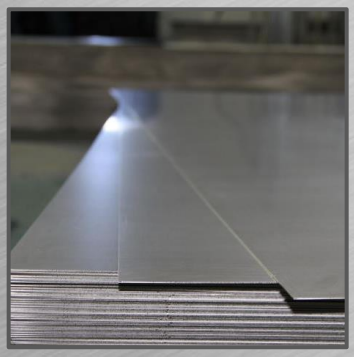
U.S. Strategic Material Supply Chain Assessment:

Titanium



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

2016

U.S. STRATEGIC MATERIAL SUPPLY CHAIN ASSESSMENT: TITANIUM

2016

PREPARED BY
U.S. DEPARTMENT OF COMMERCE
BUREAU OF INDUSTRY AND SECURITY
OFFICE OF TECHNOLOGY EVALUATION

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I. INTRODUCTION

BACKGROUND AND SCOPE

The U.S. industrial base, specifically the defense and civil aerospace segments, has grown incrementally more dependent on titanium-based metal products since the 1940s, when the U.S. Defense Department declared titanium the "metal of choice" for defense applications.[1] This rise in the adoption of titanium metal across the industrial base is largely attributed to the metal's performance characteristics, including titanium's resistance to corrosion, high strength-to-weight ratio, and sustained performance under high temperatures.

Titanium metal is derived from a number of ores and mineral concentrates, including ilmenite, leucoxene, rutile, synthetic rutile, and titaniferous slag. Despite this diversity of inputs, many precursors used for titanium metal alloying are limited in availability and often subject to supply chain disruption. This instability is due in part to the high level of competition for titanium metal precursors from non-metal market segments.

Ninety-five percent of available titanium mineral concentrate is used for titanium dioxide (TiO_2) pigment rather than titanium metal.[2] Consequently, the availability of titanium metal precursors is often driven by demand factors unrelated to the industries that consume titanium metal products made from the five percent balance of mineral concentrate. These metal consuming

[1] *History of Titanium, Titanium Industries Technical Data*, http://titanium.com/technical-data/history-of-titanium/.
[2] Most TiO_2 pigments are used in paints and coatings, plastics, rubber, and various paper products. *Titanium: Statistical Compendium*, http://minerals.usgs.gov/minerals/pubs/commodity/titanium/stat/.

sectors include aerospace (73 percent of titanium metal demand), armor, chemical processing, marine, medical, power generation, sporting goods, and other non-aerospace areas.[3]

In 2014, the U.S. Department of Defense, Defense Logistics Agency (DLA) approached the U.S. Department of Commerce, Bureau of Industry and Security (BIS) to discuss conducting an industrial base assessment measuring the health and competitiveness of the domestic titanium metal supply chain network, focusing on producers and distributors of titanium metal products. DLA also asked BIS for similar assessments on magnesium, carbon fiber composites, and select rare earth elements. BIS covers these materials in separate reports.[4]

BIS and DLA set the following objectives for the assessment:

- Map the titanium metal supply chain network in detail;
- Identify interdependencies between respondents, their suppliers and customers, and the U.S. Government (USG) agencies they support;
- Benchmark trends in business practices, competitiveness issues, financial performance, R&D and capital investment, hiring, and other 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.

[3] Bendinger, George M., *Titanium and Titanium Dioxide, U.S. Geological Survey, Mineral Commodity Summaries*, February 2014, p. 170.
[4] For these and other reports, visit www.bis.doc.gov/dib.

METHODOLOGY

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, as amended, 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.

Upon initiation of the titanium industrial base assessment, BIS took a number of steps to better understand the supply chains for this strategic material. With the assistance of DLA, the U.S. Geological Survey, and other USG stakeholders, BIS collected information on relevant USG programs and their known titanium-related supply chains. BIS also met with select titanium suppliers to gain a better understanding of the operational and business practices specific to the titanium marketplace.

For the purpose of survey development, BIS also conducted site visits with companies involved in the manufacture and distribution of titanium metal products. These direct engagements permitted discussions about challenges both industry and government stakeholders face to maintain a healthy and competitive titanium industrial base. Such on-site meetings help ensure BIS adopts the most relevant questions in its comprehensive, sector specific surveys.

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

- Organizational information;
- Products (titanium-related and other);
- Key suppliers, inventories, inputs, and sourcing;
- Operations and challenges;
- Competitiveness and outlook;
- U.S. Department of Defense participation;[5]
- Sales and customers;
- Financials;
- Workforce;
- Research and development; and
- Capital expenditures.

BIS distributed the titanium survey to respondents identified by our partner agencies, previous BIS survey efforts, and independent research. A total of 116 organizations responded to the survey. The response data was reviewed, tabulated, analyzed, and presented to DLA to facilitate their analysis and strategic planning. Additionally, aggregated results for the 2012-2014 period contained in this report were made publically available and presented to strategic materials stakeholders across the USG, the titanium industry, and academia.

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

KEY REPORT FINDINGS

- Of the 116 survey respondents, 93 (80 percent) participated in the defense sector. Due to the large number of companies supporting the aerospace sector, the aircraft segment proved to be the most common defense-related market served, with 81 companies (70 percent) participating. The defense, space, missile, and ship sectors had the next largest participation, with each constituting 45, 40, and 38 percent of respondents, respectively.

- Nearly half of the total number of products identified by respondents (315 of 650 products, 48 percent) support aerospace segments primarily. These application areas include fasteners, housings, vibration isolators, rotating blades, and structures.

- Of the 650 titanium-related products reported to BIS, 139 products (21 percent) were deemed sole source. These products include 97 "sole U.S. source" products and 42 "sole global source" products provided by 25 and 10 respondents, respectively.

- Among the identified 249 unique suppliers, 201 (81 percent) were located in the U.S. Respondents had on average three suppliers affiliated with their titanium-related product lines, most of which were domestic (84 percent).

- Respondents recorded 92 inputs procured from 18 countries in support of their titanium-related product lines. China, Russia, and Japan were the top three sources. The vast majority (87, 95 percent) of non-U.S. sourced procurements were for materials rather than services.

- Finished metal is the leading category of material sourced from China. This category's prominence contrasts sharply with raw material's prominence among non-U.S. origin procurements overall and from Russia specifically as the number two non-U.S. supplier.

- Among the 543 reported inputs supporting respondents' titanium-related product lines, 105 were single source and 18 were sole source (19 and 3 percent, respectively).

- Despite several countries maintaining single source supplier relationships with respondents (including China, Russia, Canada, Germany, the United Kingdom, Ukraine, and Israel) respondent sole source relationships were evident only in China. These particular sole source purchases of Chinese origin included stainless steel piping for commercial use and titanium powder integrated in a U.S. Department of Defense application.

- Of the 116 respondents that submitted surveys, only seven respondents, or six percent, are concerned about input availability. The specific materials posing concerns are helium and vanadium (each mentioned twice) and magnesium, molybdenum, nickel, steel, and tantalum.

- Across the 544 material inputs documented by respondents for their titanium-related products, only eight were subject to disruption since 2012. Examples of the causes of these disruptions included helium shortage, plant shutdown, late delivery, labor strike, and equipment failure.

- While small businesses represent 54 percent of all respondents, they constituted 71 percent of the 21 companies that selected government purchase volatility as an issue affecting their titanium-related operations since 2010. This difference indicates that smaller respondents operating in the titanium market are generally more vulnerable to USG procurement instability than their larger counterparts.

- Manufacturers represent 57 percent of all small businesses in the overall survey sample; however, among issue categories recorded by 10 or more respondents (16 of 26 issue categories) an average of 72 percent comprise of manufacturers. Labor/skills retention (86 percent) and reduction in U.S. Government demand (75 percent) are particularly problematic for small manufacturers.

- If faced with a sudden decline in USG demand, nearly half of all respondents (45 percent) indicated they would pursue alternative U.S. customers, while 42 percent would pursue new product or service lines.

- The suppliers most acutely affected by any sudden decline in USG demand are those most dependent on USG business for sustained viability. Consequently, results show that a large portion of the dependent sample (90 percent) would respond to a reduction in USG demand by decreasing capital expenditures. Many dependent respondents (86 percent) also anticipated increased product or service costs resulting from any reduction in USG demand. Additional reported impacts included the loss of personnel with key skills (76 percent) and reduced overall participation in USG contracts (67 percent).

- Respondent data also highlighted that much of the growth in such export sales was attributed to increases in commercial demand abroad for titanium-related products and services. During 2010-2013 respondent exports of titanium-related items from U.S. locations to commercial interests abroad increased 55 percent from $975 million to $1.5 billion.

- The sale of titanium-related goods to government customers remained relatively constant at $800 million annually from 2010-2013. Proportionately, however, as a percent of overall titanium-related sales, results show a year-over-year and periodic reduction in titanium-related government sales occurred, declining from 19.2 percent in 2010 to 14.1 percent in 2013.

- Eighty-one percent of the respondents (94 organizations) were privately held with the remaining 22 organizations publicly traded.

- Results from BIS's scorecard analysis indicated that no respondents were deemed to be at high-to-severe financial risk, while six of 116 respondents (five percent) were at moderate-to-elevated financial risk, and the remaining 110 respondents (95 percent) at low-to-neutral risk.

- Manufacturers, representing 61 percent of overall respondents, accounted for 87 percent of the number of employees reported. Their cumulative rate of growth in 2010-2013 was 30 percent.

- From 2010-2013 the total number of titanium-related workers increased nine percent, from 13,909 to 15,220.

- Data indicate that 22 percent of respondents currently face hiring or workforce retention problems, with seven percent of the sample reporting both hiring and retention problems. When asked by BIS to describe their difficulties, most respondents emphasized an inability to replace highly skilled personnel; especially those with mechanical backgrounds.

- Ninety-two respondents (79 percent) indicated that no adverse impacts involving capital expenditures were apparent by reductions in USG defense spending. Nonetheless, 24 respondents had been affected by such reductions. Their explanations of said impacts included (1) reductions in capital expenditures attributed to fluctuations and delays in program spending and (2) the renewed emphasis of industry on commercial-related spending in the wake of defense drawdowns.

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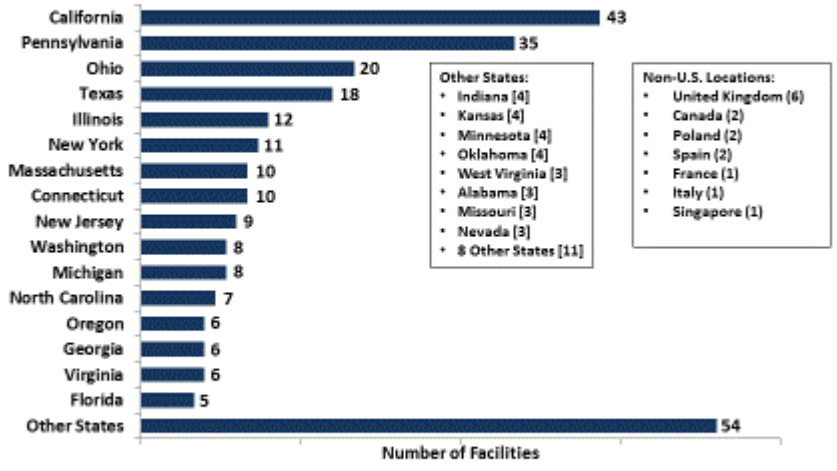
II. RESPONDENT PROFILE

LOCATION

The 116 respondents participating in the titanium assessment maintain 268 facilities with titanium-related operations (including distribution), most of which (214 facilities, 80 percent) were located in 16 states.[6] Domestically, states with the most facilities include: California (43), Pennsylvania (35), Ohio (20), and Texas (18). There are 15 non-U.S. locations included among the 268 facilities, comprising: the United Kingdom, Canada, Poland, Spain, France, Italy, and Singapore (see Figure II-1).

Figure II-1: Locations of Titanium-Related Facilities
268 facilities, identified by 116 respondents



Q1d *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

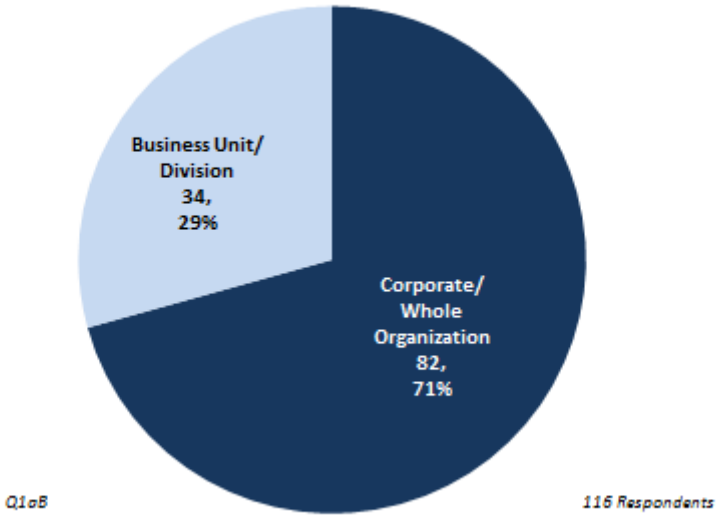
[6] Each of these 16 states contains five or more facilities with titanium-related operations.

LEVEL OF REPORTING, OWNERSHIP, AND SIZE

BIS asked participating organizations to indicate the source of their survey response. This included the level of reporting represented by the survey response (i.e., at the business unit or division level, or corporate level) and whether or not the organization was publicly or privately held. Such distinctions are critical factors when portraying both the composition and behavior of the titanium supply chain network.

Response data indicate that approximately 29 percent of suppliers reported at the business unit/division level, while nearly 71 percent of all respondents reported at the corporate/whole organization level (see Figure II-2). This high level of business unit/division participation is not uncommon in BIS assessments, because BIS requires large, diversified corporations to provide data at the more relevant business unit/division level, rather than at the consolidated corporate response.

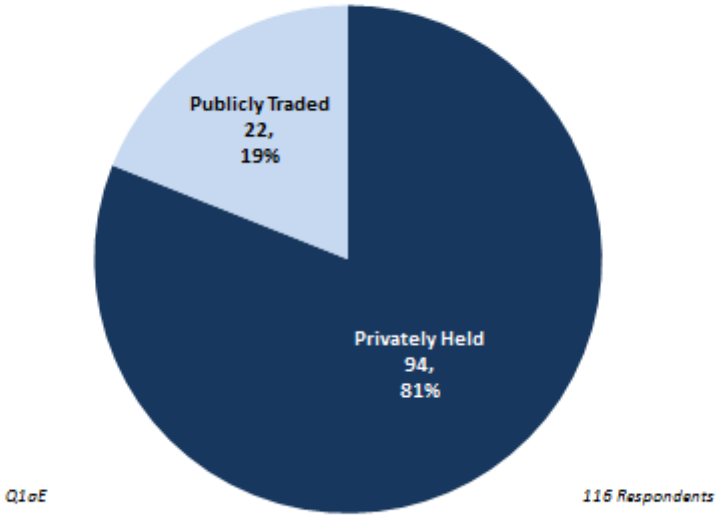
Figure II-2: Respondent Reporting Level



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

BIS determined that about four out of every five surveys were submitted by privately held companies (see Figure II-3). This distinction between the privately held and publicly traded respondent sample is particularly relevant in the areas of financial performance and titanium-related business practices.

Figure II-3: Respondent Ownership Status



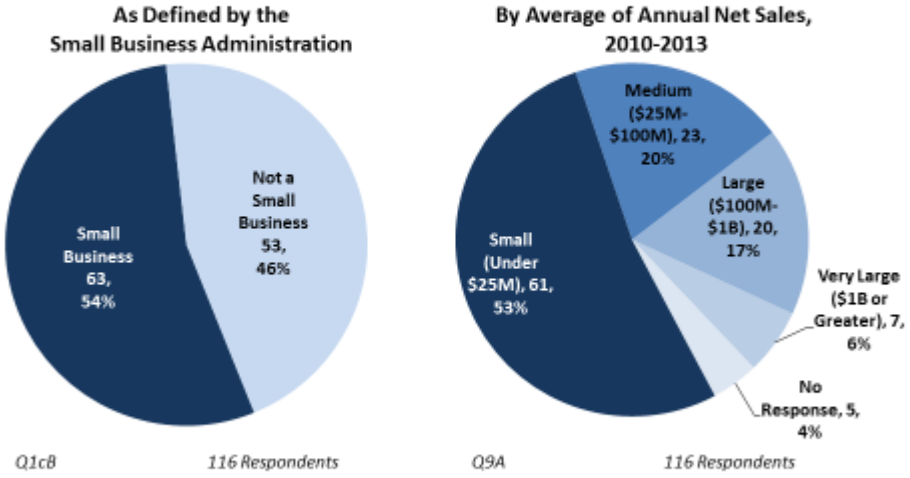
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

BIS established respondent size by adopting the methodology defined by the U.S. Small Business Administration (SBA).[7] The SBA considers any business with less than 500 employees to be small. Most respondents (63 respondents, 54 percent) reported being a small business by this standard (see Figure II-4). This sizing approach allowed BIS to later distinguish the business

[7] For additional information on Small Business Administration's (SBA) size standards, go to: https://www.sba.gov/category/navigation-structure/contracting/contracting-officials/small-business-size-standards

practices and overall performance of small suppliers of titanium-related goods and services from larger companies.[8]

Figure II-4: Respondent Size



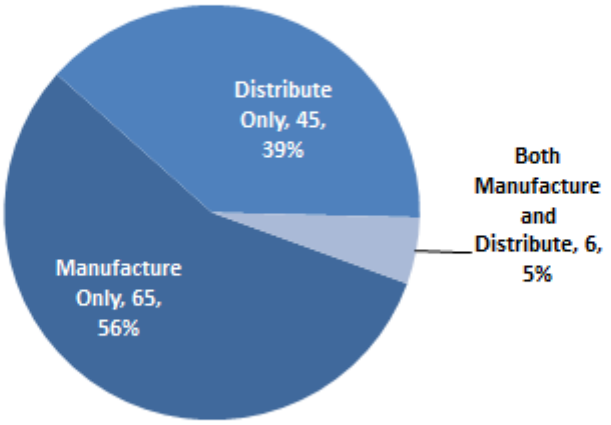
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

PRIMARY BUSINESS OPERATIONS

The respondents surveyed included both manufacturers and distributors of titanium-related products. Of the 116 respondents surveyed, 45 (38 percent) are exclusively distributors. The other 71 respondents (61 percent) are primarily manufacturers, but in select instances are distributors as well (see Figure II-5).

[8] Had BIS sized respondents based on a $25 million sales threshold, a common alterative to the employee-based methodology, the small business sample size would be little changed.

Figure II-5: Respondent Type

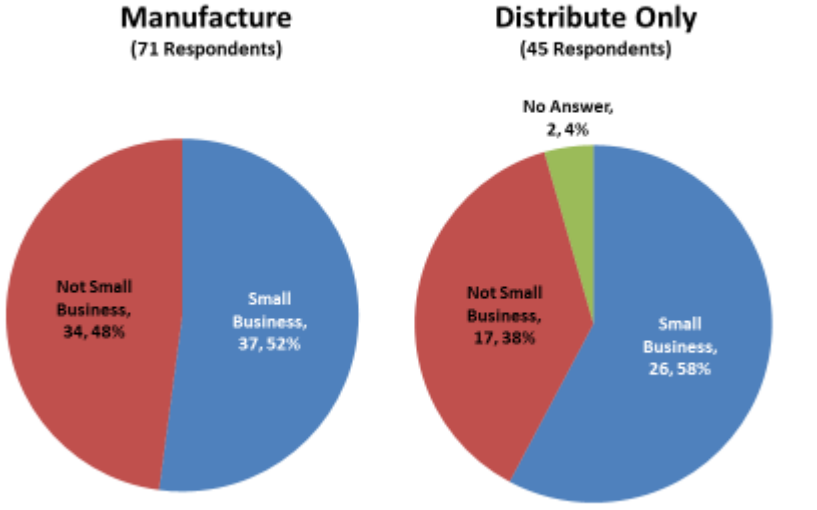


Q2a, 2b *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Most manufacturing respondents were small businesses (52 percent). Among survey respondents that distributed, twenty-six (59 percent) were small businesses (see Figure II-6).

Figure II-6: Size of Respondent Types



Q1c8, 2a, 2b *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

To determine the specific operations conducted by the respondents at the time of the survey, BIS asked each respondent to select their capabilities from a list of 14 categories.[9] Results indicated that machining, finishing, and testing/evaluation/validation were the three most common capabilities represented, with between 37-48 percent of respondents performing at least one of these three operations (see Figure II-7).[10]

Figure II-7: Respondent Current Operations

Titanium and Non-Titanium Operations at All Facilities, 2014

Q1cA *116 Respondents, 268 Facilities*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

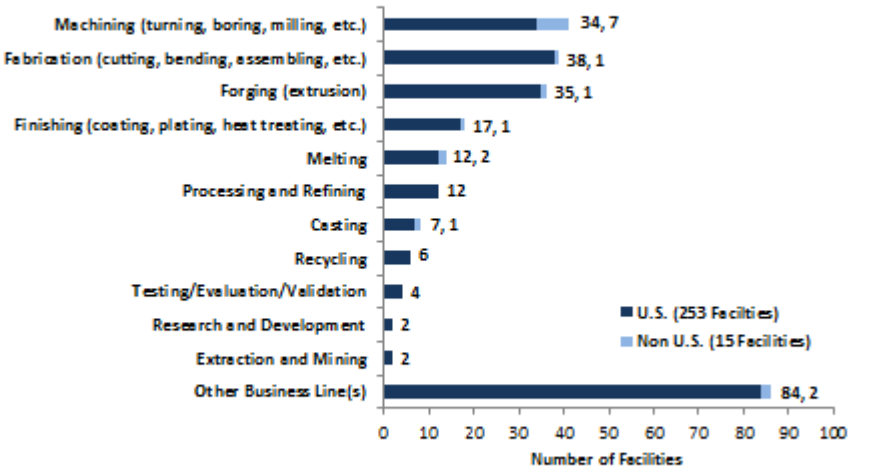
To determine more about the operations of respondents' specific titanium-related facilities, as opposed to their overall company operations, BIS asked for a breakout of such facilities by primary operation. Response data showed a noticeable segmentation in select operation categories between overall respondent capability and that occurring at titanium-related facilities. In addition, among the 15 non-U.S. titanium-related facilities reported by five respondents, the operations most frequently declared "primary" were machining and fabrication (see Figure II-8).

[9] Categories: Extraction & mining, Processing & refining, Melting, Recycling, Casting, Forging (including extrusion), Molding, Machining (turning, boring, drilling, milling, electrochemical, electron beam, ultrasonic, etc.), Stamping (punching, blanking, flanging, etc.), Fabrication (cutting, bending, assembling, etc.), Finishing (coating, plating, heat treating, etc.), Research and Development, Testing/Evaluation/Validation, Other operation(s)

[10] Respondents were allowed to select multiple capabilities to describe their overall operations.

