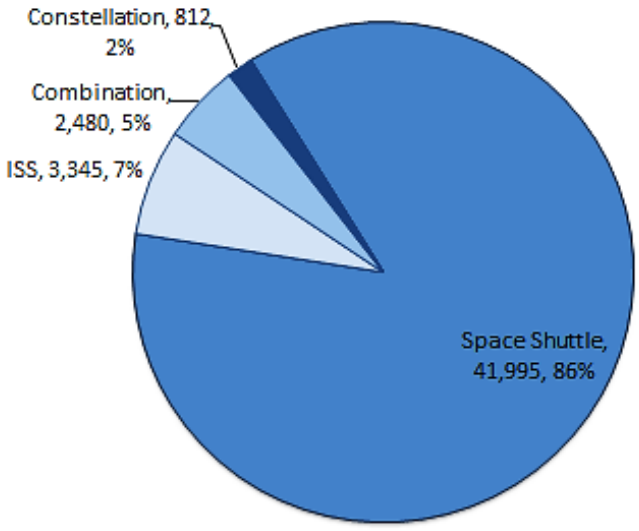
*Based on 84-86 NASA-dependent respondents that reported production capacity utilization depending on the year
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

H. Machinery, Tooling, and Facilities

NASA suppliers were asked if their company currently owned or leased any machinery, tooling, or facilities specifically for Shuttle, ISS, or CxP program-related business. Survey respondents were then asked to identify the item, its function, level of ownership, and the systems it supported, as well as the item's status. Fifty-two different companies reported that they owned or leased these items for NASA HSF programs.

Overall, 52 companies identified 48,623 specific machinery, tooling, and facilities. Of these items, 99.8 percent were identified by Tier 1 survey respondents. Ninety-one percent of the items were Government Furnished Property (GFP), while nine percent were owned by the companies.[37] A vast majority of the items, 86 percent, was used strictly to support the Shuttle (see Figure IV-26). The remaining 14 percent was divided between ISS, CxP, and a combination of all three programs.

Figure IV-26: Machinery, Tooling, and Facilities*



* A total of 48,632 units reported by 52 survey respondents.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Out of the machinery, tooling, and facilities reported, 90 percent of the items were listed as still in-use in 2010. With the 2011 retirement of the Shuttle, the majority of these items will be processed by the General Services Administration (GSA) to be transferred, sold, scrapped, or

[37] GFP is defined in the Federal Acquisition Regulations as "property in the possession of, or directly acquired by, the Government and subsequently furnished to the contractor for performance of a contract."

donated.[38] A small portion of these Shuttle-related items, as well as items used for CxP, are being evaluated for use in future HSF programs. However, the loss of the items not in use, along with the skilled workforce to operate them, will lead to a significant decrease in the space industrial base's production capacity for the foreseeable future.

I. Top Space-Related Customers

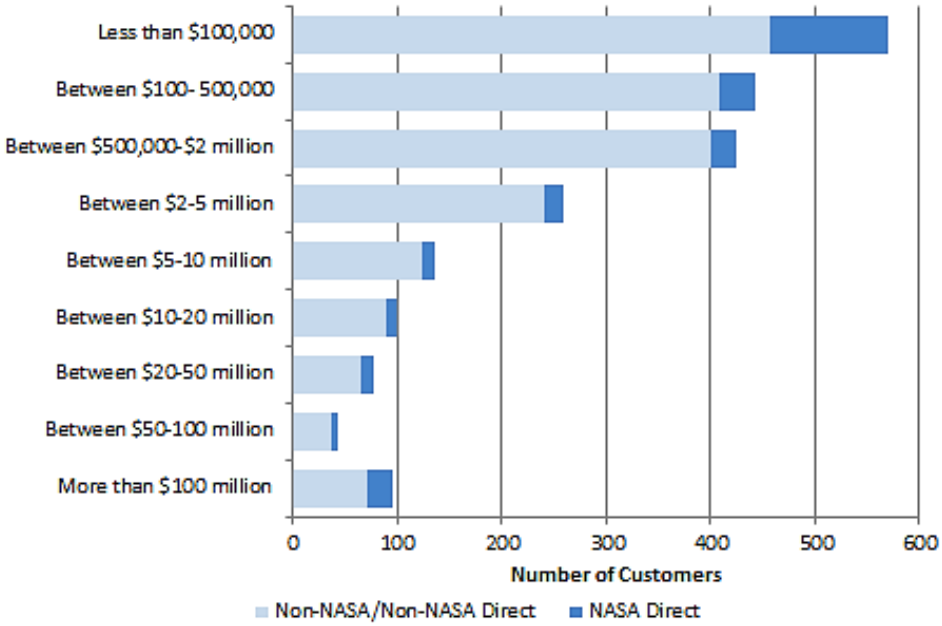
To better understand the supply chain and learn more about NASA HSF suppliers' customers, both domestic and foreign, respondents were asked to identify their most-significant space-related customers by name, domestic/foreign origin, and dollar value.

Respondents identified 2,146 customer records and 540 unique customers, which encompassed both government and industry entities. These included branches of the U.S. military, civilian agencies, government contractors, commercial customers, and non-U.S. entities. Most customers identified by respondents, particularly by those in Tier 1, were from the aerospace and defense sectors. Based upon survey comments, many companies were not sure what the end-use of their products were and were unable to identify space-related customers.

Direct sales to NASA customers constituted only 316 customer records (15 percent of 2,146), with most sales to NASA falling under $2 million in value. Among the nine category ranges provided in the survey, respondents generally sold "Less than $100,000" to any single NASA customer during the period; half of these respondents were Tier 3 companies (see Figure IV-27).[39] The vast majority of companies with sales to customers of "More than $100 million" were Tier 1 respondents.

[38] Information on acquiring surplus federal property can be found at http://www.gsa.gov/portal/content/104591.
[39] NASA centers and other "NASA" customer affiliations were consolidated to represent "NASA Direct."

Figure IV-27: Space-Related Customer Sales (2007-2010)

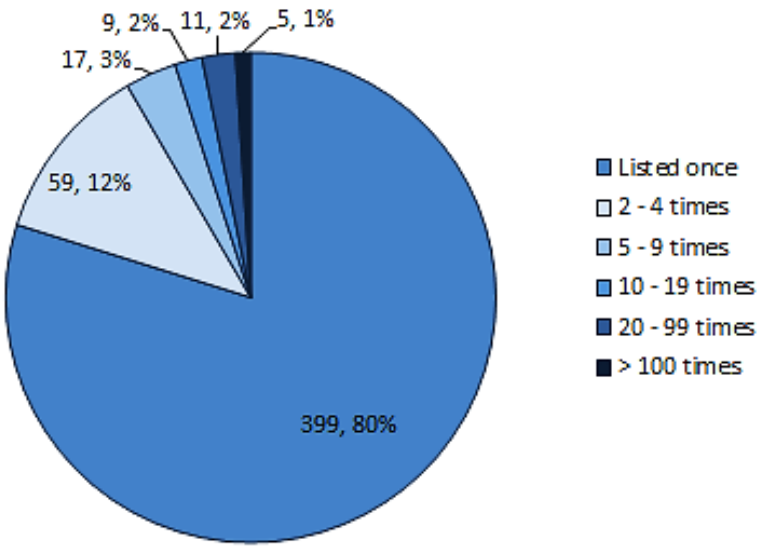


Source: U.S. Department of Commerce, Bureau of Industry and Security, NASA Supply Chain Network, June 2012

Non-U.S. space-related customers represented only six percent of the 2,146 records of most-significant customers provided by survey respondents for 2007-2010. These 124 foreign customers consisted primarily of aerospace companies, but included government agencies and government-sponsored entities such as institutes and laboratories in select instances. The sales dollar range most frequently selected for non-U.S. space-related customers was between $500,000-2 million. The second and third most frequently selected dollar ranges for non-U.S. customers were between $100,000-500,000 and $2-5 million, respectively.

Of the 540 unique customers listed, 101 were reported by more than one company; five customers were listed more than 100 times each (see Figure IV-28). Eleven of the customers listed by multiple companies were government agencies or entities, and eight were non-U.S. based companies. Fifteen percent of the 540 unique customers were surveyed in this effort.

Figure IV-28: Frequency of Space-Related Customer Mentions*



* Based on 540 unique customers reported by survey respondents.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

V. Employment

OTE asked survey respondents to provide the number of full-time equivalent employees in their U.S. operations from 2007 to 2010. This information was provided for eight different professional occupations: Administrative Staff, Facility Operations/Maintenance, IT/Network Engineers, Production Line/Support Technicians, Production Managers/Supervisors, Quality Control/Test Operators, Research and Development (R&D) Staff, and Sales and Marketing Staff, plus a catch-all Other category. These employment figures capture personnel in all business lines for the responding companies, with NASA-related activities as a small portion of the overall aggregate figures.

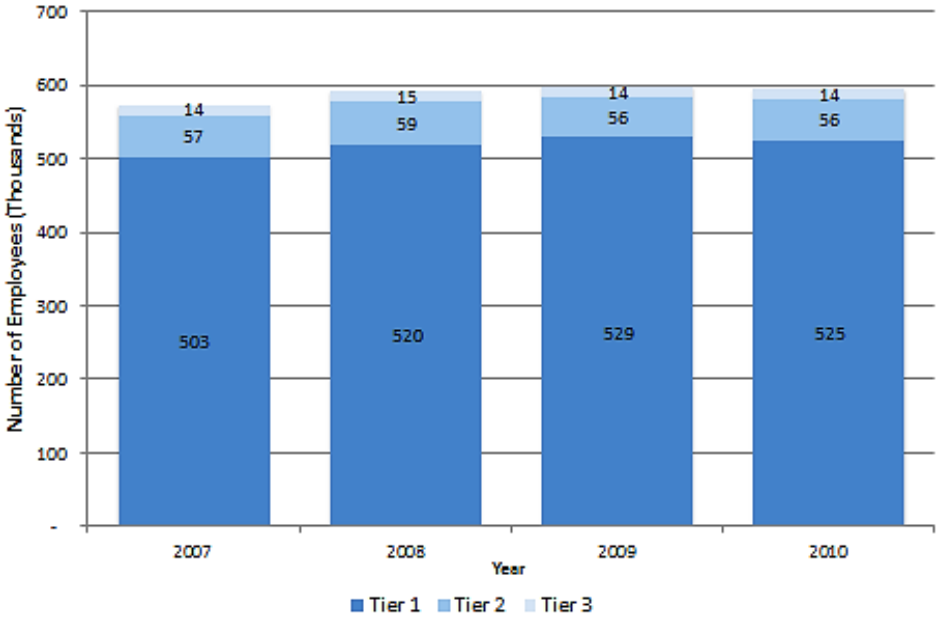
Survey respondents provided the number of scientists and engineers on staff, and the percentage breakout of personnel that were dedicated to supporting the Space Shuttle (Shuttle) and Constellation (CxP) programs during the time period. In addition, survey respondents were asked about the personnel categories difficult to hire and retain, critical personnel skills and competencies, and production and/or inspection personnel with NASA-required formal qualifications/certifications.

A. Total Aggregate Employment

Total aggregate employment for the 536 NASA human space flight (HSF) suppliers proved to be relatively stable over the 2007-2010 period. There was a 3.7 percent increase from approximately 574,000 employees in 2007 to approximately 595,000 employees in 2010, with a slight peak in 2009. Approximately one-third of the total aggregate employment each year was reported by survey respondents at the Business Unit/Division level.

Tier 1 companies employees the largest number of personnel, making up 88.2 percent of total survey respondent employment in 2010 (see Figure V-1). Tier 2 and Tier 3 companies made up 9.4 and 2.4 percent of total employment reported for the year, respectively. Tier 1 companies exhibited an increase of 4.5 percent in their employment from 2007 to 2010, while Tier 2 and Tier 3 companies exhibited overall decreases of 1.8 and .63 percent, respectively, though they did experience peaks in 2008.

Figure V-1: Total Employment (2007-2010)



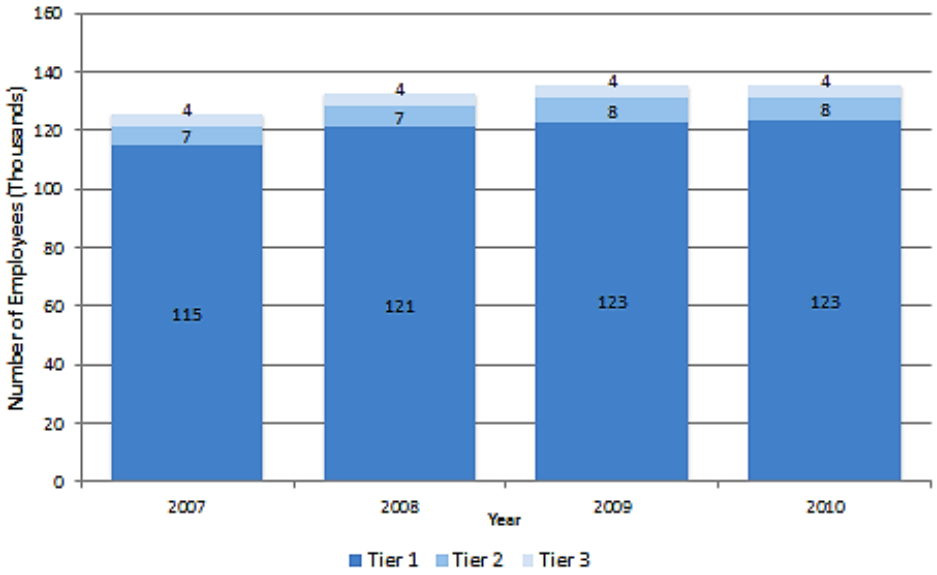
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

From a company-specific perspective, however, 254 respondents experienced a decrease in employment, and 77 respondents experienced a decrease in employment of greater than or equal to 25 percent. The average decline per company among the 254 respondents was 19 percent from 2007-2010. Of the self-identified NASA-dependent companies, 60 reported a decline in employment of greater than or equal to 25 percent. The average decline per NASA-dependent company over the period was 20 percent.

Depending on the year, the 150 NASA-dependent companies accounted for 21-24 percent of total employment, while companies not dependent on NASA-related business accounted for 76-79 percent.[40] Specifically, total employment for companies that identified themselves as dependent on NASA business increased 7.7 percent from approximately 126,000 employees in 2007 to approximately 135,000 in 2009 (see Figure V-2). This increase slowed between 2009 and 2010, when total employment grew by 319 workers.[41] It is important to keep in mind that this data does not reflect the full impact of the Shuttle retirement and CxP transition due to the timing of the survey.

[40] A chart on percentage of total employment attributable to NASA-dependent respondents can be found in Appendix A.
[41] These figures reflect total employment at these companies, and not employment specifically dedicated to NASA work.

Figure V-2: Employment of NASA-Dependent Respondents (2007-2010)



Source: U.S. Department of Commerce, Bureau of Industry and Security, NASA Supply Chain Network, June 2012

Survey respondents were asked to record the total number of full-time equivalent employees in their U.S. operations by professional occupation for 2007-2010. The largest proportion of survey respondent employees was in the Production Line/Support Technician category, followed by Administrative Staff.[42] OTE then calculated the changes for each year of data provided, as well as for the overall time frame.

While overall employment remained relatively stable, there is noticeable variation among the different professional occupations. Administrative Staff, Production Manager/Supervisors, and Quality Control/Test Operators were the professional occupation categories with the greatest increases (see Figure V-3). The largest increases in these professional occupations occurred in 2007-2008, with smaller changes occurring thereafter.

This was offset by decreases of employment in the Facility Operations Staff and Sales and Marketing Staff professional occupations. Facility Operations Staff steadily decreased from the 2007-2008 period, while Sales and Marketing Staff decreased from 2007-2008 and 2008-2009 before recovering slightly in 2009-2010. While they did decrease, IT/Network Engineers and

[42] A chart on employment by professional occupation can be found in Appendix A.

R&D Staff experienced the least amount of change overall out of all of the professional occupations.

Figure V-3: Change in Professional Occupations (2007-2010)*				
	2007-2008	2008-2009	2009-2010	Total
Production Line, Support Technicians	3.9%	-2.0%	-0.5%	1.4%
Administrative Staff	3.7%	2.6%	0.1%	6.4%
Production Managers/Supervisors	4.6%	2.0%	0.0%	6.6%
IT/Network Engineers	2.9%	-1.0%	-2.0%	-0.1%
Sales and Marketing	-2.4%	-1.9%	1.4%	-2.9%
R&D Staff	4.0%	-4.0%	-0.1%	-0.1%
Facility Operations	3.3%	-3.7%	-3.4%	-3.8%
Quality Control, Test Operations	5.4%	-1.6%	1.6%	5.4%
* Excluding employment categorized as 'Other'				

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

OTE asked survey respondents to estimate the percentage of their company's total personnel in U.S. operations who participated in Shuttle- and CxP-related work. On average, companies reported approximately 10 percent of their personnel that participated in Shuttle-related work, while approximately eight percent per company worked on CxP (see Figure V-4).

The average percentage of personnel in U.S. operations who participate in Shuttle or CxP was much higher for NASA-dependent companies (see Figure V-4). Approximately 19 percent of all personnel at NASA-dependent companies participated in Shuttle work, while nearly 18 percent of participated in CxP work. Tier 3 respondents had the highest average percentage of personnel who participate in Shuttle or CxP.

Figure V-4: Average Percentage of Personnel in U.S. Operations Participating in Space Shuttle- and Constellation-Related Work*				
Space Shuttle				
	Tier 1	Tier 2	Tier 3	All
Overall	2.2%	5.3%	15.5%	10.1%
Companies With Any Space Shuttle-Related Work	3.3%	8.0%	24.2%	15.4%
NASA-Dependent Companies	5.1%	11.7%	27.1%	19.2%
Constellation				
	Tier 1	Tier 2	Tier 3	All
Overall	2.7%	3.5%	11.9%	7.7%
Companies With Any Constellation-Related Work	5.5%	8.6%	29.7%	17.9%
NASA-Dependent Companies	6.1%	11.3%	25.4%	18.2%

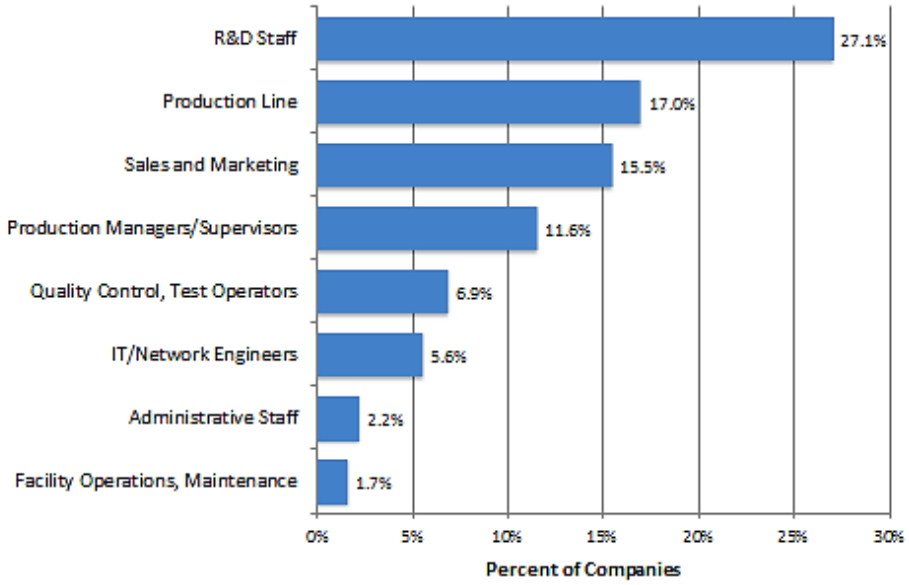
* As a percentage of 536 overall companies, 305 with any Shuttle-related work, 187 with any Constellation-related work, and 145 NASA-dependent companies.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

B. Personnel Categories Difficult to Hire and Retain

Survey respondents were asked to identify what categories of personnel are the most difficult to hire. Of the 472 NASA HSF suppliers that answered the question, 27 percent indicated that R&D Staff were the most difficult to hire, followed by Production Line Staff and then Sales and Marketing Staff (see Figure V-5).

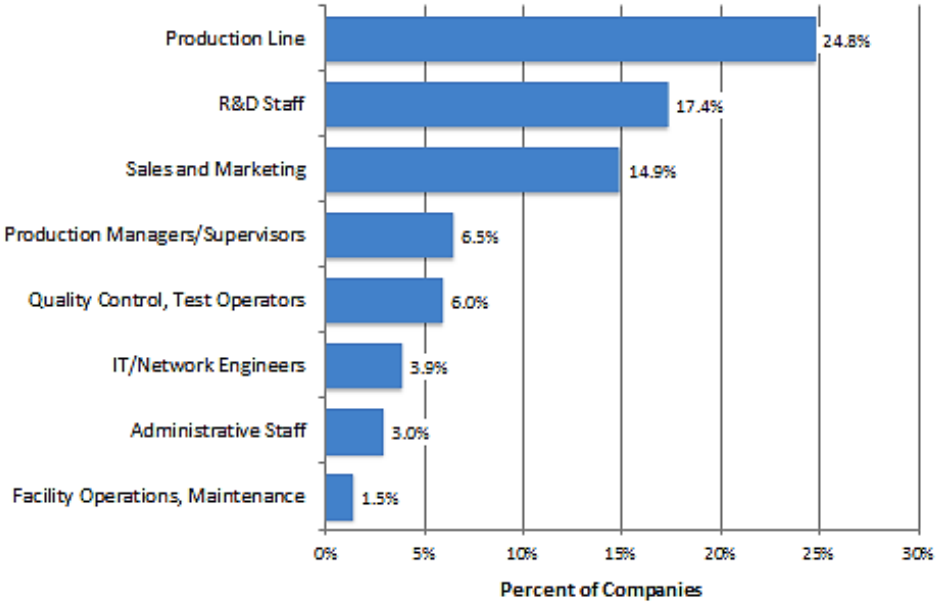
Figure V-5: Difficult to Hire Professional Occupations



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The same three categories of personnel were identified in a slightly different order by survey respondents when asked what occupations were the most difficult to retain. Twenty-five percent of responses indicated Production Line staff, followed by R&D Staff and Sales and Marketing Staff (see Figure V-6).

Figure V-6: Difficult to Retain Professional Occupations



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Respondents commented that R&D personnel are difficult to hire and retain due to the high educational levels needed and the limited number of available candidates. A Tier 2 company said that the skills it needs for guidance, navigation and control R&D are limited to few schools. Another Tier 2 respondent commented that, "Very few schools directly prepare their students for [specific engineering design applications] and need to be developed internally."

Smaller companies indicated that they face an additional burden trying to compete with larger companies for R&D workers due to the greater opportunities and benefits that larger companies often offer. A Tier 2 company commented, "There are not a lot of other engineering opportunities in the area and engineers are recruited away by larger companies." Another respondent, a Tier 3 company, stated, "Our products require uniquely specialized engineering backgrounds coveted in the aerospace industry. As such we struggle to fill R&D positions."

Respondents also indicated that the lack of continuity in NASA programs and policies was a hindrance in hiring and retaining staff. A Tier 3 company commented:

> Many folks work on NASA programs for prestige and adventure, combined with achieving human spaceflight. With Constellation, NASA embarked on 3rd Generation program where younger people could have worked for many years and seen their efforts realized. Without a serious direction, people find other things to do, rather than wait for potential direction affected by the political leaders during an election time. People want to be productive and participate in something special, NASA can offer such an opportunity. The most difficult challenge in retaining people is their need to have something they consider of value to them, their community and the country.

NASA-dependent companies also indicated R&D Staff and Production Line Staff were the most difficult to hire and retain, with R&D Staff selected by the most companies in both categories. However, NASA-dependent survey respondents reported that Production Managers/Supervisors were more difficult to hire than survey respondents not dependent on NASA-related business.[43]

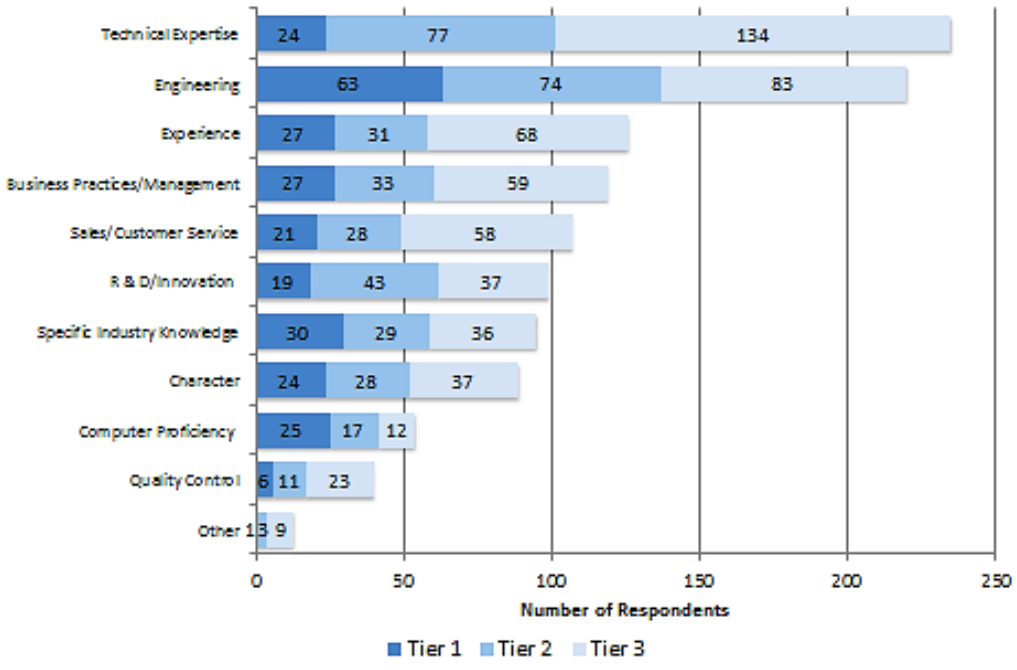
[43] Graphs on the professional occupations difficult to hire and retain by NASA-dependent companies can be found in Appendix A.

C. Critical Personnel Skills and Competencies

OTE asked NASA HSF suppliers to identify their critical personnel skills and competencies, or the expertise that is critical to viability and long-term competitiveness.[44] Overall, survey respondents indicated the leading three critical personnel skills and competencies were Technical Expertise, Engineering, and Experience, with almost 50 percent of all responses falling into those categories (see Figure V-7).

Tier 1 respondents listed a total of 267 critical personnel skills and competencies in their responses, the majority of which were categorized as Engineering and Specific Industry Knowledge. Business Practices/Management and Experience were also frequently identified. Tier 2 respondents listed a total of 374 critical personnel skills and competencies in their responses, the majority of which were categorized as Technical Expertise. Engineering and R&D/Innovation were also commonly identified. Of the 556 critical personnel skills and competencies identified by Tier 3 companies, Technical Expertise and Engineering were mentioned the most, with Experience also repeatedly identified.

Figure V-7: Critical Personnel Skills and Competencies by Tier



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[44] The answers provided were compiled and categorized by OTE staff.

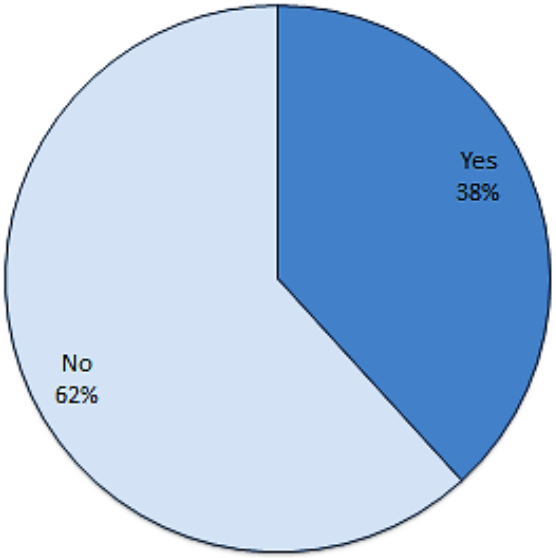
In addition to critical personnel skills and competencies, NASA HSF suppliers were also asked which categories they considered to be unique to their companies. Overall, respondents considered Industry Knowledge and Technical Expertise to be their most unique skill or competency. Tier 1 companies primarily identified Industry Knowledge as their unique skills and competencies, Tier 2 companies primarily identified R&D/Innovation, and Tier 3 companies primarily identified Technical Expertise.

For self-identified NASA-dependent survey respondents, Engineering and Technical Experience were considered by most companies to be critical skills or competencies, while R&D/Innovation and Specific Industry Knowledge were considered to be unique skills or competencies. Tier 1 and Tier 2 NASA-dependent companies primarily identified R&D/Innovation as their unique skills and competencies, while Tier 3 NASA-dependent companies primarily identified Technical Expertise.

D. Production and/or Inspection Personnel with NASA-Required Formal Qualifications/Certifications

OTE asked survey respondents if they employed production and/or inspection personnel with formal qualifications/certifications necessary for doing business with NASA, and to provide examples. Nearly 40 percent of all survey respondents indicated they had personnel who maintain such qualifications/certifications (see Figure V-8). Fifty-two percent of Tier 1 and 48 percent of Tier 2 respondents had personnel with qualifications/certifications, while 27 percent of Tier 3 respondents, respectively, indicated the same.

Figure V-8: Companies With Production/Inspection Personnel With Formal Qualifications/Certifications for Working with NASA



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Survey respondents provided a plethora of these qualifications and certifications. These examples included inspection trainings such as *Magnetic Particle Inspection* and *Through Hole Soldering Training and Inspection* and specific NASA certifications such as *Workmanship Standard for Surface Mount Technology* (NASA-STD 8739.2) and *Reliability Program Requirements for Aeronautical and Space System Contractors* (NASA NHB 5300.4).[45]

[45] A sample list of qualifications and certifications held by production/inspection personnel can be found in Appendix C. Company-specific certifications can be found in Chapter II.

VI. Research and Development

Research and development (R&D) expenditures are the costs a company incurs in the process of cultivating new knowledge, applicable to the company's business needs, that eventually will result in new or improved products, processes, systems, or services that can increase a company's sales and profits. Because R&D investment typically impacts profit margins in the medium- to long-term, current levels of R&D expenditure reflect companies' perceptions of future market potential. As a result, R&D expenditures often decline during economic downturns. R&D spending usually depends on the amount of revenue companies have available to invest, as well as on other competing internal demands for capital.

OTE asked NASA human space flight (HSF) suppliers to record their total R&D activities for 2007-2010 and to categorize them: by the types of R&D being conducted and by the sources of funding for the R&D. Types of R&D conducted were broken into three categories: Basic Research, Applied Research, and Product/Process Development. Funding sources of R&D were divided into eight categories, including Internal/Self-Funded, Federal Government, and U.S. Industry/Venture Capital sources. OTE also asked companies to estimate the percentage of R&D expenditures that related directly to their NASA business lines, and their R&D employment.

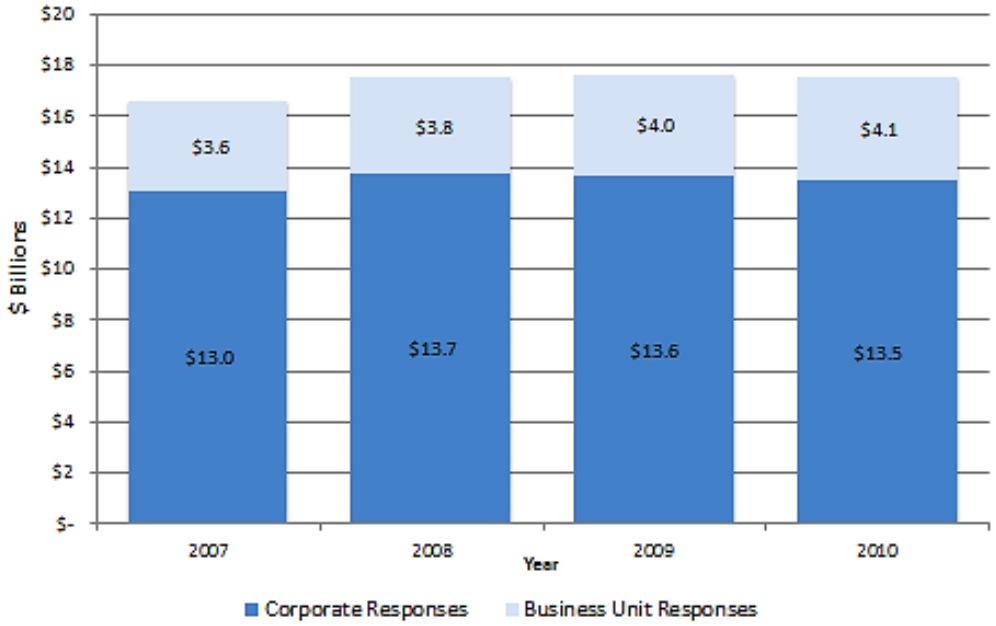
A. Overall Research and Development Expenditures

Of the 536 NASA HSF suppliers that responded to the OTE survey, 47 percent recorded no R&D expenditures between 2007 and 2010. The remaining 284 respondents invested in R&D during at least one year during the period; these companies increased their overall R&D expenditures by six percent between 2007 and 2010.

Respondents cited multiple reasons for recording no R&D expenditures for the period. Many of these companies were Tier 3 and/or listed distribution, services, or reselling as their primary business lines. A number of respondents commented that they were build-to-print operations and did not conduct R&D. Other respondents said they did not track R&D or did not have separate budget lines for R&D expenditures.

NASA HSF suppliers that reported R&D expenditures did so at either the Corporate/Whole Company or Business Unit/Division level. Corporate/Whole Company level data accounted for the largest share of total R&D expenditures each year, representing between 77-79 percent of the total over the period, measured by total dollar value (see Figure VI-1).

Figure VI-1: Total R&D Expenditures (2007-2010)*

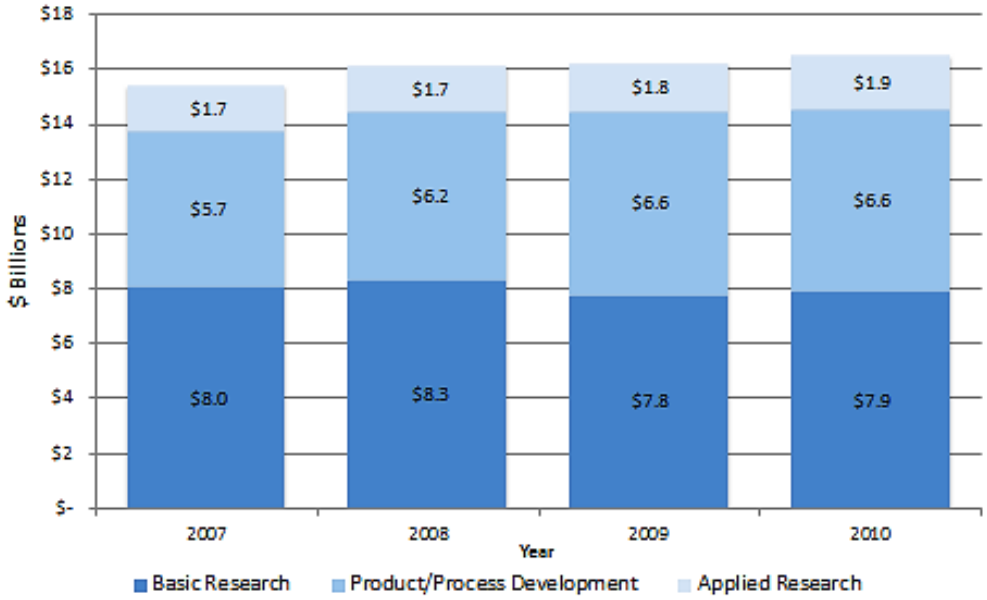


*Based on 284 respondents that reported R&D expenditures over the period; comprises all R&D expenditures, including NASA-related R&D

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

OTE asked NASA HSF suppliers to divide their R&D expenditures into three different categories: Basic Research, Applied Research, and Product/Process Development. The breakdown between each category remained relatively stable across all respondents, with no significant shifts in total R&D expenditure patterns over the period (see Figure VI-2).

Figure VI-2: Total R&D Expenditures by Category (2007-2010)*



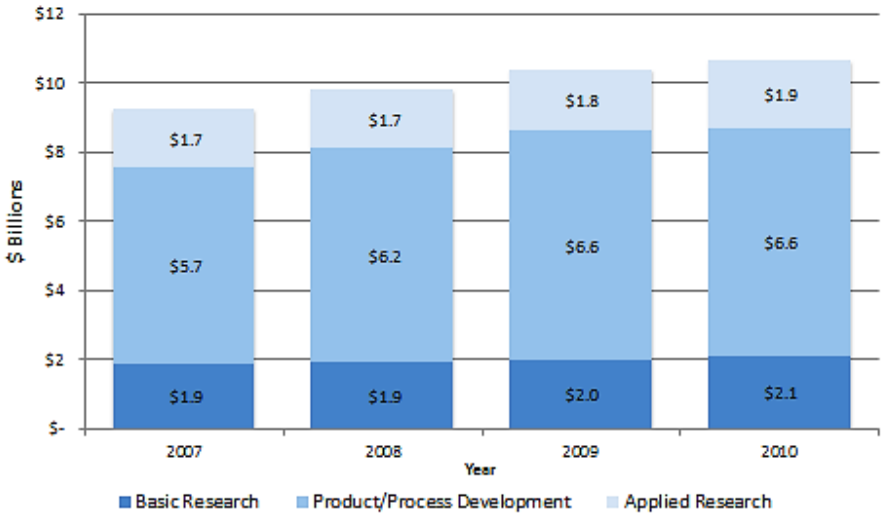
*Based on 276 respondents that reported R&D expenditures by category over the period; comprises all R&D expenditures, including NASA-related R&D

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

One of the 284 survey respondents contributed a disproportionately large amount of total R&D expenditures, accounting for 33-37 percent for the years 2007-2010. As a result, the R&D breakout in Figures X and Y are skewed toward the R&D patterns of this respondent. All of these R&D expenditures for this respondent were reported as Basic Research, inflating the proportion of Basic Research to Applied Research and Product/Process Development. To account for this, the respondent's data was removed for some of the analysis and adjusted figures are provided.

When adjusted, Product/Process Development – R&D focused on applying research to develop preliminary products, services, or processes – accounted for the largest share of total R&D expenditures, ranging between 61-64 percent between 2007 and 2010 (see Figure VI-3). Basic Research – R&D focused on experimental or theoretical work with no intended application or use – accounted for 19-20 percent during the period. Applied Research – R&D focused on a specific practical aim or objective – accounted for the smallest portion of total R&D, ranging between 17-18 percent of total R&D each year.

Figure VI-3: Adjusted Total R&D Expenditures by Category (2007-2010)*

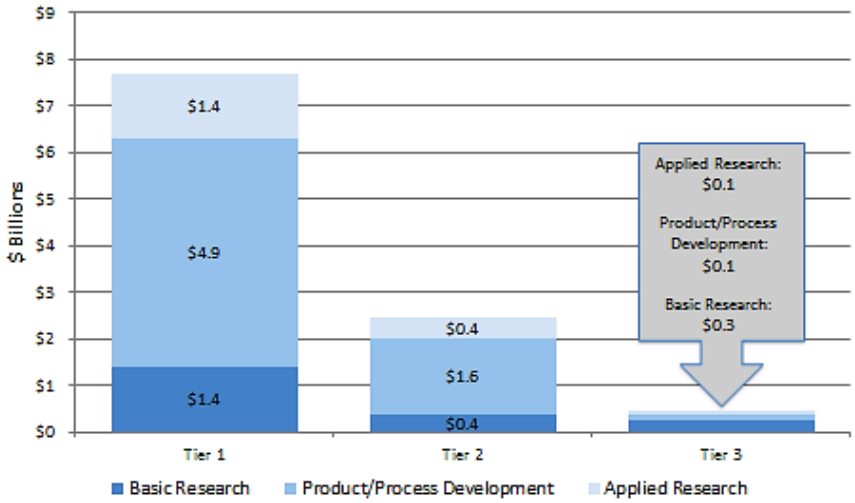


*Based on 275 respondents that reported R&D expenditures by category over the period; adjusted to remove disproportionately large value from one respondent

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

From a tier perspective, Tier 1 survey respondents had the largest amount of R&D expenditures in 2010, followed by Tier 2 and Tier 3 (see Figure VI-4). Within Tier 1, 64 percent of R&D expenditures went toward Product/Process Development, while Tier 2 companies also spent the largest amount of R&D funds on this category. Conversely, Tier 3 companies spent the majority of R&D funds on Basic Research.

Figure VI-4: Adjusted R&D Expenditures by Tier (2010)*

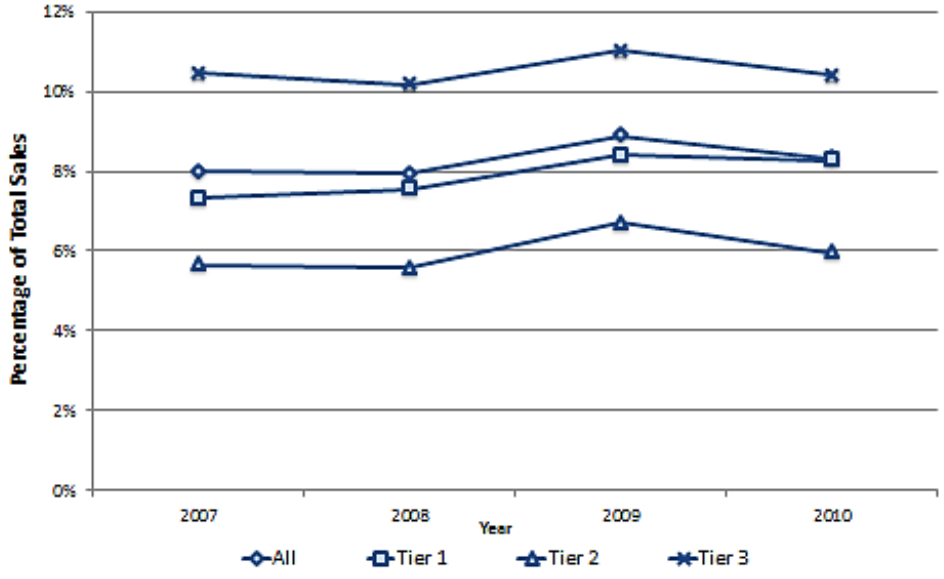


*Based on 275 respondents that reported R&D expenditures by category over the period; adjusted to remove disproportionately large value from one respondent

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

To further analyze R&D expenditures by the three tiers, calculations were made to determine R&D expenditures as a percentage of total sales.[46] Average per company R&D expenditures as a percentage of total sales increased slightly for all tiers over 2007-2010 (see Figure VI-5). On average, Tier 3 suppliers reported higher R&D expenditures as a percentage of total sales than companies in other tiers. In 2007, for example, Tier 3 suppliers allocated approximately 10 percent of sales revenue to R&D, on average. Tier 1 and Tier 2 suppliers allocated approximately six and seven percent, respectively, that same year.

Figure VI-5: Average R&D Expenditures as a Percentage of Total Sales with Tiers (2007-2010)*



*Based on 217-222 respondents that recorded R&D expenditures and total sales depending on the year

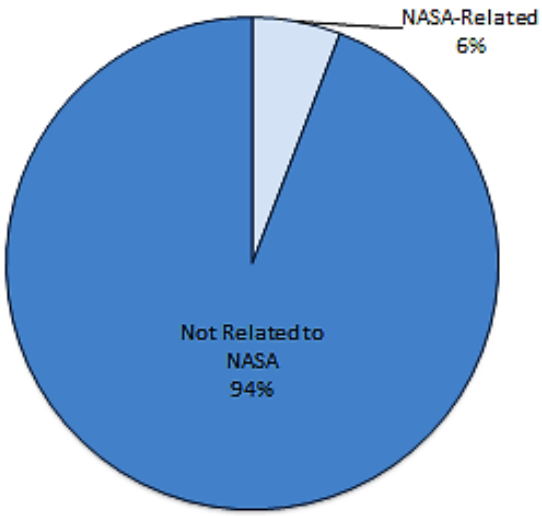
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

B. NASA-Related R&D Expenditures

OTE asked NASA HSF suppliers to estimate the percentage of total R&D expenditures that relate directly to their NASA business lines. When adjusted, NASA-related R&D expenditures accounted for six percent of total R&D outlays in 2010, $757.4 million of $11.9 billion, an increase from four percent of total R&D expenditures in 2007 (see Figure VI-6).

[46] R&D expenditures as a percentage of net sales measure the share of sales revenue that a company allocates toward generating new and innovative products, services, and business processes.

Figure VI-6: Adjusted R&D Expenditures Breakdown by Relation to NASA (2010)*

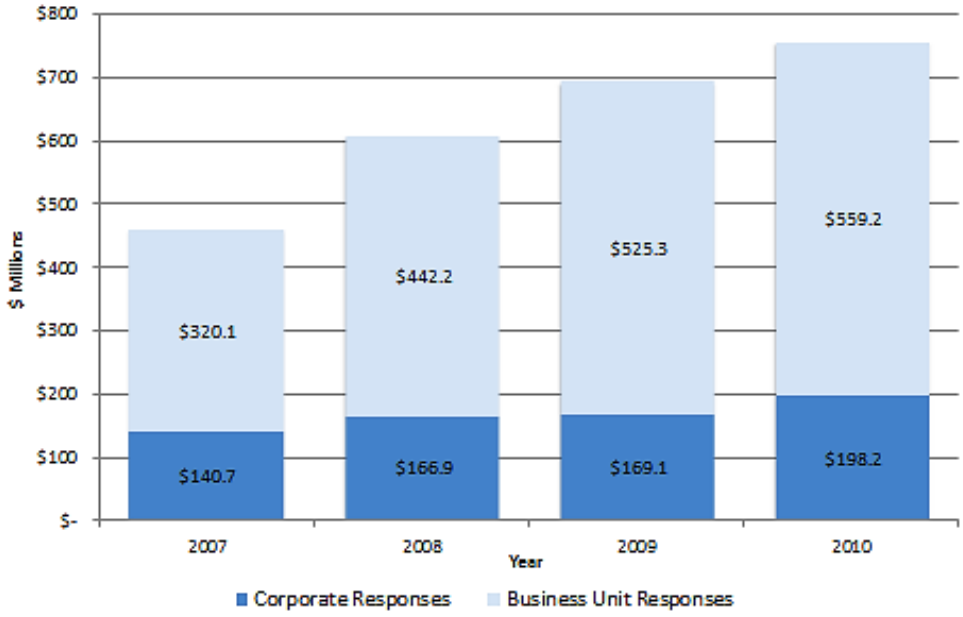


*Based on 283 respondents that reported R&D expenditures (81 that reported NASA-related R&D) over the period; adjusted to remove disproportionately large value from one respondent

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Eighty-one companies, or 15 percent of all respondents, recorded NASA-related R&D expenditures during at least one year during the period. Total NASA-related R&D expenditures for these companies increased steadily over the period by 64 percent, from $460.8 million in 2007 to $757.4 million in 2010 (see Figure VI-7). As mentioned earlier, overall R&D expenditures increased by six percent. The majority of NASA-related R&D data was reported at the Business Unit/Division level, as some NASA HSF suppliers have specific space-related Business Units/Divisions devoted to NASA.

Figure VI-7: NASA-Related R&D Expenditures (2007-2010)*



*Based on 81 respondents that reported NASA-related R&D expenditures over the period

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

On a per company basis, the average for NASA-related R&D expenditures also increased steadily over 2007-2010 (see Figure VI-8). There is a large difference between the average and median for each year because NASA-related expenditures were driven by a relatively small number of suppliers with large outlays. Six of the 81 respondents that recorded NASA-related R&D reported over $100 million in NASA-related R&D over the period. As a group, they accounted for 75 percent of the NASA-related R&D reported over the period, and one of the six suppliers accounted for 25 percent by itself.

Figure VI-8: NASA-Related R&D Expenditures Per Company*

Year	Average	Median
2007	$ 5,759,594	$ 155,000
2008	$ 7,613,194	$ 187,625
2009	$ 8,680,293	$ 203,720
2010	$ 9,467,549	$ 174,250

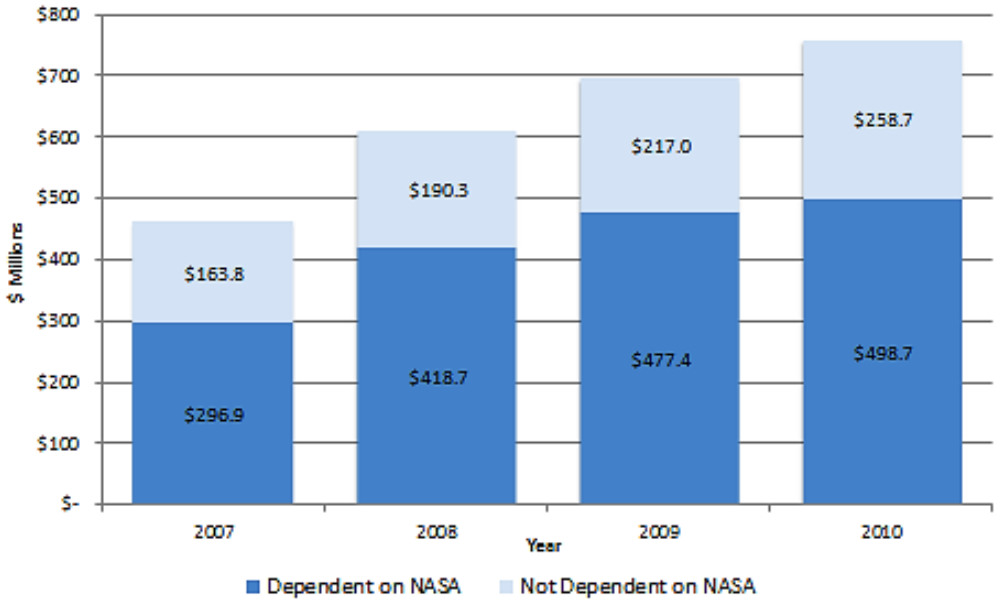
*Based on 81 respondents that reported NASA-related R&D expenditures over the period

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Although the average NASA-related R&D expenditures per company increased over 2007-2010, NASA-related R&D as a percentage of total R&D expenditures per company remained relatively flat.[47] The slight decline in the proportion of R&D spending, from 30 percent in 2007 to 29 percent in 2010, indicates that companies invested proportionately more R&D funds in other business lines.

The 38 suppliers that identified themselves as NASA-dependent conducted the majority of NASA-related R&D expenditures from 2007-2010, between 63-66 percent of reported NASA-related R&D (see Figure VI-9). The end of the Space Shuttle (Shuttle) and Constellation (CxP) programs will likely impact a large portion of NASA-related R&D if there is no formal follow-up NASA HSF mission or if these suppliers experience solvency issues.

Figure VI-9: NASA-Related R&D Expenditures by NASA-Dependent Respondents (2007-2010)*



*Based on 81 respondents (40 NASA-dependent) that reported NASA-Related R&D expenditures over the period

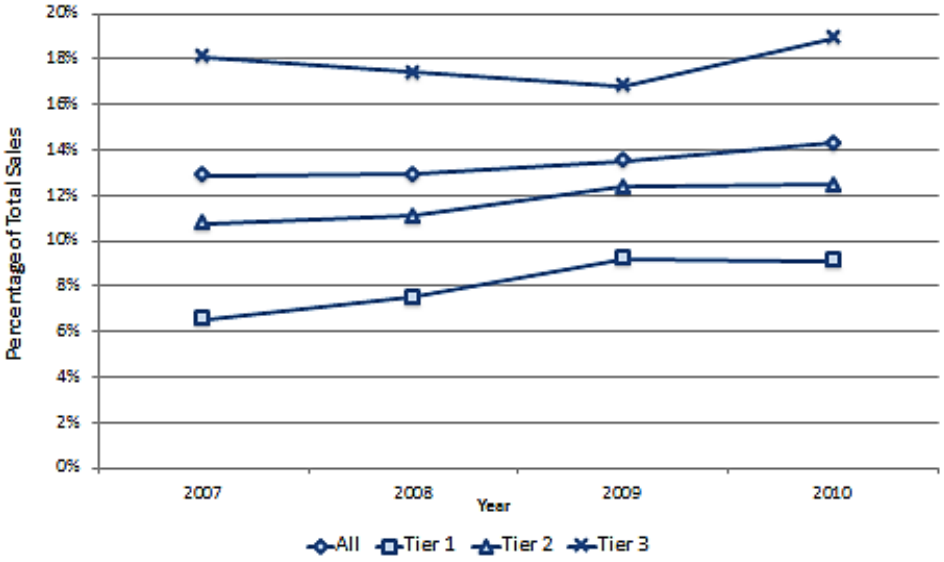
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

For NASA-dependent companies, average per company R&D expenditures as a percentage of total sales increased slightly for all tiers over 2007-2010 (see Figure VI-10).[48] On average, Tier 3 NASA-dependent suppliers reported higher R&D expenditures as a percentage of total sales

[47] A graph on NASA-related R&D as a percentage of total R&D expenditures can be found in Appendix A.
[48] A graph on median R&D expenditures as a percentage of total sales for NASA-dependent suppliers can be found in Appendix A.

than companies in other tiers. In 2007, for example, Tier 3 suppliers allocated approximately 18 percent of sales revenue to R&D, on average. Tier 1 and Tier 2 suppliers allocated approximately six and 11 percent, respectively, that same year.

Figure VI-10: Average R&D Expenditures Percentage of Total Sales for NASA-Dependent Suppliers*



*Based on 57-60 NASA-dependent respondents that reported R&D expenditures and total sales depending on the year
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The data show that NASA-dependent companies reported higher R&D expenditures as a percentage of total sales on average than suppliers that are not dependent on NASA. However, there were a number of non-dependent companies that dedicated a significant portion of their R&D expenditures to NASA-related projects.

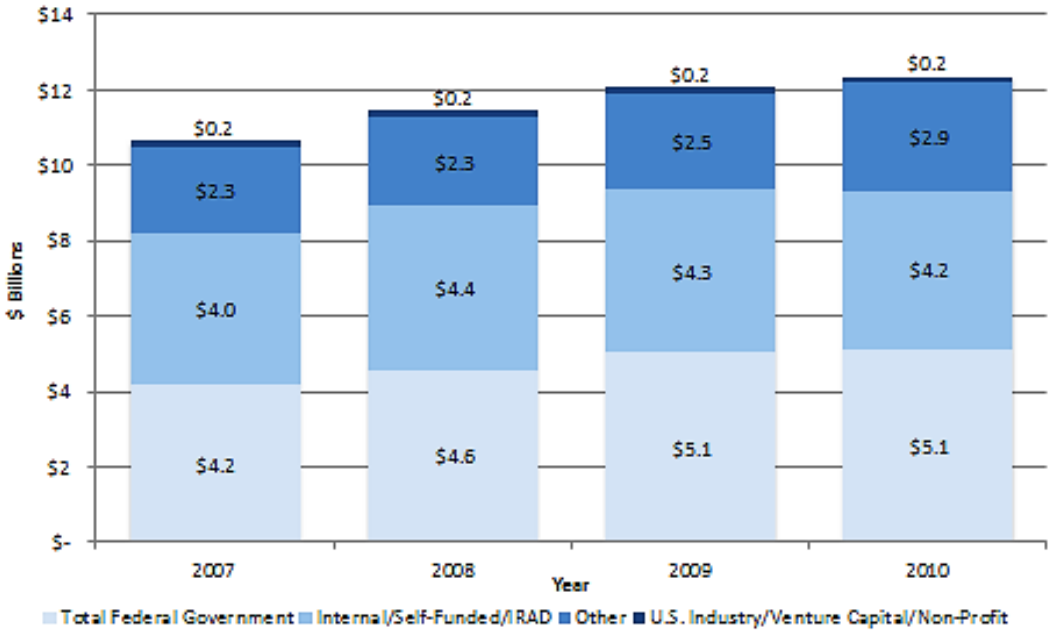
C. Overall R&D Funding Sources

OTE asked survey respondents to report the percentage of R&D funding received from different types of sources.[49] When adjusted, Federal Government-financed R&D makes up a slightly larger percentage or dollar amount of R&D funding than Internal/Self-Financed R&D (see Figure VI-11).[50] Over the four-year period, 69 of 223 respondents received R&D funding from

[49] There were eight types of R&D funding sources included in the survey: Internal/Self-Funded; Federal Government; State and Local Government; Universities – Public and Private; U.S. Industry, Venture Capital, Non-Profit; Non-U.S. Investors; and Other.
[50] One of the respondents contributed a disproportionately large amount of total Internal/Self-Funded R&D. To account for this, the respondent's data was removed for some of the analysis and adjusted figures are provided.

the Federal Government. Of these 69, seven received $1 billion or more over the 2007-2010 period, amounting to $14 billion or 74 percent of the total $19 billion in reported Federal Government-funded R&D.

Figure VI-11: Adjusted R&D Funding Sources (2007-2010)*

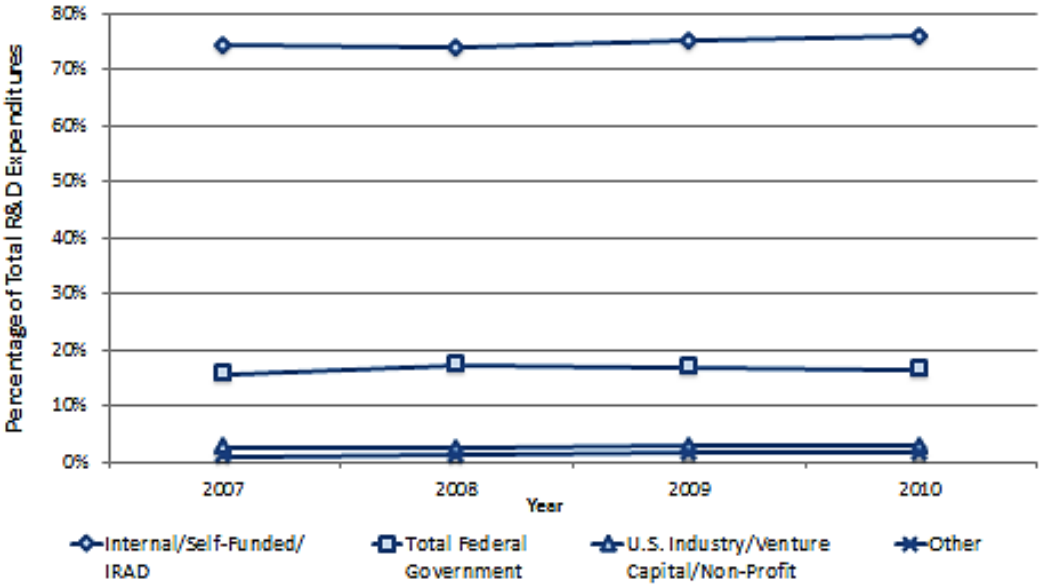


*Based on 223 respondents that reported R&D expenditures by source over the period; adjusted to remove disproportionately large value from one respondent

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

However, the figures for R&D funding sources look quite different on a per company average basis (see Figure VI-12). For survey respondents reporting R&D expenditures, Internal/Self-Financed funding was on average over 70 percent, with Federal R&D funding approximately 16 percent. Overall, Internal/Self-Financed R&D expenditures as a percentage of total R&D expenditures increased over the period by approximately two percent, from 74 percent in 2007 to 76 percent in 2010. Federal Government-financed R&D expenditures as a percentage of total R&D expenditures increased by less than one percent, remaining between 16 and 17 percent over the period. R&D expenditures financed by U.S. Industry, Venture Capital, and Non-Profits as a percentage of total R&D expenditures remained at about two percent all four years.

