U.S. Strategic Materials Assessment: Carbon Fiber Composites

U.S. Department of Commerce
Bureau of Industry and Security
Office of Technology Evaluation

June 2015

U.S. STRATEGIC MATERIAL SUPPLY CHAIN ASSESSMENT: CARBON FIBER COMPOSITES

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PREPARED BY
U.S. DEPARTMENT OF COMMERCE
BUREAU OF INDUSTRY AND SECURITY
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I. INTRODUCTION

Carbon fiber composites are lightweight, high strength structures created by embedding carbon fiber into a supporting material, known as a matrix. By combining materials manufacturers can produce parts with both the strength and stiffness of the carbon fiber and the durability and versatility of the matrix material, typically a type of plastic resin. Different types of carbon fiber and matrices exist, each with varying properties making them suitable for a range of uses.

The carbon fiber-based composite materials industry has experienced rapid growth in the past decade, with global carbon fiber production capacity estimated to have quadrupled.[1] The bulk of this increase has resulted from increased commercial and industrial uses for carbon fiber, with the share of sales to the defense sector having fallen from an estimated 28 percent in 1991 to less than 4 percent in 2015.[2] By 2020, the defense share of the carbon fiber composite market is estimated to be less than 2 percent, as defense growth slows and commercial and industrial uses of carbon fiber continue to expand rapidly.

As the carbon fiber industry's reliance on defense sales has fallen, the need of the U.S. Department of Defense (DOD) to understand the structure, constraints, and capabilities of the carbon fiber composite supply chain has increased. Companies that once were dependent on the U.S. Government (USG) now have a broader array of potential customers, some of whom may offer more lucrative possibilities or with whom contracting may be simpler.

[1] Based on estimates from Composites Forecasts and Consulting, LLC

[2] 1991 data from BIS's *Critical Technology Assessment of the U.S. Advanced Composites Industry*, available at https://www.bis.doc.gov/index.php/forms-documents/doc_view/32-critical-technology-assessment-of-u-s-advanced-composites-1993. 2015 data from Cytec Investor Presentation, available at http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9NTUyOTg3fENoaWxkSUQ9MjQ4MzcwfFR5cGU9MQ==&t=1

In 2014, the U.S. Department of Defense, Defense Logistics Agency (DLA) partnered with the U.S. Department of Commerce, Bureau of Industry and Security (BIS) to conduct an industrial base assessment measuring the health and competitiveness of the domestic carbon fiber composites supply chain network, focusing on producers and distributors of carbon fiber and carbon fiber-based materials, as well as producers of composite components for use in defense aerospace applications.

DLA also requested similar assessments focusing on magnesium, titanium, and select rare earth elements. These materials are covered in separate BIS reports.

BIS and DLA set the following objectives for the proposed industrial base survey and assessment:

- Map the carbon fiber supply chain network in detail;
- Identify interdependencies between respondents, their suppliers and customers, and the U.S. Government agencies they support, with particular focus on supply chain availability issues and challenges;
- Benchmark trends in business practices, competitiveness issues, financial performance, R&D and capital investment, workforce, and other topic areas across the supply chain network; and
- Share data with USG stakeholders, as appropriate, to better inform strategic planning, policy implementation, targeted outreach, and collaborative problem solving.

BIS performed this data collection and assessment under authority delegated to the U.S. Department of Commerce under Section 705 of the Defense Production Act of 1950 and Executive Order 13603. These authorities enable BIS to conduct surveys, study industries and technologies supporting the national defense, and monitor economic and trade issues affecting the U.S. industrial base.

Recent industrial base assessments completed by BIS include: Underwater Acoustic Transducer Systems, the Cartridge and Propellant Actuated Device Industry, the Consumers of Electro-Optical Satellite Imagery, and the U.S. Space Industry 'Deep Dive.'[3]

Upon initiation of the carbon fiber composites industrial base assessment in 2014, BIS took steps to better understand the supply chains for this strategic material. With the assistance of the DLA and other U.S. Government stakeholders, BIS collected information on relevant U.S. Government programs and their known carbon fiber composite-related supply chains.

BIS also worked with select carbon fiber suppliers and composite product manufacturers to gain a better understanding of the operational and business practices specific to the carbon fiber industry. These meetings aided in designing the survey instrument and in ensuring that issues faced by both industry and government stakeholders were covered. This due diligence allowed BIS to develop a comprehensive yet highly tailored, sector specific survey covering the carbon fiber-related business operations of the participating respondents.

[3] For these and other reports, see www.bis.doc.gov/dib.

The content of the survey instrument addresses several categories of respondent information, including sections dedicated to:

- Organization information;
- Products (carbon fiber-related and other);
- Key suppliers, inventories, inputs, and sourcing;
- Operations and challenges;
- Competitiveness and outlook;
- U.S. Department of Defense (DOD) and other U.S. Government participation;
- Sales;
- Customers;
- Financials;
- Workforce;
- Research and development (R&D); and
- Capital expenditures.

To enhance the functionality of the survey template and also render the response data more impactful, BIS adopted a dynamic survey design that allowed inputs from individual sections to inform response criteria in subsequent sections. For example, initial respondent declarations of market segment participation and carbon fiber-related product lines would populate the response criteria for subsequent supplier and U.S. Government program-related questions.[4]

[4] Information on classified activities and programs was not collected in this assessment.

This approach had two primary benefits: (1) reduce the cycle time required to complete the survey by tailoring the question criteria to each respondent's product mix and capabilities; and (2) allow BIS to more reliably collate individual response data across multiple sections of the survey.

BIS distributed the carbon fiber composites survey in late spring 2014 to respondents identified by our partner agencies, previous BIS survey efforts, and independent research. A total of 98 organizations responded to the survey. The response data was reviewed, tabulated, analyzed, and presented to DLA in order to facilitate their own analysis and strategic planning. Additionally, aggregated results, as contained in this report, were made publicly available and presented to strategic materials stakeholders across the U.S. Government, industry, and academia.

II. SELECT FINDINGS

- BIS received 98 survey responses covering carbon fiber producers, distributors, weavers, prepreggers, composite product manufacturers, and other carbon fiber-related businesses. Just over half of the respondents were composite product manufacturers.

- Sixty-nine respondents were privately held organizations, and 24 of the 29 publicly traded organizations provided a business unit or divisional survey response.

- Carbon fiber-related products constituted an increasing percentage of respondents' total sales, growing from less than 24 percent in 2010 to a forecasted 29 percent in 2014. Commercial sales of carbon fiber-related products were a key driver, growing at an annualized rate of 19 percent.

- Twenty-two respondents reported decreases in sales from 2010 to 2013, with half experiencing sales drops over 25 percent. Two-thirds of the respondents with declining sales were small organizations (less than $25 million in average annual sales).

- BIS developed a customized financial risk metric to portray the overall financial condition of respondents. 23 respondents were labeled as moderate/elevated risk from 2010 to 2013.

- Respondents with elevated financial risk were significantly more likely to have: decreased capital expenditures and R&D expenditures from 2010 to 2013; reduced their

workforce size over that period, and; had difficulty hiring or retaining workers.

- The 98 respondents identified a total of 869 products or product types they provided. Two-thirds of these products were related to carbon fiber composites, with the majority of the remainder being glass fiber products. Most products containing carbon fiber used polyacrylonitirile- (PAN) based fibers, which were found in ten times as many products as the next most common precursor, rayon.

- Approximately one-third of all products identified by respondents were intended for defense usage. By comparison, less than five percent of global carbon fiber production is estimated to be used in the defense sector.

- Forty percent of respondents had input availability problems between 2010 and 2014, and 43 percent experienced a supply chain disruption.

- Carbon fiber producers were operating at 90 percent capacity utilization on average in 2014, while other types of respondents averaged under 40 percent capacity utilization.

- One-third of respondents considered their organizations highly or moderately dependent on USG defense demand for carbon fiber-related products. Sixty-three percent of these identified reductions in USG demand as an organizational challenge, citing reduced space program spending, lower than anticipated aircraft demand, and budget sequestration as

notable causes of concern.

- In the defense sector, participation was strongest in fixed wing aircraft, but the unmanned aerial vehicle (UAV) area was expected to surpass that of fixed wing aircraft by 2018. Sixteen respondents reported plans to enter the defense UAV market, most of whom also planned to begin supporting the civilian UAV market.

- Seventy-two of the 98 respondents reported that they provided support to at least one USG agency from 2010 to 2014, and sales to the USG accounted for nearly one-quarter of all sales.

- Most of the 181 unique USG programs identified in the survey contained products using sole or single source inputs. Forty-eight of the programs used a product with at least one sole source input, and 66 used a product with at least one single source input. Nineteen of the 20 most frequently identified programs had at least one product that utilized a sole or single source input.

- Sixty-nine of the 98 respondents reported a total of $980 million in R&D expenditures in 2013, $225 million of which was related to carbon fiber. Three respondents accounted for two-thirds of all R&D spending, and five respondents accounted for 90 percent of carbon fiber-related R&D.

- The 98 respondents employed nearly 63,000 workers in 2013, up 16 percent from 2010. Carbon fiber-related employment grew at twice the rate of other employment, reaching 19,000 workers in 2013.

- Among the majority of respondents that did increase their workforces, half reported difficulty hiring or retaining workers. Engineers, scientists, and R&D staff were the most difficult positions to attract and keep. Every one of the 34 respondents who had difficulty hiring or retaining workers had trouble with these positions. Two of the most common causes for these difficulties were undesirable work locations and lack of applicant experience.

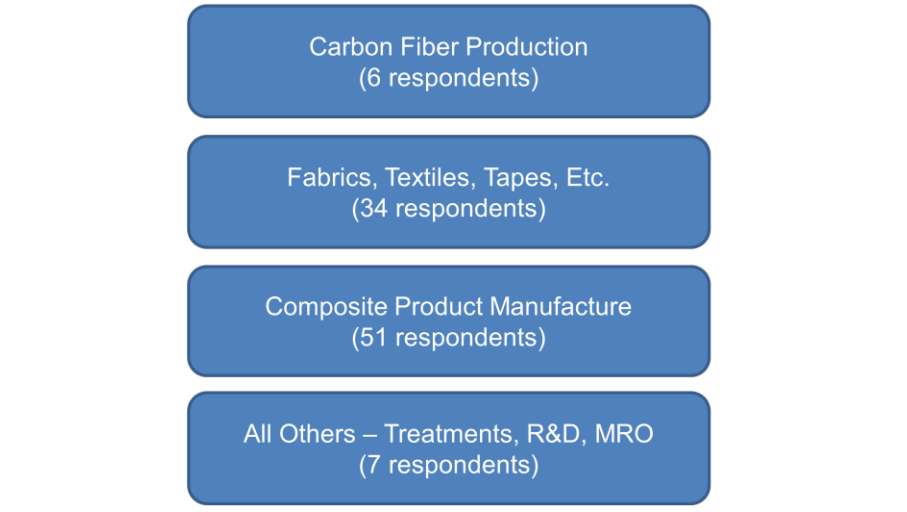
- Fifty-four respondents requested information on USG programs and services designed to aid them in competing in the global marketplace. Two of the three most requested areas of assistance related to export assistance: global export opportunities and export licensing.

- For a full list of findings, see Chapter XV.

III. Industry Profile

BIS received 98 survey responses covering carbon fiber producers, distributors, weavers, prepreggers, composite product manufacturers, and other carbon fiber-related businesses (see Figure III-1). The carbon fiber composite supply chain has a narrow base, with just a few producers of carbon fiber itself. Many more businesses buy fiber to create fabrics, textiles, or tapes which make the composite production process simpler for component manufacturers, which represent a still larger portion of the supply chain. Just over half of the responses in this assessment came from composite product manufacturers, with most of the remainder coming from distributors or weavers of carbon fabrics, textiles, and tapes.

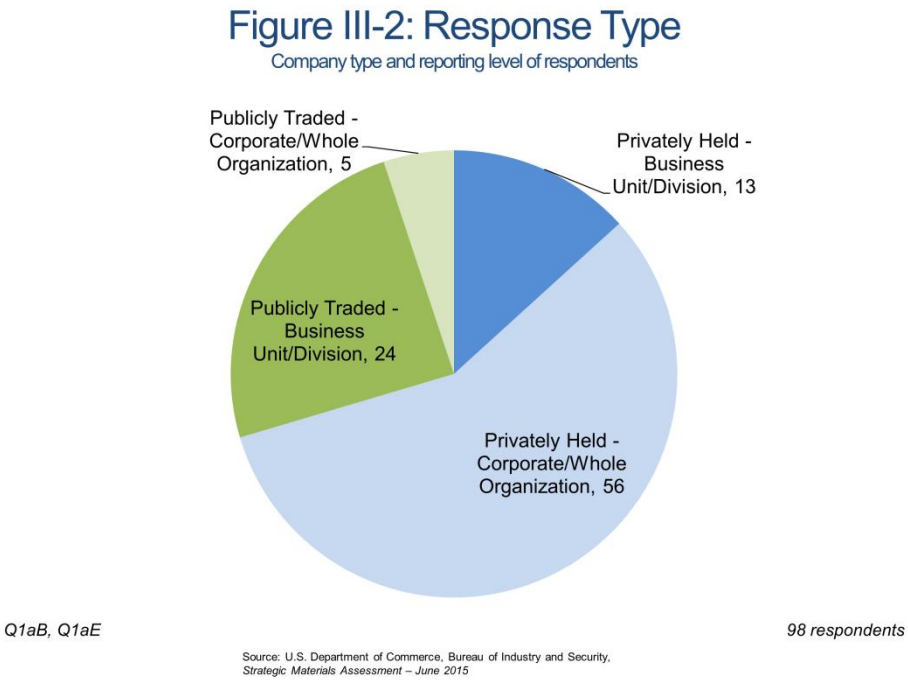
Figure III-1: Primary Business Line, 2014



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

BIS asked respondents whether their organizations were publicly traded or privately held, as well as whether responses were for a business unit or division, or represented corporate level data.

Sixty-nine of the 98 respondents were privately held organizations, and of the 29 publicly traded organizations, 24 provided a business unit- or division-level survey response (see Figure III-2).



Half of the respondents reported being classified a small business, and 79 had fewer than 500 employees—the U.S. Small Business Administration's general guideline defining a small business. For the purposes of this report, respondents were also categorized as small, medium, large, or very large based on their average net sales from 2010 to 2013 (see Figure III-3). Based on these categorizations, small respondents, with under $25 million in average annual sales, tended to be quite small in terms of workforce, typically with well under 50 employees.

Figure III-3: Respondent Size Categorizations

Defined by Average Annual Net Sales, 2010-2013

Size	Average Annual Net Sales	Number of Respondents	Average Number of Employees	Average Number of Sectors Served
Small	Under $25 Million	49	32	4
Medium	$25 Million - $100 Million	26	184	6
Large	$100 Million - $1 Billion	16	668	6
Very Large	$1 Billion or Greater	7	5046	5

Q1bA, Q9A, Q10A1 *98 respondents*

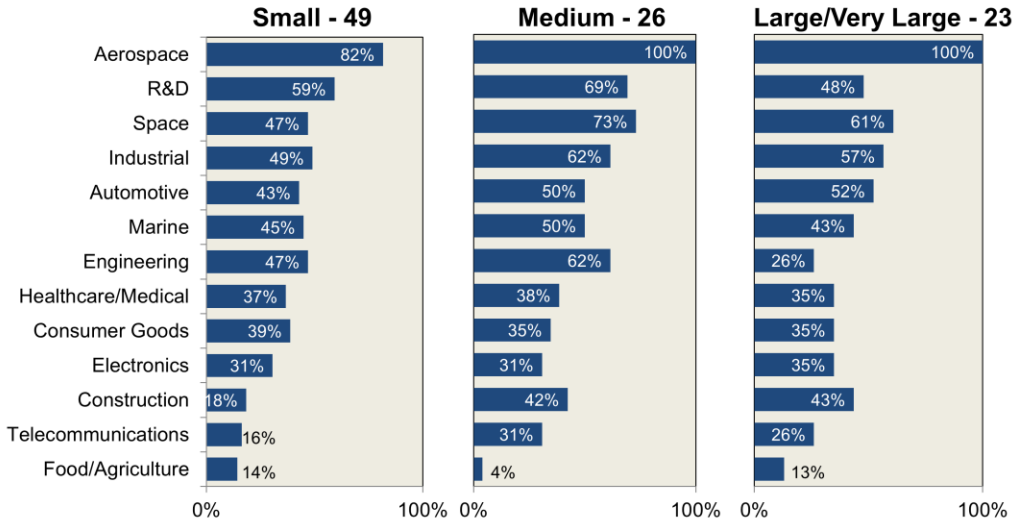
Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Very large organizations accounted for seven percent of the survey responses, but employed 62 percent of all reported full time equivalent (FTE) employees. At the other end of the spectrum, the half of the respondents categorized as small organizations employed roughly 10 percent of the nearly 64,000 reported FTEs.

All sizes of respondents participated in a broad range of market segments. Nearly all respondents considered their organizations to be participants in the target sector of the survey, aerospace. However, on average respondents also participated in an additional five sectors, with R&D, space, industrial, and automotive topping the list (see Figure III-4).

Figure III-4: Industry Sector Participation

Market Segments Served, 2014



Q1bA, Q9A

98 respondents

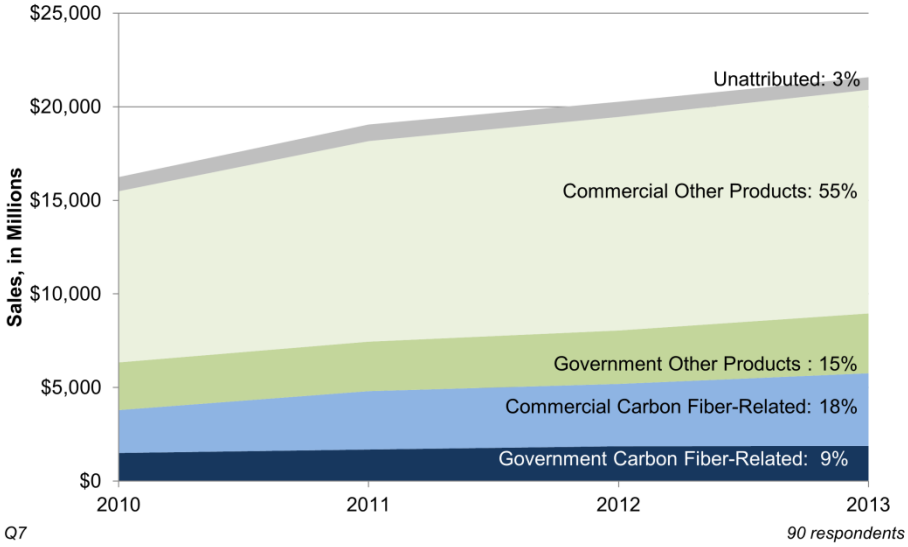
Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

The 98 respondents reported operating a total of 177 facilities in 35 states and 13 non-U.S locations. Six states – California, Ohio, Utah, South Carolina, North Carolina, and Kansas – accounted for half of all facilities. BIS asked respondents to identify all facilities at which they anticipated significant changes in operations from 2014 to 2018, and to explain these changes. Respondents expected changes to 37 facilities; in every case the change was to prepare for increasing carbon fiber-related business.

IV. Sales and Financial Performance

Respondents' total sales rose from $16.2 billion in 2010 to $21.6 billion in 2013. The bulk of these sales came from products unrelated to carbon fiber, as carbon fiber-related products, both government and commercial, accounted for 27 percent of total sales in 2013 (see Figure IV-1). The share of carbon fiber-related products made up a consistently increasing percentage of total sales, rising from under 24 percent in 2010. Respondents forecasted this share would approach 29 percent in 2014.

Figure IV-1: Total Respondent Sales, 2010-2013



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

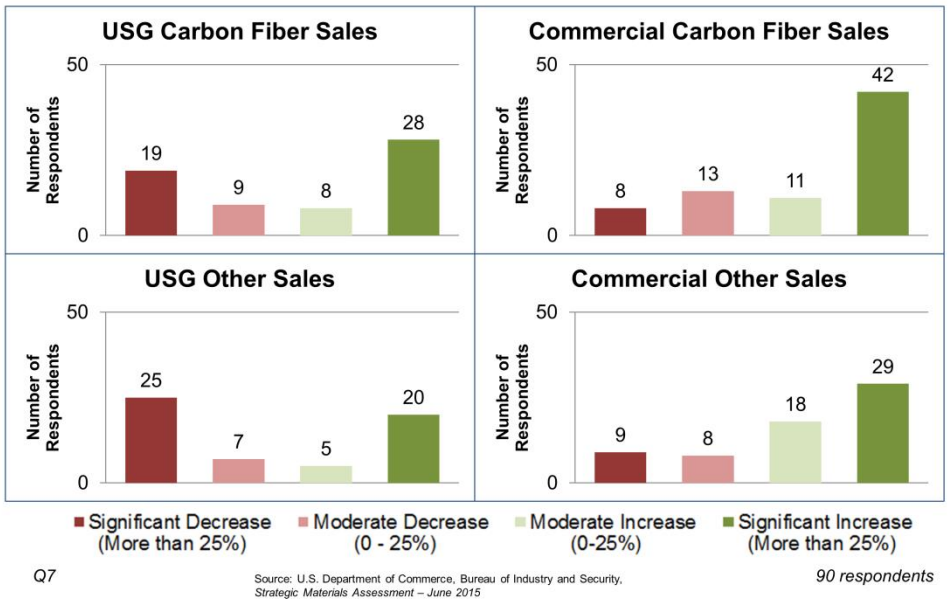
Sales of carbon fiber-related products for commercial usage were a key driver of sales across the period, growing over twice as quickly as other categories. Commercial carbon fiber-related sales grew at an annualized rate of 19 percent from 2010 to 2013, while all other sales grew at an annualized rate of 8 percent.

Although sales growth for all respondents combined was quite strong, there was significant variability in sales performance between individual respondents. Twenty-two respondents reported decreased sales in 2013 from 2010, 11 of which experienced a sales decrease of more than 25 percent. Respondents with declining sales over the period were of all sizes, but were disproportionately smaller organizations; 68 percent were categorized by BIS as small (less than $25 million in average annual sales).

Just under half of the 71 respondents with government sales in 2010 reported decreased government sales across the period, with 20 of these respondents experiencing significant declines (decreases in sales exceeding 25%). Carbon fiber-related sales to the USG, while highly variable, tended to outperform the sales of other type of products to the USG, with more respondents reporting increases in USG sales and fewer reporting significant decreases (see Figure IV-2). Commercial carbon fiber-related sales were the strongest category, with nearly 75 percent of respondents reporting increases in this type of sale, and over half reporting sales growth over 25 percent from 2010 to 2013.

Figure IV-2: Distribution of Change in Sales, 2010-2013

Respondents experiencing significant (over 25% change) and moderate (up to 25% change) in sales



Q7

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

90 respondents

Respondents provided data on selected financial line items, including net and operating income, assets, liabilities, and inventories. In addition to the intrinsic value of these measures, BIS developed a customized financial risk metric to better capture the overall financial condition of respondents. The model was based largely on standardized financial ratios covering select performance fields, such as profitability, liquidity, leverage, and default probability, and was supplemented with time series metrics as well as select qualitative data. Based on this scorecard, respondents were categorized as low/neutral risk, moderate/elevated risk, or high/severe risk.