Figure II-8: Respondent Primary Operations

Facilities with Titanium-Related Business Lines, 2014



Q1d *116 Respondents, 268 Facilities*

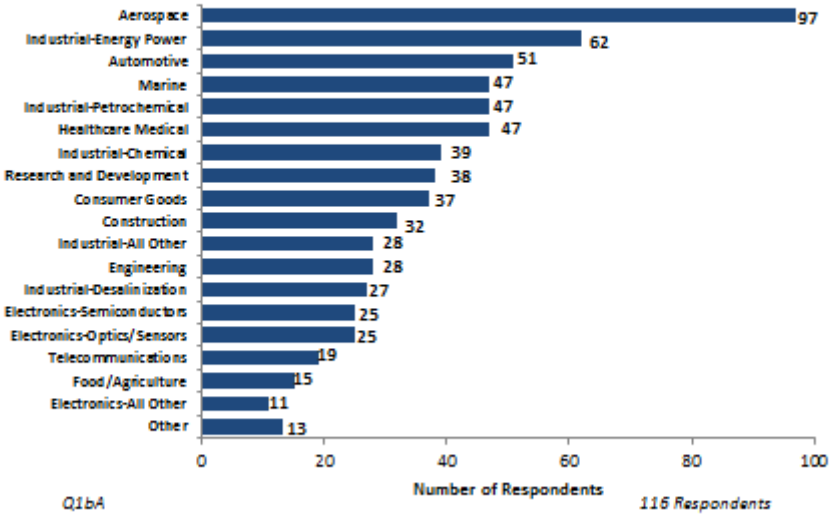
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

SECTOR PARTICIPATION

From a list of 19 individual sectors, BIS also asked respondents to identify the ones in which they operated. Results indicate a clear concentration of respondent participation in the aerospace, industrial-energy power, and automotive sectors, receiving support from 97, 62, and 51 respondents, respectively (see Figure II-9). Support for these particular segments was followed by participation in the marine, industrial-petrochemical, and healthcare medical sectors.

Figure II-9: Industry Sector Participation

Market Segments Served by Respondents, 2014

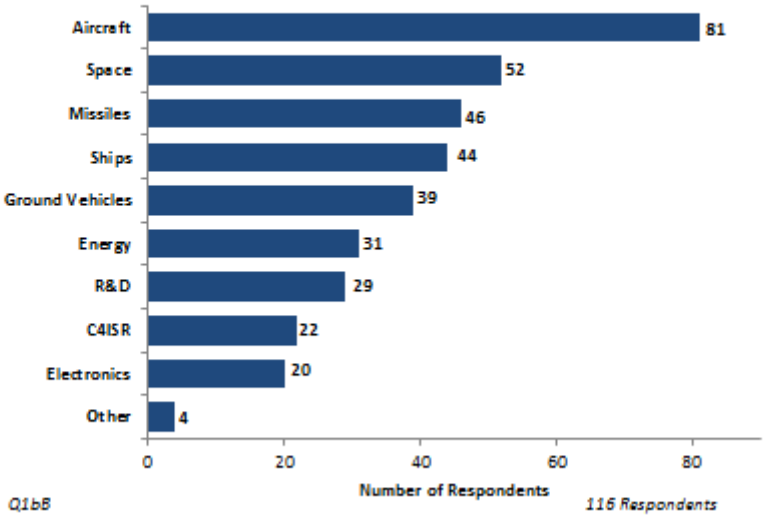


Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Of the 116 respondents, 93 (80 percent) participated in the defense sector. Due to the large number of companies supporting the aerospace sector, the aircraft segment proved to be the most common defense-related market served, with 81 respondents (70 percent) participating (see Figure II-10). The space, missiles, and ships defense sectors had the next largest participation, with each constituting 45, 40, and 38 percent of respondents, respectively.

Figure II-10: Defense Industry Sector Participation

Defense-Related Market Segments Served by Respondents, 2014



Q1bB *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

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III. PRODUCT AND CAPABILITY ANALYSIS

TITANIUM-RELATED PRODUCTS

To determine the overall production and distribution capabilities of these surveys, BIS asked respondents to report and describe all products related to titanium with specific focus on certain measures (alloyed or unalloyed, grade, etc.). Respondents were then asked to report any specific insights on sector and application end uses, monthly output, and alternative suppliers.

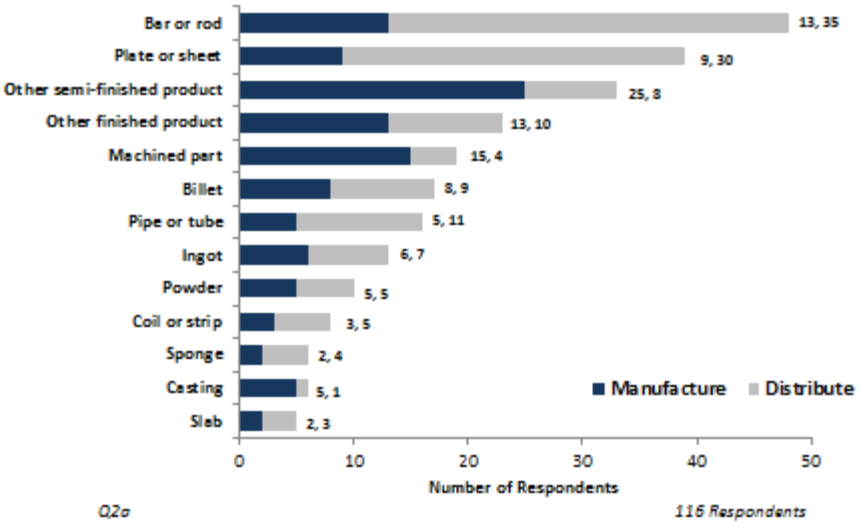
In total, respondents documented 650 products relating to titanium, each fitting into 11 specified product categories or categories of other semi-finished or finished products (see Figure III-1). Each product category received some level of participation by surveyed manufacturers and distributors. Many respondents reported products categorized in other semi-finished product (33 respondents, 28 percent) or other finished product (23 respondents, 20 percent) categories.

The most commonly reported product by manufacturers was machined parts, with 15 respondents (21 percent of manufacturers) participating. The next two most common manufacturer products—bars or rods and plates or sheets—were reported by 13 and nine manufacturers, respectively (or 18 percent and 13 percent of manufacturers).

There was proportionally less participation by distributors in customized, heavy industry fields like machined parts and castings. Distributors reported bar or rod and plate or sheets participation much more often, with 35 and 30 respondents (70 and 60 percent of distributors) reporting, respectively.

Figure III-1: Titanium Products

Product Type Manufactured or Distributed by Respondents



Q2a *116 Respondents*

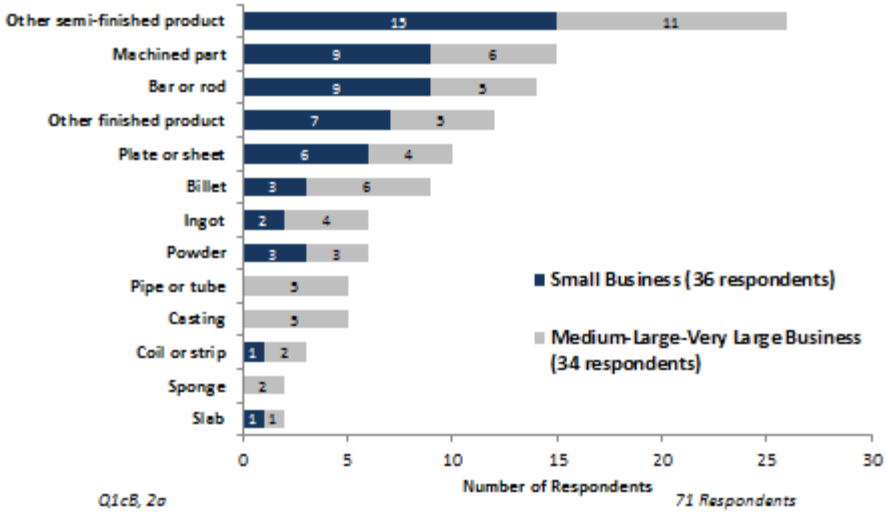
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Despite slightly fewer products being reported by smaller companies—118 by small firms and 125 by others—a significantly greater number of small companies sell bar or rod products and powder products that their larger peers (see Figure III-2.i-ii). Data indicate that 58 percent of the respondents reporting bar or rod products are small businesses while 60 percent of respondents reporting powder products are small businesses.

Analysis shows that not only do manufacturer and distributor respondents generally sell different kinds of titanium product, such as machined parts versus bar or rod, respectfully, but that on the basis of respondent size, some small manufacturers and distributors are not even represented in the supply chain (see Figures III-2.i-ii). For example, survey results indicate that no small manufacturers currently produce titanium pipe or tube, castings, or sponge. And among the small distributors, none participate in castings.

Figure III-2.i: Titanium Products

Product Type Reported by Manufacturers, by Respondent Size

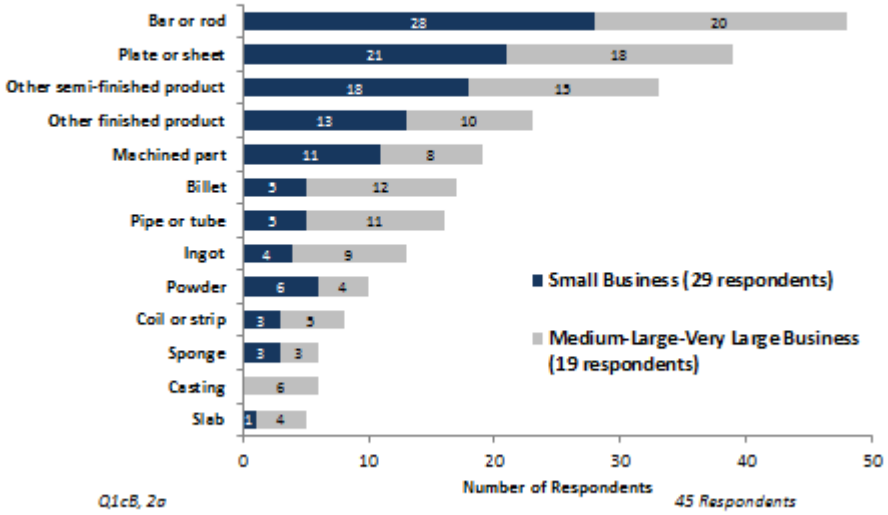


Q1cB, 2a *71 Respondents*

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

Figure III-2.ii: Titanium Products

Product Type Reported by Distributors, by Respondent Size



Q1cB, 2a *45 Respondents*

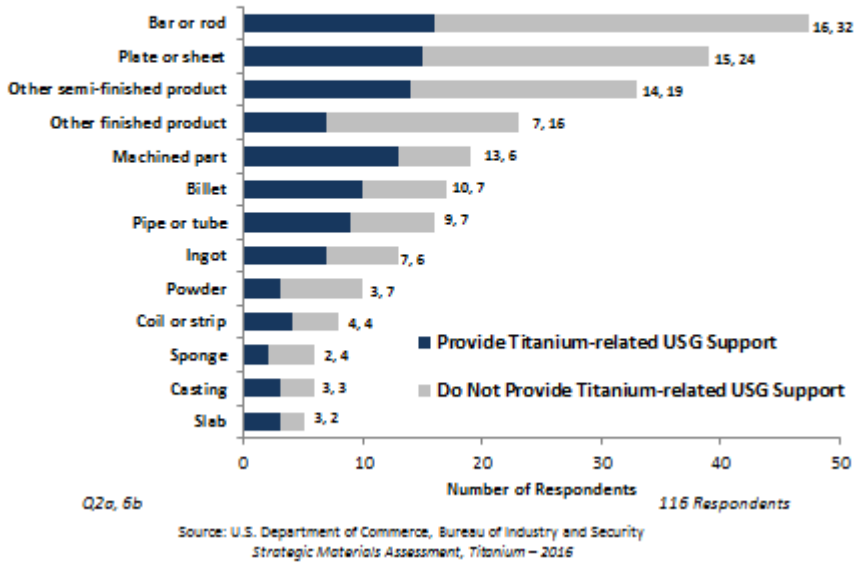
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2015

The extensive volume of products recorded by companies with no direct titanium-related sales to the U.S. Government (USG) indicates the likely availability of alternative suppliers for many

materials critical to USG work.[11] This lack of direct support is particularly acute in the powder and sponge product categories because (1) the number of vendors operating in the powder and sponge areas is low at 10 or less and (2) the number of respondents supporting the USG with titanium-related products in these fields is low relative to other product categories (see Figure III-3).[12]

Figure III-3: Titanium Products

Product Type Reported by Titanium-related USG Support



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

TITANIUM-RELATED PRODUCT COMPOSITION

In addition to reporting products by type, respondents also documented the composition of all relevant titanium-related products. The composition of a product refers to the amounts of certain metals within the product. For example, a titanium product with a 6-4 composition contains 6

[11] More than half of all survey respondents (77 of 116 respondents or 66 percent) did not sell titanium-related products or services directly to the U.S. Government. Thirty-three of the 77 respondents were distributors, or 43 percent, with 44 manufacturers constituting the balance (57 percent).

[12] While survey respondents may not directly support the U.S. Government, many do support prime contractors but simply lack visibility into ultimate U.S. Government end use.

percent aluminum and 4 percent vanadium. BIS included a list of seven common compositions in the survey for respondent reference purposes, (see Figure III-4.i), and allowed respondents to write-in any additional compositions.

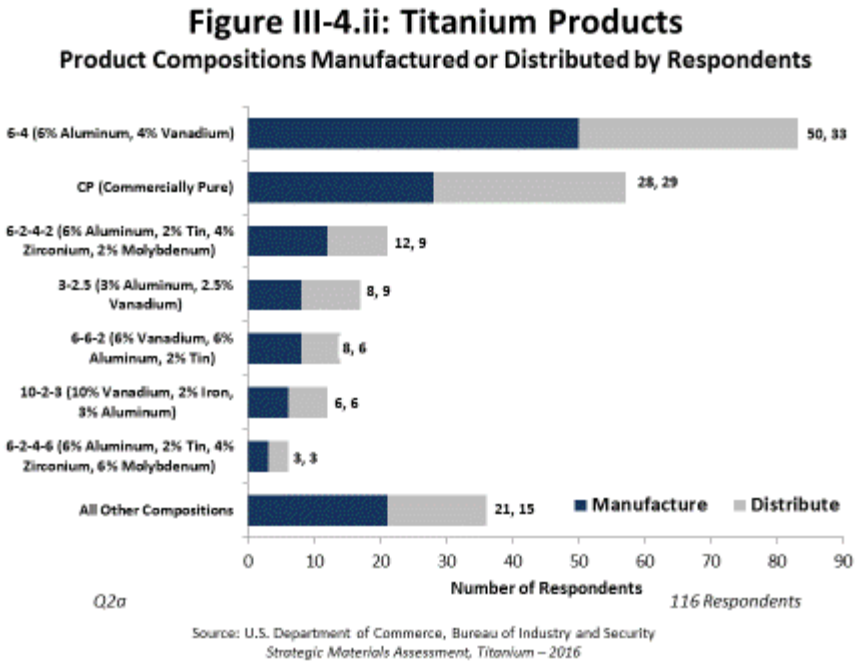
Figure III-4.i: Titanium Product Compositions/Grades

Name	Description
6-4	6% Aluminum, 4% Vanadium
CP	Commercially Pure
6-2-4-2	6% Aluminum, 2% Tin, 4% Zirconium, 2% Molybdenum
3-2.5	3% Aluminum, 2.5% Vanadium
6-6-2	6% Vanadium, 6% Aluminum, 2% Tin
10-2-3	10% Vanadium, 2% Iron, 3% Aluminum
6-2-4-6	6% Aluminum, 2% Tin, 4% Zirconium, 6% Molybdenum

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Survey results indicate that among the compositions included in the survey, 6-4 (50 manufacturers) and commercially pure (28 manufacturers) were the most frequently identified. Those least mentioned were 10-2-3 and 6-2-4-6. However, several compositions not among the prepopulated categories were also identified by respondents, including products made with cobalt, lead, nickel, niobium, tungsten, and zinc (see Figure III-4i).

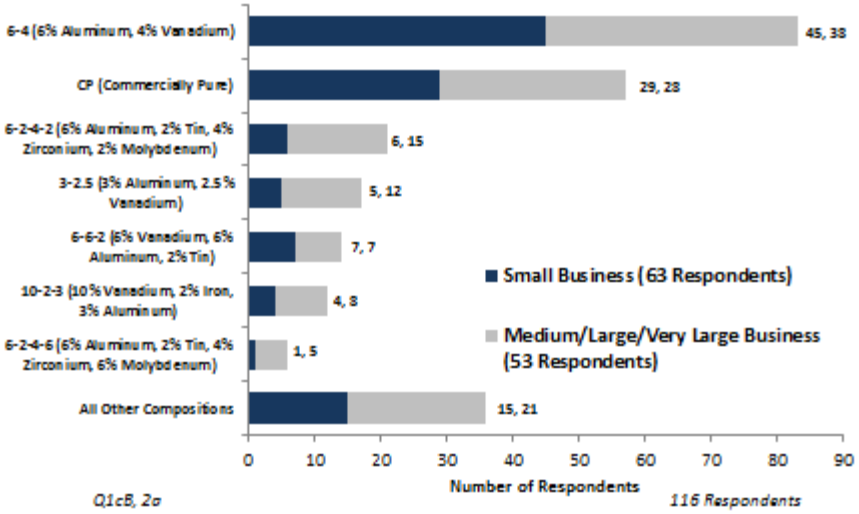
Each of the reported product compositions are manufactured and distributed domestically. However, fewer than 10 respondents are currently able to manufacture each of the 3-2.5, 6-6-2, 10-2-3, and 6-2-4-6 grade material (see Figure III-4.ii).



Not surprisingly, due to the scale of their production and distribution activities, the medium, large, and very large respondents constitute most of the capability and volume across the material compositions. In select instances, however, there is parity in the number of small and larger companies that support certain compositions, such as in the 6-4 and CP product areas (see Figure III-5).

Figure III-5: Titanium Products

Product Compositions Reported by Small and Medium/Large/Very Large Respondents

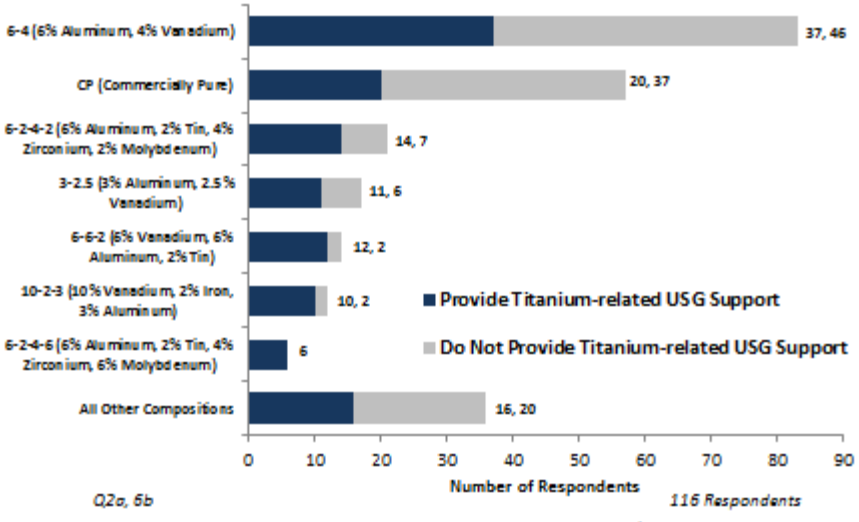


Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Response data also indicate a clear concentration of capability by respondents supplying product to USG programs. With the exception of 6-4 and CP material providers, who generally support more commercial than government work, five of the seven product compositions are dominated by vendors supporting USG programs. These five materials include more complex compositions, such as 6-2-4-2, 6-6-2, 3-2.5, 10-2-3, and 6-2-4-6 (see Figure III-6).

Figure III-6: Titanium Products

Product Composition by Titanium-related USG Support



Q2a, 6b *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

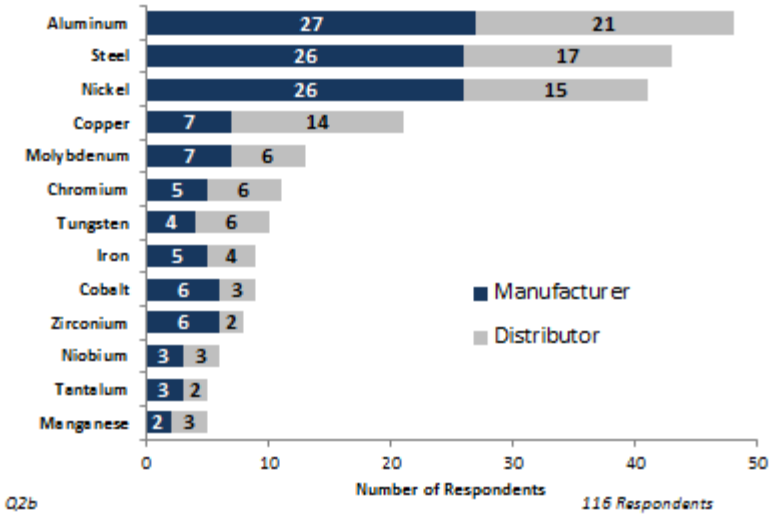
NON-TITANIUM PRODUCTS

BIS asked participating respondents to report information about their product lines unrelated to titanium. This helped identify the level of product diversification among respondents in addition to the complementary relationships and economies shared between titanium and other materials.

Data indicates that aluminum, steel, and nickel are the three most prevalent non-titanium materials produced or distributed by the 116 respondents (see Figure III-7). The products associated with these non-titanium materials include plates, sheets, bars, rods, semi-finished products, and machined parts, among others.