Figure VI-12: Adjusted Average R&D Funding Sources as a Percentage of Total R&D Expenditures (2007-2010)*

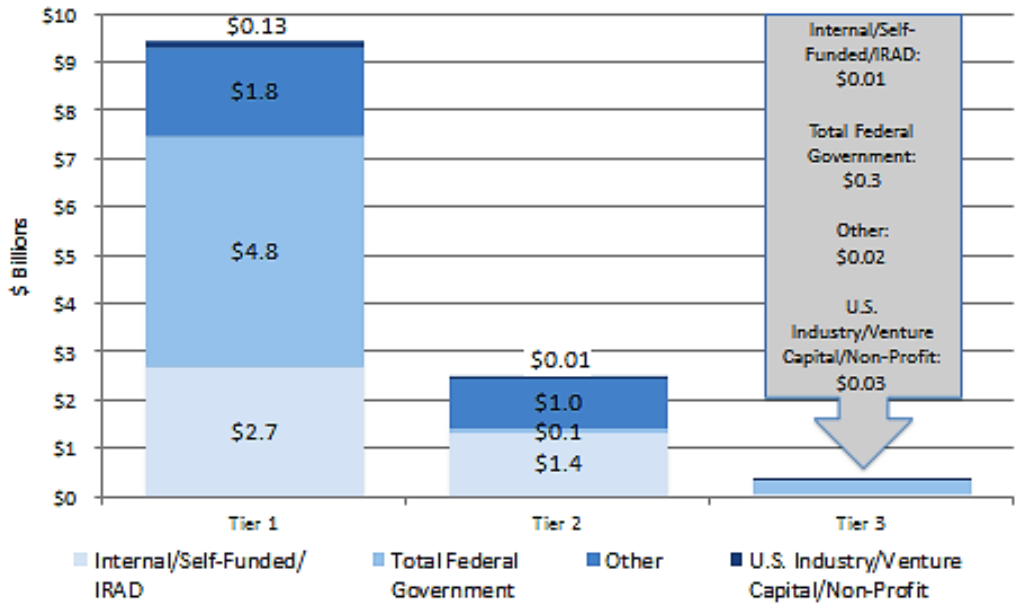


*Based on 223 respondents that reported R&D expenditures by source over the period; adjusted to remove disproportionately large value from one respondent

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

From a tier perspective, Tier 1 respondents accounted for 76 percent of the more than $12 billion in R&D funding from the identified sources in 2010, which included funding for NASA projects. Tier 1 companies received 93 percent of the approximately $5 billion in total Federal Government R&D funding and accounted for 65 percent of the approximately $4 billion in Internal/Self-Financed R&D funding (see Figure VI-13). Tier 2 and Tier 3 respondents received two and five percent of reported Federal Government-financed R&D, respectively.

Figure VI-13: Adjusted R&D Funding Sources by Tier (2010)*



*Based on 223 respondents that reported R&D expenditures by source over the period; adjusted to remove disproportionately large value from one respondent

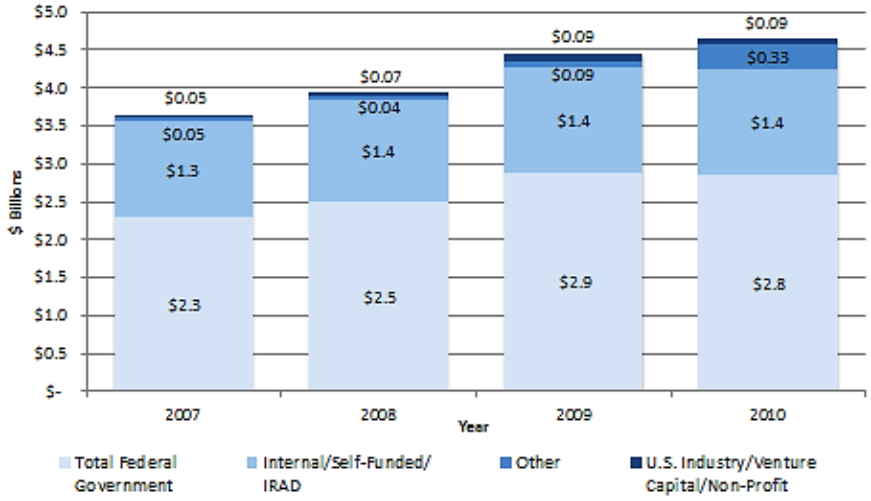
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

D. NASA-Related R&D Funding Sources

For the 81 survey respondents that conducted NASA-related R&D, approximately half of their R&D funding on a dollar basis came from Federal Government sources (see Figure VI-14).[51] Total Federal Government-financed R&D for these companies increased from $2.3 billion in 2007 to $2.9 billion in 2009 before falling to $2.8 billion in 2010. However, it is not possible to ascertain how much of the R&D from the identified sources, including funds from the Federal Government, was dedicated to NASA-related R&D activities.

[51] A graph of the average R&D funding sources as a percentage of total R&D expenditures for suppliers that conducted NASA-related R&D can be found in Appendix A.

Figure VI-14: Total R&D Funding Sources for Suppliers that Conducted NASA-Related R&D (2007-2010)*

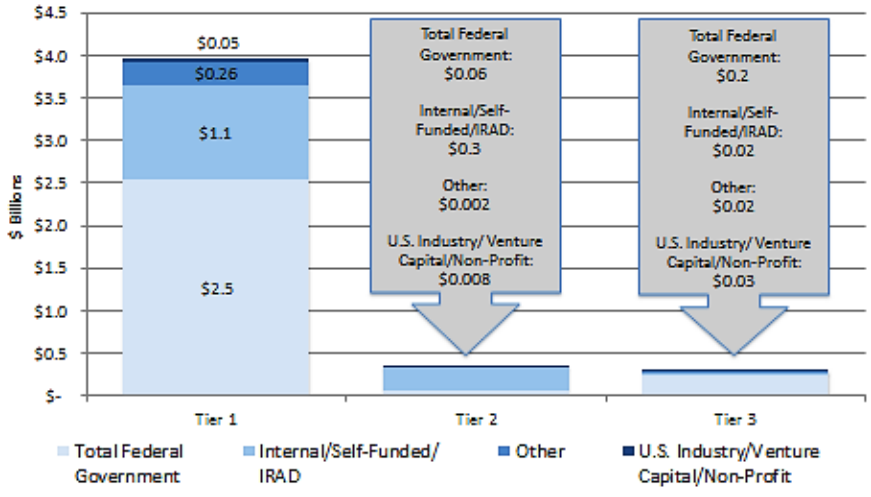


*Based on 74 respondents that reported NASA-related R&D expenditures and reported R&D expenditures by source over the period

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

From a tier perspective, Tier 1 and Tier 3 companies that conducted NASA-related R&D received the majority of their R&D funding from the Federal Government (see Figure VI-15). In 2010, 64 percent of Tier 1 R&D and 79 percent of Tier 3 R&D was from Federal Government sources. In contrast, Tier 2 companies funded the majority of their own R&D. R&D from U.S. Industry/Venture Capital/Non-Profit sources was the smallest for all three tiers.

Figure VI-15: Total R&D Funding Sources for Suppliers that Conducted NASA-Related R&D by Tier (2010)*

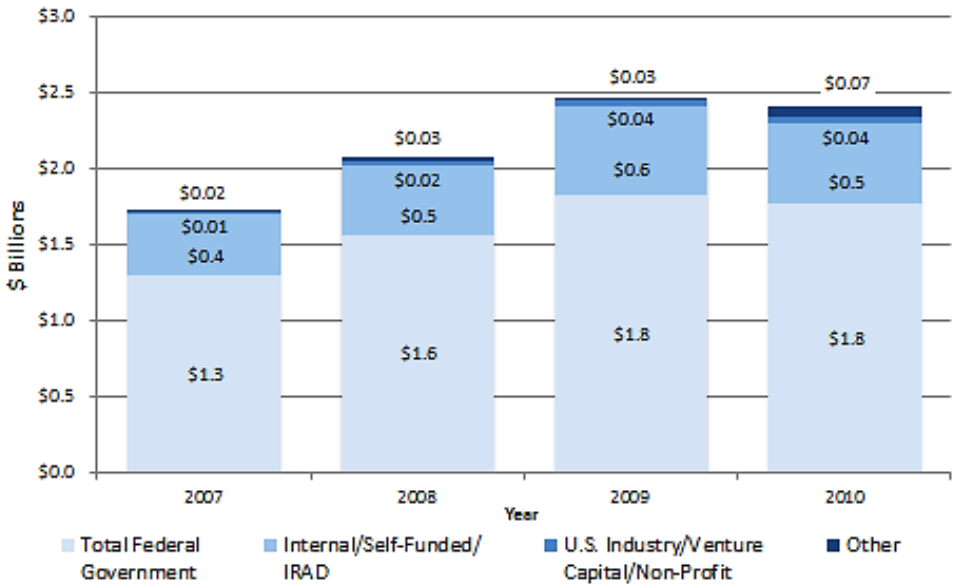


*Based on 74 respondents that reported NASA-related R&D expenditures and reported R&D expenditures by source over the period

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

A deeper examination of NASA-dependent survey respondents shows a larger dependence on total Federal Government-financed R&D funding – 75 percent of their total R&D funding sources (see Figure VI-16). This is more than companies that conducted any NASA-related R&D, for which Federal Government R&D funding was approximately 55 percent of total R&D. Overall, approximately half of the R&D funding from reported sources for NASA-dependent respondents was attributable to NASA-related R&D.[52]

Figure VI-16: Total R&D Funding Sources for NASA-Dependent Suppliers (2007-2010)*



*Based on 65 NASA-dependent respondents that reported R&D expenditures by source over the period

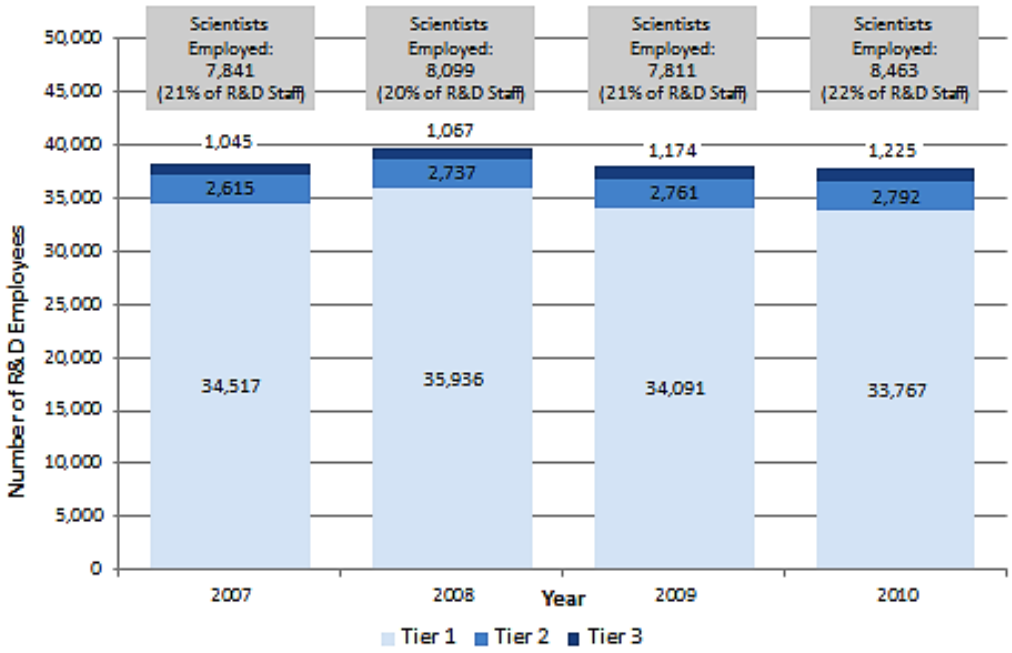
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

E. R&D Employment

OTE asked NASA HSF suppliers about their R&D workforce and hiring practices. The number of overall R&D employees increased from approximately 38,000 in 2007 to approximately 39,700 in 2008, and then declined to approximately 37,700 in 2010 (see Figure VI-17). The majority of reported R&D employees worked for Tier 1 companies. The number of scientists employed by survey respondents remained between 7,800 and 8,500 during the period, roughly 20 percent of R&D staff each year.

[52] A graph on total R&D funding sources for NASA-dependent suppliers that conducted NASA-related R&D can be found in Appendix A.

Figure IV-17: Number of R&D Employees by Tier (2007-2010)*



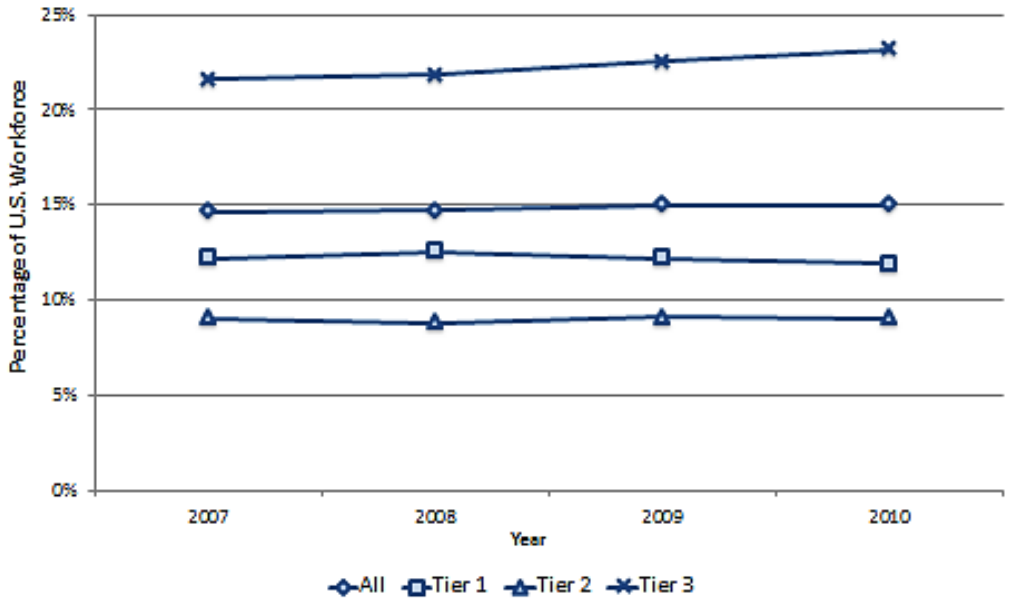
*Based on 242 respondents that employed R&D staff over the period

Source: U.S. Department of Commerce, Bureau of Industry and Security, NASA Supply Chain Network, June 2012

Overall, the average percentage of R&D personnel employed by the 242 survey respondents that reported R&D staff in the United States remained stable over 2007-2010 (see Figure VI-18). Although Tier 2 suppliers allocate the highest percent of total sales to R&D expenditures, they employed the fewest R&D employees as a percent of their U.S. workforce compared to Tier 1 and Tier 3 suppliers.[53]

[53] Figure VI-5, Average R&D Expenditures as a Percentage of Total Sales, can be found on page 61. A graph on median R&D staff as a percentage of respondent U.S. workforce can be found in Appendix A.

Figure VI-18: Average R&D Staff Percentage of Total U.S. Workforce with Tiers (2007-2010)

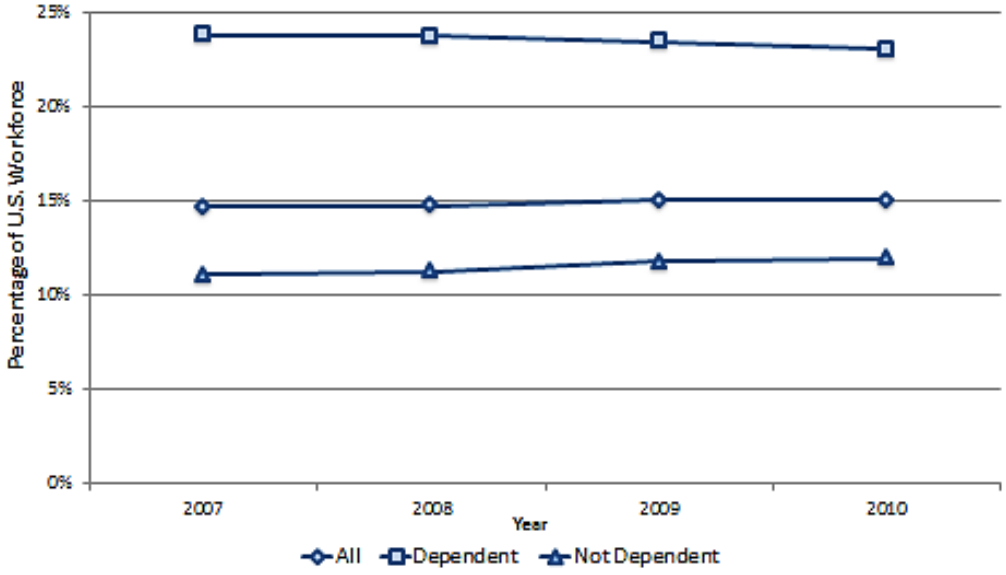


*Based on 226-240 respondents that reported both R&D staff and total workforce depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

NASA-dependent suppliers employed a much higher average percentage of R&D employees in their U.S. workforce than suppliers that were not dependent on NASA (see Figure VI-19). The percentage of R&D employees for NASA-dependent respondents remained steady at approximately 23 percent each year, while the percentage of R&D employees for respondents not dependent on NASA increased slightly from approximately 11 percent in 2007 to approximately 12 percent in 2010.

Figure VI-19: Average R&D Staff as a Percentage of Total U.S. Workforce for NASA-Dependent and Non-Dependent Respondents (2007-2010)



*Based on 226-240 respondents (64-67 NASA-dependent) that reported both R&D staff and total workforce depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

VII. Capital Expenditures

Capital expenditures are used by a company to acquire or upgrade physical assets such as property, equipment, buildings, or information technology. This type of expenditure is made by companies to maintain or increase the scope of their operations.

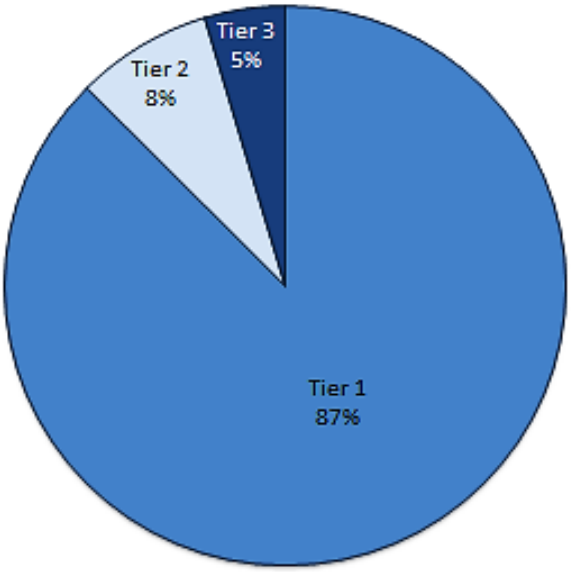
OTE asked NASA HSF suppliers to record their capital expenditures for 2007-2010 at the Corporate/Whole Company or Business Unit/Division level. Respondents were also asked to divide their capital expenditures into three main categories: Machinery, Equipment, and Vehicles; IT, Computers, and Software; and Land, Buildings, and Leasehold Improvements. In addition, respondents provided the approximate percentage of total capital expenditures that related directly to their NASA business lines.

A. Total Capital Expenditure Breakdowns

Total capital expenditures reported by survey respondents amounted to $97.2 billion for the entire 2007-2010 period.[54] Tier 1 companies accounted for the largest share of total capital expenditures, 87 percent or $85 billion (see Figure VII-1). Tier 2 companies reported expenditures of $7.7 billion and Tier 3 companies reported $4.5 billion. Together, Tier 2 and Tier 3 companies accounted for 13 percent of the total capital expenditures reported over the period.[55]

[54] Total capital expenditures include expenditures for all company business lines, including NASA HSF-related projects.
[55] A graph on the breakdown of total capital expenditures reported by business units can be found in Appendix A.

Figure VII-1: Breakdown of Total Capital Expenditures by Tier (2007-2010)*



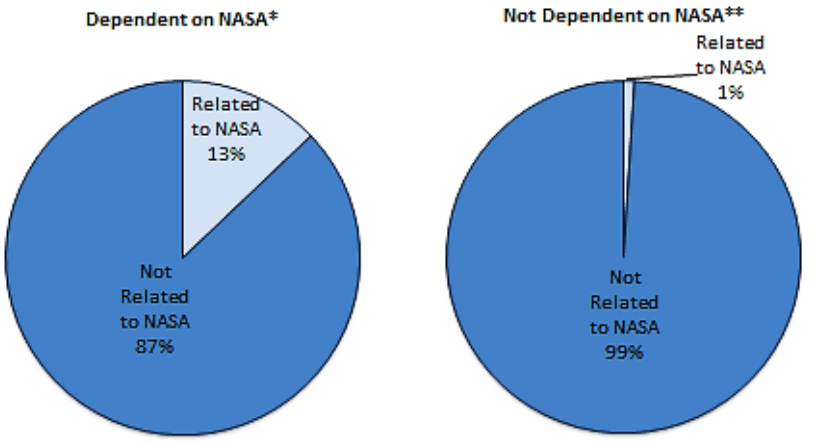
*Based on 481 respondents that recorded capital expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

All survey respondents were asked to identify the percentage of their total capital expenditures that related to NASA business. Ninety-nine percent of the reported capital expenditures between 2007 and 2010 were not directly related to suppliers' NASA business lines. The one percent dedicated to NASA may be undervalued, however, because some companies had difficulty isolating the value of their NASA-related capital expenditures from capital expenditures that serve their other business lines. Furthermore, some companies stated that their equipment was used for all of their business lines or that they have a number of customers for the same products and services that they supply to NASA.

When reviewing the capital expenditures reported by companies who declared themselves dependent on NASA business, the percentage of capital expenditures devoted to NASA increases. NASA-dependent HSF suppliers devoted 13 percent of their total capital expenditures to NASA business lines, while companies that are not dependent on NASA and recorded NASA-related capital expenditures devoted approximately one percent (see Figure VII-2).

Figure VII-2: NASA-Related Capital Expenditures Percentage of Total for NASA-Dependent and Non-Dependent Suppliers (2007-2010)



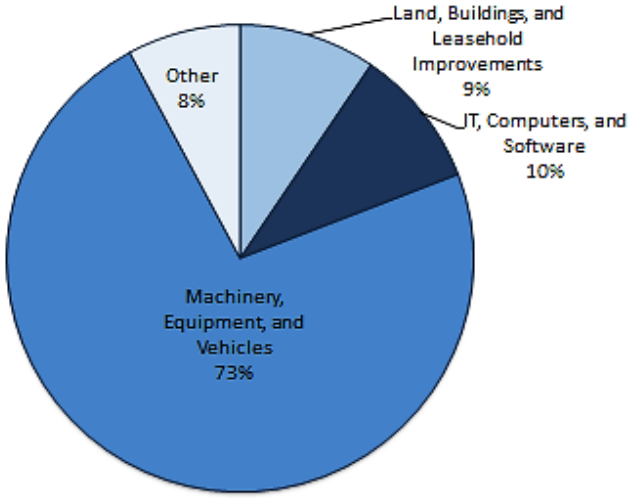
*Based on 67 NASA-dependent respondents that recorded NASA-related capital expenditures

**Based on 32 respondents that are not dependent on NASA that recorded NASA-related capital expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Companies reported their aggregate capital expenditures in three different requested categories.[56] Nearly three quarters of total capital expenditures were spent on Machinery, Equipment, and Vehicles over the period (see Figure VII-3). The shares for other categories were nearly equal.

Figure VII-3: Percentage Breakdown of Total Capital Expenditures by Category (2007-2010)



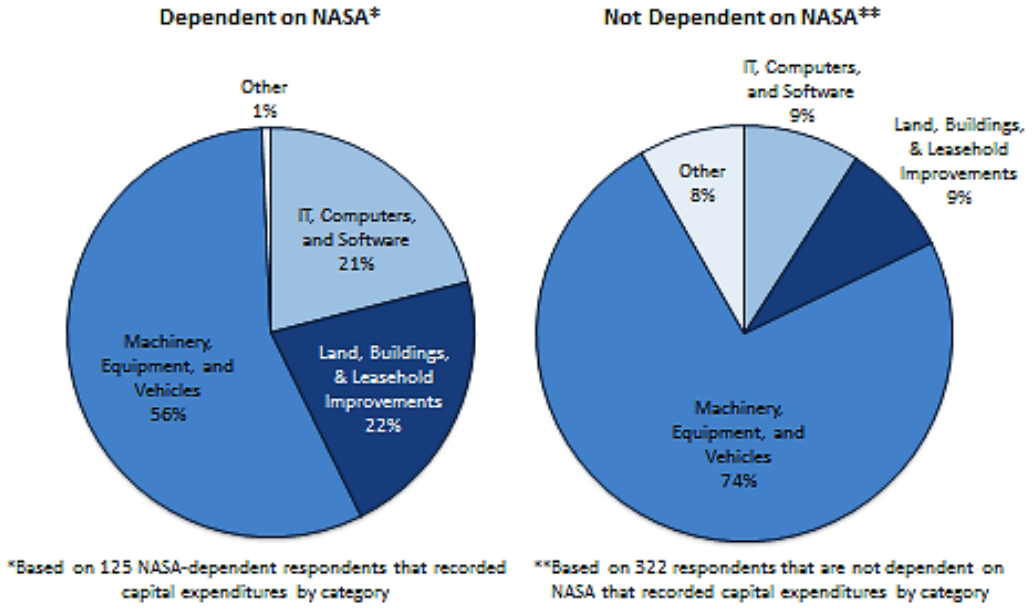
*Based on 447 respondents that recorded capital expenditures by category

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[56] The three categories of capital expenditures were Machinery, Equipment, and Vehicles; IT, Computers, and Software; and Land, Buildings, and Leasehold Improvements.

Companies that are dependent on NASA have a different mix of capital expenditures than companies that are not dependent on NASA (see Figure VII-4). NASA-dependent companies spent a greater portion of their aggregate capital expenditures on IT, Computers, and Software, and Land, Buildings, and Leasehold Improvements, while companies not dependent on NASA spent more on Machinery, Equipment, and Vehicles.

Figure VII-4: Breakdown of Total Capital Expenditures by Category for NASA-Dependent and non-Dependent Suppliers (2007-2010)



*Based on 125 NASA-dependent respondents that recorded capital expenditures by category

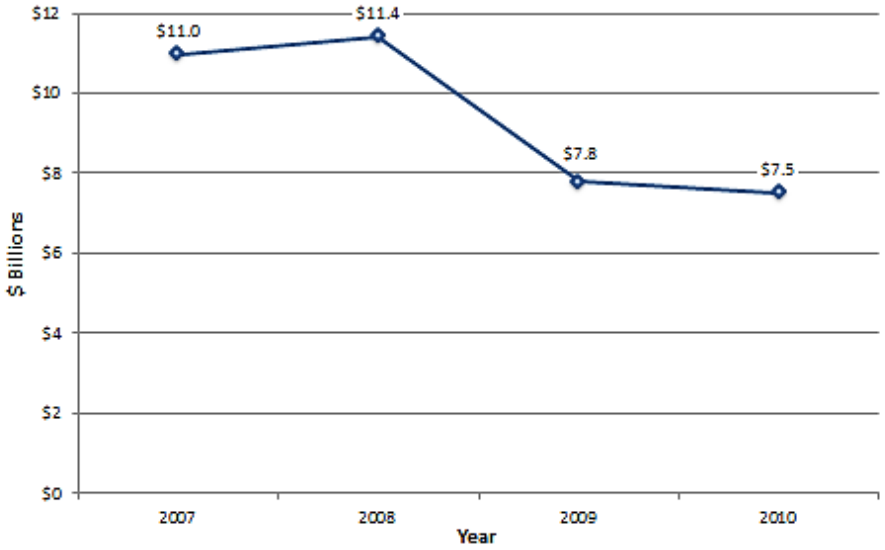
**Based on 322 respondents that are not dependent on NASA that recorded capital expenditures by category

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

B. Total Capital Expenditure Trends between 2007-2010

Overall, total capital expenditures by survey respondents declined by 32 percent from 2007-2010. Between 2007 and 2008, capital expenditures increased slightly before falling abruptly after 2008 and continued dropping in 2009 and 2010 (see Figure VII-5). While most survey respondents did not provide a reason for this decline, a couple of Tier 3 companies commented that they stopped capital expenditures due to the Shuttle retirement and CxP transition. It can also be assumed that the global recession of 2008-2009 had an impact on companies' capital expenditures.

Figure VII-5: Total Capital Expenditures (2007-2010)*

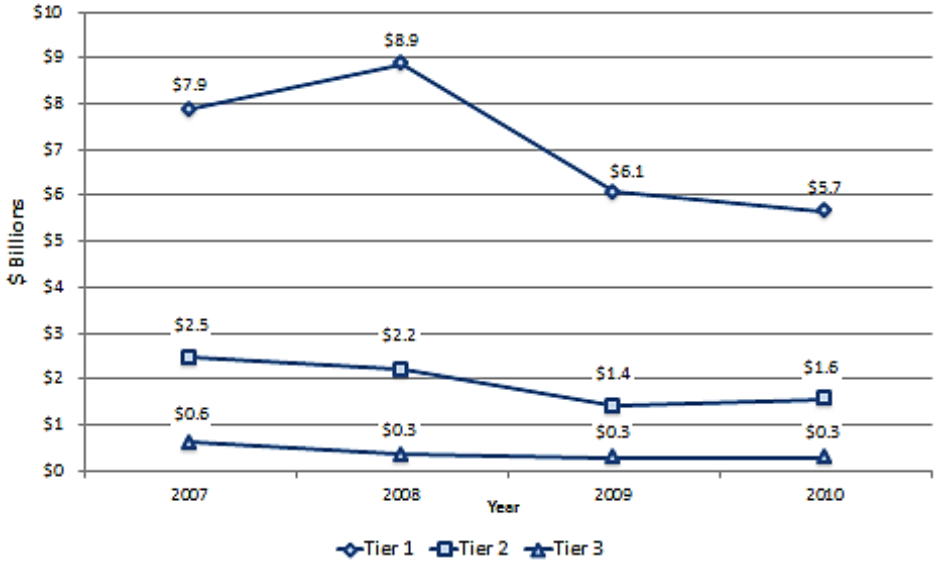


*Based on 481 respondents that recorded capital expenditures, including NASA-related capital expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Total capital expenditures for all three tiers show similar trends over the period (see Figure VII-6). Tier 1 companies reduced their total capital expenditures by 28 percent. Tier 2 and Tier 3 companies, starting from a much smaller base than Tier 1 companies, reduced their capital expenditures by 37 and 54 percent, respectively, from 2007-2010.

Figure VII-6: Total Capital Expenditures by Tier (2007-2010)*

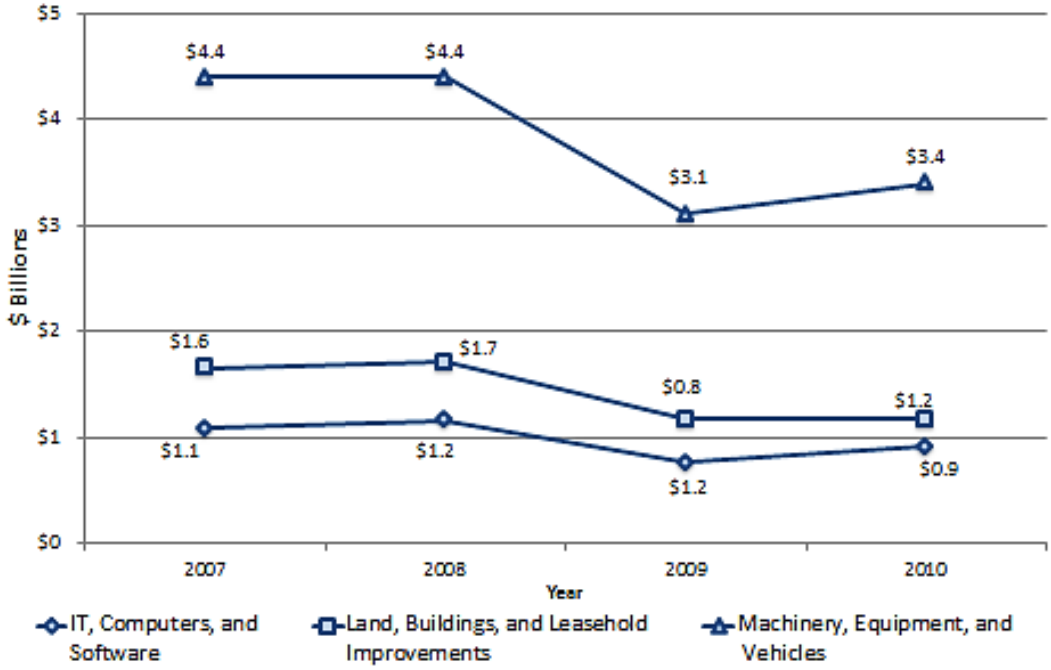


*Based on 481 respondents that recorded capital expenditures, including NASA-related capital expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Capital expenditures in all three main categories also declined over 2007-2010 (see Figure VII-7). Expenditures on Machinery, Equipment, and Vehicles experienced the largest decline in value, approximately $1 billion or 23 percent. Expenditures on IT, Computers, and Software fell by 16 percent and expenditures on Land, Buildings, and Leasehold Improvements fell by 29 percent. While aggregate capital expenditures declined over from 2007-2010, the proportion of total capital expenditures by the three main categories remained relatively stable. This was true for both NASA-dependent companies and companies that are not dependent on NASA.

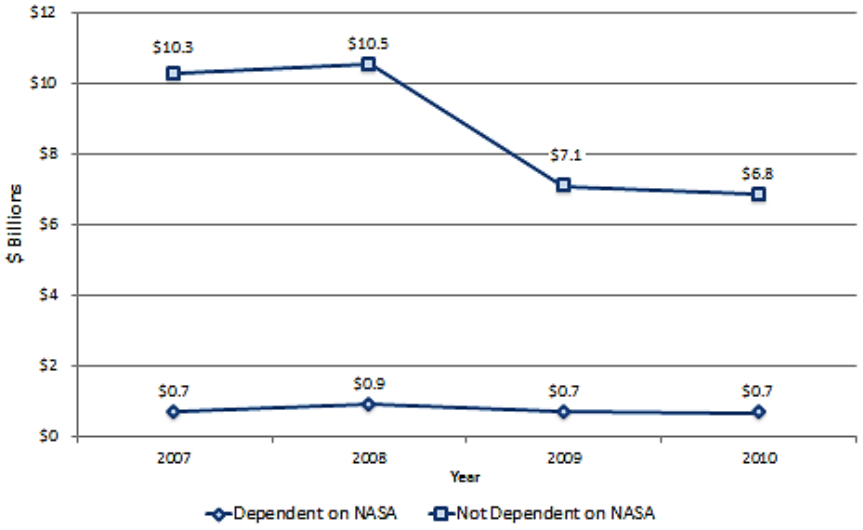
Figure VII-7: Total Capital Expenditures by Category (2007-2010)*



*Based on 447 respondents that recorded capital expenditures by category, including NASA-related capital expenditures;
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

NASA-dependent suppliers maintained relatively stable levels of capital expenditures for 2007-2010, reducing their capital expenditures over the period by only four percent overall (see Figure VII-8). This contrasts sharply with companies that are not dependent on NASA, as their capital expenditures declined by 33 percent over the period.

Figure VII-8: Total Capital Expenditures by NASA-Dependency (2007-2010)*

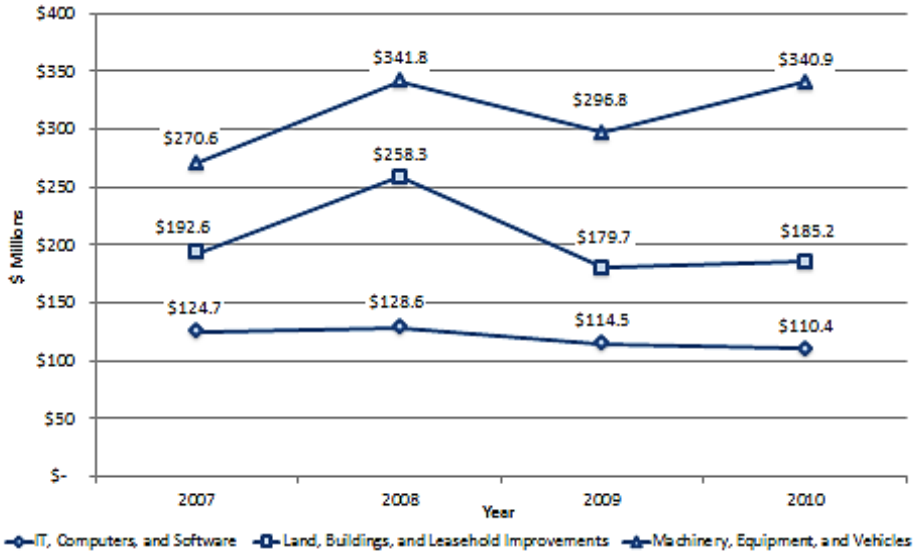


*Based on 481 respondents (130 NASA-dependent) that recorded capital expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

With regard to capital expenditure patterns in the three main categories, NASA-dependent HSF suppliers highlighted modulating spending levels in all three areas (see Figure VII-9). Expenditures on IT, Computers, and Software fell by 11 percent, while expenditures on Land, Buildings, and Leasehold Improvements decreased by four percent overall. Expenditures on Machinery, Equipment, and Vehicles, the largest category, experienced an increase of 26 percent over the period.

Figure VII-9: Capital Expenditures for NASA-Dependent Companies by Category (2007-2010)*



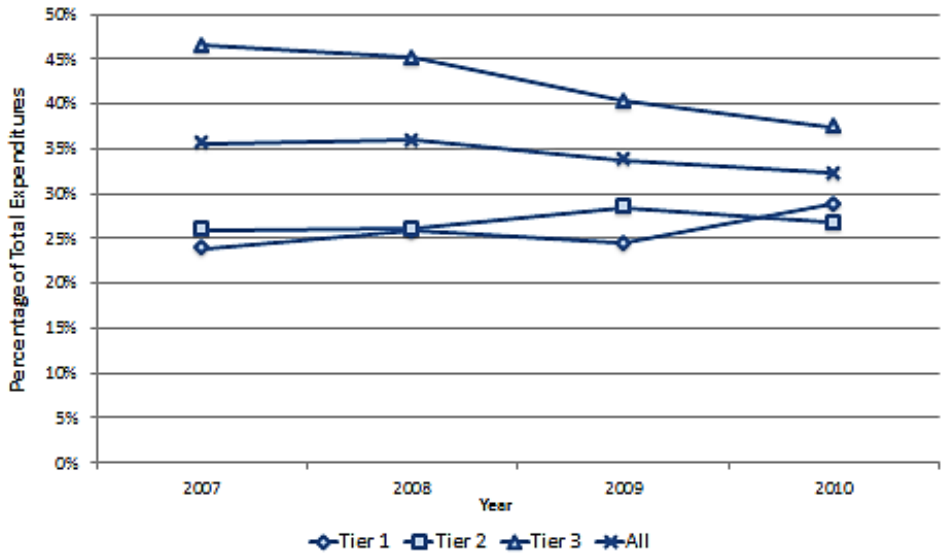
*Based on 125 NASA-dependent respondents that recorded capital expenditures by category

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

C. NASA-Related Capital Expenditure Trends

Analysis of capital expenditures of the 102 companies that reported NASA-related expenditures provides another perspective on industry actions. NASA-related capital expenditures as a percentage of total capital expenditures declined from 2007-2010 for the 102 companies that had any NASA-related expenditures (see Figure VII-10).[57] In 2007, the percentage of total capital expenditures that were directly related to NASA business averaged 36 percent for each company. By 2010, the percentage averaged 32 percent per company. Some companies indicated they reduced their capital expenditures over the period because they anticipated that NASA would cancel the Space Shuttle program.

Figure VII-10: Average NASA-Related Capital Expenditures as a Percentage of Total Expenditures by Tier (2007-2010)*



*Based on 102 respondents that recorded NASA-related capital expenditures

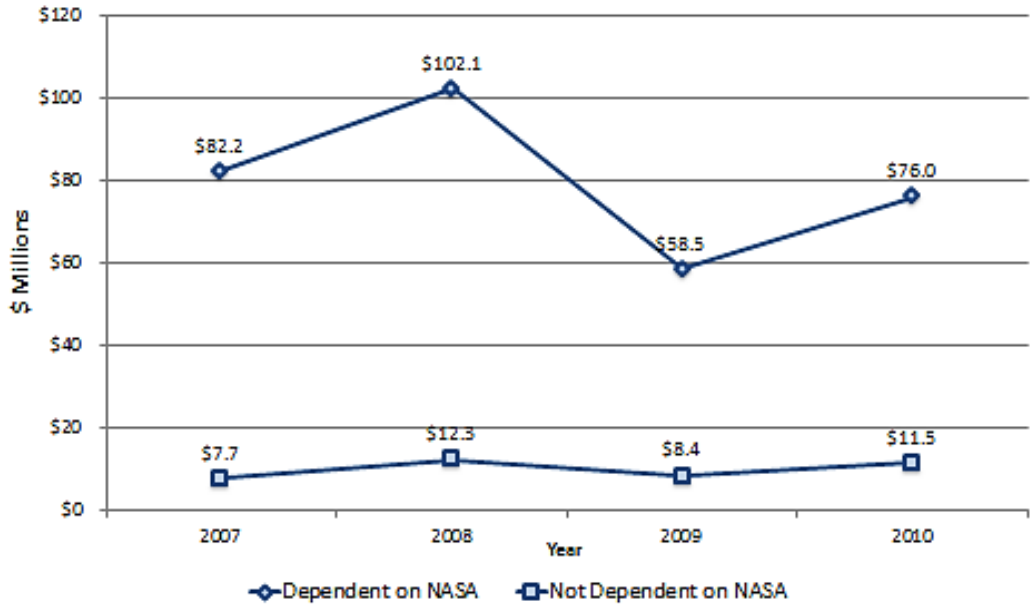
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The decline in the percentage of total capital expenditures that are directly related to NASA business lines seems to be driven mostly by Tier 3 companies. The average percentage per company for Tier 3 decreased from 39 percent in 2007 to 28 percent in 2010. In contrast, the average percentages per company for Tier 1 and Tier 2 remained relatively stable over the period.

[57] These figures represent averages of per company percentages for each year.

Of the 150 self-identified NASA-dependent suppliers, 68 reported NASA-related R&D expenditures. The R&D expenditures for these companies were slightly more than $82 million in 2007, and declined approximately $58 million in 2009 before increasing to $76 million in 2010 (see Figure VII-11). While NASA-related R&D expenditures for companies not dependent on NASA remained relatively stable over the four-year period, the amount of total outlays was much less than that of NASA-dependent companies.

Figure VII-11: Total NASA-Related Capital Expenditures by NASA-Dependent and Non-Dependent Suppliers (2007-2010)*

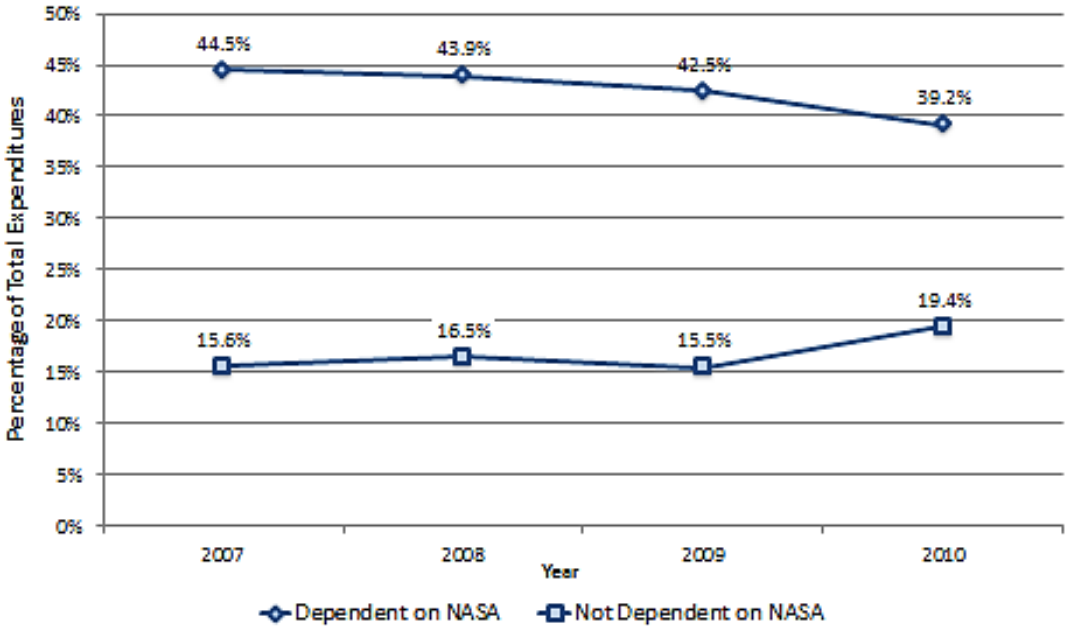


*Based on 102 respondents (68 NASA-dependent) that recorded capital expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The 68 NASA-dependent survey respondents with NASA-related expenditures also experienced a decline in the percentage of total capital expenditures directly related to NASA business lines (see Figure VII-12). The average NASA-related expenditures as a percentage of total expenditures for NASA-dependent HSF suppliers declined approximately five percent between 2007 and 2010. In contrast, the average for suppliers not dependent on NASA increased slightly during the period, although capital investment by NASA-dependent companies remained twice as large.

Figure VII-12: Average NASA-Related Expenditures as a Percentage of Total Expenditures by NASA Dependency (2007-2010)*



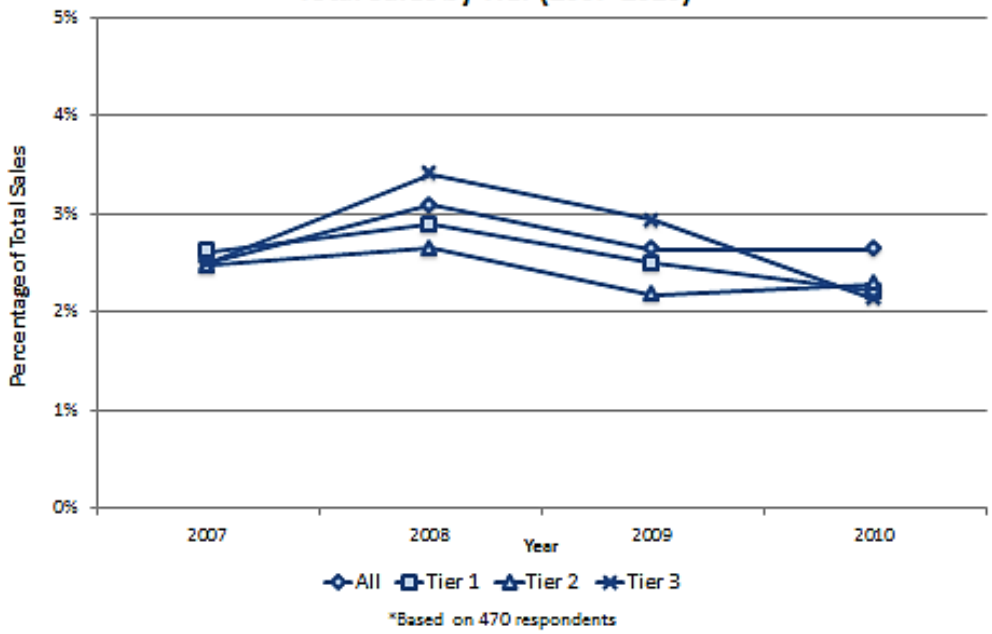
*Based on 102 respondents (68 NASA-dependent) that recorded NASA-related capital expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

D. Capital Expenditures as a Percentage of Total Sales

To better understand the extent to which NASA HSF suppliers reinvested revenues in physical assets from 2007-2010, rates of capital expenditures over total sales were calculated across both tiers and NASA dependent segments. Respondent data showed that during the period, the percentage of total sales dedicated to capital expenditures declined from 2.5 percent to 2.3 percent on an individual company basis. On average, between two to three percent of respondents' revenues were used for capital expenditures (see Figure VII-13). Tier 3 companies, on average, exhibited the largest decline in capital expenditures as a percent of revenues during the period, from 2.5 percent to 2.1 percent.

Figure VII-13: Average Capital Expenditures as a Percentage of Total Sales by Tier (2007-2010)*

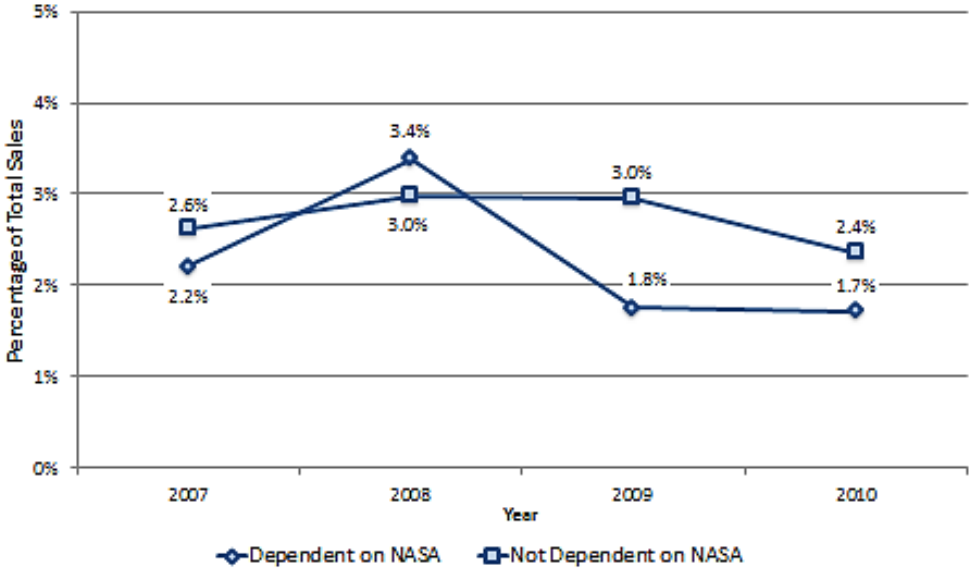


*Based on 470 respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

When evaluating the capital investment data reported by NASA dependent companies, those survey respondents dependent on NASA business invested less on average than respondents not dependent on NASA work (see Figure VII-14). Across suppliers both dependent and not dependent on NASA business, the rate of investment in capital goods as a percentage of total sales declined from 2007-2010.

Figure VII-14: Average Capital Expenditures Percentage of Total Sales with NASA Dependency (2007-2010)*



*Based on 470 respondents (124 NASA-dependent)

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

VIII. Supply Chain Relationships

A key aspect of supply chain management is understanding the different interrelationships between the companies within the supply chain that support NASA programs. To that end, OTE asked NASA human space flight (HSF) suppliers to provide information on their U.S. and non-U.S. mergers and acquisitions and joint ventures. Survey respondents also provided detailed information on their top domestic and non-U.S. competitors. Finally, companies reported on their own supply chains by supplier as well as by products and services acquired. This provided a unique portrait of relationships for NASA HSF companies throughout multiple tiers.

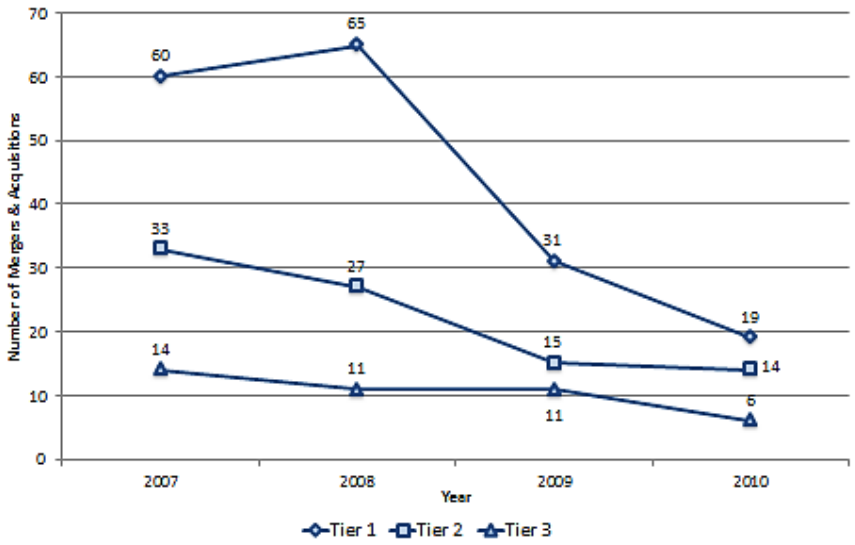
A. Mergers and Acquisitions

Survey respondents were asked to identify their most significant mergers and acquisitions (M&As) that occurred from 2007 to 2010.[58] In total, 134 survey respondents or 25 percent reported at least one M&A transaction during the period, with a total of 306 M&A transactions reported. The number of M&A transactions fell significantly from 107 in 2007 to 39 in 2010 (see Figure VIII-1).

In 2007, 60 Tier 1 respondents reported M&A transactions compared to 33 from Tier 2 and 14 from Tier 3. By 2010, M&A transactions decreased by 68 percent in Tier 1 and by 57 percent in both Tier 2 and Tier 3. Although the exact reasoning behind the decline is uncertain, it can be inferred that the economic downturn and reduction in available credit, which occurred from 2008 to 2009, had an impact on companies' M&A activities.

[58] A merger is a business activity involving the combination of two companies to form a single company, while an acquisition is the purchase of one company by another.

Figure VIII-1: Mergers & Acquisitions by Tier (2007-2010)

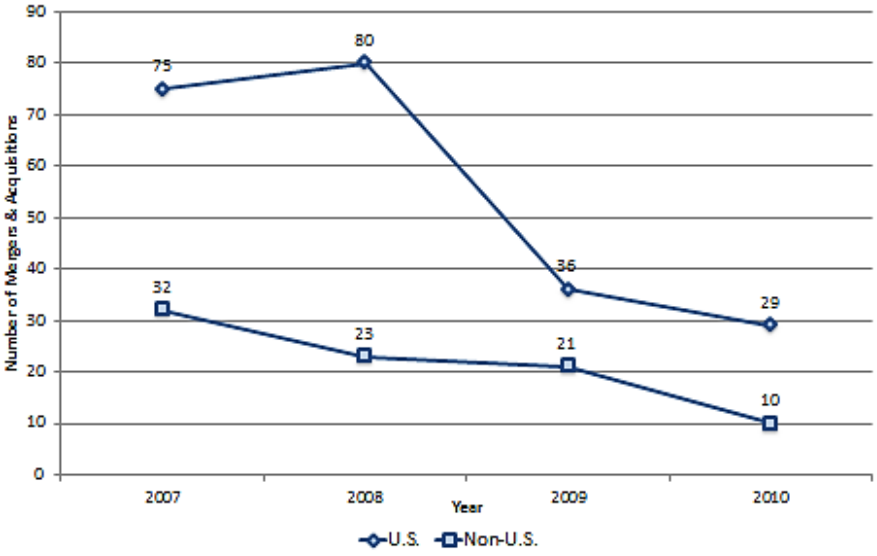


* 134 survey respondents had at least one merger & acquisition from 2007-2010

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

More than two-thirds of the reported 306 M&A transactions took place in the United States. The largest number of non-U.S. M&A transactions took place the United Kingdom and Canada; five M&A transactions took place in China.[59] The number of M&A transactions declined by more than 60 percent both in and outside the United States from 2007-2010 (see Figure VIII-2).

Figure VIII-2: Mergers & Acquisitions by Location (2007-2010)*



* 134 survey respondents had at least one merger & acquisition from 2007-2010

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[59] A chart detailing non-U.S. M&A transactions by country can be found in Appendix A.

Companies listed a number of reasons why M&A transactions occurred, including to enter new markets, to access potential new customers, to gain specific skills and abilities such as information technology and engineering, and ultimately to expand business lines. Most survey respondents did not merge or accrue firms for the sole reason of increasing NASA-related relationships, but rather to enhance their overall customer base and market position. Only one company specifically stated that they merged to enhance their business relationships with NASA, DOD, and commercial businesses.

B. Joint Venture Relationships

In addition to M&A transactions, survey respondents were asked about the number of NASA-related joint venture relationships in which they participated.[60] Joint venture relationships typically involve more affordable product development, market entry, co-production, technology transfer, or other mutually beneficial aims not requiring the large capital outlays observed in typical M&A transactions. Thirty-two of the 536 survey respondents (six percent) indicated that they participated in at least one joint venture relationship. Those companies reported a total of 49 NASA-related joint ventures, 34 of which were related to the Space Shuttle (Shuttle), the International Space Station (ISS), or the Constellation (CxP) programs.

Unlike most of the documented M&A activities, which were concentrated among Tier 1 and Tier 2 HSF suppliers, the distribution of joint venture relationships between the tiers was more evenly disbursed, with slightly more occurring at the Tier 3 level (see Figure VIII-3). The survey respondents listed multiple reasons for taking part in joint ventures, such as to increase growth in businesses, to expand profitability, to explore a wide variety of new markets, and to facilitate international cooperation. Some examples of product development-based joint ventures included advanced materials for rocket boosters and nozzles, metallurgy, rocket motors, engineering, services, and launch support activities.

[60] A joint-venture is a contractual agreement bringing together two or more parties for the purpose of executing a particular business undertaking. All parties usually agree to share in the profits and losses of the enterprise.

Figure VIII-3: Joint Venture Relationships					
Category	U.S.	Non-U.S.	By Tier 1	By Tier 2	By Tier 3
Number of Joint Ventures	48	1	15	14	20
Number of NASA HSF-Related Joint Ventures	33	1	11	8	15

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

C. U.S. and Non-U.S. Competitors

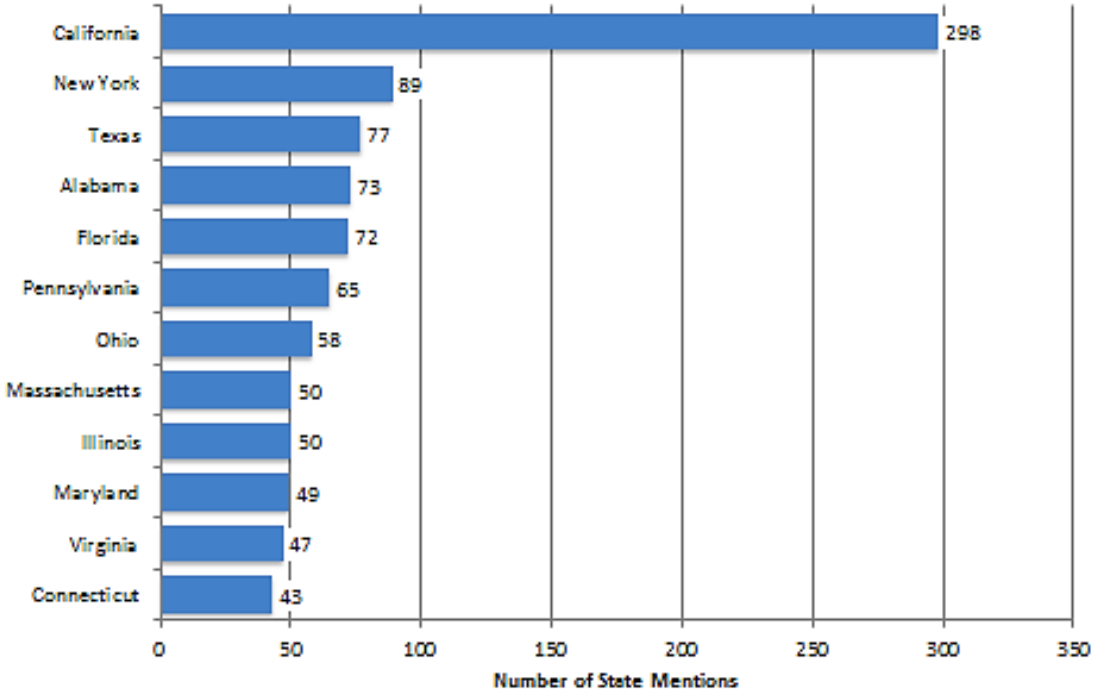
NASA HSF suppliers were asked to identify the names and locations of their company's leading U.S. and non-U.S. competitors, as well as the product or service relating to the competition. While survey respondents identified their competitors' products and services, the competitors were not necessarily related to the survey respondents' NASA activities but rather the respondent's primary business activities. Survey respondents reported 1,032 distinct U.S. competitors, of which 20 percent were surveyed in this effort.