Twenty-three respondents were labeled as moderate/elevated risk for the full period 2010 to 2013; all but four of these respondents had negative profit in 2013 and 16 had negative cumulative earnings for the four year period surveyed. Ten of the respondents with negative

earnings from 2010 to 2013 were business units or divisions of a larger company. On a yearly basis, several respondents were categorized as high/severe risk for any given year, with an increasing number of respondents shifting into the high risk category over time, as profits deteriorated and other financial conditions weakened (see Figure IV-3).

Figure IV-3: Yearly Financial Risk

	2010	2011	2012	2013
Low/Neutral Risk	81	81	80	73
Moderate/Elevated Risk	12	14	14	16
High/Severe Risk	5	3	4	9

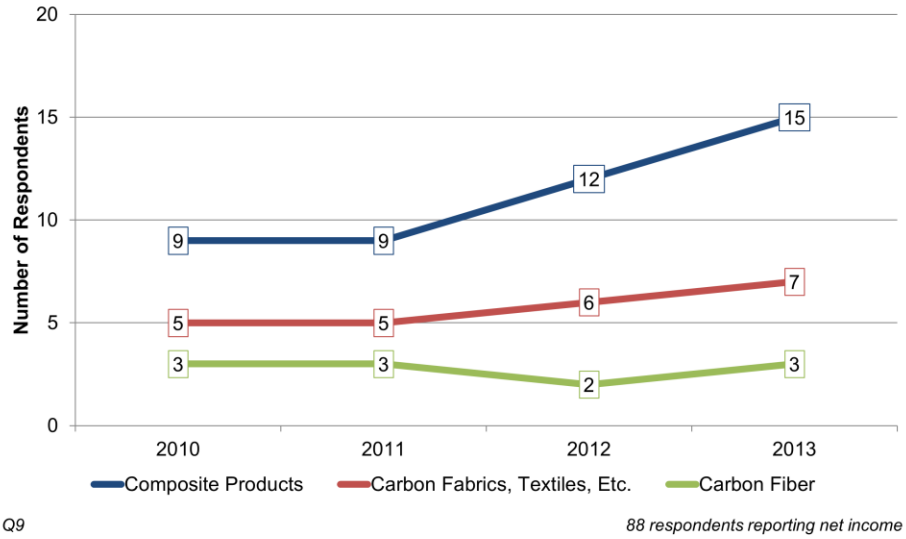
Q9, Q11, Q12, Q7, Q6a *98 respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Respondents operating with a net loss were significantly more likely to be identified by BIS to be at elevated financial risk. The number of respondents operating at a net loss increased consistently across the four years covered by the survey. Over one quarter of respondents had negative net profits in 2013, up from 17 percent in 2010. Most of this increase came from respondents whose primary business was the production of composite products (see Figure IV-4).

Figure IV-4: Respondents Operating at a Net Loss, 2010-2013

Number of respondents with net losses by primary business category

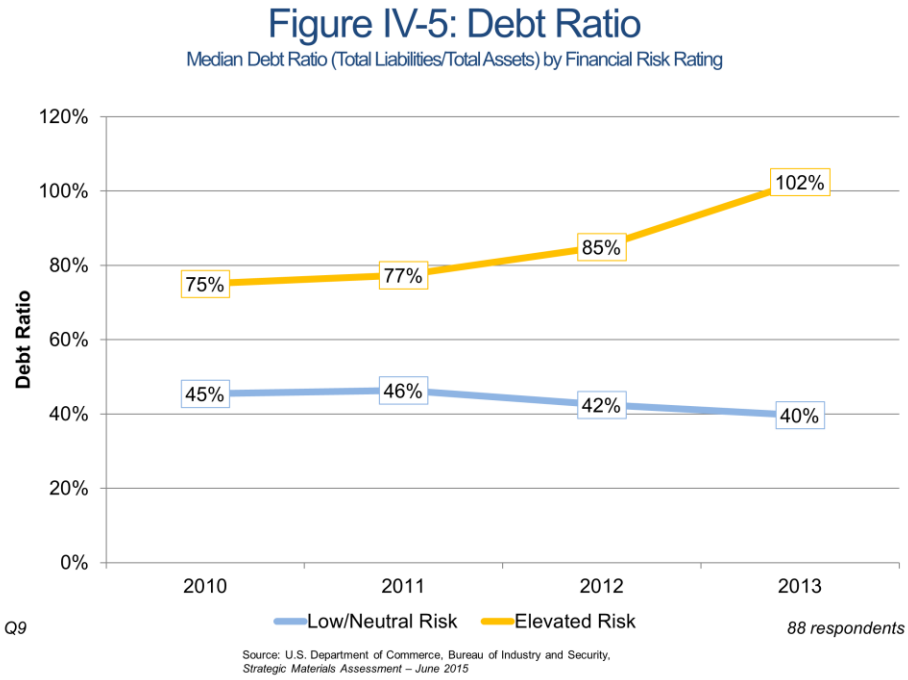


Q9 *88 respondents reporting net income*

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Composite product manufacturers tended to be more vulnerable to changes in USG purchasing. Over half of the 51 composite product manufacturers identified their organizations as dependent on USG demand, and the most frequently cited challenges facing these businesses were government purchasing volatility and reductions in USG demand. Respondents declaring their organizations dependent on USG demand were more likely than others to report a net loss in 2013.

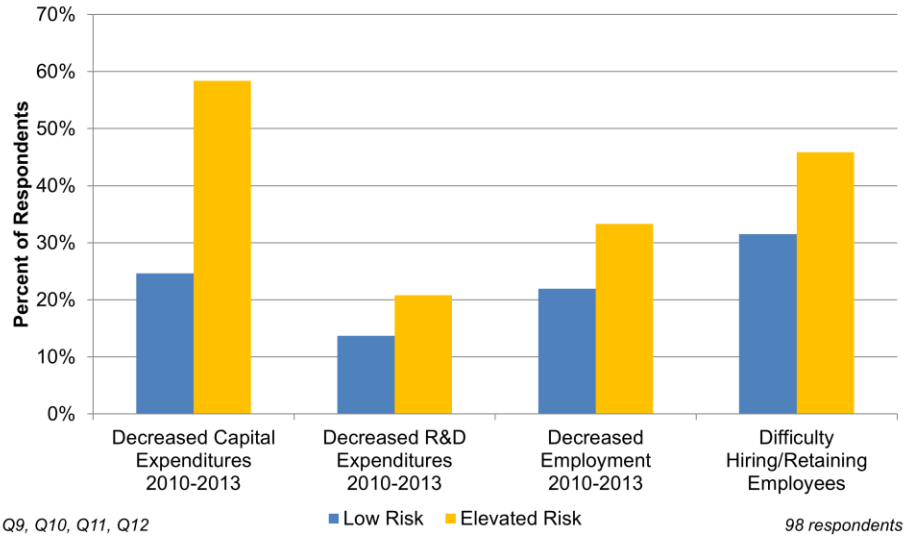
In addition to falling profits, respondents at elevated financial risk generally had higher and increasing debt loads (see Figure IV-5). The gap between the median debt ratio of elevated risk and low risk respondents grew each year, and more than doubled from 2010 to 2013. By 2013, 13 of the 23 respondents at elevated financial risk had liabilities that exceeded their total assets—resulting in a debt ratio over 100 percent—up from 8 respondents in 2010.



Elevated financial risk had several potential adverse impacts on how businesses operated with regard to capital expenditures, R&D, and workforce. Respondents with elevated financial risk were significantly more likely to have: decreased capital expenditures and R&D expenditures from 2010 to 2013; reduced their workforce size over that period; and had difficulty hiring or retaining workers (see Figure IV-6). Additionally, elevated risk respondents indicated that on the whole it would take them longer to ramp up production. The average elevated risk respondent would take 17 percent longer to reach full capacity (100 percent capacity utilization) and 50 percent longer to raise their capacity.

Figure IV-6: Impacts of Elevated Financial Risk, 2010-2013

Factors potentially affected by elevated financial risk



Q9, Q10, Q11, Q12

98 respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

V. PRODUCTS AND INPUTS

BIS requested data on the products each respondent provided, covering the products' compositions and their expected end uses. For materials used in the carbon fiber composite supply chain, respondents indicated the precursor material and tensile modulus of the fibers, and/or the type of resin used or sold. For other types of products, respondents selected only the broader type of material, such as glass fiber, aramid fiber, ceramic, and others. For all products, respondents indicated the primary sector they expected the product to be used in (Government Defense, Government Non-Defense, Commercial/Industrial, Academic/Non-Profit, and Other), and the expected primary application area.[5]

The 98 respondents identified a total of 869 products or product types (respondents were able to group together products with the same input components and similar end uses as the same basic product type). Two-thirds of these products were related to carbon fiber composites; the majority of non-carbon fiber-related products were glass fiber products. Most products containing carbon fiber used polyacrylonitrile- (PAN) based fibers, which were found in ten times as many products as the next most common precursor, rayon (see Figure V-1).

[5] Primary Application options: Fixed-Wing Aircraft, Rotary-Wing Aircraft, Unmanned Aerial Vehicles (UAV), Missiles/Rockets, Space, Automotive, Energy Production, Construction/Infrastructure, Marine, Other, Unknown

Figure V-1: Carbon Fiber Product Composition, 2010-2014

Number of products by precursor type, modulus, and matrix

Precursor	Products
PAN	419
Rayon	42
Pitch	25
Other	12
Not Applicable	79
Unknown	15

Modulus	Products
Standard (<40 MSI)	299
Intermediate (40 - 50 MSI)	117
High (50 - 65 MSI)	65
Ultra-High (>65 MSI)	29
Unknown	34
Not Applicable	48

Matrix	Products
Bismaleimide (BMI)	36
Polyimide	21
Epoxy	271
Polyester	5
Vinyl Ester	3
Phenolic	23
Benzoxazine	7
Other	56
Not Applicable	170

Q2a *98 respondents*

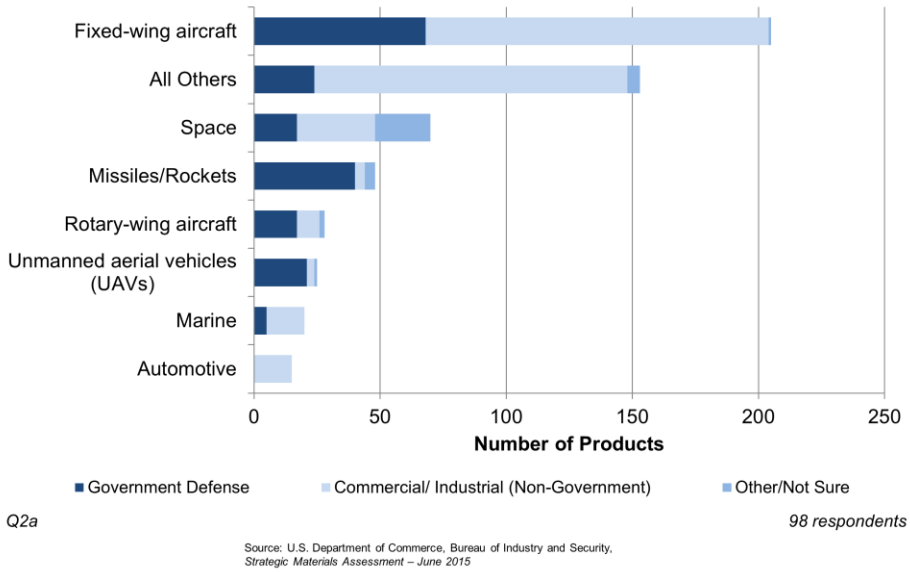
Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Carbon fibers are typically classified by their tensile modulus, which indicates the fiber's stiffness. Cost increases dramatically with higher modulus fibers, so use of these fibers tends to be restricted to applications that require special resistance to environmental stresses. The number of products listed decreased as the carbon fiber's modulus increased, with high and ultra-high modulus products accounting respectively for 13 percent and 6 percent of all known modulus listings. The largest share of these higher modulus products were destined for space or fixed-wing aircraft use, but every listed end use with the exception of construction/infrastructure was identified as a destination for high or ultra-high modulus products.

Respondents provided products to the full range of listed end uses in the survey, as well as a variety of unlisted end uses (see Figure V-2). The additional end uses cited by respondents were primarily medical devices and recreational/consumer goods. Roughly one-third of all products

were intended for defense usage, indicating—as expected based on the targeted survey mailing—the respondent sample was much more active in the defense sector than the carbon fiber composite industry as a whole. By comparison, it is estimated that less than five percent of global carbon fiber production is estimated to be used in the defense sector.[6]

Figure V-2: Primary End Use of Products by Application, 2014

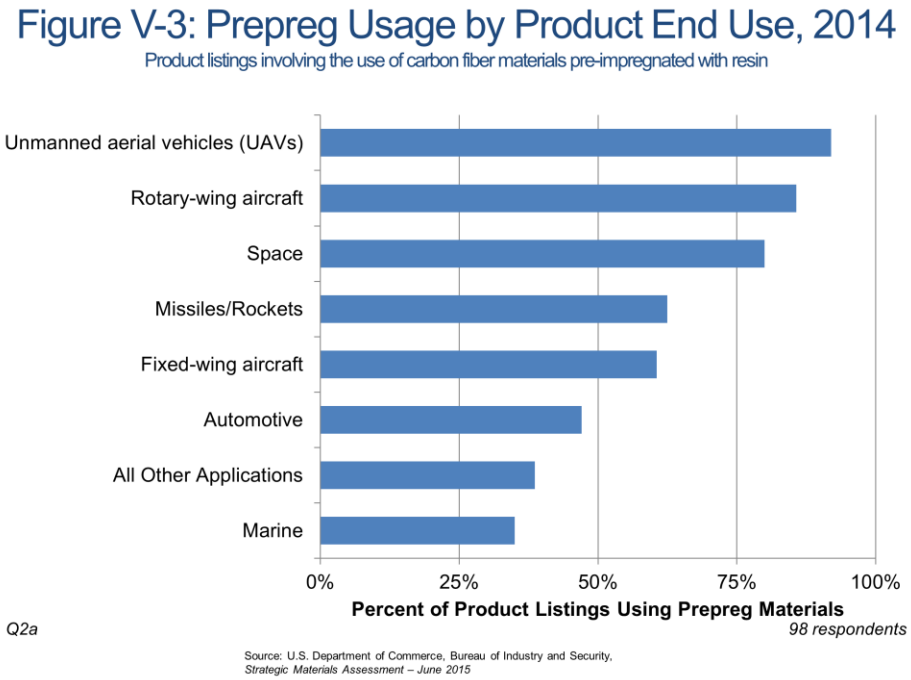


BIS also asked that respondents indicate whether each of their products was itself a prepreg or contained a prepreg.[7] Two-thirds of all respondents worked with prepreg, a figure that rises to 91 percent for composites manufacturers. Respondents used prepregs in 350 products, for all listed end uses, though to very different extents. In areas like energy production and

[6] Cytec Investor Presentation, available at http://phx.corporate-ir.net/External.File?item=UGFyZW50SUQ9NTUyOTg3fENoaWxkSUQ9MjQ4MzcwfFR5cGU9MQ==&t=1

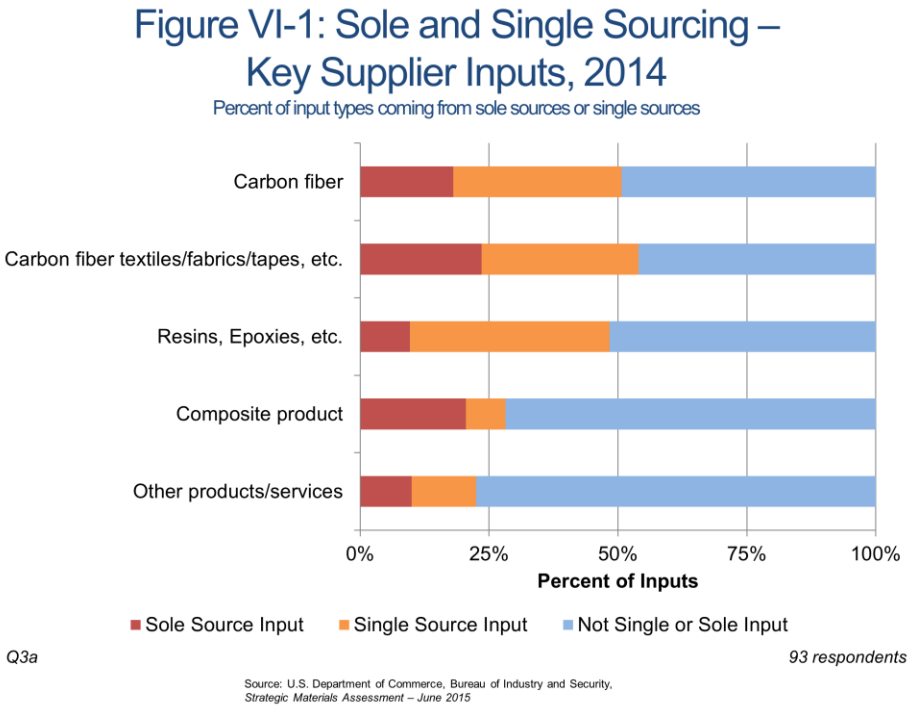
[7] Prepregs are materials in which reinforcing carbon fibers have already been combined with the matrix material, but the product has not been fully cured.

construction/infrastructure less than 30 percent of the listed products used prepregs, while in unmanned aerial vehicles (UAVs), rotary-wing aircraft, and space, over three-quarters of products involved the use of prepregs (see Figure V-3).



VI. Supply Chain Issues

Respondents listed 519 key supplier inputs to their products, which BIS determined to be sourced from 128 unique suppliers. Five suppliers accounted for half of all listings, and for three-quarters of all carbon fiber listings. Many of these suppliers were the sole source (the only known supplier in existence) or single source (the respondent's only accepted source, though others may exist); 34 percent had a sole source input, and 41 percent of respondents had a single source input. Narrow sourcing was most prevalent for carbon fiber and fiber-based fabrics, with over half of both of these types of inputs coming from sole or single sources (see Figure VI-1).

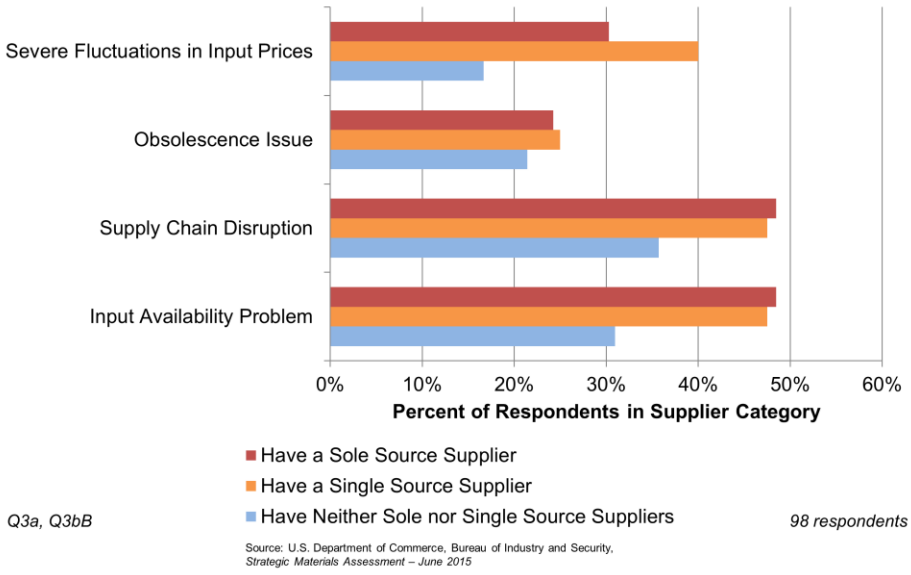


In many cases single and sole sourcing stem directly from customer requirements. A number of composite manufacturers indicated that it is normal for their customers to specify which suppliers they can use. As one medium producer stated, "[Our] materials are dictated by the

customer, so it would be the customer's direction on alternate sources or materials. Almost all materials are sole source to certain manufacturers." Products used in aerospace applications often require extensive testing and qualification of materials, making changing inputs costly and time consuming. As a result, companies can be hesitant to use new suppliers or materials.

The shallow supplier base and "just-in-time" sourcing strategies often necessitated by customer requirements mean that supply availability problems and supply chain disruptions are relatively common, and more common for respondents with sole and single source vendors (see Figure VI-2). A medium producer explained, "Since some of our fiber comes from a sole source vendor, our orders can be put at risk if we don't have priority over another government customer."

Figure VI-2: Supply Chain Issues by Input Sourcing, 2010-2014



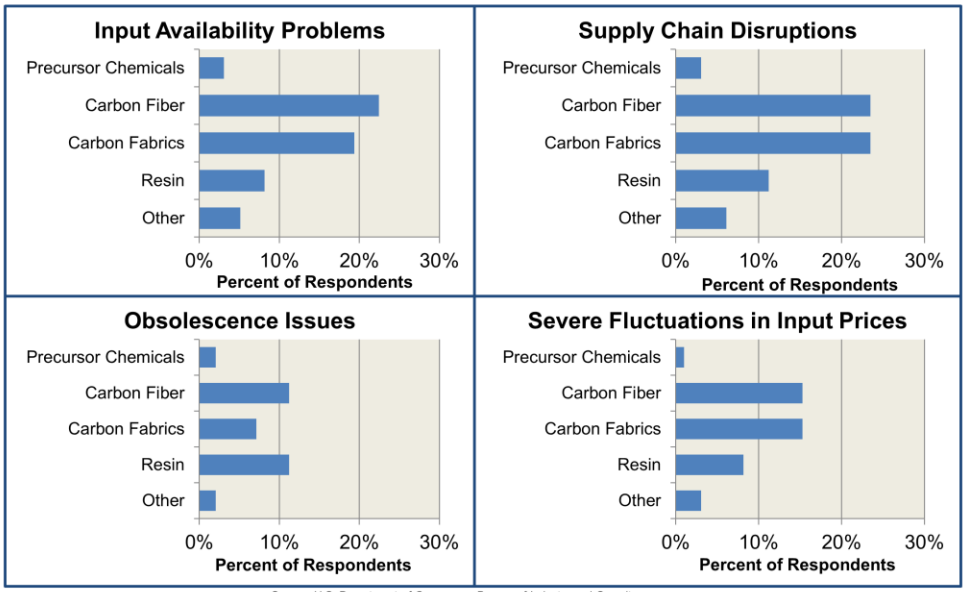
The concept of priority in orders came up several times, especially among smaller organizations. One small business simply wrote, "Due to our size, we don't have priority access [to carbon

fiber].” Another commented, “Availability of materials for small businesses is subject to the requirements/needs of large corporations.”

An industry expert attributed many of these problems to lack of communication between companies and their supply chain, telling BIS that manufacturers will often underestimate their carbon fiber needs when placing orders. The length of time between the start of the carbon fiber production cycle and delivery means there can often be mismatches between what companies initially tell their suppliers they need and what they actually need. As a result, companies looking for fiber to fill gaps in requirements are often confronted with shortages.

Input availability problems and supply chain disruptions were the most prevalent sourcing concerns for respondents (see Figure VI-3). Forty percent of respondents indicated they had input availability problems between 2010 and 2014, and 43 percent experienced some kind of supply chain disruption. For both areas, the primary problem was related to procuring carbon fiber or fabric.