Figure III-7: Non-Titanium Products

Primary Material of All Non-Titanium-Related Products Reported by Respondents Manufacturers versus Distributors



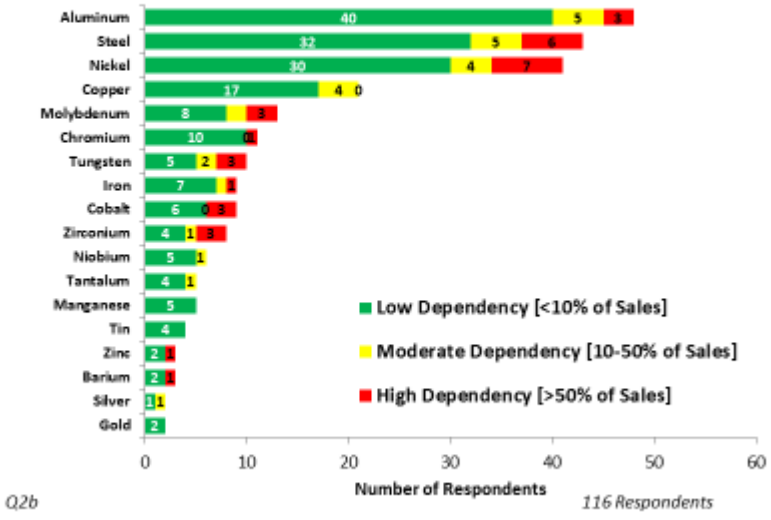
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Copper, the fourth most identified non-titanium material, along with chromium and tungsten, are the only categories with greater participation by distributors than manufacturers. This disparity is not surprising, as a distributor in the metals industry is much more likely to maintain a diverse portfolio of material-related offerings than a manufacturer, in most instances.

BIS also determined the degree to which respondent participation in non-titanium materials may influence their titanium product lines. By first calculating respondent dependency on titanium-related sales, and then correlating this dependency measurement to non-titanium material participation, BIS was able to identify non-titanium products that likely influence titanium-related business processes. For purposes of this assessment, "high dependency" means greater than 50 percent of average annual respondent sales are titanium-related; "moderate dependency" means 10-50 percent; and "low dependency" means less than 10 percent.

For instance, among the respondents that provide zirconium-related products, 38 percent are highly dependent on titanium-related sales. This proportion is similar among tungsten providers. Moreover, 23 percent and 22 percent of respondents that market molybdenum and cobalt, respectively, are dependent on revenues from titanium-related products. The only frequently reported non-titanium business line without participation from highly titanium-dependent respondents is copper (see Figures III-8.i-iii).

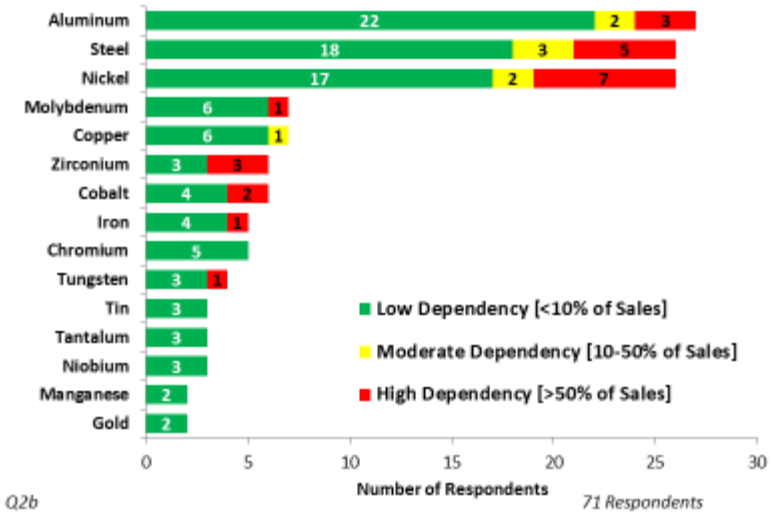
Figure III-8.i: Dependency on Titanium-Related Sales
By Primary Material of Non-Titanium Products



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Figure III-8.ii: Dependency on Titanium-Related Sales

By Primary Material of Non-Titanium Products—Manufacturers

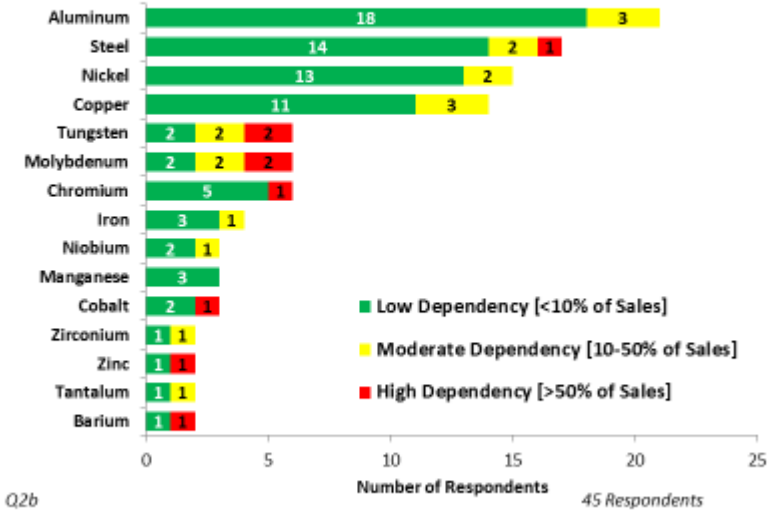


Q2b *71 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Figure III-8.iii: Dependency on Titanium-Related Sales

By Primary Material of Non-Titanium Products—Distributors



Q2b *45 Respondents*

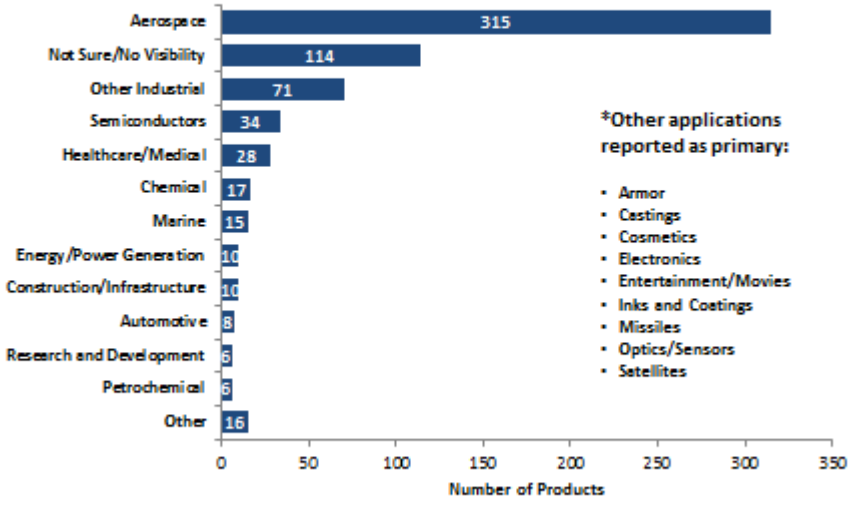
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

PRODUCT END USE APPLICATION

As anticipated by BIS, the leading end use applications of the 650 identified titanium-related products are in the aerospace sector (see Figure III-9). Nearly half of the total number of products identified by respondents (315 products, 48 percent) supported aerospace segments primarily. These application areas include fasteners, housings, vibration isolators, rotating blades, and structures (see Figure III-9).

Figure III-9: Product End Use

Primary Application Areas of Titanium-Related Products*



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

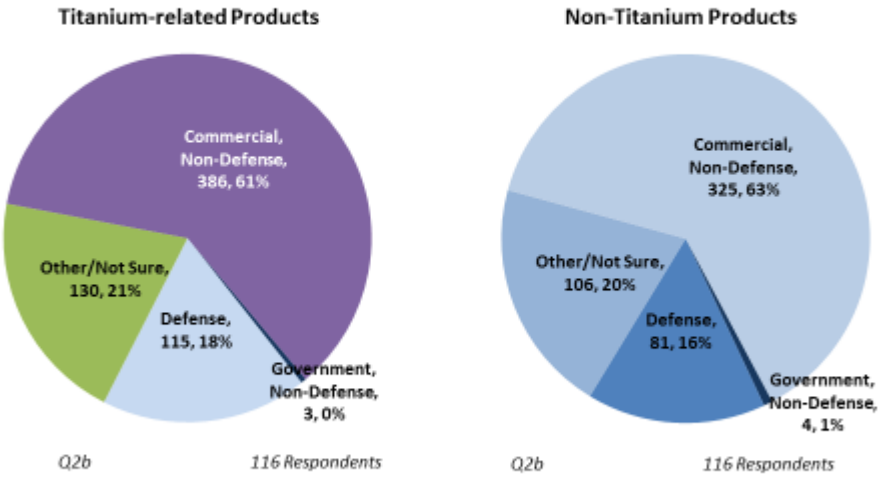
The proportion of the 116 respondents supporting aerospace applications is also noteworthy. BIS determined that the titanium-related products of 68 suppliers, or 59 percent of all respondents, serve the aerospace market. Among these 68 suppliers, 46 or 68 percent are manufacturers. In select instances, respondents recorded more than 10 individual products primarily supporting aerospace application. Median data, however, indicate respondents provided no more than 2 products on average with anticipated aerospace end use.

PRODUCT SECTOR END USE

By sector end use, there was little difference in the apportionment between titanium-related and non-titanium products. For example, data indicate that most of the products sold by respondents, whether titanium-related or not, were used in the commercial, non-defense sector. Proportionally, products used in the defense segment were also relatively even between the two product categories—18 percent of all titanium-related product sector end uses; 16 percent of all non-titanium product sector end uses (see Figure III.10).

Figure III-10: Product End Use

Primary Sector End Use of Titanium and Non-Titanium Products



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

SOLE SOURCE PRODUCTS

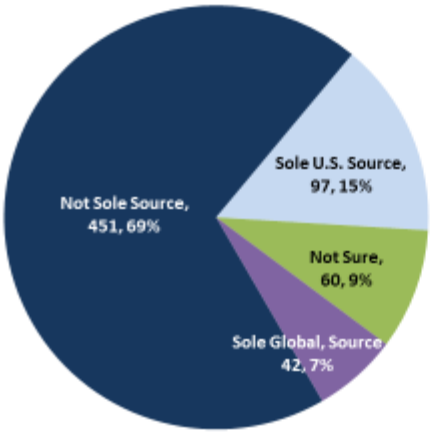
Many survey respondents identified themselves as sole source providers of titanium-related products. Sole source refers to an organization that is the only known source for the supply of parts, components, materials, or services. Conversely, single source refers to an organization

identified as the only accepted and/or qualified source for the supply of parts, components, materials, or services, even though other sources with equivalent capability may exist.

Results indicate that of the 650 titanium-related products reported to BIS, 139 products (21 percent) reported by 33 of the 116 respondents (28 percent) were deemed sole source. These products include 97 "sole U.S. source" products and 42 "sole global source" products provided by 25 and 10 respondents, respectively. In select instances (60 products reported by 22 respondents), participants did not know whether or not their products were sole source (see Figure III-11).

The leading titanium-related products that were sole sourced from the U.S. were bar or rod, plate or sheet, and machined part. The primary material composition in all three product categories was 6-4. Sole source bar or rod and plate or sheet products had aerospace applications in most instances while the 6-4 machined parts aided the production of optics and sensors.

Figure III-11: Sole Source Titanium-Related Products



Sole "U.S." Source Leading Categories		
Product Type	**Composition**	**Application**
Bar or Rod	6-4	Aerospace
Plate or Sheet	6-4	Aerospace
Machined Part	6-4	Optics/Sensors

Sole "Global" Source Leading Categories		
Product Type	**Composition**	**Application**
Coil or Strip	Commercially Pure	Aerospace
Plate or Sheet	3-2.5	Commercial/ Industrial, Non-Defense
Machined Part	6-4	Aerospace

Q3a *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

BIS also learned that 20 of the 33 respondents (61 percent) that reported sole source products were manufacturers. This proportion is consistent with the percentage of manufacturers represented in the overall sample (71 of 116 or 61 percent), suggesting that in general, manufacturers are less likely to declare the provision of sole source products than distributors.

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IV. SUPPLIERS TO TITANIUM MANUFACTURERS AND DISTRIBUTORS

RESPONDENT SUPPLIER INFORMATION

To assess the supply chain network supporting respondents' titanium-related operations in 2012 to 2014, BIS asked participants to identify all of their external suppliers that are affiliated with titanium-related product lines. Additionally, respondents were asked to record supplier location, acquired input type and application, and whether or not the supplier was a sole or single source at that time.[13] A written description of each procured material or service was also provided by participating companies.

Respondents identified 249 unique external suppliers among 633 overall vendor identifications. Nearly 75 percent of the 249 unique suppliers had provided respondents with materials while the remaining 25 percent had provided services or a combination of services and materials.[14] Among the identified 249 unique suppliers, 201 (81 percent) were located in the U.S. and respondents had on average three suppliers affiliated with their titanium-related product lines, most of which were domestic (84 percent).

SUPPLIER LOCATION

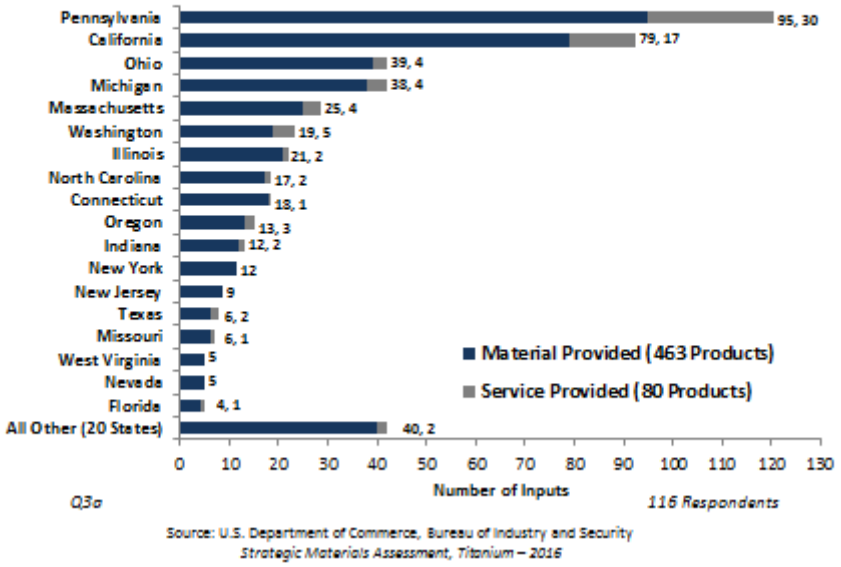
By individual input, from 2012 to 2014, Pennsylvania and California accounted for 23 and 18 percent, respectively, of the 543 recorded domestic materials and services supporting

[13] Single source is an organization 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. In contrast, sole source is an organization that is the only source for the supply of parts, components, materials, or services where no alternative U.S. or non-U.S. based suppliers exist other than the current supplier.
[14] BIS found that 52 of the 249 respondent identified vendors (21 percent) had participated in the data collection.

respondents' titanium-related product lines.[15] Additionally, approximately 16 percent of respondents' inputs were sourced from supplier locations in Ohio and Michigan combined (see Figure IV-1).

Figure IV-1: Respondents' Top U.S. Supplier Location

543 Total Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

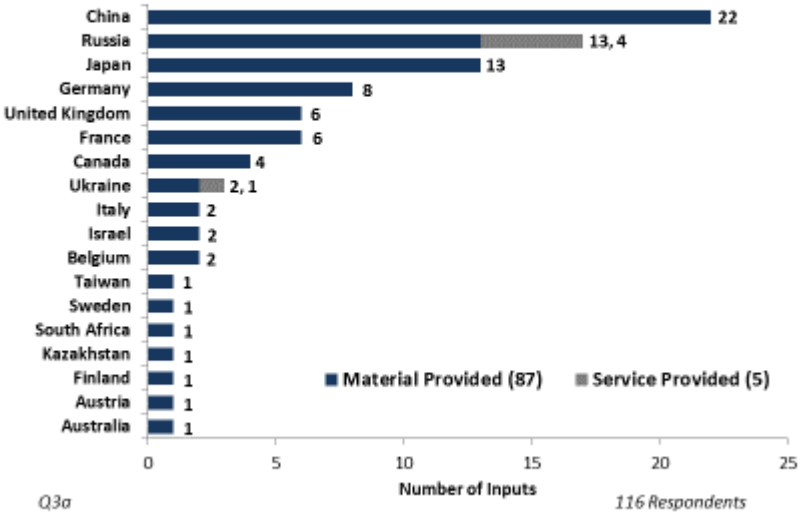
Each of the leading 11 states supporting respondents with titanium-related inputs provides both materials and services. However, more than half of services (58 percent) are sourced from Pennsylvania and California-based companies. Typical services supplied by these vendors include destructive and nondestructive testing, forging, ingot breakdown, hot rolling, pre/post cleaning, and vacuum annealing.

Respondents recorded 92 inputs procured from 18 countries in support of their titanium-related product lines. China (22 inputs, 24 percent), Russia (17 inputs, 18 percent), and Japan (13

[15] Despite the concentration of inputs sourced from Pennsylvania, constituting nearly 25 percent of all recorded inputs from U.S. locations, California represents 27 percent (55 companies) of the 201 U.S. suppliers supporting respondents compared to Pennsylvania's 19 percent (38 companies).

inputs, 14 percent) were the top three sources for the years 2012-2014. The vast majority (87 inputs, 95 percent) of non-U.S. sourced procurements was for materials rather than services (see Figure IV-2). However, one respondent did identify suppliers in both Russia and Ukraine as providers of select services, such as rolling of slabs into plate, sheets, and coil.[16]

Figure IV-2: Respondents' Top Non-U.S. Supplier Location
92 Total Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

MATERIAL SOURCED

In the survey, BIS adopted broad, prepopulated categories of sourced material, including raw material and semi-finished/finished metal, to supplement respondents' sourcing declarations. To provide greater specificity, participants were asked to include a written description of each material acquired.

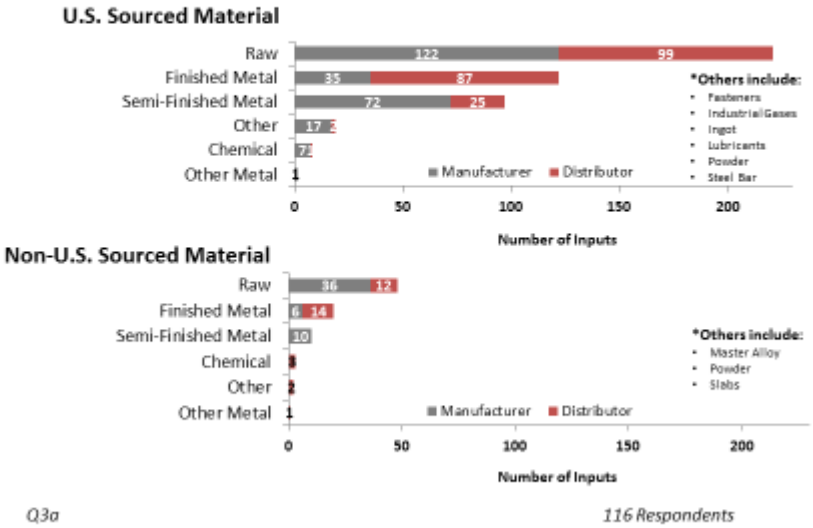
[16] Note that Figure IV-2 shows number of inputs by origin, and not total quantity of inputs imported.

Most of the materials sourced from both U.S. and non-U.S. vendors were raw materials rather than intermediate or finished goods. This is likely due to the large manufacturing focus of the respondent sample (71 of 116) (see Figure IV-3). Such materials include ingot, sponge, plate, rolled and flat bar, powder, refractory, scrap, and master alloy, among other precursors.

Some discrepancies in procurement behavior exist between manufacturer and distributor respondents. For example, among manufacturers, 77 percent of all their raw material inputs were purchased domestically, slightly less than quantities bought domestically by distributors (89 percent). Additionally, while both manufacturers and distributors source the majority of their material inputs from U.S. sources, distributors appear reluctant to procure abroad. Survey data shows that less than six percent of distributors' inputs are sourced from non-U.S. vendors, in contrast to 17 percent of those sourced by manufacturers (see Figure IV-3).

Figure IV-3: U.S. and Non-U.S. Sourced Material

Material Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



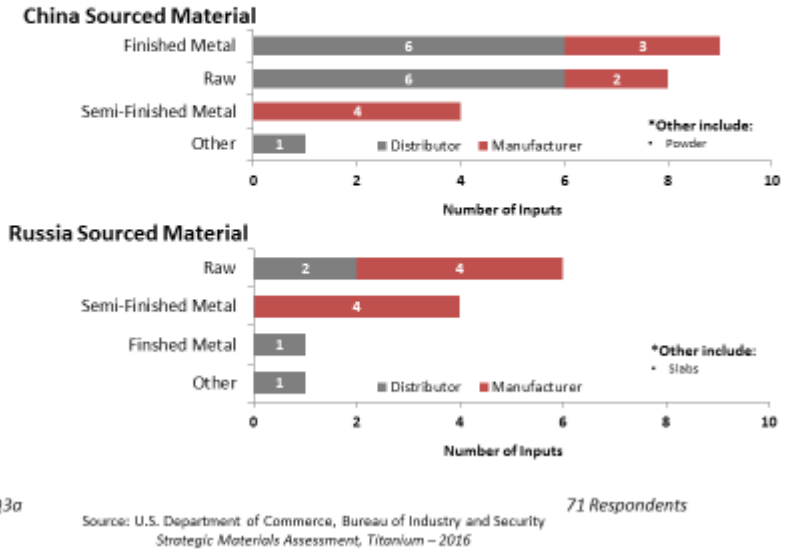
Q3a *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

The kinds of material procurements made by respondents from China-based vendors, however, proved largely disproportionate to respondents' overall acquisitions abroad (see Figures IV-3 and IV-4). For example, finished metal is the leading category of material sourced from China however this contrasts sharply with raw material's predominance among non-U.S. origin procurements overall, and from Russia, specifically, the second leading non-U.S. supplier. Indeed, across the sample of non-U.S. sourcing, the proportion of raw material inputs to finished metal is greater than 2:1. Meanwhile, in the case of China-origin purchasing, raw material purchases occur less frequently than finished metal purchases (see Figure IV-4).

Figure IV-4: Non-U.S. Sourced Material

Material Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



Q3a *71 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Between manufacturer and distributor respondents, few differences were evident in their procurement of material inputs from China and Russia. For instance, data indicate that metals and raw materials originating from China were procured by both respondent types. In the case of raw materials sourced from Russia, manufacturers proved more likely to source Russian raw and semi-finished metal than their distributor counterparts (see Figure IV-4).

LEADING NON-U.S. SUPPLIERS

Respondents identified several non-U.S. suppliers that support their titanium-related product lines, most of which reside in China, Russia, Japan, and Germany. Suppliers located in these four countries constitute 65 percent of all inputs acquired abroad by respondents for titanium-related applications.