A total of 46 states were mentioned as headquarter locations for competitors across the United States (see Figure VIII-4).[61] Like the survey respondents themselves, the largest number of identified competitors was located in California.[62] In fact, there were four times as many California competitors as Florida competitors, the fifth leading competitor location.

[61] Table X was calculated by the number of mentions listed by respondents, thus some companies may be counted more than once.

[62] Thirty-three states were reported by survey respondents but not identified in Table X. These states include (in order of number of mentions): Utah, Michigan, Colorado, Arizona, Minnesota, North Carolina, New Jersey, Washington, Missouri, Wisconsin, Indiana, Georgia, Kentucky, South Carolina, Kansas, Tennessee, Delaware, Oklahoma, New Hampshire, Oregon, Rhode Island, Alaska, Idaho, Iowa, Maine, Nevada, Vermont, West Virginia, Arkansas, New Mexico, Hawaii, Mississippi, and South Dakota. Respondents also reported the District of Columbia as a location of U.S.-based suppliers.

Figure VIII-4: Leading U.S.-Based Competitors by State

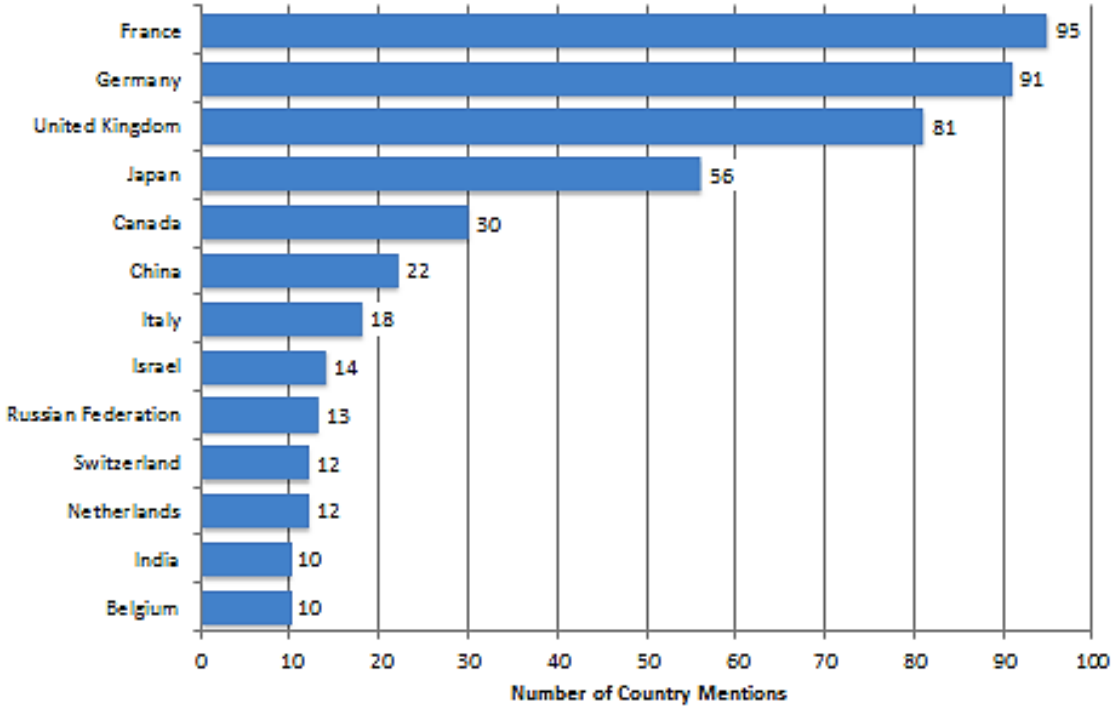


Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

A total of 462 distinct non-U.S. companies in 33 countries were identified by survey respondents as foreign HSF competitors, less than half the number of U.S. competitors reported. The largest numbers of foreign competitors were located in France, Germany and the United Kingdom (see Figure VIII-5).[63]

[63] Twenty countries were reported by survey respondents but not identified in Figure VIII-5. These countries include (in order of number of mentions): Taiwan, Mexico, Sweden, Denmark, Austria, South Korea, Finland, Norway, Singapore, Spain, Australia, Brazil, Czech Republic, North Korea, Greece, Hungary, Liechtenstein, South Africa, Sri Lanka, and Thailand.

Figure VIII-5: Leading Non-U.S. Based Competitors by Country

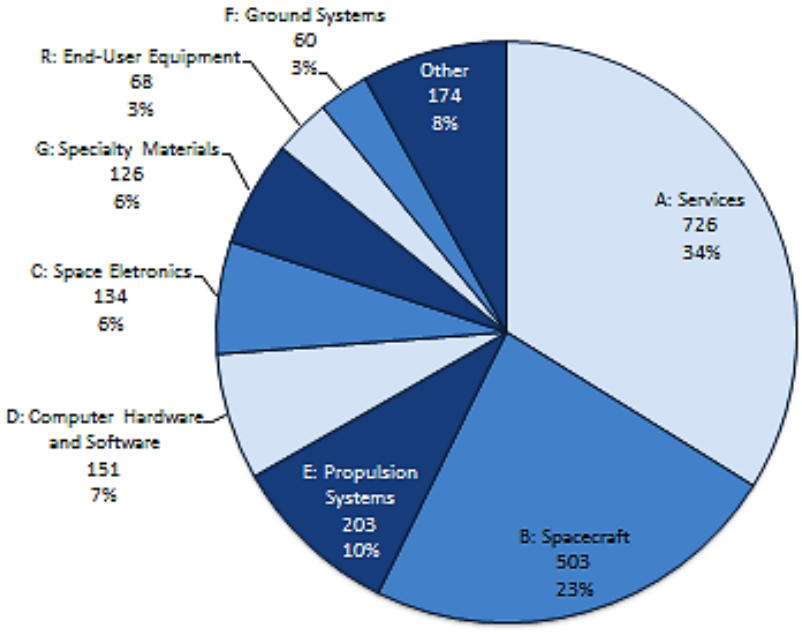


Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Survey respondents were also asked to indicate the product and services corresponding with a specific system, part, component, material, or service that related to their competition with an identified company.[64] Overall, there were 2,145 products and services mentions by NASA HSF suppliers as areas of competition in the United States, corresponding to 16 of 18 broad product and service categories. Services and Spacecraft were the two largest categories identified, making up 57 percent of the responses (see Figure VIII-6). This was followed by the Propulsion Systems and Computer Hardware and Software categories.

[64] A list of products and services can be found in the OTE survey in Appendix E.

Figure VIII-6: U.S.-Based Space Competition by Product and Service Category*

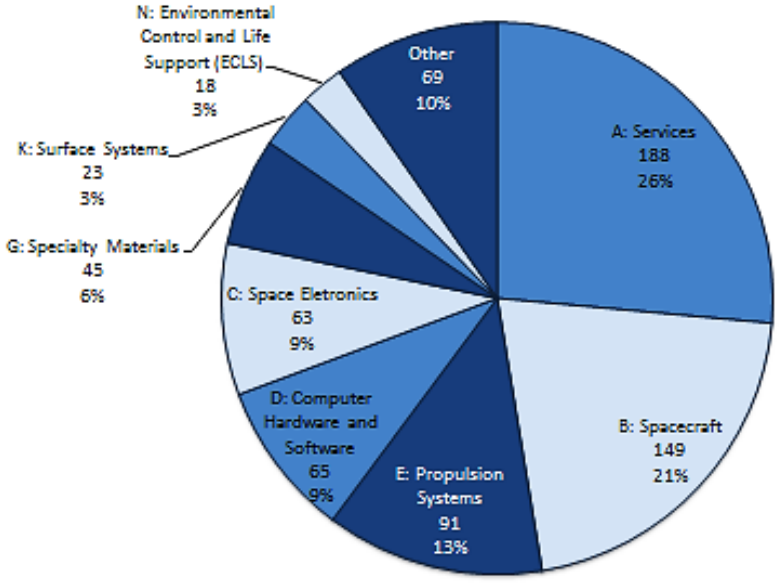


* Based on the number of times each product and service category was mentioned in a competitive relationship.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

There were 711 products and services mentions by NASA HSF suppliers as areas of competition outside of the United States, corresponding to 16 of 18 broad product and service categories. Responses indicated that Services, such as Mechanical Systems Testing and Commercial Satellite Operation, and Spacecraft, such as Hydraulics, Valves, Actuators, and Pneumatics, were leading areas of non-U.S. competition (see Figure VIII-7). Other categories, such as Specialty Materials and Surface Systems, were not as prevalent. The category break-downs for United States versus non-U.S. competition were mostly similar, even though there were three times as many product and service mentions for U.S. competitors.

Figure VIII-7: Non-U.S. Based Space Competition by Product and Service Category*



* Based on the number of times each product and service category was mentioned in a competitive relationship.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

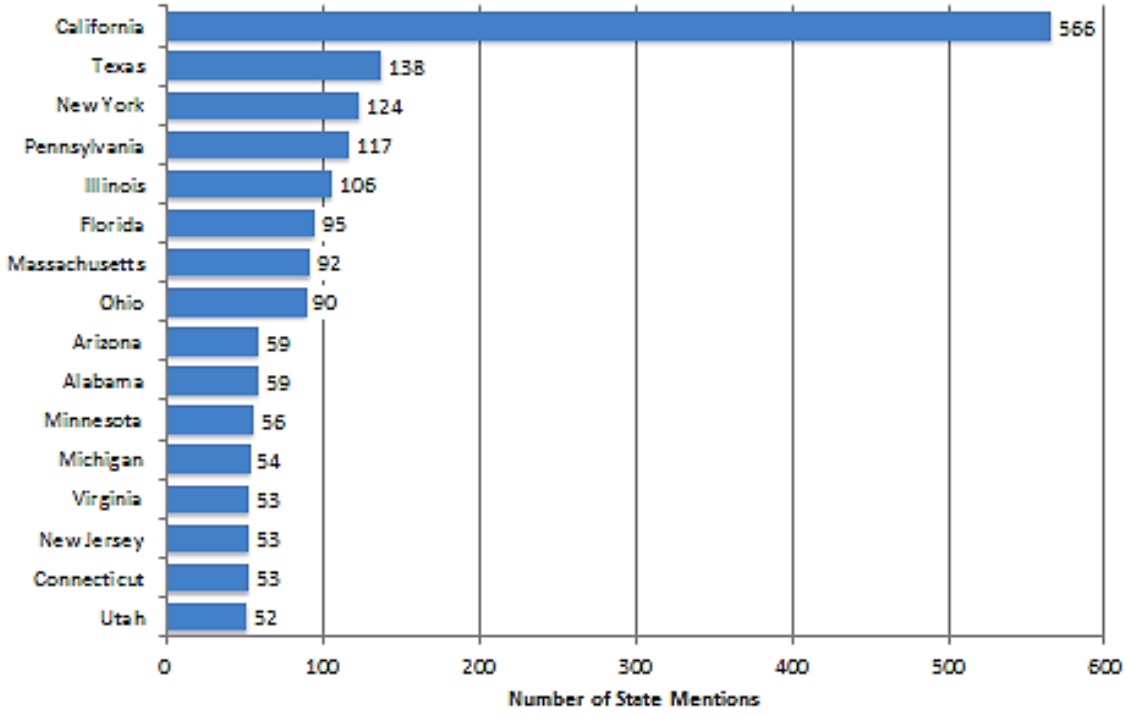
D. U.S. and Non-U.S. Suppliers

Survey respondents were asked to identify the names and locations of their company's ten most significant U.S. and non-U.S. suppliers for their NASA-related programs, as well as the top five products and services relating to the system, part, component, or service provided by each supplier. NASA HSF survey respondents reported 1,588 distinct U.S. suppliers supporting their activities, of which only 20 percent were surveyed in this effort.

Similar to survey respondent and U.S. competitor locations, a large portion of U.S-based suppliers are located in California, which was mentioned 566 times (see Figure VIII-8). There was approximately four times the number of suppliers in California as reported in Texas, the next most frequently-mentioned state, and almost six times the number reported in Florida. Overall, there were a total of 48 states reported for supplier locations across the United States.[65]

[65] Thirty-two states were reported by survey respondents but not identified in Table X. These states include (in order of number of mentions): Maryland, North Carolina, Colorado, Washington, Georgia, Indiana, South Carolina, Missouri, New Hampshire, Wisconsin, Oregon, Tennessee, Kentucky, Iowa, Delaware, New Mexico, West Virginia, Rhode Island, Kansas, Nevada, Idaho, Maine, Arkansas, Oklahoma, Louisiana, Vermont, Hawaii, Wyoming,

Figure VIII-8: Leading U.S.-Based Suppliers by State



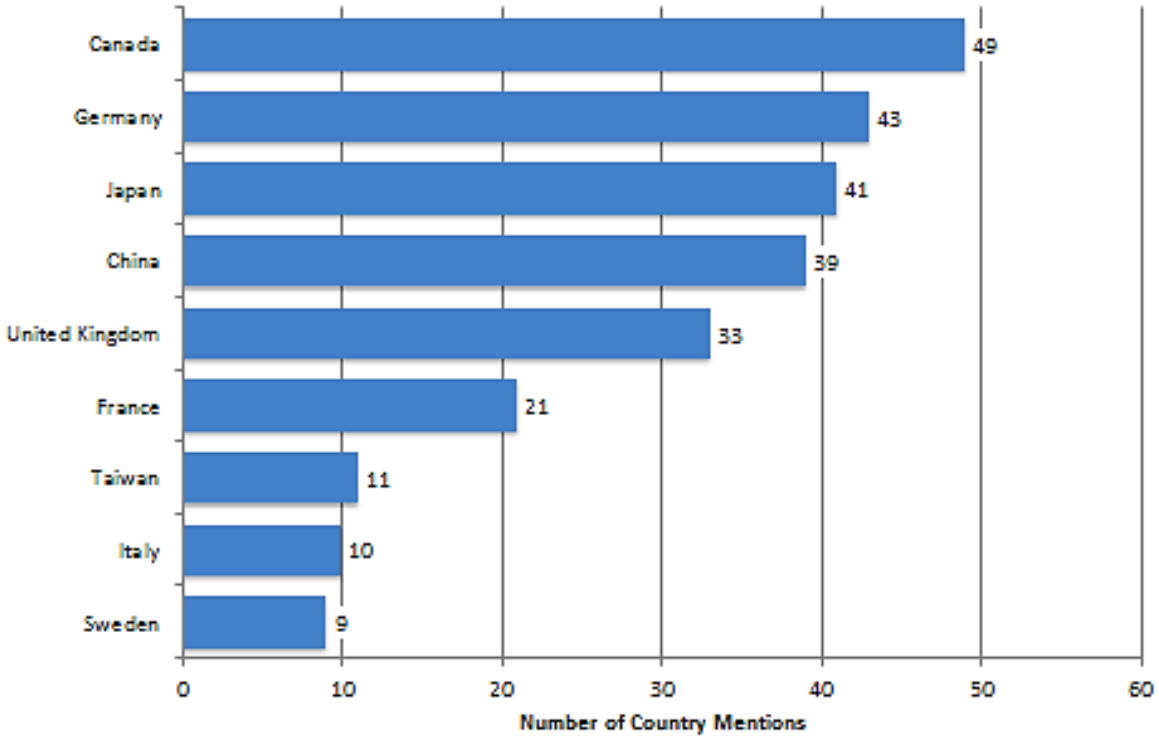
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

There were 301 distinct entities identified by companies as non-U.S. HSF suppliers. A total of 33 countries were identified as the location of respondents' leading suppliers, with concentrations in Canada, Germany, Japan, and China (see Figure VIII-9).[66]

Mississippi, Nebraska, North Dakota, and South Dakota. Respondents also reported the District of Columbia as a location of U.S.-based suppliers.

[66] Twenty-four countries were reported by survey respondents but not identified in Table X. These countries include (in order of number of mentions): Sweden, Switzerland, the Netherlands, India, Ireland, the Russian Federation, Australia, Ukraine, South Africa, Mexico, Austria, Belgium, Chile, Hungary, Israel, South Korea, Norway, Portugal, Spain, Costa Rica, Denmark, North Korea, Philippines, Puerto Rico, Singapore, and Slovenia.

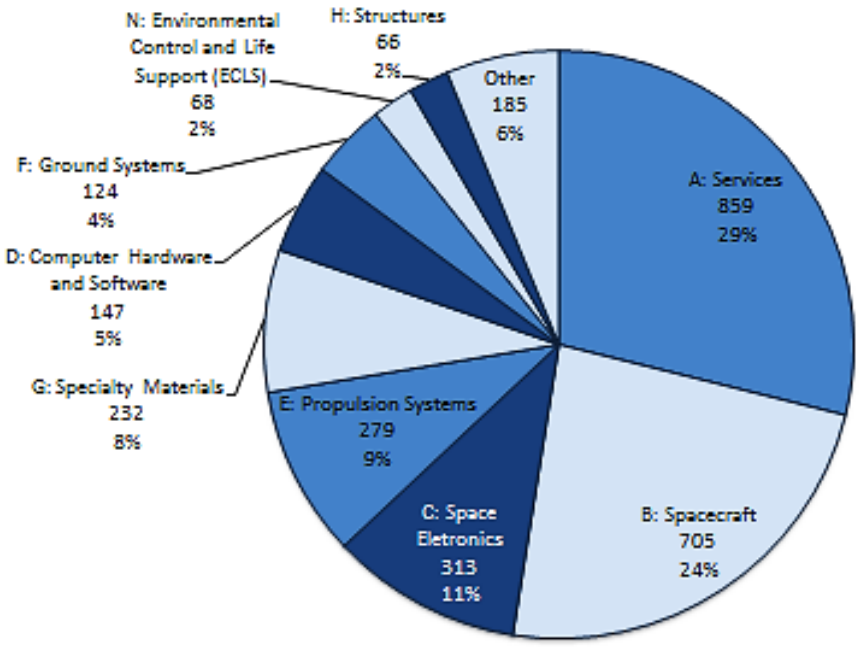
Figure VIII-9: Leading Non-U.S. Based Suppliers by Country



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Survey respondents were also asked to indicate the top five products and services corresponding with a specific system, part, component, material, or service that were provided by each identified NASA-related supplier. A total of 2,978 product and service mentions were reported across all 18 broad product and service categories (see Figure VIII-10). The Services category represented 29 percent and the Spacecraft category represented 24 percent of total product and service mentions, while the Space Electronics category accounted for 11 percent.

Figure VIII-10: U.S.-Based Space Suppliers by Product and Service Category*

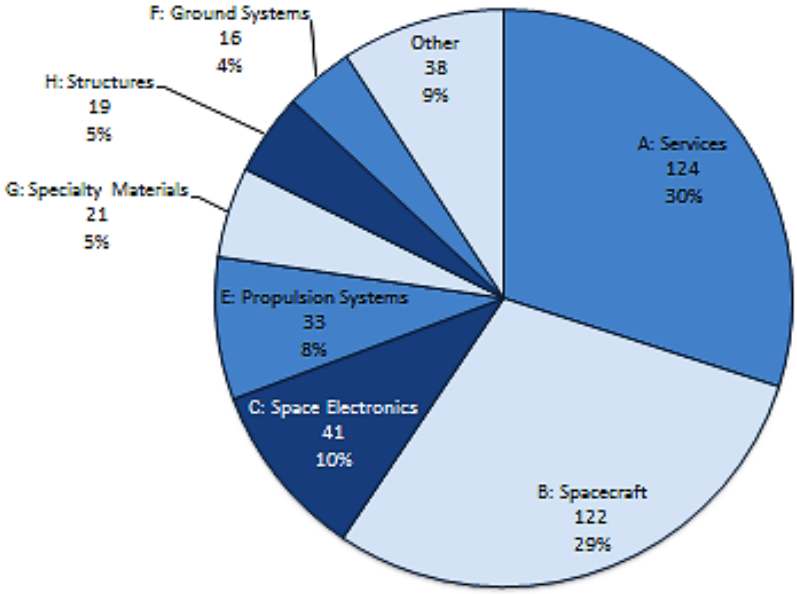


* Based on the number of times each product and service category was mentioned in a supplier relationship.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

For non-U.S. suppliers, there were 414 products and services mentioned across 13 of the 18 broad product and service categories. The Services category accounts for 30 percent of 414 mentions (see Figure VIII-11). The Services and Spacecraft categories together represented 59 percent of the total product and service mentions. The category break-downs for United States versus non-U.S. suppliers were similar, even though there were seven times as many product and service mentions for U.S. suppliers.

Figure VIII-11: Non-U.S. Based Space Suppliers by Product and Service Category*



* Based on the number of times each product and service category was mentioned in a supplier relationship.

Source: U.S. Department of Commerce, Bureau of Industry and Security. *NASA Supply Chain Network,* June 2012

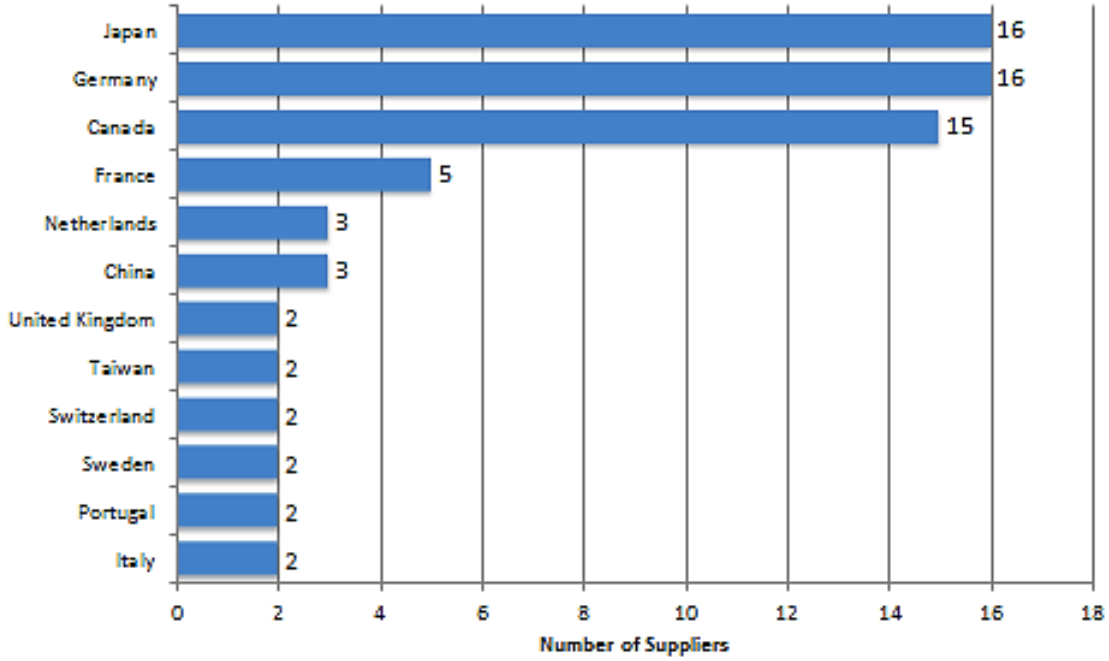
In addition, survey respondents indicated whether or not the suppliers provided systems, parts, components, materials, or services that related to HSF programs. For U.S. suppliers, 40 percent of the 1,588 suppliers identified in the survey provided products and services that were used for the NASA HSF programs Shuttle, CxP, and ISS. Twenty-nine percent of the identified U.S. suppliers provided products and services that were not used on NASA HSF programs. Survey respondents were not sure if products and services procured from the remaining 31 percent of identified U.S. suppliers were related to NASA HSF programs.

For the 301 reported non-U.S. suppliers, 29 percent provided products and services that were related to NASA HSF programs. Twenty-eight percent of identified non-U.S. suppliers provided products and services that were not related to NASA HSF programs. Survey respondents were not sure if products and services procured from the remaining 43 percent of identified non-U.S. suppliers were related to NASA HSF programs.

A total of 86 distinct non-U.S. entities were identified by survey respondents as NASA HSF suppliers. The majority of these foreign suppliers were located in Japan, Germany, and Canada

(see Figure VIII-12). Although Japan had the most number of mentions, NASA suppliers were dispersed globally across 20 recorded countries.[67]

Figure VIII-12: Leading Non-U.S. Based Suppliers for Human Space Flight Programs



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

NASA HSF respondents were also asked to report the products and services corresponding to each of their Non-U.S. suppliers. For those Non-U.S. suppliers supporting HSF programs, there were three products and services most often selected: Friction Stir Welding and Spun Formed Dome, mainly from Germany; Propellants Used for Solid Fuel Rocket Propulsion, mainly from Canada; and Integrated Circuits/Semiconductors, mainly from Japan.

[67] Nine countries were reported by survey respondents but not identified in Table X. These countries include (in order of number of mentions): Australia, Chile, India, Ireland, Norway, Russian Federation, South Africa, and Spain.

IX. Future Outlook for NASA Suppliers

In addition to quantitative data on sales, research and development, capital expenditures, and finances, OTE asked survey respondents to provide qualitative data on their actions and perspectives regarding challenges and issues facing NASA HSF suppliers. These narrative responses provide insight into the impact of the retirement of the Space Shuttle (Shuttle) and Constellation (CxP) program transition, as well as the ability of companies to operate in other markets. In most cases, these responses complimented and more fully explained the numeric provided in other sections of the survey.

A. Impact of Space Shuttle Retirement and Constellation Program Transition

Survey respondents were asked to explain how the Shuttle retirement and CxP transition would affect their business. Workforce reductions, the loss of critical skills and competencies, and declining revenue were the three most prevalent themes provided by a significant number of NASA HSF companies. A Tier 2 company summarized the issues, stating:

> The retirement of the Shuttle program without an apparent successor program will place in peril the expertise and knowledge of experienced personnel. The Constellation program allowed for transition of that knowledge, which is now in jeopardy. In addition, the sudden cancellation of the multiple Constellation contracts not only impacted future business outlook, but squanders the significant investment we have made to capture and maintain human-rated knowledge & technology.[68]

Other companies at different tiers expressed similar concerns about having to reduce their workforce and losing competencies as a result of the Shuttle retirement and CxP transition. For example, one Tier 3 company said, "We have already had to lay off 20 percent of our employees and may have to lay off more if we cannot find replacement business." A Tier 1 company commented that the Shuttle retirement and CxP transition "… may oblige us to close our [program office] and eliminate personnel. [The transitions] will also adversely affect our sales and personnel at several manufacturing locations."

[68] Man-rating or human-rating is term used to describe the certification of items as suitable for transporting humans.

Companies also expressed concerns about a reduction in revenue. One Tier 3 company said, "We anticipate losing approximately $400-500K of revenue we would otherwise have garnered without the cancellation for Constellation. This represents approximately 5 percent of any one year's revenues." A Tier 1 company dependent on NASA stated, "We will lose between $100,000 to $500,000 worth of NASA contracts per year," which accounted for 15 percent of their sales.

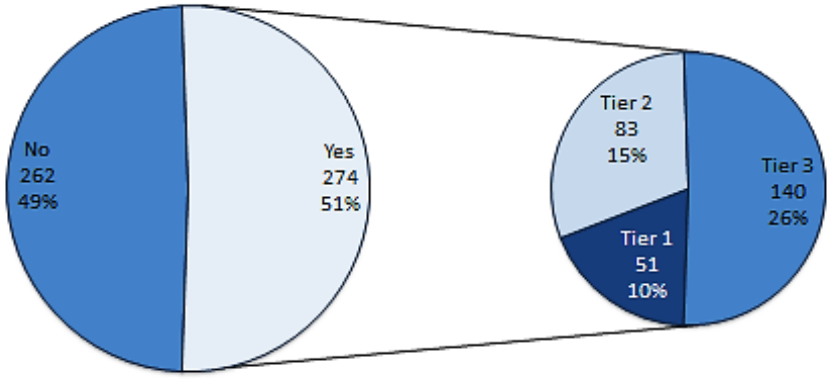
Not all companies provided negative comments on the Shuttle retirement and CxP transition. One Tier 3 company stated, "These decisions may allow for more resources to be directed to non-human-flight scientific missions – providing more science per dollar and lower risk. Developing new technology for the human space program will increase the long-term strength of NASA." A Tier 2 company stated that there would be a "short-term impact to 2011 and 2012 sales" but they expected "new revenue streams will be generated by the replacement NASA programs."[69]

B. Preservation of Current Capabilities and Workforce

To assess the possible implications of the post-Shuttle, post-CxP environment, NASA HSF suppliers were asked if they had a plan in place to preserve current capabilities and workforce. Slightly more than half of survey respondents said they did have an established plan (see Figure IX-1). Approximately the same percentage of respondents in each tier had plans in place to preserve current workforce and capabilities.

[69] Further analysis of the impact of the Shuttle retirement and CxP transition on survey respondents can be found in Chapters IV, V, VI, VII, and X.

Figure IX-1: Does Your Company Have a Plan in Place to Preserve its Current Capabilities and Workforce in the Post-Space Shuttle, Post-Constellation Program Environment?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

When asked to explain why they did not have a plan in place, the majority of companies said they did not do enough business with NASA to warrant a plan. In addition, several companies said they did not have a plan because of the difficulty of preserving competencies and the workforce. One Tier 1 company explained, "The nature of the business is such that long-term preservation of skilled teams is difficult. Given the long timelines generally required to craft new programs, considerable capability will be lost."

Survey respondents in lower tiers also lacked a plan due to difficulties in preserving their workforce. A Tier 2 company said, "[The] company is a small business; our people had nowhere else to go. They left the space program, many for good." A Tier 3 company stated, "As a company of 24 people- down from 36 due to the NASA CxP cutback – it is financially unrealistic for us to retain any of the workforce as to 'preserve capabilities'. The 'capabilities' are inside the workforce's heads. When the workforce left, the capabilities left."

Those NASA HSF suppliers with a plan in place faced significant challenges in maintaining competencies and their workforce. One Tier 1 company commented:

> The termination of these programs cannot easily be planned for - it would result in the termination of thousands of employees, reduction of R&D available for space programs company-wide, and the abandonment of Government Furnished

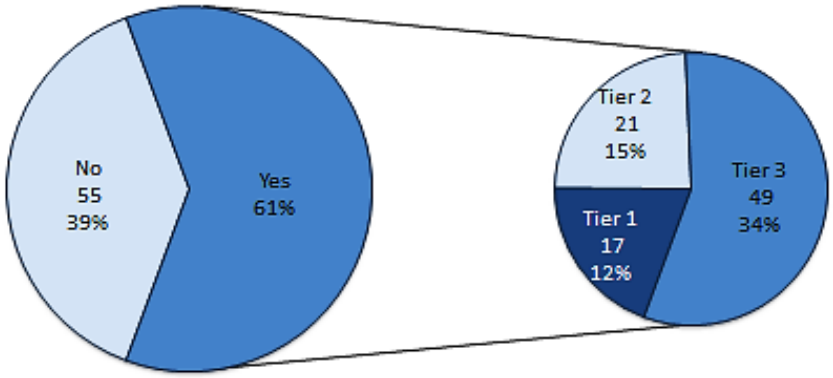
> Equipment (GFE) and capital equipment in place. We have been successful in transitioning some of the workforce to existing company programs but have still seen terminations on the order of 2,000 people."

Lack of direction from NASA and frustration with the ambiguity of NASA's future plans and programs were common themes in the comments from industry. A Tier 1 company stated, "We rely on a matrix management approach to maintain engineering capability across multiple programs. However, this approach is best for small changes in staffing, not wholesale cancellation of capability." A Tier 2 company said, "We have a plan but we are still dependent upon NASA. If there is a long delay between Constellation and a replacement program we will not be able to preserve capability."

Survey respondents cited that diversification of business lines and a focus on commercial enterprises were the leading courses of action to preserve current capabilities and workforce levels. A Tier 1 company said, "We are fortunate that [our product] has become a very attractive product for use in commercial aviation as well. We expect these upcoming requirements to allow us to retain and hopefully expand our capabilities and workforce." Another Tier 1 company focused on diversification, stating they were "working with [another company] on the preservation plan for some products. Most products made for NASA are similar to products made for other customers."

Sixty-one percent of respondents that identified themselves as NASA-dependent said that they had a plan in place to preserve their current capabilities and workforce. Of the respondents with plans to maintain their current capabilities in place, approximately half were tier 3 companies (see Figure IX-2).

Figure IX-2: NASA-Dependent Suppliers – Does Your Company Plan to Modify its Business Plan and/or Product Lines in Response to Space Shuttle Retirement and/or Constellation Transition?



* Based on 150 NASA-dependent companies.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Many of the survey comments from NASA-dependent companies reflected the tentative nature of their future plans. A Tier 3 company stated, "As a small business, all we can do is adjust expenses as related to our overall business. If revenues drop off dramatically, then all we can do slash expenses and unfortunately this would mean cutting jobs." A Tier 2 company said, "We are actively looking for other business opportunities in the event that the Constellation program is terminated but due to the magnitude of the effort, the loss of the Constellation program would devastate our business base and that would result in significant job loses."

While most NASA-dependent companies with plans in place prepared to decrease their workforce, some companies planned to redistribute workers in an effort to prevent layoffs. A Tier 1 company said, "Our plan is to redeploy as many of our staff as we can to other government programs/projects. Those we can't redeploy will be terminated. We can't guarantee that any staff that is redeployed to other programs will be available to NASA in the future."

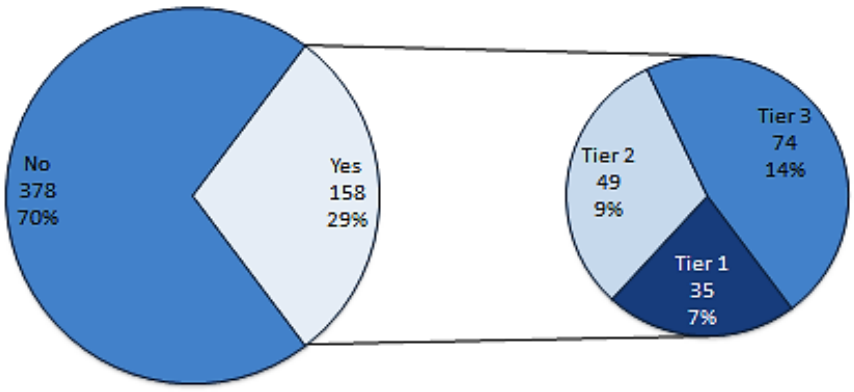
NASA-dependent survey respondents without a plan in place mentioned similar concerns about their future stability. Companies without a plan viewed job losses as the most significant impact of the Shuttle retirement and CxP transition and did not see alternatives to prevent the decrease in workforce. One Tier 3 company stated, "We will not be able to maintain our current

workforce if the space program is completely retired. We will be forced to lay off 30 percent of our employees." Another Tier 3 company voiced similar fears, stating, "If Constellation is canceled, the company will lose over half of its annual income."

C. Existing Business Plan and Product Line Modifications

Survey respondents were asked if they have already modified their business plans and/or product lines in response to the Shuttle retirement and CxP transition. Twenty-nine percent of companies said they had modified business plans and/or product lines (see Figure IX-3).

Figure IX-3: Has Your Company Already Modified its Business Plan and/or Product Lines in Response to Space Shuttle Retirement and/or Constellation Transition?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The majority of the survey respondents that have not modified their business plans stated they were waiting for definitive decisions on future HSF programs from NASA and Congress. For instance, a Tier 1 company commented, "We are waiting to understand the effects on the ongoing Orion and Ares development work before changing our business plans." A number of other companies said their sales to NASA are not significant to warrant changes to their business plans. One such respondent, a Tier 3 company, said, "We do not directly sell to NASA. Some of our customers may but there is no means to identify this activity or if it even takes place."

Of the 29 percent of survey respondents that modified their business plans, the primary action taken was to reduce their workforce. For example, one Tier 3 company stated, "We have reduced our workforce and have plans to sell or close the business and retire." Similarly, a Tier 1 company said, "We reallocated approximately 75 employees to other projects and have not hired back approximately 50 others." A Tier 2 company said:

> We have built a workforce to support the Constellation program activities. This program is included in our strategic business plan, our sales forecasts and our staffing plans. The loss of Constellation would devastate our workforce and result in significant job loss.

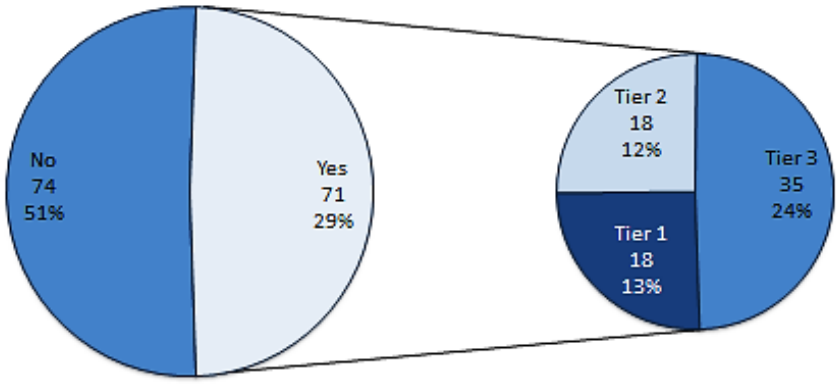
Although personnel reductions were mentioned most in industry comments, many companies also modified their plan to reduce their scale of operations. A Tier 1 company said, "We have halted hiring and plans for facility renovations and capital purchases." Similarly, a Tier 3 company said "We have already begun to not replace employees that leave and are cutting capital improvements."

Some companies also re-prioritized their business plans and objectives away from NASA, reducing their NASA-specific capabilities over time. A Tier 1 company said, "Based on the stop work order on [a] project received from the prime contract, we have begun reassignment activities and reduced the forecast for future business." A Tier 3 company said, "We cannot wait for NASA's decision – we are changing our priorities."

Some respondents focused specifically on commercial space flight and aerospace industries as a means of reducing dependency on NASA programs. For example, one Tier 3 company said, "We have begun aggressively targeting other market segments with the plan to diversify our revenue streams and ultimately eliminate our dependence on customer bases that are very unstable." Another Tier 3 company stated, "We have looked to modernize our machining capabilities to become more efficient with hopes to enter commercial [space] arenas." A Tier 1 company said, "We are allocating floor space once used for NASA production to commercial aircraft applications."

Of the NASA-dependent companies, 49 percent said that they had already modified their business plan and product lines in response to the Shuttle retirement and CxP transition. Approximately half of these respondents were Tier 3 companies (see Figure IX-4).

Figure IX-4: NASA-Dependent Suppliers - Has Your Company Already Modified its Business Plan and/or Product Lines in Response to Space Shuttle Retirement and/or Constellation Transition?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

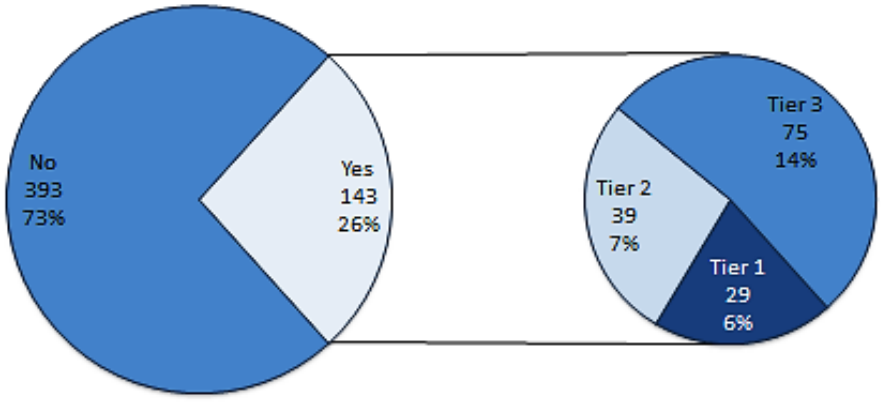
NASA-dependent companies that have already modified their business plans mentioned downsizing their workforce and considering alternative programs to generate sales. One Tier 3 company stated, "We have begun aggressively targeting other market segments with the plan to diversify our revenue streams and ultimately eliminate our dependence on customer bases that are very unstable." Another Tier 3 company said, "We were concerned with this for some time and have begun diversifying the company to include non-human spaceflight products and services and non-space products and services."

A number of NASA-dependent survey respondents with modified business plans identified a shift from actively planning to protecting their company with anticipated changes. A Tier 3 company stated, "We have modified our business plan with the workforce reductions, although it is very difficult to really strategize to determine ways to assist NASA when their direction, funding and strategy are undefined. We are in a reactionary mode vs. strategic mode."

D. Scheduled Business Plan and Product Line Modifications

In addition to existing modifications, survey respondents were asked if they were planning to modify or anticipated modifications to their business plans and/or product lines in response to the Shuttle retirement and/or CxP transition. Twenty-six percent of NASA HSF suppliers said they intended to adjust their plan (see figure IX-5). Of the 143 survey respondents that intended to modify their business plans, 101 had already made modifications to their business plans due to the Shuttle retirement and CxP transition.

Figure IX-5: Does Your Company Plan to Modify its Business Plan and/or Product Lines in Response to Space Shuttle Retirement and/or Constellation Transition?



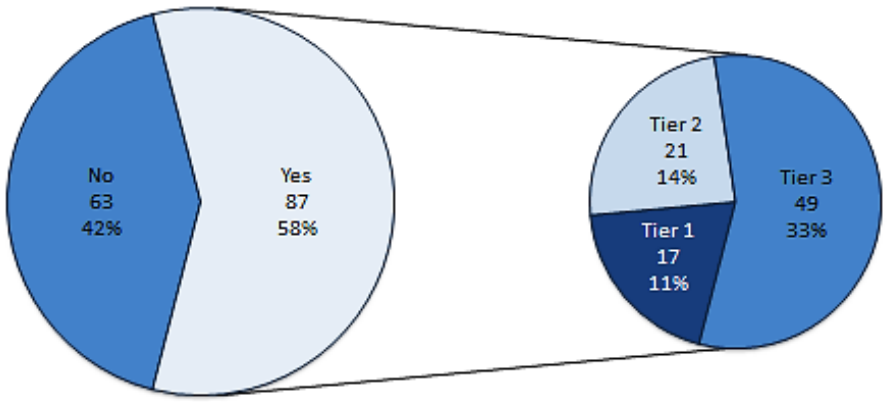
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Many of the 143 companies were looking at shifting from reliance on NASA contracts to contracts with other USG agencies and/or the commercial sector. For example, one Tier 3 company said, "We have always specialized in aerospace materials and have no plans to modify. We will continue that specialty but with extra focus on commercial and military to try to offset the loss of business from [the NASA] programs." A Tier 1 firm said, "We will have to reexamine our [product] investment strategy and potentially make changes to reflect an almost exclusive dependence on commercial aviation, with some space activity remaining via our [commercial space] business."

Some companies indicated that business planning was difficult due to fluctuating USG budgets and policy priorities. A Tier 3 company stated, "The lack of technical direction and appropriation funding inhibits our ability to have long-term vision and insight." For example, a Tier 3 company said, "Our plan is extremely fluid because Congress, the White House, and NASA are still changing their plans. Once there is stability we will have a better idea of how to move forward."

Of the 150 companies that indicated they were NASA-dependent, 58 percent plan to modify their business plans in response to the Shuttle retirement and CxP transition, compared to 29 percent of all companies surveyed (see Figure IX-6). Many companies were prepared to modify their business plan in order to remain afloat. For example, one Tier 1 company stated, "We have been and are continuing to modify our business plans and production facilities to accommodate the lower production rates anticipated in the Constellation Program and have developed contingency plans for further reductions/plant closures."

Figure IX-6: NASA-Dependent Suppliers - Does Your Company Plan to Modify its Business Plan and/or Product Lines in Response to Space Shuttle Retirement and/or Constellation Transition?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

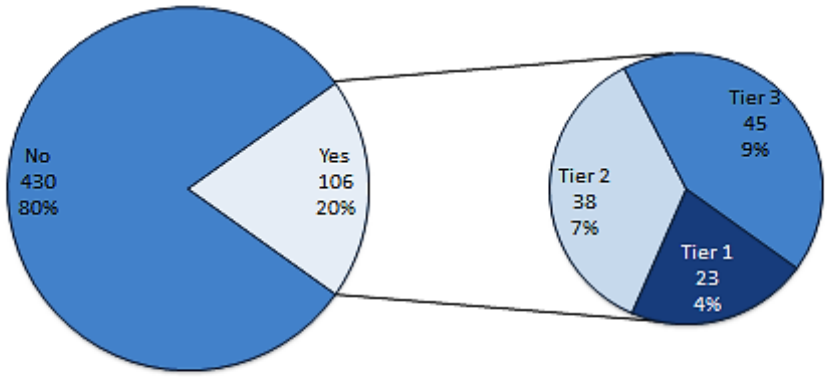
However, some NASA-dependent companies were finding it difficult to modify their business plans. As one Tier 3 company put it, "We have already been pursuing multiple other customers, [but] in today's space and defense markets, it is quite tough." Other companies are even more

desperate, when asked about modifying their business plan stating "Yes, we are looking to survive somehow."

E. Current and Future Participation in Commercial HSF Programs

Survey respondents were asked if they currently participate in commercial, non-NASA HSF programs. Eighty percent of the 536 companies indicated they were not currently part of the commercial HSF supply chain (see Figure IX-7). A portion of these respondents made attempts to participate but have not received any commercial business or were unable to identify opportunities.

Figure IX-7: Does Your Company Currently Participate in Commercial (non-NASA) Human Space Flight Programs?



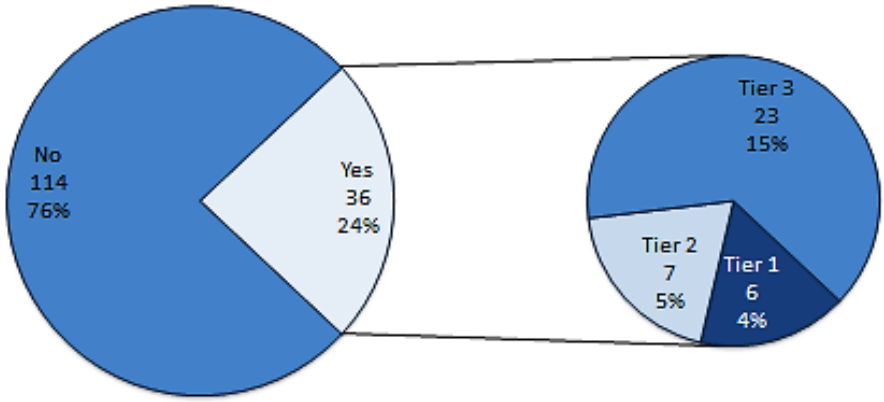
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Some of the 106 companies participating in non-NASA HSF programs indicated they provided a number of specific products and services – such as propulsion systems, electronics, structural components, mechanical products, and training support – to U.S. commercial companies. A Tier 2 company stated, "We are currently supporting [companies] with their commercial space flight programs and we are hoping to support others."

When asked if they currently participate in commercial, non-NASA HSF programs, 76 percent of NASA-dependent survey respondents indicated they were not part of the commercial HSF supply chain (see Figure IX-8). Many of these companies were not sure of the destination of

their final goods, or stated that wanted to enter the commercial HSF market but believed there were no opportunities to do so.

Figure IX-8: NASA-Dependent Suppliers - Does Your Company Currently Participate in Commercial (non-NASA) Human Space Flight Programs?

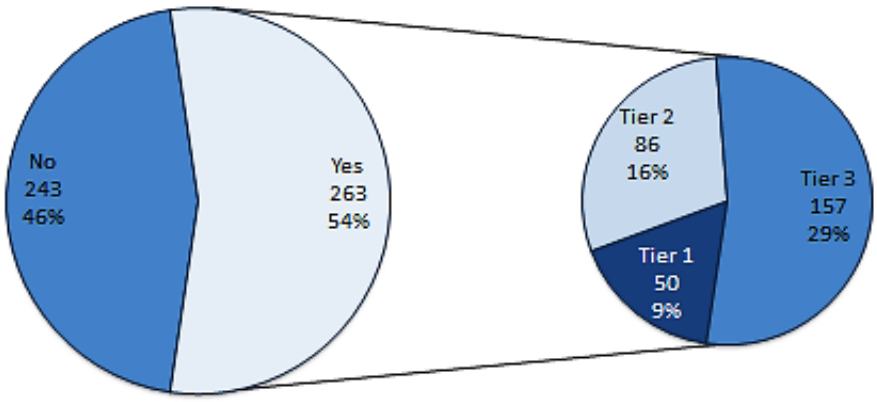


* Based on 150 NASA-dependent companies.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

In addition to current participation, all survey respondents were asked if they anticipated taking part in commercial, non-NASA HSF programs in the future. More than half of respondents said they intended to participate in commercial HSF programs (see Figure IX-9).

Figure IX-9: In the Future, Will Your Company Participate in Commercial (non-NASA) Human Space Flight Programs?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

While many companies expressed desire to participate in commercial HSF programs, they anticipated barriers to entering the market. A Tier 3 company hoped to participate, but stated, "…there is currently nothing in our backlog that supports commercial human space." Another Tier 3 company said, "That will depend on how successful we are in building new professional relationships in the commercial sector. We expect this to be difficult, but we are willing to try."

Another barrier to entering the commercial HSF market listed by respondents was vertical integration. One Tier 3 company said they will attempt to gain commercial HSF business, but have not received orders because commercial HSF companies were performing the work in-house. A Tier 2 company stated, "Although we are hopeful to participate in future programs, early indications are that the primes involved have a preference for vertical integration except for commercial off-the-shelf hardware."

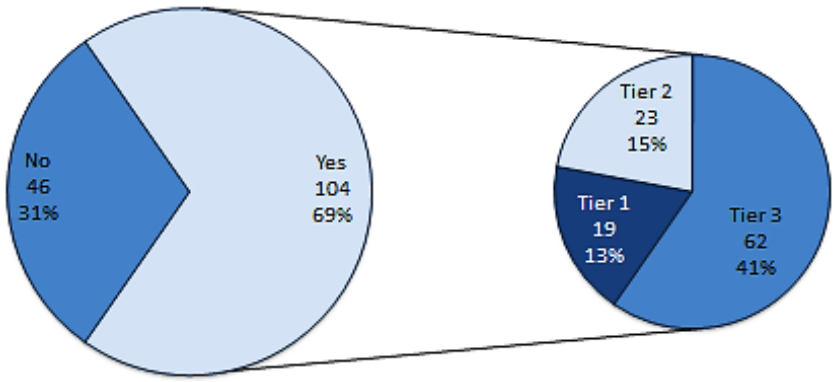
Some respondents expressed concern with conducting work on both commercial and NASA HSF programs in the future. For example, a Tier 2 company said, "Participation in commercial human spaceflight programs may be possible, but will be examined on a case-by-case basis. Avoidance of organizational conflicts of interest with current work is a significant factor." A

Tier 1 company said their participation in commercial HSF programs will depend on NASA, stating:

> As NASA determines how to move forward with commercial human spaceflight, we anticipate we will participate in whatever [effort is] mandated. [It] depends on NASA funding level of commercial human spaceflight programs and the willingness of commercial ventures to contract with existing NASA contractors for human spaceflight engineering services expertise. There may be a bias against expertise developed under support to NASA Field Centers being viewed as too traditional or too bureaucratic in nature to support a commercially funded venture.

Of the survey respondents that identified themselves as dependent on NASA, 69 percent indicated they planned to participate in commercial, non-NASA HSF programs (see Figure IX-10). Many of these companies were willing to support commercial programs if they could find opportunities or find the right fit for their business. However, some respondents indicated that they were not sure about the feasibility of participating in such programs. For example, a Tier 1company stated, "Without NASA providing the base and stability we do not believe human spaceflight will advance beyond the venture capital stage. With a NASA commercial space program to provide an anchor tenant, commercial spaceflight programs may be viable."

Figure IX-10: NASA-Dependent Suppliers – In the Future, Will Your Company Participate in Commercial (non-NASA) Human Space Flight Programs?



* Based on 150 NASA-dependent companies.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

F. Impact on Other USG Agencies

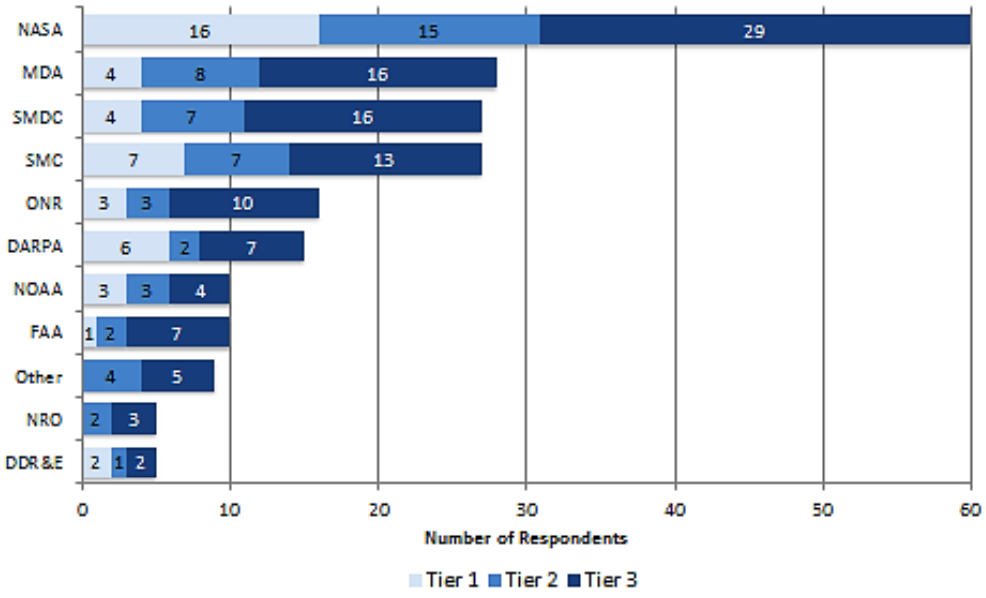
Survey respondents were asked if the loss of Shuttle or CxP business would directly or indirectly affect their ability to maintain business lines with other USG customers, and to identify the affected customers. Sixteen percent or 86 NASA HSF suppliers stated that their business with other USG customers will be impacted in some form. Of these companies, 77 percent were dependent on NASA business. Overall, Tier 3 companies had the highest rate of cross-agency impact as a result of the Shuttle retirement and CxP transition.

Companies expected the loss of Shuttle or CxP business to primarily impact the availability of products and services, program costs, workforce levels, and technology development. These companies provided goods and services not only to other NASA programs, but to the National Oceanic and Atmospheric Administration, the Federal Aviation Administration, and various defense-related agencies.[70]

The Shuttle retirement and CxP transition will primarily affect NASA's centers and non-HSF programs, with 60 survey respondents reporting that their NASA business will be impacted (see Figure IX-11). After NASA, the Missile Defense Agency, the U.S. Army's Space and Missile Defense Command, and the U.S. Air Force's Space and Missile Systems Center were identified as the most affected agencies.

[70] Defense-related agencies were the Defense Advanced Research Projects Agency (DARPA), the Office of the Director for Defense Research and Engineering (DDR&E), the Missile Defense Agency (MDA), the National Reconnaissance Office (NRO), the U.S. Army's Space and Missile Defense Command (SMDC), and the U.S. Air Force's Space and Missile Systems Center (SMC), and the U.S. Navy's Office of Naval Research (ONR).

Figure IX-11: U.S. Government Agencies Impacted by Respondent Loss of Space Shuttle/Constellation Business by Tier



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Specifically, survey respondents noted that the loss of Shuttle or CxP program business will impact contracts with other USG agencies through the loss of experienced personnel, increased cost of equipment and operations, potential loss of software and manufactured products, and reduction in R&D expenditures. Encapsulating many of the issues raised by survey respondents, a Tier 1 company explained:

> The Constellation Program … has been a significant source of business for us and our supplier base. Sales base generates R&D funds that are used to innovate across the enterprise. The reduction of sales will result in the reduction of R&D funds across the enterprise. Additionally, critical capabilities being developed for the Constellation program … have cross cutting applicability to the enterprise—in talent that moves between programs and in capital facilities. The skilled workforce that supports the Constellation Program is of direct benefit to our NASA and other government customers. The importance of high visibility programs such as the Space Shuttle and Constellation programs for education and outreach in STEM areas should not be underestimated. In most cases these programs are the ambassadors on college campuses drawing students to work in defense and aerospace jobs.

NASA's non-HSF programs stand to be most affected, as the workforce and expertise of survey respondents providing services to Shuttle and/or CxP were also used for other NASA-programs,

including earth sciences. Some survey respondents indicated that CxP work was critical in allowing companies to maintain large, skilled workforces that could then be used to support a variety of NASA programs. The loss of personnel and increased cost of operations could impact many companies' ability to cost-effectively support NASA in the future. As a Tier 3 company explained:

> Prior to Shuttle and Constellation cancellation we were able to leverage Shuttle/Constellation personnel to support, for example, Space Station needs. Post-Shuttle/Constellation cancellation, these personnel are no longer available for cross-utilization.

The Missile Defense Agency (MDA) was the second most mentioned agency, with 28 companies indicating that their business with MDA will be impacted by the Shuttle retirement and CxP transition. A Tier 3 company explained the cross-functional impact, stating, "MDA business opportunities have benefited from our successful NASA R&D efforts." Likewise, a Tier 2 company stated, "We have applied similar skills sets to both NASA and MDA and the loss of our NASA personnel will negatively influence our ability to provide such resources to MDA." Not only will innovation and workforce be affected, but maintenance of physical inventory could be vulnerable, as a Tier 3 company explained, "With the loss of the space customers we may not be able to keep enough inventory to satisfy Missile Defense." Finally, a Tier 2 company stated, "The loss of the Constellation & Space Shuttle programs will invariably cause an increase in costs to MDA and SMDC."

In addition to MDA, 27 survey respondents maintaining business with the U.S Air Force/Space and Missile Systems Center (SMC) expected cost increases and collateral impact to workforce and innovation as a result of lost NASA work. Cost seemed to be the primary issue concerning suppliers, as several Tier 2 and 3 companies said the loss of Shuttle or CxP business will force prices to rise for other programs. A Tier 3 company explained, "Technology developed on NASA projects provided foundation for proposals and programs with DOD customers." Regarding workforce, a Tier 2 company stated:

> Because we had developed a workforce to support large programs such as Constellation, we have the ability to respond to other opportunities as they arise. The Constellation program gives us the ability to share human resources across programs and to retain a skilled workforce.

Additionally, 27 companies said their business lines to the U.S Army/Space and Missile Defense Command (SMDC) would be impacted as result of the loss of Shuttle and/or CxP business. Survey respondents again indicated that reductions in NASA-related workforce, capability, and revenue will affect their performance in furnishing SMDC programs. As a Tier 1 company stated, "Some [NASA-related] materials are in common [with SMDC programs], and therefore the overall technical base gets impacted by the loss." Additionally, a Tier 3 company explained, "Loss of skill and capabilities means any new work will start without the benefit of in-place resources."

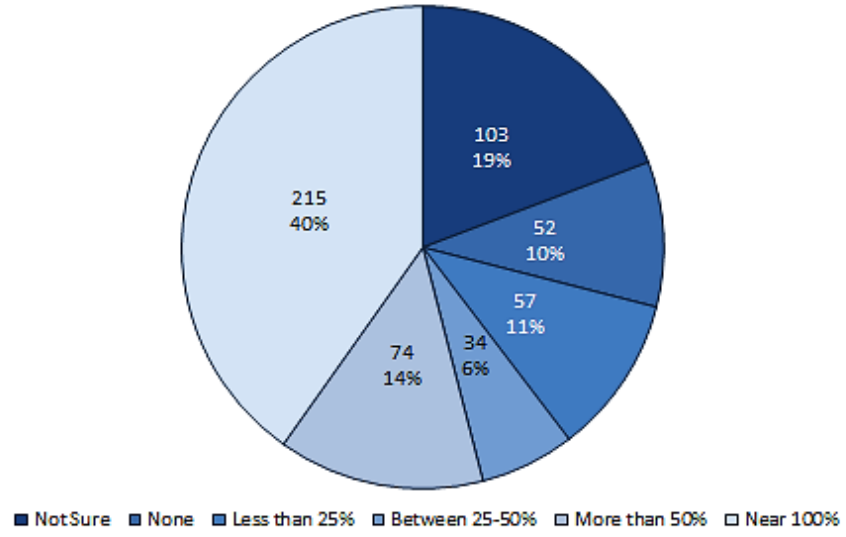
Companies will be strained to begin new work with other USG agencies, as one Tier 3 company described, "The loss of expertise and revenue from NASA will directly impact our ability to bid tasks and the quality of those bids." Overall, there could be fewer companies bidding on NASA-related and other USG projects because of declining skills and capabilities. The repercussions of lost NASA HSF business could be more dramatic as some survey respondents, especially in the lower tiers, did not know what USG agencies they supported.