Figure VI-3: Sourcing Issues 2010-2014



Q3bB

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

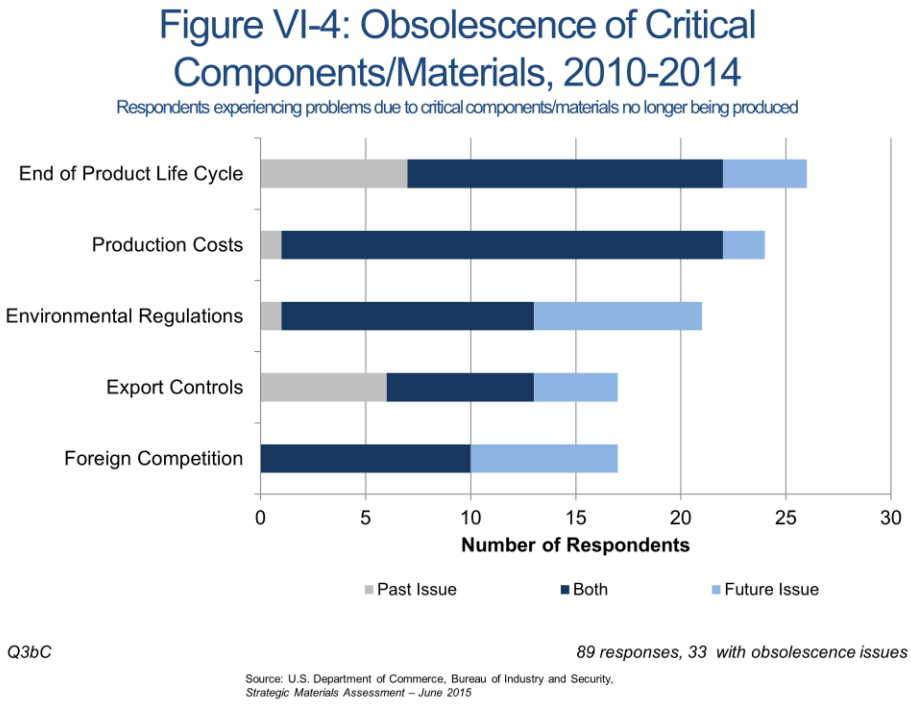
98 respondents

Changes in input prices were another area of concern, primarily in purchasing carbon fiber or carbon fabric. Over one-quarter of all respondents reported having experienced severe input price fluctuations from 2010 to 2014. Several respondents commented on limited market availability of carbon fiber, with one small respondent writing that their primary fiber supplier had "huge minimum buy requirements, 6 to 10 month lead times, and price increases," which forced them "to make very costly advance purchases 6 to 12 months before the need date to ensure we have fiber/fabrics to support our military and commercial aircraft customer requirements."

Obsolescence issues were the one sourcing concern in which resins presented as significant an issue as carbon fiber. Twenty-two percent of respondents reported having had any type of obsolescence problem from 2010 to 2014, and half of those respondents had an obsolescence

issue relating to resins. Several respondents noted that some types of resins were no longer available, citing environmental regulations. In explanation, one large respondent attributed some of their supply chain problems to the "discontinuation of production for certain chemicals and resins," and a small respondent commented, "EPA has forced the retirement of several resin chemistries."

Several other causes of supply obsolescence were also identified. BIS asked respondents to identify these causes and to indicate whether they had occurred in the past only, were expected to occur in the future only, or were ongoing. While the greatest number of respondents expected environmental regulations to become an issue in the future, more respondents noted production costs as an ongoing and future reason for obsolescence (see Figure VI-4).



Almost all respondents with obsolescence concerns were actively managing these issues. The most commonly identified obsolescence management methods included use of alternative

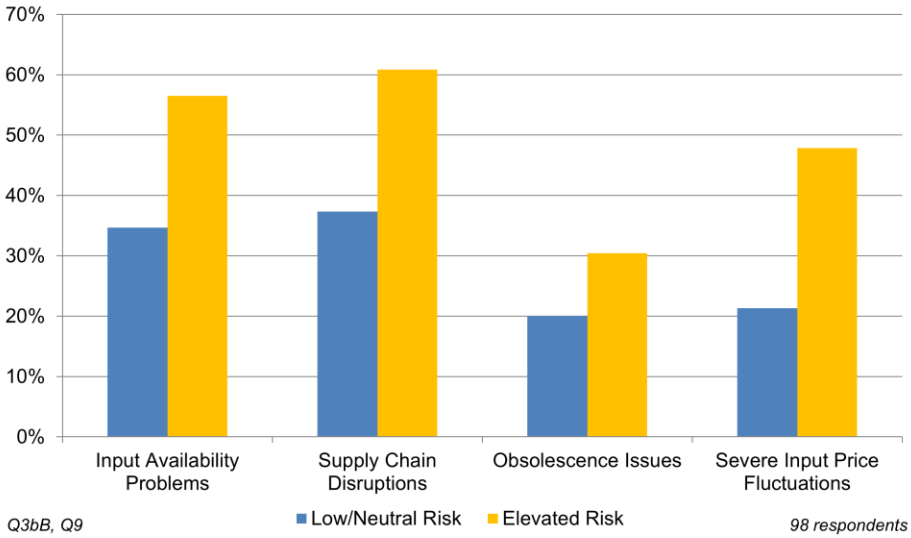
materials, finding additional sources, keeping more inventory on hand, and increased communication across the supply chain to work around potential issues.

Many of these practices have their own costs. Respondents can seek alternate materials, but specifications are often customer-driven, and implementing changes can be difficult. One medium respondent wrote, "We recommend qualification of other companies, but [this is] not usually cost acceptable to OEMs unless [the material] is not available at all."

Another respondent noted that in managing obsolete materials, "We have attempted to secure lifetime buys, and have incurred storage costs associated with that." Some materials—prepregs in particular—have a shelf life of just a few months or require controlled storage environments, making longer-term buys impossible or impractical and increasing the potential for obsolescence complications.

Sourcing issues were more prevalent among respondents at elevated financial risk. Over half of the 23 respondents with elevated financial risk reported having experienced input availability problems or supply chain disruptions from 2010 to 2014, and severe input price fluctuations were more than twice as common among elevated risk respondents (see Figure VI-5). Many of these supply chain problems can contribute to an organization's financial strain, due to factors such as increased lead times, costs of finding new materials or suppliers, and inability to pass along price increases to customers.

Figure VI-5: Sourcing Issues by Financial Risk Score, 2010-2014



Q3bB, Q9

98 respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

VII. OPERATIONAL ISSUES

In order to better understand the capabilities and challenges of the carbon fiber composite industrial base, BIS asked respondents for information on their ability to increase their production levels, as well as on the issues that were impacting their operations. Different categories of respondents in the overall supply chain exhibited vastly differing rates of capacity utilization and therefore had very different time requirements for expansion (see Figure VII-1).

Figure VII-1: Capacity Utilization and Expansion Capabilities, 2014

Time to reach full capacity and 50% above full capacity

	Average Current Utilization Rate	Average Weeks Necessary to Reach 100% Utilization	Average Weeks Necessary to Reach 150% Utilization
Carbon Fiber Producers	90%	8	52
Carbon Fabric Providers	30%	12	25
Composite Product Manufacturers	36%	12	20

Q4A *82 respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

The six producers of carbon fiber reported an average capacity utilization rate of 90 percent, equivalent to operating 24 hours-per-day for approximately six days a week. Reaching full capacity would take relatively little time from this level of production, requiring an average of just eight weeks to reach. For carbon fiber producers to increase their production to 50 percent

above their 2014 capacity would require a full year, over twice as long as for the other two categories of survey respondents.

New carbon fiber production lines are typically dedicated to one specific fiber type, and take years to build. In an example that may be representative of the state of the industry as a whole, according to public annual reports with the Securities and Exchange Commission (SEC), a U.S.-based producer of carbon fiber—Cytec Industries—has been constructing a new carbon fiber production line since 2012, and does not expect the line to be completed and qualified for aerospace until 2016.[8] Such extended timeframes help explain how easily material availability problems can arise, particularly if customer demand is difficult to forecast.

Providers of carbon fabric and composite product manufacturers, starting with much lower utilization rates, had greater ability to increase production based on 2014 capacity levels. However, they would require less time than carbon fiber producers to increase production to 50 percent above capacity levels. These types of businesses have much greater flexibility in responding to changes in demand, with shorter production cycles and wider availability of production equipment.

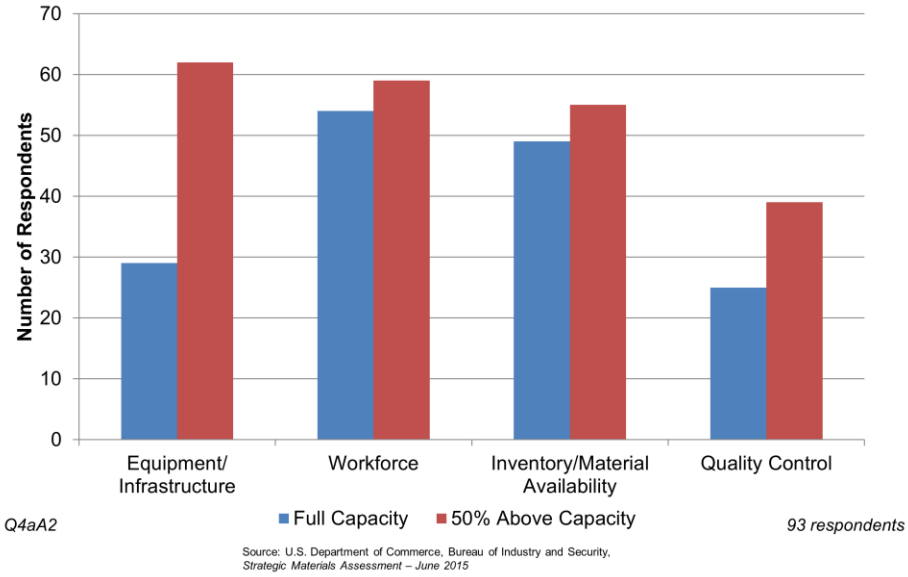
All types of businesses noted limits to equipment, facilities, and infrastructure as a major constraint to increasing their production capacity. Limits to these capital components were the most frequently cited constraint to increasing production to 50 percent above maximum capacity (see Figure VII-2). However, fewer than half of these respondents identified capital factors as an

[8] Cytec Industries' 2013 Annual Report (Form 10-K). Available at https://www.sec.gov/Archives/edgar/data/912513/000091251314000003/cyt-20131231x10k.htm

obstacle in reaching full capacity. On the whole, respondents had the necessary equipment to increase production to 100 percent capacity utilization, but in order to increase capital most would need significant changes in their equipment, facilities, or infrastructure. Several respondents noted long lead times on purchase of new equipment like autoclaves or large storage containers.

Figure VII-2: Constraints to Production Increases, 2014

Constraints in reaching full capacity and 50% above full capacity



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Workforce constraints were the most consistently cited issue for increasing production levels. Over half of all respondents identified labor availability or labor costs as a limit to their ability both to reach full capacity as well as to increase their future capacity. More than half the respondents would have to add employees even to reach full capacity utilization, and finding and training workers is often difficult and time-consuming.

One small respondent wrote that it is, “Very difficult to hire experienced work force. [We] must train new employees and this would slow growth rate due to time and personnel required to train new hires.” A medium respondent indicated that six months of training would be required, and another small respondent commented that the “workforce would be the single largest constraint” in increasing production levels.

VIII. ORGANIZATIONAL CHALLENGES

BIS provided respondents with a list of 27 potential business challenges (including an "other" category), and asked that they identify all areas that had affected their operations from 2010 to 2014. Respondents also ranked their five biggest challenges, providing additional insight on which were the most significant areas of concern. Every factor on the provided list was identified as an organizational challenge by multiple respondents.

Figure VIII-1: Organizational Challenges

Complete list of challenges to respondents' businesses provided in survey

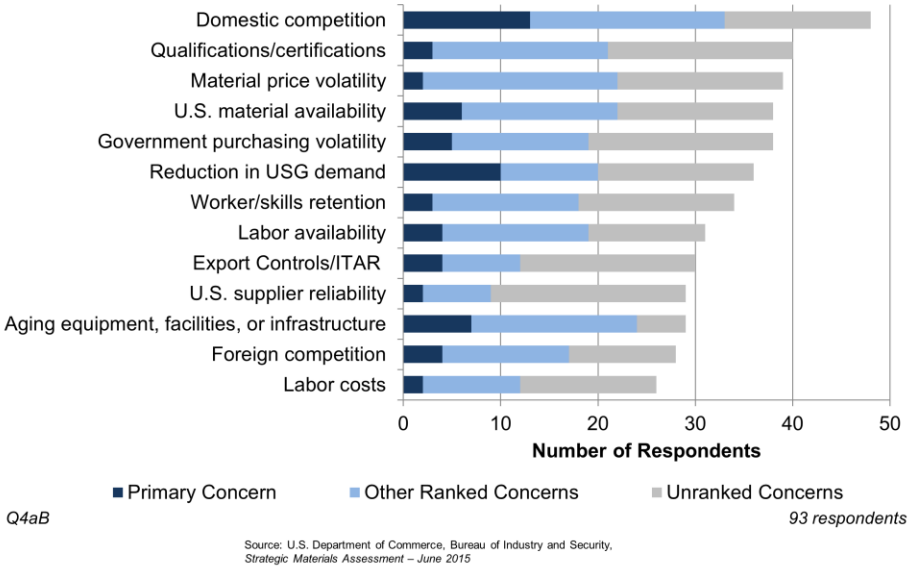
Aging equipment, facilities, or infrastructure	Labor costs	Reduction in USG demand
Domestic competition	Material price volatility	Qualifications/certifications
Environmental regulations/remediation	New production methods	Quality of inputs
Export controls/ITAR	New products	R&D costs
Foreign competition	Non-U.S. material availability	Taxes
Government purchasing volatility	Non-U.S. supplier reliability	U.S. material availability
Government regulatory burden	Pension costs	U.S. supplier reliability
Healthcare	Proximity to customers	Worker/skills retention
Labor availability	Proximity to suppliers	Other

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Domestic competition was identified by nearly half of all respondents as a challenge to their carbon fiber-related operations, and was also most frequently listed as a primary challenge (see Figure VIII-2). This level of attention to domestic competition is typical; virtually every study in which BIS has included this measure finds domestic competition to be a leading concern. As one small respondent succinctly stated, "Competition is always a problem."

Figure VIII-2: Top Organizational Challenges, 2010-2014

Respondents identified all challenges to operations and ranked their top five challenges



Q4aB *93 respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Other challenges tend to be more instructive in the difficulties particular to the carbon fiber composites industry. Issues like qualifications/certifications and material price volatility are not typically common business complaints, but are more specialized to the carbon fiber industry. Additionally, the number of respondents ranking aging equipment and reduction in USG demand as their primary business concern indicates that although some challenges may not be widespread, they affect some organizations severely.

Issues related to qualifications/certifications were the second most identified organizational challenge. Respondents commented that "aerospace qualifications can take years," and that "any new material requires program evaluation and qualification, which may cause significant schedule delays." Organizations with concerns about qualifications/certifications reported requiring significantly more time to increase their production levels. On average these

respondents estimated it would take 62 percent longer to reach full production capacity and over three times as long to reach 50 percent above current capacity. Additionally, several respondents expressed concern that required certifications add restrictive burdens and barriers to market entry, especially to smaller businesses.

The third most frequently cited business challenge was material price volatility. The vast majority of carbon fiber is created from polyacrylonitrile (PAN) precursors, a material derived from crude oil, the price of which is directly linked to that of crude oil. With PAN accounting for as much as half of the overall carbon fiber cost,[9] the considerable fluctuations in the price of oil in the past decade had major effects on carbon fiber costs. Even falling oil prices did not necessarily provide immediate help; as a medium respondent noted, "Fiber prices rising and falling creates issues with 'older' fiber costing more than current market conditions will support."

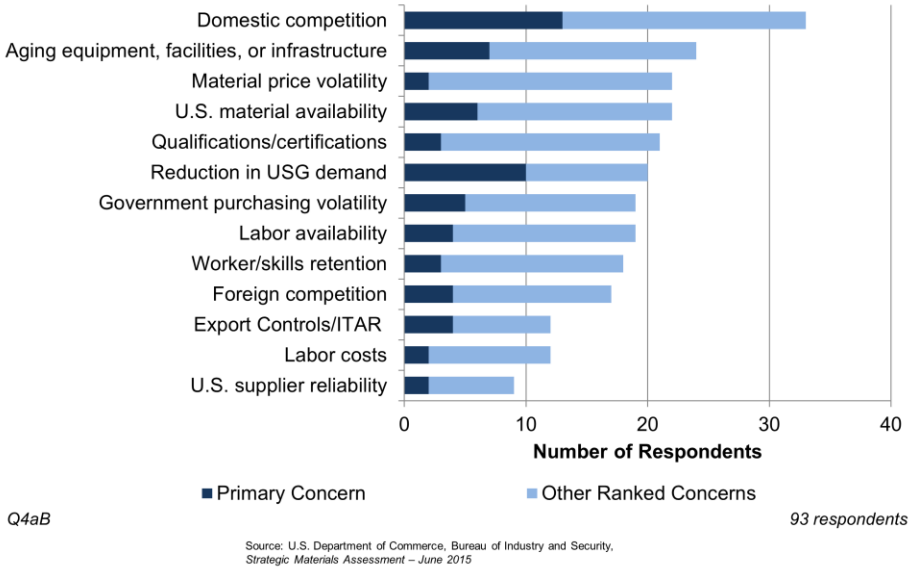
Some respondents also noted that the limited supplier base often drove price changes. The few carbon fiber producers that exist are often vertically integrated, creating additional limits to competition. SGL Group noted in their publicly available 2010 interim financial report, for instance, that the addition of a new joint venture meant they now had "two independent suppliers who exclusively produce precursor for SGL Group."[10] Similarly, according to the Toray Group's public announcements, their 2014 addition of a precursor plant in France gave them three proprietary precursor facilities.[11]

[9] Source: Oak Ridge National Laboratory presentation, dated May 9, 2011. Available at: http://energy.gov/sites/prod/files/2014/03/f11/lm002_warren_2011_o.pdf
[10] Available at http://www.sec.gov/Archives/edgar/vprr/0000/1001/10016304.pdf, accessed 1/15/2015
[11] Information from http://www.toray.com/csr/ourgroup/europe/eur_035.html, accessed 1/15/2015

Some challenges were not among the most commonly cited issues as a whole, but were significant challenges for those who did have them. One such acute issue was aging equipment, facilities, or infrastructure. While this was only the eleventh most cited challenge overall, it was second in the number of respondents ranking it in their top five challenges, and ranked third as respondents' primary challenge (see Figure VIII-3).

Figure VIII-3: Ranked Organizational Challenges, 2010-2014

Respondents identified all challenges to operations and ranked their top five challenges



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Five of the six carbon fiber producers surveyed reported that aging equipment, facilities, or infrastructure had impacted their operations since 2010. One of these respondents noted trouble with "Production interruptions due to failing equipment." Another wrote of an old production line: "It would require significant investment to bring up to a standard required for existing customer base."

A large portion of composites manufacturers also reported trouble from aging equipment, facilities, or infrastructure; one-third indicated these had affected their operations. Many of these noted that the upgrades required could not be incremental or piecemeal, but would rather require large investments in both new facilities and equipment. A medium respondent commented that they "need to replace aging equipment, [but their] footprint will not allow growth." A large respondent wrote that their "limited floor space, aged machinery, and facility is currently at maximum capacity." Respondents cited long lead times, expensive equipment, lack of access to capital, and the inability to include the cost of upgrades in their bids as major impediments to upgrading aging equipment.

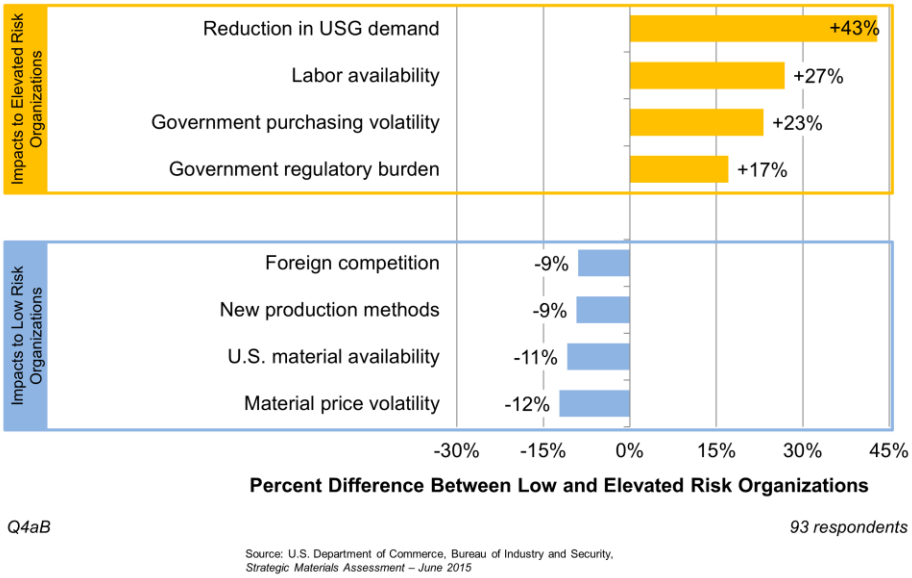
Concerns about reduction in USG demand were the sixth most frequently identified business challenge overall, but were second in the number of respondents marking this as their single biggest obstacle. Although the rapid expansion of carbon fiber composites in commercial and industrial sectors has made the industry as a whole less reliant on the U.S. Government, some companies remain reliant on government contracts.

One-third of respondents considered their organizations highly or moderately dependent on USG defense demand for carbon fiber composite-related products. Sixty-three percent of these respondents found reduction in USG demand to be an organizational challenge since 2010. Respondents cited reduced space program spending, lower than forecast aircraft demand, and budget sequestration as some of the most notable causes of concern.

Respondents with elevated financial risk had different types of concerns and organizational challenges than lower risk respondents. These higher risk respondents were disproportionately concerned about difficulties related to government demand and their workforces (see Figure VIII-4). Seventy percent of elevated risk respondents cited reduction in USG demand as an organizational challenge. This was just the eleventh most frequently cited issue for low risk respondents, identified by 27 percent.

Figure VIII-4: Operational Impacts by Financial Risk, 2010-2014

Areas of largest difference in operational impacts between low risk and elevated risk organizations



Q4aB *93 respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Government purchasing volatility was an area of high concern for both elevated and low risk companies, but was indicated as a challenge 23 percentage points more frequently by respondents at elevated risk (56 percent of elevated risk respondents compared to 33 percent of low risk respondents). These levels of concern over government demand are expected, given that 65 percent of elevated risk respondents consider their organization to be dependent on USG defense programs for their continued viability. Reductions and fluctuations in USG demand are likely a contributing factor to these respondents' elevated financial risk.