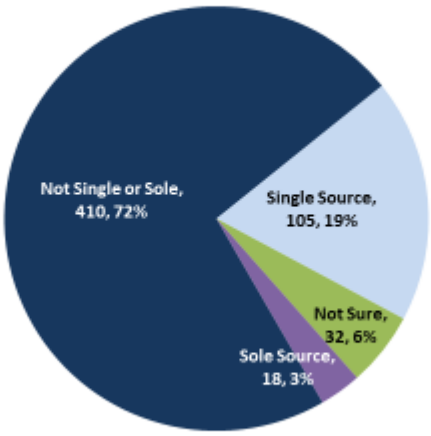
The ratio of input to individual vendor varies significantly between countries. Countries like Russia, Japan, and Germany maintain a relatively consolidated titanium supplier base with multiple inputs procured from only a handful of companies. This contrasts sharply with China, where survey respondents identified several vendors that offer the same or very similar precursors. For example, in Russia, despite the relative high frequency of sourcing by respondents, all 17 reported inputs (18 percent of all non-U.S. inputs supporting titanium-related product lines) were acquired from only two suppliers. Conversely, in China, 22 material inputs were purchased from 17 individual suppliers and only a select few were mentioned more than once. The number of reported precursor suppliers located in Japan and Germany, as with Russia, proved minimal with inputs sourced from only a few select conglomerates.

SINGLE AND SOLE SOURCE SUPPLIER INPUTS

For each input that was procured from an external supplier and used in their titanium-related product lines, respondent companies indicated whether or not the purchase was made on a single or sole source basis. Results indicate that there are a substantial number of single and sole source purchases among respondents from both U.S. and non-U.S. suppliers.

Specifically, the data shows that among the 543 reported inputs supporting respondents' titanium-related product lines, 105 were single source and 18 were sole source (19 and 3 percent) (see Figures IV-5.i-ii).

Figure IV-5.i: Sole Source Titanium-Related Inputs 2012-2014



Q3a *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Figure IV-5.ii: Sole Source Titanium-Related Inputs 2012-2014

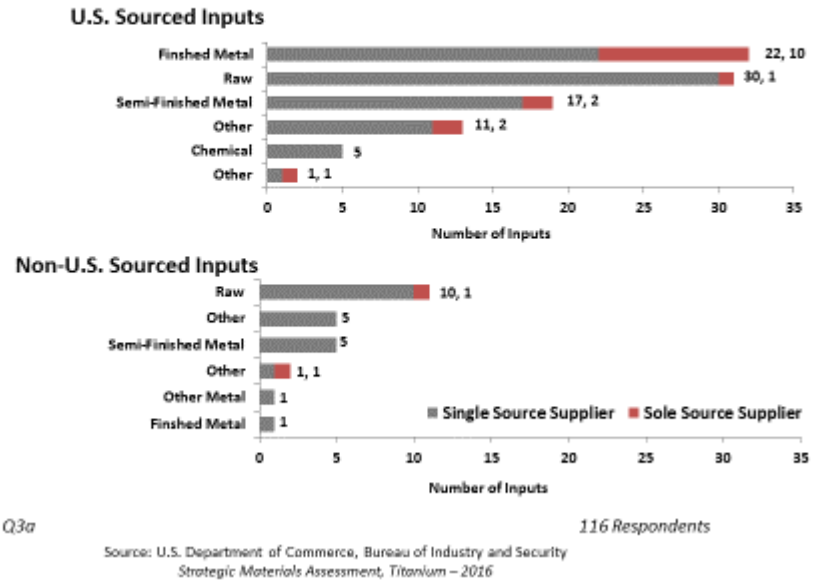
Sole Source Sample Input and Application		
Input Type	**Description**	**Application**
Finished Metal	Extrusion	Bar or rod, Alloy, 3-2.5 and 6-4 for Defense Applications
Semi-Finished Metal	Powder	Casting, Alloy, 6-2-4-2 for Non-Defense Applications
Other	Lubricant	Other, Alloy, 6-4 for Non-Defense Applications

Q3a *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Domestically, single and sole source purchases were comprised largely of finished metal and raw material, with sole source supplier relationships involving 32 finished metal inputs. Internationally, single and sole source procurements made by respondents from non-U.S. vendors consisted primarily of raw material (see Figure IV-6.i).

Figure IV-6.i: Single and Sole Source Inputs
Material Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



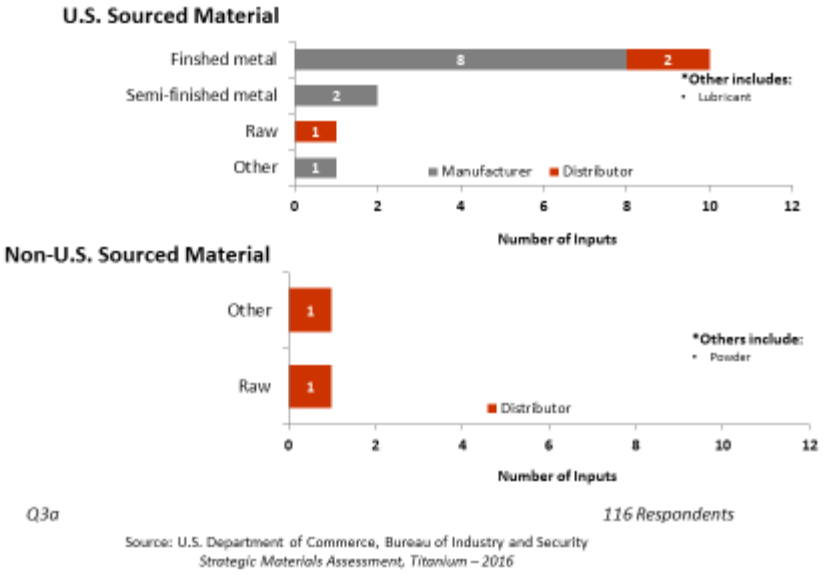
Q3a *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Sole source procurements were infrequent among both manufacturers and distributor respondents. Nonetheless, most sole source purchases were domestic and made by manufacturers (2:1 ratio between manufactures and distributors) and also largely comprised of finished metal (see Figure IV-6.ii).

Figure IV-6.ii: U.S. and Non-U.S. Sole Sourced Material

Material Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



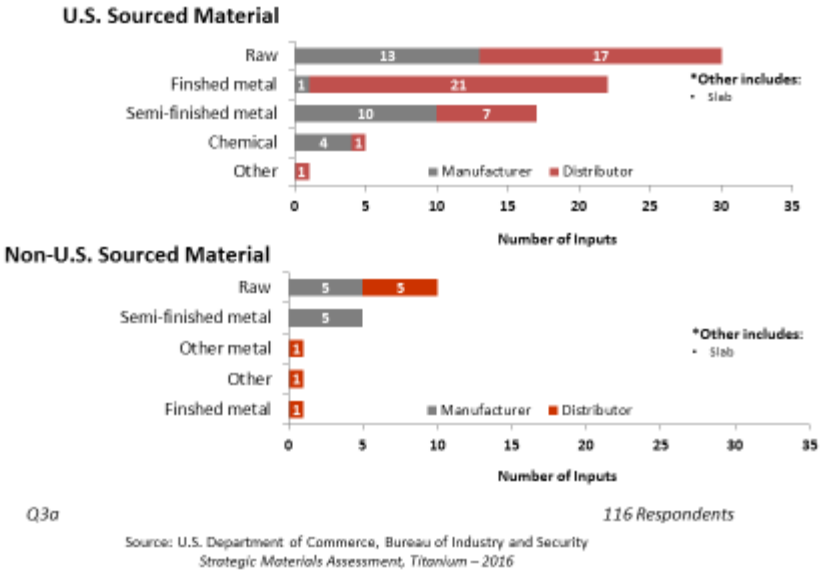
Q3a *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

In contrast to sole source buys, single source purchases, especially domestic ones, were made primarily by distributors rather than manufacturers. This contrast was particularly evident in the procurement of single sourced finished metal. Not surprisingly, as manufacturers are less prone than distributors to procure finished metal, distributors accounted for the majority (95 percent) of these single source purchases made from U.S. vendors (see Figure IV-6.iii).

Figure IV-6.iii: U.S. and Non-U.S. Single Sourced Material

Material Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



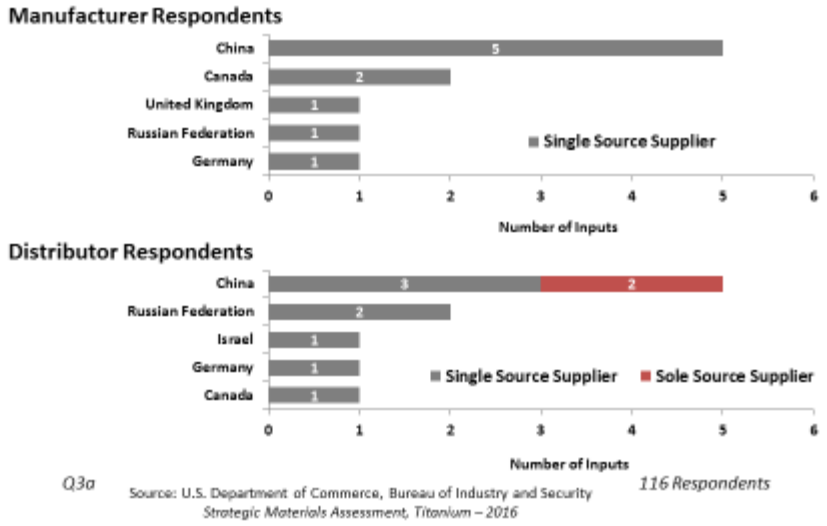
Q3a *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Descriptions indicated sole source purchases from U.S. vendors consisted of extrusions, investment castings, lubricants, machined gears and gear shafts, and select powders among other product areas.

Despite several countries maintaining single source supplier relationships with respondents, including China, Russia, Canada, Germany, the United Kingdom, Ukraine, and Israel, respondent sole source relationships were evident only in China. These particular sole source purchases of Chinese origin included stainless steel piping for commercial use and titanium powder integrated in a U.S. Department of Defense application (see Figure IV-7).

Figure IV-7: Single and Sole Source Non- U.S. Location
Locations of Material Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



Q3a Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*
Strategic Materials Assessment, Titanium – 2016

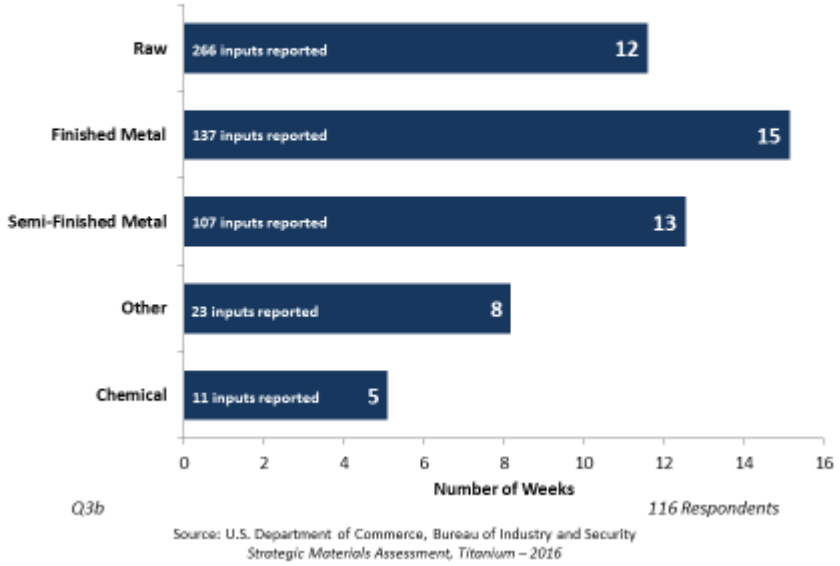
INVENTORY LEVELS—MATERIAL INPUTS SUPPORTING TITANIUM OPERATIONS

To better understand respondents' inventory practices and the management of inputs needed for the manufacturing and distribution of their titanium-related product lines, BIS asked survey participants to record select inventory measures. Data included the inventory (in weeks) currently maintained for each input, the number of weeks necessary to exhaust all current inventory in a 100 percent (surge) capacity utilization scenario, and the number of weeks required to return inventory to current levels given a 100 percent drawdown.

By material type, respondents reported on average a comparatively higher level of finished metal inventories (15 weeks) than semi-finished metal (13 weeks), raw material (12 weeks), other materials (8 weeks), and chemicals (5 weeks). This disparity in inventory levels between material categories is generally attributed to the lengthy lead times required to purchase finished

metals, especially those with customized specifications. In contrast, the lead time necessary to procure most precursors is more predictable and less constrained by intricate production steps inherent to semi-finished and finished metal production. The comparatively shorter shelf life and increased storage costs of select raw materials and chemicals, like powder, sponge, and dioxide, also contribute to the discrepancy in inventory levels between categories of material inputs (see Figure IV-8.i).

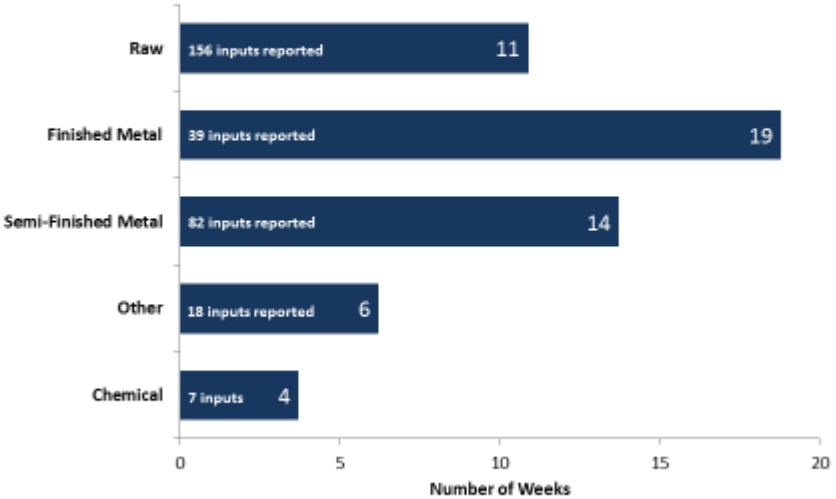
Figure IV-8.i: Average Inventory Level of Material Type
Material Inputs to Respondents' Titanium Related Product Lines, 2012-2014



In addition to discrepancies in inventory levels on the basis of input type, survey results also indicate distinct inventory practices between manufacturers and distributors, both overall and by input type (see Figure III-8.ii-iii). For example, across all inventory types, distributors maintained 3.5 weeks of inventories on average in contrast to 2.4 weeks held by manufacturers.

Furthermore, while manufacturers represent 61 percent of the sample, only 56 percent of all inventories were reported by manufacturers.[17]

Figure IV-8.ii: Average Manufacturer Inventory Level
Material Inputs to Manufacturer Titanium Related Product Lines, 2012-2014

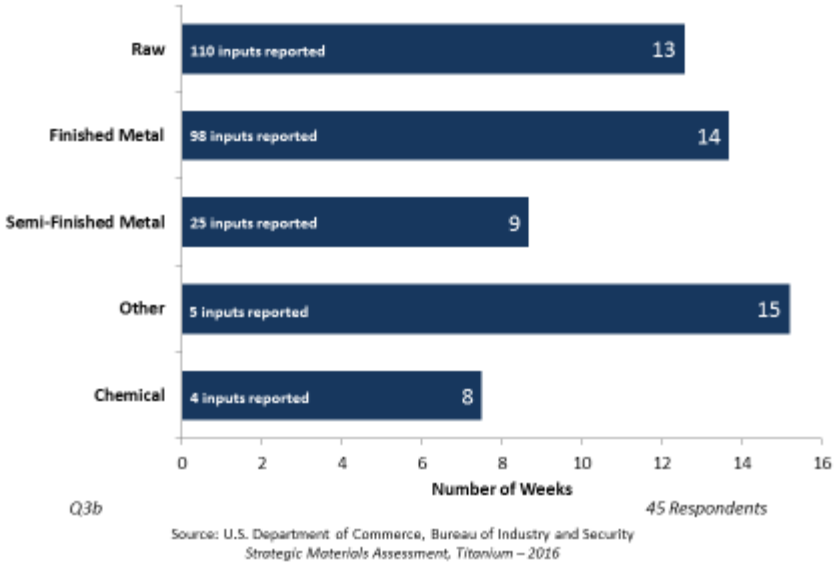


Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

[17] BIS also examined respondent inventory levels by the products being served rather than simply by the specific inputs. This approach permitted greater insight into the inventory dynamics affecting the availability of respondents' titanium-related product lines, many of which are customized.

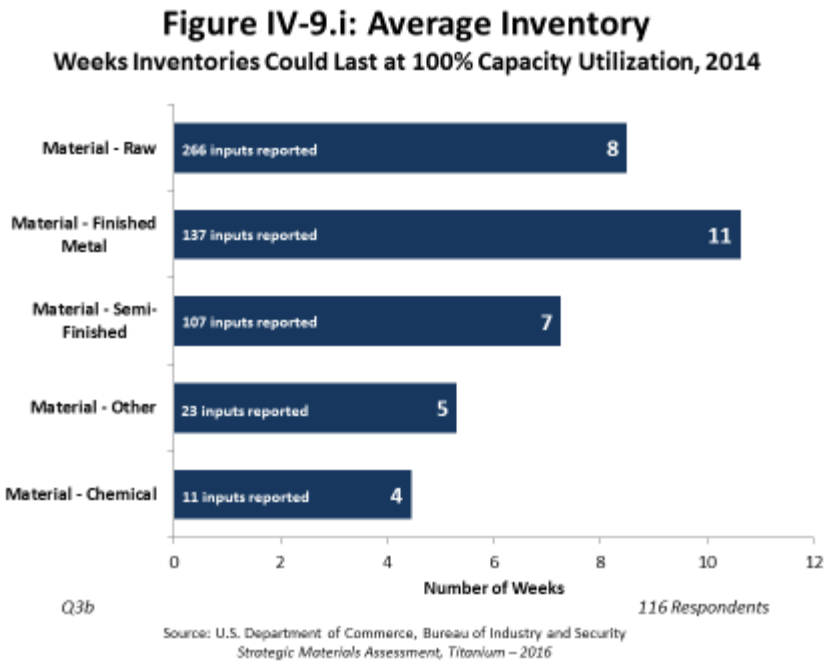
Figure IV-8.iii: Average Distributor Inventory Level

Material Inputs to Distributor Titanium Related Product Lines, 2012-2014



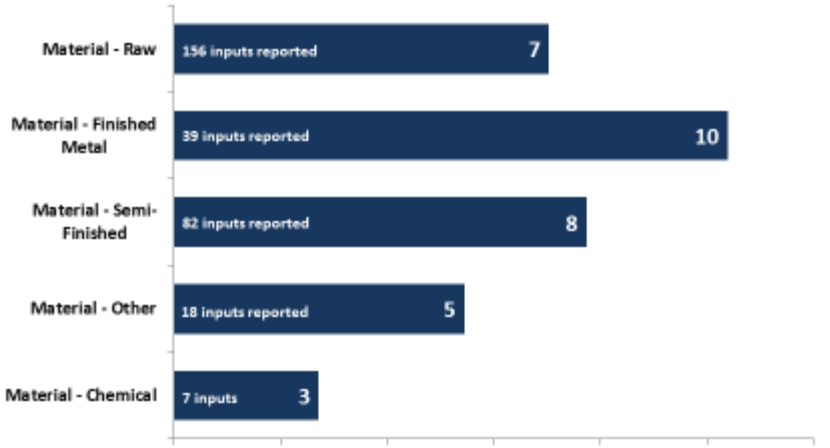
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

If respondents are suddenly faced with a surge in demand with capacity utilization levels brought to 100 percent, BIS found that depending on the material type involved, current inventory levels would last between four to 11 weeks before being exhausted. The materials that would last the longest in this surge scenario are: finished metal (11 weeks), raw materials (8 weeks), and semi-finished materials (7 weeks). These materials typically have longer lead times, meaning that larger quantities of such material are kept on hand. Conversely, chemicals and other precursor materials, like lubricants and industrial gases, would be depleted much more quickly, lasting only four to five weeks (see Figure IV-9.i). Yet stocks of these materials are more readily replenished, so less is kept on hand.



Between manufacturer and distributor respondents in this surge scenario, select differences in inventory shelf life were evident. Distributor raw material inventories, for example, appeared to be much more resilient, lasting on average four weeks longer than those of manufacturers (see Figures IV-9ii-iii). The discrepancy in shelf life duration was also apparent among chemical inventories, although relatively fewer chemicals had been reported by either respondent type.

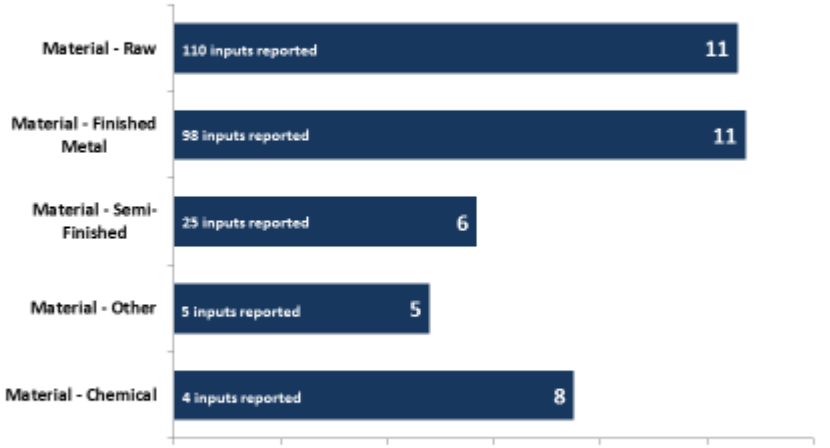
Figure IV-9.ii: Average Manufacturer Inventory
Weeks Inventories Could Last at 100% Capacity Utilization, 2014



Q3b *71 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Figure IV-9.iii: Average Distributor Inventory
Weeks Inventories Could Last at 100% Capacity Utilization, 2014



Q3b *45 Respondents*

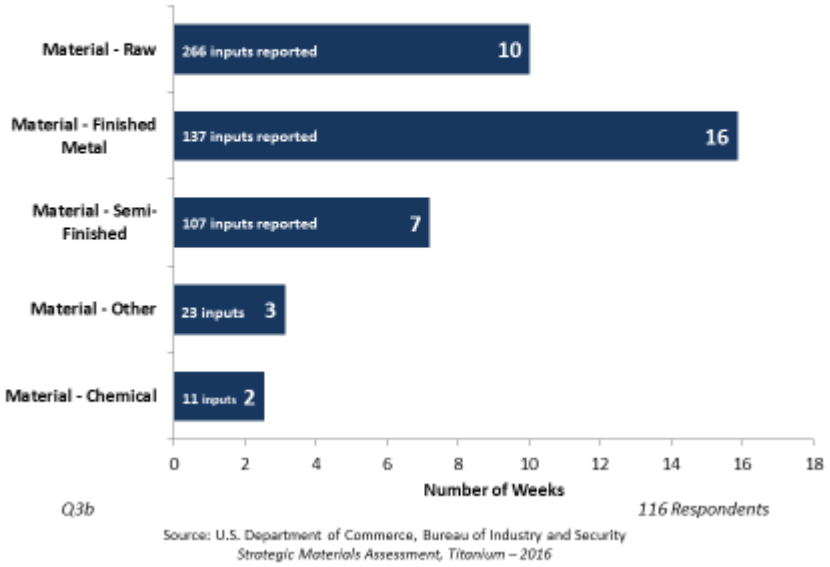
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

In the same surge scenario, BIS found that depending on the materials type, respondents would require between two and 16 weeks to reconstitute spent inventories to current levels. The

materials requiring the greatest lead time to replace would be: finished metal (16 weeks), followed by raw materials (10 weeks) and semi-finished materials (seven weeks). However chemicals and precursor materials, such as lubricants and industrial gases, could be replaced in two to three weeks (see Figure IV-10.i).