G. NASA-Related Product Compatibility with Non-NASA Customers

Compatibility between NASA-related products and non-NASA customers indicates the potential ability of companies to diversify their customer base in light of declining NASA HSF business opportunities. To gauge the industrial base's ability to diversify, OTE asked survey respondents to report the percentage of their NASA-related products that were compatible with non-NASA customers and applications.

Forty percent of survey respondents indicated that their NASA-related products were nearly 100 percent compatible with non-NASA customers, with an additional 14 percent of companies having more than 50 percent compatibility (see Figure IX-12). Conversely, 27 percent of companies said they had between 50 and zero percent compatibility between their NASA-related products and their non-NASA customers and applications. The remaining 19 percent of survey respondents were not sure about the compatibility of their NASA-related products, which could be due to a lack of market knowledge or inexperience with non-traditional customers.

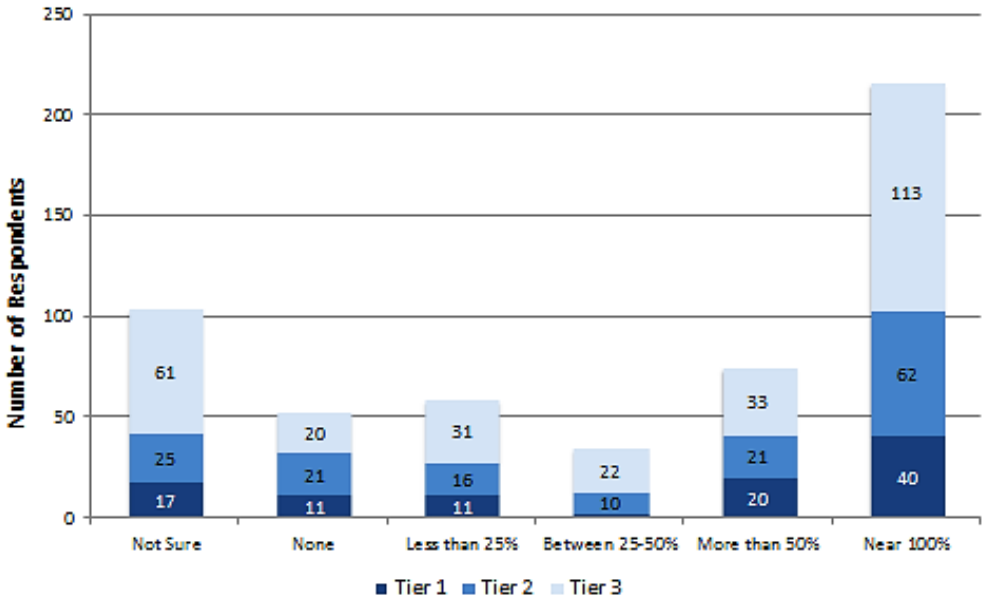
Figure IX-12: Compatibility of NASA-Related Products with Non-NASA Customers



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

From a tier perspective, approximately 40 percent of the companies in each tier said they had near 100 percent compatibility between their NASA-related products and their non-NASA customers (see Figure IX-13).

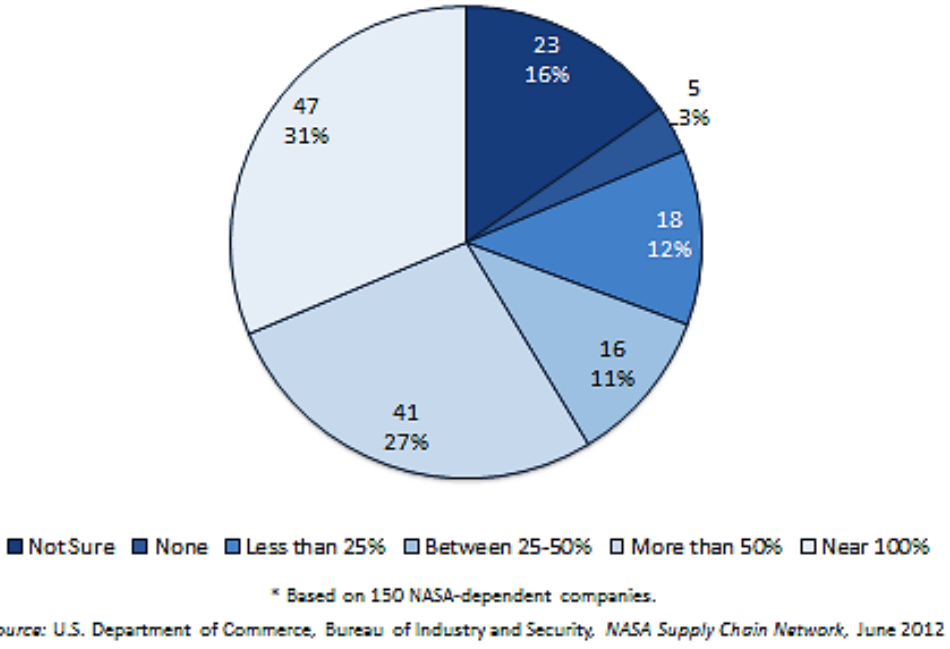
Figure IX-13: Compatibility of NASA-Related Products with Non-NASA Customers by Tier



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Of the 150 survey respondents that identified themselves as dependent on NASA, 31 percent indicated that their NASA-related products were nearly 100 percent compatible with non-NASA customers, with an additional 27 percent of companies having more than 50 percent compatibility (see Figure IX-14). Conversely, 26 percent of NASA-dependent companies said they had between 50 and zero percent compatibility between their NASA-related products and their non-NASA customers and applications. The remaining 16 percent of NASA-dependent survey respondents were not sure about the compatibility of their NASA-related products.

Figure IX-14: NASA-Dependent Suppliers – Compatibility of NASA-Related Products with Non-NASA Customers



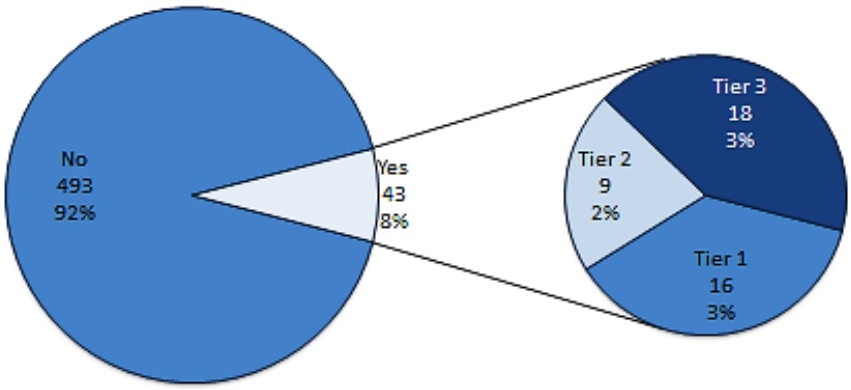
* Based on 150 NASA-dependent companies.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

H. Post-Shuttle/Constellation Guidance from Prime Contractors

Survey respondents were asked if they received any guidance from prime contractors affiliated with NASA on how to respond to the Shuttle retirement and CxP transition. Ninety-two percent of companies received no guidance from NASA-affiliated prime contractors (see Figure IX-15).

Figure IX-15: Have Prime Contractors Affiliated with NASA Programs Provided Your Company Guidance on How to Best Respond to Space Shuttle Retirement and/or Constellation Transition?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

For the vast majority of respondents, there was a general lack of information and communication from the prime contractors on this subject. To this point, a Tier 3 company said, "The prime contractors do not provide any guidance on the issue or really any other issues. Their only concern is that we are available when needed." Another Tier 3 company said, "We received no communication from the prime other than the stop work order." A third Tier 3 company said, "No guidance has been provided directly and/or indirectly from NASA or the primes. As such, the only source of information is based upon media reports."

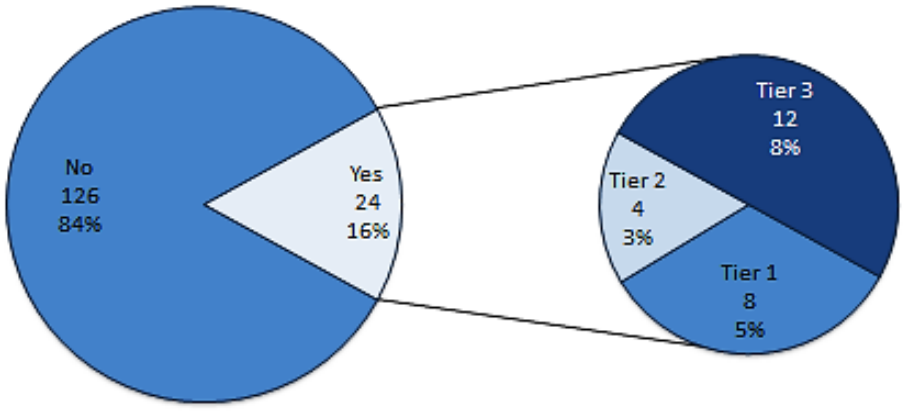
Some companies were sympathetic to primes and indicated that the primes were in a similar situation of uncertainty. A Tier 3 company said, "NASA's current lack of strategic vision and programmatic opportunities presents the same challenges to primes." Another group of survey respondents were not concerned by the lack of guidance from prime contractors, stating that their NASA-related business was too small to warrant such communication.

Some of the eight percent of survey respondents that received guidance documented the benefits of communication with prime contractors. For example, a Tier 3 company said, "We have worked with [the prime contractor] and NASA to adjust our inventory levels and helped transition departments that have been closed. We have shifted resources accordingly." One

prime, a Tier 1 company, also reported that they "provided guidance to [their] subs on required reductions based on reduced funding and revised task orders from NASA."

Of the 150 companies that identified themselves as dependent on NASA, 84 percent received no guidance from their NASA-affiliated prime contractors (see Figure IX-16). One Tier 3 company stated, "I think there is still too much confusion as to what is going to take place with regards to how it will impact our business." A Tier 2 company said, "I think they are probably figuring that we will all take care of ourselves if we are not a major supplier."

Figure IX-16: NASA-Dependent Suppliers - Have Prime Contractors Affiliated with NASA Programs Provided Your Company Guidance on How to Best Respond to Space Shuttle Retirement and/or Constellation Transition?



* Based on 150 NASA-dependent companies.

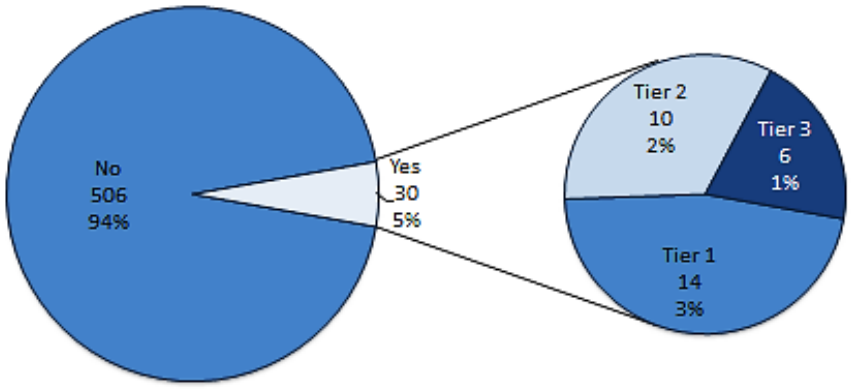
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The majority of those that did receive guidance were Tier 3 companies. One Tier 3 company said of their prime contractor, "To the best of their ability they have attempted to project future requirements for the Constellation Program." A Tier 2 company commented, "We worked with [the prime contractor] to address production of final components and maintenance of tooling and other customer-owned resources as required under existing contracts."

I. Post Shuttle/Constellation Guidance from NASA

Similar to their experiences with prime contractors, the vast majority of survey respondents did not receive guidance from NASA. Ninety-four percent of survey respondents indicated they have not received any guidance on how to best respond to the Shuttle retirement and CxP transition (see Figure IX-17).

Figure IX-17: Have NASA Officials Provided Your Company Any Guidance on How to Best Respond to Space Shuttle Retirement and/or Constellation Transition?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

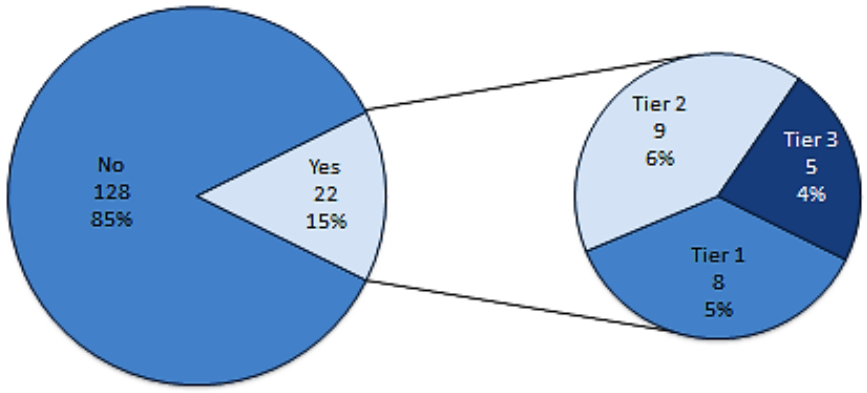
The comments from companies that did not receive guidance from NASA were similar to those who did not receive guidance from prime contractors. A Tier 3 company stated, "We have received no communication from an official source." Several companies stated that the survey for this assessment was the first government notice they received that the Shuttle and CxP programs were being cancelled, with one Tier 3 company stating, "This survey is the first interaction I have had on the subject."

Those companies that did receive guidance from NASA were satisfied with the information and quality of services they received. A Tier 1 company said, "Industry forums and workshops NASA sponsored in 2010 … have proven helpful in planning alternative uses for [our] technologies and capabilities beyond Constellation." A Tier 2 company stated:

> The [Johnson Space Center (JSC)] Joint Leadership Team is working with senior contract management to determine JSC core competencies and how they can be applied to surrounding job markets such as petrochemical, medical, and shipping. JSC is also working to make available resources that can aid the Shuttle/Constellation workforce in the transition.

Of the survey respondents that identified themselves as NASA-dependent, 85 percent indicated they have received no guidance from NASA (see Figure IX-18). Most of these companies stated that they have had no conversations with NASA personnel on this subject. A Tier 3 company said, "There have been no opportunities for such interchange."

Figure IX-18: NASA-Dependent Suppliers – Have NASA Officials Provided Your Company Any Guidance on How to Best Respond to Space Shuttle Retirement and/or Constellation Transition?



* Based on 150 NASA-dependent companies.

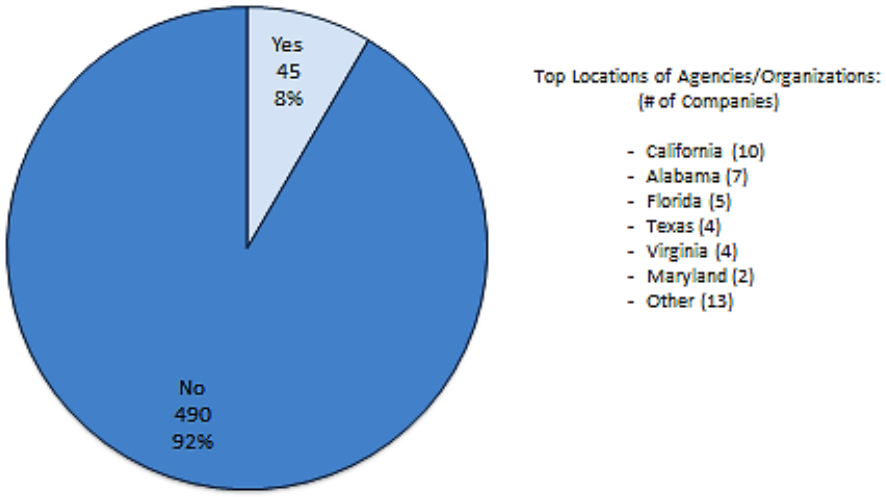
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The majority of those NASA-dependent companies that did receive guidance from NASA were Tier 1 companies. For example, a Tier 1 company stated, "We work closely with NASA senior management at the center and headquarters level, along with local community and state-level initiatives." A Tier 3 company said that while it has had contact with NASA, "it has been difficult due to the fact that NASA does not have a great degree of information to share with its Contractors regarding Constellation."

J. Interaction with Economic Development Agencies/Organizations

OTE asked survey respondents if they had worked with any regional, state, local, or non-profit economic development agencies/organizations to address the post-Shuttle, post-CxP environment and to explain their response. Of the 536 responses, 45 companies or eight percent indicated that they had worked with any such agency/organization (see Figure IX-19). The top locations of the agencies/organizations that companies reported working with were in California, Alabama, and Florida.

Figure IX-19: Survey Respondents Who Have Worked With Any Regional, State, Local, or Non-Profit Economic Development Agencies/Organizations



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Contact with agency/organizations varied between tiers. Eighteen percent of all Tier 1 companies indicated that they had worked with an agency/organization to address the post-Shuttle, post-CxP environment. In comparison, six percent of both Tier 2 and Tier 3 companies reported that they had done the same.[71]

Some companies indicated they have worked extensively with numerous organizations to address multiple issues. A Tier 1 company commented, "Our company works with numerous agencies, organizations, and universities to promote and advance human spaceflight, our communities, and our business interests. These efforts include policy advocacy and the location

[71] A list of organizations/agencies mentioned by survey respondents can be found in Appendix D.

of future business operations." A Tier 2 company also commented on their extensive work with agencies/organizations, stating,

> We have worked extensively with [multiple organizations/agencies], providing information related to our workforce's capabilities, skills availability, and demographics. Together we've identified industries and businesses where our skills are directly transferable. … We are also working with local DOD representatives, representatives from the [universities] to help define opportunities, possibilities and challenges.

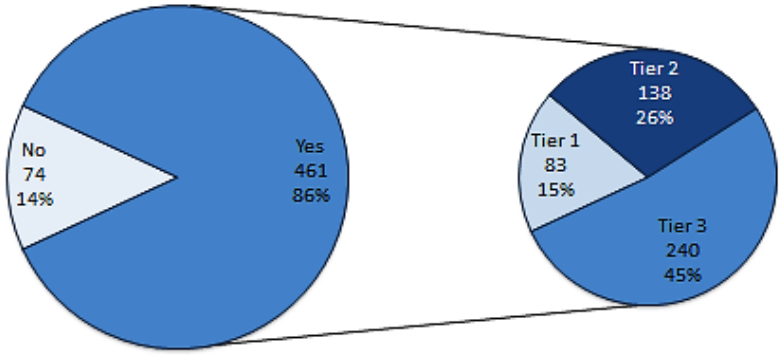
Other companies had less extensive interactions with agencies/organizations regarding addressing the post- Shuttle, post-CxP environment. A Tier 3 company stated the, "Center for Economic Growth in NY has helped us with training." Another company explained that, "Introductory meetings [have been] held with Space Florida."

Ninety-two percent of companies indicated they had no contact with any agency/organization to address the post-Shuttle, post-CxP environment. Many of these companies were struggling with a lack of available information, as one Tier 3 company explained, "We were not aware that these resources were available to address the post Shuttle and Constellation programs." Some did not see a need to work with an agency/organization because, as one company stated that their "revenue from NASA related projects is inconsequential to our overall business."

K. Willingness to Work with NASA on Future Programs

In an effort to obtain industry views on future cooperation with NASA, OTE asked survey respondents if they were willing to support future NASA human space flight (HSF) programs. Despite losing current and future Space Shuttle (Shuttle) and Constellation (CxP) contracts, 86 percent of survey respondents indicated their willingness to support future NASA HSF programs (see Figure IX-20). This willingness was apparent in all three tiers.

Figure IX-20: Is Your Company Willing to Support Future NASA Human Spaceflight Programs?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Many companies highlighted their competencies and ability to assist in future NASA HSF programs. For example, a Tier 3 company said, "We believe our skill set(s) would be useful for any future space program, and would be helpful for the man-rating of software and hardware."[72] Another company commented that, "The expertise and capabilities developed with the Space Shuttle program can translate directly to the next generation of programs for forming, machining and processing of complex sheet metal parts and assemblies."

Some of these companies emphasized that while there was personal fulfillment in working with NASA, it often was not the easiest business relationship for them to maintain due to business uncertainties and risks. A Tier 1 company said, "…Our support for NASA's human spaceflight dates back many decades, and we would like to continue to support it in the future. However, the uncertainty in NASA's planning creates a difficult situation for businesses." A Tier 3 company echoed similar concerns, stating:

> We love assisting NASA. We have the best aerospace engineers and technicians available in the USA today, many who came to NASA because of Constellation and Shuttle. Today, many work on NASA programs fully knowing they can make higher pay elsewhere. While there is potential that they will look elsewhere because their dream job is disappearing, any new, strong leadership with a focus on human spaceflight and a near term mission will likely entice people to stay. Otherwise, it's just a job and they will go for the highest pay.

[72] Man-rating or human-rating is a term used to describe the certification of items as suitable for transporting humans.

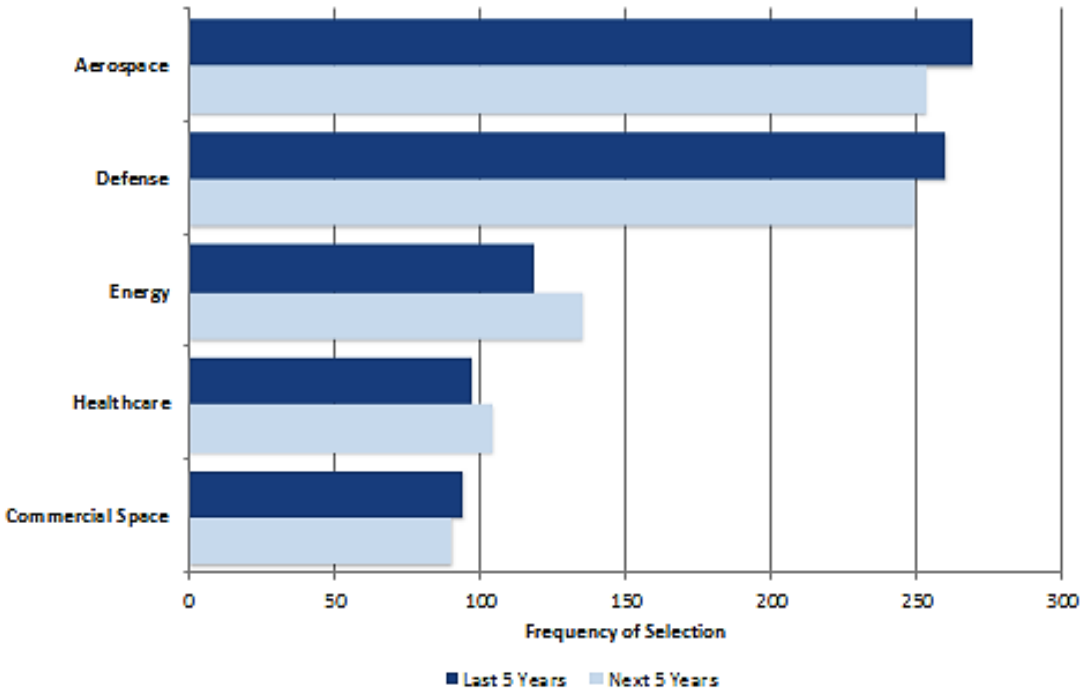
Some of the 74 survey respondents or 14 percent who indicated they were not willing to support future NASA HSF programs also mentioned uncertainties faced by NASA suppliers. More than half of these respondents, 54 percent, were Tier 3 companies. Some respondents said NASA was unrelated to the main focus of their business, while others said the environment was too uncertain to factor NASA business into future plans. For example, one Tier 3 company commented, "Probably not. It does not appear to be a sustainable business."

L. Market Segments Served in Last 5 Years/Next 5 Years

Survey respondents were asked to identify what industry/market segments their company served in the last five years, as well as what segments their company planned to target in the next five to ten years. Companies could identify up to five industries/market segments for each timeframe, which OTE then classified into 29 different categories. It is important to note that while a company might have indicated that it will stay in the same category, any shifts in focus to other aspects of the industry/market segment are not captured by these broad categories.

The largest industry/market segments served in the past five years were Aerospace and Defense at 16 and 15 percent of total reported segments, respectively (see Figure IX-21). While these two segments remained the largest industry/market segments identified by respondents for the next five to ten years, both experienced declines. In addition, the Energy and Healthcare industry/market segments experienced the largest increases in the number mentions by respondents for the next five to ten years.

Figure IX-21: Top Five Industry/Market Segments Served



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

M. Actions Taken to Improve Competitiveness in Last 5 Years/Next 5 Years

Survey respondents were asked to describe the actions they have taken in the past five years to improve their competiveness. They were also asked to describe the actions they planned to take in the next five years to improve their competiveness. OTE then classified the narrative responses into ten action categories. Companies could provide one or more responses.

Capacity/Property, Plant and Equipment (PP&E) Investment was the action most commonly identified by companies for increasing past and future competiveness (see Figures IX-22 and IX-23). Cost Reductions and Efficiency was the second most commonly cited action identified by companies for increasing past as well as future competiveness, comprising 16 percent of responses for both past and future actions. Staff Adjustments and Training/Certifications continued to be actions taken to improve competitiveness by 10 percent or more of NASA-dependent respondents.

Figure IX-22: Actions To Improve Competitiveness in the Last 5 Years			
Category	All Respondents	Not Dependenton NASA Respondents	NASA Dependent Respondents
Capacity/PP&E Investment	21%	22%	18%
Cost Reductions/Efficiency	16%	16%	17%
Automation/Lean Manufacturing	10%	11%	7%
Innovation/R&D, Design	10%	10%	10%
Customer Service/Quality Control	9%	9%	10%
Marketing Improvements	8%	8%	5%
Business Restructuring	8%	8%	7%
Training/Certifications	7%	7%	11%
Staff Adjustments	7%	6%	11%
Status Quo	3%	3%	4%

Based on 512 responses

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network,* June 2012

Figure IX-23: Actions To Improve Competitiveness over the Next 5 Years			
Category	All Respondents	Not Dependenton NASA Respondents	NASA Dependent Respondents
Capacity/PP&E Investment	21%	22%	19%
Cost Reductions/Efficiency	16%	14%	20%
Innovation/R&D/Design	11%	12%	9%
Customer Service,/Quality Control	10%	10%	10%
Marketing Improvements	9%	10%	9%
Training/Certifications	8%	7%	10%
Business Restructuring	8%	9%	4%
Automation/Lean Manufacturing	7%	8%	4%
Status Quo	6%	6%	6%
Staff Adjustments	5%	2%	10%

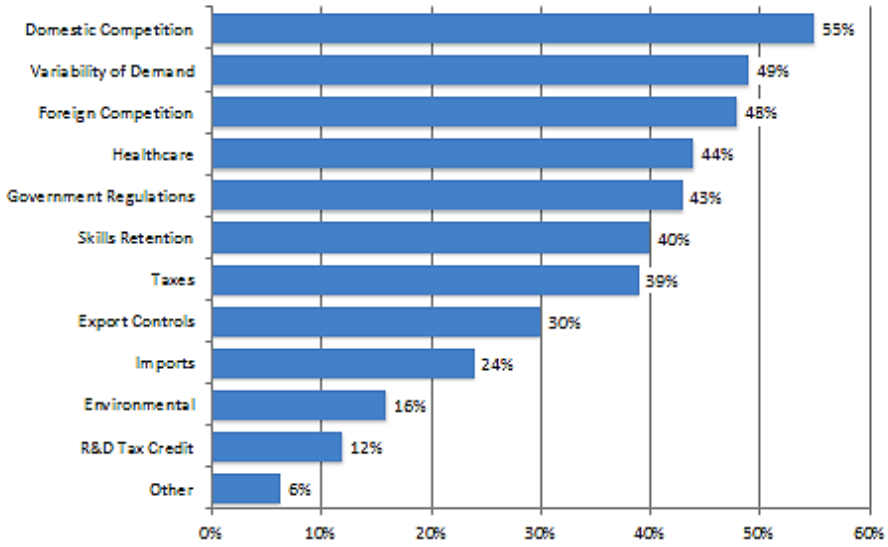
Based on 493 responses

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network,* June 2012

N. Main Issues Affecting Long-Term Industry Viability

Survey respondents were asked to identify the main issues and challenges that affected the long-term viability of their company. OTE asked companies to choose from 12 pre-identified issues; respondents could select one or more issues that were of concern. The issue identified by the most respondents was Domestic Competition, with 55 percent of respondents overall (see Figure IX-24). It was also the main issue identified by the most respondents in each tier. A Tier 2 company stated, "Larger competitors offer lower prices due to being more vertically integrated and having more automation." A Tier 2 company said, "Domestic competition has increased due to fewer customers in tough economic times."

Figure IX-24: Main Issues Affecting Long-Term Viability*



*Based on 469 respondents that answered

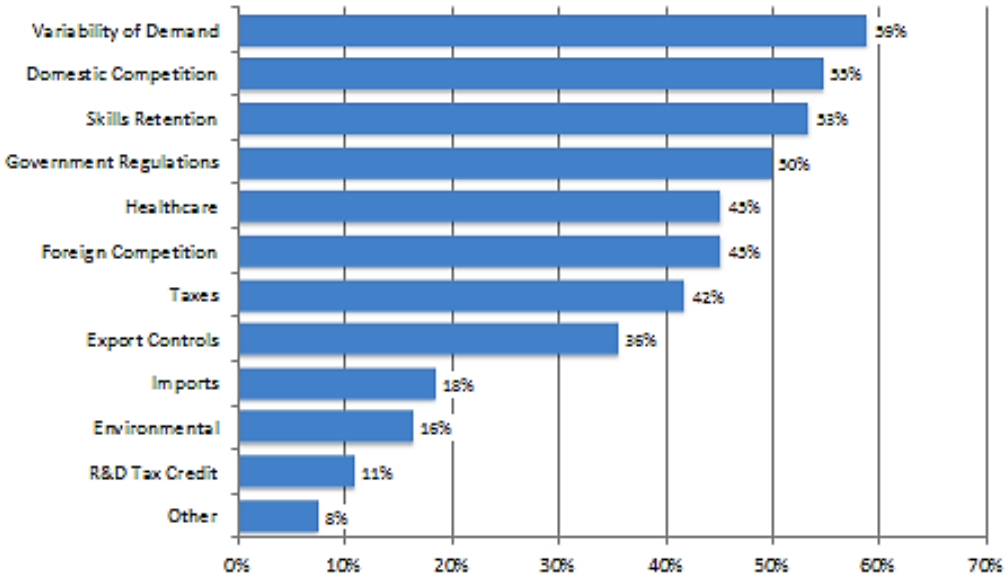
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The second most commonly cited issue/challenge by survey respondents was Variability of Demand. Many of these respondents commented on how this issue affects all aspects of their businesses. For example, a Tier 2 company stated, "Variability of demand driven by changing launch manifests as well as low volume & single year orders, is the single greatest challenge we face in both retaining a qualified workforce and justifying minimal capital investment/ improvements." A Tier 3 company said, "Variability of demand has been brutal over the last two years, before that we could withstand the slight variations but the last two years has seen us set back in growth by 10 years."

Respondents face other challenges, such as Healthcare. Several respondents mentioned that healthcare costs were their highest cost after payroll, and most companies cited the increased costs of healthcare as driving up their expenses. As one Tier 3 company explained, "Healthcare costs increasing at 10 to 15 percent per year are unsustainable and will crush us in the next five to 10 years and likely force us to abandon or decrease benefits." A majority of Tier 3 companies, 51 percent, cited Healthcare as a main issue/challenge affecting their company, as compared to only 39 percent of Tier 2 and 32 percent of Tier 1 companies.

Similar to the overall survey population, NASA-dependent respondents cited Variability of Demand and Domestic Competition as the top two issues affecting their long-term viability (see Figure IX-25). However, NASA-dependent companies identified Skills Retention as the third top issue, which was impacted mostly by uncertain economic conditions. As one Tier 2 company stated, "Without a program such as the Constellation program we will be unable to retain a skilled workforce that has the ability to support the potential commercial providers when they are ready." One Tier 1 company said, "In programs which fluctuate year after year, it is very difficult to continue to keep skilled positions without them desiring more stability and will leave the company."

Figure IX-25: NASA-Dependent Suppliers – Main Issues Affecting Long-Term Viability*



*Based on 146 NASA-dependent respondents that answered

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

O. Recommended Policy/Regulatory Changes for the U.S. Government

OTE asked survey respondents to identify what policy changes or regulatory reforms they recommend the USG implement to enhance their competiveness. OTE received 429 recommendations and sorted them into 13 different categories (see Figure IX-26). Due to the in-depth narrative provided by some survey respondents, a number of individual comments were classified into multiple categories.

Figure IX-26: Top Policy Changes/Regulatory Reforms Recommended to the U.S. Government*	
Implement Export Control Reform	18%
Implement Tax Reform	15%
Strengthen Industrial Policy	15%
General Regulation Reform	14%
Address Small-Medium Enterprise (SME) Concerns	10%
Implement Contracting/Procurement Reform	9%
Implement Healthcare Reform	6%
Support R&D Efforts (Tax Credits, etc.)	4%
Strengthen/Establish Stable Space Policy	7%
Address Minority Business Issues	2%
* As a percentage of 429 comments received.	

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Export Control Reform was the most commonly cited recommendation, with 17 percent of responses recommending the USG take action in the area. For example, a Tier 1 company recommended that the USG should engage in "developing a better ITAR regime for launch vehicle and space products."[73] Another Tier 1 company wanted export regulations to be simpler, stating:

> The U.S. Government should provide a single export control restriction list limited to only those critical technologies that we must protect, and the list should be reviewed frequently for relevancy. There should be clear criteria what should be on the list. Provide a single agency for handling all export control.

Fifteen percent of responses cited Tax Reform as the second most mentioned recommendation for the USG. A Tier 2 company commented, "Tax strategies in the U.S. prevent us from bringing money into the U.S. that was earned by our subsidiaries - including royalties owed to

[73] ITAR stands for International Traffic in Arms Regulations.

the parent company. This limits funds available for U.S. investment by the parent company." A Tier 3 company explained, "High taxes on small businesses reduce the amount of capital that could otherwise be invested in R&D or expanding the business."

In addition, 15 percent of survey responses also recommended policy changes related to Industrial Policy, with the majority of comments for strengthening current policies. For example, one Tier 3 company said, "Remove all the exceptions to the Buy America Act; purchase domestic materials only wherever possible." Another respondent, a Tier 1 company, suggested implementing "a U.S. Government policy that requires all Government payloads (including secondary and hosted payloads) to be launched by U.S. launch service providers…" A Tier 2 company stated, "Foreign contribution should be considered a viable option in the areas where U.S. firms do not maintain the greatest level of experience and heritage."

Many of the responses grouped into the Industrial Policy category expressed concerns about currency manipulation and their desire for the USG to address the issue. Comments from these companies highlighted the belief that this practice puts U.S. companies at a disadvantage. For example, a Tier 3 company commented that the USG should, "Punish sovereign currency manipulation." Another Tier 3 company stated that the USG should "implement and enforce stronger policies with foreign countries that are using unfair trading practices such as currency value manipulation."

X. Supply Chain Dependency on NASA

The transition of NASA human space flight (HSF) programs, specifically from the Space Shuttle (Shuttle) and Constellation (CxP), will have a varied effect on the health and competitiveness of companies identified in NASA's supply chain. For survey respondents with limited financial exposure to NASA business, the loss of these programs is anticipated to have minimal, if any financial impact. Other groups of survey respondents that had more exposure to NASA-related business expressed some concern about the potential loss of sales, skills, knowledge, and production capabilities. The remaining 150 survey respondents – the focus of this chapter – were companies determined to be dependent on business from NASA to maintain their core production, workforce, and technical capabilities and overall financial viability.

HSF suppliers that are dependent on NASA were identified through their survey responses. Survey respondents were asked if they thought they were dependent on NASA-related business. The definition of dependency was left open to allow companies to reflect on how they were specifically affected by NASA business. Most of these respondents supplied explanations to provide insight into the reasons for and potential consequences of their dependency on NASA. In total, 150 companies, or 28 percent of all survey respondents, declared themselves dependent on NASA-related business.

To validate and further understand this dependency, OTE determined NASA-dependent HSF suppliers using a sales metric as a determinant of dependency – the percentage of total sales they derived from NASA-related business. This percentage also allowed OTE to isolate dependencies on specific programs in NASA's supply chain – the Space Shuttle (Shuttle), Constellation (CxP), and the International Space Station (ISS). Based on this analysis, OTE determined a minimum of 25 percent of total sales in at least one year from 2007-2010 was a reasonable threshold value to establish NASA HSF program dependency. Approximately half of the 150 companies who identified themselves as NASA-dependent met this criteria.

In addition, OTE examined a subset of the 150 NASA-dependent HSF suppliers that experienced low profitability as a potential area of concern for the health and viability of NASA's supply chain. Forty-six NASA-dependent suppliers reported negative net profit margins for at least one

year in 2007-2010, with some operating at a loss in multiple years. Overall, these 46 suppliers underperformed both operationally and financially compared to other NASA HSF suppliers, and represent the highest risk of insolvency and potential lost capability to NASA's HSF supply chain.

Finally, 16 survey respondents that did not consider themselves NASA-dependent (and are not part of the 150 companies) but derived 25 percent or more of their total sales from sales to NASA and/or from sales to specific NASA HSF programs were also reviewed.[74]

To better assess the comparative performance of NASA-dependent suppliers with those not dependent on NASA work, OTE analyzed four performance metrics: capacity utilization rates, net profit margins, current ratios, and debt ratios. These metrics measure suppliers' efficiency, profitability, solvency, and indebtedness. Unless otherwise stated, the 150 HSF suppliers who declared themselves as dependent on NASA business were those suppliers utilized in the forthcoming analysis.

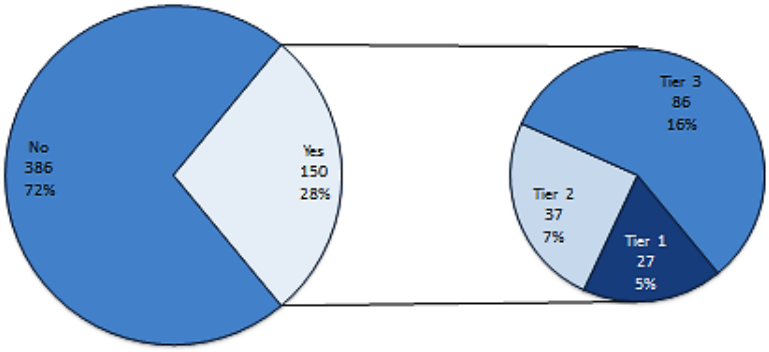
A. Profile of NASA-Dependent HSF Suppliers

Survey respondents that identified themselves as NASA-dependent were represented in all three tiers, participated in an array of primary business lines, and were spread geographically throughout the United States. Moreover, a number of these suppliers listed reasons for their dependency and what actions they were taking in response to the Shuttle retirement and CxP transition.

The majority of the 150 NASA-dependent suppliers were Tier 3 companies (see Figure X-1). Eighty-six Tier 3 companies, 37 Tier 2 companies, and 27 Tier 1 companies identified themselves as dependent on business from NASA.

[74] An analysis of these 16 companies can be found in section J of this chapter.

Figure X-1: Is Your Company Dependent on NASA-Related Business?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

NASA-dependent companies were also identified across multiple primary business lines (see Figure X-2). NASA-dependent companies operated in 14 of the 17 primary business lines listed in the survey. The largest number of companies that identified themselves as NASA-dependent indicated their primary business line was Manufacturing. The other most common primary business lines were Professional Services, R&D, and Distribution. Of the 27 survey respondents that identified R&D as their primary business line, 18 were dependent on NASA.

Figure X-2: NASA-Dependent Suppliers by Business Description

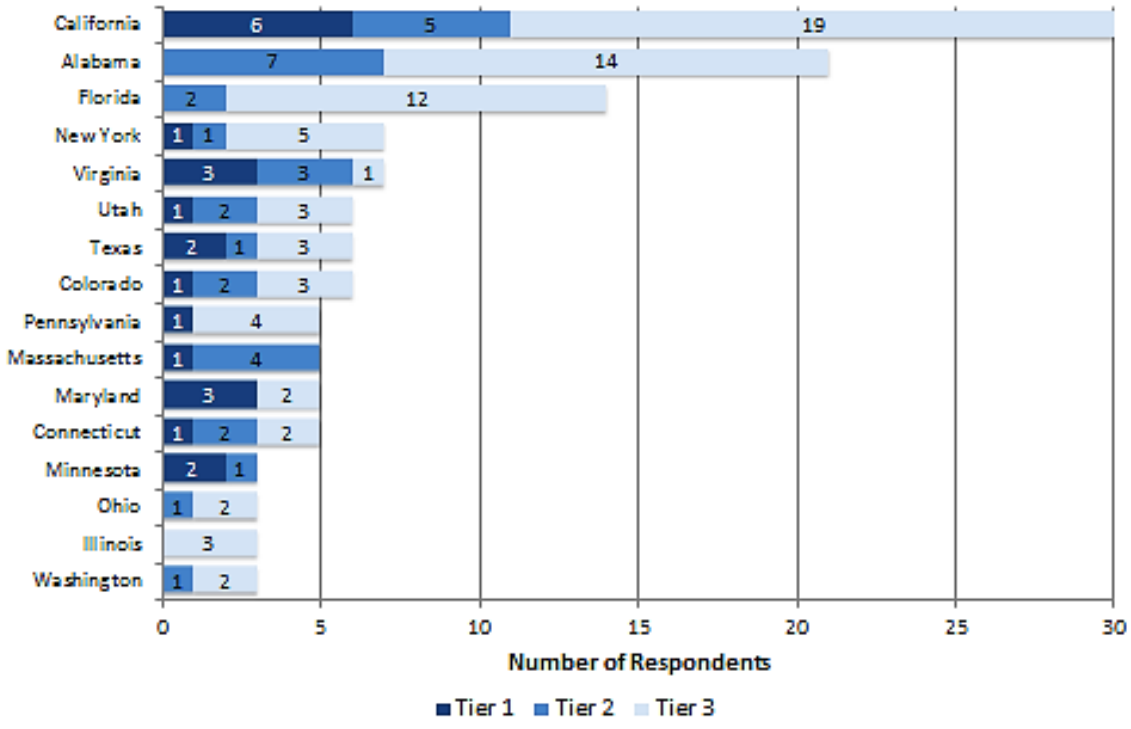
Primary Business Line Descending Order by Frequency	Tier 1	Tier 2	Tier 3	% of Total
Manufacturing	9	14	33	37%
Professional Services	5	6	12	15%
R&D	7	3	8	12%
Distribution	1	1	15	11%
Product and Design Engineering (Tooling, New Processes, etc.)		2	5	5%
Manufacturing Systems Development and Management	3	2		3%
Raw Materials	1	2	2	3%
Reseller		1	4	3%
Service		3	2	3%
Material Finishing (Machining, Coating, Plating, Assembly, etc.)		1	2	2%
Material Preparation (Casting, Forming, Molding, Forging, etc.)	1		1	1%
Testing/Evaluation/Validation		2		1%
Maintenance/Aftermarket			1	1%
Retail			1	1%
Total	**27**	**37**	**86**	**100%**

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

From a HSF program perspective, of the 244 companies that identified themselves as supporting the Constellation program (CxP), 110 or 45 percent identified themselves as being dependent on NASA. Of the 389 survey respondents that indicated they supported the Space Shuttle program (Shuttle), 121 or 31 percent identified themselves as NASA-dependent. For the 203 companies that indicated they support the International Space Station (ISS), 88 or 43 percent of companies identified themselves as being dependent on NASA.

NASA-dependent HSF suppliers were located in 31 states across the United States, but were geographically concentrated in California, Alabama, and Florida (see Figure X-3).[75] These states had a mix of companies in all tiers, but the majority of companies were Tier 3. Approximately two-thirds of the California-based, NASA-dependent companies were Tier 3, while the NASA-dependent companies in Alabama and Florida consisted of only Tier 2 and Tier 3 companies.

Figure X-3: U.S. Locations of NASA-Dependent Survey Respondents



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[75] Fifteen states were reported by survey respondents but not identified in Table X. These states include (in order of number of mentions): Tennessee, Arkansas, Georgia, New Hampshire, Arizona, New Mexico, Oregon, Nevada, Missouri, Louisiana, New Jersey, North Carolina, Michigan, Wisconsin, and South Carolina. Respondents also reported the District of Columbia as a location of U.S.-based suppliers.

A number of NASA-dependent companies commented that NASA funds helped support their specialized workforce. For example, a Tier 1 company stated that while it is not financially dependent on NASA-related business, its "account structure includes a NASA account that employs about 350 staff that solely support NASA and are dependent on NASA business." A Tier 2 company said:

> Our company is very dependent upon NASA business. Approximately 50 percent of the engineering staff is dedicated to supporting the Orion Crew Exploration Vehicle (CEV) … program. We are also supporting NASA on various other planetary probe activities and are currently supporting NASA Langley on the Inflatable Reentry Vehicle (IRVE) program.

NASA-dependent respondents cited a number of other consequences of and reasons for their dependency. One commonly cited reason for dependency was that the company's business operations were built around serving NASA. For example, a Tier 3 supplier stated, "As a small business, our infrastructure has been developed to deal with the rigors of NASA related business and makes it difficult to expand into more commercial markets." Another Tier 3 supplier said that, "Our business was built on supporting the Space Station through NASA and its subcontractors."

In addition, some suppliers indicated they were dependent on NASA because of their sales relationships with NASA prime contractors. For instance, a Tier 3 company stated, "Subcontracts on the ISS provide a stable labor base and help us maintain core competencies. Competencies in engineering and design enable [our company] to pursue additional business opportunities in cyclical commercial business." Some of these respondents also commented that the subcontractor relationship hindered their visibility to NASA's priorities and changing policies, as information on end-users is often not passed down to the subcontractors.

When asked about the actions their company had taken in the past five years or planned to take in the next five years to increase their competiveness, survey respondents indicated a focus on Cost Reductions/ Efficiency and Capability/Property, Plant and Equipment (PP&E) Investment (see Figure X-4). Marketing Improvements showed the greatest percent change in strategy of all the actions reported; five percent of respondents listed Marketing Improvements as an action for the last five years while nine percent listed this strategy for the next five years.

Figure X-4: Actions Taken by NASA-Dependent Suppliers To Improve Competitiveness			
Category	Last 5 Years	Next 5 Years	Change
Marketing Improvements	5%	9%	+ 4%
Cost Reductions/Efficiency	17%	20%	+ 3%
Status Quo	4%	6%	+ 2%
Capacity/PP&E Investment	18%	19%	+ 1%
Customer Service/Quality Control	10%	10%	0%
Innovation/R&D/Design	10%	9%	- 1%
Training/Certifications	11%	10%	- 1%
Staff Adjustments	11%	10%	- 1%
Automation/Lean Manufacturing	7%	4%	- 3%
Business Restructuring	7%	4%	- 3%

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

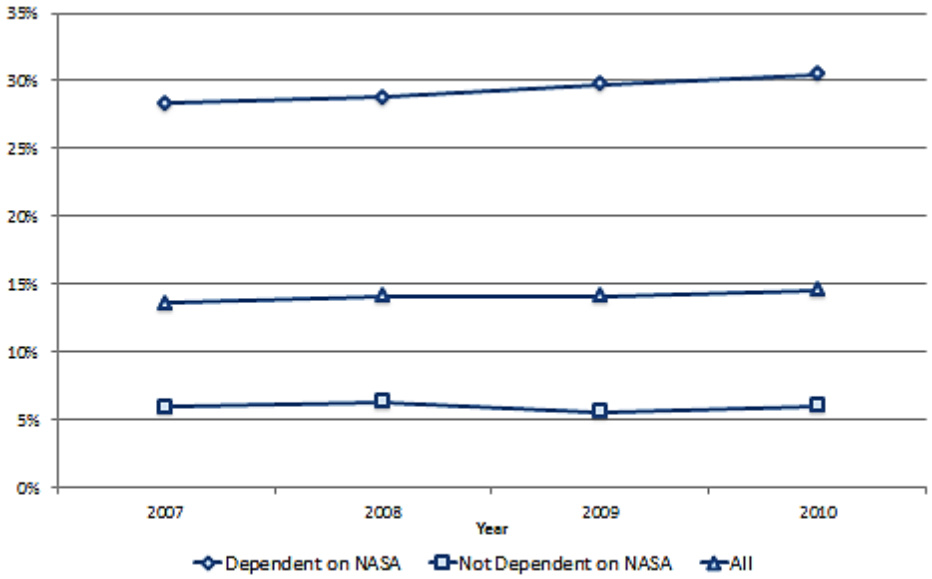
Companies that identified themselves as NASA-dependent were also more likely to indicate that they needed to make changes in the Staff Adjustment category as compared to companies who did not consider themselves NASA-dependent.[76] For the next five years, 10 percent of the responses from NASA-dependent companies indicated that they were making staff adjustment verses 2 percent of non-NASA dependent survey respondents.

B. NASA Dependency and Sales

Survey respondents that declared themselves NASA-dependent had a per year average of NASA sales as a percentage of aggregate sales between 28 and 30 percent over 2007-2010 (see Figure X-5). This ratio increased over the period, suggesting that NASA-dependent suppliers became slightly more dependent on sales to NASA. Companies that are not dependent on NASA averaged NASA sales that were approximately six percent of total sales each year.

[76] As mentioned in Chapter IX.

Figure X-5: Average NASA Sales as a Percentage of Total Sales*



*Based on 225-244 respondents (122-131 NASA-dependent) depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The vast majority of comments from the 150 NASA-dependent cited a large percentage of sales to NASA as the primary reason for their dependency. For example, one respondent said, "Our business relies heavily on the health of NASA. Our U.S. business units derive over 50 percent of their work from robotics, space structures, mechanisms, engineering services, and manned operations services."

As stated previously, approximately half of the 150 NASA-dependent respondents had sales to NASA that were equal to or greater than 25 percent of their total sales for at least one year from 2007-2010. These companies accounted for 83-89 percent of survey respondents with sales to NASA that were equal to or greater than 25 percent of their total sales, depending on the year (see Figure X-6). The companies that identified themselves as NASA-dependent but did not have more than 25 percent of their sales directed to NASA indicated they had indirect sales to NASA through prime contractors. These sales would not be recorded as NASA sales.

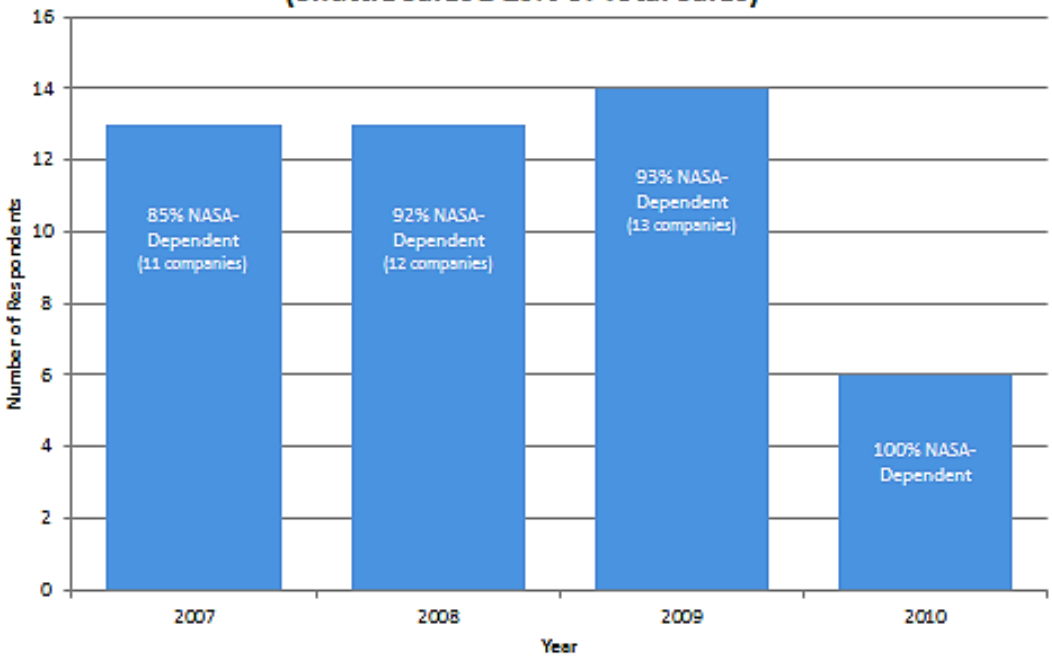
Figure X-6: Sales Dependency – NASA Sales ≥ 25% of Total Sales

	2007	2008	2009	2010
# of Respondents	60	59	61	58
% NASA Dependent	85%	86%	89%	83%

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

NASA sales were broken out by three specific HSF programs: Shuttle, CxP, and ISS.[77] The number of companies that had greater than or equal to 25 percent of sales to Shuttle declined after 2009, from 14 respondents to only six respondents (see Figure X-7). It is conceivable that companies anticipated the Shuttle retirement and made decisions which lowered their sales exposure to the program. There were a small number of companies that derived greater than or equal to 25 percent of total sales from Shuttle sales between 2007-2009 that did not consider themselves NASA-dependent. In 2010, however, the six companies that had 25 percent or more total sales from Shuttle sales all identified themselves as NASA-dependent.

Figure X-7: Number of Respondents Dependent on Shuttle Sales (Shuttle Sales ≥ 25% of Total Sales)

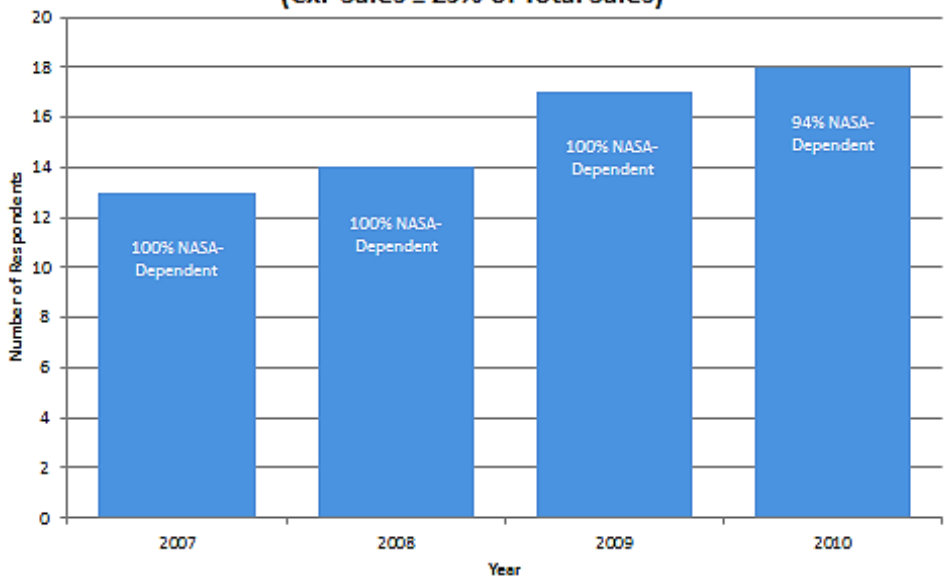


Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Unlike Shuttle, the number of suppliers that had greater than or equal to 25 percent of sales to CxP increased each year over the period, from 13 in 2007 to 18 in 2010 (see Figure X-8). This increase could be due to companies shifting their focus from Shuttle to CxP. This finding reflects the increasing trend of CxP sales as a percentage of HSF sales over the period, identified in Section IV.

[77] Not all survey respondents were able to provide data at the program-level.

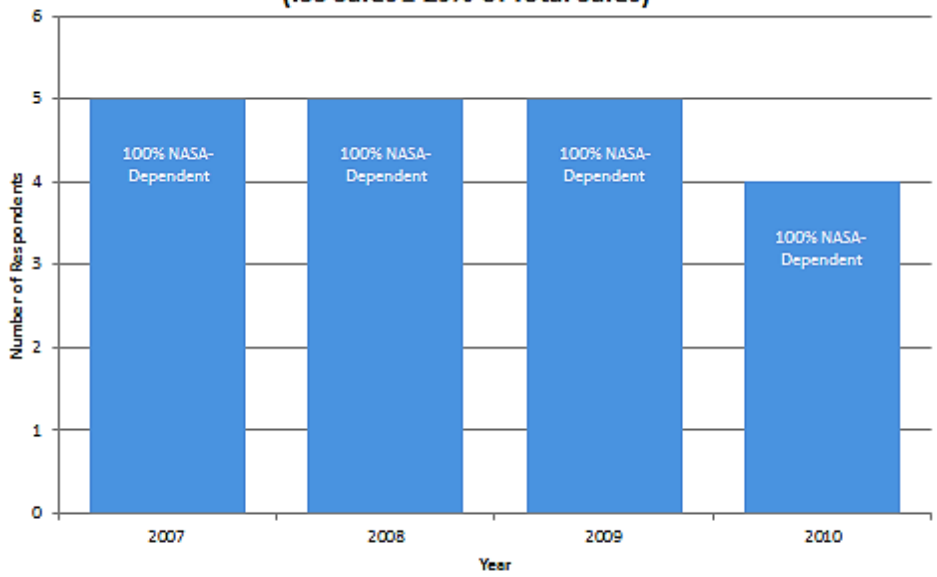
Figure X-8: Number of Respondents Dependent on CxP Sales (CxP Sales ≥ 25% of Total Sales)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Similar to Shuttle, the number of companies that derived 25 percent or more of total sales from ISS program sales decreased from five over 2007-2009 to four in 2010 (see Figure X-9). Every company that reported greater than or equal to 25 percent of total sales from ISS sales identified itself as NASA-dependent.

Figure X-9: Number of Respondents Dependent on ISS Sales (ISS Sales ≥ 25% of Total Sales)



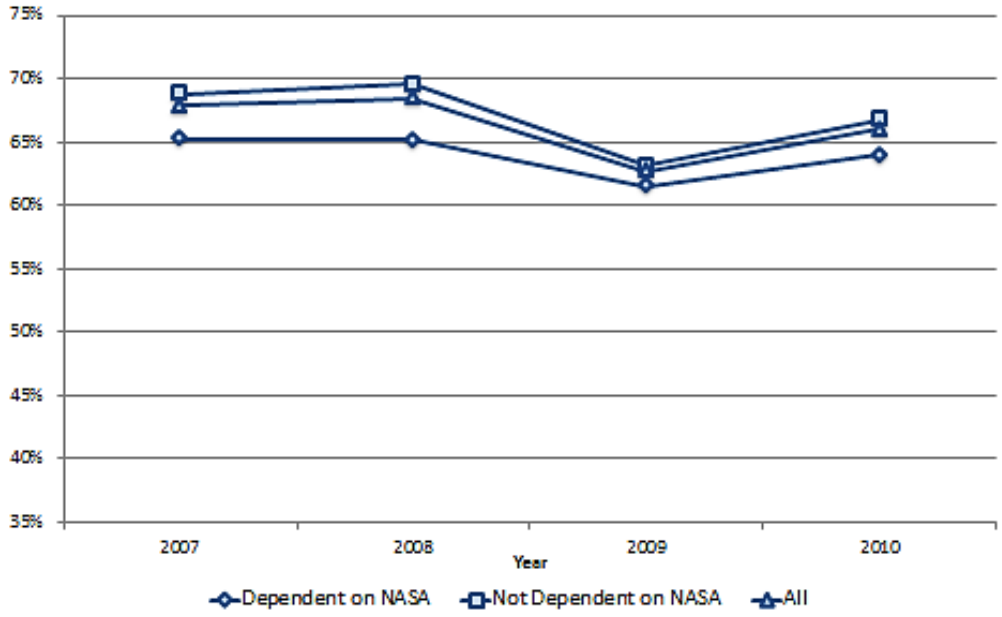
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

C. Production Capacity Utilization Rates for NASA-Dependent Suppliers

Survey respondents were asked to report their overall production capacity utilization rate for 2007-2010. High capacity utilization rates mean that companies are more efficiently using their total annual installed production capacity, while low capacity utilization rates can be a sign of current and future financial problems. In general, suppliers that identified themselves as NASA-dependent had higher levels of excess capacity than suppliers that are not dependent on NASA.