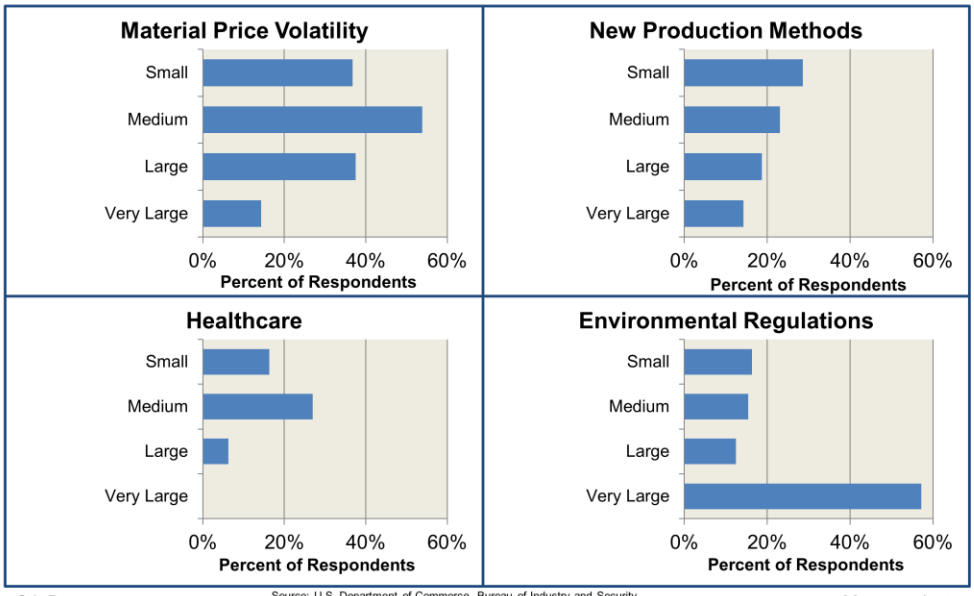
Neither labor availability nor labor costs were among the ten most frequently cited concerns for low risk organizations, yet among elevated risk respondents labor availability was listed third most often, and labor costs seventh most often. In some cases, these respondents stated they had trouble competing for workers with large prime contractors in their areas. Others had difficulty affording new workers in a competitive pricing environment. One such respondent wrote, "Customers want us to hold pricing, but we have to increase wages." The pressures of increased labor costs, stagnant pricing, and less USG demand are major sources of concern among businesses at elevated financial risk.

At the other end of the spectrum, respondents with elevated financial risk were markedly less concerned about new products and production methods, material price volatility, and aging equipment than were low risk respondents. All four of these issues were outside of the ten most frequently identified concerns for elevated risk respondents, and none were ranked as the top concern for any of the respondents with elevated financial risk.

Several issues exhibited significant variability across respondents of different sizes. Material price volatility, new production methods, and healthcare were all more frequently noted as problems by smaller respondents, while environmental regulations were overwhelmingly more significant for very large respondents (see Figure VIII-5).

Figure VIII-5: Operational Challenges 2010-2014

Issues with significant variability by respondent size



Q4aB

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

93 respondents

Material price volatility has been discussed earlier, providing some insight into why smaller organizations might be more affected. Smaller companies typically have less negotiating power when it comes to pricing, and often buy for specific contracts, making it difficult to lock in prices ahead of time. Additionally, larger respondents are more likely to be vertically integrated, cushioning the effect of price fluctuations.

Neither new production methods nor healthcare were major concerns for the full set of respondents, yet each was of disproportionate concern for smaller companies. When it came to developing new production methods, many smaller respondents noted the up-front investment required. One small respondent wrote that it takes, "Major investments to keep current." Another commented that new production methods require "costly equipment and modifications."

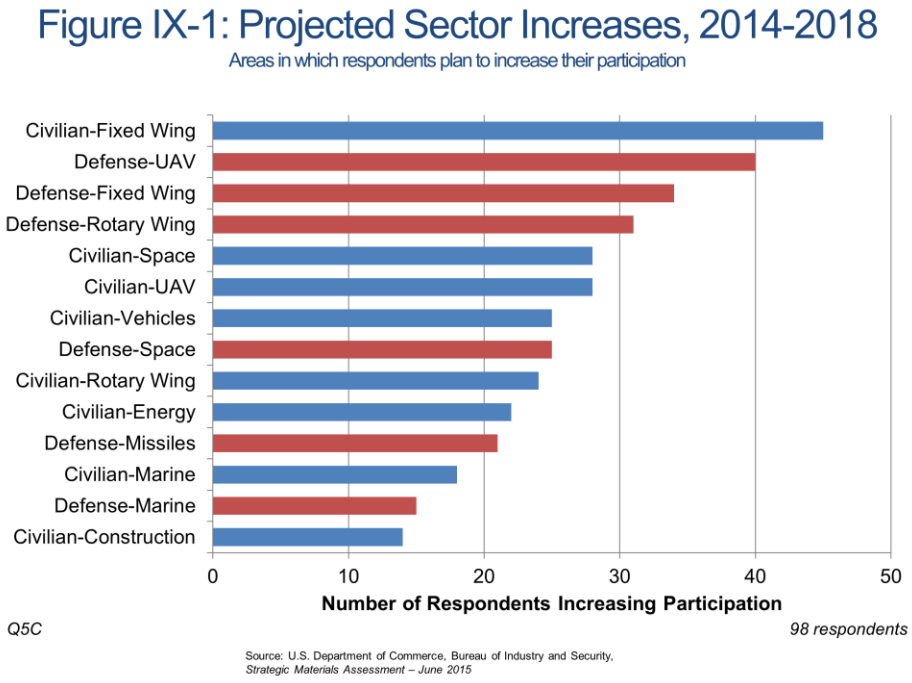
Many new production methods have increased technical requirements that are costly for smaller businesses to implement. One medium respondent found that new products brought "start-up issues that are requiring additional technical support," an issue that was echoed by other respondents. A small respondent wrote that "learning new techniques takes time. Time is money."

Healthcare was not a problem for most large and very large respondents, but impacted operations at nearly 20 percent of small and medium businesses. Large businesses are often better equipped to negotiate and absorb healthcare costs than smaller businesses. Every comment from respondents on healthcare noted high and quickly rising costs. One small respondent reported that healthcare is their "third largest expense behind only materials and labor." Others said it is "expensive and getting worse every year," and that "insurance costs are constantly going up."

Environmental regulations and remediation were a significant concern primarily for very large businesses (see Figure VII-5). These organizations dealt with a wider range of regulations, noting requirements from the U.S. Environmental Protection Agency (EPA), U.S. Department of Transportation (DOT), and the European Chemicals Agency (ECHA), as well as internal controls. Additionally, some respondents noted that while their organizations were not directly impacted by environmental regulations, they had major difficulties finding some materials due to environmental restrictions on their suppliers.

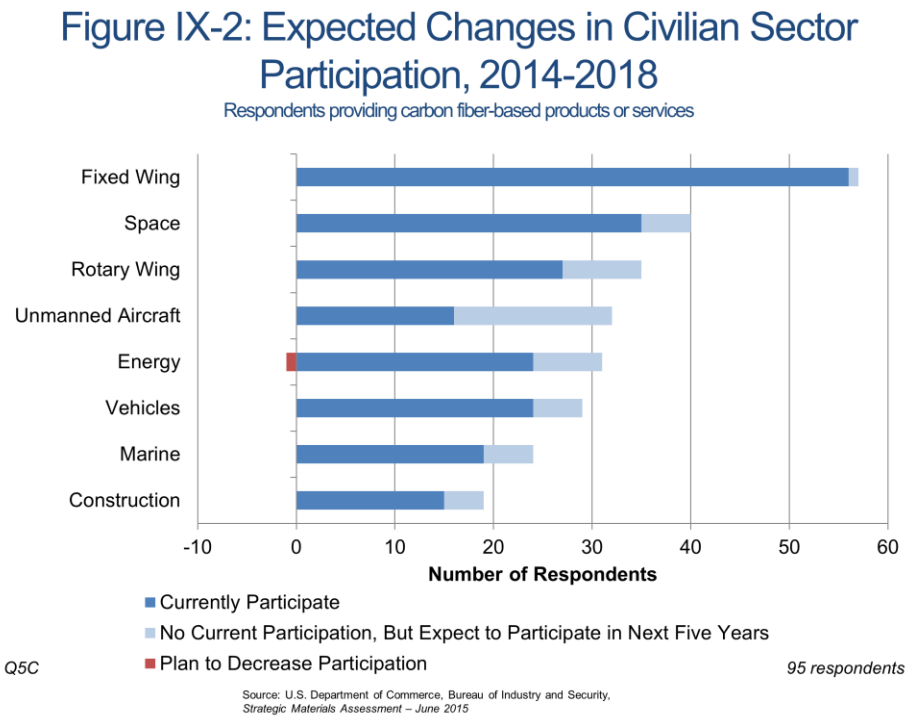
IX. End Usage Projections

Respondents provided BIS with data on the end usage areas of their carbon fiber-based products, as well as their expectations for broad usage trends from 2014 to 2018. On the whole respondents were optimistic, with most planning to increase participation in multiple usage areas. Fixed wing aircraft—both civilian and defense—were among the three most targeted sectors for expansion, along with defense unmanned aerial vehicles (UAVs) (see Figure IX-1).



In the civilian sector, participation was currently highest in fixed wing aircraft (see Figure IX-2). Over half of all respondents—and nearly two-thirds of respondents operating in the civilian sector—provided products or services for civilian fixed wing uses. This area was expected to continue to be a source of growth as the number and type of airplanes using carbon fiber

increases. One medium respondent commented, "Business jet growth is expected," while others cited the increased use of carbon fiber by Boeing and Airbus.



The UAV area was one of the lowest areas of current participation, but was expected to grow the most, with the number of respondents participating forecast to double from 2014 to 2018. A small respondent commented that the "FAA opening airspace to non-military use of UAV" would be a positive for them. Similarly, one very large respondent noted increasing "Interest in new materials from smaller UAV manufacturers."

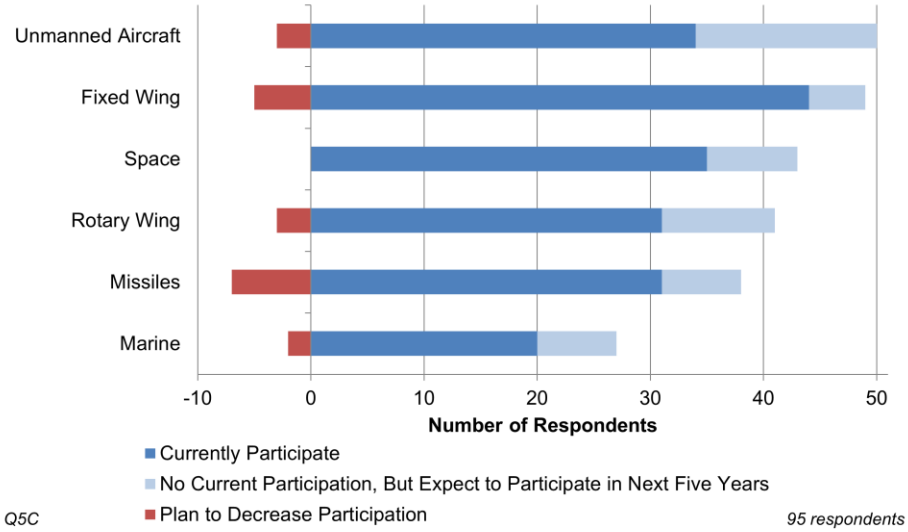
The lone civilian usage area in which any respondents planned to decrease participation was energy. The main source of concern was from wind turbines, with one small respondent writing, "[We] expect the wind energy market to be fickle, and the use of prepreg carbon to similarly 'come and go' with the fashion." Other respondents, however, expected wind turbines to

continue to be a growth driver. Additionally, a number of respondents were optimistic about the use of composites in offshore drilling, as well as in solar panels and fuel cells.

In the defense sector, as in the civilian sector, participation was strongest in fixed wing aircraft, though participation in the UAV area was expected to surpass that of fixed wing aircraft by 2018 (see Figure IX-3). Many respondents supporting defense fixed wing aircraft were preparing for continued growth. Several indicated reliance on the F-35 program for growth, providing comments such as, "Increased demand is mostly driven by F-35 JSF build rates." Others anticipated growth from foreign markets. One medium respondent stated, "Korean and Indian markets are driving the increase" in defense fixed wing aircraft orders.

Figure IX-3: Expected Changes in Defense Sector Participation, 2014-2018

Respondents providing carbon fiber-based products or services



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

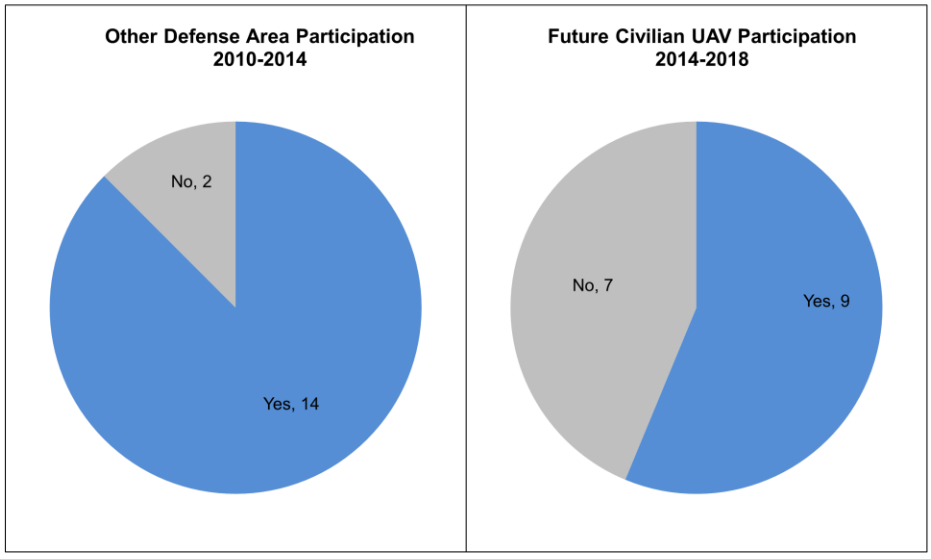
Several respondents did indicate plans to decrease their support for defense fixed wing aircraft. One large respondent stated, "Military programs are anticipated to reduce requirements" in this

area. Another indicated that the dominance of the F-35 program meant there was less other fixed wing aircraft work available.

The UAV area was projected to experience the strongest growth in participation of all defense areas. Sixteen respondents reported plans to enter the defense UAV market; as a result by 2018 more respondents are expected to provide products and services to this area than to any other defense area. These organizations were generally new to the UAV area but not new to supporting the defense sector; 14 of the 16 respondents already support another defense area (see Figure IX-4). Very few of these same organizations already provided products or services to the civilian UAV area, but most planned to start doing so by 2018.

Figure IX-4: Unmanned Aircraft Market Entrants – Defense Sector

Respondents planning to start supporting the defense UAV area between 2014 and 2018



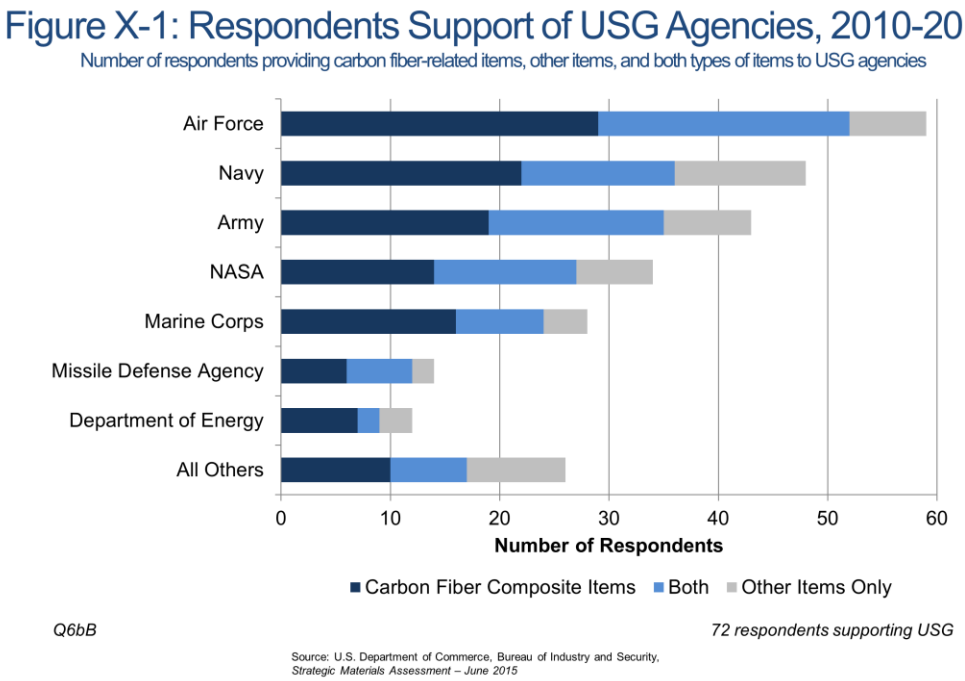
Missiles were one of the weakest defense usage areas, with seven respondents planning on decreasing their participation. A large respondent commented that they, "Anticipate reduced

DOD spending on this category." One very large respondent was not planning for a decrease, but was still "Not expecting additional defense spending; hoping for a no change scenario." Several respondents forecasting increases noted a reliance on exports; as a medium respondent wrote, their projected increase was "All driven largely by Foreign Military Sales."

Although respondents planned for decreases in participation in a number of defense sectors, they were not cutting defense participation across the board. Eighteen respondents planned to decrease their involvement in at least one defense sector, but only two respondents expected decreases in multiple defense sectors. Changes in defense sectors thus appear to reflect realignments of priorities, rather than broad decreases in defense participation.

X. Support for U.S. Government Programs

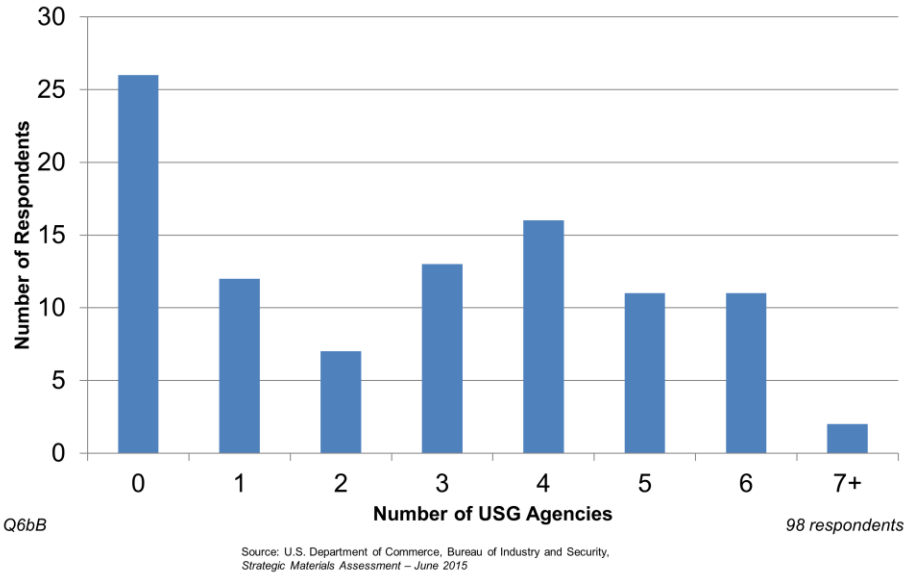
Despite the rapid expansion of carbon fiber products in a wide variety of commercial uses, the U.S. Government (USG) remains an important source of business for many organizations, particularly for defense applications. Seventy-two of the 98 respondents reported that they provided support to at least one USG agency from 2010 to 2014, and sales to the USG accounted for nearly one-quarter of all sales reported by respondents. The greatest number of respondents supported the Armed Forces and the National Aeronautics and Space Administration (NASA) (see Figure X-1).



The U.S. carbon fiber composite defense industrial base is highly interconnected. Eighty-three percent of respondents supporting the USG provided support to more than one agency, and half supported four or more agencies (see Figure X-2). For example, of the 59 respondents

supporting the U.S. Air Force (USAF), just five did not support another USG agency. Similarly, just three of the 48 respondents supporting the U.S. Navy supported only the Navy. Many of the respondents not currently providing products for the USG are still considered part of the defense industrial base; 14 of the 26 respondents providing no known USG support in their survey response indicated they had the capabilities to supply USG programs.

Figure X-2: Number of USG Agencies Supported, 2010-2014



Respondents also provided a list of the USG programs and systems they supported. BIS consolidated these free-text responses, identifying as many as 181 unique programs from 317 total programs identified.[12] Ten programs had at least five respondents providing products or services, led by the F-35 Joint Strike Fighter, with 14 respondents (see Figure X-3). Defense

[12] In some cases the ambiguity of the written response made program categorization impossible. These entries (such as "rocket launchers", or "helicopters" were not consolidated into other programs, but remained as unique "programs". The actual number of unique programs/systems supported may as a result be lower than the total calculated by BIS.

programs were the dominant type of program listed; the only non-defense agency with a significant number of program listings was NASA.

Figure X-3: USG Program Identification, 2010-2014

20 Most Frequently Supported USG Programs,

Program	Number of Respondents	Program	Number of Respondents
F-35 JSF	14	Delta IV	4
F/A-18 Super Hornet	9	RIM-161 Standard Missile 3	4
V-22 Osprey	9	Trident II D5 Missile	4
Sikorsky CH-53K	7	F-22 Raptor	4
Atlas Rocket	6	CH-47 Chinook	4
C-17 Globemaster	6	Orion	3
AH-64 Apache Helicopter	5	Zumwalt Class Destroyer	3
MQ-1 Predator	5	Tomahawk	3
UH-60 Blackhawk	5	C-130 J	3
AGM-158 JASSM	5	F-15E Strike Eagle	3

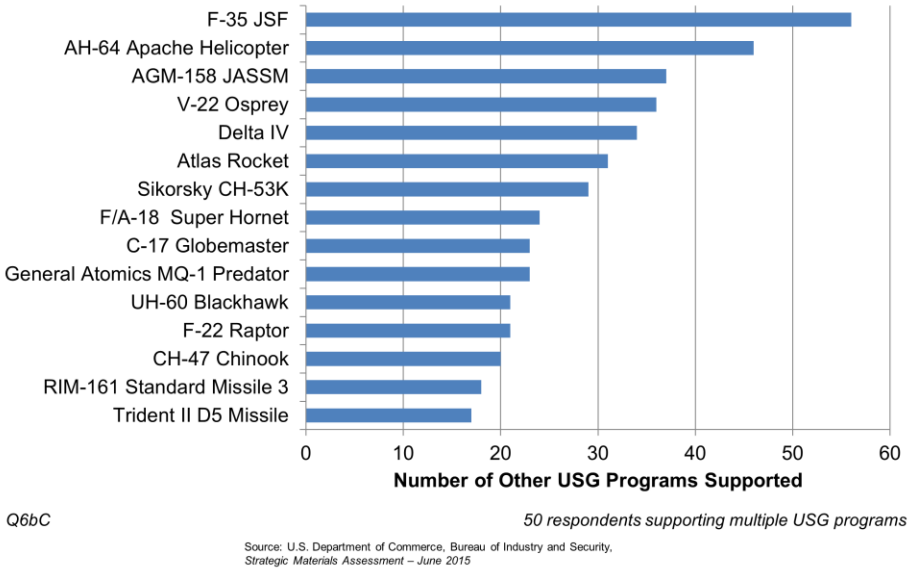
Q6bC *63 respondents identifying USG programs*

Source: U.S. Department of Commerce, Bureau of Industry and Security,
Strategic Materials Assessment – June 2015

Most respondents supported multiple USG programs. The average respondent supporting USG programs identified between four and five programs that they participated in, with some respondents listing the maximum of 20 programs. Accordingly, there are many interdependencies across USG programs and agencies, with changes to any one USG program having the potential to affect several other USG programs.

For many of the most frequently identified programs, the respondents supporting these also support over 20 other USG programs (see Figure X-4). For example, respondents supporting the F-35 Joint Strike Fighter supported over 50 other USG programs; for the AH-64 Apache Helicopter over 40 additional programs were supported.