Figure IV-10.i: Inventory Replacement

Weeks to Reconstitute Inventories at 100% Capacity Utilization, 2014



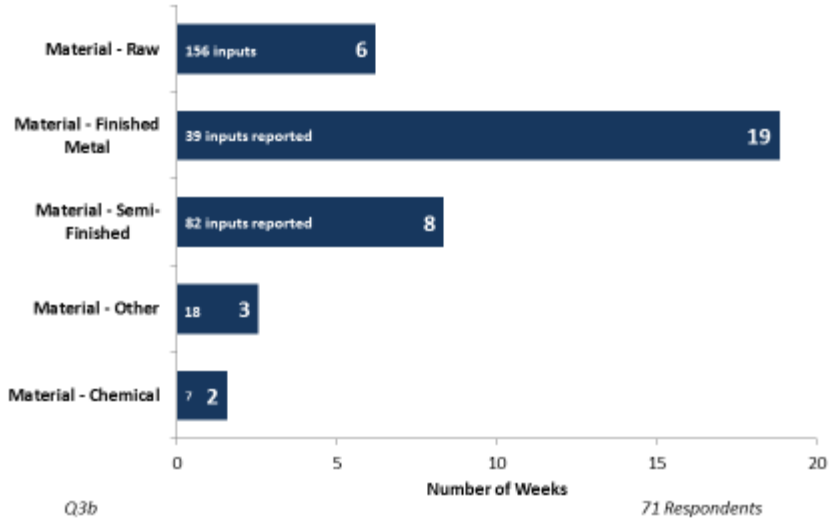
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

In an immediate inventory drawdown scenario, where 100 percent capacity unitization is maintained, distributors on average must wait more than twice as long (15 weeks) as manufacturers (six weeks) to replenish spent raw material inventories.[18] This discrepancy in inventory replacement lead times contrasts sharply with that of semi-finished materials, where manufacturers would need eight weeks to replenish, rather than three weeks for distributors (see Figures IV-10.ii-iii).

[18] Evidence of a labor strike reported by a distributor contributed to lengthy lead times for the replacement of select raw materials like titanium-related bars, billets, and extrusions.

Figure IV-10.ii: Inventory Replacement, Manufacturers

Weeks to Reconstitute Inventories at 100% Capacity Utilization, 2014

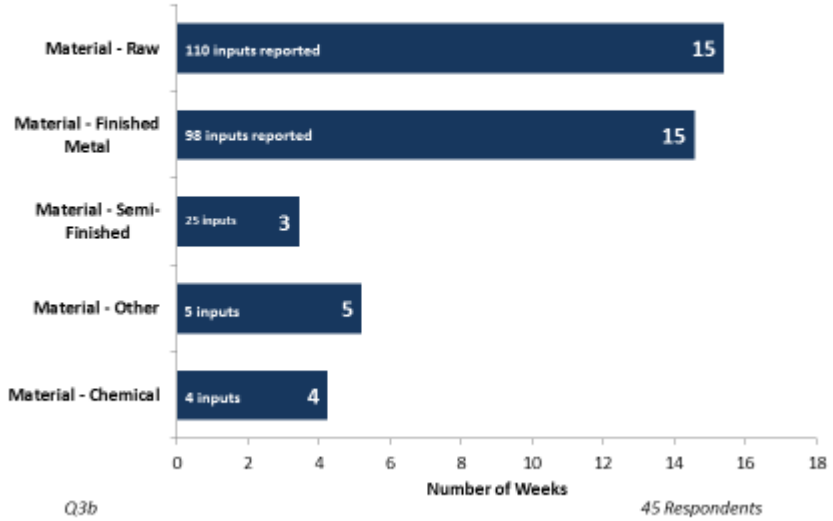


Q3b *71 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Figure IV-10.iii: Inventory Replacement, Distributors

Weeks to Reconstitute Inventories at 100% Capacity Utilization, 2014



Q3b *45 Respondents*

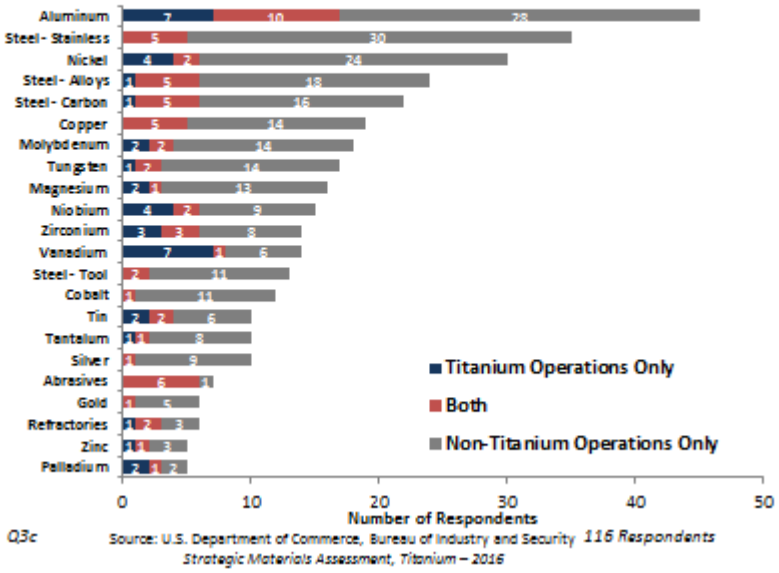
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

MATERIAL INPUTS SUPPORTING OVERALL OPERATIONS

BIS requested information on respondents' overall materials inventory, including materials not related to titanium product lines. Respondents first identified these materials by name and then indicated whether or not they had any role in their titanium-related operations. Their current inventory levels and the type and location of their sources were also reported.

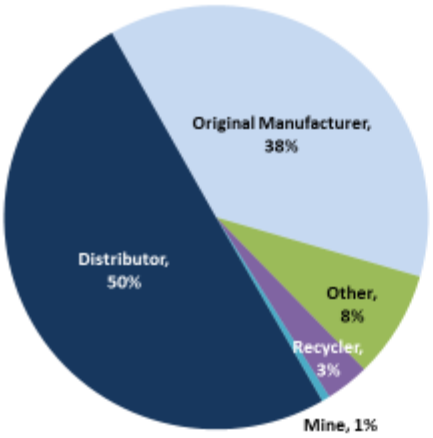
There were 22 categories of material identified by respondents, all of which supported titanium-related activities to some degree (see Figure IV-11). Select materials such as aluminum, niobium, vanadium, and zirconium were often designated as supporting titanium operations. Materials like steel and abrasives were categorized as supporting both titanium and non-titanium related operations.

Figure IV-11: Respondent Participation in Other Non-Titanium Materials



Data indicate that half of these additional materials were sourced from distributors, while original manufacturers accounted for 31 percent of such inputs (see Figure IV-12).

Figure IV-12: Other Material Source Type
Based on 329 Other Material Inputs



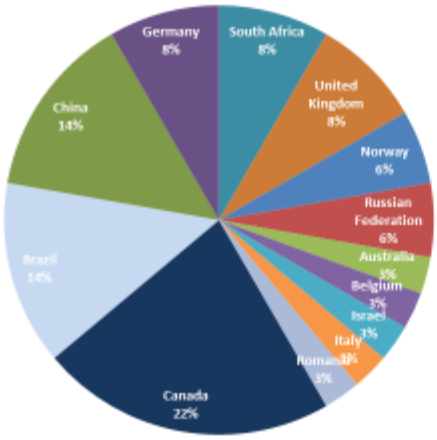
Other Material Source Type		
Source Type	**Frequency**	**Percent of Total**
Distributor	165	50%
Original Manufacturer	124	38%
Other	27	8%
Recycler	11	3%
Mine	2	1%

Q3c *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Based on 305 additional material inputs recorded with direct country source information, the vast majority of inputs, 269 or 88 percent, were procured from U.S. locations. Additionally, among the 36 inputs sourced directly from 13 non-U.S. country locations, there is a concentration of procurements from Canada, Brazil, and China (see Figure IV-13).

Figure IV-13: Non-Titanium Material Direct Source Location
Based on 36 Non-Titanium Material Inputs



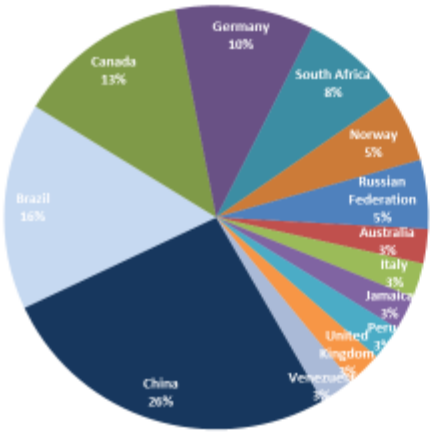
Direct Source Location (leading non-U.S. countries)		
Country	**Frequency**	**% of non-U.S.**
Canada	8	22%
Brazil	5	14%
China	5	14%
Germany	3	8%
South Africa	3	8%
United Kingdom	3	8%
Norway	2	6%
Russian Federation	2	6%

Q3c *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

The composition of countries designated as the original source location of the 305 additional material inputs is not dramatically different than that of the countries actually selling to respondents. China, the noteworthy exception to this trend, accounts for 14 percent of the non-U.S., non-titanium inputs sold directly to respondents, yet by source origin China accounts for 26 percent of these inputs (see Figures IV-13 and 14).

Figure IV-14: Non-Titanium Material Source Origin Location
Based on 38 non-U.S., non-Titanium Material Inputs



Source Origin Location (leading non-U.S. countries)		
Country	**Frequency**	**% of non-U.S.**
China	10	26%
Brazil	6	16%
Canada	5	13%
Germany	4	11%
South Africa	3	8%
Norway	2	5%
Russian Federation	2	5%

Q3c *116 Respondents*

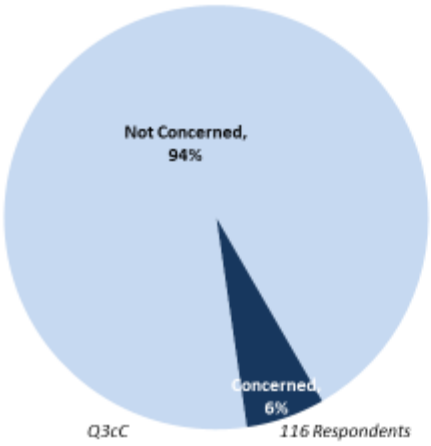
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

The 10 additional material inputs with China identified as the original source include cobalt, molybdenum, niobium, stainless steel, tantalum, tungsten, and zirconium, and six of these 10 inputs were acquired from a U.S. source directly, five of which were U.S.-based distributors.

INPUT AVAILABILITY

Results indicate that respondents overall are not concerned about the availability of inputs used in their operations, the bulk of which did not support titanium-related operations. Of the 116 respondents that submitted surveys, only seven respondents (six percent) are concerned about input availability. The specific materials posing concerns are helium and vanadium (each mentioned twice), magnesium, molybdenum, nickel, steel, and tantalum (see Figure IV-15).

Figure IV-15: Non-Titanium Material Availability Concerns



Material Deemed a Concern by 7 of 116 Respondents (6% of sample)		
Material	Frequency	Percent of 9 Mentions
Helium	2	22%
Vanadium	2	22%
Magnesium	1	11%
Molybdenum	1	11%
Nickel	1	11%
Steel	1	11%
Tantalum	1	11%

Q3cC *7 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Respondents offered explanations of the risks posed by the lack of availability of each of the material inputs they identified. Some respondents expressed concern over the finite supply of helium, an important element in many titanium-related products. Others were concerned with the availability of tantalum and vanadium among other materials and the quality control impacts posed by limited domestic supply.

Expounding on such risk, a small business respondent operating at low financial risk and specializing in melting, casting, and machining reported: "Due to a limited supplier base here in the United States, we now have to order tantalum and vanadium from a distributor who gets the materials out of China and we [then] have to have the material tested because the [procured] material is not always what was advertised."

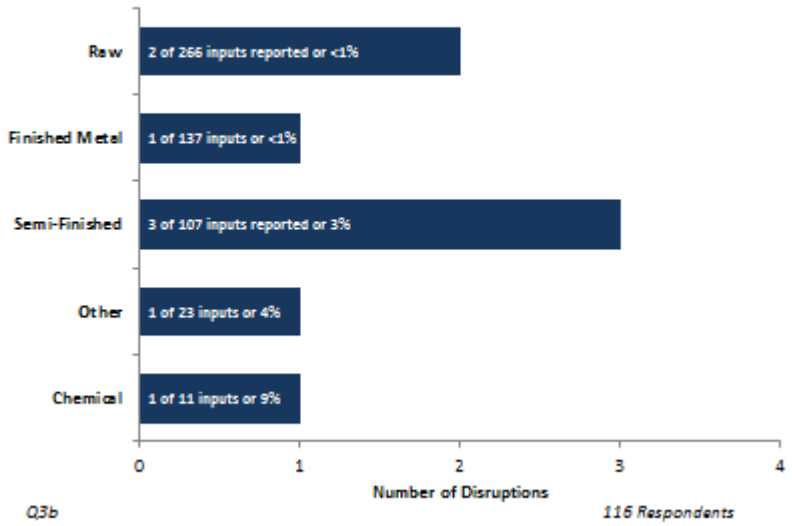
In regards to nickel, one respondent indicated, "No new sources of high purity nickel are being worked on, leading to the potential for demand to outstrip supply in future time period." In regards to molybdenum, another respondent wrote how their "Molybdenum source has announced the recent closure of its mine, resulting in tighter supply."

DISRUPTION IN SUPPLY: INPUTS SUPPORTING TITANIUM OPERATIONS

For each of the 544 overall material inputs supporting respondents' titanium-related operations, BIS asked whether or not a disruption in supply had occurred since 2012. Across the 544 materials, only eight incurred disruption since 2012. Causes of these disruptions include helium shortage, plant shutdown, late delivery, labor strike, and equipment failure. The limited number of documented disruptions in the supply of precursor materials (one percent of reported inputs) is indicative of the reliability of associated vendors, their adequate number, and the overall health of the related supply chains (see Figure IV-16).

Figure IV-16: Supply Disruptions of Input Material Types

Material Inputs to Respondents' Titanium-Related Product Lines, 2012-2014



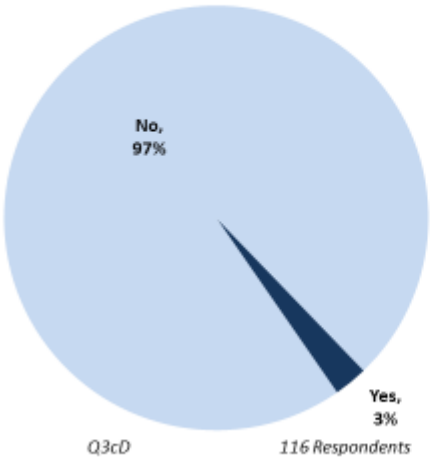
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

DISRUPTION IN SUPPLY: INPUTS SUPPORTING NON-TITANIUM OPERATIONS

BIS also asked respondents to describe any supply chain disruptions involving documented material inputs that had affected non-titanium related operations. Results indicate very few instances of such supply chain disruptions occurring among companies over the three year period—only four instances reported by three respondents (see Figure IV-17).

There was some evidence of disruptions in the copper supply chain, for example, where one respondent reported how "during times of aggressive Chinese buying, instead of scrap [they] have to use more expensive primary copper." A respondent also reported disruptions caused by the beryllium shortage in 2011 and the export tariff imposed by China on phosphorus in 2008.[19]

Figure IV-17: Non-Titanium Material Supply Chain Disruptions



Supply Chain Disruptions Reported by 3 of 116 Respondents (3% of sample)

Material	Frequency	% of Total
Beryllium	1	25%
Copper	1	25%
Phosphorus	1	25%
Rare Earths	1	25%

Q3cD *3 Respondents*

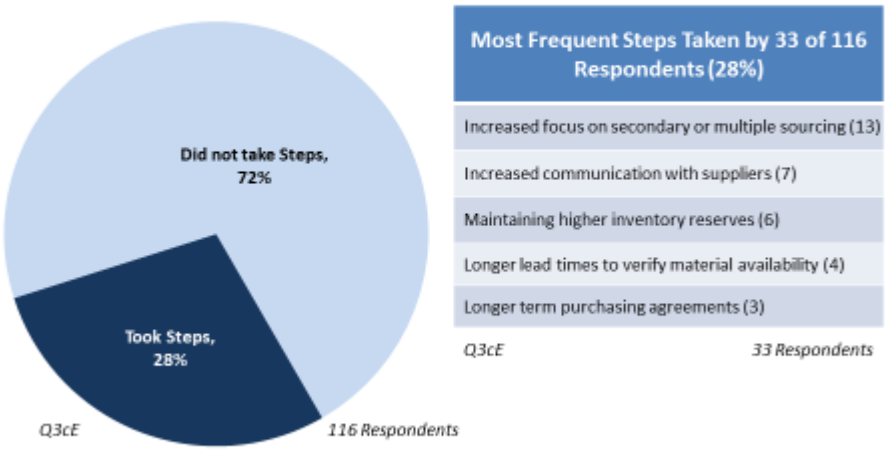
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

[19] Tariffs (export) on phosphate rock and fertilizer products had been raised by China in 2008 to ensure domestic requirements/availability. See: https://minerals.usgs.gov/minerals/pubs/commodity/phosphate_rock/mcs-2009-phosp.pdf

EFFORTS TO ENSURE SUPPLY

The lack of supply chain disruptions documented by respondents is partly attributed to the robust number of steps currently employed to mitigate such disruptions. BIS learned that 33 respondents (28 percent overall) had adopted some kind of mitigation to reduce such risk. Batched into five categories, the approaches most often pursued by respondents include increased focus on secondary or multiple sourcing, increased communication with suppliers, maintaining higher inventory reserves, longer lead times to verify material availability and longer term purchasing agreements (see Figure IV-18).

Figure IV-18: Non-Titanium Material Steps Taken to Minimize Disruptions



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

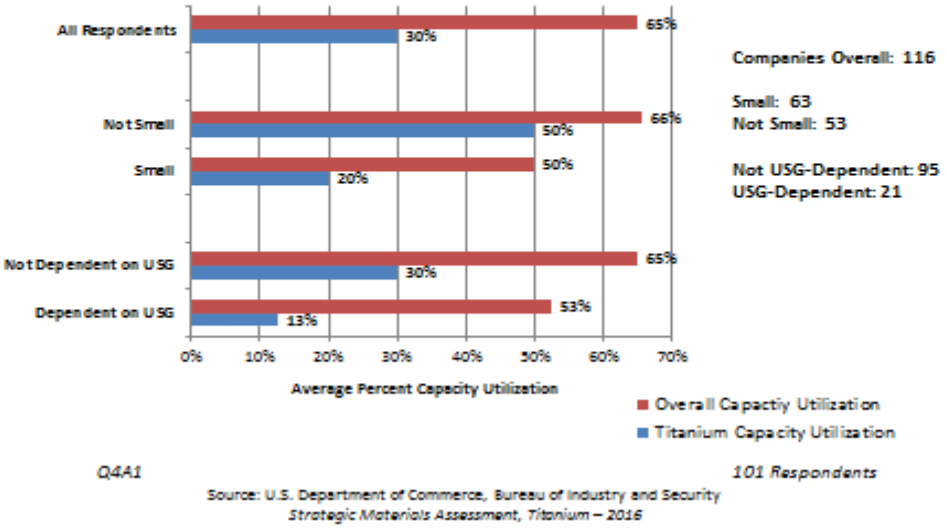
Noteworthy representative examples of mitigation techniques adopted by respondents include the development of entirely new organizations for strategic sourcing and supply chain in order to manage assured supply, the establishment of inventory reserves, communication of material lead time information up and down the supplier-customer channel, and the securing of alternative suppliers, both domestic and abroad, for critical raw materials.

V. OPERATIONS AND CHALLENGES

CAPACITY MEASUREMENT

To determine the operational behavior of participating respondents, BIS asked respondents to report their capacity utilization rates for both overall operations and those dedicated to titanium-related product lines. Data indicate that in their overall operations, across all product lines, respondents maintained an average capacity utilization rate of 65 percent. This rate is much higher in comparison to the 30 percent average capacity utilization rate reserved for titanium-related production. Additionally, results show that the larger and more dependent the respondent is on the U.S. Government, the higher both their overall and titanium-related capacity utilization rates are (see Figure V-1).[20]

Figure V-1: Current Average Capacity Utilization
2014

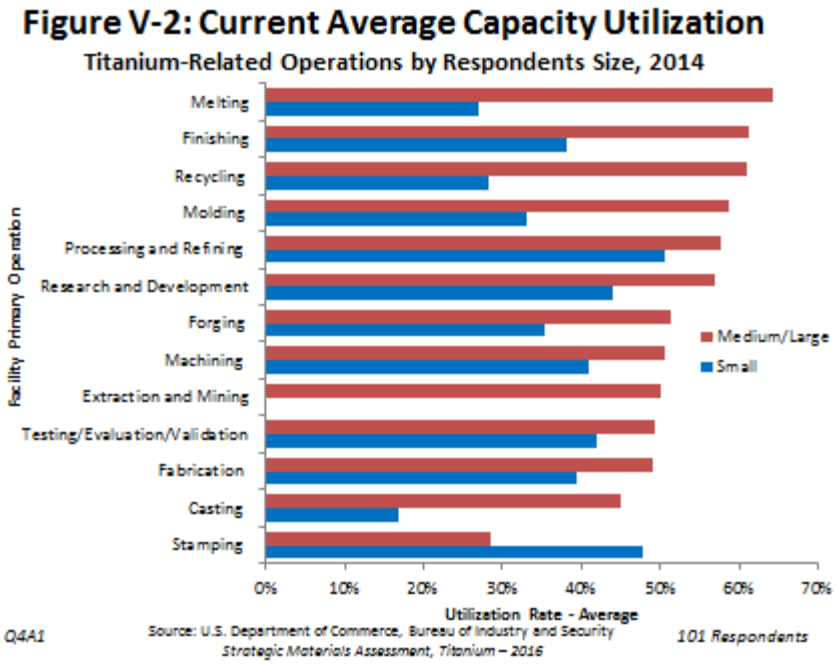


[20] In determining USG-dependency, BIS took into account both respondents' self-declarations of dependency and their reported sales data. Maintaining an average revenue contribution of 25 percent or greater in USG-related sales in 2010-2014 constitutes a dependent status. For more information, see "VII. U.S. Government and Defense Program Participation."