All suppliers experienced a drop in capacity utilization rates from 2007 to 2009; NASA-dependent suppliers experienced a four percent drop in capacity utilization and suppliers not dependent on NASA experienced a drop of six percent (see Figure X-10). This is primarily because companies that are not dependent on NASA participated more in the commercial sector, which experienced a large contraction in demand during the recession.[78] Government sales reported by survey respondents, on the other hand, increased during the recession.

Figure X-10: Average Production Capacity Utilization Rate*



*Based on 340 respondents (86 NASA-dependent) that recorded capacity utilization rates

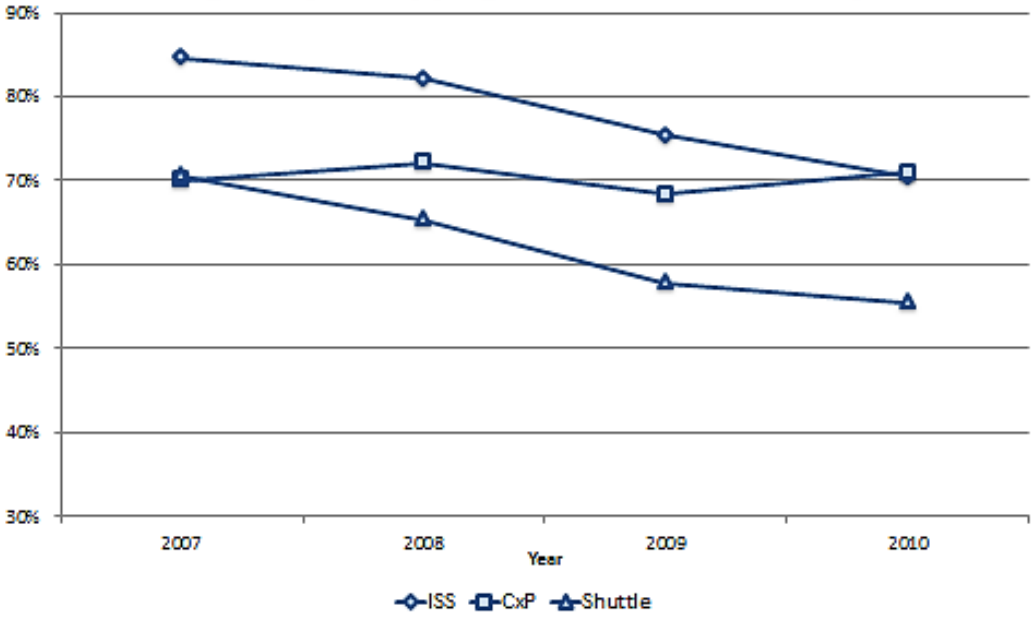
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

At the program-level, suppliers that derived 25 percent or more of total sales revenue from ISS and Shuttle exhibited declines of 15 percent in their average capacity utilization rates over the

[78] See Section IV.

period, though ISS-dependent suppliers had higher capacity utilization rates on average than Shuttle-dependent suppliers (see Figure X-11). These declines are in line with the maturity of ISS and the pending retirement of Shuttle. Suppliers that derived 25 percent or more of total sales revenue from CxP did not exhibit the same trend, but maintained relatively stable capacity utilization rates over the period as CxP contracts were still underway during the survey time period. While these results are informative, they are not that significant because there were only five ISS-dependent suppliers, 10 CxP-dependent suppliers, and 11 Shuttle-dependent suppliers in the population that reported production capacity utilization.

Figure X-11: Average Production Capacity Utilization Rate and Program Dependency (Program Sales ≥ 25% of Total Sales)*



*Based on 5, 10, and 12 respondents for ISS, CxP, and Shuttle, respectively

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

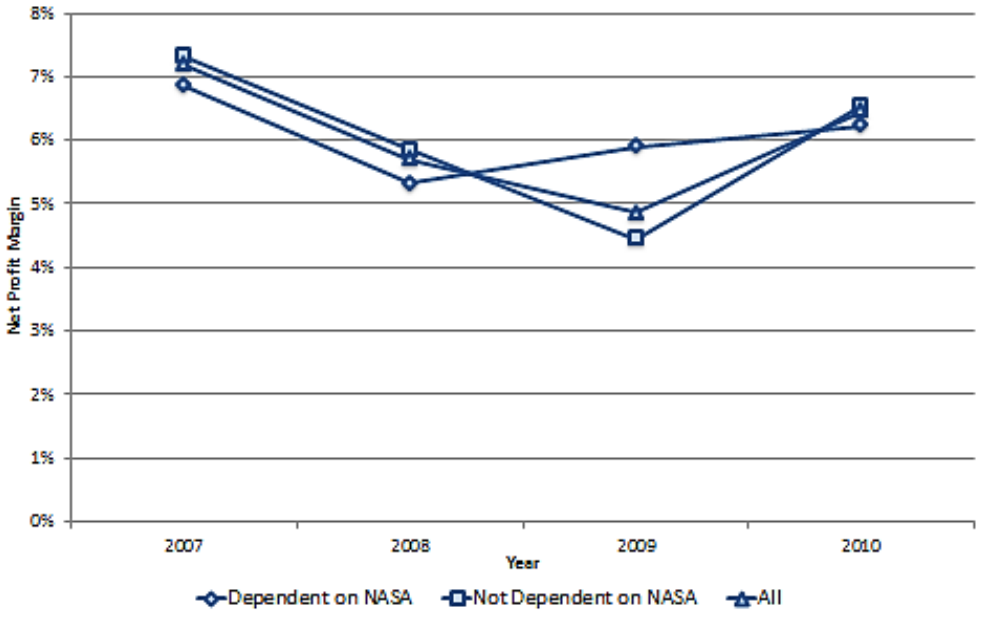
In addition to diminished sales revenue, some NASA-dependent suppliers commented that reduced production volume resulting from declining NASA sales would negatively impact their companies. One Tier 3 company stated that their production will significantly drop as NASA cuts back purchases. Another Tier 3 company said, "About one-third of our company supported NASA prior to the Constellation cancellation cutback of June 2010. Now less than 4 percent of our company supports NASA. This hurts our rates, revenues, etc. a lot…" This suggests that this company may have to increase prices to other customers to remain profitable, and as a result become less competitive overall.

D. Profitability of NASA-Dependent Suppliers

As part of their financial statement information, survey respondents provided total sales and total income data for 2007-2010. OTE used this data to calculate net profit margins for NASA HSF suppliers in order to analyze company profitability. [79]

The average net profit margins for NASA-dependent and non-dependent suppliers tracked closely together, though the average profitability of NASA-dependent suppliers was less affected by the recession than non-dependent suppliers (see Figure X-12). Profitability rebounded beginning in 2008 for NASA-dependent companies and beginning in 2009 for non-dependent companies. It is likely that continued NASA sales during the recession helped NASA-dependent suppliers rebound more quickly, since they tended to participate in the commercial sector less than non-dependent suppliers. Median net profit margins followed the same trend over the period, but tended to be a percent lower than the average values.[80]

Figure X-12: Average Net Profit Margins*



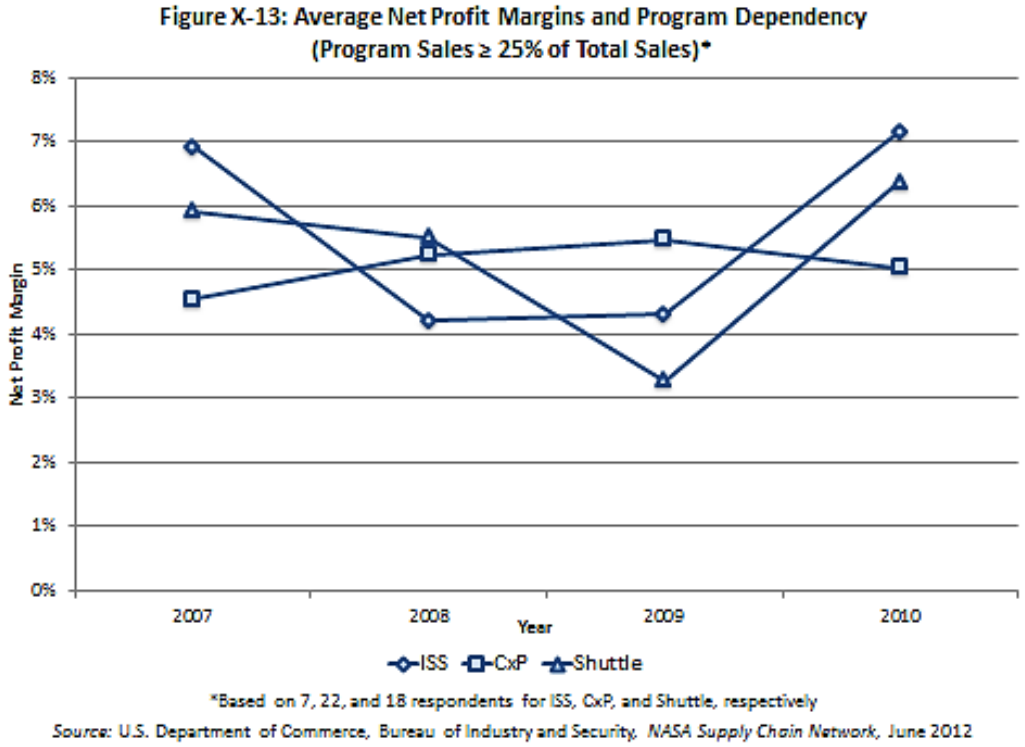
*Based on 477-491 respondents (128-136 NASA-dependent) depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

At the program-level, respondents that were dependent on ISS and Shuttle experienced a decrease in net profit margins from 2007-2009, which was followed by an increase in 2010 (see

[79] Net profit margins evaluate the amount of profit generated, after expenses, for each dollar of booked revenue.
[80] A graph on median net profit margins can be found in Appendix A.

Figure X-13). CxP-dependent companies increased their profitability on average between 2007 and 2009 and experienced a modest decline in 2010. The trend line for the net profit margins of CxP-dependent companies was less volatile than Shuttle and ISS, as was the case for average capacity utilization rate trends over the period.



E. Current Ratio of NASA-Dependent Suppliers

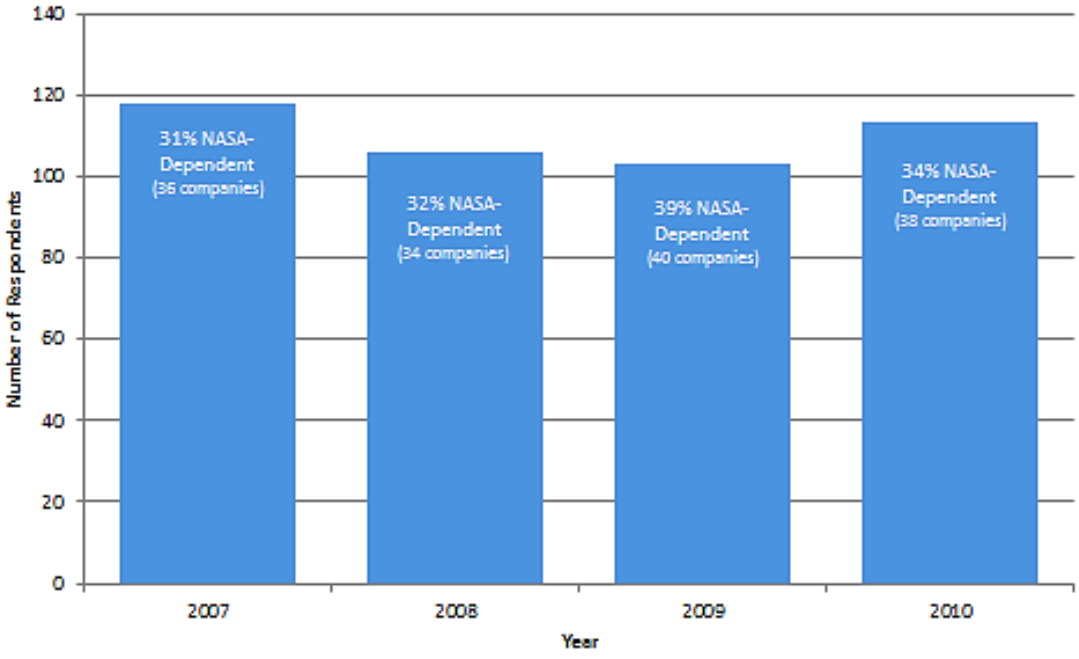
Survey respondents also provided financial statement data on their current assets and current liabilities for 2007-2010.[81] OTE used this data to calculate current ratio for NASA HSF suppliers in order to analyze the ability of companies to cover short-term liabilities with cash or assets that can be converted to cash within one year. A current ratio of less than 1.0 indicates a company has fewer current assets than current liabilities, which can lead to liquidity and solvency problems.

Overall, the number of total suppliers with current ratios of less than 1.0 decreased between 2007 and 2009; approximately a third of illiquid companies each year identified themselves as NASA-

[81] Current assets include accounts receivable, inventory, and other assets that can be quickly converted to cash.

dependent (see Figure X-14). It is difficult to determine the exact reason for this decline due to the broad nature and diversity of the surveyed companies. The decline may indicate that NASA-dependent suppliers accumulated cash to increase liquidity and protect against potential loss, or that inventories increased. After 2009, the number of companies with illiquid current ratios increased to a level closer to that of 2007.

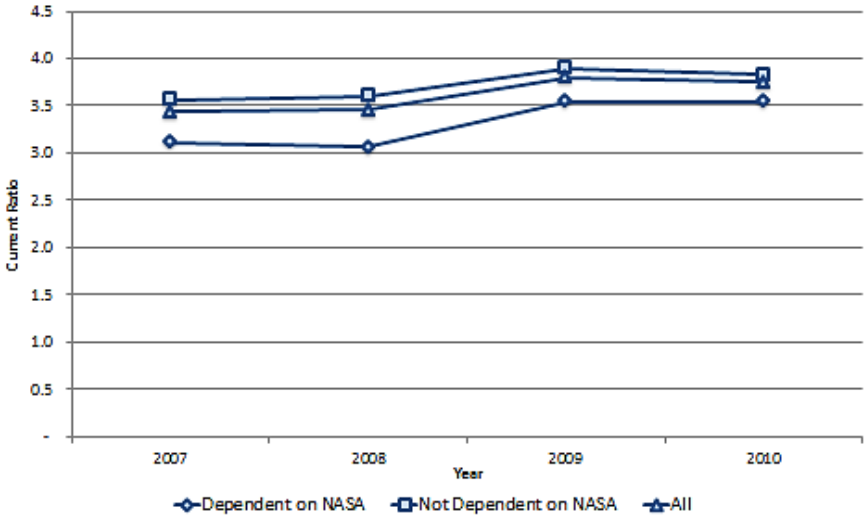
Figure X-14: Number of Respondents with Illiquid Current Ratios (Current Ratio < 1)



Source: U.S. Department of Commerce, Bureau of Industry and Security, NASA Supply Chain Network, June 2012

The average current ratios of NASA-dependent companies over the period were slightly lower than those of companies that were not dependent on NASA (see Figure X-15). NASA-dependent companies' current ratios increased over the period from approximately 3.0 in 2007 to 3.5 in 2010. Non-dependent NASA suppliers followed a similar trend, increasing from approximately 3.5 in 2007 to 4.0 in 2010.

Figure X-15: Average Current Ratio*

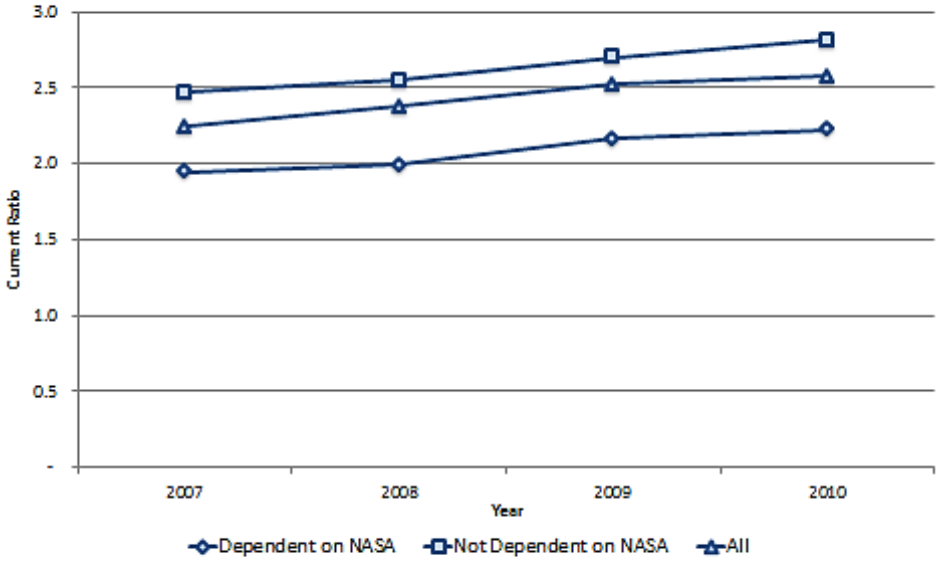


*Based on 462-478 respondents (125-132 NASA-dependent) depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The median current ratios also increased over the period, but were generally lower than the average values (see Figure X-16). Like the average values, median current ratios indicate that both NASA dependent and non-dependent suppliers may have accumulated cash or cash-equivalence during the period. Companies that were not dependent on NASA tended to have a higher median current ratio than their NASA-dependent counterparts.

Figure X-16: Median Current Ratio*

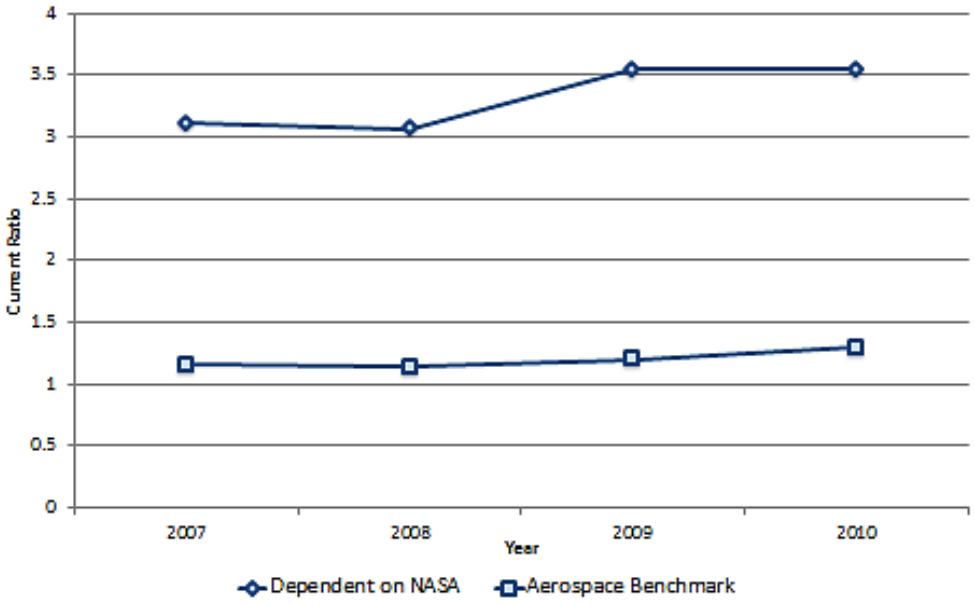


*Based on 462-478 respondents (125-132 NASA-dependent) depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

NASA-dependent suppliers that reported current assets and current liabilities had average current ratios that far exceeded the aerospace industry over the period (see Figure X-17).[82] The aerospace industry experienced an increasing trend between 2007 and 2010, which was similar to respondent averages, but current ratio values remained between 1.0 and 1.5 over the entire period. NASA-dependent respondents seemed to have held much higher levels of liquidity than their aerospace industry counterparts over the period.

Figure X-17: Average Current Ratio for NASA-Dependent Respondents vs. Aerospace Industry Benchmark*



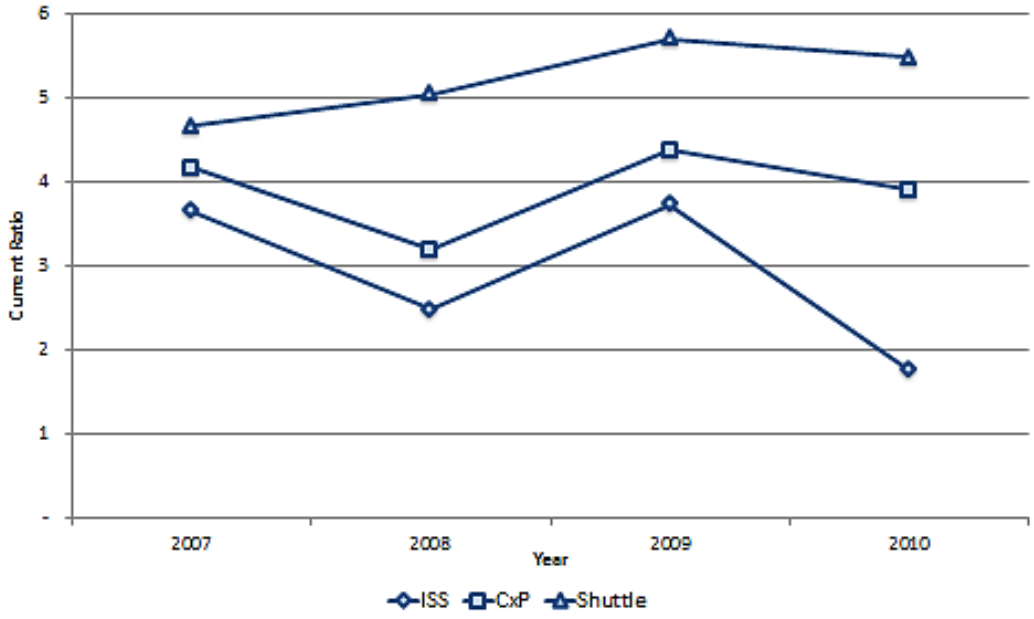
*NAICS 3364 Aerospace benchmark from the Quarterly Financial Report issued by the U.S. Census Bureau

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

At the program level, Shuttle- and CxP-dependent suppliers exhibiting program sales greater than or equal to 25 percent of total sales tended to have higher current ratios over the period than ISS-dependent suppliers (see Figure X-18). CxP- and ISS-dependent suppliers had more volatile current ratio trends over the period compared to Shuttle-dependent suppliers, declining substantially before increasing after 2008 and then declining again. Overall, ISS-dependent companies' average current ratios declined by nearly one-half between 2007 and 2010.

[82] The Quarterly Financial Report issued by the U.S. Census Bureau tracks select financial information for industries on a quarterly basis. To obtain annual figures for 2007-2010, OTE averaged data over four quarters. The Quarterly Financial Report can be found at http://www.census/econ/qtf.

Figure X-18: Average Current Ratio and Program Dependency
(Program Sales ≥ 25% of Total Sales)*



*Based on 7, 20, and 16 respondents for ISS, CxP, and Shuttle, respectively

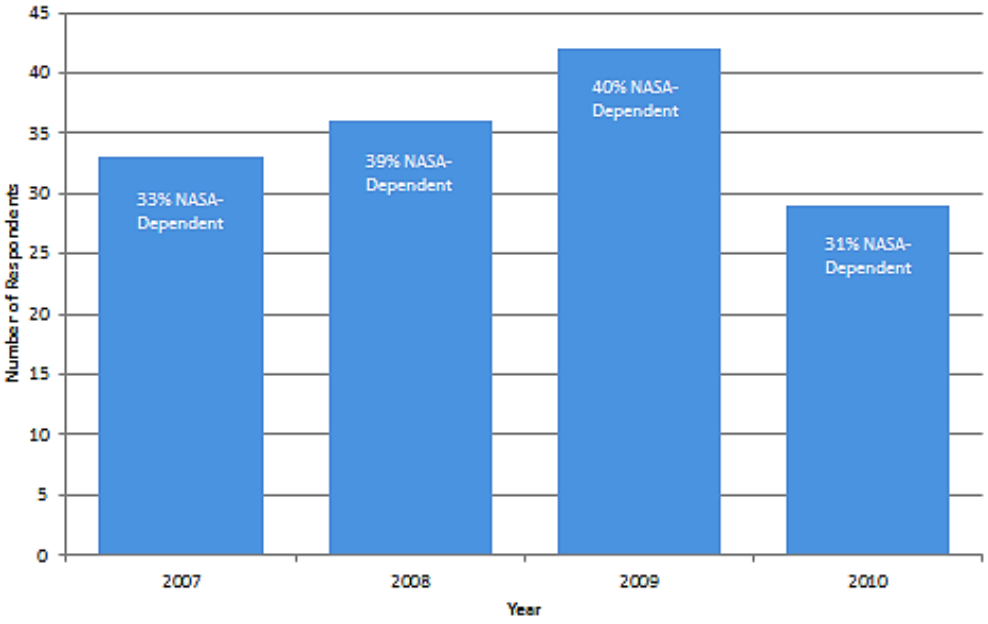
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

F. Debt Ratio of NASA-Dependent Suppliers

The debt ratio is a measure frequently used to assess financial leverage and refers to the level of debt/liabilities used to purchase assets. This measure is calculated by dividing total debt/liabilities by total assets. The higher the debt ratio, the higher the level of debt used to purchase assets; a debt ratio greater than 1.0 indicates that a company has more total liabilities than total assets.

Overall, the number of suppliers with debt ratios greater than 1.0 increased between 2007 and 2009 (see Figure X-19). The increase in companies with debt ratios higher than 1.0 indicates that some suppliers may have had to take on more debt as a result of the recession and/or the Shuttle retirement and CxP transition to maintain operations and capabilities. After 2009, the number of companies with debt ratios higher than 1.0 declined.

Figure X-19: Number of Suppliers that are Highly Leveraged (Debt Ratio > 1)



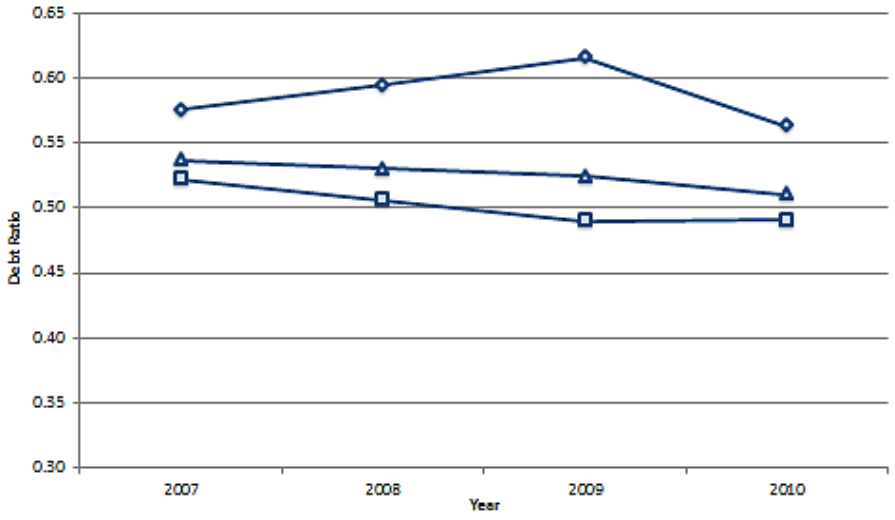
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

More than a third of highly leveraged companies each year identified themselves as NASA-dependent. Since NASA-dependent companies made up roughly 28 percent of the total survey population, this indicates that NASA-dependent companies were slightly more likely than non-dependent respondents to be highly leveraged, especially in 2008 and 2009.

The likelihood of NASA-dependent respondents to be more leveraged is also reflected in the debt ratio levels (see Figure X-20). According to the average values, NASA-dependent companies exhibited greater leverage between 2007 and 2009, while non-dependent companies reduced their leverage.[83]

[83] A graph on median debt ratios can be found in Appendix A.

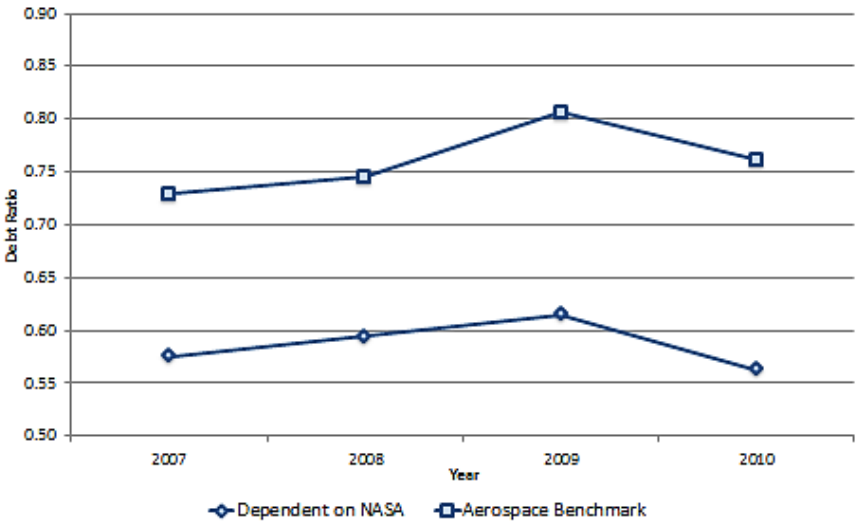
Figure X-20: Average Debt Ratio*



*Based on 474-488 respondents (128-134 NASA-dependent) depending on the year
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

The average debt ratio values follow the same trend as their aerospace industry counterparts, though they tend to be much lower (see Figure X-21).[84] The average values for both show deleveraging beginning in 2009 and likely continuing after 2010.

Figure X-21: Average Debt Ratio for NASA-Dependent Respondents vs. Aerospace Industry Benchmark*

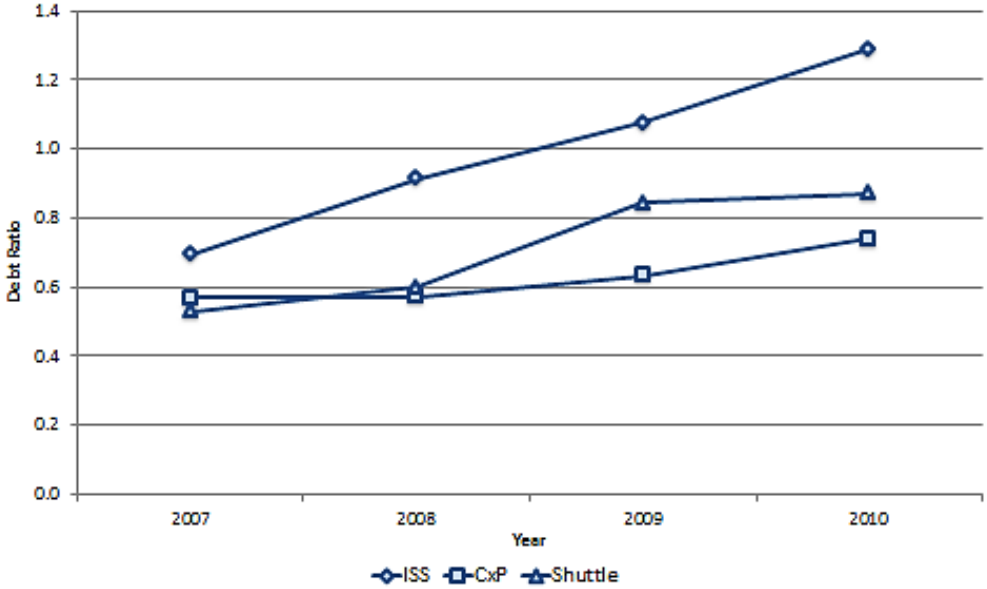


*NAICS 3364 Aerospace benchmark from the Quarterly Financial Report issued by the U.S. Census Bureau
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

[84] The Quarterly Financial Report issued by the U.S. Census Bureau tracks select financial information for industries on a quarterly basis. To obtain annual aerospace industry figures for 2007-2010, OTE averaged data over four quarters. The Quarterly Financial Report can be found at http://www.census.gov/econ/qfr.

Suppliers dependent on sales to ISS showed higher debt ratios on average than those dependent on the other HSF programs (see Figure X-22). Moreover, the increase from 2007-2010 is sharper than the debt ratios for Shuttle and CxP, suggesting that ISS-dependent companies are becoming more leveraged by comparison. Due to the small number of observations, this finding should not be broadly applied to other parts of NASA's supply chain.

Figure X-22: Average Debt Ratio and Program Dependency
(Program Sales ≥ 25% of Total Sales)*



*Based on 7, 22, and 18 respondents for ISS, CxP, and Shuttle, respectively

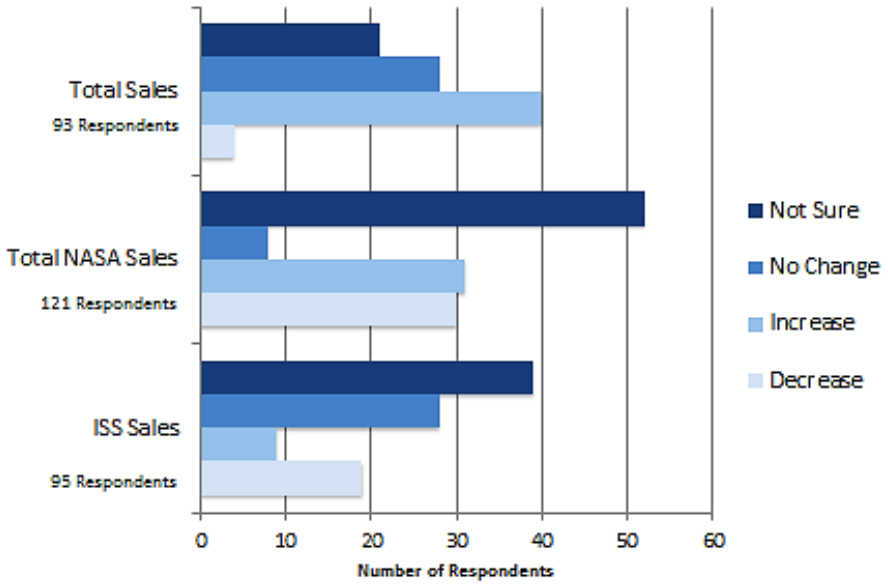
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

G. Sales Projections of NASA-Dependent Suppliers

OTE asked all NASA HSF suppliers to provide their future sales projections for 2011-2015 based on 2010 conditions. According to survey responses, a significant portion of NASA-dependent suppliers anticipated an increase in their Total Sales for all customers (see Figure X-23). In contrast, a greater proportion of companies were highly uncertain as to how future decisions by NASA would affect sales revenue, as the largest number of NASA-dependent suppliers was unsure if sales to NASA would increase or decrease. Furthermore, the number of suppliers that forecasted an increase in NASA sales was virtually equal to the number that anticipated a decrease.

For ISS sales, the only NASA HSF program scheduled to continue at the time of the survey, NASA suppliers were either unsure about future sales or predicted there would be no change. Almost twice as many suppliers anticipated that ISS sales would decline than those that anticipated they would increase.

Figure X-23: Future NASA Sales Projection (2011-2015) for NASA-Dependent Suppliers



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

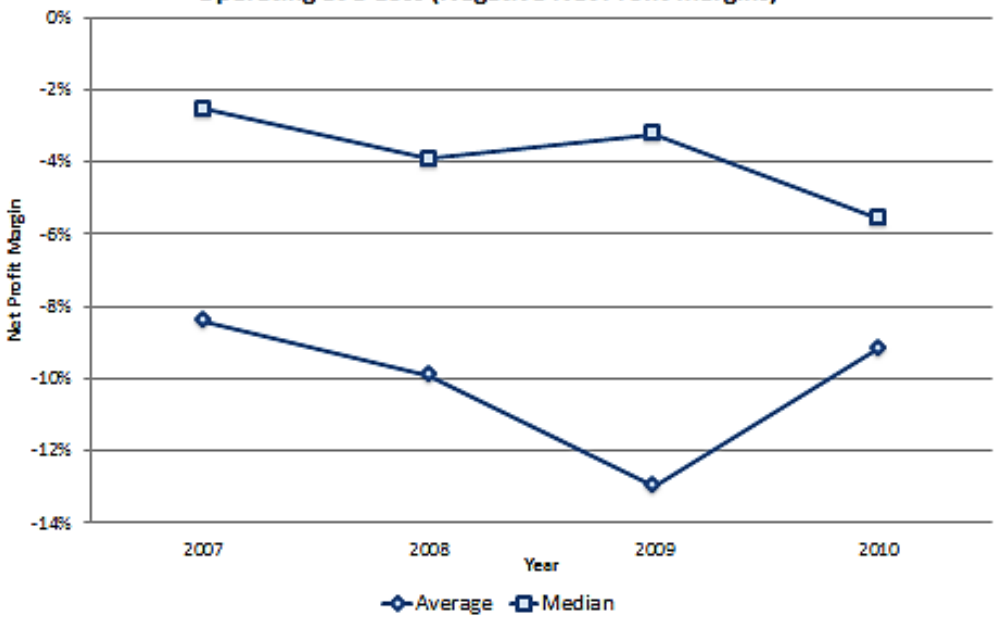
This survey data indicates that uncertainty in NASA-related policies is making it difficult for companies to assess market risk with confidence and plan for the future. As a result, companies can be hesitant to engage in expansionary economic activities such as capital investment and research and development expenditures. Moreover, they might resist hiring new employees and dismissing current employees to lower overhead costs.

H. NASA-Dependent Suppliers Operating at a Loss

There is clear evidence of the financial strain faced by many HSF suppliers during the global economic recession in 2008 and 2009. The number of suppliers operating at a loss rose from 55 to 99, an 80 percent increase, despite total sales for these companies increasing from $6.4 billion

in 2007 to $7.5 billion in 2010.[85] Both the average and median net profit margin measures among HSF suppliers operating at a loss declined from 2007-2010 (see Figure X-24). The average annual net profit margin fell from negative eight percent in 2007 to negative nine percent in 2010, while the median loss figure declined from negative three percent to negative six percent.

Figure X-24: Average and Median Net Profit Margins for Respondents Operating at a Loss (Negative Net Profit Margins)



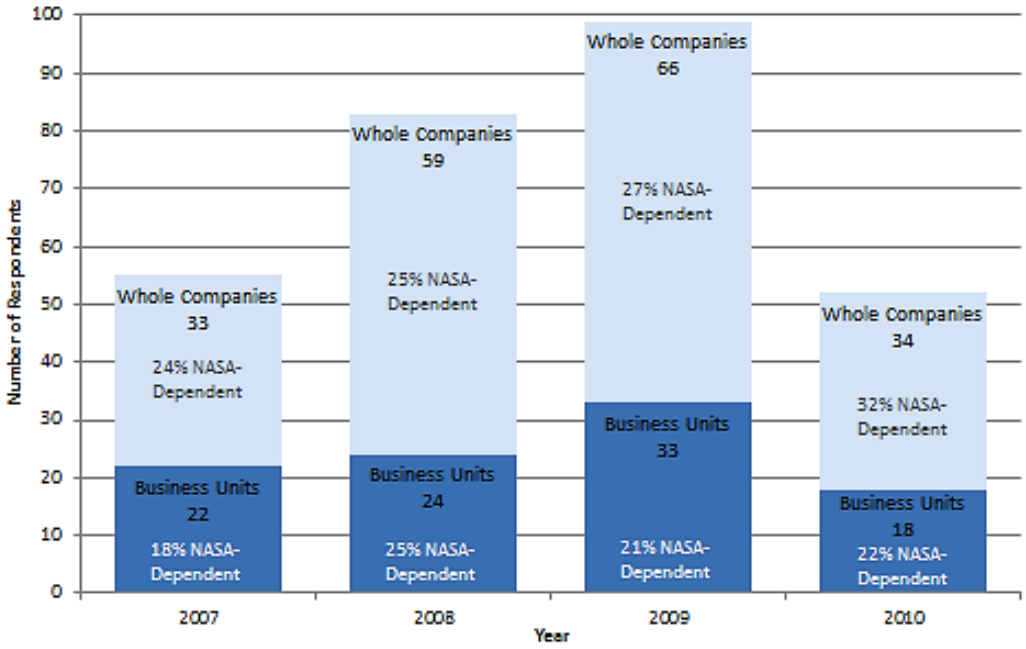
*Based on 55, 83, 99, and 52 respondents for 2007-2010, respectively

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Of all the survey respondents, approximately 27 percent of these companies were NASA-dependent. This indicates that NASA-dependent companies were no more likely to experience negative net profit margins than other NASA suppliers during the period, because NASA-dependent companies make up roughly 28 percent of the total survey population. The majority of NASA-dependent suppliers reporting negative net profit margins were Corporate/Whole Company level respondents, as compared to Business Unit/Division level respondents (see Figure X-25).

[85] A graph on total sales of NASA-dependent suppliers operating at a loss can be found in Appendix A.

Figure X-25: Number of Whole Companies and Business Units Operating at a Loss (Negative Net Profit Margins)

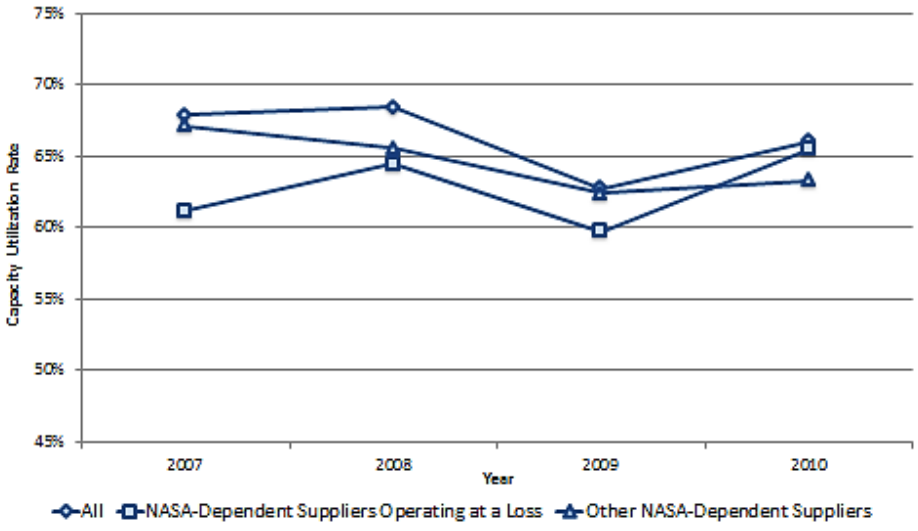


Source: U.S. Department of Commerce, Bureau of Industry and Security, NASA Supply Chain Network, June 2012

NASA-dependent suppliers that experienced low profitability are an area of concern for the health of NASA's supply chain. NASA-dependent suppliers operating at a loss, defined as exhibiting negative profit margins, were most at risk for insolvency and losing capabilities that are important to NASA's current and future. Forty-six of the 150 NASA-dependent suppliers exhibited negative net profit margins in at least one year during 2007-2010. These HSF suppliers experienced low profitability for a number of reasons, including overall decline in demand, the decision to cancel Shuttle and CxP, the 2008-2009 recession, and other operational and financial difficulties that affected profitability.

Furthermore, the average capacity utilization rates for NASA-dependent companies operating at a loss did not follow the trend for all NASA-dependent companies (see Figure X-26). Average capacity utilization rates for NASA-dependent companies operating at a loss fluctuated over the period, but remained at lower rates in 2007-2009. NASA-dependent companies that operated at a profit followed the general trend for NASA-dependent companies, experiencing declines between 2007 and 2009 and a modest increase in 2010.

Figure X-26: Average Capacity Utilization Rates for
NASA-Dependent Suppliers Operating at a Loss*

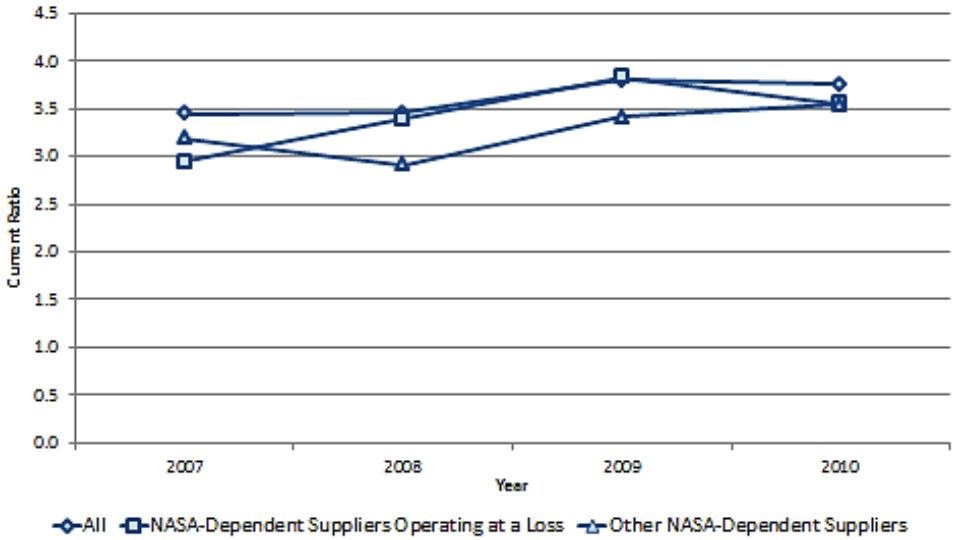


*Based on 27 NASA-dependent respondents with negative net profit margins and 59 other NASA-dependent respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

NASA-dependent companies that had negative net profit margins at least one year between 2007 and 2010 tended to have higher average current ratios on average than other NASA-dependent companies (see Figure X-27). This may signal that NASA-dependent companies operating at a loss maintained excess liquidity to protect against financial problems during the recession.

Figure X-27: Average Current Ratios for
NASA-Dependent Suppliers Operating at a Loss

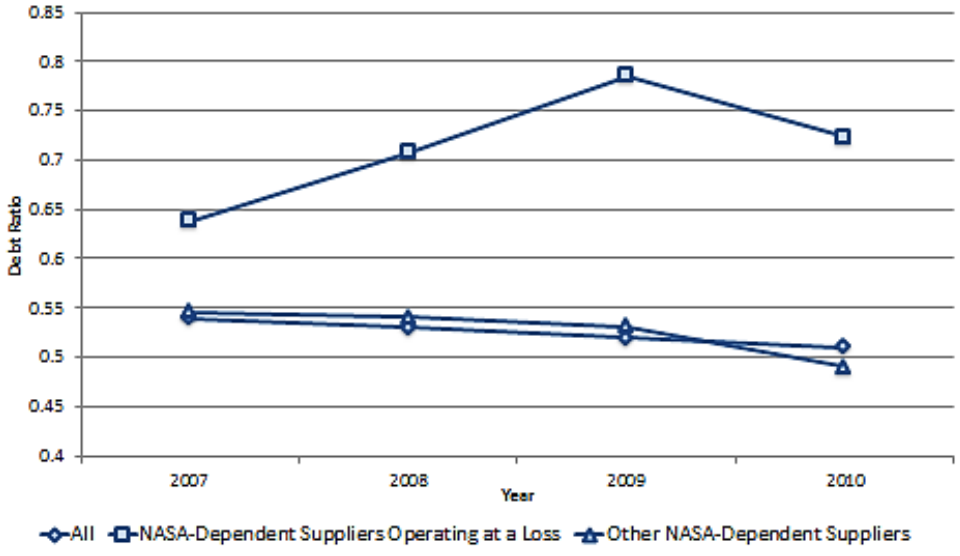


*Based on 39-42 NASA-dependent respondents with negative net profit margins and 86-90 other NASA-dependent respondents depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

On average, the NASA-dependent suppliers operating at a loss had higher debt ratios and were more likely to be leveraged than other NASA-dependent HSF suppliers (see Figure X-28). Moreover, the debt ratio spread between NASA-dependent companies operating at a loss and the other NASA-dependent companies widened between 2007 and 2009 from 0.09 to 0.25. This means that NASA-dependent companies operating at a loss became more highly leveraged during 2007-2009 on average, while other NASA-dependent suppliers lowered their levels of financial leverage.

Figure X-28: Average Debt Ratios for NASA-Dependent Suppliers Operating at a Loss*



*Based on 40-44 NASA-dependent respondents with negative net profit margins and 88-90 other NASA-dependent respondents depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

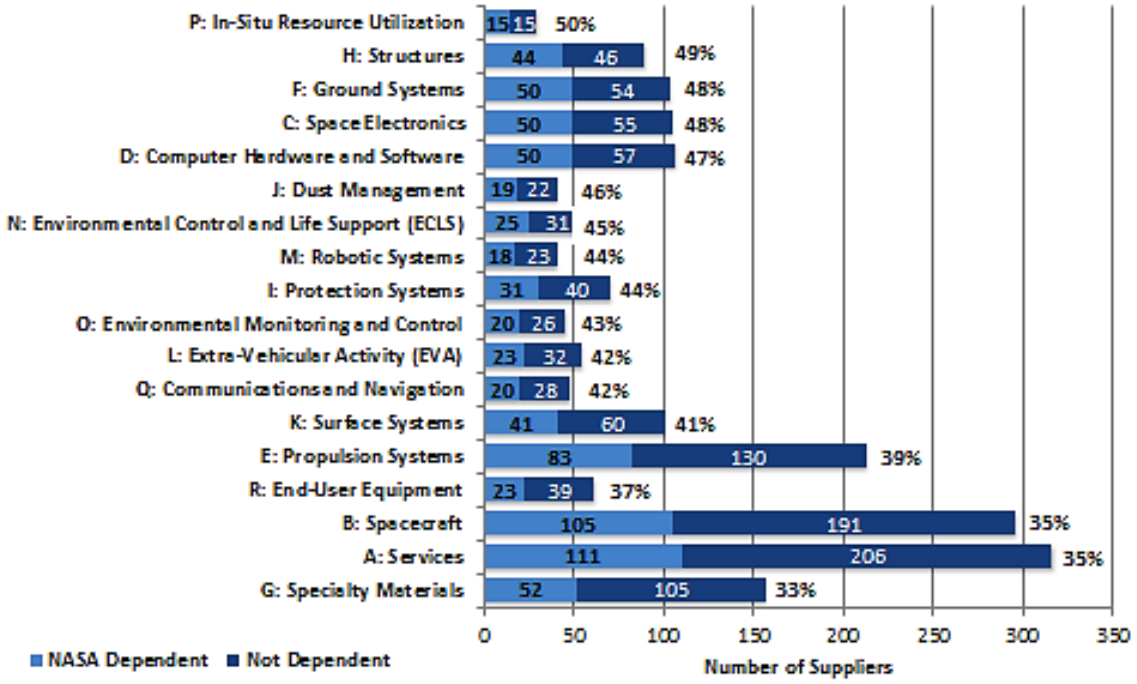
I. NASA-Dependent Company Participation in Product and Service Categories

The potential risk of NASA losing important supply chain capabilities is elevated in areas where a large portion of product and services are provided by NASA-dependent companies. To determine the areas of risk, OTE analyzed the product and service categories identified by NASA HSF suppliers as within their business lines.[86] These 18 categories were broken down into one, two, and in some cases three subcategory levels to improve specificity.

[86] See Section III.

The 150 NASA-dependent survey respondents worked in all 18 product and service categories, and were at least a third of the companies that reported each product and service category (see Figure X-29). The overall product and service categories that represent the greatest potential loss include In-Situ Resource Utilization, Structures, Ground Systems, and Space Electronics (see Figure X-29).

Figure X-29: Participation in 1-Digit Product and Service Categories by NASA-Dependent Suppliers*



*Based on 138 NASA-dependent respondents that reported product and service categories

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

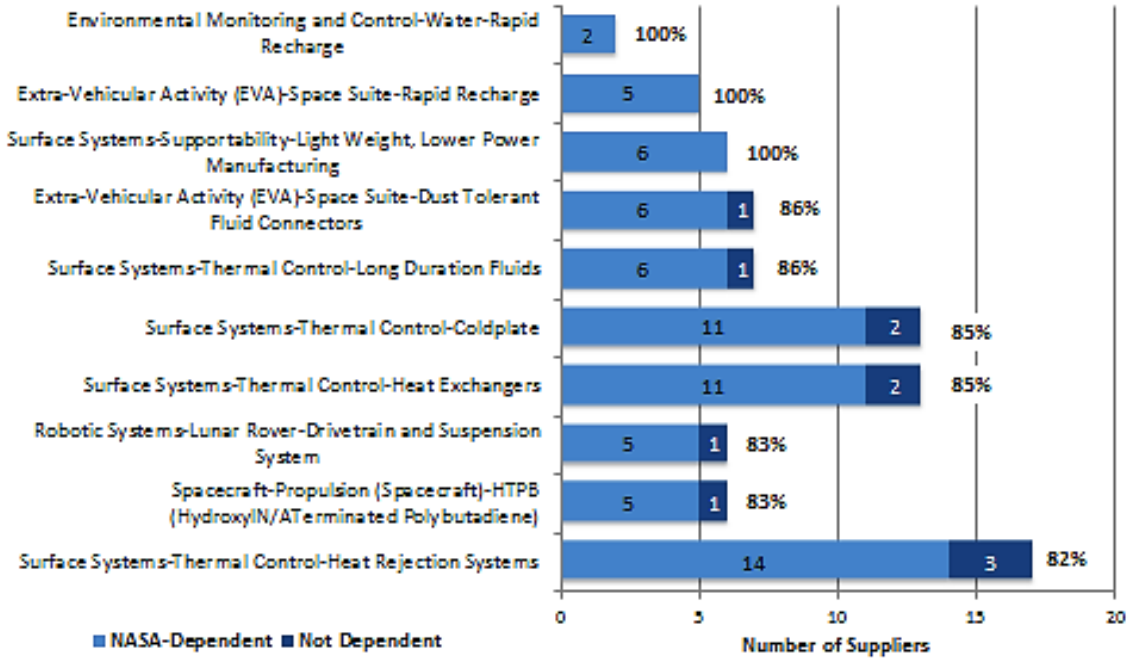
Furthermore, lost capabilities in NASA's supply chain could impact a number of specific product and service list (PSL) subcategories of the 18 categories. The PSL subcategories that may be at the highest risk of lost capabilities are where NASA-dependent suppliers, and those operating at a loss in particular, have the highest proportion of involvement.

Figure X-30 lists the top three-digit PSLs where NASA-dependent suppliers are most concentrated compared to suppliers that did not identify themselves as NASA-dependent.[87] Most of these PSL subcategories correspond to the one-digit Surface Systems category.

[87] The three-digit PSLs refer to product and service categories where NASA HSF suppliers identified one of the main categories and further specified two subcategory levels.

However, some of the three-digit codes correspond to other PSF categories, such as Environmental Monitoring and Control, Robotic Systems, and Extra-Vehicular Activity (EVA). The top three three-digit PSL subcategories represent areas where 100 percent of companies that identified these three-digit PSLs were NASA-dependent suppliers.

Figure X-30: Top 10 3-Digit Product and Service Categories Impacted by NASA-Dependent Suppliers*



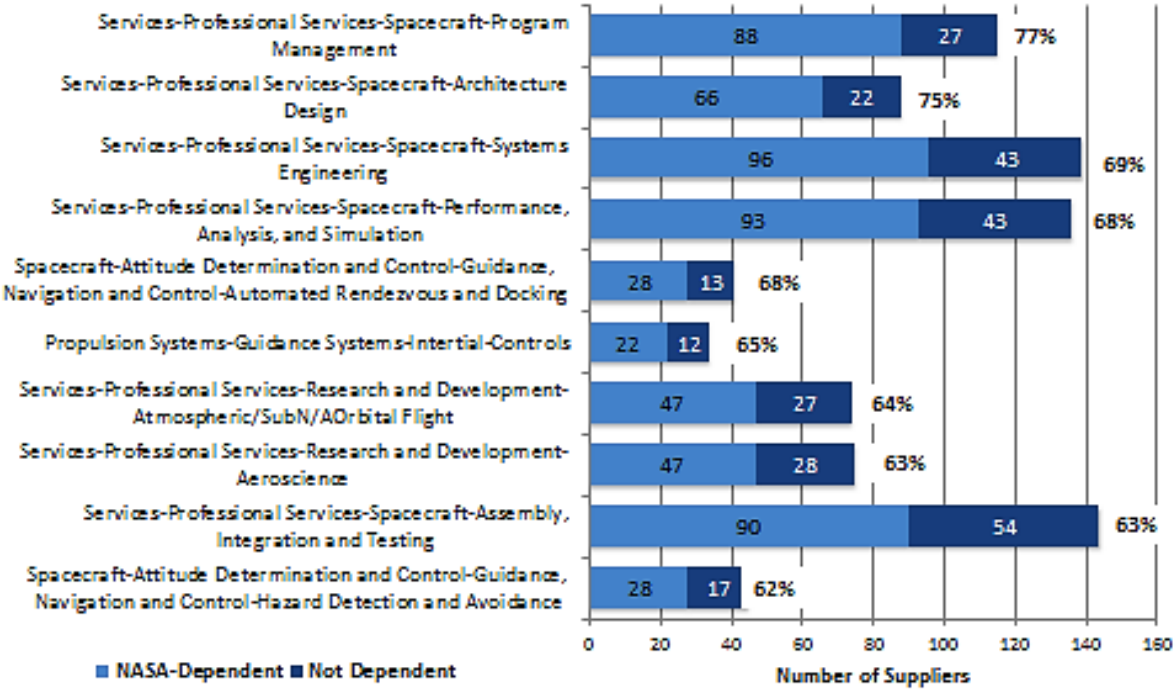
*Based on 143 complete 3-digit product and service categories that respondents reported they supply to NASA

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

NASA HSF suppliers also identified four-digit PSL subcategories in which they participated.[88] NASA-dependent suppliers identified 37 of 40 four-digit PSL subcategories, the vast majority of which were under the Services main category. Figure X-31 list the top 15 four-digit PSL subcategories where NASA-dependent suppliers are most concentrated compared to suppliers that did not identify themselves as NASA-dependent. The top two four-digit PSL subcategories, Services-Professional Services-Spacecraft-Program Management and Services-Professional Services-Spacecraft-Architecture Design represent areas where 75 percent or more of companies that identified these four-digit PSLs were NASA-dependent suppliers.

[88] Four-digit PSL codes refer to product and service categories where NASA HSF suppliers identified one of the main categories and further specified three subcategory levels.

Figure X-31: Top 10 4-Digit Product and Service Categories Impacted by NASA-Dependent Suppliers*



*Based on 37 complete 4-digit product and service categories that respondents reported they supply to NASA

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

When the 150 NASA-dependent survey respondents were asked if they had a plan in place to preserve their current capabilities and workforce in the post-Shuttle, post-CxP environment, many said they planned to pursue new business, including outside of the space industry, or diversify their products and services. Other NASA-dependent companies said they planned to reduce staffing levels and stop hiring. Some companies were waiting for NASA and Congress to make decisions on the future of NASA's HSF programs, although this delay could be problematic for those NASA-dependent companies operating at a loss. For example, a Tier 3 company stated, "We have modified our business plan with workforce reductions, although it is very difficult to really strategize to determine ways to assist NASA when their direction, funding and strategy are undefined."

J. NASA Sales-Dependent Suppliers that did not Consider Themselves NASA-Dependent

There were a small number of NASA suppliers that did not identify themselves as NASA-dependent, but after further analysis fit into OTE's sales dependency criteria. Sixteen companies derived 25 percent or more of their total sales from sales to NASA and/or from sales to specific NASA programs, but did not consider themselves dependent on NASA-related business. Twenty-five percent of these companies derived 90 percent or more of their annual total sales from sales to NASA in at least one year from 2007-2010.

Of these 16 survey respondents, 11 were Tier 3 companies, four were Tier 2 companies, and one was a Tier 1 company. Sixty-three percent of the 16 companies selected Spacecraft as a business line, while 38 percent selected services. The largest number of these survey respondents, seven, indicated that they supported the Shuttle, five supported CxP, and two supported ISS.