Figure X-4: USG Program Identification – Respondent Cross-Program Support, 2010-2014

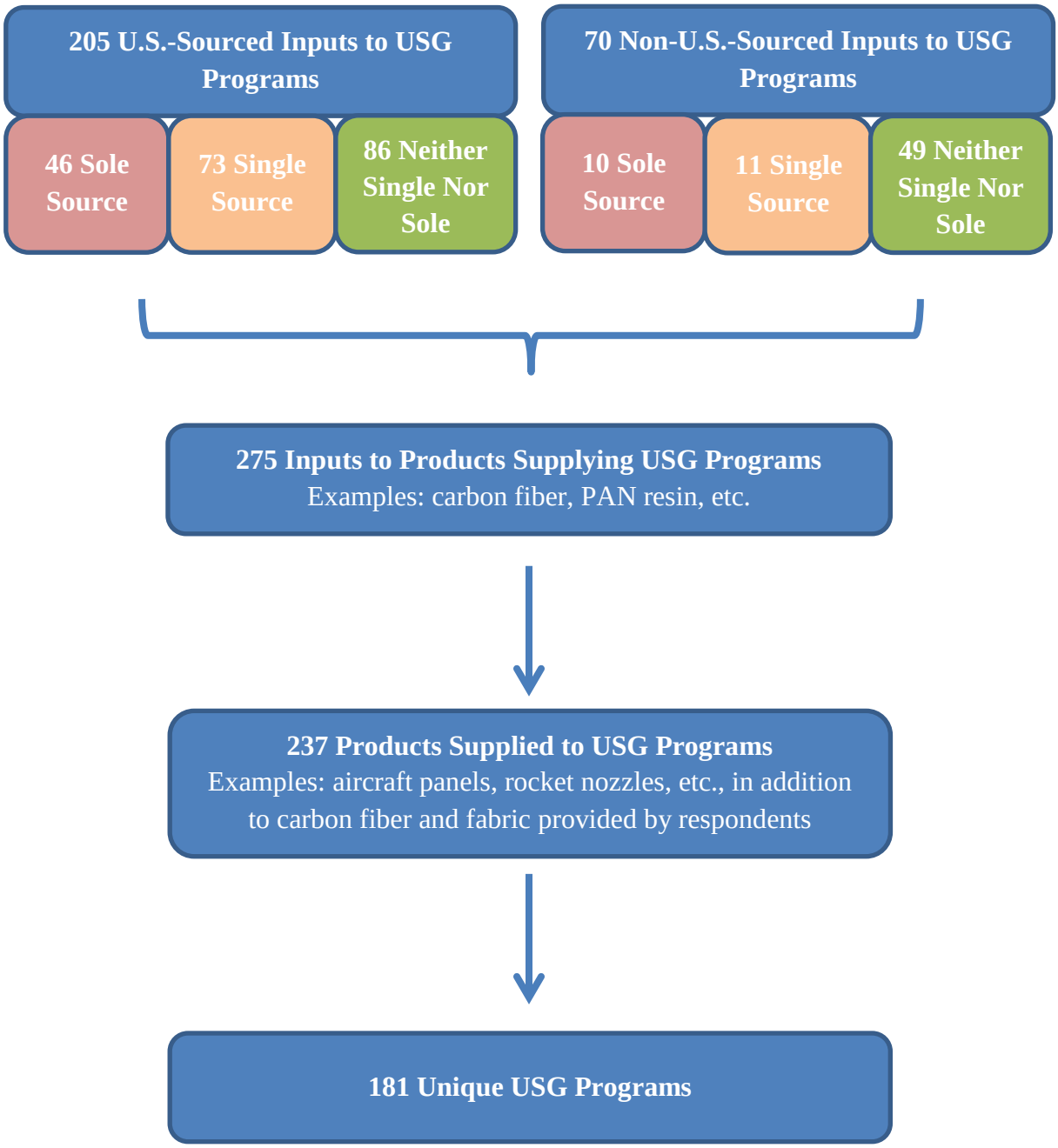


Cross-program dependencies make understanding the structure of the carbon fiber composites defense industrial base supply chain critical, as no program can be viewed in isolation. The survey template allowed for linkages between USG programs and respondents' products, and between these products and their component inputs.[13] Using this survey design, BIS was able to map material inputs across several tiers of the supply chain directly to USG programs. In total, respondents listed 275 inputs into 237 products going to USG programs (see Figure X-5). Three-quarters of these inputs came from suppliers located in the U.S.

[13] This structure also enables BIS to overlay financial analysis, vulnerabilities, and challenges across the supply chain for a robust analysis of the industrial base.

Figure X-5: Overall Supply Chain for USG Programs, 2010-2014

Inputs Used in Carbon Fiber-Related Products Supporting USG Programs

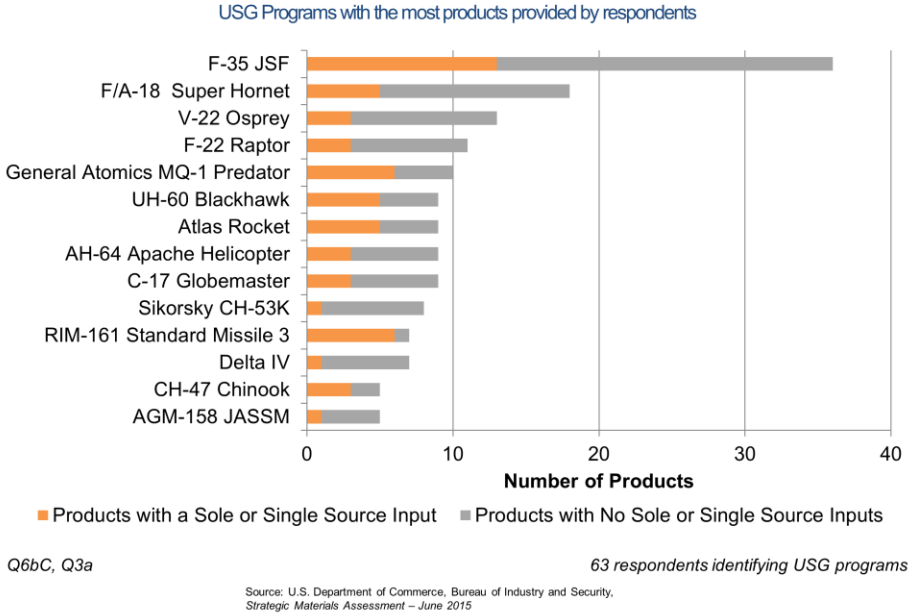


Just over half of the inputs respondents used for USG programs came from sole or single source suppliers. The largest portion of these inputs was carbon fibers or fabrics, which accounted for 122 of the 140 sole and single source inputs used for USG programs. Most sole and single source inputs used for USG programs came from suppliers located in the U.S. Twenty-one of these inputs came from non-U.S. sources, and all but one non-U.S. sole or single source suppliers for products used in USG programs were located in Japan or Germany.

Most USG programs supported by respondents contained products using sole or single source inputs. Forty-eight of the programs used a product with at least one sole source input, and 66 used a product with at least one single source input. The prevalence of sole or single source input usage was higher among the most frequently identified programs; 19 of the 20 most frequently identified programs had at least one product that utilized a sole or single source input.

For many of these USG programs, a significant percentage of the products provided by respondents used sole or single source inputs. In the case of the F-35 Joint Strike Fighter, for instance, 13 of the 36 identified products utilized at least one sole or single source input. (see Figure X-6). Additionally, four of these products contained multiple sole or single source inputs.

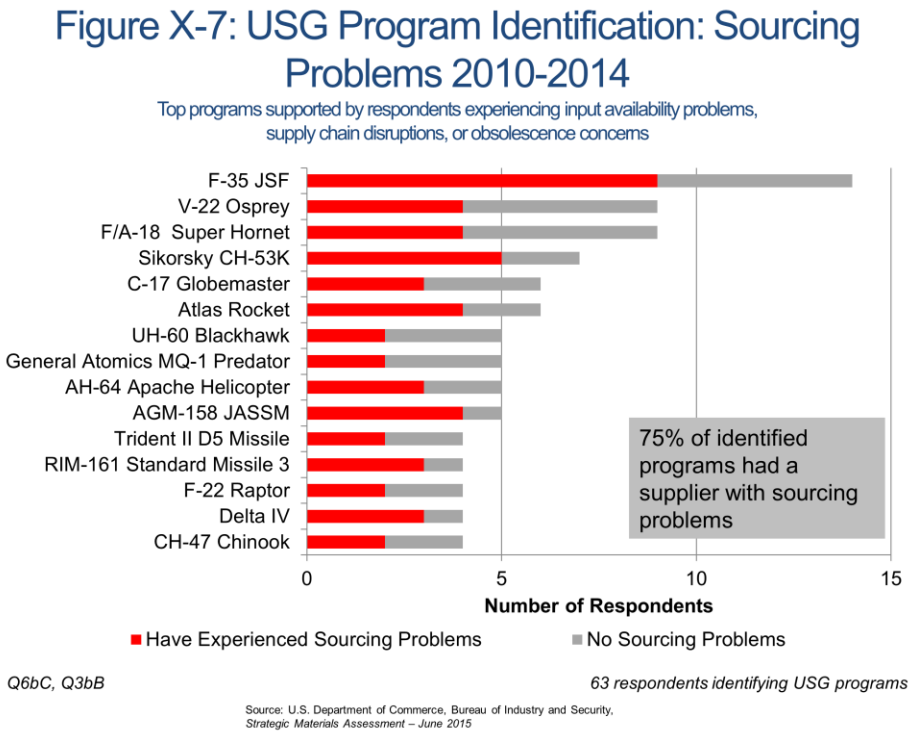
Figure X-6: Use of Sole and Single Source Inputs in Products for USG Programs, 2010-2014



The prevalence of sourcing difficulties tends to increase with greater dependence on sole and single sourcing. As noted earlier, many respondents reported input sourcing problems in the form of input availability problems, supply chain disruptions, and obsolescence concerns from 2010 to 2014. As a result, most of the USG programs identified in this survey were supported by respondents who experienced a supply chain problem from 2010 to 2014.

Fifty respondents reported having had input availability problems, supply chain disruptions, or obsolescence issues during this period, and these respondents supported 75 percent of the USG programs identified (see Figure X-7). In 71 percent of the USG programs at least half of the respondents supporting the program experienced a supply chain problem. These supply chain problems were not necessarily tied directly to the materials needed for USG programs, but even unrelated disruptions can expose the industrial base to vulnerabilities. As noted earlier,

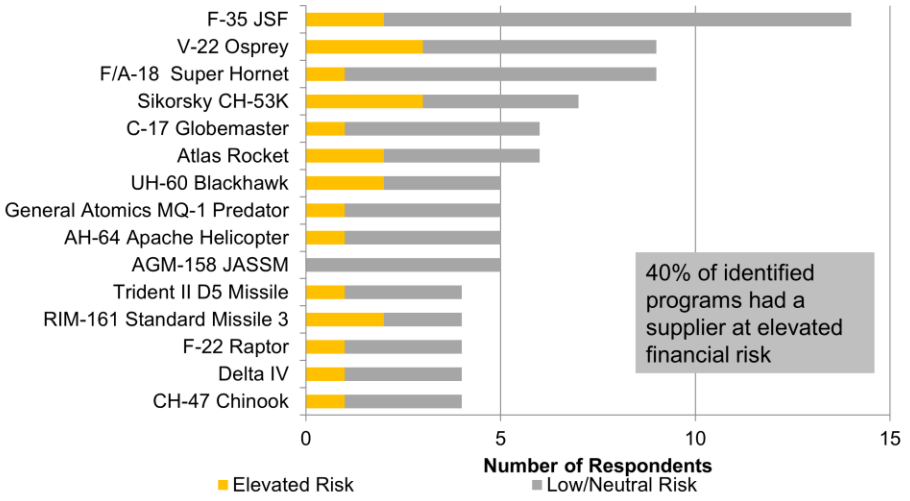
organizations with sourcing problems are more likely to be at elevated financial risk, as the costs of these supply chain problems can affect the entire organization.



Forty percent of the USG programs identified in this assessment were supported by at least one respondent at elevated financial risk, including all but one of the 15 most frequently supported programs (see Figure X-8). Additionally, of the 36 USG programs supported by multiple respondents, just two had no respondents with either supply chain problems or elevated financial risk. Most of the respondents at elevated financial risk supported multiple USG programs; 13 supported more than three programs and three respondents supported more than 10 USG programs.

Figure X-8: USG Program Identification: Financial Risk, 2010-2014

Top programs supported by respondents



Q6bC, Q9

63 respondents identifying USG programs

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

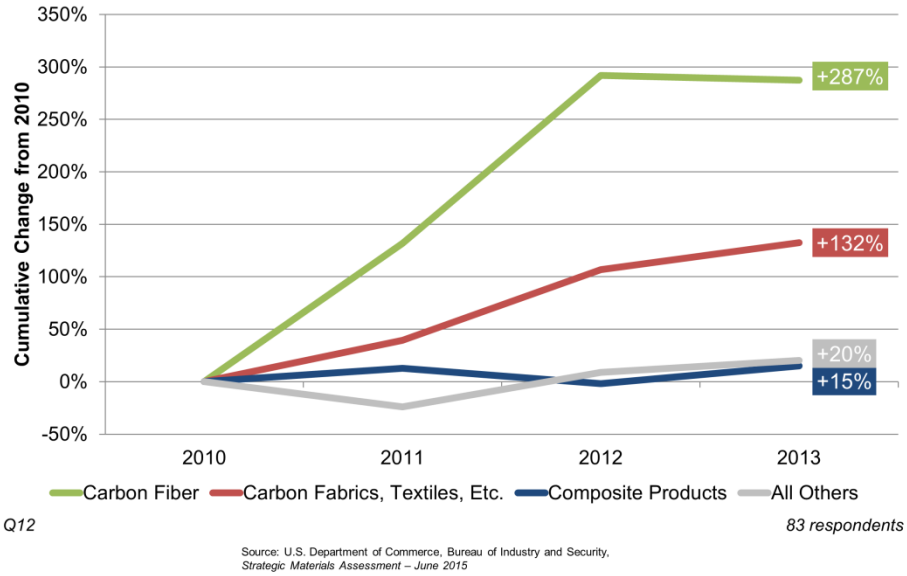
XI. CAPITAL EXPENDITURES

Total capital expenditures by respondents grew robustly, with aggregate capital expenditures of all 98 reaching $1.4 billion in 2013, up 63 percent from 2010. Capital expenditures tied directly to carbon fiber-related products accounted for 40 percent of the total and grew more rapidly, increasing by 78 percent from 2010 to 2013 to reach $583 million.

However, at the individual respondent level capital expenditures were much more modest. Five respondents accounted for 88 percent of all carbon fiber-related capital expenditures from 2010 to 2013; most other respondents reported average annual carbon fiber-related capital expenditures well under $1 million.

Additionally, the levels of growth in capital expenditures were highly differentiated by the respondents' primary business line. Producers of carbon fiber exhibited by far the greatest increases in capital expenditures, followed by suppliers of carbon fabrics and textiles (see Figure XI-1). In contrast, manufacturers of composite parts added little to their capital expenditures across the period; nearly half of composite product manufacturers with capital expenditures in 2010 had reduced their level of expenditure by 2013.

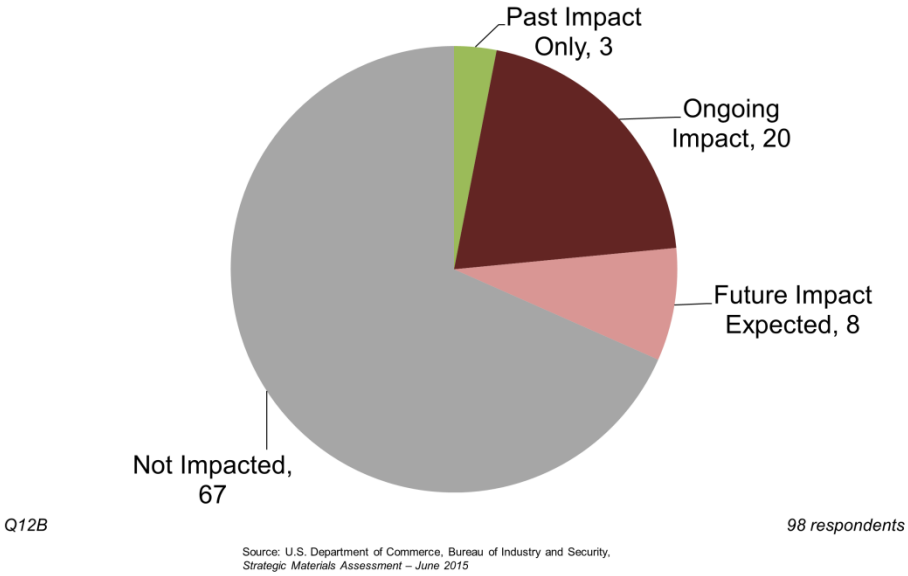
Figure XI-1: Total Change in Capital Expenditures by Primary Business, 2010-2013



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Many of the respondents with decreasing capital expenditures indicated that reductions in USG defense spending were a reason for the drop. Overall, over 30 percent of respondents reported that their capital expenditures were or would be adversely impacted by reductions in USG defense spending (see Figure XI-2). One small organization that reduced their capital expenditures from 2010 to 2013 wrote, "If U.S. Government defense spending would have remained equivalent to [the level it was] before 2012, we would have purchased new equipment to manage both defense work as well as commercial."

Figure XI-2: Respondents with Capital Expenditures Impacted by Reductions in USG Defense Spending



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

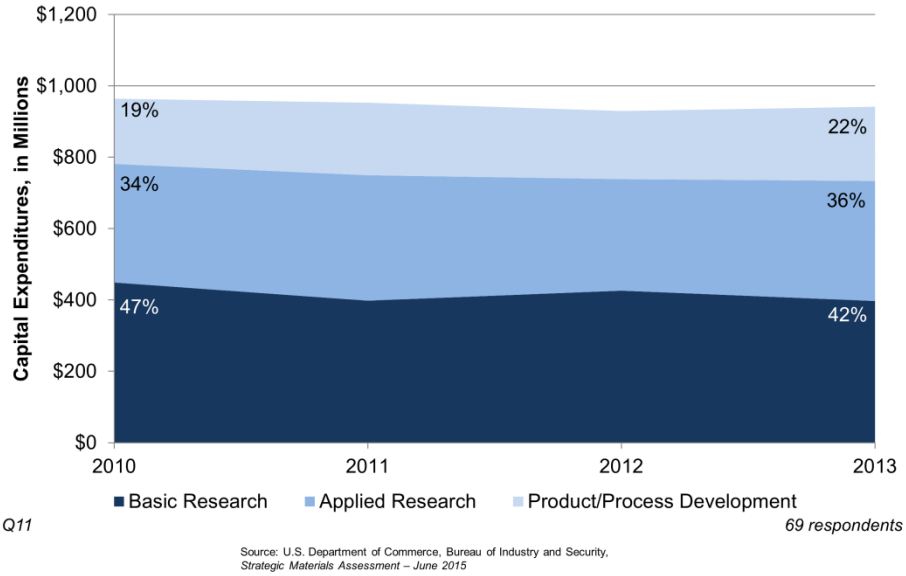
Another small organization wrote that changes in USG spending were severe enough to have "caused the entire company to rethink its plan for capital expenditures, both in terms of location (Europe vs. USA) and market focus." Several respondents commented that delays to the Joint Strike Fighter program were impacting their capital expenditures; one large organization wrote that "Delayed JSF ramp-up and reduced peak program build rates have deferred capital investment for [our] new facility."

XII. Research and Development Expenditures

Sixty-nine of the 98 respondents reported $980 million of total research and development (R&D) expenditures in 2013, $225 million of which was related to carbon fiber. As with capital expenditures, R&D expenditures were highly concentrated among a few larger respondents. Three respondents accounted for two-thirds of total R&D spending, and five respondents accounted for 90 percent of carbon fiber-related spending.

Total R&D expenditures by respondents declined two percent from 2010 to 2013, with spending on basic research falling by 11 percent (see Figure XII-1). The impact of this $52 million drop was lessened by increases in applied research and product/process development ($4 million and $25 million increases respectively).

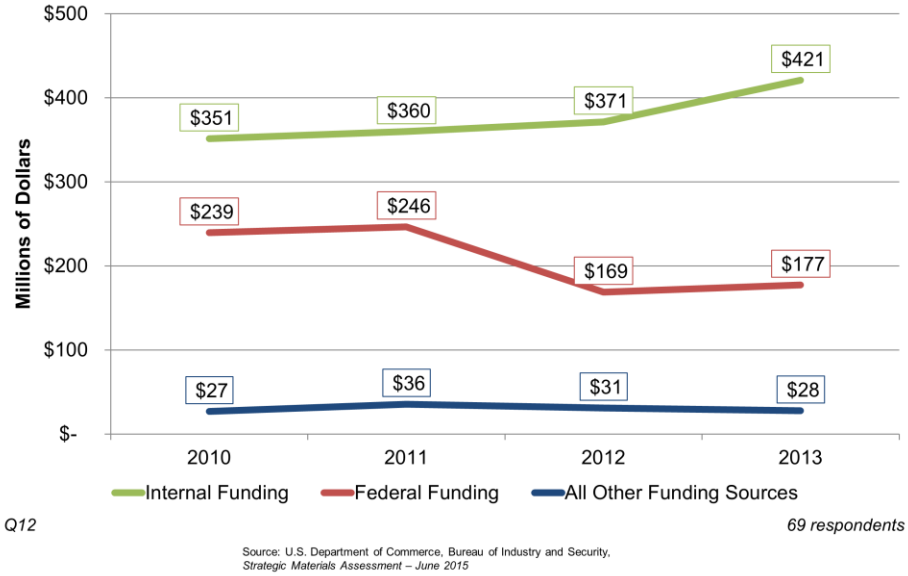
Figure XII-1: Aggregate R&D Expenditures, 2010-2013



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

A significant factor in R&D reductions was a decrease in the availability of external funding. R&D funding received from the USG decreased 26 percent from 2010 to 2013 (a $62 million decline), increasing respondents' reliance on internal funding. In 2013, internal funding for R&D accounted for over two-thirds of all funding sources, up from 57 percent in 2010 (see Figure XII-2).

Figure XII-2: Capital Expenditures by Funding Source, 2010-2013

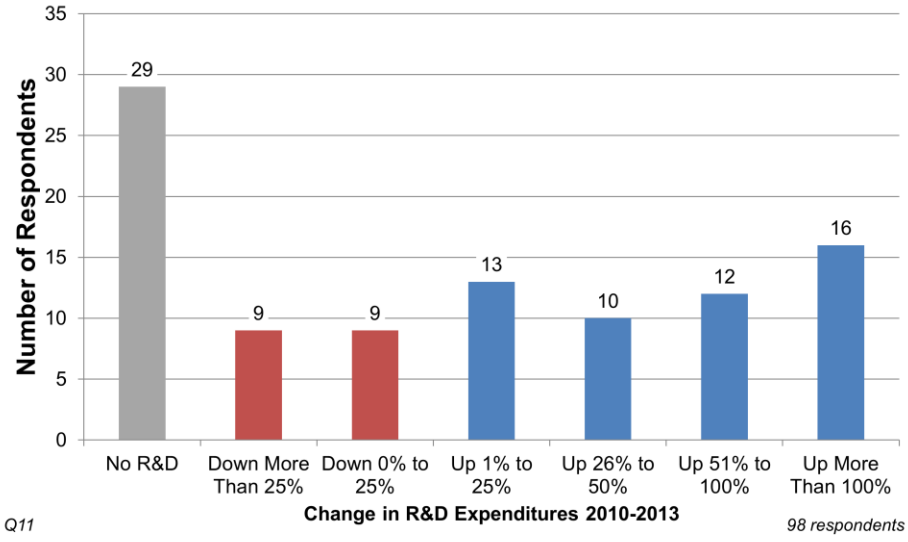


Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Despite the overall reduction in R&D, most respondents increased their R&D expenditures. Of the 69 respondents reporting R&D expenditures, 51 increased their expenditures from 2010 to 2013, and more than half of those increased R&D expenditures by more than 50 percent, though typically from a small base (see Figure XII-3). Eighteen respondents decreased their R&D expenditures from 2010 to 2013, with three organizations accounted for 88% of the reductions in dollar terms.