The clear gaps in both the overall and titanium-related capacity utilization rates between the respondent samples suggest that companies that are larger and less dependent on the USG maintain more efficient operations than their smaller, more public sector oriented peers. The infrequent procurements and extended lead times attributed to USG rather than commercial material production also likely contributed to the sizeable gap in capacity utilization.

BIS also learned that titanium-related rates of capacity utilization vary significantly by both respondent operation and respondent size. For example, rates among larger companies for 12 of 13 recorded operation types (less stamping) significantly exceed those of small respondents. Excluding stamping operations, results indicate larger companies utilize on average 22 percent more of their current capacity than their smaller peers (see Figure V-2).

By operation type, the most acute differences in capacity utilization rates between small and larger respondents are found in melting (37 percent), recycling (33 percent), and casting (28 percent) operations. Molding (26 percent), finishing (23 percent), and forging (16 percent) also represent a substantial disparity in production activity (see Figure V-2).

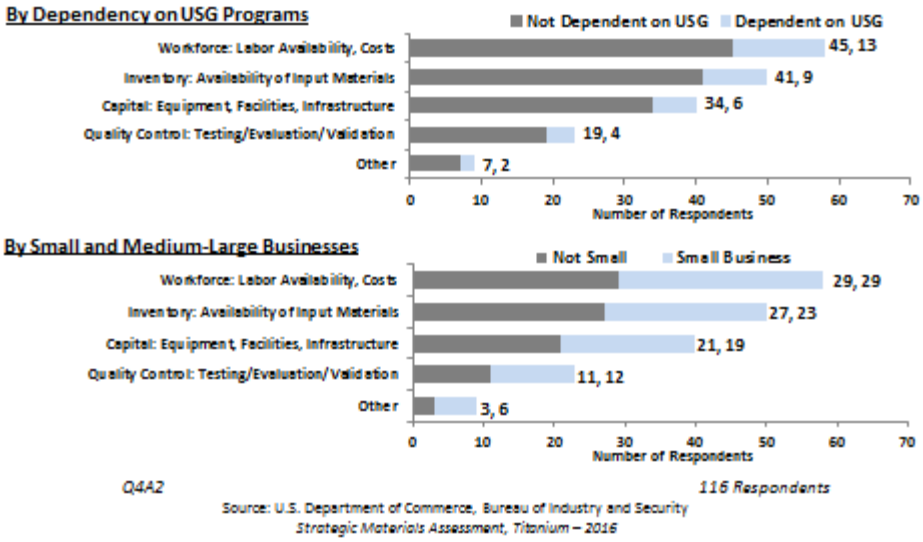


CONSTRAINTS TO MEETING INCREASED DEMAND

BIS asked respondents to identify any constraints likely to impede their ability to increase production of titanium-related products in the event of a sudden surge in demand. Results indicate that labor availability and associated labor costs would be the leading constraint among respondents. The second and third most common impediments to increasing production were limited inventories and capital equipment. Additionally, 20 percent of respondents, mostly small businesses, identified quality control measures as a factor. This is the only constraint category identified by more small respondents than larger respondents. Regulatory barriers, product requirements, return on investment, funding, and the availability of ore were also mentioned as influencing suppliers' responsiveness to increased customer demand (see Figure V-3).

Figure V-3: Constraints to Meeting a Surge in Demand

By Respondent Dependency on USG and Size



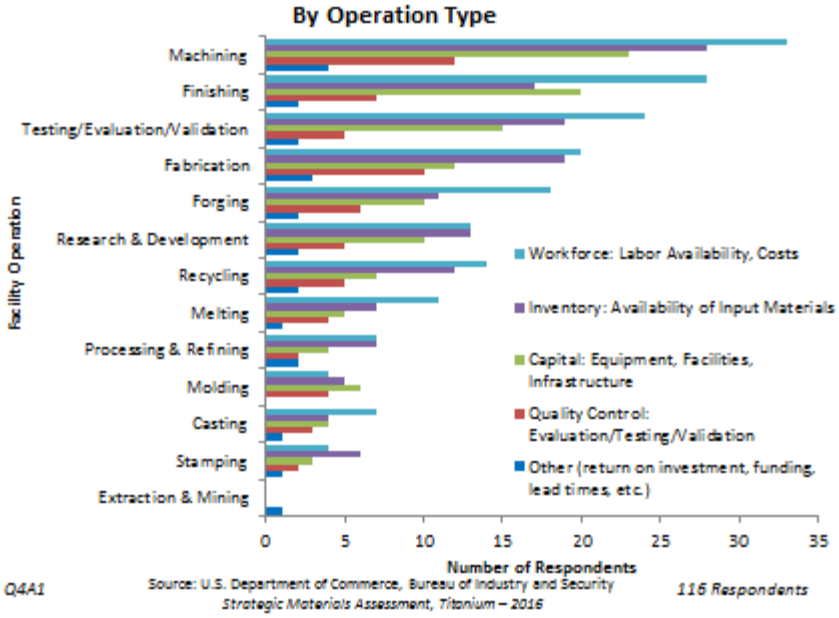
Q4A2 *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Between respondents' operation types, the kinds of constraints affecting suppliers' ability to meet a surge in demand are relatively consistent. For example, workforce and related manpower issues remain the prevailing challenge among 10 of 13 operations represented in the sample, including the leading five—machining, finishing, testing, fabrication, and forging. Additionally, inventory levels and material availability are consistently reported across operation types.

However, differences in the kinds of constraints faced by respondents do exist on the basis of operation type. For example, the constraints emphasized by machining and finishing respondents differ. Machining suppliers are more acutely influenced by inventory levels and material availability than by the capital equipment deficiencies emphasized by participating finishing suppliers (see Figure V-4).

Figure V-4: Constraints to Meeting a Surge in Demand



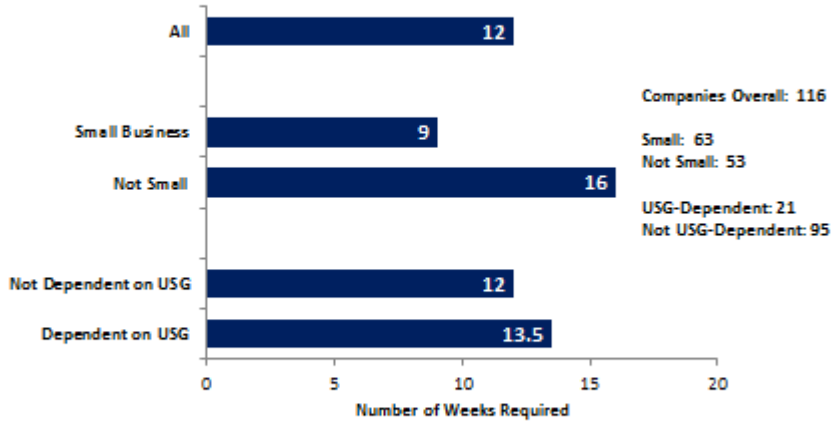
TIME REQUIRED TO REACH 100 PERCENT CAPACITY UTILIZATION

Time plays a critical role in a supplier's ability to meet a surge in demand. To help advance U.S. Department of Defense (DOD) planning in the event of a surge in demand for titanium-related products, BIS asked respondents to record the number of weeks required for them to reach 100 percent capacity utilization. BIS later analyzed the results by respondent size, dependency on USG programs, and business lines.

Data indicate that on average, respondents would require 12 weeks to maximize their production levels. The smaller respondents would need nine weeks to ramp up production while larger respondents would require 16 weeks (see Figure V-5). This difference in requisite lead time is not surprising, however, due to the complexity and scale of operations at larger companies.

There is markedly little difference in the time required to ramp up capacity utilization for respondents dependent on USG programs and those not dependent on such programs.

Figure V-5: Average Time Required to Reach 100% Titanium-Related Capacity Utilization

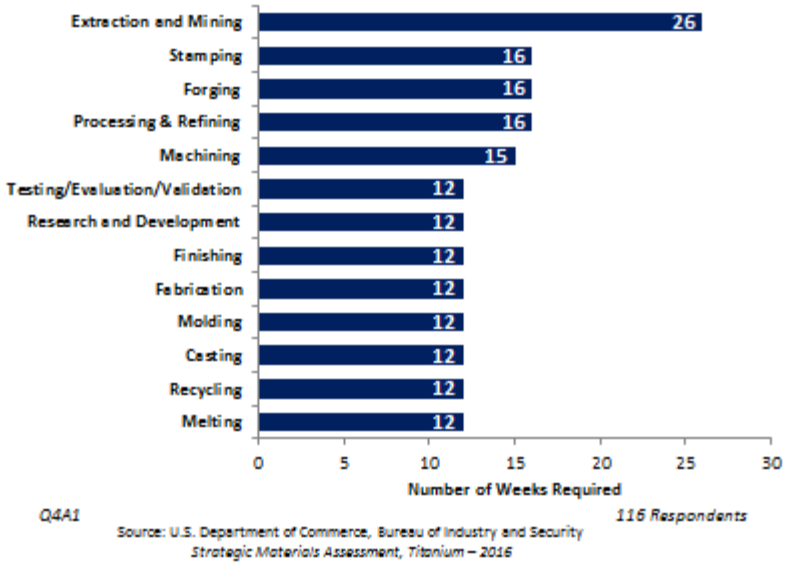


Q4A1 *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Respondents engaged in certain business lines needed more time to reach 100 percent capacity. Data show that the operations requiring the most time to reach full capacity are: extraction and mining (26 weeks), stamping, forging, and process and refining (16 weeks each), and machining (15 weeks) (see Figure V-6). The eight other operations included in the survey each required 12 weeks to reach 100 percent utilization.

Figure V-6: Average Time Required to Reach 100% Titanium-Related Capacity Utilization



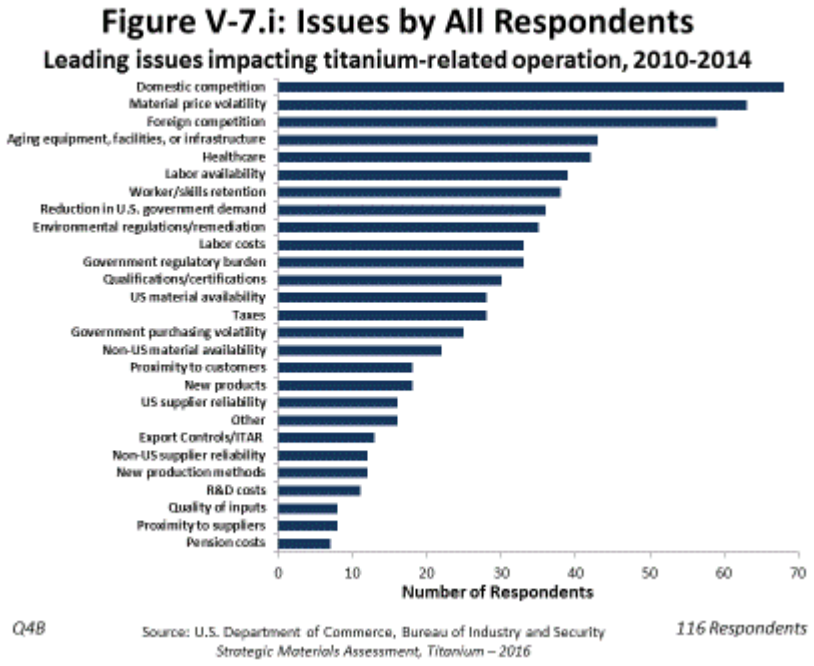
BUSINESS ISSUES IMPACTING TITANIUM-RELATED OPERATIONS

To determine the issue areas affecting respondents' titanium-related operations, BIS asked participants to select from 27 issues all those that have influenced their operations since 2010.[21] Supplementing their issue identification, respondents also ranked from 1-5 the leading issues and provided explanations for each.

BIS found that among the 27 issue areas, all of which were selected at least once by respondents, the leading 10 issues affecting their operations since 2010 were domestic competition, material

[21] 27 issue areas include: Aging equipment, facilities, or infrastructure; Domestic competition; Environmental regulations/remediation; Export controls/ITAR; Foreign competition; Government purchasing volatility; Government regulatory burden; Healthcare; Labor availability; Labor costs; Material price volatility; New production methods; New products; Non-U.S. material availability; Non-U.S. supplier reliability; Pension costs; Proximity to customers; Proximity to suppliers; Reduction in U.S. Government demand; Qualifications/certifications; Quality of inputs; R&D costs; Taxes; U.S. material availability; U.S. supplier reliability; Worker/skills retention; Other.

price volatility, foreign competition, aging equipment, healthcare, labor availability, skills retention, reduction in USG demand, environmental regulations, and labor costs (see Figure V-7.i).



BUSINESS ISSUES AND RESPONDENT SIZE

Data indicate that small business respondents were disproportionately vulnerable to government purchasing volatility, as compared to their larger peers. While small businesses represent 54 percent of all respondents, they constituted 71 percent of the 21 companies selecting government purchase volatility as an issue affecting their titanium-related operations since 2010.

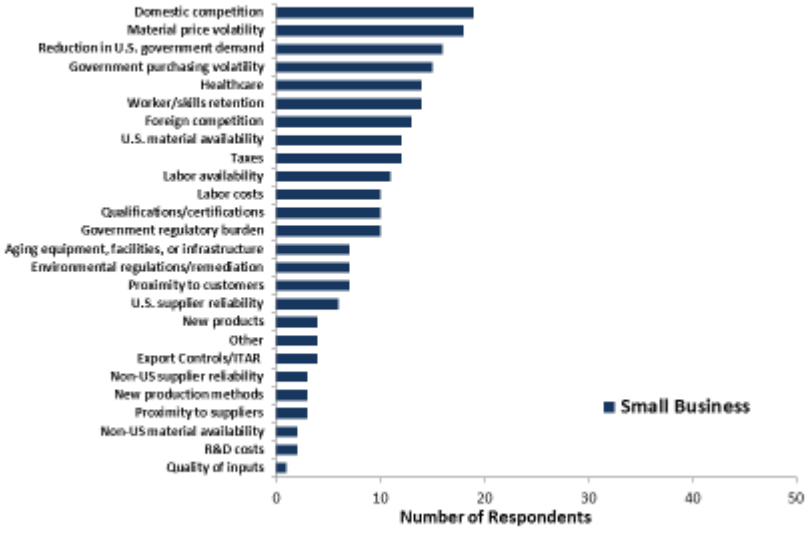
This difference indicates that smaller respondents operating in the titanium market are generally more vulnerable to USG procurement instability than their larger counterparts. Additional response data support this observation as 21 percent of small business respondents reported

being dependent on the USG as compared to 15 percent of medium to large respondents (see Figures V-7.ii-iii).

Taxes, U.S. material availability, and proximity to both customers and suppliers represent other issue areas where greater than 54 percent of the respondent sample—between 58-75 percent of respondents in each case—were small businesses (see Figures V-7ii-iii).

Figure V-7.ii: Issues by Small Respondents

Leading issues impacting titanium-related operation, 2010-2014



Q4B

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

Figure V-7.iii: Issues by Medium-Large Respondents

Leading issues impacting titanium-related operation, 2010-2014

Q4B

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

In contrast to the issue categories where small business respondents constitute a disproportionate increase, select areas like foreign competition and aging equipment, facilities, or infrastructure represent a significant disproportionate decrease. For example, only seven respondents or 28 percent of those that identified aging equipment, facilities, or infrastructure as an issue impacting their titanium-related operations were small businesses. And only 13 respondents or 33 percent of those that selected foreign competition as an issue were small businesses. In both of these instances, the proportion of small businesses was markedly lower than their proportion of 54 percent in the overall sample. This suggests that (1) many small businesses in the titanium market are focused on domestic business and (2) obsolescing equipment, facilities, or infrastructure is not a major factor influencing their sustainment of titanium-related operations.

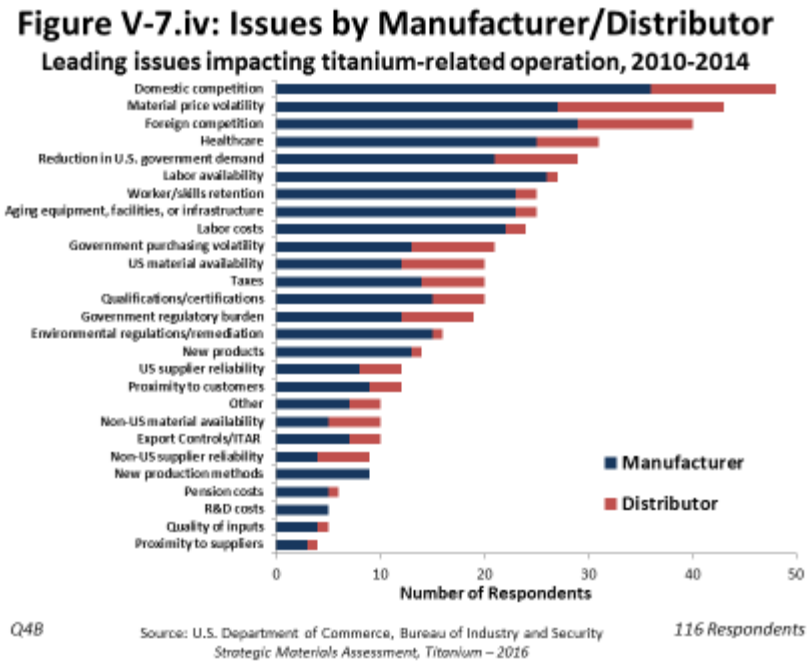
These challenges differ markedly from those affecting a disproportionate number of larger respondents. For example, while small business respondents are severely impacted by USG

purchase volatility, domestic material availability, and taxes, larger respondents are more preoccupied with pension costs, material price volatility, and non-U.S. material availability (see Figures V-7.ii).

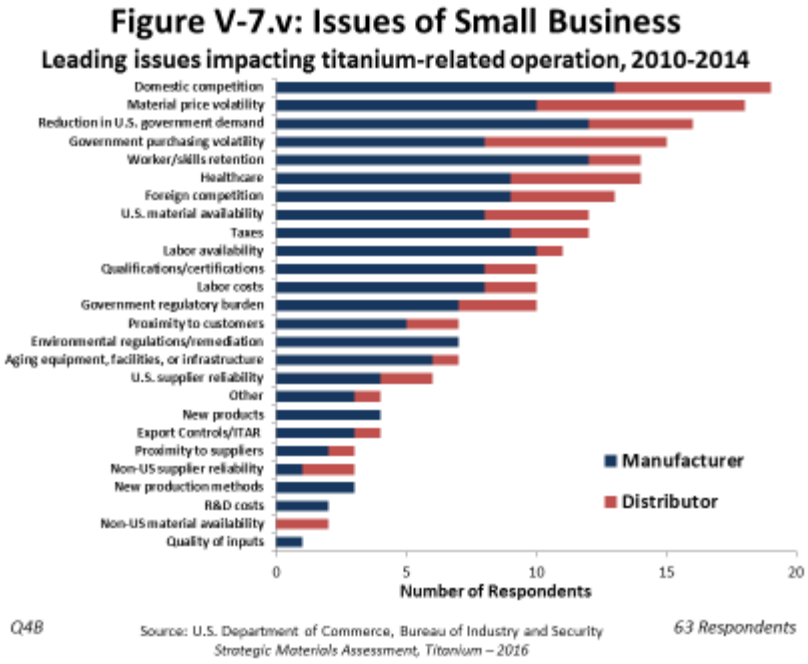
Moreover, medium to large companies represent 46 percent of the overall sample yet constitute a much larger portion of select issue area reporting totals, including non-U.S. materials (80 percent), new products (71 percent), aging equipment, facilities, or infrastructure (72 percent), labor availability (59 percent), and material price volatility (58 percent) (see Figure V-7.iii).

BUSINESS ISSUES AFFECTING MANUFACTURERS AND DISTRIBUTORS

In addition to assessing industry challenges by respondent size, BIS analyzed issues areas reported by manufacturer and distributor respondents. Manufacturer and distributor respondents represent 61 and 39 percent of the overall response sample, respectively. However, a significantly larger proportion of issues (76 percent) were reported by manufacturers. This concentration of manufacturer representation was evident across most issue categories, from environmental regulations and remediation (94 percent manufacturer) to labor availability (96 percent manufacturer). The few challenge areas where distributors represent a proportionally larger number of respondents than manufacturers overall are non-U.S. supplier reliability (56 percent), non-U.S. material availability (50 percent), and U.S. material availability (40 percent) (see Figure V-7.iv).

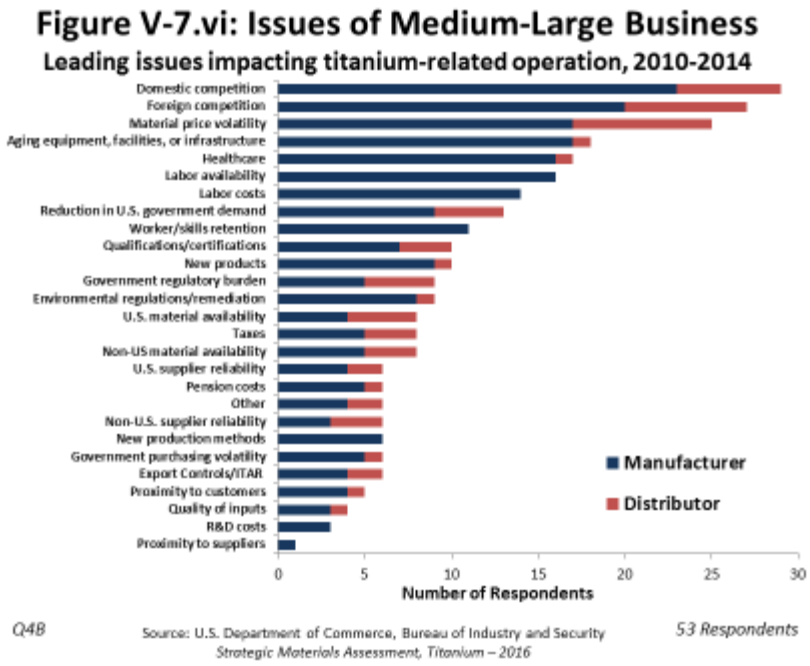


Issues documented by small business respondents are reported primarily by small manufacturers rather than small distributors. Manufacturers represent 57 percent of all small businesses in the overall survey sample; however, among issue categories recorded by 10 or more respondents (16 of 26 issue areas contained such concentrations) an average of 72 percent comprised of manufacturers. Labor/skills retention (86 percent) and reduction in U.S. Government demand (75 percent) are also particularly problematic for small manufacturers (see Figure V-7.v).