These suppliers tended to have, on average, lower debt ratios and higher current ratios, capacity utilization rates, and net profit margins than self-identified NASA-dependent companies.[89] In other words, NASA sales-dependent companies that did not identify themselves as NASA-dependent had lower levels of financial leverage, higher levels of liquidity to cover short-term needs, higher capacity utilization rates and, better financial performance than suppliers that identified themselves as NASA-dependent. However, further analysis indicated that despite the current high performance of these companies, they also deserve to be tracked over time to monitor their health and competitiveness.

[89] See Appendix A for graphs on the debt ratios, current ratios, capacity utilization rates, and net profit margins for NASA-dependent suppliers that did not consider themselves NASA-dependent.

XI. Conclusion

While the report data, collected for the 2007-2010 period, ended before the full impact of the Space Shuttle (Shuttle) retirement and Constellation (CxP) transition could be documented (Shuttle and CxP activity was still occurring in 2011), several conclusions can be drawn about the health of the NASA HSF supply chain and the potential implications of changes in NASA's programs on the 536 survey respondents.

A. Overall State of NASA HSF Survey Respondents

The majority of NASA HSF companies, 370 of 536, will not be negatively impacted by the Shuttle retirement and the CxP transition. This is reflected most prominently in the 2007-2010 sales data collected by the survey, which indicated that total NASA sales represented only two percent of total respondent aggregate sales. Similarly, the vast majority of the employment levels, capital expenditures, and research and development (R&D) spending for all 536 survey respondents were not reliant or focused on NASA-related HSF business.

While the Shuttle retirement and CxP transition will not negatively affect the financial outlook for the majority of NASA HSF survey respondents, there are potential impacts on future NASA HSF programs through a loss of unique skills, capabilities, products, and services resident at these companies. Many of the 370 survey respondents not dependent on NASA may decide to drop a business line and related skills and capabilities necessary for future NASA HSF missions, as the majority of these companies stated in the survey they were not sure if they would have future NASA-related sales. Therefore, it would be prudent for NASA to review all providers of products and services that are deemed important for future NASA HSF missions, regardless of the company's financial health or dependence on NASA-related business.

Of more immediate concern for NASA supply chain analysts, however, are 150 NASA HSF companies that identified themselves as dependent on NASA and the additional 16 companies that, after further analysis, proved to be dependent on NASA. These companies, representing all tiers, are most likely to be impacted by the Shuttle retirement and CxP transition, which in turn would directly impact NASA. These companies participate in all 18 product and service

categories, are the main suppliers for some of these categories, and conduct the majority of reported NASA-related R&D. A further review of each of these 166 survey respondents, beyond the scope of this assessment, is necessary to determine the importance of the companies and their unique products and services for future NASA HSF missions.

There are subsets within the 166 NASA-dependent survey respondents where NASA could prioritize its attention, as these subsets pose the most immediate challenge to the NASA HSF supply chain. One subset is the 46 NASA-dependent companies operating at a loss pre-Shuttle retirement/CxP transition, as they have the highest potential of shutting down. A second subset is whole companies dependent on NASA where closure could also result in the loss of skills and capabilities. Finally, NASA could review divisions and business units of larger corporations that make up the remaining portion of the 166 NASA-dependent companies. While the skills and knowledge of closed divisions or business units can be absorbed into other divisions of the larger companies, there is still a likelihood that capabilities needed for NASA HSF programs could disappear.

It is important to note that while the survey covered 536 NASA HSF suppliers, there are many more suppliers and competitors that were not captured by this study effort. Of the suppliers and competitors listed by the HSF survey respondents, only 20 percent of each category received the NASA HSF survey. This means there is a pool of companies NASA is currently contractually unaware of that could potentially be used for future HSF efforts.

As an alternative to a well-articulated short- to medium-term vision and strategic plan with the requisite funding for a broad-based HSF program, NASA could be more proactive in sustaining the varied portions of the HSF supply chain that would be the most difficult to reconstitute. Ongoing efforts to develop a capsule and heavy-lift rocket capability are important first steps, and should be viewed as the building blocks to spur the larger HSF supply chain.

B. Opportunities for Future NASA Action

Many NASA HSF survey respondents indicated that they are trying or plan to try to shift into other, non-NASA space-related business areas in order to compensate for lost Shuttle and CxP

business. However, Federal Government budget cuts and Department of Defense plans to reduce spending make shifts to defense-related business uncertain, while the current commercial HSF industry is small and vertically integrated, limiting opportunities for companies to enter the industry. Almost half of survey respondents have already made the decision not to pursue future commercial HSF business, while 14 percent are not willing to support future NASA HSF programs. Additionally, the majority of survey respondents believe there are too many domestic and foreign space-related competitors, which pose a challenge to their future viability. This indicates an opportunity for NASA to get more involved in issues related to the sustainability of its HSF supply chain.

One issue apparent from the NASA HSF survey data is the lack of communication between NASA, prime contractors, and the HSF supply chain. With the Shuttle retirement and CxP transition, only eight percent of companies received guidance from prime contractors and five percent received guidance from directly from NASA. In addition, many survey respondents commented on the lack of insight into NASA's HSF and non-HSF plans and decisions. Increased communication and outreach, such as a series of forums to articulate NASA's current programs and future plans, could help suppliers develop business plans that would allow them to remain viable entities and continue to maintain capabilities important for NASA.

Outreach efforts by NASA and its various facilities, centers, and laboratories could also be better coordinated with regional, state, local, educational, and non-profit organizations and institutions. Survey respondents listed more than 40 such organizations and institutions, but only eight percent of the 536 companies had worked with them. NASA could take a leading role in getting the HSF survey respondents and identified suppliers and customers to participate with the organizations and institutions. In turn, these organizations and institutions could assist NASA in reaching out to companies in lower tiers, and could help create programs to maintain the supply chain's generic business base and related skills and competencies. NASA's large pool of excess machine tools and equipment, primarily from the Shuttle program and strategically located around the country, could be leveraged to assist these state and regional efforts.

Another issue that calls for further action is the identified supplier interdependencies, not only within NASA HSF and non-HSF programs but also between U.S. Government agencies. For example, 86 HSF suppliers stated that their business with other U.S. Government agencies would

be impacted by the Shuttle retirement and CxP transition. Moreover, 53 percent of NASA HSF survey respondents said they also support Department of Defense end-users. These supply chain interdependencies open up the opportunity for NASA to work with other U.S. Government organizations, primarily defense agencies and the intelligence community, to find commonalities and leverage mutual interests to support the industrial base. This coordination is especially important, considering U.S. Government agencies with space interests are all facing budget challenges, which could impact current and future NASA programs. Several interagency organizations are already in place that can be utilized, such as the Critical Technology Working Group of the Space Industrial Base Council (SIBC).

A third issue revealed by the survey data is the state of NASA-related R&D funding. Of the 81 NASA HSF survey respondents providing R&D data, six Tier 1 companies accounted for 75 percent of all NASA-related R&D expenditures; four of the six companies were dependent on NASA. The data also showed that the majority of reported NASA-related R&D expenditures stemmed from Federal Government R&D funds. This indicates a concentration of Federal R&D funding in the largest companies and upper tiers and a lack of NASA-related R&D expenditures occurring in the lower tiers. NASA could work to direct more Federal Government R&D funds to lower tiers, especially those which indicated formal professional, industry, and standards qualifications/certifications necessary for doing business with NASA, and diversify the number of companies conducting NASA-related R&D.

***

Survey respondents, as well as NASA HSF companies interviewed during field visits, overwhelmingly expressed their willingness to participate in future NASA HSF programs. For many, it is not a money-making exercise, but rather a point of national pride and enthusiasm to work on space missions, something which has not been identified in other OTE assessments of the U.S. industrial base. However, this corporate goodwill is not boundless, and will only go so far toward maintaining the vital elements of the HSF supply chain. NASA, in conjunction with other federal and state organizations, should consider rapid action to ensure a robust industrial supply chain and workforce will be there when needed for the next great milestone into space.

Appendix A: Additional Charts

CHAPTER II: COMPANY PROFILE OF SURVEY RESPONDENTS

Table A-1: Tier 1 Companies			
Tier	# of Respondents	Total Sales (2009)	Total U.S. Employees (2009)
1	101	> $200 Million	Average: 5,555 Median: 1,421
Primary Business Line			
Manufacturing			49%
Distribution			11%
R&D			9%
Professional Services			9%
Service			5%
Manufacturing Systems D&M			4%
Raw Materials			4%
Reseller			3%
Product and Design Engineering			2%
Inspection and Quality Control			1%
Integration			1%
Material Preparation			1%
Testing/Evaluation/Validation			1%

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Table A-2: Tier 2 Companies			
Tier	# of Respondents	Total Sales (2009)	Total U.S. Employees (2009)
2	155	$25 - 200 Million	Average: 371 Median: 238
Primary Business Line			
Manufacturing			56%
Distribution			12%
Professional Services			6%
Service			6%
Raw Materials			4%
Material Finishing			3%
Product and Design Engineering			3%
Manufacturing Systems D&M			3%
R&D			3%
Testing/Evaluation/Validation			3%
Reseller			2%
Material Preparation			1%

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Table A-3: Tier 3 Companies			
Tier	# of Respondents	Total Sales (2009)	Total U.S. Employees (2009)
3	280	< $25 Million	Average: 51 Median: 28
Primary Business Line			
Manufacturing			48%
Distribution			21%
Professional Services			6%
R&D			5%
Reseller			4%
Material Finishing			3%
Raw Materials			3%
Product and Design Engineering			2%
Service			2%
Material Preparation			1%
Maintenance/Aftermarket			1%
Inspection and Quality Control			1%
Manufacturing Systems D&M			1%
Retail			0.4%
Testing/Evaluation/Validation			0.4%

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-4: Non-U.S. Company Headquarters by Tier			
Country	Tier 1	Tier 2	Tier 3
Canada	0	3	1
Denmark	0	0	1
France	1	2	0
Finland	0	1	0
Germany	2	1	0
Japan	0	1	0
Sweden	0	1	0
United Kingdom	0	5	3

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-5: Sample of 'AMS,' 'NADCAP,' and 'NCLS' Certifications			
AMS		NADCAP	NCLS
AMS-1595	AMS-2750D	AC 7004	Z540-1-1994
AMS-2154	AMS-2759	AC 7108	NDT
AMS-2404	AMS-2759-3	AC 7110	Z540
AMS-2405	AMS-3824	AC 7112	Z540-1
AMS-2418	AMS-3846	AC 7114	
AMS-2469	AMS-9084	AC 7114/1.	
AMS-2470	AMS-C-26074	AC 7114/15	
AMS-2471	AMS-C-27725	AC 7114/2	
AMS-2472	AMS-P-81728	AC 7114/25	
AMS-2482	AMS-QQ-P-35	AC 7114S	
AMS-2700		AS 7003	
AMS-2750		AS 7003	

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-6: Sample of 'Other' Certifications			
AZLA	Atex EN13980	ISO AS9100	QML
ANSI Z54.1	AWS	ISO TS16949	SAE AS9120
AS 9100	Baseefa	ISO 13485	SEI-CMMI ML2
AS 9100 Rev B	CFR-21	JSC RITF	SSP 30007
AS 9100:2004	CISSP	M55302	TS 16949:2002
AS 9100B	CMM II	MIL-I-45208	USA-SM647
AS 9101	CMMI Level III	MIL-I-45208A	VPP star
AS 9104	DOT-HT	NAS-410	WMBE
AS 9110	FAA 145	NASA STD 8739	
AS 9120	FAA PC4	NHB 5300.4	
AS 91210	ISO 13485	NPG 2810	
AS/EN/JISQ 9100	ISO 14001	NQA-1-2000	
ASME	ISO 17025	OHSAS 18000	
ASNT	ISO 18001	OHSAS 18001	
ASQR-01	ISO 20000	PWA-LCS	

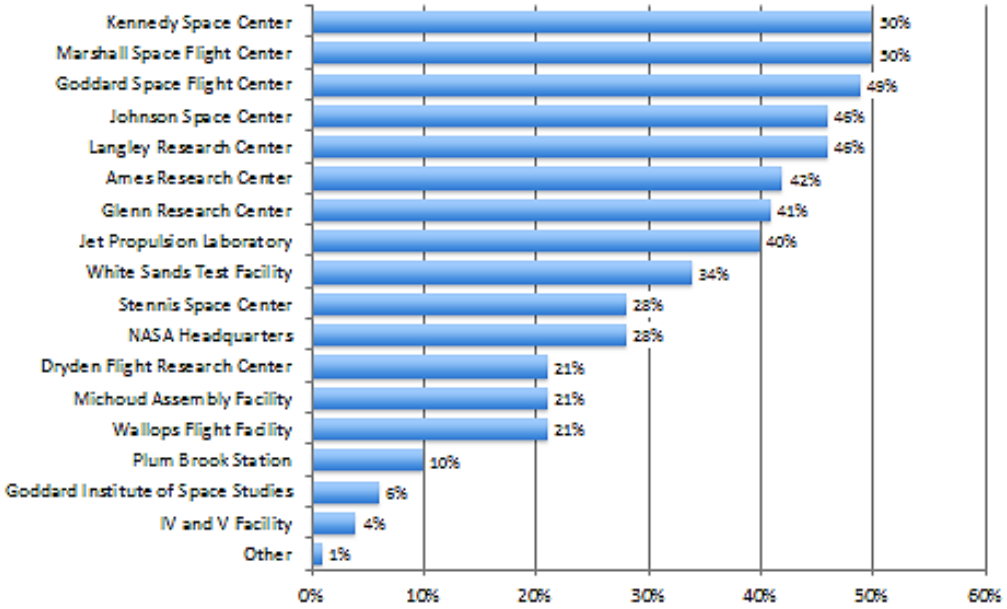
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-7: Leading Supply Chain Management Practices, Methodologies, and Systems by Tier

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

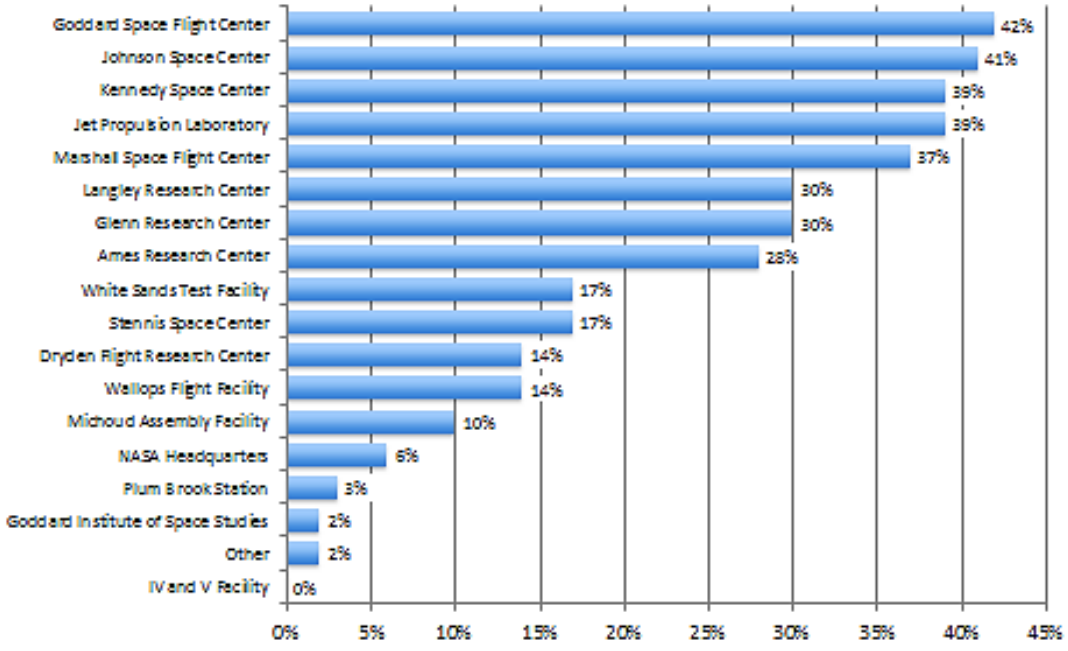
CHAPTER III: PRODUCTS AND SERVICES

Figure A-8: Survey Respondents Supporting NASA Customers – Tier 1



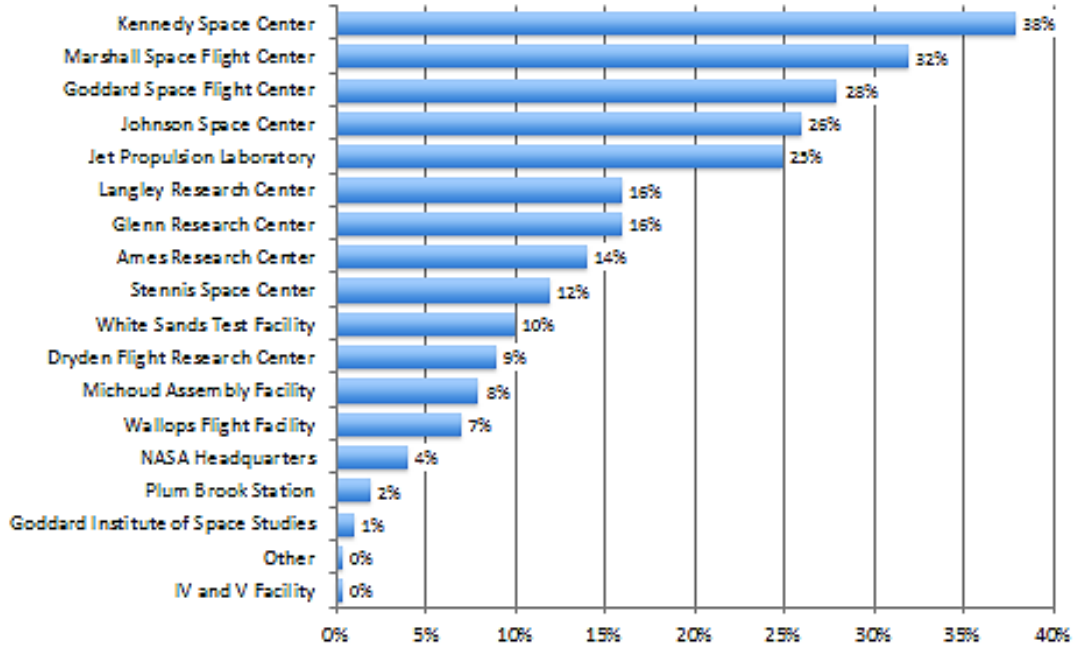
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-9: Survey Respondents Supporting NASA Customers - Tier 2



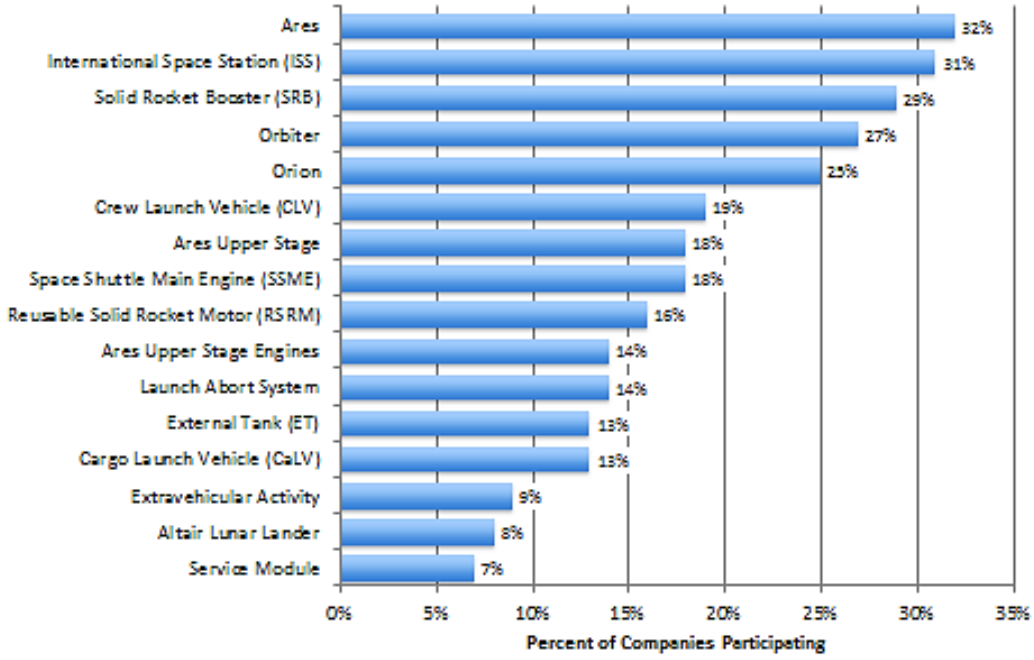
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-10: Survey Respondents Supporting NASA Customers - Tier 3



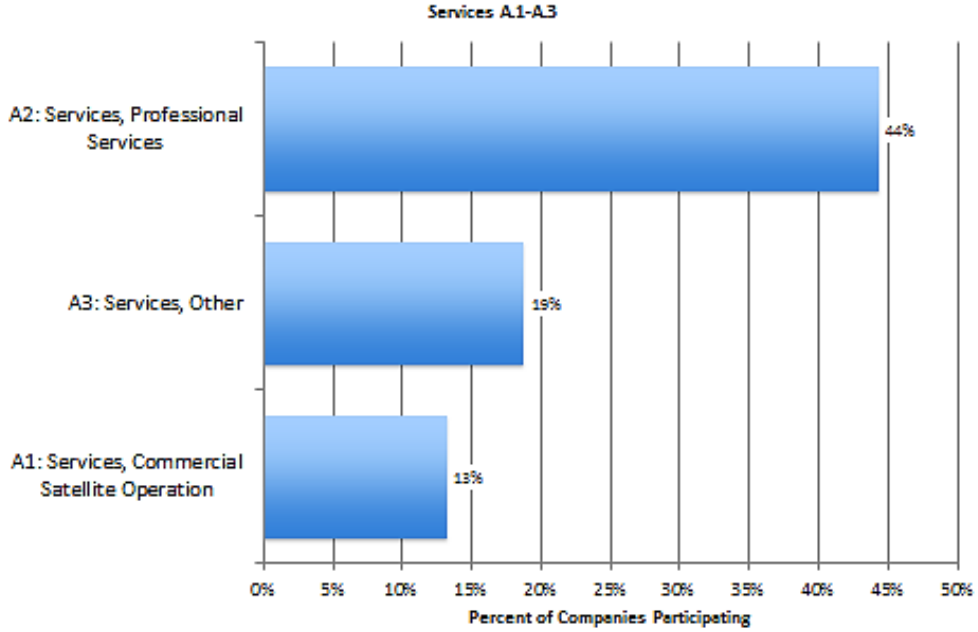
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-11: Participation in Human Space Flight Program



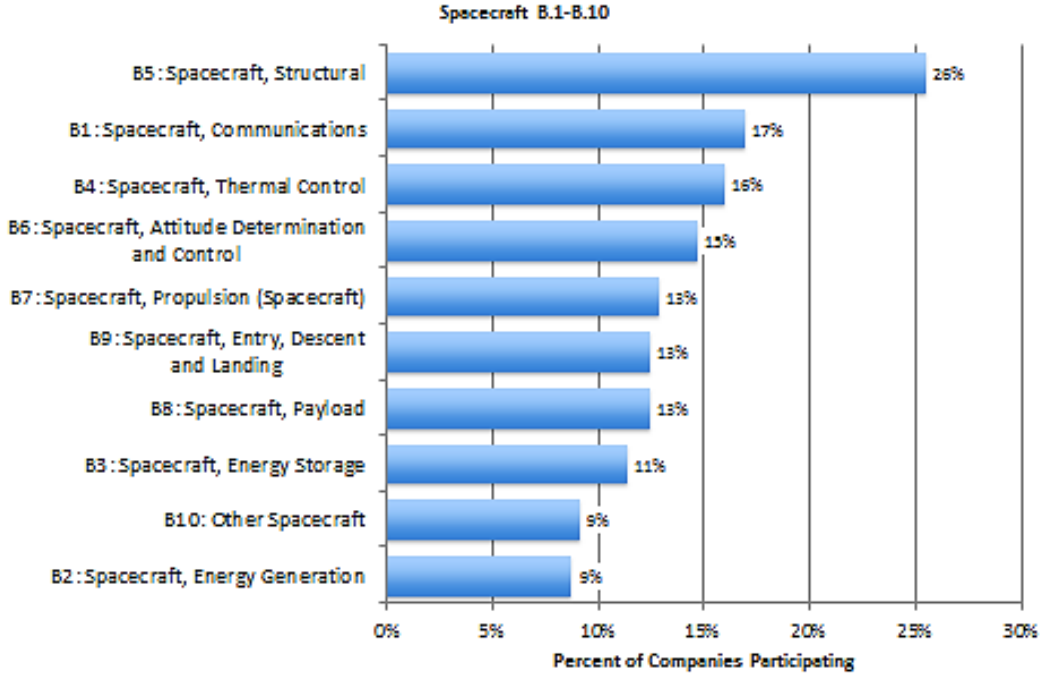
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-12: Participation in Product and Service Categories:



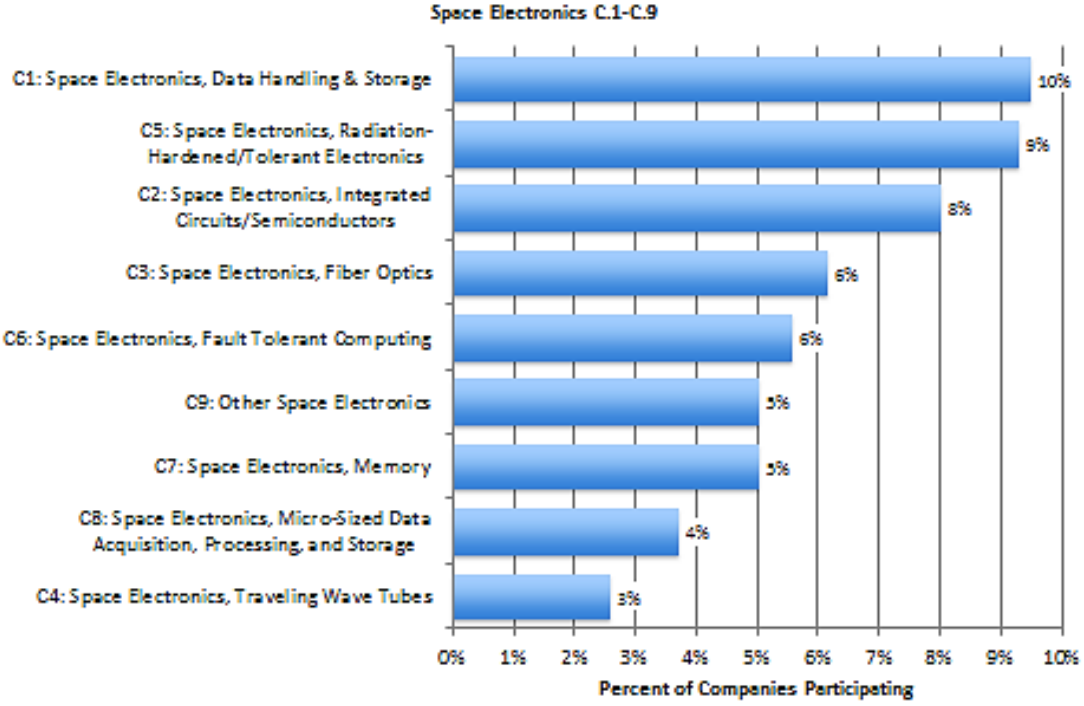
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-13: Participation in Product and Service Categories:



Source: U.S. Department of Commerce, Bureau of Industry and Security. *NASA Supply Chain Network*, June 2012

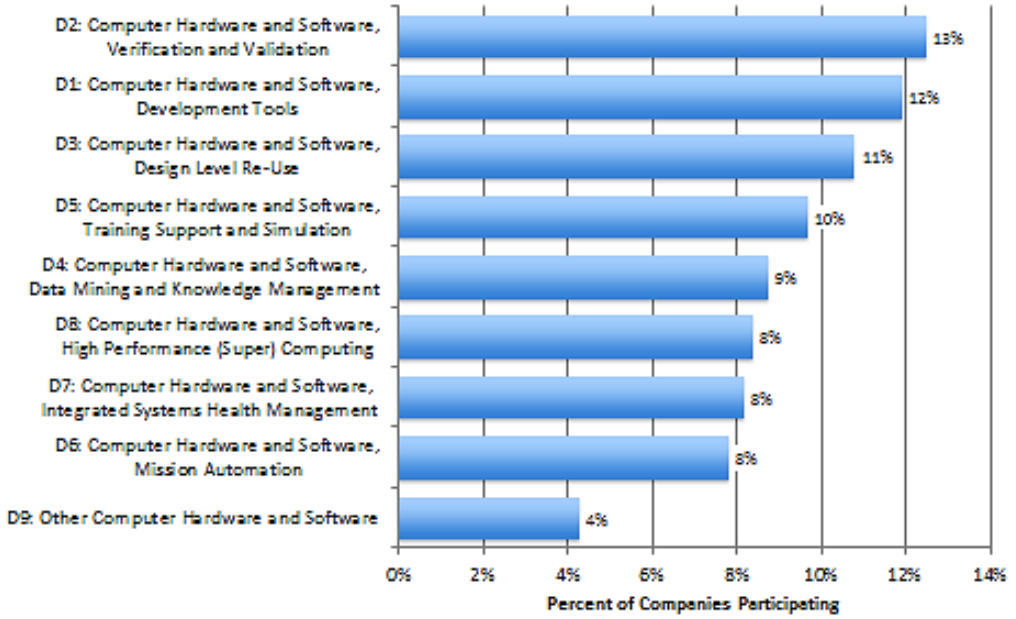
Figure A-14: Participation in Product and Service Categories:



Source: U.S. Department of Commerce, Bureau of Industry and Security. *NASA Supply Chain Network*, June 2012

Figure A-15: Participation in Product and Service Categories:

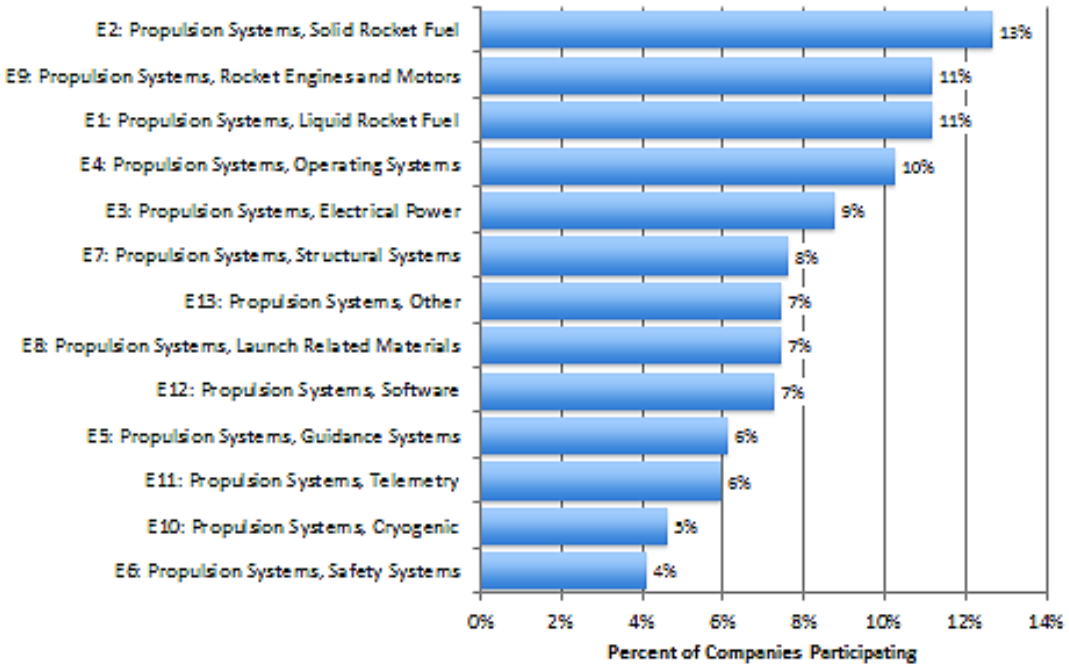
Computer Hardware and Software D.1-D.9



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

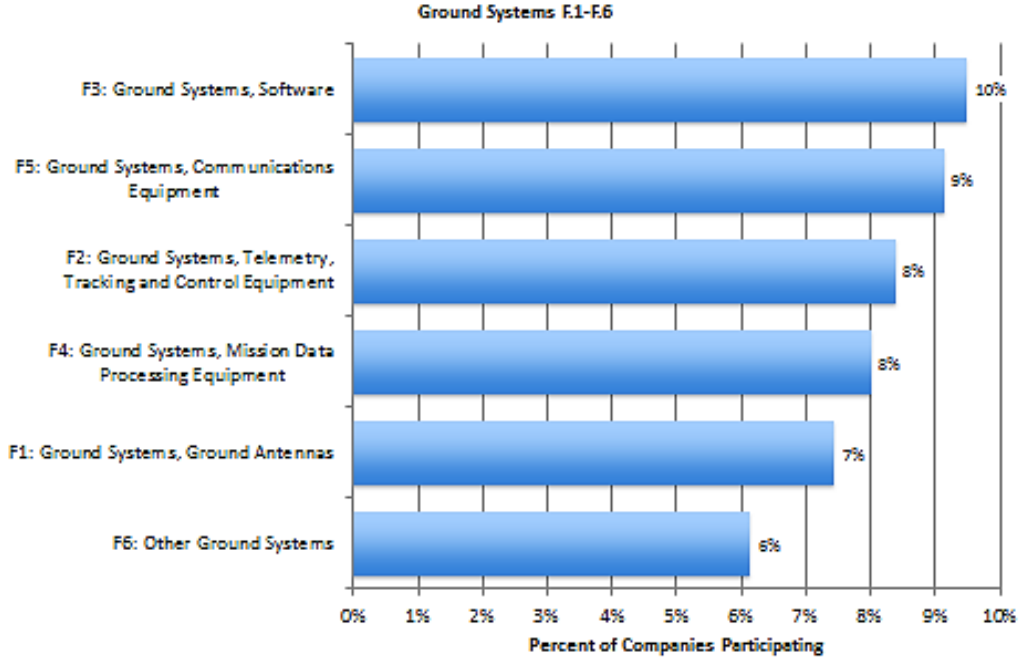
Figure A-16: Participation in Product and Service Categories:

Propulsion Systems E.1-E.13



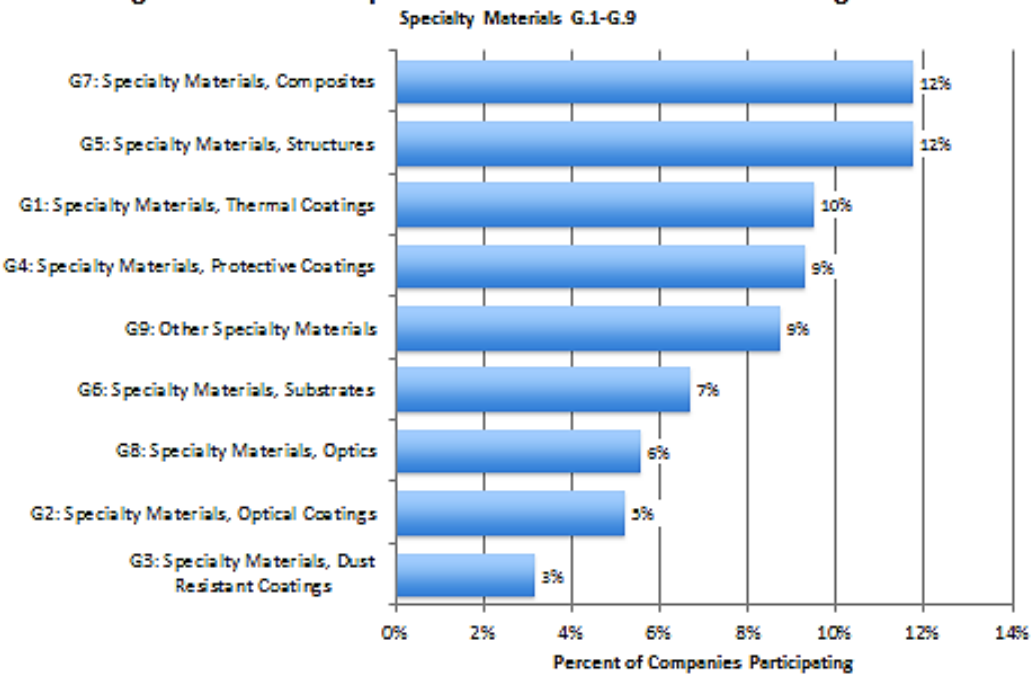
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-17: Participation in Product and Service Categories:



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

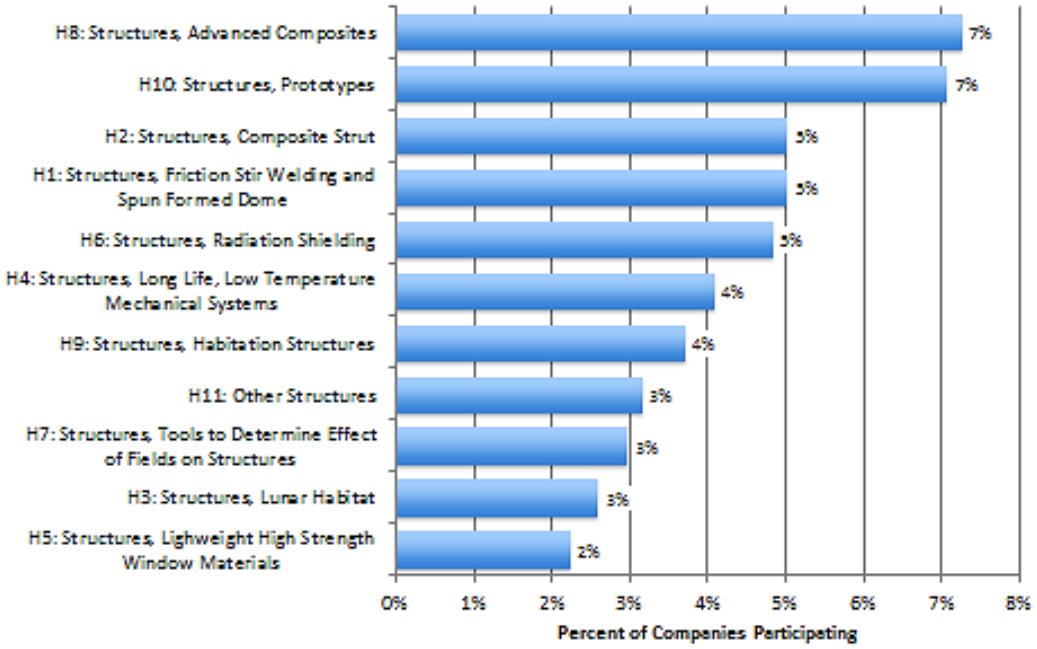
Figure A-18: Participation in Product and Service Categories:



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-19: Participation in Product and Service Categories:

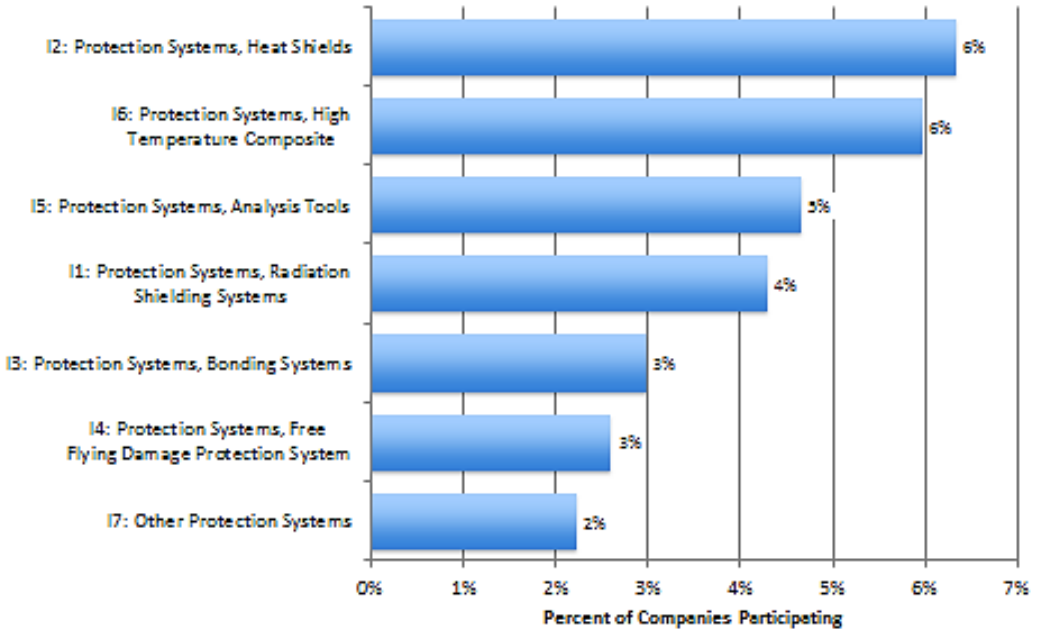
Structures H.1-H.11



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-20: Participation in Product and Service Categories:

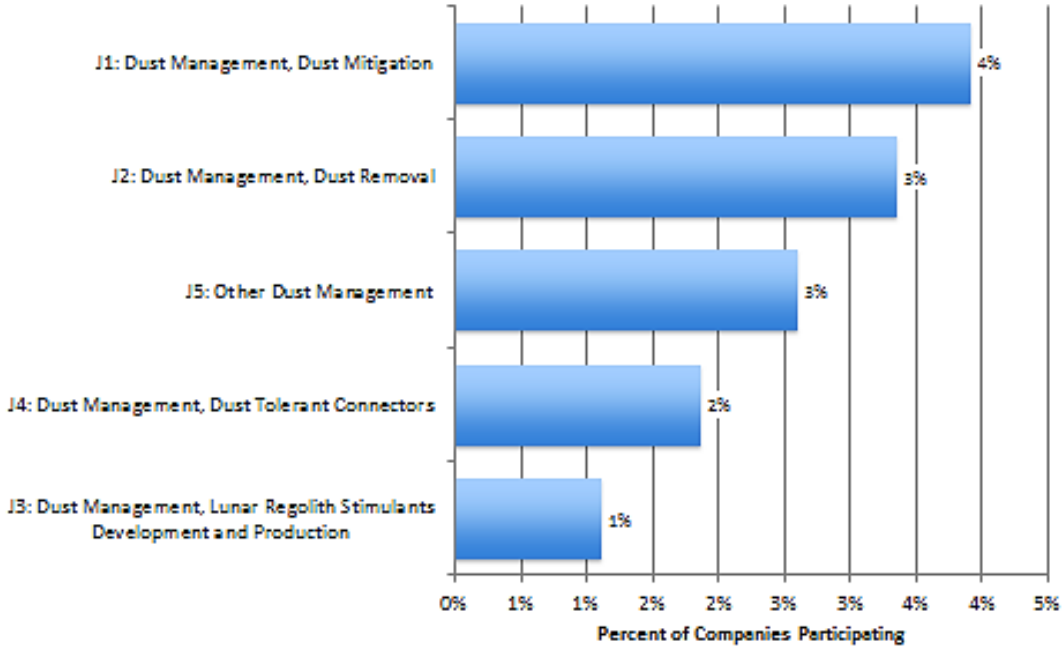
Protection Systems I.1-I.7



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-21: Participation in Product and Service Categories:

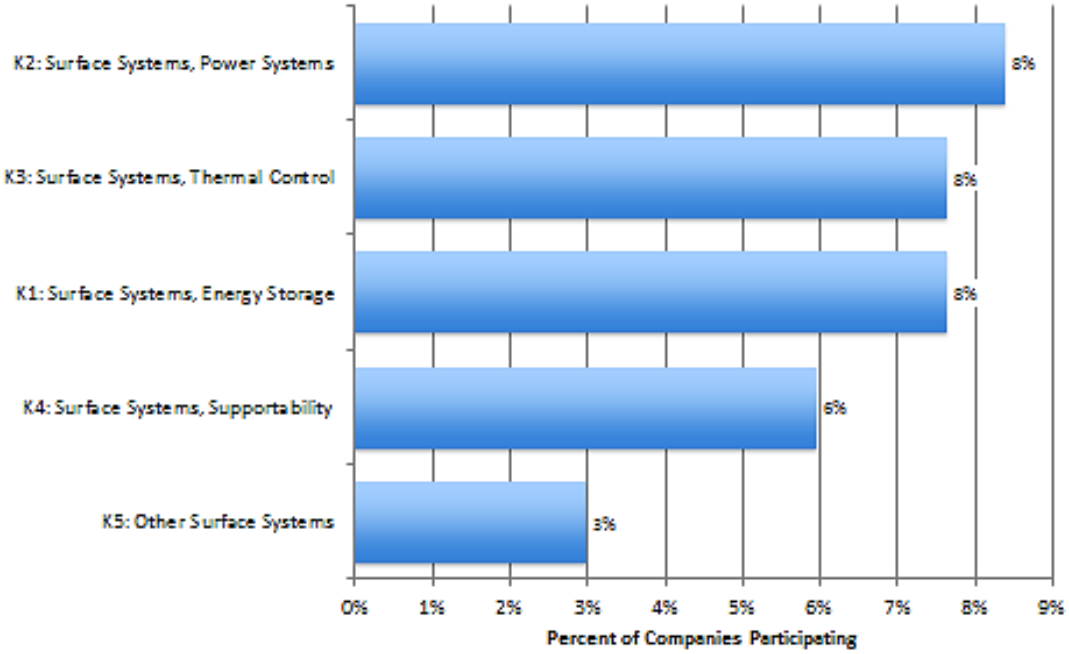
Dust Management J.1-J.5



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

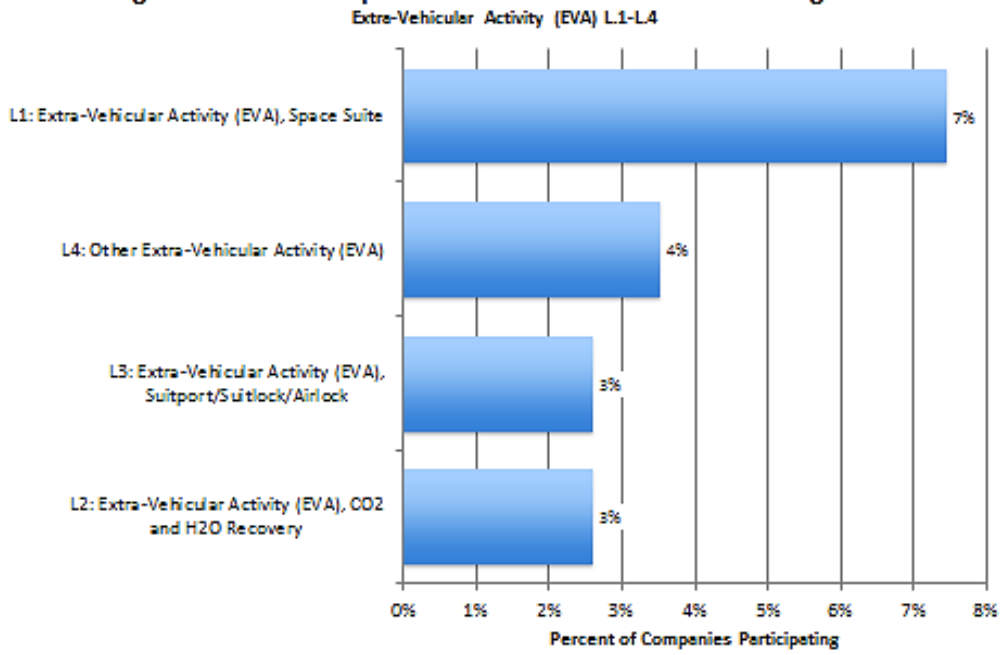
Figure A-22: Participation in Product and Service Categories:

Surface Systems K.1-K.5



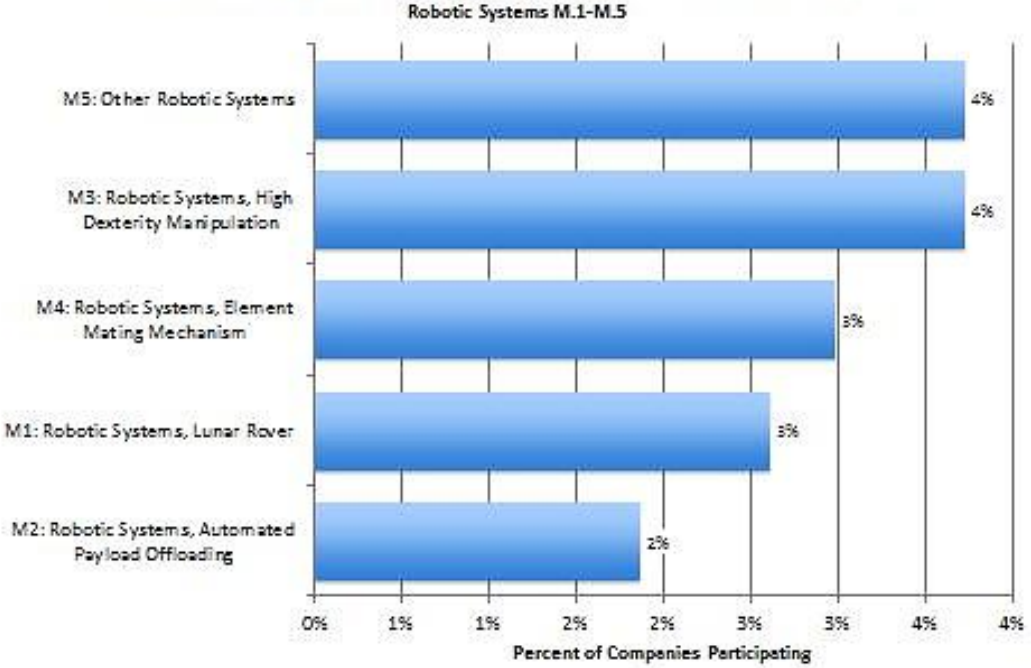
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-23: Participation in Product and Service Categories:



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

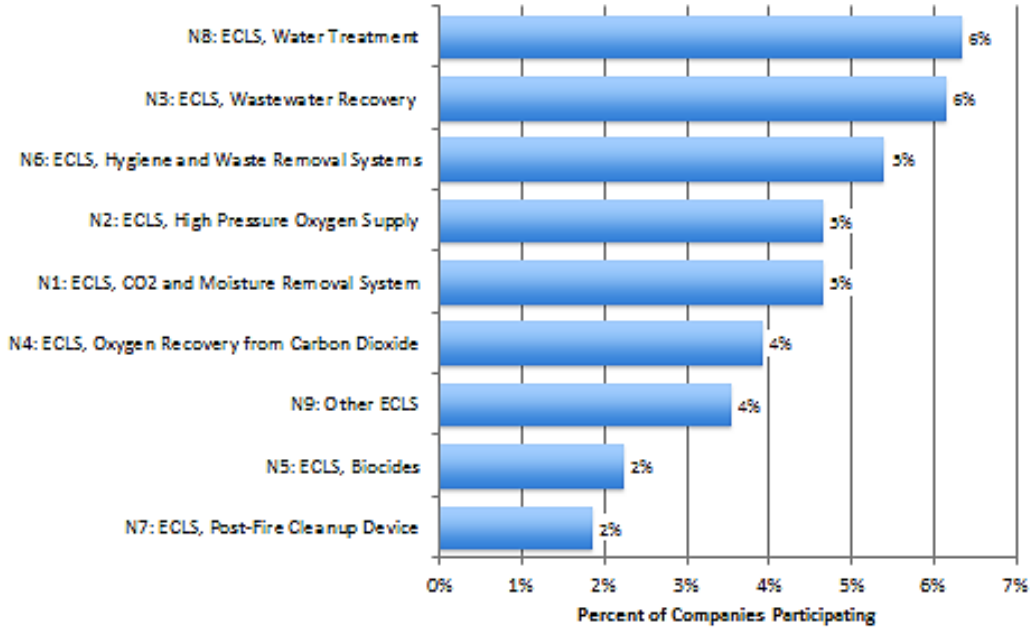
Figure A-24: Participation in Product and Service Categories:



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-25: Participation in Product and Service Categories:

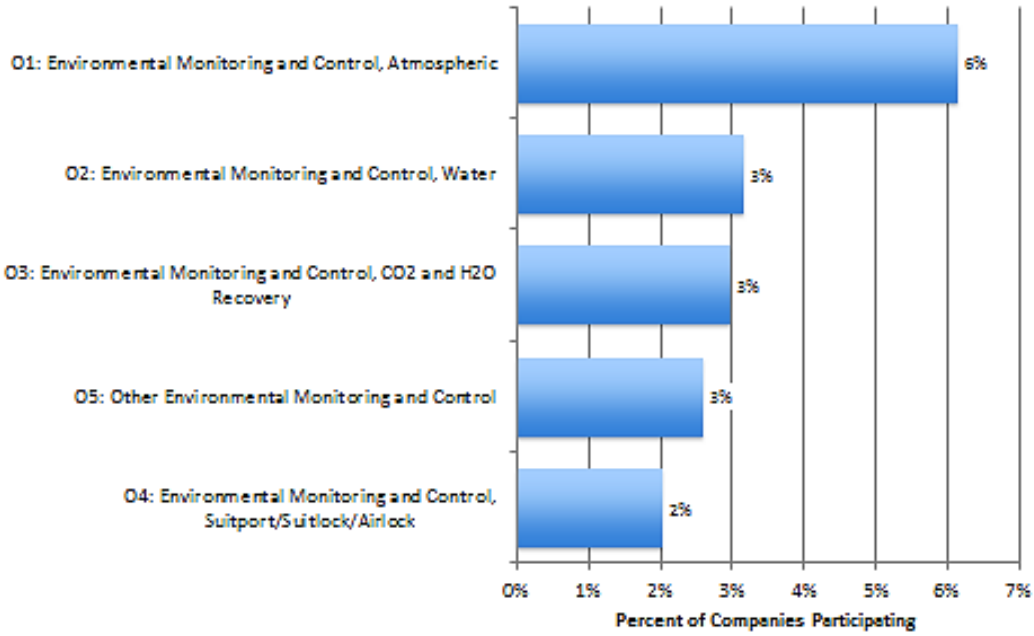
Environmental Control and Life Support (ECLS) N.1-N.9



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-26: Participation in Product and Service Categories:

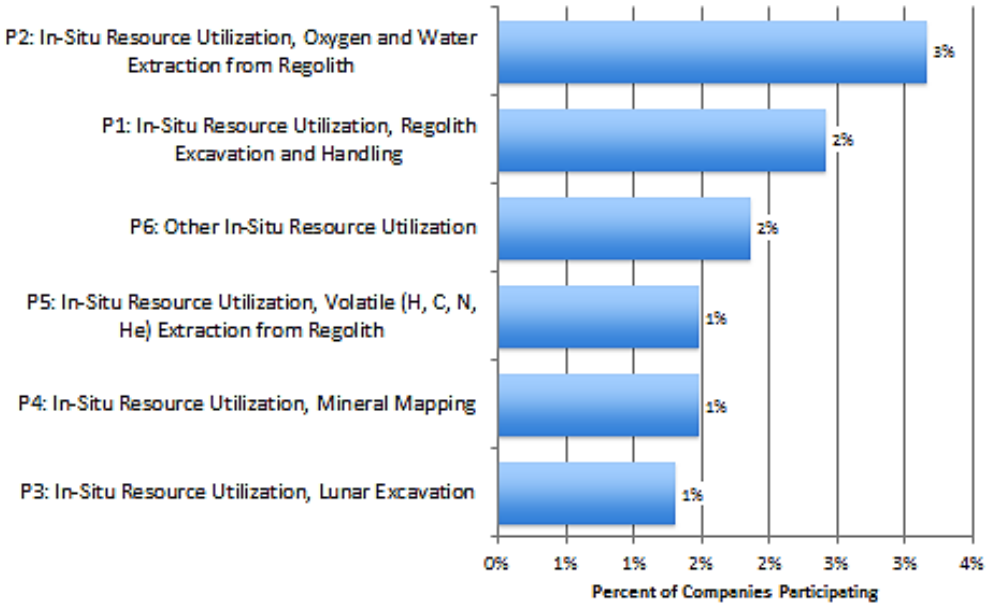
Environmental Monitoring and Control O.1-O.5



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-27: Participation in Product and Service Categories:

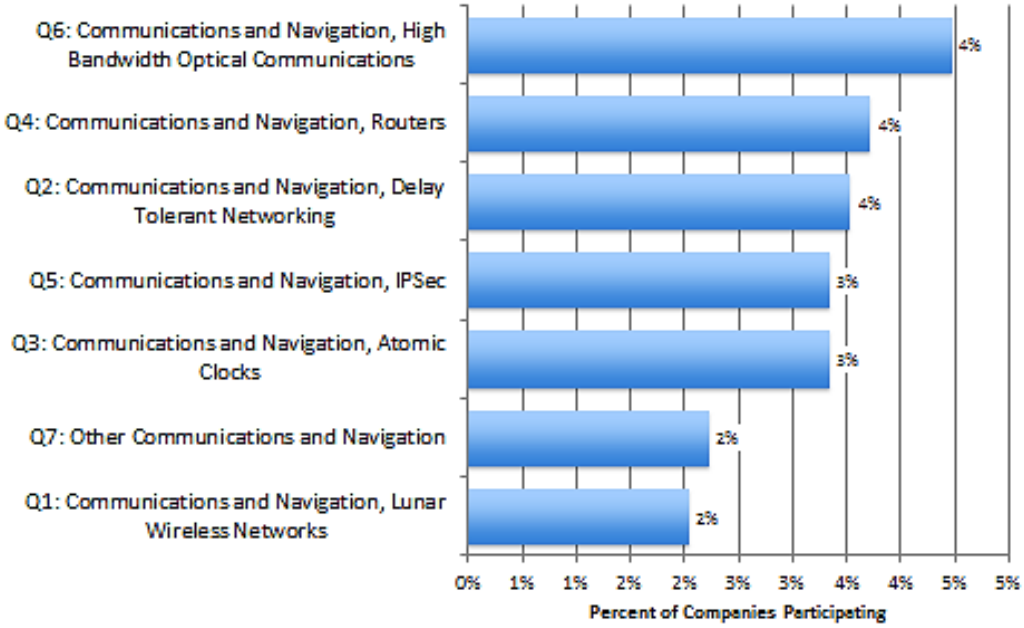
In-Situ Resource Utilization P.1-P.6



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

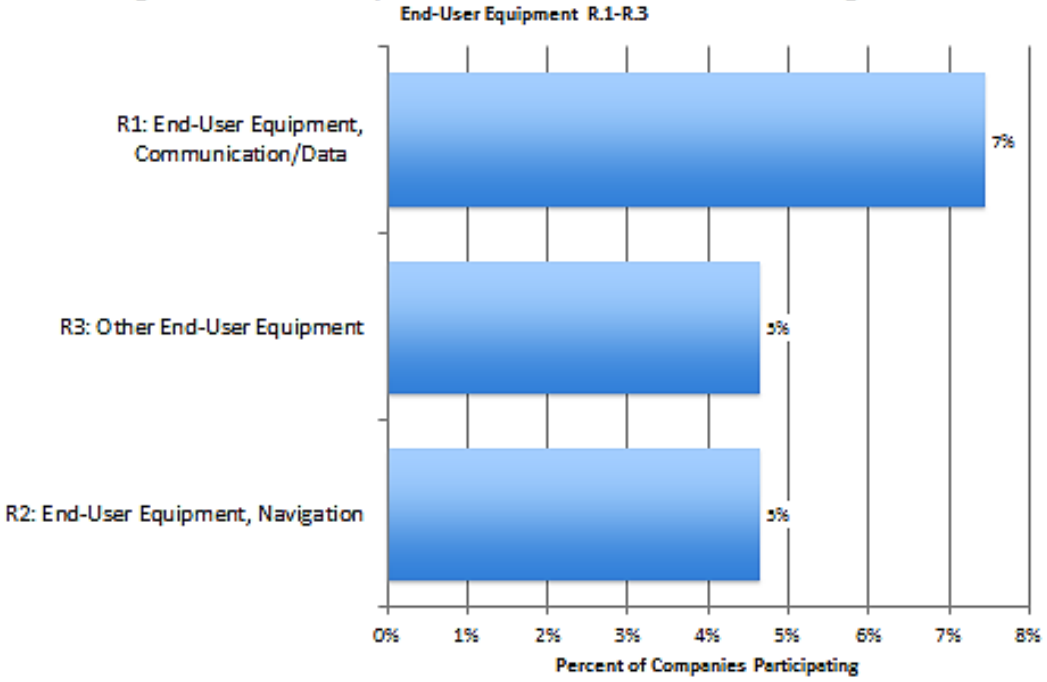
Figure A-28: Participation in Product and Service Categories:

Communications and Navigation Q.1-Q.7



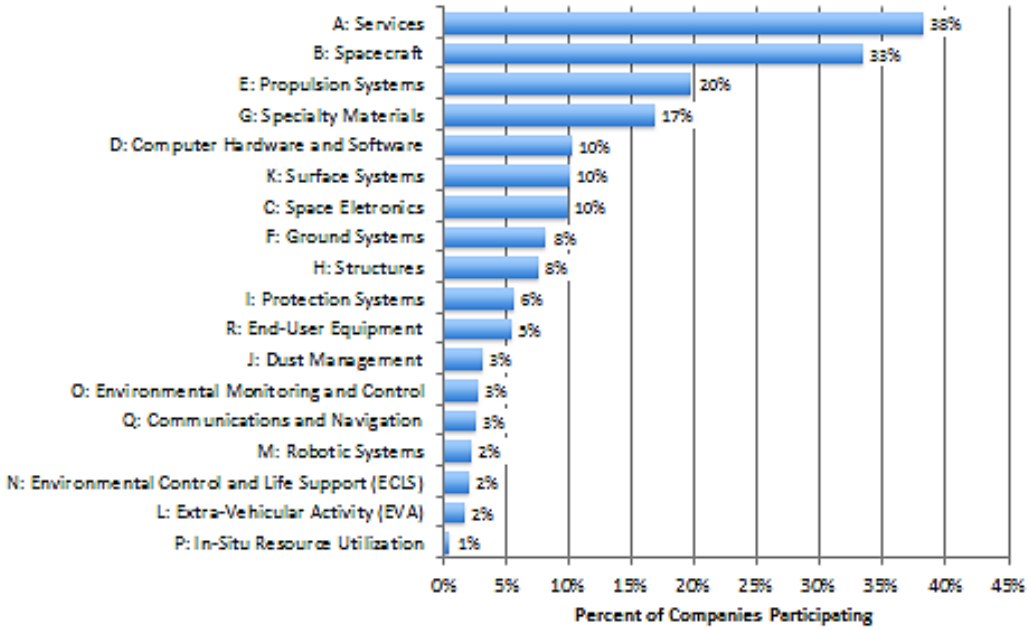
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-29: Participation in Product and Service Categories:



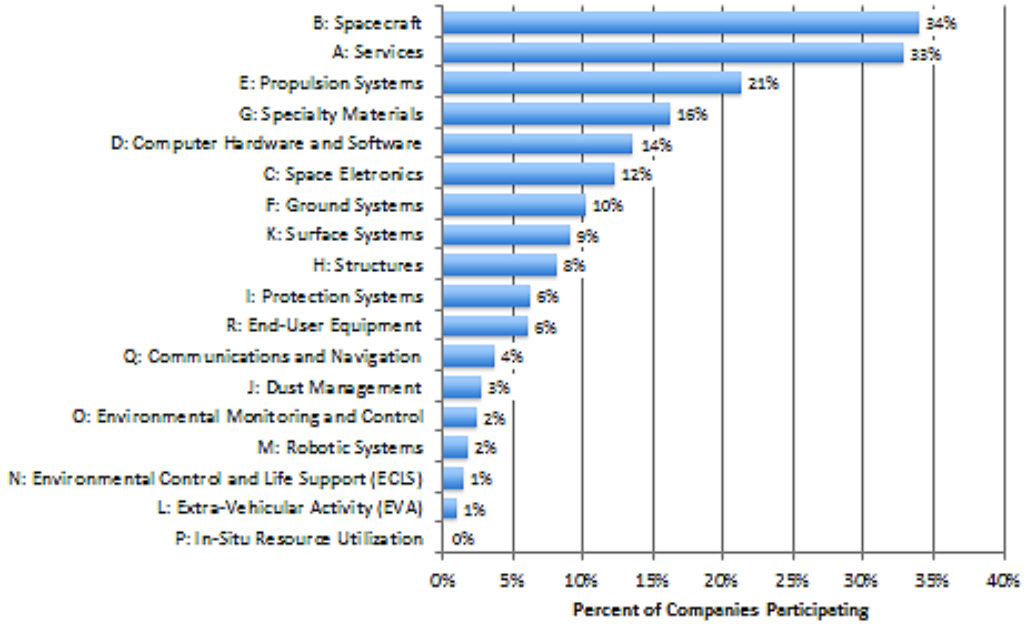
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-30: Participation in Product and Service Categories for Commercial End-Users



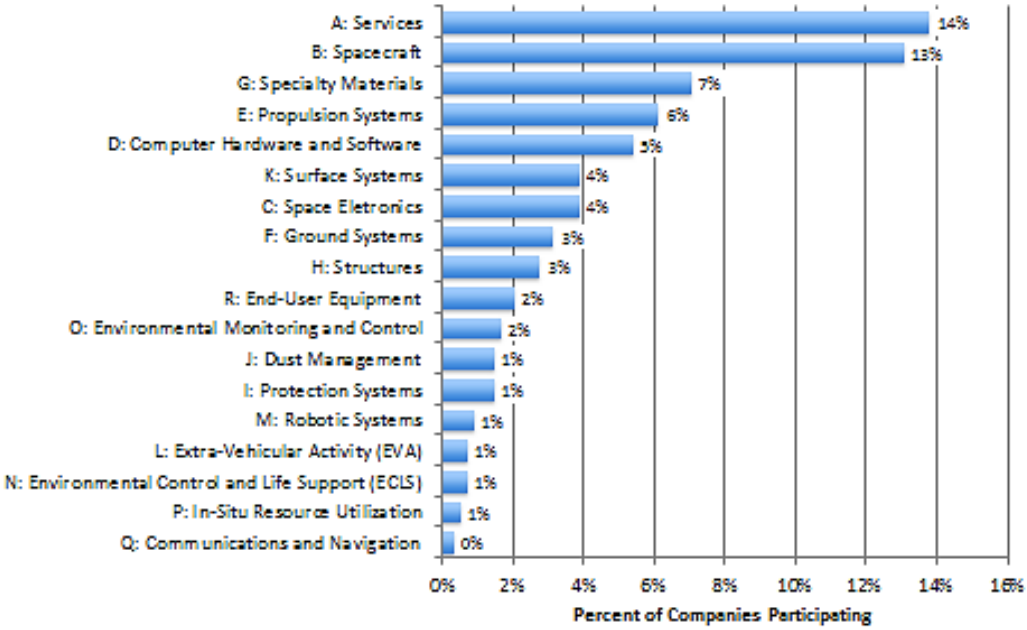
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-31: Participation in Product and Service Categories for DOD End-Users



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

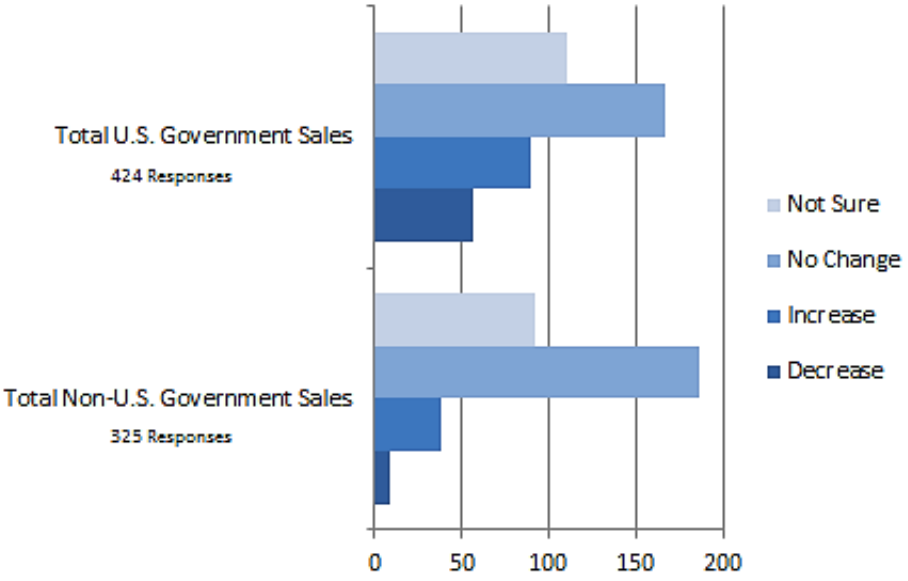
Figure A-32: Participation in Product and Service Categories for Other End-Users



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

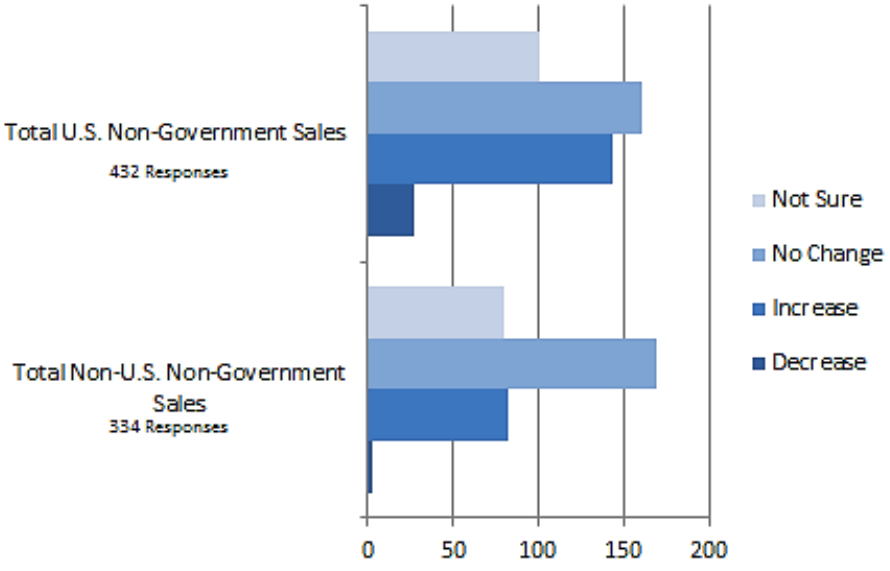
CHAPTER IV: NASA SUPPLIER SALES

Figure A-33: Future Government Sales Projection (2011-2015)



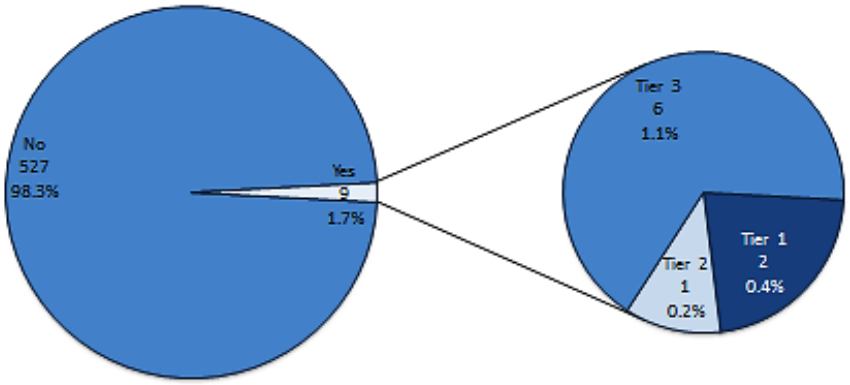
Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-34: Future Non-Government Sales Projection (2011-2015)



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

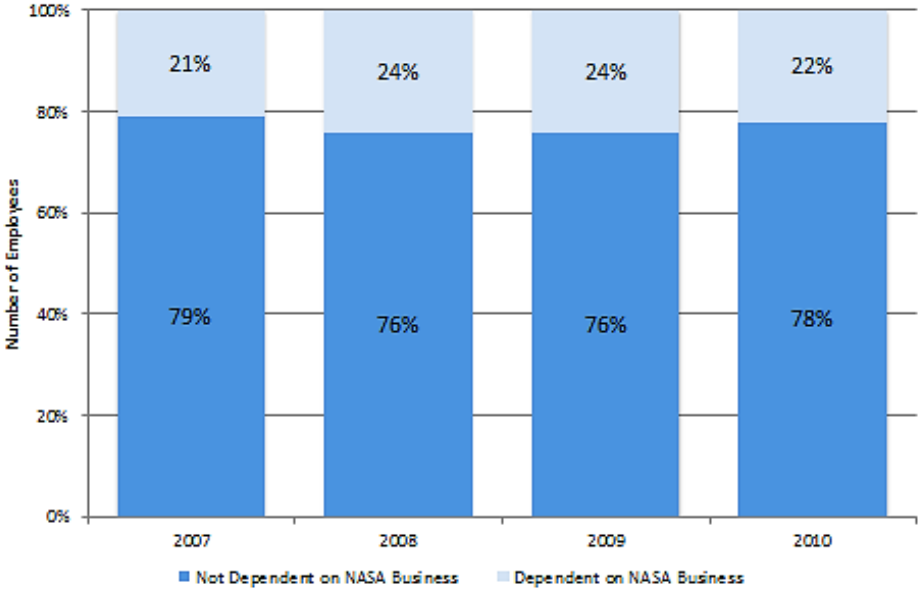
Figure A-35: Have You Decided to Stop Exporting Space-Related Products or Services Because of Past Experiences with U.S. Export Control License Denials, Conditions, or Extended Delays?



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

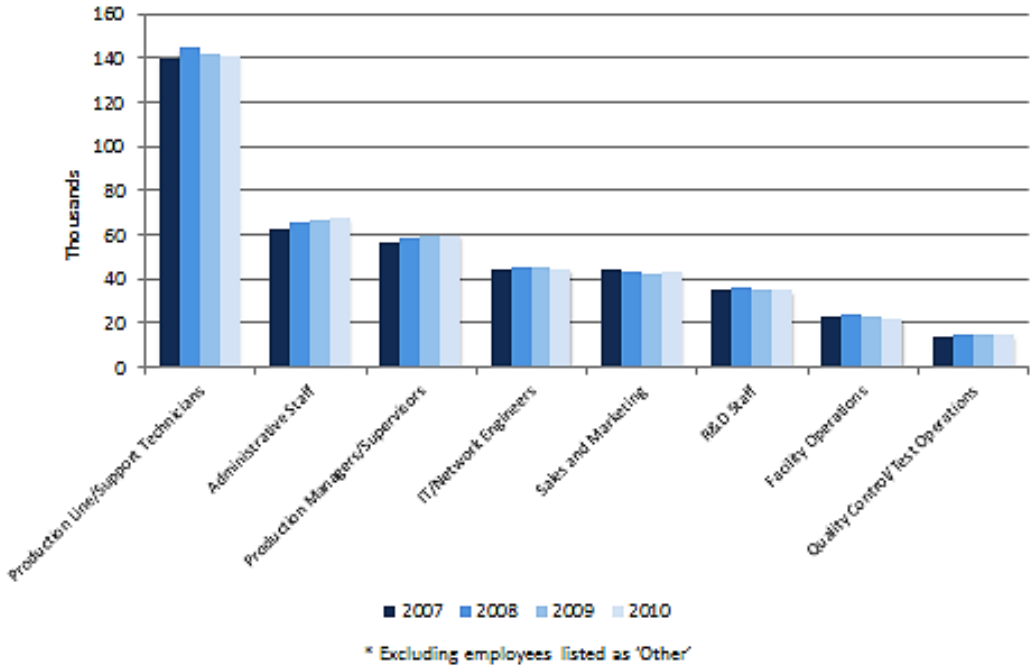
CHAPTER V: EMPLOYMENT

Figure A-36: Total Employment by Dependency on NASA



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

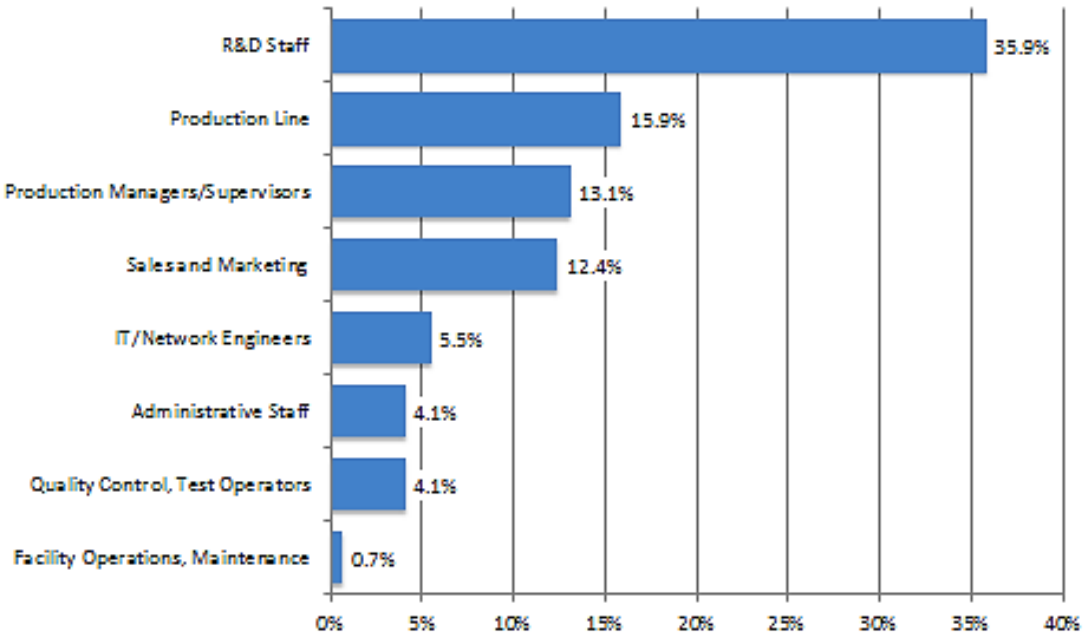
Figure A-37: Employment by Professional Occupation (2007-2010)*



* Excluding employees listed as 'Other'

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

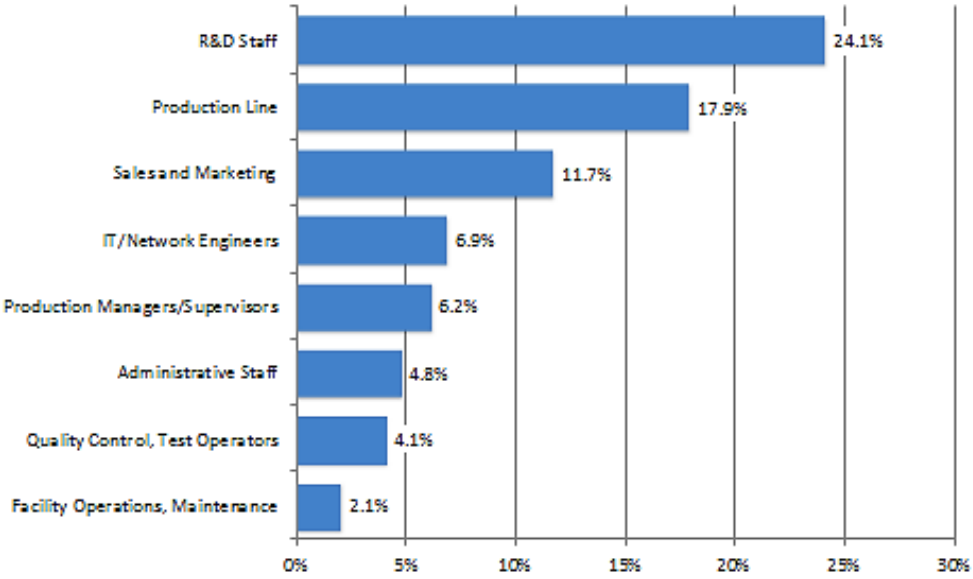
Figure A-38: Difficult to Hire Professional Occupations - NASA-Dependent Companies*



* As a percentage of 145 NASA dependent companies.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-39: Difficult to Retain Professional Occupations - NASA-Dependent Companies*

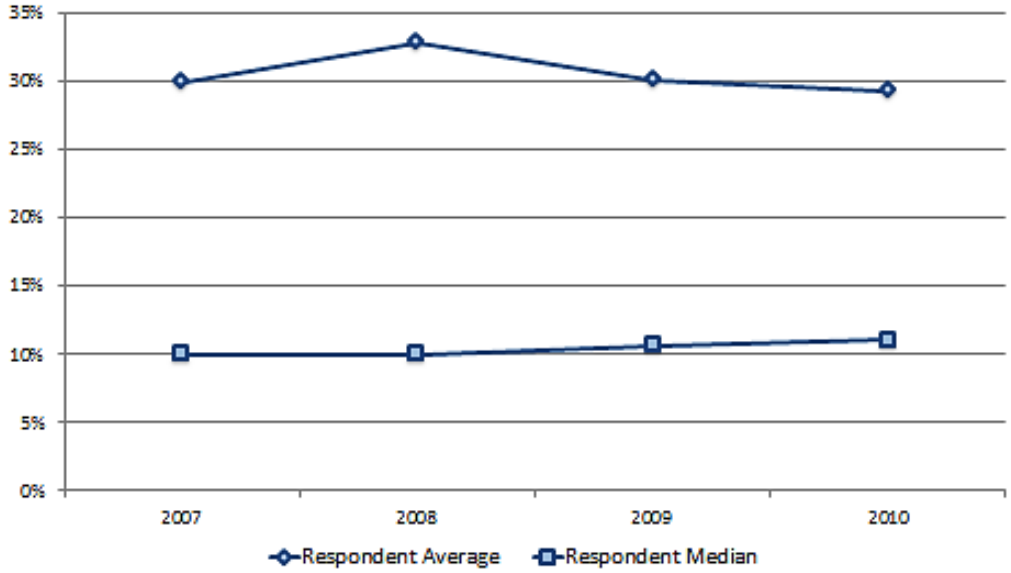


* As a percentage of 145 NASA dependent companies.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

CHAPTER VI: RESEARCH AND DEVELOPMENT (R&D)

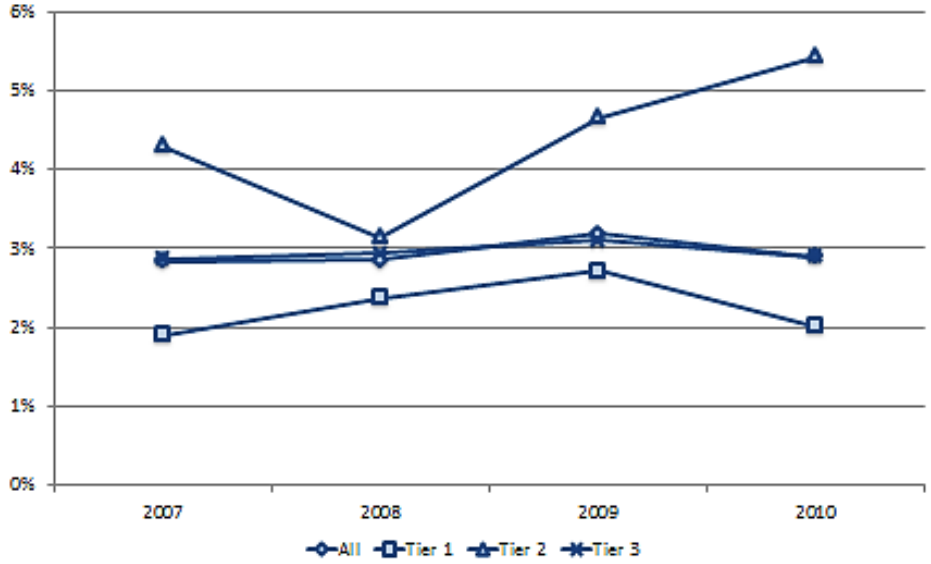
Figure A-40: NASA-Related R&D as a Percentage of Total R&D Expenditures (2007-2010)*



*Based on 80 respondents that reported NASA-related R&D expenditures over the period

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

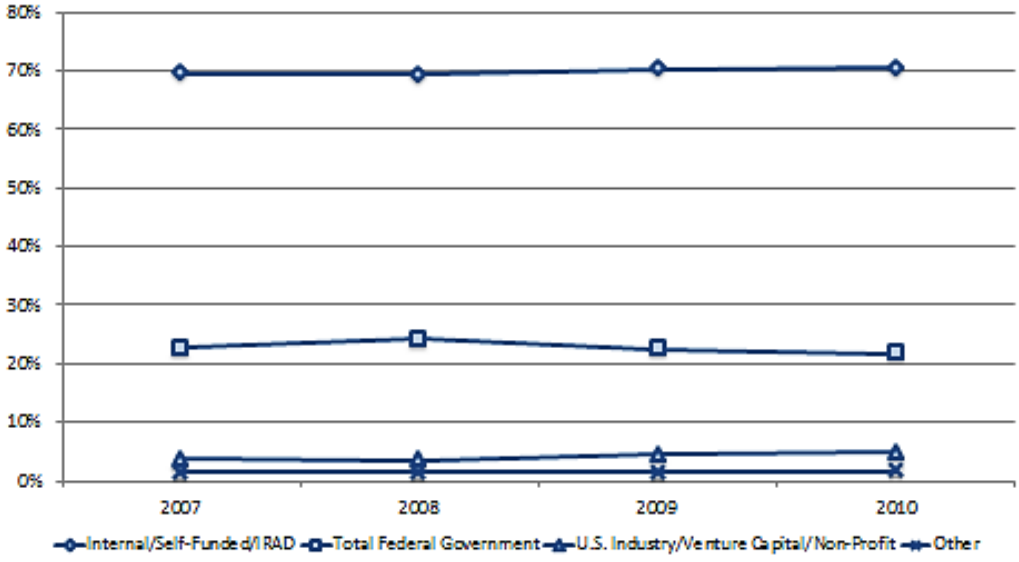
Figure A-41: Median R&D Expenditures as a Percentage of Total Sales for NASA-Dependent Suppliers by Tier*



*Based on 57-60 NASA-dependent respondents that reported R&D expenditures and total sales depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

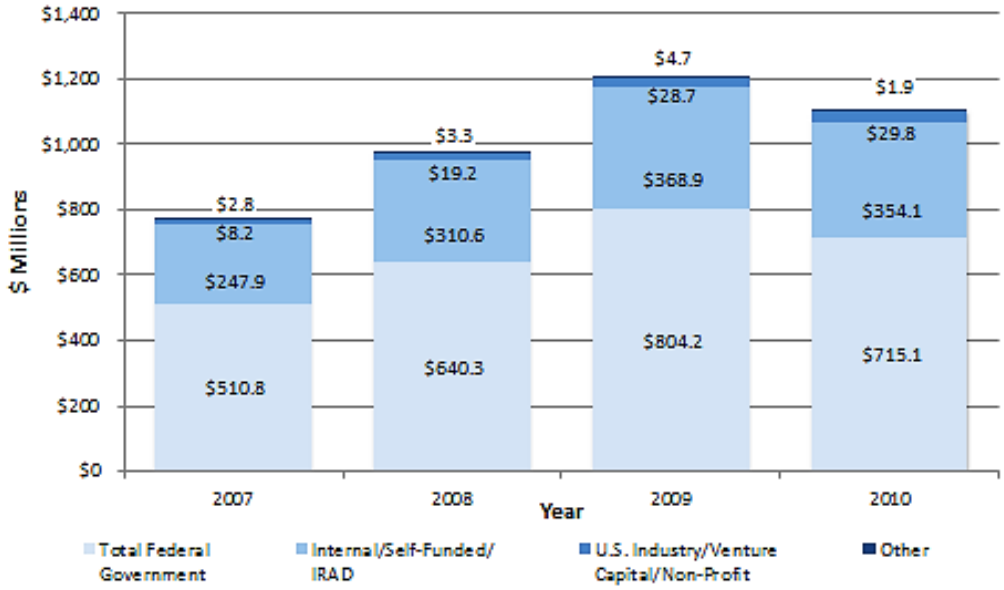
Figure A-42: Average R&D Funding Sources as a Percentage of Total R&D Expenditures for Suppliers that Conducted NASA-Related R&D (2007-2010)*



*Based on 72 respondents that reported NASA-related R&D expenditures and reported R&D expenditures by source over the period

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

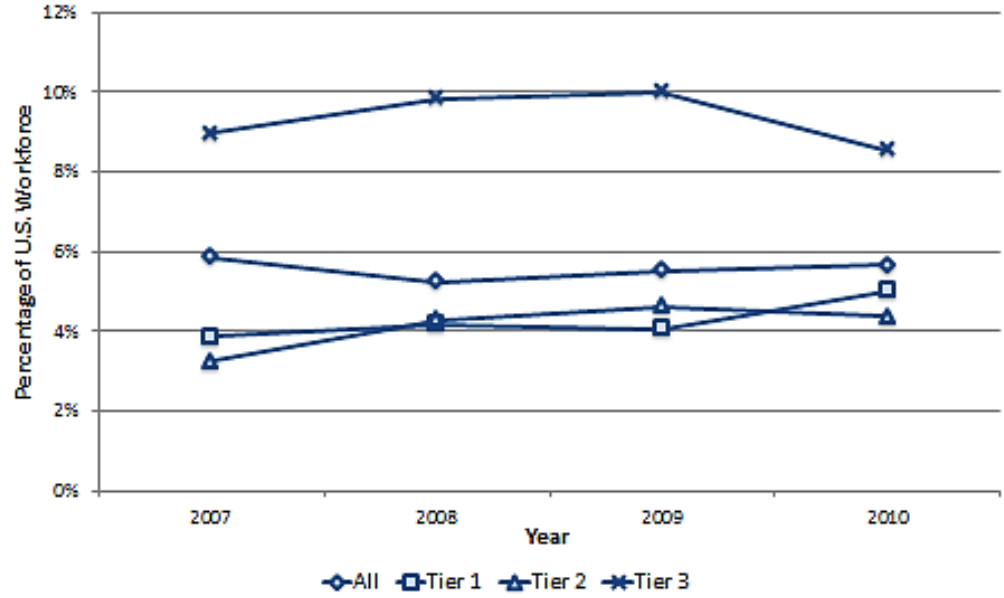
Figure A-43: Total R&D Funding Sources for NASA-Dependent Suppliers that Conducted NASA-Related R&D (2007-2010)



*Based on 34 NASA-dependent respondents that reported NASA-related R&D expenditures and reported R&D expenditures by source over the period

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-44: R&D Staff as a Percentage of Total U.S. Workforce, Median by Tier (2007-2010)

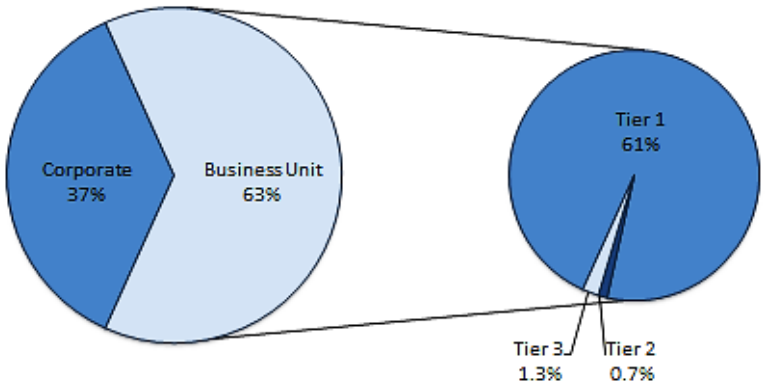


*Based on 226-240 respondents that reported both R&D staff and total workforce depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

CHAPTER VII: CAPITAL EXPENDITURES

Figure A-45: Breakdown of Total Capital Expenditures Reported by Business Units with Tiers (2007-2010)*

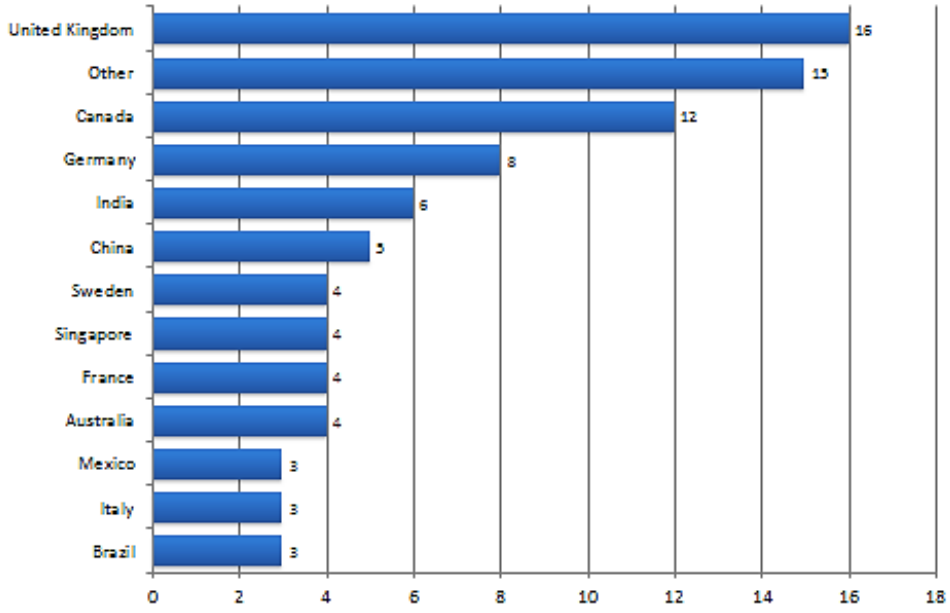


*Based on 481 respondents that recorded capital expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

CHAPTER VIII: SUPPLY CHAIN RELATIONSHIPS

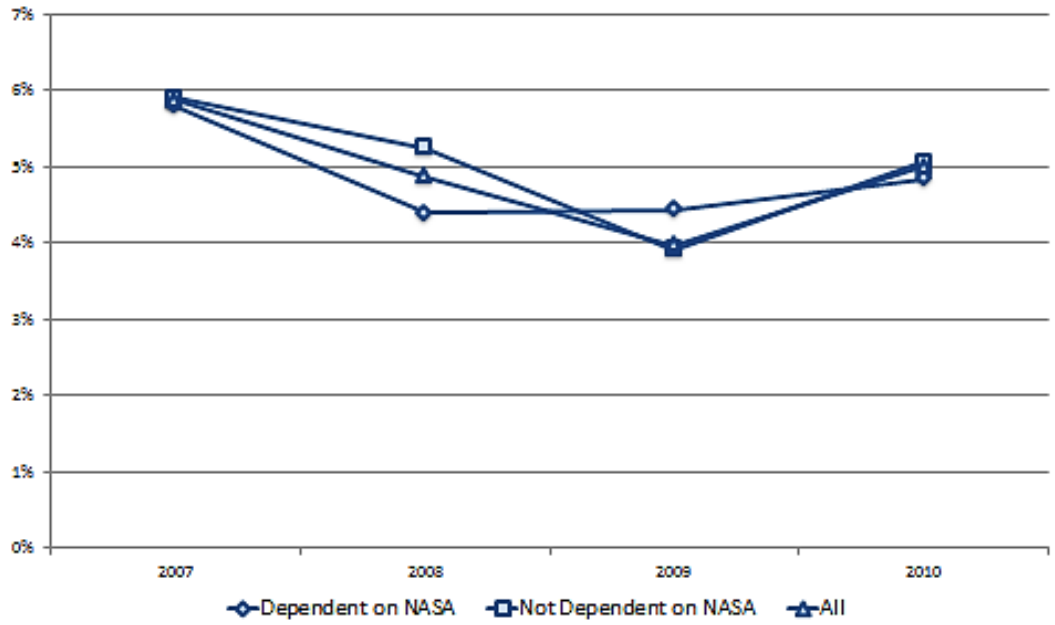
Figure A-46: Non-U.S. Mergers and Acquisitions by Country



Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

CHAPTER X: SUPPLY CHAIN DEPENDENCY ON NASA

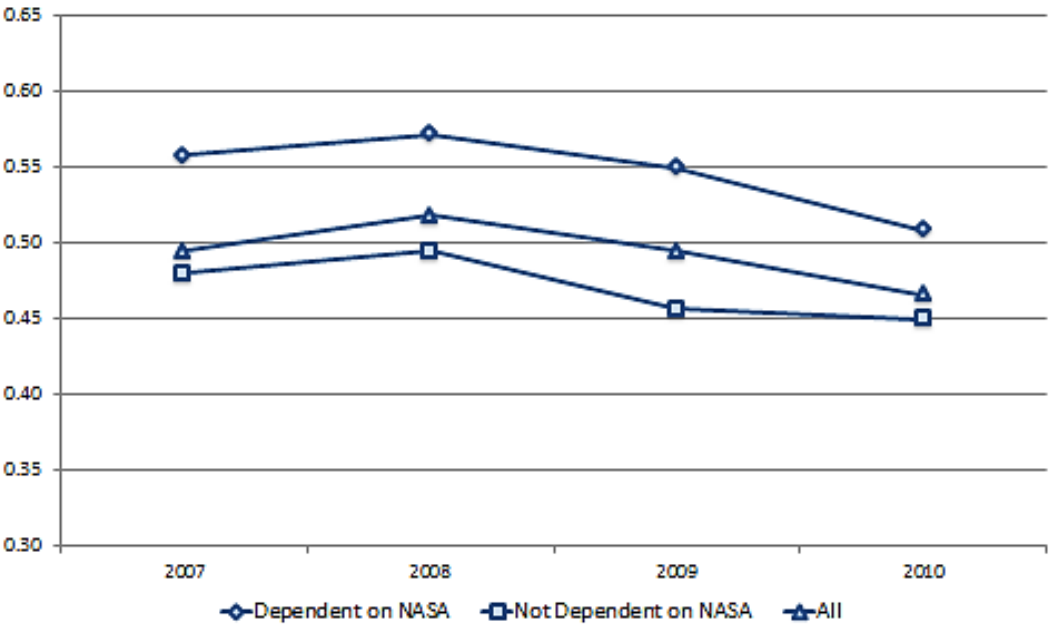
Figure A-47: Median Net Profit Margins*



*Based on 477-491 respondents (128-136 NASA-dependent) depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

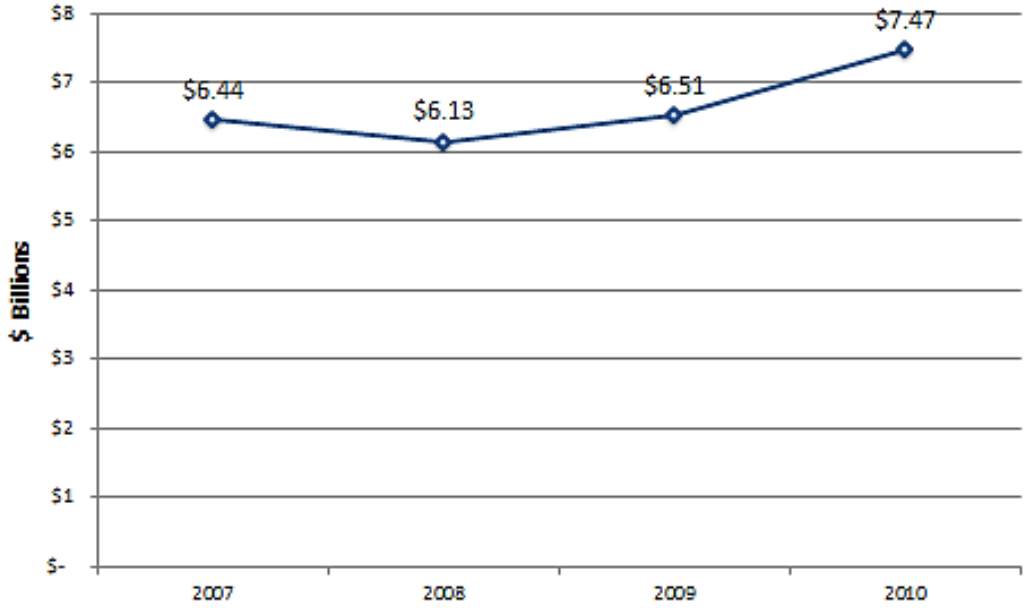
Figure A-48: Median Debt Ratio*



*Based on 474-488 respondents (128-134 NASA-dependent) depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

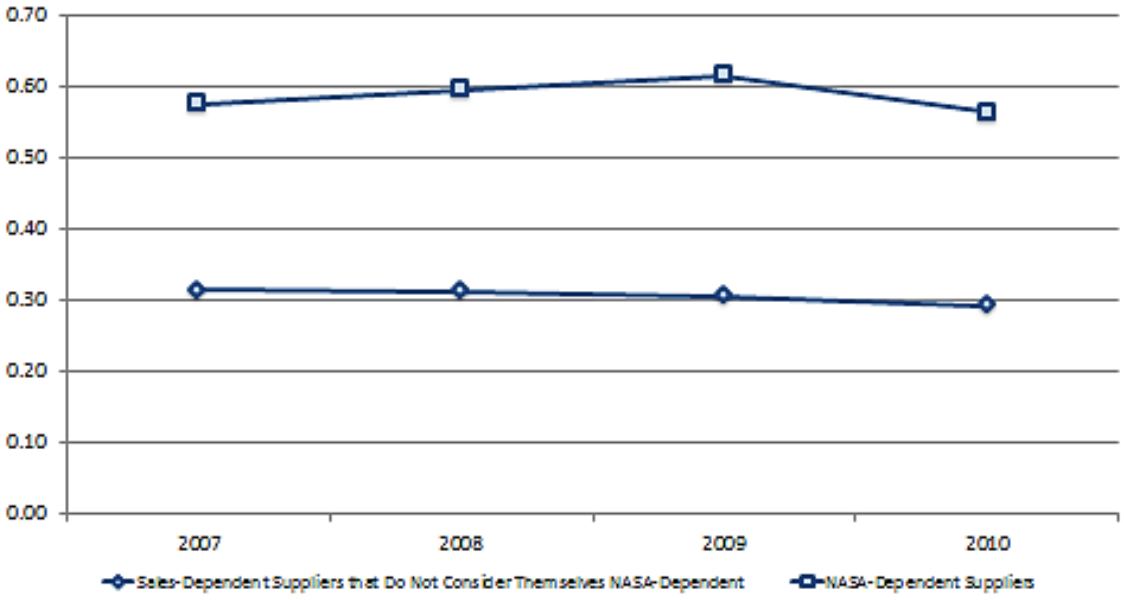
Figure A-49: Total Sales by NASA-Dependent Suppliers Operating at a Loss



*Based on 46 NASA-dependent respondents operating at a loss for at least one year from 2007-2010

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

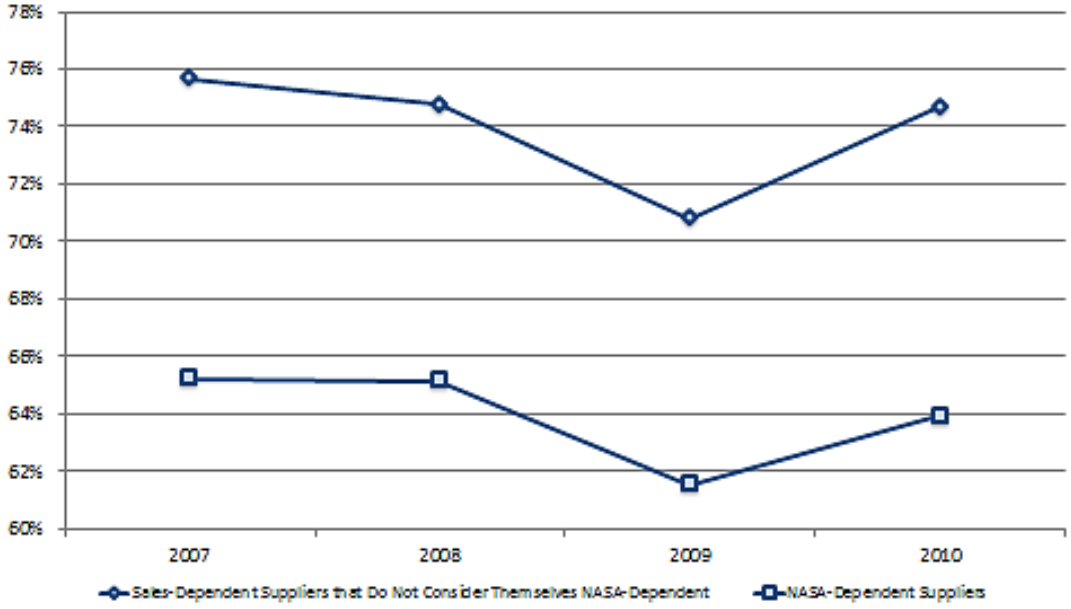
Figure A-50: Average Debt Ratios for NASA Sales-Dependent Suppliers that Do Not Consider Themselves NASA-Dependent*



*Based on 15 NASA sales-dependent respondents that don't consider themselves NASA-dependent and 128-134 NASA-dependent respondents depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

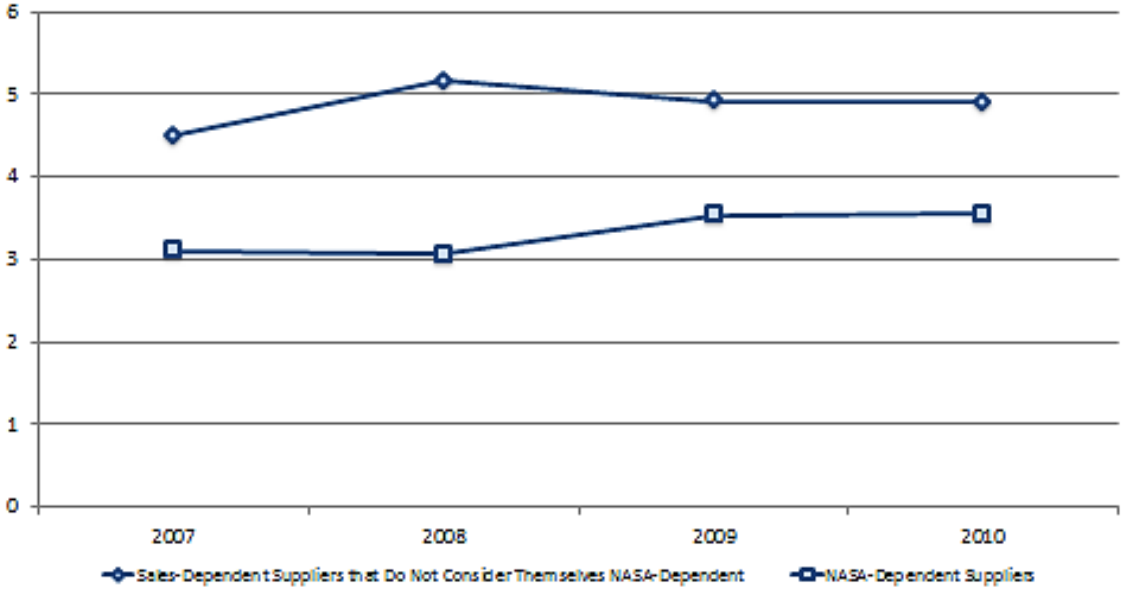
Figure A-51: Average Capacity Utilization Rates for NASA Sales-Dependent Suppliers that Do Not Consider Themselves NASA-Dependent*



*Based on 9 NASA sales-dependent respondents that don't consider themselves NASA-dependent and 86 NASA-dependent respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

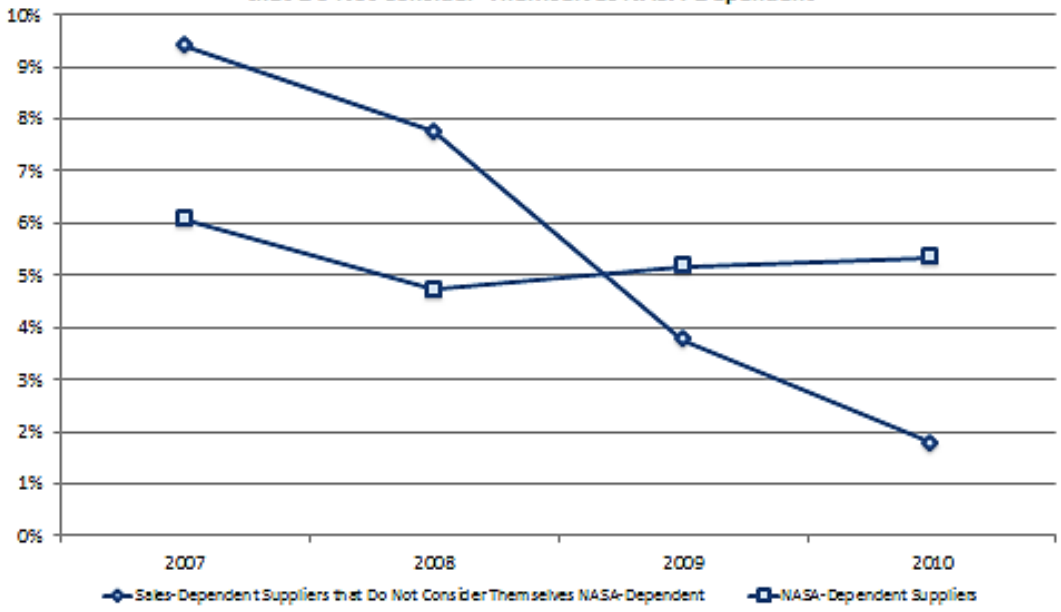
Figure A-52: Average Current Ratios for NASA Sales-Dependent Suppliers that Do Not Consider Themselves NASA-Dependent*



*Based on 15 NASA sales-dependent respondents that don't consider themselves NASA-dependent and 125-132 NASA-dependent respondents depending on the year

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Figure A-53: Average Net Profit Margins for NASA Sales-Dependent Suppliers that Do Not Consider Themselves NASA-Dependent*



*Based on 16 NASA sales-dependent respondents that don't consider themselves NASA-dependent and 149 NASA-dependent respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *NASA Supply Chain Network*, June 2012

Appendix B: Certification Index

ANSI/ISO/IEC 17025

The ANSI/ISO/IEC 17025 is a standard used by testing and calibration laboratories. It applies to those organizations that produce testing and calibration results. The requirements emphasize the responsibilities of senior management and provide requirements for continual improvement of the management system itself. The two main sections of the standard are Management Requirements and Technical Requirements. Management requirements are primarily related to the operation and effectiveness of the quality management system within the laboratory. Technical requirements include factors that determine the correctness and reliability of the tests and calibrations performed in laboratory. Laboratories use ISO/IEC 17025 to implement a quality system aimed at improving their ability to consistently produce valid results.

Source: http://webstore.ansi.org/RecordDetail.aspx?sku=ISO%2fIEC+17025%3a2005

ANSI/ESD S20.2

The ANSI/ESD S20.2, or The ESD Association Standard for the Development of an Electrostatic Discharge Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment (Excluding Electrically Initiated Explosive Devices), works to specify the method for developing an electrostatic discharge (ESD) control program. The standard covers the requirements necessary to design, establish, implement, and maintain an ESD control program for activities that handle electrical or electronic parts, assemblies, and equipment subject to damage by ESD equal to or greater than a 100 V human body model (HBM)." The fundamental control principles presented in the standard are: 1) All conductors in the work environment, including personnel, must be electrically connected to ground 2) Ionization systems must be used to neutralize charges on necessary nonconductors in the work environment 3) ESD-sensitive items must not be transported outside a protected area except when they are enclosed in static-protective materials.

Source: http://www.esdsystems.com/whitepapers/wp_ESD-S20.html

ANSI/ASQC Z1.4

The ANSI/ASQ Z1.4 standard, or Sampling Procedures and Tables Package, establishes sampling plans and procedures for inspection by variables and attributes for use in procurement, supply, storage and maintenance operations. Tables are provided to guide the process of measuring, examining and testing.

Source: http://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2fASQ+Z1.4+and+Z1.9+-+Sampling+Procedures+and+Tables+Package

AMS

The objective of the Aerospace Materials Specifications are to provide guidelines and requirements for detailed production, interoperability and high quality manufacturing of parts and components used in aerospace technologies and equipment. AMS requirements clarify legal and regulatory grey areas; condense product development cycles and work to ensure consistency.

Source: http://store.sae.org/intstan.htm

A2LA

The American Association for Laboratory Accreditation (A2LA) is a nonprofit, non-governmental, public service, membership society. The mission of A2LA is to provide comprehensive services in accreditation and accreditation-related training. A2LA also offers programs for the accreditation of testing laboratories, calibration laboratories, inspection bodies, proficiency testing providers, medical testing laboratories, reference material producers and product certification bodies.

Source: http://www.a2la.org/#

ANSI Z54.1

This standard establishes guidance for the design and use of installations that use x-ray–generating devices and sealed gamma-ray sources of energies up to 10 MeV for non-medical purposes. The standard's main objectives are to keep the exposure of persons to radiation to levels as low as reasonably achievable (ALARA) and to ensure that no one receives a dose equivalent greater than the maximum permissible dose equivalent. These objectives may be achieved by the use of engineered controls, firm management controls, safe operating procedures, appropriate equipment, and a comprehensive maintenance and surveillance program.

Source: http://hps.org/hpssc/documents/N43_3-2008.pdf

AS 9100

AS9100 is the quality management standard specifically written for the aerospace industry. The current version of AS9100 aligns the standard with ISO 9001:2008 and has extra requirements regarding Regulatory Compliance and the following aerospace-sector specific requirements: Configuration management, Design phase, design verification, validation and testing processes, Reliability, maintainability and safety, Approval and review of subcontractor performance, Verification of purchased product, Product identification throughout the product's life cycle, Product documentation, Control of production process changes, Control of production equipment, tools and numerical control machine programs, Control of work performed outside the supplier's facilities, Special processes, Inspection and testing procedures, Methods, resources and recording, Corrective action, Expansion of the internal audit requirements in ISO 9001:2000, First article inspection, Servicing, including collecting and analyzing data, delivery, investigation and reporting and control of technical documentation, Review of disposition of non-conforming product.

Source: http://www.isoqar.com/uk/Standards/AS9100/AS-9100-About.aspx

AS 9100 Rev B or AS9100B

See AS9100. AS9100 Rev A contained both ISO9001/2, 1994 and ISO9001:2000. AS9100 was reissued as Rev B in 2004 and the only difference was that references to ISO9001/2, 1994 were removed.

Source: http://www.smithersregistrar.com/as9100/page-differences-between-as9100-as9100b.shtml

AS 9100: 2004

The current version, AS9100 Rev B published in 2004, includes the ISO 9001:2000 standard verbatim and adds supplementary requirements that apply to the aerospace industry. These supplementary requirements emphasize areas that impact on process and service safety, quality and reliability for aerospace products. It is designed to meet the complex and unique demands of the aerospace industry, from commercial aviation to defense and include several additional requirements to ISO 9001 that participating aerospace OEM companies felt were necessary to clearly define their expectations for aerospace suppliers.

Source: http://www.askartsolutions.com/faqas9100.html

AS9101

AS9100 is the international management system standard for the Aircraft, Space and Defense (AS&D) industry. The standard provides suppliers with a comprehensive quality system for providing safe and reliable products to the aerospace industry. It also addresses civil & military aviation requirements.

Source: http://as9100store.com/what-is-AS9100.aspx

AS9104

The AS9104 is a part of the AS9100 standard. It provides the guidelines and details for the Quality Management Systems Assessment

Source: http://www.whittingtonassociates.com/v2/standards/aerospace.shtml

AS9110

This standard defines the quality system requirements and offers additional comprehensive requirements/criteria for overhaul facilities and the maintenance repair for the aircraft industry at all levels of the Maintenance, Repair & Overhaul process. It is tailored for organizations with national airworthiness authority (NAA) repair station certification, but is also suitable for non-certificated organizations including those that provide maintenance, repair, and overhaul services for military aviation products. Companies whose primary business is providing maintenance, repair, and overhaul services for aviation sector products. It is also intended to be used by organizations with maintenance, repair, and overhaul operations that operate autonomously, or that are substantially different from their manufacturing operations.

Source: http://as9100store.com/what-is-AS9110.aspx#implementas9110

AS 9120

AS 9120 is for use by the organizations that procure parts, materials and assemblies, and sells these products to a customer in the Aerospace industry. This includes organizations that procure products and split them into smaller quantities. The standard provides the requirements and guidelines for Traceability, Controls of records, Airworthiness certificates, Splitting, and Evidence of Conformance.

Source: http://www.isaregistrar.com/as9120.html

ASME

The American Society of Mechanical Engineers, ASME, is the leading international developer of codes and standards associated with mechanical engineering. ASME's codes and standards have grown to nearly 600 offerings, covering a breadth of topics that include pressure technology, nuclear plants, elevators / escalators, construction, engineering design, standardization, and performance testing.

Source: http://www.asme.org/

ASNT

The American Society for Nondestructive Testing, Inc. or ASNT is a technical society for nondestructive testing (NDT) professionals. There are four divisions of ASNT: Technical and Education, Research, Section Operations, and Certification. ASNT publishes and maintains important standards including Codes of Practice that covers all aspects of qualification and certification of NDT personnel. Certifications include an employer based certification scheme for Level I and Level II NDT personnel, which is extensively used in countries not enforcing EN 473 (European Union) and a central certification scheme for Level III NDT professionals.

Source: http://asnt.org

ATEX EN13980

ATEX is a European Union directive for equipment used in hazardous locations. The directive covers the different requirements applicable to mining (group I) and surface (group II) applications, and applies to electrical and mechanical equipment, including electric motors, compressors, diesel engines, lighting fittings, control and communications devices, and monitoring and detection equipment. For most categories, mandatory third party certification by an ATEX Notified Body is required. A second ATEX directive applies to the locations themselves and contains rules for the persons responsible for the location. Employers must classify areas where hazardous explosive atmospheres may occur into zones. The classification given to a particular zone, and its size and location, depends on the likelihood of an explosive atmosphere occurring and its persistence if it does.

Source: http://ce-mark.com/atexdir.html

AWS

The American Welding Society offers certification programs to assist industry in identifying qualified welding personnel and to provide opportunities for welding professionals to demonstrate their qualifications to the welding industry. Certifications include the Certified Welding Engineer, Certified Robotic Arc Welding, Certified Welding Fabricator, and Accredited Test Facility. These programs have been contributors to improved weld quality and reduced costs of inspection. AWS offers certification programs for welding supervisors, engineers, radiographic interpreters, educators, and welders.

Source: http://www.aws.org/w/a/about/index.html

Baseefa

Baseefa is the certification body for explosion protected equipment, delivering IECE, ATEX and DSEAR certification. The credibility, assurance and international recognition associated with the services that Baseefa provide is supported by comprehensive formal third party accreditations and approvals. Each of these endorsements involves independent third party assessment against recognized standards. Baseefa gives confidence to Manufacturers, Equipment Users and Regulatory Authorities within the area that we operate by demonstrating our competence, impartiality and performance capability.

Source: http://www.baseefa.com/index.asp

CFR-21

CFR-21 is the Federal Aviation Authority's certification procedures for products and parts. It describes the procedural requirements for issuing and changing design approvals, production approvals, airworthiness certificates, and airworthiness approvals. It also states the rules governing applicants for reporting falsification of applications, reports, or records and failures, malfunctions, and defects. It establishes the rotorcraft flight manual and the requirements for the manufacture of new aircraft, aircraft engines, and propellers.

Source: http://www.access.gpo.gov/nara/cfr/waisidx_06/14cfr21_06.html

CISSP

The Certified Information Systems Security Professional (CISSP) is an independent information security certification governed by the International Information Systems Security Certification Consortium,

commonly known as the ISC. The CISSP was the first information security credential accredited by ANSI ISO/IEC Standard 17024:2003. It is formally approved by the U.S. Department of Defense (DoD) in both their Information Assurance Technical (IAT) and Managerial (IAM) categories.

Source: https://www.isc2.org/cissp/default.aspx

CMM II

The Software Engineering Institute's (SEI) Capability Maturity Model (CMM) provides a well-known benchmark of software process maturity. The CMM has become a popular vehicle for assessing the maturity of an organization's software process in many domains. CMMI in software engineering and organizational development is a process improvement approach that provides organizations with the essential elements for effective process improvement.