Figure XII-3: Change in R&D Expenditures, 2010-2013

Net change by individual respondents



Q11

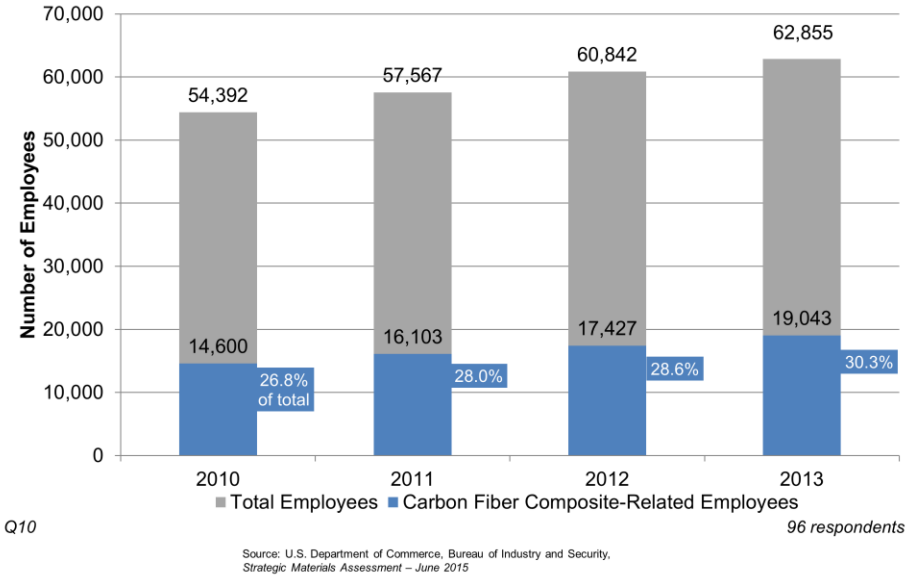
98 respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

XIII. EMPLOYMENT

The 98 respondents employed nearly 63,000 workers in 2013, a 16 percent increase from 2010 (see Figure XIII-1). Carbon fiber-related workers made up a minority of all workers, but accounted for an increasing share of the total. Carbon fiber-related employment grew by 30 percent from 2010 to 2013, more than twice the rate of other employment.

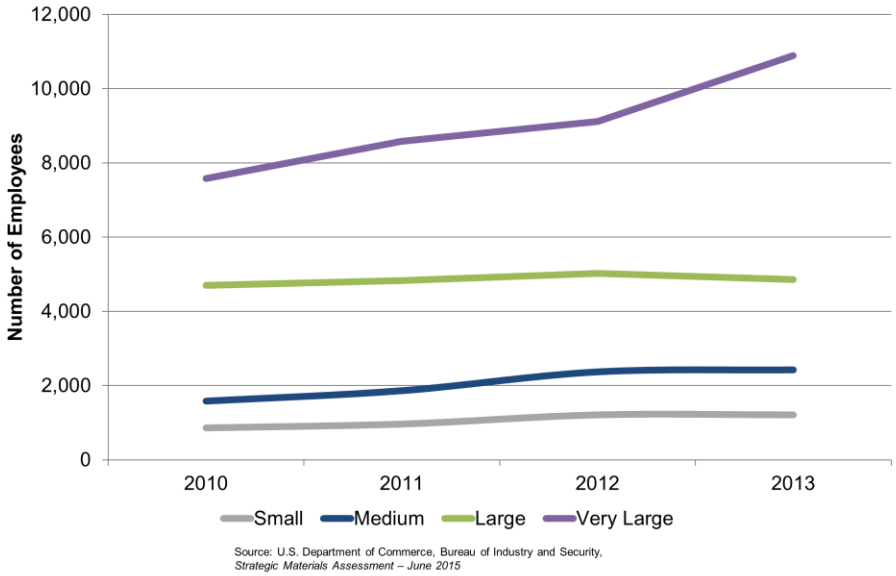
Figure XIII-1: Total and Carbon Fiber Composite-Related Employment, 2010-2013



Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Larger respondents employed a disproportionately high number of carbon fiber-related workers, with the seven very large respondents having 56 percent of all carbon fiber-related workers. Conversely, while small organizations accounted for half of the survey sample, they employed just six percent of the carbon fiber-related employees (see Figure XIII-2).

Figure XIII-2: Carbon Fiber-Related Employment by Respondent Size, 2010-2013

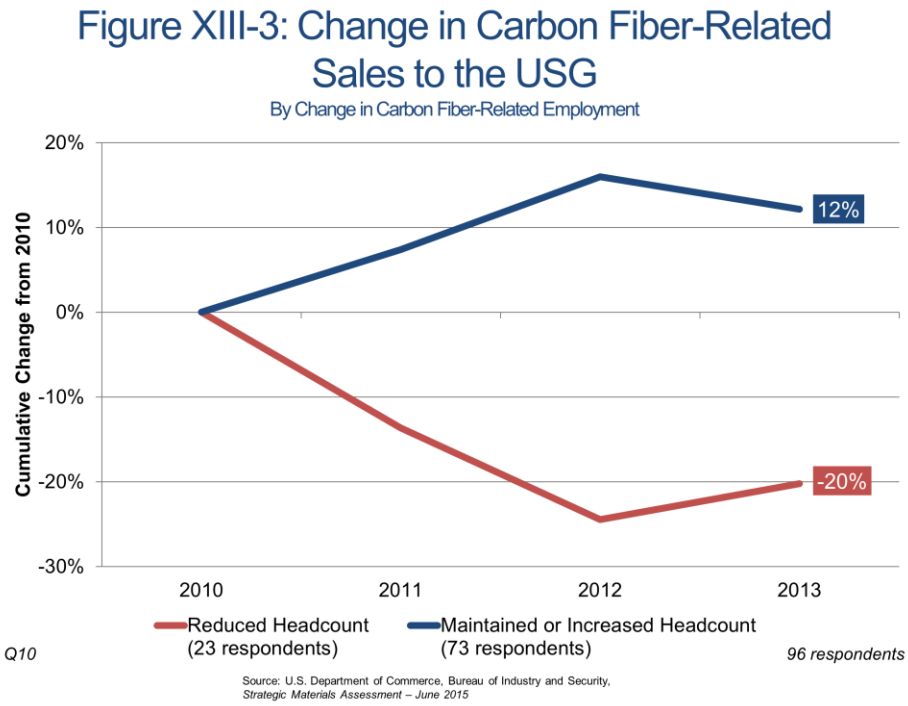


Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Eighteen respondents reduced their carbon fiber-related headcount from 2010 to 2013, cutting 496 positions. Most of these respondents were small; 11 had under $25 million in average annual sales, and all but three had fewer than 100 carbon fiber-related workers. As indicated previously, many of these smaller respondents reported difficulties competing with their larger counterparts, in areas like access to materials, developing new production methods, and workforce training. This may have been a factor in retaining employees, due to both direct competition for workers from larger and better funded organizations, and to competition for sales reducing the ability of small companies to maintain their workforces.

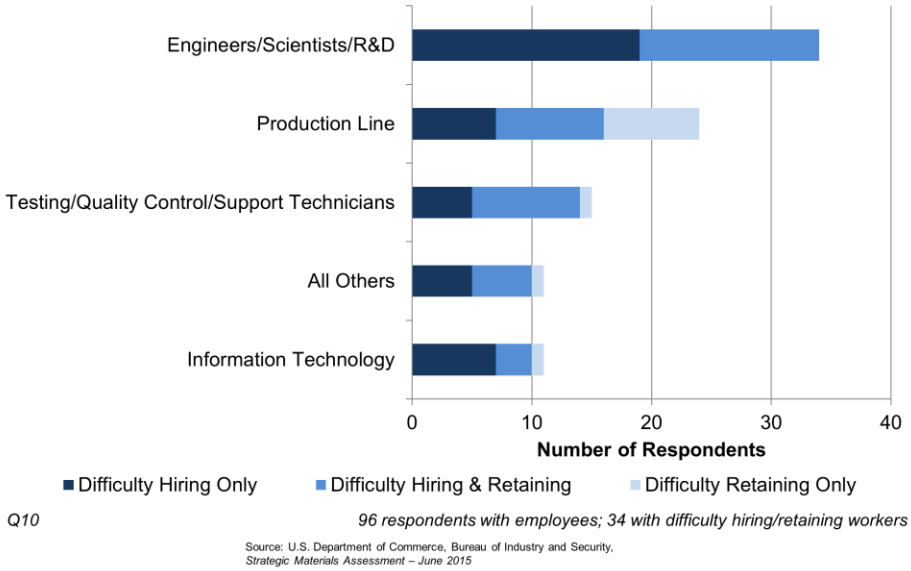
One significant difference between respondents who decreased their levels of carbon fiber-related employees and those who did not was their sales to the USG. The 23 respondents who reduced their employee levels generally reported declining carbon fiber-related sales to the USG,

while others did not (see Figure XIII-3). Overall, these respondents were not more dependent on the USG but did report diminished success selling their products to the USG.



Among the majority of respondents that did increase their workforces, half reported difficulty hiring or retaining workers. Engineers, scientists, and R&D staff were the most difficult positions to attract and keep. Every one of the 34 respondents who had difficulty hiring or retaining workers had trouble with these positions (see Figure XIII-4). The main other occupation that respondents had trouble keeping filled was production line work, where retention of workers was a major issue.

Figure XIII-4: Difficulty Hiring and Retaining Workers, 2010-2014



Q10 *96 respondents with employees; 34 with difficulty hiring/retaining workers*

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Respondents indicated two major causes for their difficulties finding engineers, scientists, and R&D staff: undesirable work locations and lack of experience. Many companies located in rural or remote locations noted a lack of qualified local candidates and challenges in attracting highly skilled workers. As one small respondent summarized, workers "don't like our location, are unwilling to relocate, [and find the] pay too low."

The other major area of concern in hiring engineers, scientists, and R&D staff was lack of practical experience. A small respondent wrote, "Too many engineers are 'qualified' but not 'practical'." Several respondents commented that their work has "very specific skillset requirements" or had "highly specialized skills needed," which made finding workers with relevant experience difficult.

For production line workers, the major complaints were heavy turnover and a limited number of skilled workers. For many respondents, high turnover rates were linked to the lack of qualified workers. A very large respondent wrote, "The incoming labor pool is not as experienced and the work can be labor intensive and repetitive. As result, the inexperienced labor pool cannot meet the performance expectations and/or they find this work is not an individual fit."

Other respondents echoed this comment. A small respondent wrote that "Capabilities and interest are issues," and another found, "Few candidates with textile background, [and a] general lack of people wanting to do recurring production duties." Several respondents noted that higher pay would help retain workers, but that heavy competition meant they would be unable to pass those costs along to customers. One small respondent noted that they would hire and train workers only to find other companies recruit them away with better pay.

XIV. Requests for Government Assistance

As part of the survey, BIS provided respondents with an opportunity to request information on federal and state services aimed at helping companies better compete in the global marketplace. Fifty-four of the 98 respondents indicated they would like to receive information on at least one of the 12 assistance areas (see Figure XIV-1). BIS generated bulletins covering programs from a wide variety of USG agencies, including the Small Business Administration, Department of Labor, National Science Foundation, State Department, and several Department of Commerce agencies, such as NIST's Manufacturing Extension Partnership.

Figure XIV-1: Interest in Government Assistance

Areas of interest in information from USG agencies

Q13a *54 respondents seeking assistance*

Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment – June 2015*

Two of the most requested areas of assistance were related to exporting. The greatest number of respondents sought information on global export opportunities, with nearly as many interested in assistance with export licensing. Several respondents commented in the survey that export

control regulations are hindrances to their ability to compete. Costs of these controls are both direct—in terms of lost sales—and indirect, via additional administrative costs, inefficient labor allocations, and long lead times.

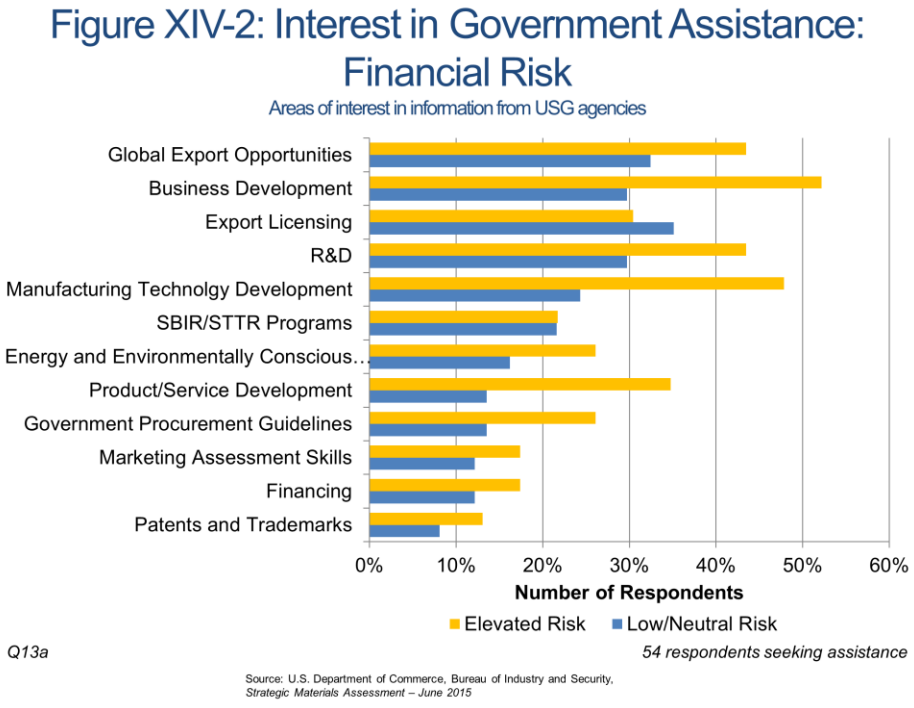
One small respondent wrote that export controls "take manpower that can be better utilized in other areas to ensure compliance. The regulations are not clear and can be misinterpreted very easily." Similarly, a medium respondent commented, "We have had to hire a person to be responsible for International Traffic in Arms Regulations (ITAR) control and have had to add an ITAR statement to many documents."

However, another medium respondent wrote that the USG export control reforms are having a positive effect, noting that the "recent re-classification of space materials has helped." As found in the 2014 BIS report *U.S. Space Industry "Deep Dive" Assessment: Impact of U.S. Export Controls on the Space Industrial Base*, many businesses do not attempt to export because of their perceptions of the export control system. Providing these organizations with more information on export control reforms may help push some who have never exported before to begin to do so.

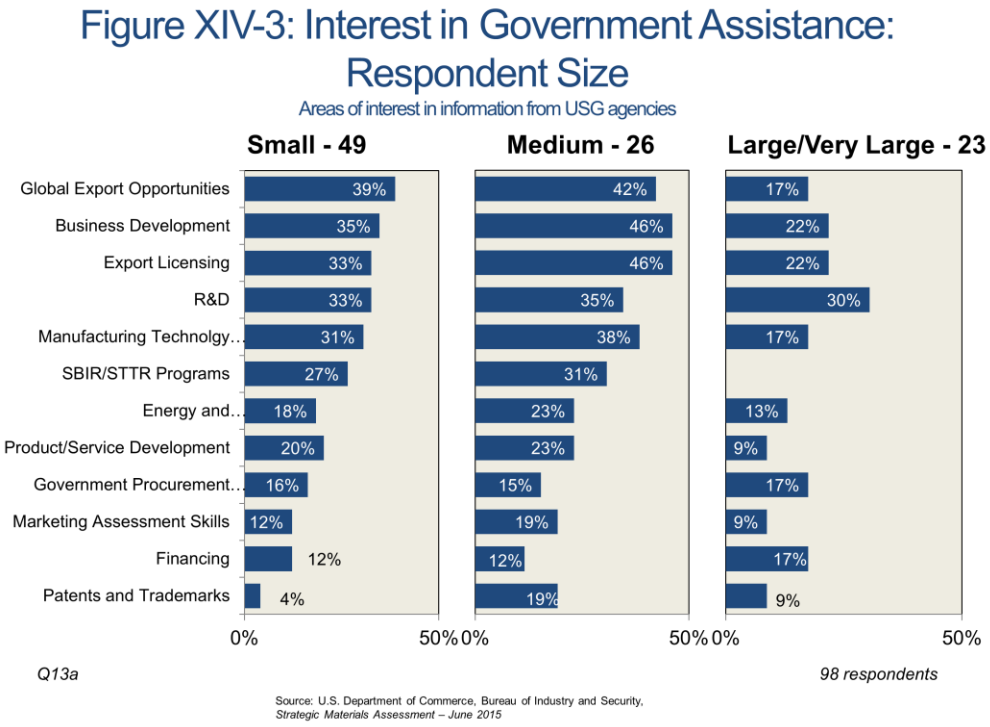
Assistance in business development was equally as requested as global export opportunities, sought by roughly one-third of respondents. Organizations requesting information about business development programs were disproportionately more reliant on the USG at the time of the survey. Forty-one percent identified their organizations as dependent on USG programs for their continued viability, and 44 percent listed reduction in USG demand as one of the top

challenges facing their business. These respondents were also more likely than not to be at elevated financial risk, the only assistance area in which this was the case.

In almost all categories, respondents at elevated financial risk sought more assistance than lower risk respondents (see Figure XIV-2). The largest difference in interest was in manufacturing technology development, where respondents at elevated financial risk were twice as likely to request assistance. Business development and product/service development were similarly much more commonly identified by elevated risk respondents than those with lower risk. These respondents appear to see a need to upgrade their processes and products, and require assistance in implementing changes.



Small and medium respondents were significantly more likely than larger respondents to indicate an interest in USG assistance programs (see Figure XIV-3). The only area in which more than one-quarter of larger respondents sought information was in R&D assistance. Large and very large respondents on average expressed interest in assistance in two areas compared to between three and four areas for small and medium respondents. As discussed earlier, several smaller respondents commented on the difficulties they faced competing with their larger counterparts, in finding material inputs, hiring and retaining workers, and selling their products. Government information and assistance may be helpful in overcoming some of these challenges.



XV. FINDINGS

Industry Profile

- BIS received 98 survey responses covering carbon fiber producers, distributors, weavers, prepreggers, composite product manufacturers, and other carbon fiber-related businesses. Just over half of the respondents were composite product manufacturers.
- Sixty-nine respondents were privately held organizations, and 24 of the 29 publicly traded organizations provided a business unit or divisional survey response.
- Respondents anticipated significant changes to 37 of their 177 facilities between 2014 and 2018. Each of these changes was to prepare for increasing carbon fiber-related business.

Sales and Financial Performance

- Carbon fiber-related products constituted an increasing percentage of respondents' total sales, growing from less than 24 percent in 2010 to a forecasted 29 percent in 2014. Commercial sales of carbon fiber-related products were a key driver, growing at an annualized rate of 19 percent.
- Twenty-two respondents reported decreases in sales from 2010 to 2013, with half experiencing sales drops over 25 percent. Two-thirds of the respondents with declining sales were small organizations (less than $25 million in average annual sales).
- BIS developed a customized financial risk metric to portray the overall financial condition of respondents. Twenty-three respondents were labeled as moderate/elevated risk from 2010 to 2013.

- The number of respondents with negative net profits grew across the period, rising from 17 percent of respondents in 2010 to 25 percent in 2014. Most of this increase came from respondents whose primary business was the production of composite products.
- Over half of the 51 composite product manufacturers identified their organization as dependent on USG demand. These organizations were more likely than others to report net losses.
- Respondents with elevated financial risk were significantly more likely to have: decreased capital expenditures and R&D expenditures from 2010 to 2013; reduced their workforce size over that period; and had difficulty hiring or retaining workers.

Products and Inputs

- The 98 respondents identified a total of 869 products or product types they provided. Two-thirds of these products were related to carbon fiber composites, with the majority of the remainder being glass fiber products. Most products containing carbon fiber used polyacrylonitirile- (PAN) based fibers, which were found in ten times as many products as the next most common precursor, rayon.
- Approximately one-third of all products identified by respondents were intended for defense usage. By comparison, less than five percent of global carbon fiber production is estimated to be used in the defense sector.

Supply Chain Issues

- Respondents listed 519 key supplier inputs to their products, which BIS determined to be sourced from 128 unique suppliers. Five suppliers accounted for half of all listings and for three-quarters of all carbon fiber listings.
- Forty-one percent of respondents used a single source supplier and 34 percent used a sole source supplier.
- Forty percent of respondents had input availability problems between 2010 and 2014, and 43 percent experienced a supply chain disruption.
- Over half of the 23 respondents with elevated financial risk reported having experienced input availability problems supply chain disruptions, and severe input price fluctuations were more than twice as common among this group.

Operational Issues

- Carbon fiber producers were operating at 90 percent capacity utilization on average in 2014, while other types of respondents averaged under 40 percent capacity utilization.
- Carbon fiber producers would require a full year on average to increase production to 50 percent above 2014 capacity, over twice as long as other types of respondents.
- Equipment, facilities, and infrastructure would be the biggest limit to increasing capacity, followed closely by workforce constraints.

Organizational Challenges

- Issues related to qualifications/certifications were the second most identified organizational challenge. Respondents with these concerns indicated they would require

62 percent more time to reach full production capacity and over three times as long to reach 50 percent above 2014 capacity.

- Five of the six carbon fiber producers surveyed reported aging equipment, facilities, or infrastructure has impacted their operations since 2010. One-third of composite product manufacturers reported trouble from aging equipment, facilities, or infrastructure. Many noted that upgrades would require large investments both in new facilities and equipment.
- One-third of respondents considered their organizations highly or moderately dependent on USG defense demand for carbon fiber-related products. Sixty-three percent of these identified reductions in USG demand as an organizational challenge, citing reduced space program spending, lower than anticipated aircraft demand, and budget sequestration as notable causes of concern.
- Respondents with elevated financial risk were disproportionately concerned about difficulties related to government demand and to their workforces. Seventy percent of these respondents cited reduction in USG demand as an operational challenge, compared to 27 percent of low risk respondents. Labor availability and costs were the third and seventh most identified challenges by elevated risk respondents, but neither were in the top 10 for low risk respondents.
- Material price volatility, new production methods, and healthcare were more frequently noted as problems by smaller respondents.

End Usage Projections

- Over half of all respondents and nearly two-thirds of respondents operating in the civilian sector provided products or services for civilian fixed wing aircraft uses. This area was expected to continue to be a source of growth from 2014 to 2018 as the number and type of airplanes using carbon fiber increases.
- Unmanned aerial vehicles (UAVs) was one of the lowest areas of current civilian sector participation, but was expected to grow the most, with the number of respondents operating in the area forecast to double from 2014 to 2018.
- In the defense sector, participation was strongest in fixed wing aircraft, but participation in the UAV area was expected to surpass that of fixed wing aircraft by 2018. Sixteen respondents reported plans to enter the defense UAV market, most of whom also planned to begin supporting the civilian UAV market.
- The missile area was one of the weakest defense usage area projections, with seven respondents planning on decreasing their participation.