Medium to large companies constitute 46 percent of the overall survey sample and most are manufacturers (35 of 53 larger suppliers are manufacturers, or 66 percent). Unlike the small businesses participating in the survey, foreign competition is a leading issue among larger respondents, particularly manufacturers—20 of the 27 larger respondents (74 percent) that identified foreign competition as an issue are manufacturers (see Figure V-7.vi).

Much like small business manufacturers when compared to their small business distributor peers, medium to large manufacturers are significantly more challenged by worker/skills retention, labor costs, labor availability, and environmental regulation/remediation than distributors of the same size. This discrepancy is not surprising, however, as distributors are generally less labor intensive and rarely subject to the level of environmental compliance faced by manufacturers.

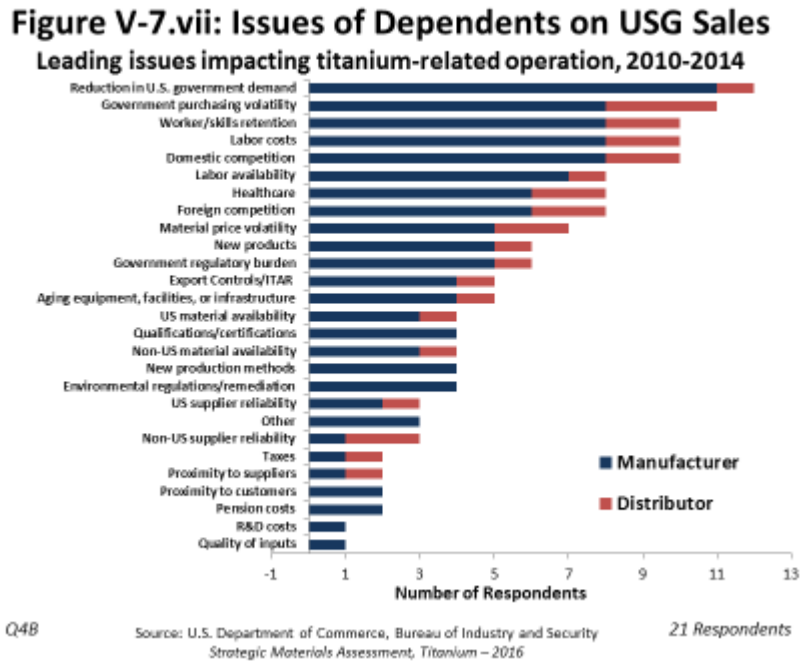


The acute challenges faced by distributors, irrespective of size, rather reside in areas of material price volatility, material availability, government regulatory burden, and supplier reliability. Distributors of titanium maintain extensive networks of suppliers abroad yet lack visibility into the operations and practices of foreign vendors. This lack of insight compounded by material price fluctuations and increased regulations can frustrate a distributor's ability to manage its inventories and develop a reliable, steadfast vendor relationship (see Figure V-7.v).

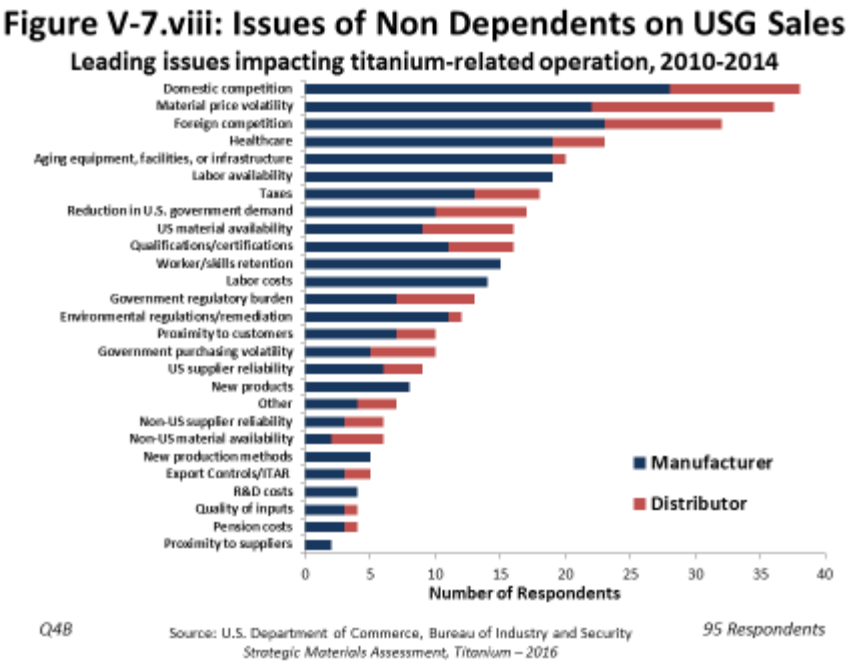
BUSINESS ISSUES AND RESPONDENTS DEPENDENT ON U.S. GOVERNMENT PROGRAMS

By conducting a comparative analysis of issue areas affecting respondents dependent on USG programs (21 of 116, 18 percent), BIS was able to identify challenges specific to vendors repeatedly involved in contracts with the U.S. Government. This approach also generated a more manageable group of supplier issues likely influencing the long-term sustainment of the Department of Defense (DOD) and other USG programs.

Not surprisingly, issues like reduction in USG demand and government purchase volatility are highly relevant to respondents dependent on USG sales, each issue affecting more than half of the 21 dependent respondents. Additionally, skills retention and labor costs are areas where the proportion of affected dependent respondents is near 50 percent of the sample (see Figure V-7vi).



Those respondents not dependent on USG sales recorded the same issues as dependent respondents overall but in slightly different concentrations. For example, domestic competition, material price volatility, and foreign competition predominate the kinds of issues reported by respondents not dependent on the USG but not those reported by dependent respondents (see Figures V-7.vi-vii). Between distributor samples, material price volatility remains slightly more acute a challenge for non-dependents (39 percent of sample; second most frequent issue) rather than dependents (29 percent of sample; ninth most frequent issue).



Respondents provided more than 300 explanations to supplement their issue category selections. Noteworthy examples submitted by respondents that are dependent on USG programs include the following:

- Government Purchase Volatility: "The U.S. Government understands neither the lead times necessary for the manufacture of complex component nor the cost of starting, stopping, and then restarting a program." *Distributor*

- Material Price Volatility: "Material costs vary by 20 percent at any given time. This price volatility is not [sufficiently] considered in U.S. Government contracts." *Distributor*

- Foreign Competition: "Both the Republic of Korea and China have added excess capacity [in Ti-related products] and are selling tubing at very low worldwide pricing." *Manufacturer*

- Labor Availability: "Training for machinists in the United States is very limited. This is a highly skilled position that should be valued but is rather dismissed as a blue collar job. This is sad for the United States as Germany is investing money in training people to build things." *Distributor*

- Aging Equipment, Facilities, or Infrastructure: "Nothing stays the same. Things [property, plant, and equipment] wear out and have to be repaired and/or replaced. How come small businesses cannot get low interest loans [for such purposes] so we can be successful?" *Distributor*

- Proximity to Suppliers: "Currently, my company has a good source of local [titanium-related] suppliers, but with investment bankers purchasing companies and cutting overhead, local sources may be forced to close local branches." *Manufacturer*

VI. COMPETITIVENESS AND OUTLOOK

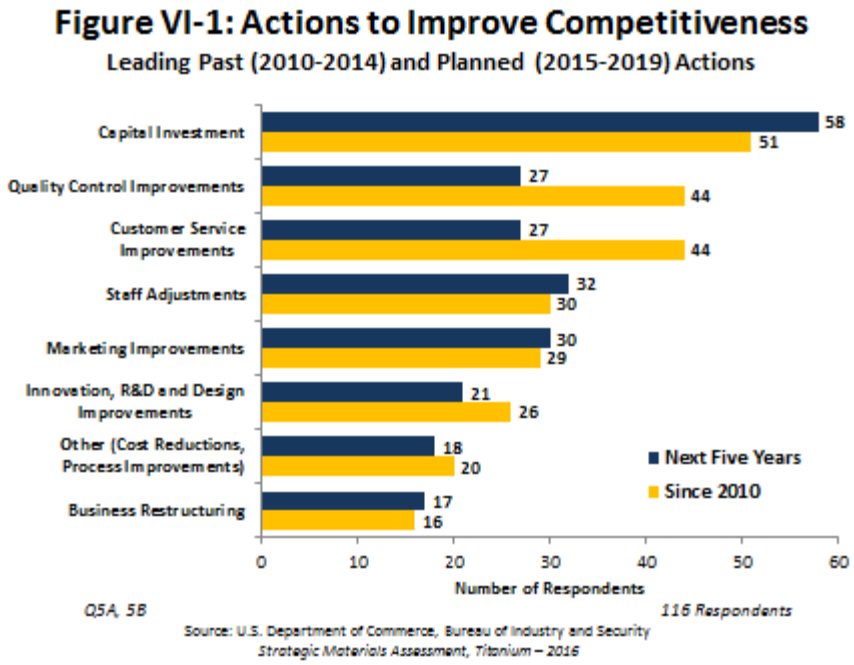
KEY ACTIONS TAKEN TO IMPROVE COMPETITIVENESS

BIS asked respondents to document the primary actions already adopted or planned to enhance their competitiveness. Each respondent could select one or more actions listed in the survey and then qualify their selection with narrative explanation, as necessary.[22]

Leading among respondents' past and planned actions was capital investment, with more respondents planning future investment in capital goods than those conducting similar investments since 2010. The comparatively large number of respondents planning to make such procurements in the near future suggests some optimism and preparation by respondents in relation to projected demand for titanium-related products and services (see Figure VI-1).

Results also indicate that 42 of the 67 respondents (63 percent) performing capital investment had done so since 2010 and planned on similar spending over the next five years.

[22] Provided Action Categories: Business Restructuring; Capital Investment; Customer Service Improvements; Innovation, R&D, and Design Improvements; Marketing Improvements; Quality Control Improvements; Staff Adjustments; Other

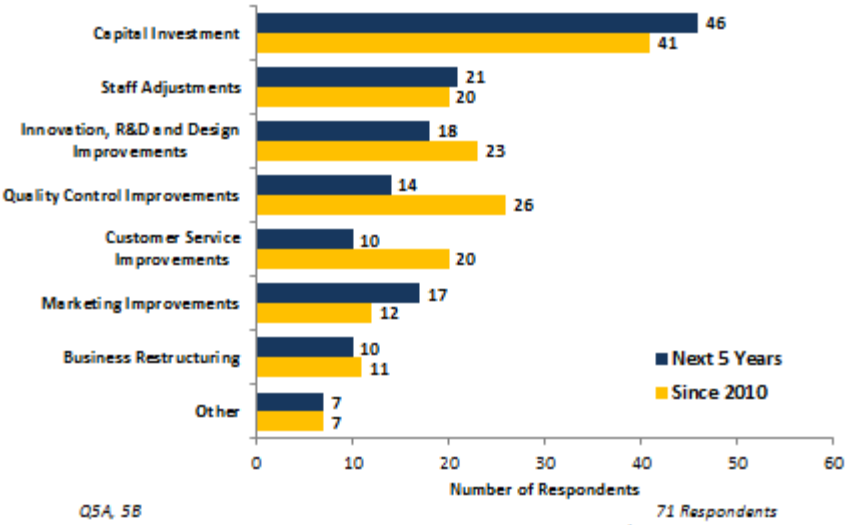


MANUFACTURER AND DISTRIBUTOR ACTIONS

To be expected, there are significant disparities in the kinds of actions implemented between manufacturer and distributor respondents. For example, customer service and quality control are leading distributor actions while capital investment and staff adjustments are the primary actions performed by manufacturers. Additionally, manufacturers are more prone to make investments in innovation, R&D, and design improvements than distributors, whether historically or planned in the next five years (see Figures VI-2-3).

Figure VI-2: Manufacturer Actions to Improve Competitiveness

Leading Past and Planned Actions

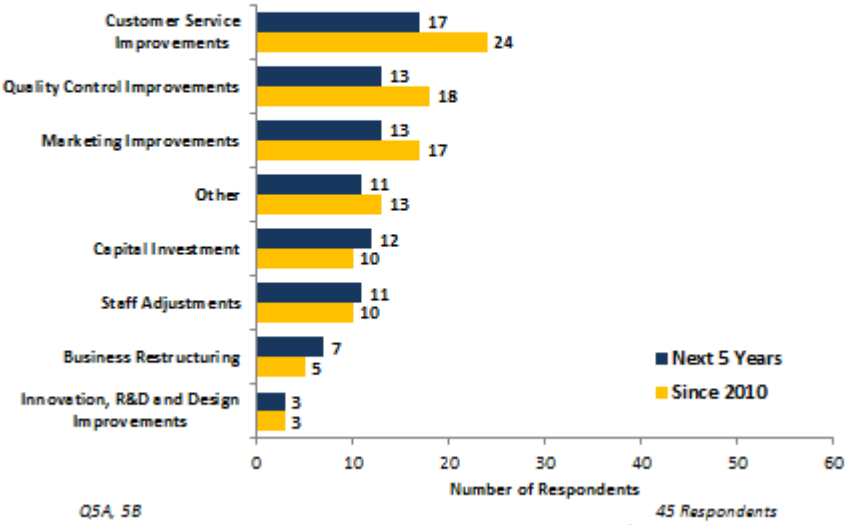


Q5A, 5B *71 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Figure VI-3: Distributor Actions to Improve Competitiveness

Leading Past and Planned Actions



Q5A, 5B *45 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Investments in capital goods frequently involve large outlays by the purchasing company and therefore necessitate significant liquidity or creditworthiness to secure the cash or credit used to make such purchases. Consequently, the projected increases in capital improvement actions by

respondents over the next five years indicate a rise in producer confidence, as compared to the previous five years, while signaling the overall viability of this strategic materials segment.

The narrative examples of respondents' planned acquisitions informed BIS of the specific property, plant, and equipment (PP&E) purchases required to meet current and future demand. PP&E purchases planned by respondents dependent on U.S. Government procurements, for instance, include:

- Capital Investment: "Additional capital equipment to keep pace with ramp [up] in aerospace production rates." *Manufacturer*
- Capital Investment: "Purchase of a milling machine to further enhance our capabilities." *Distributor*
- Capital Investment: "A new 60,000 ton hydraulic forging press and 100,000 square foot building, supporting infrastructure." *Manufacturer*

These particular examples are similar to the planned procurements reported by small business respondents, such as:

- Capital Investment: "Additional space and equipment to lower production costs and add new products." *Manufacturer*
- Capital Investment: "Adding finishing capacity." *Manufacturer*
- Capital Investment: "Expand present facility and purchase forging and machining equipment." *Manufacturer*
- Capital Investment: "Modernize equipment and buy more robotics." *Manufacturer*
- Capital Investment: "Installation of a new processing line for increased capacity." *Manufacturer*
- Capital Investment: "Continued investment in equipment needed to thermally process tomorrow's emerging materials and their associated technologies." *Manufacturer*

However, not all of the eight key action categories were forward-looking like capital investment. More respondents had already implemented both quality control and customer service improvements since 2010 (38 percent of respondents in both cases) than those planning such investments in the forthcoming five years (23 percent of respondents in both cases).

Notable examples of common quality control improvements implemented by respondents since 2010 include: adoption of ISO 9001, AS9100, and other quality standards; purchase of test and inspection equipment; and increased investment in quality-related personnel. These particular improvement areas, while less frequent, resemble the kinds of quality steps planned by respondents in the next five years.

Some of the customer relationship improvement actions implemented by respondents since 2010 involved the monitoring of customer satisfaction and feedback, focus on sales staff training, and the reduction of lead times. These examples, as with the quality control improvement category breakout, closely resembles the customer oriented actions planned in the next five years.

KEY AIRCRAFT DEVELOPMENTS—PROGRAMS AND SYSTEMS

Historically, the aerospace sector—in particular aircraft-related systems, subsystems, materials, parts, and components—has driven much of the material science, innovation, and supply chain network dynamics in the titanium industry. Accordingly, BIS assessed whether or not aircraft programs and systems, including military and commercial platforms, would continue to play a leading role in the titanium market in the next five years.

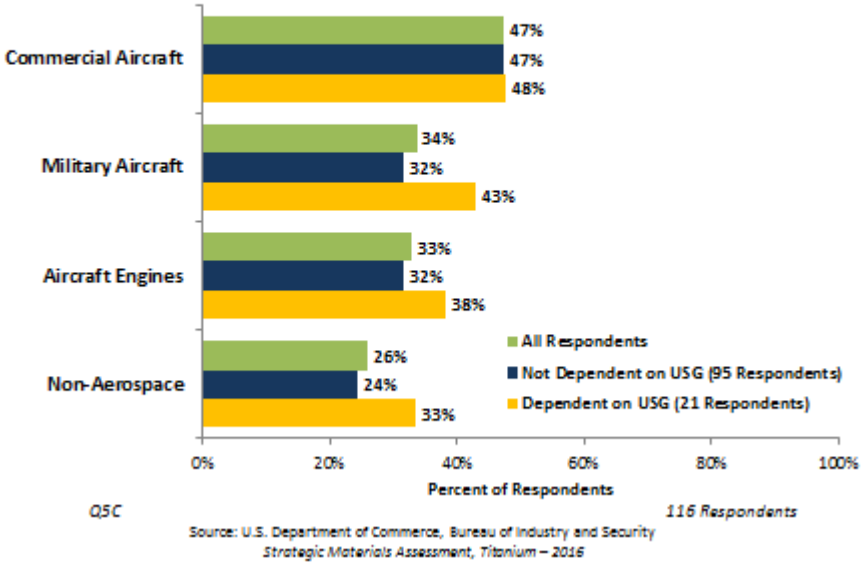
BIS first provided respondents with a list of aircraft programs, including the F-35 Joint Strike Fighter, the Boeing 787, and the Airbus A350, and asked whether or not the programs would

have a positive impact on the titanium industry in the near future.[23] For each specified program, respondents indicated if an impact would occur and then provided BIS with an explanation.

Overall, respondents reported that developments in the commercial aircraft sector rather than in the military aircraft sector would have more of an impact on their industry in the near term. This perspective was shared by respondents both dependent and not dependent on USG programs for their ongoing viability (see Figure VI-4).[24]

Figure VI-4: Sector Impacts on Titanium Industry

Anticipated Impacts by Dependence on U.S. Government, 2015-2019



In contrast to the dependency-based results, where there is relative parity in impact between respondent samples, respondent size-based results show a clear disparity in the anticipated impacts of sector and program developments (see Figure VI-3). For example, response data

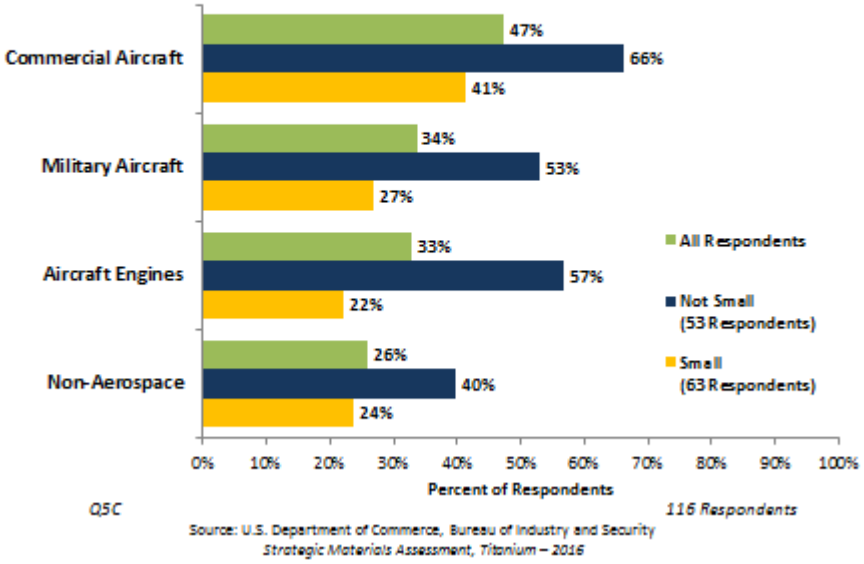
[23] Aircraft Programs: F-35 Joint Strike Fighter, Other fixed wing military aircraft, Rotary wing military aircraft, Boeing 787, Other Boeing aircraft, Airbus A350, Other Airbus aircraft, other aircraft, CFM International, Engine Alliance, General Electric Aviation, Pratt & Whitney, Honeywell, Rolls Royce, Other

[24] Respondents to the recent BIS survey of Carbon Fiber Composites also stated that Commercial Aircraft rather than military aircraft would have more of a positive impact on their industry. See: https://bis.doc.gov/index.php/forms-documents/technology-evaluation/1380-carbon-fiber-composites/file

indicate that smaller suppliers of titanium-related products are less susceptible than their larger peers when faced with military and commercial program developments. This discrepancy by respondent size is apparent across all four sector/program impact categories evaluated by BIS—military aircraft, commercial aircraft, aircraft engines, and the non-aerospace segment—and by a margin of between 15-25 percent in each category (see Figure VI-5).