Source: http://www.sei.cmu.edu/cmmi/

DoD 5000

The DoD 5000 provides the management principles and mandatory policies/procedures for managing acquisition programs. An acquisition program is a directed, funded effort that provides a new, improved, or continuing material, weapon, information system, or service capability in response to an approved need. The Defense Acquisition System exists to manage the nation's investments in technologies, programs, and product support and acquire quality products that improve mission capability and operational support.

Source: http://www.dtic.mil/whs/directives/corres/pdf/500001p.pdf

FAA 145

This part describes how to obtain a repair station certificate. This part also contains the rules a certificated repair station must follow related to its performance of maintenance, preventive maintenance, or alterations of an aircraft, airframe, aircraft engine, propeller, appliance, or component part to which part 43 applies. It also applies to any person who holds, or is required to hold, a repair station certificate issued under this part.

Source:
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title14/14cfr145_main_02.tpl

ISO 9000

The ISO 9000 family addresses "Quality management", meaning what a business or organization does to fulfill the customer's quality requirements and regulatory requirements while aiming to enhance customer satisfaction and improve performance in pursuit of this objective. The ISO 9000 family of standards represents an international consensus on good quality management practices. It consists of standards and guidelines relating to quality management systems and related supporting standards. The other standards in the family cover specific aspects such as fundamentals and vocabulary, performance improvements, documentation, training, and financial and economic aspects.

Source:
http://www.iso.org/iso/iso_catalogue/management_and_leadership_standards/quality_management/iso_9000_essentials.htm

ISO 9001

ISO 9001 is an international standard that gives requirements for an organization's quality management system (QMS). The requirements cover a wide range of topics, including your supplier's top management commitment to quality, its customer focus, adequacy of its resources, employee competence, process management (for production, service delivery and relevant administrative and support processes), quality planning, product design, review of incoming orders, purchasing, monitoring and measurement of its processes and products, calibration of measuring equipment, processes to resolve customer complaints, corrective/preventive actions and a requirement to drive continual improvement of the QMS. The ISO 9001 is the only standard in the ISO 9000 family that can be used for the purpose of conformity assessment.

Source:
http://www.iso.org/iso/iso_catalogue/management_and_leadership_standards/quality_management/more_resources_9000/9001supchain.htm#what_is_iso_9001

ISO 10012-1

ISO 10012 is an international standard that gives requirements and guidance for successful management of an organization's measurement processes and metrological confirmation of measuring equipment used to support and demonstrate compliance with metrological requirements. It specifies quality management requirements of a measurement management system that can be used by an organization performing

measurements as part of the overall management system. The ISO 10012 applies to testing laboratories, including those providing a calibration service, suppliers of products or services, and other organizations where measurement is used to demonstrate compliance with specified requirements.

Source: http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=26033

ISO 13485

ISO 13485 is a standard that represents the requirements for a comprehensive management system for the design and manufacture of medical devices. While it remains a stand-alone document, ISO 13485 is generally harmonized with ISO 9001. It establishes controls in the work environment to ensure product safety, risk management activities and design transfer activities during product development, specific requirements for inspection and traceability for implantable devices, specific requirements for documentation and validation of processes for sterile medical devices, specific requirements for verification of the effectiveness of corrective and preventive actions.

Source: http://www.iso.org/iso/catalogue_detail?csnumber=36786

ISO 14000

The ISO 14000 family addresses "Environmental management", meaning what a business or organization does to minimize harmful effects on the environment caused by its activities. This includes efforts to achieve continual improvement of its environmental performance and implement a systematic approach to setting environmental objectives and targets. The standards deal with environmental management systems (EMS) by providing the requirements and guidelines for a successful EMS. Other standards in the ISO 14000 address specific environmental aspects, including: labeling, performance evaluation, life cycle analysis, communication and auditing.

Source:
http://www.iso.org/iso/iso_catalogue/management_and_leadership_standards/environmental_management/iso_14000_essentials.htm

ISO 17025

ISO/IEC 17025:2005 specifies the general requirements for the competence to carry out tests and/or calibrations, including sampling. It covers testing and calibration performed using standard methods,

non-standard methods, and laboratory-developed methods. It is applicable to all organizations performing tests and/or calibrations. These include, for example, first-, second- and third-party laboratories, and laboratories where testing and/or calibration forms part of inspection and product certification.

Source: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=39883

ISO 18001

The ISO 18001 provides the results of three surveys identifying the applications for radio frequency identification (RFID) in an item management environment, and the resultant classification of these applications based on various operational parameters, including operating range and memory size. It also provides an explanation of some of the issues associated with the parameters of distance and number of tags within an RFID interrogator's field-of-view, a means by which classification of RF tags may be accomplished based on the application requirements defined in the survey results, and recommendations for areas of standardization.

Source: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=40733

ISO 20000

ISO/IEC 20000-1:2005 promotes the adoption of an integrated process approach to effectively deliver managed services to meet business and customer requirements. For an organization to function effectively it has to identify and manage numerous linked activities. Co-ordinated integration and implementation of the service management processes provides the ongoing control, greater efficiency and opportunities for continual improvement. Organizations require increasingly advanced facilities (at minimum cost) to meet their business needs. With the increasing dependencies in support services and the diverse range of technologies available, service providers can struggle to maintain high levels of customer service. The ISO/IEC 20000 series enables service providers to understand how to enhance the quality of service delivered to their customers, both internal and external.

Source: http://www.iso.org/iso/catalogue_detail?csnumber=41332

ISO AS9100

AS9100 is a widely adopted and standardized quality management system for the aerospace industry. AS9100 replaces the earlier AS9000 and fully incorporates the entirety of the current version of ISO 9000, while adding additional requirements relating to quality and safety. Major aerospace manufacturers and suppliers worldwide require compliance and/or registration to AS9100 as a condition of doing business with them.

Source: http://www.isoqar.com/uk/Standards/AS9100/AS-9100-About.aspx

ISO TS 16949

The ISO/TS16949 is an ISO technical specification aiming to the development of a quality management system that provides for continual improvement, emphasizing defect prevention and the reduction of variation and waste in the supply chain. ISO 16949, in conjunction with ISO 9001, defines the quality management system requirements for the design and development, production and, when relevant, installation and service of automotive-related products. ISO/TS 16949 is applicable to sites of the organization where customer-specified parts, for production and/or service, are manufactured.

Source: http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=52844

J-STD-001DS

The IPC J-STD-001 standard specifies the requirements for Soldered Electrical and Electronic Assemblies. The standard describes materials, methods and verification criteria for producing high quality soldered interconnections and emphasizes process control and industry-wide consensus requirements for a broad range of electronic products. The standard works to ensure the quality and reliability of soldered electrical and electronic assemblies that must survive the vibration and thermal cyclic environments.

Source: http://www.ipc.org/ContentPage.aspx?pageid=J-STD-001

JSC RITF

JSC RITF stands for Johnson Space Center Receiving Inspection & Test Facility. The JSC RITF is a high standard laboratory and testing facility. The RITF has a wide range of testing and analysis capabilities

including Chemical Analysis, Mechanical Testing, Metallography, and Screening of Parts and Components. All services offered at the JSC RITF are certified according to NASA and Aerospace industry requirements.

Source: www.jsc.nasa.gov/info/annualreports/ar2001/s11.pdf

MIL-DTL-55302

The MIL-DTL-55302 is the requirement for Connectors, Printed Circuit, Subassembly and Accessories. This specification covers connectors (plugs and receptacles) for printed circuit subassembly and their accessories, for use with single-sided printed wiring, double-sided printed wiring, and multilayer printed wiring.

Source: http://www.dscc.dla.mil/Programs/MilSpec/ListDocs.asp?BasicDoc=MIL-DTL-55302

MIL-I-45208

This specification establishes requirements for contractors' inspection systems.
These requirements pertain to the inspections and tests necessary to substantiate product conformance to drawings, specifications and contract requirements and to all inspection and tests required by the contract. It provides technical specifications for the contractor responsibilities, documentation, records, corrective action, inspection and testing, drawings and changes, measuring and test equipment, process control, and indication of inspection status.

Source: http://www.quality-control-plan.com/mil-i-45208-spec.htm

MIL-STD-45662A

The MIL-STD-45662A was the standard in use before the ISO-10012 for Measurement and Calibration System Requirements. It was cancelled in 1995. It provided guidance for selecting intervals for the frequency of calibrations, instrument checks, personnel, traceability, reference materials, environment, procedures, and records. The MIL-STD-45662A may still apply to legacy equipment and tooling.

Source: http://www.kingsburycorp.com/?s=inav&p=mil-std_45662a

MIL-Q-9858

MIL-Q-9858 requires the establishment of a quality program by the contractor to assure compliance with the requirements of the contract. The program and procedures used to implement this specification are developed by the contractor. A government representative reviews the quality program, including the procedures, processes and products. The specification requires that the program assure adequate quality throughout all areas of contract performance including design, development, fabrication, processing, assembly, inspection, test, maintenance, packaging, shipping, storage, and site installation.

Source: http://www.quality-control-plan.com/mil-q-9858-spec.htm

NADCAP

Nadcap, formerly the National Aerospace and Defense Contractors Accreditation Program, is a global cooperative standards-setting program for aerospace engineering, defense and related industries. Nadcap's membership of "prime contractors" convenes to coordinate industry-wide standards for special processes and products. Through the Performance Review Institute, Nadcap provides independent certification of manufacturing processes for the industry. PRI's mission is to "provide international, unbiased, independent manufacturing process and product assessments and certification services for the purpose of adding value, reducing total cost, and facilitating relationships between primes and suppliers."

Source: http://www.pri-network.org/Nadcap/

NAS 410

NAS 410 is Aerospace Industries Association's National Aerospace Standard for Certification and Qualification of Nondestructive Test Personnel. The standard specifies the requirements for ultrasonic, magnetic-particle, liquid penetrant, radiographic, remote visual inspection (RVI), eddy-current testing, and low coherence interferometry, and other common Nondestructive testing techniques.

Source: http://global.ihs.com/news/temp/aia-nas-ppc/aia-nasppclp.htm?RID=Z56&MID=5280&s_kwcid=TC%7C5891%7Clockheed%20specifications%7C%7CS%7C%7C5679028754

NASA STD 8739

The NASA STD 8739 prescribes NASA's requirements, procedures, and documenting requirements for hand and machine soldering of surface mount electrical connections. These may be tailored to the program applications to obtain the most cost effective, best quality product. The standard describes basic considerations necessary to ensure reliable soldered surface mount connections and establishes the responsibility for documentation of those fabrication and inspection procedures to be used for NASA work including supplier innovations, special processes, and changes in technology.

Source: http://snebulos.mit.edu/projects/reference/NASA-Generic/NASA-STD-8739-2.pdf

NHB 5300.4

This publication sets forth inspection system requirements for the procurement of materials, parts, components, and services for aeronautical and space systems. These requirements provide for an effective system to ensure that contractual quality requirements and technical criteria are satisfactorily met.

Source: http://www.usa-suppliernet.com/NHB%205300.4%201C%20Document.pdf

SAE AS9003

The AS9003 standard contains the minimum requirements for an Inspection and Test Quality System and was intended for use by small build/machine to print organizations. The intent of the AS9003, Inspection and Test Quality System; is to ensure that the inspection, conformity and airworthiness of products are maintained. A quality system structured to include the AS9003 requirements provides the supplier with a system that defines activities necessary to support product integrity.

Source: http://standards.sae.org/as9003/

SAE AS9100

This standard AS9100 includes ISO 9001 quality management system requirements and specifies additional requirements for a quality management system for the aerospace industry. It is emphasized that the quality management system requirements specified in this standard AS9100 are complementary (not alternative) to contractual and applicable law and regulatory requirements. This International Standard

AS9100 specifies requirements for a quality management system where an organization a) needs to demonstrate its ability to consistently provide product that meets customer and applicable regulatory requirements, and b) aims to enhance customer satisfaction through the effective application of the system, including processes for continual improvement of the system and the assurance of conformity to customer and applicable regulatory requirements.

Source: http://standards.sae.org/as9100b/

Appendix C: Sample List of Formal Qualifications/Certifications Necessary for Doing Business with NASA that Are Held by Production and/or Inspection Personnel

- AS 9100: Quality Management Systems – Requirements for Aviation, Space and Defense Organizations
- AS 9120: Quality Management Systems – Aerospace – Requirements for Stockist Distributors
- American Welding Society Certified Weld Inspectors
- American Welding Society Certified Weld Operators
- Electrostatic Discharge Training
- NASA 8739.1: Workmanship Standard for Polymeric Application on Electronic Assemblies
- NASA 8739.2: Workmanship Standard for Surface Mount Technology
- NASA 8739.3: Soldered Electrical Connections
- ISO 9001: Quality Management Systems - Requirements
- IPC 610: Acceptability of Electronic Assemblies
- J-STD 001: Requirements for Soldered Electrical and Electronic Assemblies
- NDT Level 1: Non Destructive Testing, Level 1
- NDT Level 2: Non Destructive Testing, Level 2
- NDT Level 3: Non Destructive Testing, Level 3
- NADCAP Accreditation
- Six Sigma Black Belt
- Six Sigma Green Belt
- X-Ray Technician Level III

Appendix D: Regional, State, Local, and Non-Profit Agencies/Organizations Listed by Respondents

- Aerospace Industry Association
- Alabama Economic Development Authority
- American Astronautically Society
- Bay Area Houston Economic Partnership
- Brevard County Economic Development Council
- Brevard Workforce Development
- California Space Authority
- Center for Economic Growth in NY
- City of New Orleans
- Colorado Office of Economic Development
- Colorado Space Business Roundtable
- Colorado Space Coalition
- Commercial Spaceflight Coalition
- Department of Defense
- Economic Development Corporation of Utah
- Enterprise Florida
- Florida Economic Counsel
- Greater New Orleans, Inc.
- Horizon Initiative
- Huntsville Association of Small Business in Advanced Technology
- Huntsville Chamber of Commerce
- Huntsville Space Professionals
- Louisiana Economic Development
- Manufacturing Extension Partnership of Louisiana
- Metro Denver Chamber of Commerce
- Michoud Aerospace Corridor Alliance
- Mississippi State University
- National Electronic Distributors Association
- National Space Foundation
- National Defense Industrial Association
- Procurement Technical Assistance Center
- Space Enterprise Council
- Space Florida
- Space Transportation Associates
- St. Tammany Economic Development

- Texas Workforce Commission
- The Economic Commission of Florida’s Space Coast
- Texas Space Grant Consortium
- University of Alabama, Huntsville
- University of Central Florida
- University of Houston, Clear Lake
- US Air Force
- Utah Governor’s Office of Economic Development
- Von Braun Center for Science and Innovation
- Women in Aerospace

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OMB Control Number: 0694-0119
Expiration Date: 12/31/2010

INDUSTRIAL BASE ASSESSMENT:
NASA Supply Chain Network

SCOPE OF ASSESSMENT

The U.S. Department of Commerce, Bureau of Industry and Security (BIS), Office of Technology Evaluation (OTE), in coordination with the National Aeronautics and Space Administration (NASA), Exploration Systems Mission Directorate (ESMD), is conducting an industrial base survey of NASA's supply chain network. The principal goal of this data collection is to analyze the health and competitiveness of this U.S. supplier segment. The data collected will also be used to measure the industrial base impacts attributed to both the retirement of the Space Shuttle program and NASA's transition from the Constellation program.

RESPONSE TO THIS SURVEY IS REQUIRED BY LAW

A response to this survey is required by law (50 U.S.C. app. Sec. 2155). Failure to respond can result in a maximum fine of $10,000, imprisonment of up to one year, or both. Information furnished herewith is deemed confidential and will not be published or disclosed except in accordance with Section 705 of the Defense Production Act of 1950, as amended (50 U.S.C App. Sec. 2155). Section 705 prohibits the publication or disclosure of this information unless the President determines that its withholding is contrary to the national defense. Information will not be shared with any non-government entity, other than in aggregate form. The information will be protected pursuant to the appropriate exemptions from disclosure under the Freedom of Information Act (FOIA), should it be the subject of a FOIA request.

Not withstanding any other provision of law, no person is required to respond to nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the Paperwork Reduction Act unless that collection of information displays a currently valid OMB Control Number.

BURDEN ESTIMATE AND REQUEST FOR COMMENT

Public reporting burden for this collection of information is estimated to average 11 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information to BIS Information Collection Officer, Room 6883, Bureau of Industry and Security, U.S. Department of Commerce, Washington, D.C. 20230, and to the Office of Management and Budget, Paperwork Reduction Project (OMB Control No.0694-0119), Washington, D.C. 20503.

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Section II — WHO MUST RESPOND TO THIS SURVEY

Please select the description(s) that most closely reflects your company.

1.	My company has manufactured products and/or provided services, including integration, R&D, or software, for the National Aeronautics and Space Administration (NASA) since January 2000.	
2.	Has your company, directly or indirectly, performed any work for NASA since January 2007?	

3. If you selected "Yes" to either of the above questions, identify the corresponding programs your company has supported, if known, and continue completing this survey.

Space Shuttle		International Space Station		Constellation	
Science Mission Directorate (SMD)		Aeronautics Research Directorate (ARD)		Other NASA	

4. If you selected "No," complete "Exemption From Survey" below.

EXEMPTION FROM SURVEY

If your operations have not involved any NASA business since 2000, you may be exempt from completing this U.S Government survey. Please call one of the BIS contacts listed in the "General Instructions" to verify your status. Then complete steps 5-7 below.

5. Briefly explain the products and/or services provided by your organization in the space below:

6. Before 2000, did your company do any work for NASA? If "Yes," describe the products and/or services below.

7. Please complete and print out the "Certification" page. Then return a signed copy of the "Certification" page only after your Empowered Official or Point of Contact has confirmed your company's exemption by speaking with one of our staff. Please transmit the "Certification" to our offices via U.S. mail, express courier, e-mail, or fax (202) 482-5361.

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Section III	General Instructions
A.	BIS will only accept Excel versions of this survey that are downloaded and saved from http://www.bis.doc.gov/NASA_Survey. Before making inputs make sure to save a copy of the Excel survey to your computer.
B.	For your convenience and internal data collection/reference purposes only, a PDF version of the survey is made available on the BIS web link. Do not submit the PDF version. BIS will only accept the Excel version.
C.	Upon completion, review, and certification of the survey please transmit the Excel survey document by e-mail to the secure, U.S. Federal Government e-mail address at NASA_Survey@bis.doc.gov.
D.	Questions related to this questionnaire should be directed to: NASA_Survey@bis.doc.gov (preferred method of contact for survey questions) Jason Bolton, Trade and Industry Analyst, (202) 482-5936 Michael Finucane, Trade and Industry Analyst, (202) 482-3893 Meaghan Archer, Trade and Industry Analyst, (202) 482-2081 Valerie Goldman, Trade and Industry Analyst, (202) 482-5415 Erika Maynard, Trade and Industry Analyst, (202) 482-5572
E.	Upon completion, review and certification of the survey, transmit the survey via e-mail to NASA_Survey@bis.doc.gov
F.	For letter correspondence or program questions to the Office of Technology Evaluation (OTE), please write to: Brad Botwin, Director, Industrial Studies Office of Technology Evaluation, Room 1093 U.S. Department of Commerce 1401 Constitution Avenue, NW Washington, DC 20230 Please do not submit completed surveys to this address; all surveys must be submitted electronically. Brad Botwin can also be reached at bbotwin@bis.doc.gov or (202) 482-4060.

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Section IV **Table of Contents**

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Section V	Definitions
Term	Definition
Applied Research	R&D research expenditure category dedicated to the application of findings from basic research toward discovering new scientific knowledge that has specific commercial objectives with respect to new product, services, processes, or methods [National Science Foundation].
Authorizing Official	Executive officer of the company or business unit or other individual who has the authority to execute this survey on behalf of the firm.
Basic Research	R&D research expenditure category dedicated to the pursuit of new scientific knowledge or understanding that does not have specific immediate commercial objectives with respect to new products, services, processes, or methods [National Science Foundation].
CAGE Code	Commercial and Government Entity (CAGE) Code identifies companies doing or wishing to do business with the U.S. Federal Government. The code is used to support mechanized government systems and provides for a standardized method of identifying a given facility at a specific location. The code may be used for a Facility Clearance, a Pre-Award survey, automated Bidders Lists, pay processes, source of supply, etc. In some cases, prime contractors may require their sub-contractors to have a CAGE Code.
Capacity Utilization	The extent to which an enterprise uses its total annual installed manufacturing capacity.
Commercial Human Spaceflight	Non-government, non-NASA industry operated human carrier spaceflight services, systems, or hardware. This would include business lines in support of human spaceflight tourism or ISS "taxi" support.
End-User	Entity responsible for the intended application or use of a particular product or service.
Export Controls	Meaning U.S. administered laws, regulations, or lists governing the export of space-related dual-use and/or munitions items from the U.S. to non-U.S. customers and end-users. These include the Arms Export Control Act of 1976, the Export Administration Regulations (EAR), the International Traffic in Arms Regulations (ITAR), the Commodity Control List (CCL), and the U.S. Munitions List (USML).
Full Time Equivalent (FTE) Employees	Employee in each labor type/function area based on a 40 hour work-week. NASA suppliers should allocate no less than 1/4 of a person to a particular function and also convert part-time employees into "full-time" equivalent, e.g. 10 part-time employees working 20 hours per week for a full 12 month period are the full-time equivalent of 5 full-time employees for that 12 month period.
Human Spaceflight	Manned spaceflight programs (commercial or government run) containing manned vehicles (orbiters) like the Space Shuttle or Orion.
Joint Venture	A contractual agreement joining together two or more parties for the purpose of executing a particular business undertaking. All parties agree to share in the profits and losses of the enterprise.
Merger and Acquisition	Business activity involving the combination of two companies (merger) to form a new single company or the purchase of one company by another (acquisition) in which no new company is formed.
NAICS Code	North American Industry Classification System (NAICS) codes identify the category of product(s) or service(s) provided by your company. Find NAICS codes at http://www.census.gov/epcd/www/naics.html

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Orbiter	Reusable human spacecraft used in the Space Transportation System (STS), e.g. Atlantis, Challenger, Columbia, Discovery, and Endeavor. The orbiter, also known as the orbiter vehicle, contains both the astronauts and payload on STS/Space Shuttle missions.
Orion	Human spacecraft formally known as the Crew Exploration Vehicle (CEV) and part of the Constellation program.
Process/Product Development	R&D development expenditure category dedicated to the systematic use of the knowledge or understanding gained from research or practice experience directed toward the production of significant improvement of useful products, services, processes, or methods, including the design and development of prototypes, materials, devices, and systems [National Science Foundation].
Space-Related	Refers to all product, service, and technology categories enumerated in this survey's Product and Service Type List.
Space Transportation System (STS)	Includes the Space Shuttle and all NASA facility operations in support of Space Shuttle launch. NASA will have performed 134 STS missions from 1982-2010.
Total Operating Expenses	Income Statement line item reflecting expenses related to primary business operations. This includes Research and Development (R&D); Selling, General, and Administrative (SG&A); Non-Recurring; and Other operating expenses. For BIS assessment purposes, Interest Expense and Tax Expense are not included in Total Operating Expenses.
Total Operating Income	Income Statement line item reflecting Gross Margin or Gross Profit less Total Operating Expenses.
United States	The "United States" or "U.S." includes the 50 states, Puerto Rico, the District of Columbia, the island of Guam, the Trust Territories, and the U.S. Virgin Islands.
Utilization Rate	Percentage measure of production capacity use based on a 7 day-a-week, 3x8 hour shift production schedule.

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Section 1.a **Company Information**

A.

U.S. Address Only

Name of Company	Street Address	City	State	Zip Code

Internet Home Page	Phone Number	Fax Number

B.

Business Identification Information

Data Universal Numbering System (DUNS) Number(s)*		Space-related NAICS (6-digit) Code(s)**	
Commercial and Government Entity (CAGE) Code(s)		Space-related Harmonized Tariff Schedule (HTS) (10-digit) code(s)***	

* Find your company's DUNS number(s) at http://www.usitc.gov/index.htm

** North American Industry Classification System (NAICS) codes identify the category or product(s) or service(s) provided by your company. Find NAICS codes at http://www.census.gov/epcd/www/naics.html

*** Harmonized Tariff Schedule (HTS) codes (10-digit) can be found at "HTS Online Resource Tool" located under "Research Tools" at http://www.ustic.gov/index.htm

C.

Primary Point of Contact Regarding Survey Completion

Name(s)	Phone Number	State	E-mail Address

D.

Business Description

From the drop-down select the business lines describing your company's primary focus. Provide a short description of the corresponding business lines next to each selected category. If your company has more than one dominant focus, rank them 1st-3rd by net sales.

	Business Lines	Additional Description
1.		
2.		
3.		

Comments	

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Section 1.b **Company Information (cont.)**

A. Identify the certifications that your company currently has below:

AMS (specify)			ISO TS16948		
ANSI/ASQC Z1.4			J-STD-001DS		
ANSI/ESD S20.20			MIL-Q-9858		
ANSI/ISO/IEC 17025			MIL-STD-45662 A		
DoD 5000			NADCAP (specify)		
ISO 9000			NCLS (specify)		
ISO 9001			SAE AS9003		
ISO 10012-1			SAE AS9100		
ISO 14000			Other (specify)		

* AMS (Aerospace Material Specifications)
* ANSI (American National Standards Institute)
* ASQ (American Society for Quality)
* ISO (International Organization for Standards)
* NADCAP (National Aerospace and Defense Contractors Accreditation Program)
* NCLS (National Clinical Lab Specialist)
* SAE (SAE International, formerly the Society of Automotive Engineers)

B. How does your company sell its products or services to NASA?

C. **Company Ownership**

My company is headquartered in:

I am the parent company:

I am a U.S. subsidiary of a non-U.S. parent company:

I am a business unit or division of a U.S. parent company or organization:

Parent Company Name, if applicable	City	State	Country

Comments:

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Section 2.a **Product and Service Type Listing**

Identify the NASA Space Shuttle, International Space Station (ISS), or Constellation program elements in which your company has participated.

HSFPE1	Ares		HSFPE9	ISS - International Space Station	
HSFPE2	Altair Lunar Lander		HSFPE10	Launch Abort System	
HSFPE3	Ares Upper Stage		HSFPE11	Orbiter	
HSFPE4	Ares Upper Stage Engines		HSFPE12	Orion	
HSFPE5	CaLV - Cargo Launch Vehicle (e.g. Ares V)		HSFPE13	RSRM - Reusable Solid Rocket Motor	
HSFPE6	CLV - Crew Launch Vehicle (e.g. Ares 1)		HSFPE14	Service Module	
HSFPE7	ET - External Tank		HSFPE15	SRB - Solid Rocket Booster	
HSFPE8	EVA - Extravehicular Activity		HSFPE16	SSME - Space Shuttle Main Engine	

Comments:	

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Section 2.b **Product and Service Type Listing**

Indicate the product and service type codes corresponding to your company's current business lines and indicate whether the end-user is "NASA," "DoD," "Commercial," "Other," or "Not Sure." Blank or "No" responses mean your company presently has no corresponding business lines.

A	Services	NASA	DoD	Commercial	Other	Not Sure
A1	Commercial Satellite Operation					
A1A	Broadcast					
A1B	Communication/Data					
A1C	Remote Sensing					
A2	Professional Services					
A2A	Spacecraft					
A2A1	Product Assurance, Quality Control, Safety					
A2A2	Assembly, Integration and Testing					
A2A3	Systems Engineering					
A2A4	Program Management					
A2A5	Performance, Analysis and Simulation					
A2A6	Architecture Design					
A2B	Launch					
A2B1	Operations					
A2B2	Product Assurance, Quality Control, Safety					
A2B3	Assembly, Integration and Testing					
A2C	Ground					
A2C1	Operations					
A2C2	Maintenance					
A2D	Research and Development					
A2D1	Aeroscience					
A2D2	Atmospheric/Sub-Orbital Flight					
A2D3	Biomedical Affects of Space Flight					
A2D4	Materials					
A2E	Testing					
A2E1	Acoustics					
A2E2	Vibration					
A2E3	Aeronautics Ground					
A2E4	Aeronautics Flight					
A2E5	Thermal Vacuum Chamber					
A2E6	Materials					
A2E7	Mechanical Systems					
A2F	Crew Operations and Training					
A2G	Space Medicine					
A2H	Human Factors Engineering					
A3	Other (specify)					

Comments:

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Section 2.c **Product and Service Type Listing (cont.)**

Indicate the product and service type codes corresponding to your company's current business lines and indicate whether the end-user is "NASA," "DoD," "Commercial," "Other," or "Not Sure." Blank or "No" responses mean your company presently has no corresponding business lines.

B	Spacecraft	NASA	DoD	Commercial	Other	Not Sure
B1	Communications					
B1A	Antenna Technology					
B1B	Microwave Technology					
B1C	Digital Technology					
B1D	Switching Equipment					
B1E	Transponder					
B1F	Laser Technology					
B1G	Software					
B2	Energy Generation					
B2A	Solar Cell Technology					
B2B	Solar Array Technology					
B2C	Power Generators (Excluding Solar)					
B3	Energy Storage					
B3A	Batteries					
B3B	Other Energy Storage Equipment					
B3C	Power Conditioning					
B4	Thermal Control					
B4A	Blankets					
B4B	Coatings					
B4C	Cryogenics					
B4D	Heaters					
B4E	Radiators					
B4F	Insulation					
B4G	Heat Pipes					
B5	Structural					
B5A	Hydraulics, Valves, Actuators, Pneumatics					
B5B	Mechanisms (Gimbals, Antennas, Arrays, Masts, etc.)					
B5C	Safety, Destruction Technology, Pyrotechnics					
B5D	Metalworking					
B6	Attitude Determination and Control					
B6A	Sensors					
B6B	Stabilization Hardware					
B6C	Momentum Wheel					
B6D	Rendezvous and Docking					
B6D1	Navigation Using Lunar Bearings					

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B6E	Guidance, Navigation and Control						
B6E1	Automation for all Mission Phases						
B6E2	Autonomous Landing						
B6E3	Hazard Detection and Avoidance						
B6E4	Automated Rendezvous and Docking						
B6E5	Natural Feature Image Recognition						
B6E6	LIDAR Feature Recognition						
B6E7	Lunar Surface Navigation						
B6F	Software						
B7	Propulsion (Spacecraft)						
B7A	Chemical Propulsion Technology						
B7B	Electronic Propulsion Technology						
B7C	Cold Gas Propulsion Technology						
B7D	Non-Toxic Monopropellant						
B7E	HTPB (Hydroxyl-Terminated Polybutadiene)						
B7F	LOX/LH2 (Liquid Oxygen/Liquid Hydrogen Reaction Control System)						
B7G	LO2/LCH4 (Liquid Oxygen/Liquid Methane Propulsion System)						
B7H	Composite Nozzles						
B8	Payload						
B8A	Optical Components						
B8B	Infrared Detectors						
B8C	Visible Detectors						
B8D	Nuclear Detectors						
B8E	Hyper-Spectral Detectors						
B8F	Radar Components						
B8G	Software						
B8H	Atomic Clocks						
B8I	Microwave Instruments						
B9	Entry, Descent and Landing						
B9A	Deceleration						
B9B	Guidance Navigation and Control						
B9C	Thermal Protection						
B9D	Structural Support						
B9E	Landing						
B10	Other (specify)						
Comments:							

Section 2.d **Product and Service Type Listing (cont.)**

Indicate the product and service type codes corresponding to your company's current business lines and indicate whether the end-user is "NASA," "DoD," "Commercial," "Other," or "Not Sure." Blank or "No" responses mean your company presently has no corresponding business lines.

C	Space Electronics	NASA	DoD	Commercial	Other	Not Sure
C1	Data Handling & Storage					
C2	Integrated Circuits/Semiconductors					
C3	Fiber Optics					
C4	Traveling Wave Tubes					
C5	Radiation-Hardened/Tolerant Electronics					
C5A	Field Programmable Gate Arrays					
C5B	Non-Volatile Memory					
C6	Fault Tolerant Computing					
C7	Memory					
C7A	Microprocessors					
C8	Micro-Sized Data Acquisition, Processing, and Storage					
C9	Other (specify)					

D	Computer Hardware and Software	NASA	DoD	Commercial	Other	Not Sure
D1	Development Tools					
D2	Verification and Validation					
D3	Design Level Re-Use					
D3A	Modeling and Analysis Tools of Physical Systems					
D3B	Modeling and Analysis Tools of Software Systems					
D3C	Compliance and Model Checkers					
D4	Data Mining and Knowledge Management					
D5	Training Support and Simulation					
D6	Mission Automation					
D6A	Operation					
D6B	Monitoring					
D7	Integrated Systems Health Management					
D7A	Prognostic/Diagnostic Tools					
D7B	Solid Rocket Motor Health Management					
D7C	On-Board Decision Support Tools					
D7D	Fault Isolation and Root Cause Determination Tools					
D8	High Performance (Super) Computing					
D8A	Large Scale Computational Simulations					
D8B	Data Visualization and Analysis					
D9	Other (specify)					

Comments:

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Section 2.e **Product and Service Type Listing (cont.)**

Indicate the product and service type codes corresponding to your company's current business lines and indicate whether the end-user is "NASA," "DoD," "Commercial," "Other," or "Not Sure." Blank or "No" responses mean your company presently has no corresponding business lines.

E	Propulsion Systems	NASA	DoD	Commercial	Other	Not Sure
E1	Liquid Fuel Rocket					
E1A	Chamber					
E1B	Propellant					
E1C	Igniter					
E1D	Nozzle					
E2	Solid Fuel Rocket					
E2A	Casing					
E2B	Igniter					
E2C	Propellant					
E2D	Nozzle					
E2E	Thrust Control					
E3	Electrical Power					
E3A	Generator					
E3B	Battery					
E3C	Harness					
E4	Operating System					
E4A	Hydraulic					
E4B	Pneumatic					
E4C	Electro-Mechanical					
E5	Guidance Systems					
E5A	GPS					
E5A1	Receivers					
E5A2	Processor					
E5B	Inertial					
E5B1	Gyroscope					
E5B2	Processor					
E5B3	Controls					
E6	Safety System					
E6A	Destruct Receiver					
E6B	Ordnance					
E6C	Navigation Devices					
E7	Structural System					
E7A	Inter-stage					

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E7B	Fairings						
E7C	Skirt						
E8	Launch Related Materials						
E8A	Ablatives						
E8B	Advanced Composites						
E8C	Fibers						
E9	Rocket Engines and Motors						
E9A	Solid						
E9B	Liquid						
E10	Cryogenic						
E10A	In-Space Storage						
E10B	In-Space Transfer						
E10C	In-Space Management						
E11	Telemetry						
E12	Software						
E13	Other (specify)						
Comments:							

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Do Not Submit - Excel Only!

Section 2.f **Product and Service Type Listing (cont.)**

Indicate the product and service type codes corresponding to your company's current business lines and indicate whether the end-user is "NASA," "DoD," "Commercial," "Other," or "Not Sure." Blank or "No" responses mean your company presently has no corresponding business lines.

F	Ground Systems	NASA	DoD	Commercial	Other	Not Sure
F1	Ground Antennas					
F2	Telemetry, Tracking and Control Equipment					
F3	Software					
F4	Mission Data Processing Equipment					
F5	Communications Equipment					
F6	Other (specify)					
G	**Specialty Materials**	**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**
G1	Thermal Coatings					
G2	Optical Coatings					
G3	Dust Resistant Coatings					
G4	Protective Coatings					
G5	Structures					
G6	Substrates					
G7	Composites					
G8	Optics					
G9	Other (specify)					
H	**Structures**	**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**
H1	Friction Stir Welding and Spun Formed Dome					
H2	Composite Strut					
H3	Lunar Habitats					
H4	Long Life, Low Temperature Mechanical Systems					
H5	Lightweight High Strength Window Materials					
H6	Radiation Shielding					
H7	Tools to Determine Effect of Fields on Structures					
H8	Advanced Composites					
H9	Habitation Structures					
H10	Prototypes					
H11	Other (specify)					
I	**Protection Systems**	**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**
I1	Radiation Shielding Systems					
I2	Heat Shields					
I3	Bonding Systems					
I4	Free Flying Damage Protection System					

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I5	Analysis Tools						
I6	High Temperature Composites						
I7	Other (specify)						
J	**Dust Management**		**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**
J1	Dust Mitigation						
J2	Dust Removal						
J3	Lunar Regolith Stimulants Development and Production						
J4	Dust Tolerant Connectors						
J5	Other (specify)						
Comments:							

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Section 2.g **Product and Service Type Listing (cont.)**

Indicate the product and service type codes corresponding to your company's current business lines and indicate whether the end-user is "NASA," "DoD," "Commercial," "Other," or "Not Sure." Blank or "No" responses mean your company presently has no corresponding business lines.

K	Surface Systems	NASA	DoD	Commercial	Other	Not Sure
K1	Energy Storage					
K1A	Rechargeable Batteries					
K1B	Fuel Cells					
K1B1	PEM					
K1B2	Regenerative					
K2	Power Systems					
K2A	High Voltage Distribution					
K2B	Power Management					
K2C	Lightweight Cabling					
K2D	Lightweight, High Strength Solar Arrays					
K2E	Nuclear Fission					
K3	Thermal Control					
K3A	Phase Change Material					
K3B	Heat Rejection Systems					
K3C	Heat Sinks					
K3D	Heat Exchangers					
K3E	Long Duration Fluids					
K3F	Coldplate					
K4	Supportability					
K4A	Detection, Repair, and Self-Repair					
K4B	Non-Destruction Evaluation					
K4C	Light Weight, Lower Power Manufacturing					
K4D	Repair Tools and Techniques					
K5	Other (specify)					

L	Extra-Vehicular Activity (EVA)	NASA	DoD	Commercial	Other	Not Sure
L1	Space Suite					
L1A	Packaging					
L1B	Ventilation					
L1C	Oxygen Supply					
L1D	Thermal Control					
L1E	Communications, Avionics, and Informatics					
L1F	Dust Tolerant Fluid Connectors					
L1G	Materials and Pressure Garment Components					

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L1H	Rapid Recharge						
L2	CO2 and H20 Recovery						
L3	Suitport/Suitlock/Airlock						
L4	Other (specify)						
M	**Robotic Systems**	**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**	
M1	Lunar Rover						
M1A	Wheels						
M1B	Automated Docking						
M1C	Drivetrain and Suspension System						
M1D	Active Suspension Control System						
M2	Automated Payload Offloading						
M3	High Dexterity Manipulation Systems						
M4	Element Mating Mechanism						
M5	Other (specify)						
N	**Environmental Control and Life Support (ECLS)**	**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**	
N1	CO2 and Moisture Removal System						
N2	High Pressure Oxygen Supply						
N3	Wastewater Recovery						
N4	Oxygen Recovery from Carbon Dioxide						
N5	Biocides						
N6	Hygiene and Waste Removal Systems						
N7	Post-Fire Cleanup Device						
N8	Water Treatment						
N9	Other (specify)						
	Comments:						

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Section 2.h **Product and Service Type Listing (cont.)**

Indicate the product and service type codes corresponding to your company's current business lines and indicate whether the end-user is "NASA," "DoD," "Commercial," "Other," or "Not Sure." Blank or "No" responses mean your company presently has no corresponding business lines.

O	Environmental Monitoring and Control	NASA	DoD	Commercial	Other	Not Sure
O1	Atmospheric					
O1A	Particulate					
O1B	Microbial					
O1C	Fire					
O1D	Gases					
O2	Water					
O2A	Materials and Pressure Garment Components					
O2B	Rapid Recharge					
O3	CO2 and H20 Recovery					
O4	Suitport/Suitlock/Airlock					
O5	Other (specify)					
P	**In-Situ Resource Utilization**	**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**
P1	Regolith Excavation and Handling					
P2	Oxygen and Water Extraction from Regolith					
P3	Lunar Excavation					
P4	Mineral Mapping					
P5	Volatile (H, C, N, He) Extraction from Regolith					
P6	Other (specify)					
Q	**Communications and Navigation**	**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**
Q1	Lunar Wireless Network					
Q2	Delay Tolerant Networking					
Q3	Atomic Clocks					
Q4	Routers					
Q5	IPSec					
Q6	High Bandwidth Optical Communications					
Q7	Other (specify)					
R	**End-User Equipment**	**NASA**	**DoD**	**Commercial**	**Other**	**Not Sure**
R1	Communication/Data					
R2	Navigation					
R3	Other (specify)					

Comments:	

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Section 3.a	Future Outlook - NASA Supply Chain Network	
A.	Is your company dependent on NASA-related business? Explain.	
B.	How will NASA's retirement of the Space Shuttle program and transition from Constellation affect your business? Explain.	
C.	Does your company have a plan in place to preserve its current capabilities and workforce in the post-Space Shuttle, post-Constellation program environment? Explain.	
D.	Has your company already modified its business plan and/or product lines in response to Space Shuttle retirement and/or Constellation transition? Explain.	
E.	Does your company plan to modify its business plan and/or product lines in response to Space Shuttle retirement and/or Constellation transition? Explain.	
F.	Does your company currently participate in commercial (non-NASA) human spaceflight programs? Explain.	
G.	In the future, will your company participate in commercial (non-NASA) human spaceflight programs? Explain.	
Comments:		

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Section 3.b Future Outlook - NASA Supply Chain Network (cont.)

A.	Will the loss of Space Shuttle or Constellation program business directly or indirectly affect your company's ability to maintain its business lines with other government customers? If "Yes," indicate which government customer and/or programs and explain.		
	Agency	Yes/No	Explanation
	Central Intelligence Agency (CIA)		
	Defense Advanced Research Projects Agency (DARPA)		
	Director, Defense Research and Engineering (DDR&E)		
	Federal Aviation Administration (FAA)		
	Missile Defense Agency (MDA)		
	NASA Centers/NASA Non-Human Space Flight Programs		
	National Oceanic and Atmospheric Administration (NOAA)		
	National Reconnaissance Office (NRO)		
	U.S. Air Force/Space and Missile Systems Center (SMC)		
	U.S. Army/Space and Missile Defense Command (SMDC)		
	U.S. Navy, Office of Naval Research (ONR)		
	Other (specify)		
B.	Record the degree of compatibility of your overall NASA-related product lines with non-NASA customers and applications.		
C.	Have prime contractors affiliated with NASA programs provided your company any guidance on how to best respond to Space Shuttle retirement and/or Constellation transition? Explain.		
D.	Have NASA officials provided your company any guidance on how to best respond to Space Shuttle retirement and/or Constellation transition? Explain		
E.	Is your company willing to support future NASA human spaceflight programs after NASA's retirement of the Space Shuttle and transition from Constellation? Explain.		
	Comments:		

Section 3.c **Future Outlook - NASA Supply Chain Network (cont.)**

A. Identify what industry/market segments your company has served in the last 5 years.

1.	
2.	
3.	
4.	
5.	

B. Identify what industry/market segments your company will target in the next 5-10 years.

1.	
2.	
3.	
4.	
5.	

C. Describe the actions your company has taken in the last 5 years to improve its competitiveness.

D. Describe the actions your company plans to take to improve its competitiveness over the next 5 years.

E. In addition to retirement of the Space Shuttle and Constellation program transition, identify the main issues and challenges affecting the long-term viability of your company. Explain your response.

Domestic Competition		Healthcare	
Environmental		Imports	
Export Controls		R&D Tax Credit	
Foreign Competition		Skills Retention	
Government Regulations		Taxes	
Other (specify)		Variability of Demand	

Comments:	

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Section 3.d	Future Outlook - NASA Supply Chain Network	
A.	Identify what policy changes or regulatory reforms you recommend the U.S. Government implement to enhance your competitiveness.	
B.	Have you worked with any regional, state, local, or non-profit economic development agencies/ organizations to address the post-Space Shuttle, post-Constellation program environment? These might include Space Florida, the California Space Authority (CSA), Texas Space Grant Consortium (TSGC), or public/private universities. Explain.	
Comments:		

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Section 4.a **Relationships - NASA Supply Chain Network**

Mergers and Acquisitions

A. Identify your company's five most significant U.S. mergers and acquisitions from 2007 to date. Record the merged/acquired company's name(s) and location, the year the merger/acquisition occurred, and the primary objective of the merger/acquisition.

	Company Name	State	Year	Primary Objective
1.				
2.				
3.				
4.				
5.				

B. Identify your company's five most significant non-U.S. mergers and acquisitions from 2007 to date. Record the merged/acquired company's name(s) and location, the year the merger/acquisition occurred, and the primary objective of the merger/acquisition.

	Company Name	Country	Year	Primary Objective
1.				
2.				
3.				
4.				
5.				

Comments:	

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Section 4.b **Relationships - NASA Supply Chain Network (cont.)**

Joint Venture Relationships

Identify your company's current NASA-related joint venture relationships, including public/private R&D partnerships. Provide the name of the company/entity involved, indicating whether a U.S. or non-U.S. enterprise, and a description of the joint venture's purpose, e.g. patent licensing, co-production, product integration, after-market support, etc. Then, indicate whether the joint venture is related to Space Shuttle, ISS, or Constellation programs.

A.

	Company/Entity Name	U.S./Non-U.S.	Primary Objective of Relationship	Space Shuttle, ISS, or Constellation Program-Related?
1.				
2.				
3.				
4.				
5.				

Competition

Identify your company's leading U.S. and non-U.S. competitors. Record the name, location, and corresponding Product and Service Type Codes relating to the competition.

B.

	Name and Location of Five U.S. Competitors		System/Part/Component/Material/Service				
	Company Name	State	1	2	3	4	5
1.							
2.							
3.							
4.							
5.							

	Name and Location of Five Non-U.S. Competitors		System/Part/Component/Material/Service				
	Company Name	Country	1	2	3	4	5
1.							
2.							
3.							
4.							
5.							

Comments:

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Section 4.c **Relationships - NASA Supply Chain Network (cont.)**

U.S. and Non-U.S. Supplier Relationships

Identify your company's ten most significant U.S. and non-U.S. supplier relationships that support NASA programs, directly or indirectly. Record the names and locations of the ten supplier facilities. Do not include internal company suppliers. Then, select the top 5 most significant codes corresponding to the part, component, material, or service supplied to your company by each supplier. Lastly, indicate if the supplied systems, parts, components, materials, or services are used in Space Shuttle, ISS, or Constellation programs.

	Name and Location of Ten U.S. Suppliers		System/Part/Component/Material/Service					Space Shuttle, ISS, or Constellation Program-Related?
	Company Name	State	1	2	3	4	5	
A. 1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

	Name and Location of Ten Non-U.S. Suppliers		System/Part/Component/Material/Service					Space Shuttle, ISS, or Constellation Program-Related?
	Company Name	Country	1	2	3	4	5	
B. 1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
9.								
10.								

Comments:	

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Section 4.d Relationships - NASA Supply Chain Network (cont.)

NASA Customers

Identify the NASA facilities/centers/laboratories your company has served in any production or service capacity since 2007. If you do not know which facilities/centers/laboratories your company has served, indicate this in the box below.

	We do not know which ones have been served		
A.	1.	Ames Research Center - Moffett Field, California	
	2.	Dryden Flight Research Center - Edwards, California	
	3.	Glenn Research Center - Cleveland, Ohio	
	4.	Goddard Space Flight Center - Greenbelt, Maryland	
	5.	Goddard Institute of Space Studies - New York, New York	
	6.	IV and V Facility - Fairmont, West Virginia	
	7.	Jet Propulsion Laboratory - Pasadena, California	
	8.	Johnson Space Center - Houston, Texas	
	9.	Kennedy Space Center - Cape Canaveral, Florida	
	10.	Langley Research Center - Hampton, Virginia	
	11.	Marshall Space Flight Center - Huntsville, Alabama	
	12.	Michoud Assembly Facility - New Orleans, Louisiana	
	13	NASA Headquarters - Washington, DC	
	14.	Plum Brook Station - Sandusky, Ohio	
	15.	Stennis Space Center - Mississippi	
	16.	Wallops Flight Facility - Wallops Island, Virginia	
	17.	White Sands Test Facility - Las Cruces, New Mexico	
	18.	Other (specify)	
	19.	Other (specify)	
	20.	Other (specify)	

Comments:	

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Section 5.a **Operations - NASA Supply Chain Network**

A. **Product Capacity Utilization**

Record your company's annual overall production capacity utilization for 2007-2009, and projected rate for 2010.
Note: Indicate whether Business Unit/Division or Corporate/Whole Company-level data.
Note: If you do not manufacture but perform only services or R&D, select "Yes" here and proceed to the next question.

Level of Reporting:

	2007	2008	2009	2010*
Production Capacity Utilization Rate (%)				

* If data is not available for 2010, please provide estimates.

B. **Supply Chain Management**

From the list below, select the supply chain management practices, methodologies, and systems that your company uses.

1.	Advanced Planning System (APS)		18.	Network Centric Manufacturing		
2.	Bar Coding		19.	Outsourcing		
3.	Close Partnership with Customers		20.	Plan Strategically		
4.	Close Partnership with Suppliers		21.	Radio Frequency Identification (RFID)		
5.	Customer Relationships Management (CRM)		22.	Subcontracting		
6.	Decision Support/Expert System		23.	Supplier Relationships Management (SRM)		
7.	E-business		24.	Supply Chain Benchmarking		
8.	E-commerce		25.	Supply Chain Management (SCM)		
9.	Electronic Data Interchange (EDI)		26.	Theory of Constraints (TOC)		
10.	Enterprise Resource Planning (ERP)		27.	Third Party Logistics (3PL)		
11.	E-procurement		28.	Use of External Consultants		
12.	Few Suppliers		29.	Vendor Managed Inventory (VMI)		
13.	Hold Safety Stock		30.	Vertical Integration		
14.	Just in Time (JIT)		31.	Warehouse Management System (WMS)		
15.	Manufacturing Resources Planning (MRPII)		32.	Other (specify)		
16.	Many Suppliers		33.	Other (specify)		
17.	Materials Requirements Planning (MRP)		34.	Other (specify)		

Comments:

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Section 5.b **Operations - NASA Supply Chain Network (cont.)**

Machinery, Tooling, Facilities

Does your company currently own or lease any machinery, tooling, or facilities specifically for NASA Space Shuttle, International Space Station (ISS), or Constellation program-related business?

If "Yes," record [1] all related machinery, tooling, and/or facilities; [2] the use/purpose of each item; [3] whether the item was purchased, leased, or government furnished equipment (GFE), or combination thereof; [4] whether the item currently supports Space Shuttle, ISS, Constellation program-related business lines, or a combination thereof; and [5] the current status of the machine/tool/facility (e.g. idle, mothballed, in-use, re-tooled/re-built for non-NASA business lines, etc.).

Note: Indicate whether Business Unit/Division or Corporate/Whole Company-level data.

Level of Reporting:

A.

	Machine/Tool/Facility	Use/Purpose	Level of Ownership	Program Use	Current Status
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

B. Provide the first and most recent year of your company's receipt of a Space Shuttle-related NASA production or service order.

First	Most Recent

Comments:

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Section 6.a **Financial Health - NASA Supply Chain Network**

Sales Table

Provide your company's 2007-2010 sales information and projected 2011-2015 sales trend information.
Note: Calendar year data is preferred.

Source of Sales Data:	
Reporting Schedule:	

"U.S." means U.S. domestic sales; "Non-U.S." means export sales from U.S. located facilities			Record in $ Thousands, e.g. $12,000.00 = survey input $12									
			2007		2008		2009		2010*		2011-2015*	
			U.S.	Non-U.S.	U.S.	Non-U.S.	U.S.	Non-U.S.	U.S.	Non-U.S.	U.S.	Non-U.S.
A.	Total Sales, all Customers											
B.	Total Non-Government Sales (as a % of part A)											
C.	Total Government Sales (as a % of part A)											
D.	Total NASA Sales, all Programs											
E.	NASA Non-Human Space Flight											
F.	NASA Human Space Flight											
G.	Human Space Flight Categories	Total Space Shuttle (as a % of part F)										
		Total ISS (as a % of part F)										
		Total Constellation Program (as a % of part F)										

* If data is not available, please provide estimates.

Comments:	

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Section 6.b **Financial Health - NASA Supply Chain Network (cont.)**

Top 10 Customers

Identify your company's ten most significant space-related customers (e.g. government, commercial, other) by dollar amount for years 2007-2010. Record the individual customer names and the dollar amount corresponding to aggregate sales from 2007-2010. Do not include internal customers.

A.

	Source of Customer Data:		
	Customer Name	U.S. or Non-U.S. Customer	2007-2010* Aggregate Dollar Sales
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

* If data is not available, please provide estimates.

Comments:	

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Section 6.c **Financial Health - NASA Supply Chain Network (cont.)**

Export Sales

Record the country of destination for your company's space-related export sales in 2007-2010.
Note: Calendar year data is preferred.

If your company has not exported space-related export products or services since 2007, indicate so here:

Source of Export Sales Data:	
Reporting Schedule:	

A.

	Country	Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
		2007	2008	2009	2010*
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

* If data is not available for 2010, please provide estimates.

Export Controls

B. Have you decided to stop exporting space-related products or services because of past experiences with U.S. export license denials, conditions, or extended delays? Explain.

C. Have you lost export sales opportunities of space-related products or services to non-U.S. competitors because of U.S. export controls? If "Yes," select the total dollar amount of lost export sales opportunities from 2007-2010. Explain.

Yes/No	Lost Sales

Comments:

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Section 6.d **Financial Health - NASA Supply Chain Network (cont.)**

Report select line items from your company's financial statement for years 2007-2010. From the drop-down indicate whether the reported income statement and balance sheet select line items are Business Unit/Division or Corporate/Whole Company financials.

Note: Business Unit/Division financials are preferred.
Note: Calendar year data is preferred.

Source of Financial Line Items:	
Reporting Schedule:	

	Income Statement (Select Line Items)	Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
		2007	2008	2009	2010*
A.	Net Sales (and other revenue)				
B.	Cost of Goods Sold				
C.	Total Operating Expenses				
D.	Total Operating Income (Loss)				
E.	Total Other Income (Expenses)				
F.	Earnings Before Interest and Taxes				
G.	Interest Expense				
H.	Income Tax Expense				
I.	Net Income				

	Balance Sheet (Select Line Items)	Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
		2007	2008	2009	2010*
A.	Cash				
B.	Marketable Securities				
C.	Accounts Receivable				
D.	Inventories				
E.	Total Current Assets				
F.	Property, Plant, and Equipment				
G.	Total Non-Current Assets				
H.	Total Assets				
I.	Accounts Payable				
J.	Total Current Liabilities				
K.	Long-Term Debt (less current portion)				
L.	Total Non-Current Liabilities				
M.	Total Liabilities				
N.	Total Owner's Equity				

* If data is not available for 2010, please provide estimates.

Comments:	

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Section 6.e	Financial Health - NASA Supply Chain Network (cont.)	
Financial Statements (cont.)		
Use the space below to qualify with narrative any anomalies, transactions, or non-recurring events reflected in your financial statement line items, e.g. reporting restatement, merger and acquisition, chapter 11, SEC investigation, etc.		
A.	2007	
B.	2008	
C.	2009	
D.	2010	
Comments:		

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Section 7.a **Employment - NASA Supply Chain Network**

Record the total number of full time equivalent (FTE) employees in your U.S./domestic operations by labor type for the 2007-2010 period. Do not double count personnel who may perform cross-operational roles.

Note: "Total in U.S. Operations" should comprise all preceding labor categories. If not, please indicate why in the comment box.

Source of Operational Data:	
Reporting Schedule:	

		Professional Occupations	2007	2008	2009	2010*
A.	1.	Administrative Staff				
	2.	Production Managers/Supervisors/Executives				
	3.	Research and Development (R&D) Staff				
	4.	Production Line Workers, Support Technicians				
	5.	Quality Control, Test Operations				
	6.	Sales and Marketing				
	7.	Facility Operations, Maintenance				
	8.	IT/Network Engineers				
	9.	Other (specify)				
	10.	Other (specify)				
	11.	Total in U.S. Operations				
	12.	Total Number of Scientists				
	13.	Total Number of Engineers				

* If data is not available for 2010, please provide estimates.

	Personnel Description		
B.	Estimate the percentage of your company's total personnel in U.S. operations who participate (at any level) in Space Shuttle and Constellation program-related work?	Space Shuttle	Constellation Program

Comments:	

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Section 7.b **Employment - NASA Supply Chain Network (cont.)**

A.	From the drop-down list of professional occupations, indicate what categories of personnel are the most difficult to hire and retain. Explain.	Difficult to Hire	Difficult to Retain

B. Identify your company's critical personnel skills and competencies, i.e. expertise that is critical to your company's viability and long-term competitiveness.

1.	
2.	
3.	
4.	

C. From the above list, which does your company consider its unique skills and competencies? Explain.

1.	
2.	
3.	
4.	

D. Does your company have production and/or inspection personnel that possess formal qualifications/certifications necessary for doing business with NASA, e.g. Non-Destructive Testing, Soldering Workmanship, etc.?

Provide examples of such qualifications/certifications.

1.		5.	
2.		6.	
3.		7.	
4.		8.	

E. Does your company require its suppliers to maintain these same qualifications/certifications? Identify any additional qualifications/certifications your company requires of its suppliers below.

1.		5.	
2.		6.	
3.		7.	
4.		8.	

Comments:	

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Section 8 Research and Development - NASA Supply Chain Network

R&D Expenditures and R&D Funding Sources

Record your company's total research and development (R&D) dollar expenditures and the percentage of total R&D expenditures relating to NASA business lines. Then, indicate both the type of R&D performed, by percent allocation, and your company's R&D funding sources, by percent of total R&D dollars sourced.

Note: If your company's annual Total R&D Expenditures and Total R&D Funding Sources do not match, explain the discrepancy in the space provided.
Note: Calendar year data is preferred.

Source of R&D Data:	
R&D Reporting Schedule:	

	R&D Expenditures	Record $ in Thousands, e.g. $12,000.00 = survey input of $12			
		2007	2008	2009	2010*
A.	1. Total R&D Expenditures				
	2. Basic Research (as a percent of 1)				
	3. Applied Research (as a percent of 1)				
	4. Product/Process Development (as a percent of 1)				
	5. Total (must equal 100%)	0%	0%	0%	0%
	6. % of Total R&D Expenditures relating to NASA business lines				

	R&D Funding Sources	Record $ in Thousands, e.g. $12,000.00 = survey input of $12			
		2007	2008	2009	2010*
B.	1. Total R&D Funding Sources				
	2. Internal/Self-Funded/IRAD (as a percent of 1)				
	3. Total Federal Government (as a percent of 1)				
	4. Total State and Local Government (as a percent of 1)				
	5. Universities - Public and Private (as a percent of 1)				
	6. U.S. industry, venture capital, non-profit (as a percent of 1)				
	7. Non-U.S. investors (as a percent of 1)				
	8. Other (specify)				

* If data is not available for 2010, please provide estimates.

Comments:	

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Section 9 **Investment - NASA Supply Chain Network**

Capital Expenditures

Record your company's capital expenditures corresponding to the select categories.
Note: Calendar year data is preferred.

Source of Capital Expenditure Data:	
Capital Expenditure Reporting Schedule:	

Capital Expenditure Category		Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
		2007	2008	2009	2010*
1.	Total Capital Expenditures				
2.	Machinery, Equipment, and Vehicles (as a percent of 1)				
3.	IT, Computers, Software (as a percent of 1)				
4.	Land, Buildings, and Leasehold Improvements (as a percent of 1)				
5.	Other (specify)				
6.	Other (specify)				
7.	% of Total Capital Expenditures relating to NASA business lines				

* If data is not available for 2010, please provide estimates.

Comments:	

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Section 10 Certification Page

The undersigned certifies that the information herein supplied in response to this questionnaire is complete and correct to the best of his/her knowledge. It is a criminal offense to willfully make a false statement or representation to any department or agency of the United States Government as to any matter within its jurisdiction. [18 U.S.C.A. 1001 (1984 & SUPP. 1197)]

Company or Organization Name	Internet Address	
Name of Authorizing Official	Title of Authorizing Official	
Phone Number	Fax Number	
Point of Contact	Title	
Email Address	Phone Number	Extension

How many hours did your company dedicate to completion of this survey?	
Indicate here if you would like a copy of the completed NASA Supply Chain Network industrial base assessment.	

Comments

In the space below, please provide all additional comments or any other information you wish to include regarding your participation in this assessment:

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OFFICE OF TECHNOLOGY EVALUATION (OTE)
PUBLICATIONS LIST

September 19, 2012

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