Support for USG Programs

- Seventy-two of the 98 respondents reported that they provided support to at least one USG agency from 2010 to 2014, and sales to the USG accounted for nearly one-quarter of all sales.
- Eighty-three percent of respondents who supported the USG provided support to more than one agency, and half supported four or more agencies.
- Respondents identified as many as 181 unique USG programs they supported. The average respondent provided products to between four and five programs.

- Respondents listed 275 inputs they used for 237 products that supported the 181 USG programs. Three-quarters of these inputs came from suppliers located in the United States.
- Most USG programs identified in the survey contained products using sole or single source inputs. Forty-eight of the programs used a product with at least one sole source input, and 66 used a product with at least one single source input. Nineteen of the 20 most frequently identified programs had at least one product that utilized a sole or single source input.
- Most USG programs identified in this survey were supported by respondents who experienced a supply chain problem from 2010 to 2014. Fifty respondents reported having had input availability problems, supply chain disruptions, or obsolescence issues during this period, and these respondents supported 75 percent of the USG programs identified.
- Forty percent of the USG programs identified in this assessment were supported by a respondent at elevated financial risk, including all but one of the 15 most frequently supported programs. Of the 36 USG programs supported by multiple respondents, just two were free of respondents with supply chain problems or elevated financial risk.

Capital Expenditures

- Capital expenditures tied to carbon fiber-related products accounted for 40 percent of all capital expenditures and grew more quickly, increasing by 78 percent from 2010 to 2013, to reach $583 million.

- Five respondents accounted for 88 percent of all carbon fiber-related capital expenditures. Most other respondents reported average annual carbon fiber-related capital expenditures well under $1 million.
- Nearly half of composite product manufacturers with capital expenditures in 2010 had reduced their expenditure levels by 2013. Thirty percent of respondents reported that their capital expenditures were or would be adversely impacted by reduction in USG defense spending.

R&D Expenditures

- Sixty-nine of the 98 respondents reported a total of $980 million of R&D expenditures in 2013, $225 million of which was related to carbon fiber. Three respondents accounted for two-thirds of all R&D spending, and five respondents accounted for 90 percent of carbon fiber-related R&D.
- R&D funding received from the USG decreased 26 percent from 2010 to 2013. As a result, internal funding for R&D grew from 57 percent of funding in 2010 to two-thirds in 2013.

Employment

- The 98 respondents employed nearly 63,000 workers in 2013, up 16 percent from 2010. Carbon fiber-related employment grew at twice the rate of other employment, reaching 19,000 workers in 2013.
- Eighteen respondents reduced their carbon fiber-related headcount from 2010 to 2013, cutting 296 positions. Most of these respondents were small, with 11 having under $25

million in average annual sales and all but three having fewer than 100 carbon fiber-related workers.

- Among the majority of respondents that did increase their workforces, half reported difficulty hiring or retaining workers. Engineers, scientists, and R&D staff were the most difficult positions to attract and keep. Every one of the 34 respondents who had difficulty hiring or retaining workers had trouble with these positions. Two of the most common causes for these difficulties were undesirable work locations and lack of applicant experience.

Requests for Government Assistance

- Fifty-four respondents requested information on USG programs and services designed to aid them in competing in the global marketplace. Two of the three most requested areas of assistance related to export assistance: global export opportunities and export licensing.
- Assistance in business development was equally as requested as global export opportunities, sought by roughly one-third of respondents. Organizations requesting information about business development programs were disproportionately more reliant on the USG at the time of the survey, and more than half were at elevated financial risk.
- In nearly all categories of assistance, respondents at elevated financial risk sought more help than lower risk respondents. The largest gap was in manufacturing technology development, were respondents at elevated financial risk were twice as

likely to request assistance. Higher risk respondents appear to see a need to upgrade their processes and products but require assistance to implement changes.

- Small and medium respondents were significantly more likely than larger respondents to indicate an interest in USG assistance programs. The only area in which more than one-quarter of larger respondents sought information was in R&D assistance.

OFFICE OF TECHNOLOGY EVALUATION (OTE)
PUBLICATIONS LIST

July 24, 2015

The U.S. Department of Commerce's Office of Technology Evaluation is the focal point within the Department for conducting assessments of defense-related industries and technologies. The studies are based on detailed industry-specific surveys used to collect information from U.S. companies and are conducted on behalf of the U.S. Congress, the military services, industry associations, or other interested parties.

PUBLICATION TITLE	*__Bold__ indicate forthcoming studies
C-17 Supplier Impact Assessment – Fall 2016	
U.S. Rocket Propulsion Industrial Base Assessment – Spring 2016	
Printed Circuit Boards Supply Chain Assessment– Spring 2016	
Strategic Materials Supply Chain Assessment – Fall 2015	
Defense Industrial Base Assessment of the U.S. Underwater Acoustics Transducer Industry – Spring 2015	
Cost-Metric Assessment of Diminishing Manufacturing Sources and Material Shortages (Update) – February 2015	
U.S. Space Industrial Base "Deep Dive" Assessments: Small Businesses – December 2014	
U.S. Space Industrial Base "Deep Dive" Assessments: Workforce Issues – September 2014	
U.S. Space Industrial Base "Deep Dive" Assessments: Export Controls – February 2014	
Industrial Base Assessment of Consumers of U.S. Electro-Optical (EO) Satellite Imagery – August 2013	
National Security Assessment of the Cartridge and Propellant Actuated Device Industry: Fourth Review – July 2013	
Critical Technology Assessment: Night Vision Focal Plane Arrays, Sensors, and Cameras – October 2012	
National Aeronautics and Space Administration (NASA) Industrial Base – Post-Space Shuttle – June 2012	
Defense Industrial Base Assessment of the Telecommunications Industry Infrastructure – April 2012	
Reliance on Foreign Sourcing in the Healthcare and Public Health (HPH) Sector – December 2011	
Cost-Metric Assessment of Diminishing Manufacturing Sources and Material Shortages – August 2010	
Critical Technology Assessment: Impact of U.S. Export Controls on Green Technology Items – August 2010	
Technology Assessment of Fine Grain, High-Density Graphite – April 2010	
Defense Industrial Base Assessment of Counterfeit Electronics – January 2010	
Technology Assessment of 5-Axis Machine Tools – July 2009	
Defense Industrial Base Assessment of U.S. Integrated Circuit Design and Fabrication Capability – March 2009	
Defense Industrial Base Assessment of the U.S. Space Industry – August 2007	
Technology Assessment of Certain Aromatic Polyimides – July 2007	
Defense Industrial Base Assessment of U.S. Imaging and Sensors Industry – October 2006	
National Security Assessment of the Cartridge and Propellant Actuated Device Industry: Third Review – August 2006	

Archived Studies	
Economic Impact Assessment of the Air Force C-17 Program – Dec. 2005	Critical Technology Assessment of U.S. Artificial Intelligence – Aug.1994
National Security Assessment of the Munitions Power Sources Industry – Dec. 2004	Critical Technology Assessment of U.S. Superconductivity - April 1994
National Security Assessment of the Air Delivery (Parachute) Industry – May 2004	Critical Technology Assessment of U.S. Optoelectronics – Feb.1994
Industry Attitudes on Collaborating with DoD in R&D – Air Force – Jan. 2004	Critical Technology Assessment of U.S. Advanced Ceramics – Dec.1993
Industrial Base/Economic Impact Assessment of Army Theater Support Vessel Procurement – Dec.2003	Critical Technology Assessment of U.S. Advanced Composites – Dec. 1993
A Survey of the Use of Biotechnology in U.S. Industry – Oct. 2003	The Effect of Imports of Ceramic Semiconductor Packages on the National Security – Aug. 1993
Industrial Base Assessment of U.S. Textile and Apparel Industries – Sept. 2003	National Security Assessment of the U.S. Beryllium Industry - July 1993
Technology Assessment of U.S. Assistive Technology Industry – Feb. 2003	National Security Assessment of the Antifriction Bearings Industry – Feb. 1993
Heavy Manufacturing Industries: Economic Impact and Productivity of Welding – Navy – June 2002	National Security Assessment of the U.S. Forging Industry – Dec. 1992
The Effect of Imports of Iron Ore and Semi-Finished Steel on the National Security – Oct. 2001	The Effect of Imports of Gears & Gearing Products on the National Security – July 1992
National Security Assessment of the U.S. High-Performance Explosives & Components Sector –June 2001	Natl. Sec. Assessment of the Dom. and For. Subcontractor Base~3 US Navy Systems - March 1992
National Security Assessment of the U.S. Shipbuilding and Repair Industry - May 2001	Natl. Sec. Assessment of the U.S. Semiconductor Wafer Processing Equipment Industry - April 1991
Statistical Handbook of the Ball and Roller Bearing Industry (Update) - June 2001	National Security Assessment of the U.S. Robotics Industry - March 1991
National Security Assessment of the Cartridge and Propellant Actuated Device Industry: Update – Dec.2000	National Security Assessment of the U.S. Gear Industry – Jan. 1991
The Effect on the National Security of Imports of Crude Oil and Refined Petroleum Products – Nov. 1999	The Effect of Imports of Uranium on the National Security – Sept. 1989
U.S. Commercial Technology Transfers to The People's Republic of China – Jan. 1999	The Effect of Imports of Crude Oil and Refined Petroleum on Natl. Security – Jan. 1989
Critical Technology Assessment of Optoelectronics – Oct. 1998	The Effect of Imports of Plastic Injection Molding Machines on Natl. Security – Jan. 1989
National Security Assessment of the Emergency Aircraft Ejection Seat Sector – Nov. 1997	The Effect of Imports of Anti-Friction Bearings on the Natl. Security - July 1988
Critical Technology Assessment of the U.S. Semiconductor Materials Industry - April 1997	Investment Castings: A Natl. Security Assessment – Dec. 1987
National Security Assessment of the Cartridge and Propellant Actuated Device Industry – Oct.1995	An Economic Assessment of the U.S. Industrial Fastener Industry – Mar. 1987
International Market for Computer Software with Encryption – NSA -1995	Joint Logistics Commanders/DOC Precision Optics Study - June 1987
The Effect of Imports of Crude Oil and Petroleum Products on the National Security – Dec. 1994	Joint Logistics Commanders/DOC Bearing Study - June 1986

For further information about OTE's programs or for additional copies of reports, please visit us at
http://www.bis.doc.gov/dib or contact:
Brad Botwin, Director, Industrial Base Studies, OTE
Phone: 202-482-4060 Fax: 202-482-5650 E-mail: Brad.Botwin@bis.doc.gov

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OMB Control Number: 0694-0119
Expiration Date: 31 December 2014

DEFENSE INDUSTRIAL BASE ASSESSMENT:
Strategic Materials - CARBON FIBER COMPOSITE MATERIALS

SCOPE OF ASSESSMENT

The U.S. Department of Commerce, Bureau of Industry and Security (BIS), Office of Technology Evaluation (OTE), in coordination with the Defense Logistics Agency (DLA) is conducting an industrial base survey and assessment of the supply chain associated with select critical and strategic materials required for key defense systems and platforms. The focus of this survey is on the materials involved in the manufacture of carbon fiber composites.

The primary goal of this assessment is to assist the defense community in understanding the health and competitiveness of critical material suppliers, and identify specific issues and problems facing the industry. Over the longer term, agencies will be better informed to develop targeted planning and acquisition strategies to ensure the availability of the materials supply chain to support critical defense missions and programs.

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 14 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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Important Note:
Complete Section 2 before moving on to later sections. Menu options in later sections are based on information in Section 2.

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Section I: General Instructions	
A	Your organization is required to complete this survey using an Excel template, which can be downloaded from the U.S. Department of Commerce, Bureau of Industry and Security (BIS) website: www.bis.doc.gov/CFSurvey. At your request, survey support staff will e-mail the Excel survey template directly to your organization. For your convenience, a PDF version of the survey is available on the BIS website to aid internal data collection. DO NOT submit the PDF version of your organization's response to BIS.
B	Respond to every question. Surveys that are not fully completed will be returned for completion. Use comment boxes to provide any information to supplement responses provided in the survey form. Make sure to record a complete answer in the cell provided, even if the cell does not appear to expand to fit all the information. **DO NOT COPY AND PASTE RESPONSES WITHIN THIS SURVEY.** Survey inputs should be made manually, by typing in responses or by use of a drop-down menu. The use of copy and paste can corrupt the survey template. If your survey response is corrupted as a result of copy and paste responses, a new survey will be sent to you for immediate completion.
C	**Do not disclose any classified information in this survey form.**
D	If information is not available from your organization's records in the form requested, you may furnish estimates.
E	Questions related to this survey should be directed to BIS survey staff at **CFSurvey@bis.doc.gov** or by calling survey support staff and team lead David Boylan at 202-482-7808. Email is the preferred method of contact.
F	Upon completion, review, and certification of this Excel survey, transmit the survey via e-mail attachment to: **CFSurvey@bis.doc.gov**. Be sure to retain a copy for your records.
G	For questions related to the overall scope of this strategic materials industrial base assessment, contact: Brad Botwin, Director, Industrial Studies Office of Technology Evaluation, Room 1093 U.S. Department of Commerce, BIS 1401 Constitution Avenue, NW Washington, DC 20230

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Section II: Definitions

Term	Definition
Alloyed Metal	A metal made by combining two or more metallic elements to give, for example, greater strength or resistance to corrosion.
Applied Research	Systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met. This activity includes work leading to the production of useful materials, devices and systems or methods, including design, development, and improvement of prototypes and new processes.
Authorizing Official	Executive officer of the organization or business unit or other individual who has the authority to execute this survey on behalf of the organization.
Basic Research	Systematic, scientific study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind.
Commercial and Government Entity (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 a standardized method of identifying a given facility at a specific location. Find CAGE codes at: http://www.logisticsinformationservice.dla.mil/BINCS/begin_search.aspx
Component	Any raw material, substance, piece, part, software, firmware, labeling, or assembly which is intended to be included as part of the finished, packaged, and labeled device.
Customer	An entity to which an organization directly delivers the product or service that the facility produces. A customer may be another company or another facility owned by the same parent organization. The customer may be the end user for the item but often will be an intermediate link in the supply chain, adding additional value before transferring the item to yet another customer.
Data Universal Numbering System (DUNS)	A nine-digit numbering system that uniquely identifies an individual business. Find DUNS numbers at: http://fedgov.dnb.com/webform
Direct Support	Product/service is provided by your organization to the specified customer, not through a third party (for example, prime contractor or distributor).
Distributor	An entity that buys noncompeting products or product lines, warehouses them, and resells them to retailers or directly to the end users or customers.
Finished Product	Any product, or accessory to any product, that is suitable for use or capable of functioning, whether or not it is packaged or labeled.
Full Time Equivalent (FTE) Employees	Employees who work for 40 hours in a normal work week. Convert part-time employees into "full time equivalents" by taking their work hours as a fraction of 40 hours.
Indirect Support	Product/service is provided to the specified customer through a third party (for example, prime contractor or distributor).
Manufacturer	An organization that uses labor and capital to convert raw materials into finished or semi-finished goods. For the purpose of this survey, manufacturing includes integration and assembly.
Manufacturing Material	Any material or substance used in or used to facilitate the manufacturing process, a concomitant constituent, or a byproduct constituent produced during the manufacturing process, which is present in or on the finished device/product.
Matrix	The material that binds together the reinforcing fibers of a composite.
Modulus	The tensile modulus of the carbon fiber. Throughout this survey modulus will be measured in million pounds per square inch (MSI). The gradations are as follows, with both MSI and gigapascals (GPa) included for reference: Standard (below 40 MSI or 275 GPa); Intermediate (40-50 MSI / 275-345 GPa); High (50-65 MSI / 345-450 GPa); and Ultrahigh (Over 65 MSI / 450 GPa).
North American Industry Classification System (NAICS) Code	North American Industry Classification System (NAICS) codes identify the category of product(s) or service(s) provided by your organization. Find NAICS codes at: http://www.census.gov/epcd/www/naics.html
Precious Metals	Metals that have high economic value due to their rarity. Most commonly gold, silver, platinum, and palladium.
Prepreg	A fiber-based material in which the matrix material is already present but not yet fully cured.
Product/Process Development	The systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods, including design, development, and improvement of prototypes and new processes to meet specific requirements.
Rare Earth Element	A category that includes element numbers 57-71 of the periodic table (lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, and lutetium) as well as yttrium (39) and scandium (21).
Service	An intangible product (contrasted to a good, which is a tangible product). Services typically cannot be stored or transported, are instantly perishable, and come into existence at the time they are bought and consumed.
Single Source	An organization that is designated as the only accepted source for the supply of parts, components, materials, or services, even though other sources with equivalent technical know-how and production capability may exist.
Sole Source	A organization that is the only source for the supply of parts, components, materials, or services. No alternative U.S. or non-U.S. based suppliers exist other than the current supplier.
STEM	STEM stands for Science, Technology, Engineering and Mathematics.
Supplier	An entity from which your organization obtains inputs. A supplier may be another firm with which you have a contractual relationship, or it may be another facility owned by the same parent organization. The inputs may be goods or services.
Unalloyed Metal	A metal in its pure form, not combined with any other substance.
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	The percentage of an organization's potential output that is actually being used in current production, where potential output is based on a 7 day-a-week, 3x8-hour shift production schedule. Note: 100% utilization rate equals full employment with no downtime beyond that necessary for maintenance.

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Section 1a: Organization Information

A	From the dropdown, select the description that best identifies your organization:		
B	Indicate whether this survey response captures the operations of your whole organization or an individual business unit/division. Your organization may provide a single corporate-level response, or individual responses for each business unit/division with carbon fiber composite-related activities. All data throughout this response must be reported at the same organizational level.		
	Is this the sole response for your organization, or will additional business units/divisions be submitting responses? Unless a single corporate response is provided, all business units/divisions with carbon fiber composite-related activities must submit a response.		

C — Provide the following information for the level at which your organization is responding to this survey:

Organization Name	
Business Unit/Division Name (if applicable)	
Street Address	
City	
State	
Zip Code	
Website	
Phone Number	
Primary DUNS Code for this Level (nine digit number with no dashes)	

D — Provide the following information for your parent company, if applicable:

Organization Name	
Street Address	
City	
State	
Country	
Postal Code/Zip Code	
Primary DUNS Code for Parent Company (nine digit number with no dashes)	

E	Is your organization publicly traded or privately held?		

F — Point of Contact regarding this survey:

Name	Title	Phone Number	E-mail Address	State

Comments:	

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Section 1b: Organization Information

A	From the list below, identify any of the market segments your organization currently serves:		
	Aerospace		
	Automotive		
	Consumer goods		
	Construction/Infrastructure		
	Electronics		
	Engineering		
	Food/Agriculture		
	Healthcare/Medical		
	Industrial		
	Marine (surface and underwater)		
	Research and Development		
	Space (satellites, launch, instruments, support, etc.)		
	Telecommunication		
	Other	(specify)	
B	From the list below, identify any of the **defense-related** market segments that your organization currently serves:		
	Aircraft		
	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR)		
	Electronics		
	Energy/Power Generation		
	Ground Vehicles		
	Missiles		
	Research and Development		
	Marine (surface and underwater)		
	Space		
	Other	(specify)	

Comments:	

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Section 1c: Organization Information

A

From the list below, select all business lines related to carbon fiber-based composites in which your organization currently manufactures or distributes products.

Precursor chemical		
Carbon fibers		
Carbon fiber textiles/fabrics/tapes, etc. (including prepregs)		
Composite resins/matrices		
Composite structures		
Product integration/assembly		
Maintenance, repair, or overhaul		
Other business line(s) (specify)		
Other business line(s) (specify)		

B

Is your organization considered a small business, as defined by the Small Business Administration (SBA)?

For information on SBA's small business size standards, see:
http://www.sba.gov/category/navigation-structure/contracting/contracting-officials/eligibility-size-standards

If yes, specify the type of small business (e.g., minority-owned, 8(a), etc.):

C

Provide the following identification codes (see definitions), as applicable, to your organization.
*Find your organization's Commercial and Government Entity (CAGE) Codes at:
http://www.logisticsinformationservice.dla.mil/BINCS/begin_search.aspx

**Find your organization's North American Industry Classification System (NAICS) codes at:
http://www.census.gov/epcd/www/naics.html

Commercial and Government Entity (CAGE) Code(s)*	NAICS (6-digit) Code(s)**

Comments:

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Section 1d: Organization Information

Identify all of your organization's facilities with **carbon fiber composite-related** operations.

		Location			Operations		Outlook	
	Facility Name	City	State	Country	Facility Primary Operation (select from dropdown)	Specify Additional Detail or Other Business Line	Do you anticipate any significant changes in the operations at this facility over the next five years?	If yes, provide a brief explanation.
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Comments:	

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Section 2a: CARBON FIBER COMPOSITE-RELATED Products

Complete the table below to describe **ALL** of your organization's capabilities regarding **carbon fiber composite-related** products. This includes both items sold externally and those produced and used within your organization.
For example, if your organization produces carbon fibers or woven carbon materials later used to produce a composite component products at each stage must be included.

In the PRODUCT COMPOSITION portion, where applicable specify the **TYPE OF PRECURSOR** and **MODULUS OF THE CARBON FIBER** in the product, the **TYPE OF MATRIX** in the product, whether the product is itself or contains **PREPREG**, and provide a brief **ADDITIONAL DESCRIPTION** with any additional information/unique properties of the product. If you indicated **OTHER** in any section, specify the makeup of the product here.

In the END USE portion, indicate the primary **SECTOR** the final product is used in, its **PRIMARY APPLICATION**, as well as a more complete **END USE DESCRIPTION**, if known.

In the PRODUCT DISPOSITION portion, estimate the percentage of this product **USED ENTIRELY WITHIN YOUR ORGANIZATION,** and whether your organization is a **SOLE SOURCE** for the product.

		Product Name (write-in)	Product Type	Manufacture / Distribute	Product Composition					End Use			Product Disposition	
					Precursor Type	Carbon Fiber Tensile Modulus	Matrix Type	Prepreg Made or Used	Additional/Other Description (write-in)	Primary Sector Use	Primary Application	End Use Description (write-in)	Percentage used entirely within your organization	Sole Source of Product
A	1													
	2													
	3													
	4													
	5													
	6													
	7													
	8													
	9													
	10													
	11													
	12													
	13													
	14													
	15													

Comments:

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Section 2b: Other (Non-Carbon Fiber Composite-Related) Products

A Does your organization provide non-carbon fiber composite-related products and/or services? If no, proceed to Section 3a.

B Complete the information below for products your organization supplies that are unrelated to carbon fiber composites.

Select the **TYPE of MATERIAL** your organization supplies and provide a **PRODUCT NAME** and brief **PRODUCT DESCRIPTION** with any additional materials details in the product.
Complete the **PRIMARY SECTOR END USE** to indicate the product's general end use, select the **PRIMARY END USE APPLICATION** to specify the type of end use, and, if needed, provide an **ADDITIONAL/OTHER DESCRIPTION**.

	Product Composition			Manufacture/ Distribute (select from dropdown)	End Use		
	Material Type (select from dropdown)	Product Name (write-in)	Product Description (write-in)		Primary Sector End Use (select from dropdown)	Primary End Use Application (select from dropdown)	Additional/Other Description (write-in)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Comments:

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Section 3a: Suppliers for CARBON FIBER COMPOSITE - RELATED Product Lines

For each of the products your organization identified in the PRODUCTS Section (2a), indicate the name of **EXTERNAL SUPPLIERS** providing key inputs.

Where applicable, specify the **TYPE OF PRECURSOR** and **MODULUS OF THE CARBON FIBER** in the product, the **TYPE OF MATRIX** in the product, whether the product is itself or contains **PREPREG**, and provide a brief additional **DESCRIPTION** with any additional information/unique properties of the product. If you indicated **OTHER** in any section, specify the makeup of the product here.

In the INPUT PRODUCT APPLICATION portion, indicate which of your products identified in Section 2 use this input. If a single supplier is used for multiple inputs, repeat their information on an additional row.

	Supplier Name	Input Information						Supplier Information			Input Product Application		
		Input Type	Precursor Type	Carbon Fiber Tensile Modulus	Matrix Type	Prepreg	Description (write-in)	Supplier State	Supplier Country	Single/Sole Source	Carbon Fiber Composite-Related Product 1	Carbon Fiber Composite-Related Product 2	Carbon Fiber Composite-Related Product 3
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													

Comments:

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Section 3b: Inputs and Sourcing

A

Estimate your organization's average inventory of carbon fiber composite inputs (in weeks), based on the last two years of operation.

	Fibers (weeks of inventory)	Prepreg Fabrics (weeks of inventory)	Matrices (weeks of inventory)	
Standard Modulus PAN-based fibers (<40 MSI)			Polyimide Resin	
Intermediate Modulus PAN-based fibers (40-50 MSI)			Bismaleimide Resin	
High Modulus PAN-based fibers (50-65 MSI)			Epoxy	
Ultrahigh Modulus PAN-based fibers (>65 MSI)			Other (specify here)	

B

For each material listed below, identify which issues your organization has experienced since 2010:

Material	Input Availability Problems	Supply Chain Disruptions	Obsolescence	Severe Input Price Fluctuations	Explain
Precursor chemical for carbon fiber					
Carbon fiber					
Carbon fiber textiles					
Resin, epoxies, etc.					
Other					

Describe any steps you have taken to minimize the risk posed by the issues above:

C

Since 2010 has your organization experienced any problems due to critical components and/or materials no longer being produced?	
Does your organization expect to experience any such problems in the next five years?	

Identify reasons for these problems by selecting past, future, both, or neither:

Environmental Regulations		Production Costs		Export Controls		Other	(specify here)	
Other Regulations		End of Product Life Cycle		Foreign Competition		Other	(specify here)	

Describe the problems and any steps you have taken to minimize the risks posed by the issues above:

D

If your organization purchases carbon fiber as a fiber or fabric, is it primarily from a manufacturer or through a distributor?	
If your organization were no longer able to purchase carbon fiber from your current primary supplier, for how many weeks would you be able to continue normal operations?	
How many weeks would it take your organization to find a new supplier that can meet your production needs?	
Provide an explanation for your answer above:	

Comments:	

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Section 3c: Inputs and Sourcing

A. Does your organization utilize any of the materials listed in part A (below) for carbon fiber composite-related operations, other operations, or both? If you use none of the listed materials, proceed to Section 4.

B. Complete the information below for each material your organization utilizes.

In the DIRECT SOURCE portion, select the **TYPE** of supplier providing the product (options include: Distributor; Mine, Original Manufacturer, Recycler) and the supplier's **LOCATION**. In the **PRIMARY ORIGINAL SOURCE COUNTRY** column, indicate the country where the material originally came from (if known).

Material		Utilization in Carbon Fiber Composite-Related and/or Other Operations	Sourcing Problems		Inventory			Direct Source (select from dropdown)		Primary Original Source Country (if known)
			Availability is a Concern	Experienced Supply Chain Disruptions (since 2010)	Quantity	Quantity Unit of Measure	Quantity in KG	Type	Location (country)	
Aluminum							0			
Ceramics & Fibers										
Silicon carbide fibers	(specify)						0			
Abrasives	(specify)						0			
Refractories	(specify)						0			
Other ceramics	(specify)						0			
Cobalt							0			
Copper							0			
Gallium							0			
Lead							0			
Lithium							0			
Magnesium							0			
Molybdenum							0			
Nickel							0			
Niobium							0			
Platinum Group & Precious Metals										
Palladium							0			
Platinum							0			
Gold							0			
Silver							0			
Rare Earth Elements (specify)										
							0			
							0			
							0			
							0			
							0			
Steel										
Alloys	(specify)						0			
Carbon	(specify)						0			
Stainless	(specify)						0			
Tool	(specify)						0			
Tantalum							0			
Tin							0			
Titanium							0			
Tungsten							0			
Vanadium							0			
Zinc							0			
Zirconium							0			
Other	(specify)						0			
Other	(specify)						0			
Other	(specify)						0			

C. Describe your concerns over availability or disruptions, as well as any steps your organization has taken to minimize future disruptions.

Comments:

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NOTICE: PDF is for internal data collection purposes only. BIS will only accept Excel-formatted survey responses. This survey utilizes dropdown menu options not visible in PDF format.

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Section 4a: Operations and Challenges

A

Describe your organization's utilization rates and constraints. "Utilization" is the fraction of an organization's total potential output that is actually being used in current production, where potentia output is based on a **7 day-a-week, 24-hour a day production schedule**.
Note: 100% utilization rate equals full employment with no downtime beyond that necessary for maintenance.

1	Estimate your organization's current utilization rate (select from dropdown)	
	Estimate your organization's current carbon fiber composite-related utilization rate (select from dropdown)	
	If a sudden surge in customer demand occurred, estimate how many weeks it would take to raise your organization's carbon fiber composite-related utilization rate to 100%.	
	Estimate the number of weeks required to increase your carbon fiber composite-related production to 150% of your current capacity.	

2 Identify which of the factors below would limit your organization's ability to raise your carbon fiber composite-related utilization rate to 100% (maximum current capacity) and to 150% (50% increase from current maximum capacity) to meet a surge in demand. Provide a brief description of the constraints.

Factor	Scenario: 100%	Scenario: 150%	Description (write-in)
Capital: Equipment, Facilities, Infrastructure			
Workforce: Labor Availability, Labor Costs			
Quality Control: Evaluation/Testing/Validation			
Inventory: Availability of Input Materials			
Other (specify in description)			

B

Identify the issues that have impacted your organization's carbon fiber composite-related operations since 2010.
In column A, select YES/NO from the dropdown menu.
In column B, rank your top five issues (one being most important) by writing in numbers one through five, using each rank exactly once.
In column C, provide a brief explanation of your organization's top five issues.

	Type of Issue	A -Yes/No-	B Rank Top 5	C Explanation of Issue (write-in)
1	Aging equipment, facilities, or infrastructure			
2	Domestic competition			
3	Environmental regulations/remediation			
4	Export Controls/ITAR & EAR			
5	Foreign competition			
6	Government purchasing volatility			
7	Government regulatory burden			
8	Healthcare			
9	Labor availability			
10	Labor costs			
11	Material price volatility			
12	New production methods			
13	New products			
14	Non-U.S. material availability			
15	Non-U.S. supplier reliability			
16	Pension costs			
17	Proximity to customers			
18	Proximity to suppliers			
19	Reduction in U.S. Government demand			
20	Qualifications/certifications			
21	Quality of inputs			
22	R&D costs			
23	Taxes			
24	U.S. material availability			
25	U.S. supplier reliability			
26	Worker/skills retention			
27	Other			

Comments:

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Section 4b: Operations and Capabilities

A	Estimate the percentage of your organization's carbon fiber composite-related production that occurs within the United States:	
	How many hours does your facility operate in a typical day?	
	How many days per week does your facility typically operate?	

B — If your organization produces carbon fiber fabrics, what weaving capabilities does it currently possess?

Fabric Type		Capable	Maximum Width (in)	Additional Details
Unidirectional				
Biaxial weave				
Triaxial weave				
Quadraxial weave				
Braided/Tubular Weave				
Other	(specify)			
Other	(specify)			

C — If your organization manufactures carbon fiber composite products, identify which processes it currently is capable of performing, the maximum dimensions of composite parts that can be produced with these processes, and the primary products manufactured using these processes, as identified in Section 2a:

Process		Capable	Maximum Width (in)	Maximum Length (in)	Carbon Fiber Composite Product 1	Carbon Fiber Composite Product 2	Carbon Fiber Composite Product 3
Hand Lay-Up							
Pultrusion							
Filament Winding							
Automated Fiber Placement/Tape Laying							
Resin Transfer Molding							
Compression Molding							
Autoclave Cure							
Out of Autoclave Cure							
Other	(specify)						
Other	(specify)						

Comments:	

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Section 5: Competitiveness and Outlook

In parts A and B, identify three key actions your organization has taken or plans to take to improve competitiveness. Select general improvement categories from the dropdown menu and provide an explanation for each. General areas include: business restructuring; capital investment; customer service; innovation, R&D, and design improvements; marketing improvements; staff adjustments; and quality control improvements.

A Improvement actions taken **since 2010.**

	Improvement Action (select from dropdown)	Explanation of Action (write-in)
1		
2		
3		

B Improvement actions anticipated **within the next five years.**

	Improvement Action (select from dropdown)	Explanation of Action (write-in)
1		
2		
3		

C From the list below, identify whether your organization currently provides carbon fiber composite-related products or services in the listed usage area, and how this isexpected to change in the next five years. Provide comments where appropriate.

Defense Uses	Current Participation	Expected Change	Comments
Fixed-wing aircraft			
Rotary-wing aircraft			
Unmanned aerial vehicles (UAVs)			
Missiles/Rockets			
Space			
Marine (surface and underwater)			
Transportation Vehicles			
Other (specify here)			
Other (specify here)			
Other (specify here)			
Civilian Uses	Current Participation	Expected Change	Comments
Fixed-wing aircraft			
Rotary-wing aircraft			
Unmanned aerial vehicles (UAVs)			
Space			
Marine (surface and underwater)			
Transportation Vehicles			
Energy/Power Generation			
Construction/Infrastructure			
Other (specify here)			
Other (specify here)			
Other (specify here)			

Comments:	

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Section 6a: U.S. Government and DOD Participation

	On a scale of 1-5 (1 = not dependent; 5 = highly dependent), specify the dependency of your organization on:	Type of Operation: Carbon Fiber Composite-Related	Type of Operation: All Other Operations	Provide a brief explanation (write-in)
A	U.S. Government defense demand			
	U.S. Government non-defense demand			
	Commercial demand			

	Note: For the purposes of this survey, U.S. Government defense sales should include direct sales to government customers and indirect sales to government customers (such as sales through a prime contractor). All sales with government end uses should be reported as government sales.	
B	Estimate the percentage of your U.S. Government defense carbon fiber composite-related business lines that are readily convertible to commercial business lines. (select from dropdown)	
	Estimate the percentage of your commercial carbon fiber composite-related business lines that are readily convertible to U.S. Government defense business lines. (select from dropdown)	
	Does your organization consider itself dependent upon current U.S. Government defense programs for its continued viability? Explain your response below.	

From the list below, select the likely impacts that a sudden change in direct and/or indirect U.S. Government defense demand would have on your organization and provide an explanation where applicable:

	Business Operation	Impact of sudden DECREASE in USG Defense Demand	Impact of sudden INCREASE in USG Defense Demand	Explanation
C	Capital Expenditures			
	Research & Development Expenditures			
	Participation in USG Contracts			
	Product/Service Costs			
	Organization Viability/Solvency			
	Personnel with Key Skills			
	Number of Product/Service Lines			
	Pursuit of Non-U.S. Customers			
	Level of Key Production Equipment			
	Movement of Operations to Non-U.S. Locations			
	Other (specify)			
	Other (specify)			

D	Since 2010, has your organization received a rated order (DO or DX) from a U.S. Government agency and/or affiliated contractor? A rated order means a prime contract, a subcontract, or a purchase order in support of an approved program issued in accordance with the provisions of the Defense Priorities and Allocation System (DPAS) regulations (15 CFR part 700).	

Comments:	

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Section 6b: U.S. Government and DOD Participation

A Since 2010, has your organization directly or indirectly supported any U.S. Government agencies or programs in any way?
If no, proceed to section 7. If yes, complete parts B and C below.

B From the list of U.S. government agencies below, select those your organization has supported since 2010. If you support an unlisted agency, identify it in an "Other" box.
Indicate the type of support provided (carbon fiber composite-related, non-carbon fiber composite-related, both, unknown)

U.S. Air Force		U.S. Intelligence Community (such as CIA, NGA, NRO, NSA)		Department of Energy (DOE)		
U.S. Army		Missile Defense Agency (MDA)		Defense Logistics Agency (DLA)		
U.S. Marine Corps		National Aeronautics & Space Administration (NASA)		Other	(specify here)	
U.S. Navy		National Oceanic & Atmospheric Administration (NOAA)		Other	(specify here)	

C Identify the specific U.S. Government programs/systems your organization has supported since 2010. Provide as much detail on the **GOVERNMENT PROGRAM/SYSTEM NAME** as possible and spell out all acronyms.

In the **CARBON FIBER COMPOSITE-RELATED PRODUCT** columns, select the specific carbon fiber composite-related products your organization provides in support of the specific program/system. If applicable, select a **NON-CARBON FIBER COMPOSITE PRODUCT** as well. The dropdown options for these columns are based on the products identified in Section 2. If additional products are provided in support of a specific government program/system, repeat the program/system on a new row and select the remaining products.

NOTE: If your organization is unsure of the specific **GOVERNMENT PROGRAM/SYSTEM NAME** or **AGENCY NAME**, provide as much information as possible.

	Government Program/System Name (write-in)	Agency Name (select from dropdown)	Carbon Fiber Composite-Related Product 1 (select from dropdown)	Carbon Fiber Composite-Related Product 2 (select from dropdown)	Carbon Fiber Composite-Related Product 3 (select from dropdown)	Carbon Fiber Composite-Related Product 4 (select from dropdown)	Carbon Fiber Composite-Related Product 5 (select from dropdown)	Other Product (select from dropdown)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

Comments:

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Section 7: Sales

Provide your U.S. operation's 2010-2013 U.S. and non-U.S. sales information for all products. In part A, provide your organization's **total sales** and estimate the percentage of those sales in lines 1 and 2 (should sum to 100%). In part B, provide your organization's total **carbon fiber composite-related sales** and estimate the percentage of those sales in lines 1 and 2 (should sum to 100%). For 2014, estimate the percentage change in total sales and carbon fiber composite-related sales (from 2013).

*Government sales include direct sales to government customers and indirect sales to government customers (such as sales through a prime contractor). All sales with government end uses should be reported as government sales.

Note: Ensure your Source of Sales Data is consistent with your response in section 1a. If you have declared this to be a Business Unit/Division-level response, this section should contain Business Unit/Division-level data.

Source of Sales Data:	
Reporting Schedule:	

"U.S." means U.S. domestic sales; "Non-U.S." means only export sales from U.S. locations		Record in $ Thousands, e.g. $12,000.00 = survey input $12								Record as Percent Change from 2013	
		2010		2011		2012		2013		2014	
		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 (in $)										
1	Total Non-Government Sales [as a % of line A]										
2	*Total Government Sales [as a % of line A]										
	Lines 1 & 2 must sum to 100%	0%	0%	0%	0%	0%	0%	0%	0%		
B	Total Carbon Fiber Composite-Related Sales (in $)										
1	Carbon Fiber Composite-Related **Non-Government** Sales [as a % of line B]										
2	*Carbon Fiber Composite-Related **Government** Sales [as a % of line B]										
	Lines 1 & 2 must sum to 100%	0%	0%	0%	0%	0%	0%	0%	0%		
a	*Carbon Fiber Composite-Related U.S. Government **Defense** Sales [as a % of line B]										
b	*Carbon Fiber Composite-Related U.S. Government, **Non-Defense** Sales [as a % of **line B**]										

*Government sales include direct sales to government customers and indirect sales to government customers (such as sales through a prime contractor).
All sales with government end uses should be reported as government sales.

Comments:

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Section 8: Customers

A

Identify your leading direct customers for **carbon fiber composite-related** business lines based on average annual sales 2010-2013. Provide the **DIRECT CUSTOMER NAME** and location (City, State, Country). Estimate the **AVERAGE ANNUAL CARBON FIBER COMPOSITE-RELATED SALES 2010-2013** (in thousands) to each customer, and select the **carbon fiber composite-related** products your organization provided to each.

	Direct Customer Name	City	State	Country	Average Annual Sales 2010-2013 to Customer (in $1,000's)	Carbon Fiber Composite-Related Product Provided 1	Carbon Fiber Composite-Related Product Provided 2	Carbon Fiber Composite-Related Product Provided 3
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

Comments:

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Section 9: Financials

Report line items from your organization's financial statement for years 2010-2013. From the drop-down indicate whether the reported income statement and balance sheet line items are Business Unit/Division or Corporate/Whole Organization financials.

Note: Ensure your Source of Financial Line Items is consistent with your response in section 1a. This means if you have declared this to be a Business Unit/Division-level response, this section should contain Business Unit/Division-level data.

Source of Financial Line Items:	
Reporting Schedule:	

	Income Statement (Select Line Items)	Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
		2010	2011	2012	2013
A	Net Sales (and other revenue)				
B	Cost of Goods Sold				
C	Total Operating Income (Loss)				
D	Earnings Before Interest and Taxes				
E	Net Income				

	Balance Sheet (Select Line Items)	Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
		2010	2011	2012	2013
A	Cash				
B	Inventories				
C	Current Assets				
D	Total Assets				
E	Current Liabilities				
F	Total Liabilities				
G	Retained Earnings				
H	Total Owner's Equity*				

*Total Owner's Equity should equal Total Assets minus Total Liabilities

Comments:	

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Section 10: Workforce

Record the total number of full time equivalent (FTE) employees in your U.S.-based operations for the 2010-2013 period. Then, estimate the percentage of these employees that perform the professional occupations indicated in parts a-i.

Do not double count personnel who may perform cross-operational roles. Estimates are encouraged.

Note: Ensure your Source of Workforce Data is consistent with your response in section 1a. If you have declared this to be a Business Unit/Division-level response, this section should contain Business Unit/Division-level data.

Source of Workforce Data:							
Reporting Schedule:							
A	1	**Professional Occupations**		**2010**	**2011**	**2012**	**2013**
		Total Full Time Equivalent (FTE) Employees					
		a	Administrative, Management, & Legal Staff [as a % of 1]				
		b	Engineers, Scientists, and R&D Staff [as a % of 1]				
		c	Facility & Maintenance Staff [as a % of 1]				
		d	Information Technology Professionals [as a % of 1]				
		e	Marketing & Sales [as a % of 1]				
		f	Production Line Workers [as a % of 1]				
		g	Testing Operators, Quality Control, and Support Technicians [as a % of 1]				
		h	Other (specify)				
		i	Other (specify)				
		Lines a through i must total 100%		**0%**	**0%**	**0%**	**0%**
	2	Estimate the percentage of your total FTEs that worked on **CARBON FIBER COMPOSITE-RELATED** business lines:					

B	Does your organization have difficulty hiring and/or retaining any parts of your workforce? If yes, identify which occupations and provide an explanation.			
	Occupation		Difficulty	Explanation
	Engineers, Scientists, and R&D Staff			
	Information Technology Professionals			
	Production Line Workers			
	Testing Operators, Quality Control, and Support Technicians			
	Other (specify)	(specify)		
	Other (specify)	(specify)		

C	Identify any unique carbon fiber composite-related skills and/or competencies that are essential to your organization. Identify the general type of skill and/or competency from the drop-down menu then describe it in the right hand box.		
		Type of Skill or Competency	Explanation
	1		
	2		
	3		
	4		
	5		

Comments:	

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Section 11: Research and Development

Report your organization's total research and development (R&D) dollar expenditures for the years 2010 to 2013. In addition, estimate the percentage of total R&D expenditures related to carbon fiber composite-related business lines and defense business lines. Next, detail the source of your organization's R&D funds.

Note: Ensure your Source of R&D Reporting is consistent with your response in section 1a. If you have declared this to be a Business Unit/Division-level response, this section should contain Business Unit/Division-level data.

Source of R&D Data:					
R&D Data Schedule:					
R&D Expenditures		Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
		2010	**2011**	**2012**	**2013**
A	Total R&D Expenditures				
1	Basic Research *[as a % of A]*				
2	Applied Research *[as a % of A]*				
3	Product/Process Development *[as a % of A]*				
Lines 1 through 3 must sum to 100%		0%	0%	0%	0%
4	Carbon Fiber Composite-Related R&D Expenditures [as a % of A]				
5	All Defense-Related R&D Expenditures [as a % of A]				
R&D Funding Sources		Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
		2010	**2011**	**2012**	**2013**
B	Total R&D Funding Sources				
1	Internal/Self-Funded/IRAD [as a % of B]				
2	Total Federal Government [as a % of B]				
3	Total State and Local Government [as a % of B]				
4	Universities - Public and Private [as a % of B]				
5	U.S. Industry, Venture Capital, Non-Profit [as a % of B]				
6	Non-U.S. Investors [as a % of B]				
7	Other (specify)				
Lines 1 through 7 must sum to 100%		0%	0%	0%	0%
C	Please provide a brief description of your organization's carbon fiber composite-related R&D activities.				
Comments:					

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Section 12: Capital Expenditures

Record your organization's capital expenditures corresponding to the select categories below.

Note: Ensure your Source of Capital Expenditure Data is consistent with your response in section 1a. If you have declared this to be a Business Unit/Division-level response, this section should contain Business Unit/Division-level data.

Source of Capital Expenditure Data:	
Capital Expenditure Reporting Schedule:	

		Capital Expenditure Category	Record in $ Thousands, e.g. $12,000.00 = survey input of $12			
			2010	2011	2012	2013
A		Total Capital Expenditures				
	1	Machinery, Equipment, and Vehicles [as a % of A]				
	2	IT, Computers, Software [as a % of A]				
	3	Land, Buildings, and Leasehold Improvements [as a % of A]				
	4	Other (specify)				
	5	Other (specify)				
		Lines 1 through 5 must total 100%	0%	0%	0%	0%
	6	Carbon fiber composite-related capital expenditures [as a % of A]				

B	From 2010-2013, were your organization's capital expenditures adversely impacted by reductions in U.S. Government defense spending, or do you anticipate them to be in the future? Explain your response below.	

C Identify any unique or critical equipment, infrastructure, and/or facilities owned and/or operated by your organization for **carbon fiber composite-related** applications. Provide a brief description of each.

	Type of Equipment, Infrastructure, or Facility	Description
1		
2		
3		
4		
5		

Comments:	

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Section 13a: U.S. Government Outreach

There are many federal and state government programs and services available to assist your organization to better compete in the global marketplace.

If you would like more information regarding these U.S. Government programs, select the specific areas of interest below.

The Commerce Department will follow-up with your organization regarding your selections.

A

Business development (joint ventures, new markets, etc.)		Patents and trademarks		
Energy and environmentally conscious manufacturing		Product/service development (including manufacturing standards, processes, and practices)		
Export licensing (ITAR/EAR)		R&D programs		
Financing (access to capital, loans, etc.)		Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) contracts		
Global export opportunities		Training Opportunities		
Government procurement guidelines and e-commerce		Country Commercial Guides (specify countries in box)		
Manufacturing technology development (including acquiring, licensing, and/or commercializing federally developed technologies)		Other (specify)		
Marketing assessment skills		Other (specify)		

Comments:

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Section 13b: Certification

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)).

Organization Name:	
Organization's Internet Address:	
Name of Authorizing Official:	
Title of Authorizing Official:	
E-mail Address:	
Phone Number and Extension:	
Date Certified:	

In the box below, provide any additional comments or any other information you wish to include regarding this survey assessment.

How many hours did it take to complete this survey?	

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