Figure VI-5: Sector Impacts on Titanium Industry

Anticipated Impacts by Respondent Size, 2015-2019



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

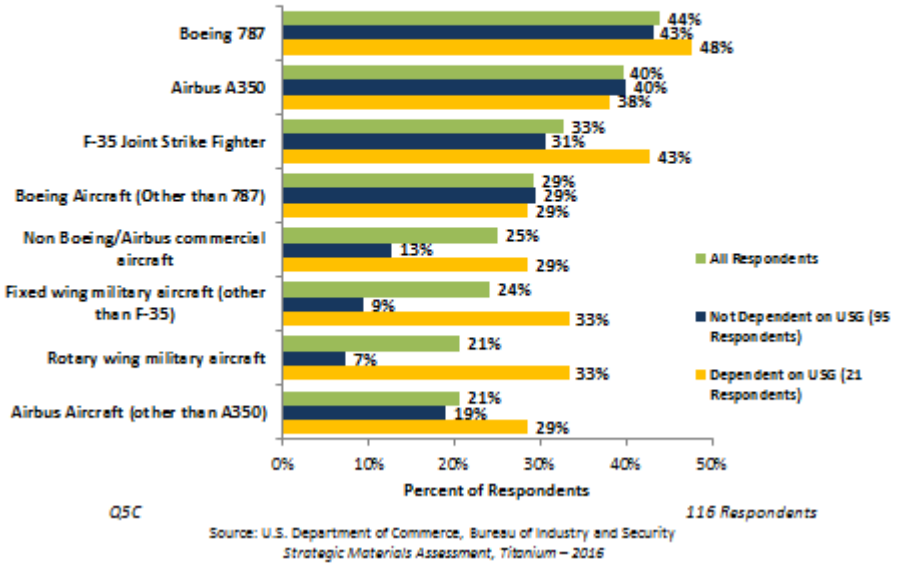
To bring greater specificity to the discussion of program impacts, BIS analyzed the various military and commercial programs identified by respondents as impacting the titanium industry in 2014-2018. Boeing's 787 and Airbus's A350, both commercial aircraft, were identified by nearly half of respondents—44 and 40 percent, respectively—as the platforms most likely to impact the titanium market in 2014-2018. The reasons for their identification relate primarily to

increased unit production rates and their elevated titanium content as compared to other platforms (see Figure VI-6).[25] Explanations include:

- "[These platforms are] likely to affect supply chain due to their high titanium content;" *Manufacturer*
- "Higher levels of titanium content [are being used] for new wide body models;" *Manufacturer*
- "[Their] increased build rates should eventually tighten supply;" *Distributor*
- "Increased prices and longer lead time for raw materials;" *Manufacturer* and
- "[These platforms are] huge consumer of titanium material once all of the excess inventory is consumed." *Manufacturer*

Figure VI-6: Platform Impacts on Titanium Industry

Anticipated Impacts by Dependence on U.S. Government, 2015-2019



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Mirroring the respondents that identified military aircraft as a source of industry impact, larger respondents and those dependent on USG programs for ongoing viability both selected the F-35 Joint Strike Fighter (JSF) as a leading military platform affecting the titanium industry through 2018 (see Figures VI-7).

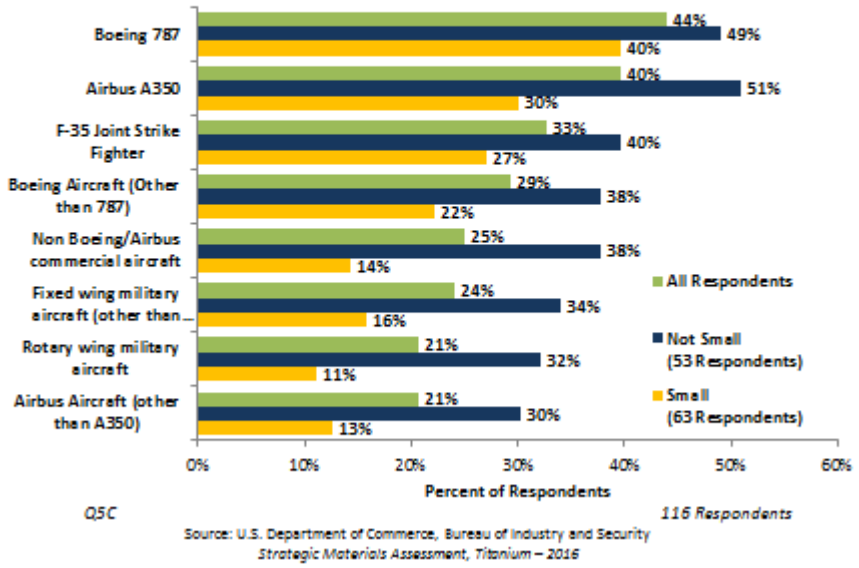
[25] Boeing production of the 787 Dreamliner will reach 12+ platforms per month. Polek, Gregory, "After Record Ramp-Up, Boeing Fine-Tunes 787 Production," AINonlin, http://www.ainonline.com/aviation-news/air-transport/2015-06-11/after-record-ramp-boeing-fine-tunes-787-production

Most respondents provided an explanation for their selection of the F-35 as having an impact on the titanium industry, claiming:

- "The F-35 uses significant amounts of titanium in its structure;" *Manufacturer*
- "This depends on [the] build rate and what [the U.S.] Congress authorizes in the budget;" *Manufacturer*
- "Ramp-up of F-35 production will increase titanium consumption;" *Manufacturer*
- "The downsizing of the F-35 program will decrease the demand for scrap and the amount of scrap generated;" *Manufacturer* and
- "Impacts include transition breakthroughs generated in commercial aircraft to military aircraft." *Manufacturer*

Figure VI-7: Platform Impacts on Titanium Industry

Anticipated Impacts by Respondent Size, 2015-2019



Q5C *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

The F-35 JSF was not the only military aircraft program identified by respondents as having an impact on the industry in the next few years. Additional reported military fixed wing platforms include the C-130 Hercules, F/A-18 Hornet, F-22 Raptor, and KC-767 (see Figure VI-8) while identified rotary platforms comprise of the AH-64 Apache, CH-53K King Stallion, the Joint-Multi-Role (JMR), and V-22 Osprey.

In the commercial domain, multiple Boeing and Airbus platforms were identified to supplement the commercial aircraft of focus in the titanium industry—Boeing's 787 and the Airbus A350. Most of the additional planes identified by respondents as having an impact on the titanium industry were mentioned more than once, among them:

- Boeing's 737, 737 MAX, 747, 757, 767, 777X, and 780; and
- Airbus A320, A320 NEO, A330, A340, A350, and A380.

Figure VI-8: Impacts on Titanium Industry

Anticipated Impacts by Platform Type, 2015-2019

Military Aircraft		Commercial Aircraft	
Fixed Wing	**Rotary Wing**	**Boeing**	**Airbus**
C-130 Hercules	AH-64 Apache	737	A320
C-17 Globemaster	CH-47 Chinook	737 MAX	A320 NEO
F/A-18 Hornet	CH-53K King Stallion	747	A330
F-15 Strike Eagle	369D	757	A340
F-22 Raptor	Joint Multi-Role (JMR)	767	A350
F-35 JSF	UH-60 Black Hawk	777X/MAX	A380
KC-767	V-22 Osprey	780	
P-8 Poseidon			

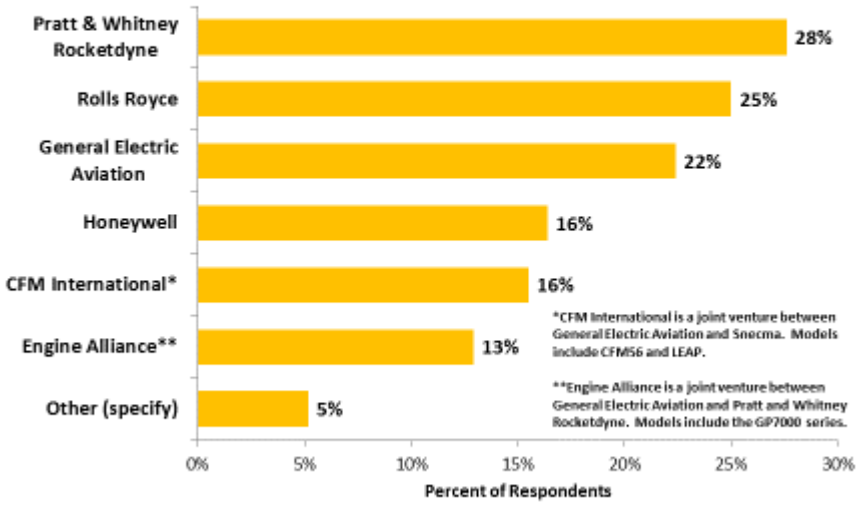
Q5C Source: U.S. Department of Commerce, Bureau of Industry and Security, *2016 Respondents*
Strategic Materials Assessment, Titanium – 2016

Impact response data also allowed BIS to assess the role of particular aircraft engine manufacturers in influencing the titanium industry in the forthcoming years. From a list of six manufacturers, respondents identified Pratt and Whitney Rocketdyne (PWR) (28 percent), Rolls Royce (25 percent), and General Electric (GE) Aviation (22 percent) as the primary sources of industry impact among aircraft engine suppliers (see Figure VI-9).

The anticipated impacts of these engine manufacturers on respondents were not always positive, however. For instance, PWR's substitution of titanium-based blades with composite will affect revenues for select titanium suppliers, as will NASA's idling of the J2X engine program, a PWR rocket propulsion system supported by a small respondent with a sole source metals contract.

Conversely, in the case of GE, one large survey respondent reported manufacturing titanium-based fittings, fasteners, and actuation and gear boxes for multiple GE engines.

Figure VI-9: Engine Impacts on Titanium Industry
Engines by Manufacturer with Anticipated Impacts, 2015-2019



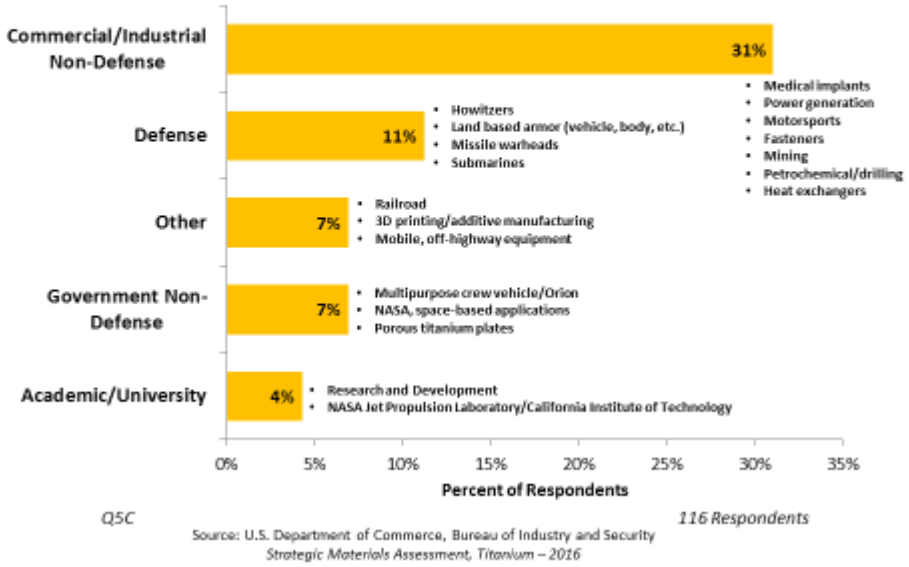
Q5C Source: U.S. Department of Commerce, Bureau of Industry and Security *Strategic Materials Assessment, Titanium – 2016* *116 Respondents*

To supplement the aforementioned aerospace source of industry impact, several non-aerospace programs and systems were identified by respondents as influencing the titanium supply chain network through 2018. The most frequently identified commercial source of impact proved to be the medical device field, titanium-based implants in particular, in addition to applications in motorsports, fasteners, and heat exchangers among others (see Figure VI-10). Leading areas of product identified as non-aerospace defense were howitzers and land based armor.

This sampling of product applications and market impacts, distinct from those generated by the military and commercial aircraft sectors, suggests alternate sources of product demand exist, in particular for respondents heavily dependent on a single sector like aircraft engine manufacture.

Figure VI-10: Titanium Industry Impacts

Non-Aerospace Programs/Systems with Anticipated Impacts, 2015-2019



Q5C *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

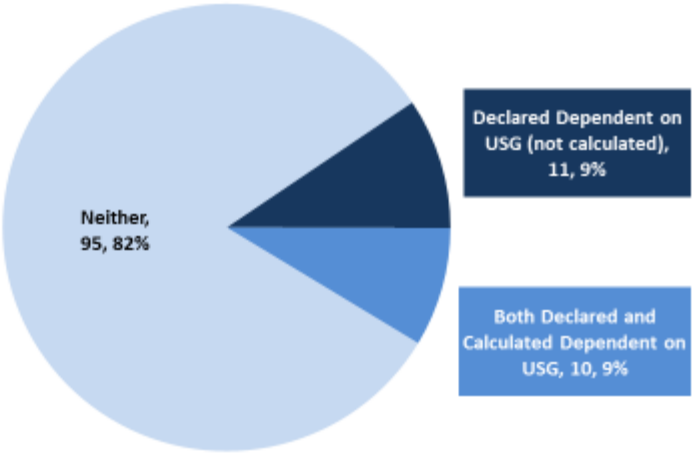
VII. U.S. GOVERNMENT AND DEFENSE PROGRAM PARTICIPATION

DEPENDENCY ON U.S. GOVERNMENT VERSUS COMMERCIAL SALES

Uncoordinated fluctuation in U.S. Government defense-related procurements can significantly impact the financial viability of organizations supporting the defense industrial base. Over time, the failure of USG organizations to either inform suppliers of planned increases or reductions in procurements or consistently invest in relevant programs and associated technologies can impede industry's ability to fulfill its cost, schedule, and technical requirements for specific USG programs. This can reduce suppliers' incentive to maintain their government-related business lines.

In qualifying a respondent's status as dependent on the USG, BIS took into account both participating organizations' self-declarations of dependency and their provided sales information. If a respondent maintained an average revenue contribution of 25 percent or greater in USG-related sales in 2010-2014, and/or declared being dependent on the USG for viability, the respondent was deemed dependent for purposes of analysis. By this approach, 21 respondents or 18 percent were deemed dependent on the USG for sustained viability (see Figure VII-1).

Figure VII-1: Dependency on U.S. Government Sales
By Declaration and Calculated from 2010-2014 Sales Data



Q6aB, 7 *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Each of these 21 respondents also provided BIS with an explanation of their dependency.

Representative comments of their reliance on USG sales include:

- "No plant or production line is dedicated to business for U.S. Government end use. But business for U.S. Government end use makes an important contribution to utilization and overall cost structure;" *Manufacturer*

- "It is too difficult to maintain high level quality systems and be competitive in the commercial industry sectors;" *Manufacturer* and

- "The production volumes for defense aerospace and armor applications are important contributors to ingot, billet, bar, plate, sheet and coil product lines." *Manufacturer*

The explanation provided by another dependent respondent succinctly describes the important role played by USG demand in the endurance of the titanium industry:

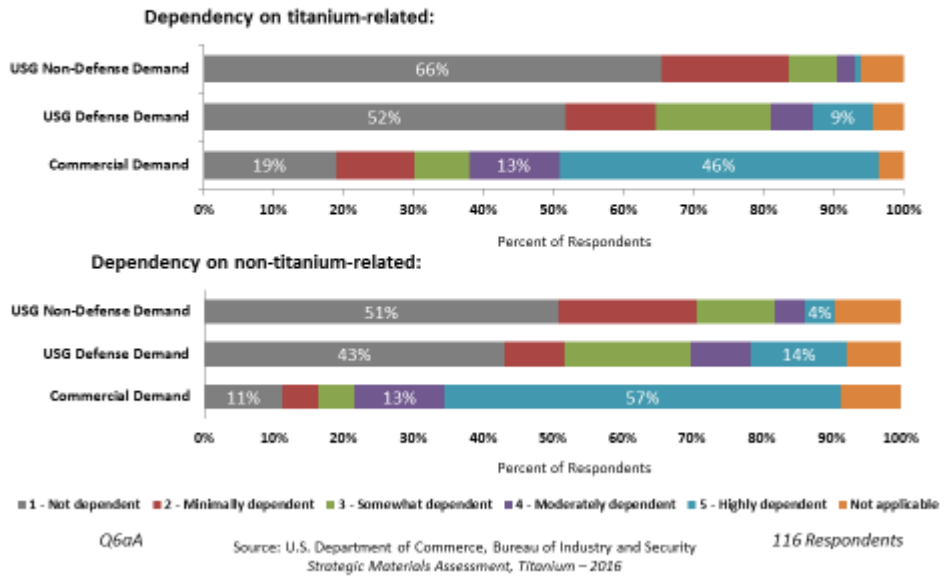
> "The titanium industry has historically been very cyclical. Military demand is generally less cyclical. [Consequently,] having a steady military demand has sustained the industry through the difficult down-cycles of the commercial aerospace market." *Manufacturer*

This observation underscores not only the benefit of stable defense-related demand but also the importance of the commercial marketplace, particularly the aerospace sector, in shaping the titanium industry. BIS survey results reaffirm this perspective. In fact, when asked by BIS to

rate their level of dependency by individual customer segment, respondents overwhelmingly indicated higher dependence on commercial rather than USG demand in both their titanium and non-titanium operations at 59 and 70 percent, respectively (see Moderately dependent and Highly dependent combined under Commercial Demand in Figure VII-2).

Figure VII-2: Dependency on Customer Demand

Dependency of Respondent Operations by Customer Demand



Q6aA

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

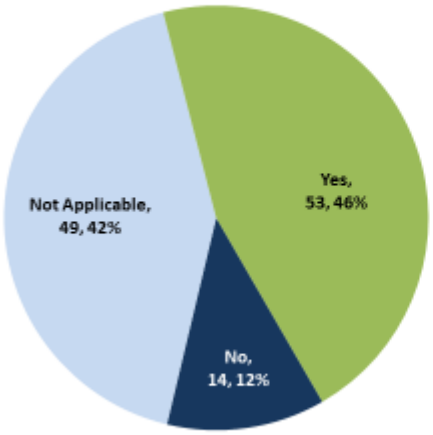
BUSINESS LINE CONVERSION AND COMPATIBILITY

If faced with a sudden decline in USG demand, a supplier's ability to readily convert its USG-related business lines to commercial ones could sharply reduce the impact of USG procurement reductions. Survey results highlighted that 53 respondents (46 percent) are able to readily convert their business lines in this manner. Among the 14 respondents (12 percent) not positioned to convert their government lines, any unanticipated reduction in USG demand would likely cause increased operational risk and consequently jeopardize the availability of relevant product lines once USG demand resumes. This problem is particularly acute for five of the 14

respondents (36 percent) dependent on the USG for ongoing viability. Leading business lines at these companies include machining, testing/evaluation/validation, fabrication, finishing, and research and development (see Figure VII-3).

Figure VII-3: Ready Conversion of Operations

Ability to Convert Business Lines from U.S. Government to Commercial



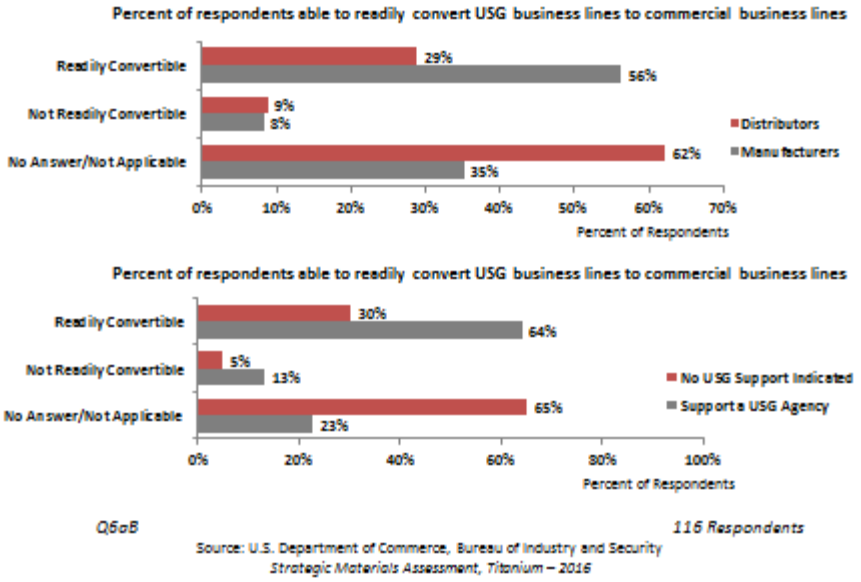
45 business lines of 14 respondents unable to convert U.S. Government business lines to commercial business lines	
Business Line/Operation	**Frequency**
Machining	10
Testing/Evaluation/Validation	7
Fabrication	6
Finishing	6
Research and Development	5
Forging (including extrusion)	4
Processing and refining	2
Melting	2
Recycling	2
Other operation(s)	1

Q6a8 *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Results also indicated that manufacturers are more adept than distributors at readily converting their titanium-related USG business lines to commercial ones. This disparity in the proportion of manufacturers versus distributors (56 percent and 29 percent, respectively) is also reflected in the business line compatibility data (see Figure VII-4).

Figure VII-4: Ready Conversion of Titanium Operations



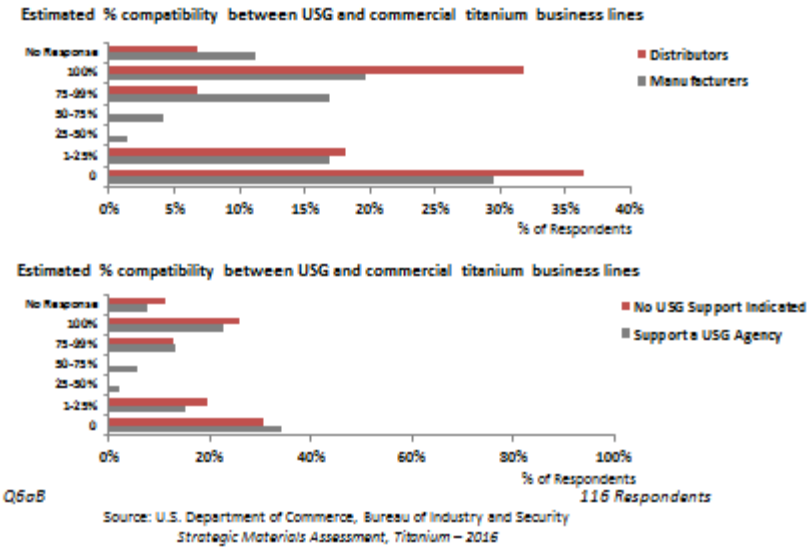
Q6aB *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

BIS asked respondents to record the compatibility between their titanium-related USG business lines and their commercial business lines. Response data indicate that 59 percent of manufacturers maintain some degree of compatibility, with 21 percent of manufactures reporting more than 75 percent compatibility. The degree of compatibility among distributors was also high as 57 percent of distributors maintain some level of business line compatibility, with 32 percent of distributors declaring 100 percent compatibility (see Figures VII-5).

Figure VII-5: Compatibility of Business Lines

By manufacturer/distributor and declared USG support



Q6aB *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

However, despite 57 percent of distributors proclaiming some degree of compatibility, only 29 percent of distributors are actually able to readily convert their titanium-related USG business lines to commercial lines in the event of a sudden decline in USG demand. This result means that most titanium-related distributor support for USG customers is highly tailored and not readily adapted for commercial applications. Such insight suggests that USG buyers should not focus solely on manufacturers but rather also on distributors when planning for industrial base impacts resulting from titanium-related procurement fluctuations.

IMPACT OF DECLINE IN U.S. GOVERNMENT DEMAND

The defense industrial base, specifically the lower tiers where USG sales dependency is the highest, is generally susceptible to any substantive decline in USG demand. Reductions in USG-related spending are often preceded by changes to the governing policies, modifications to

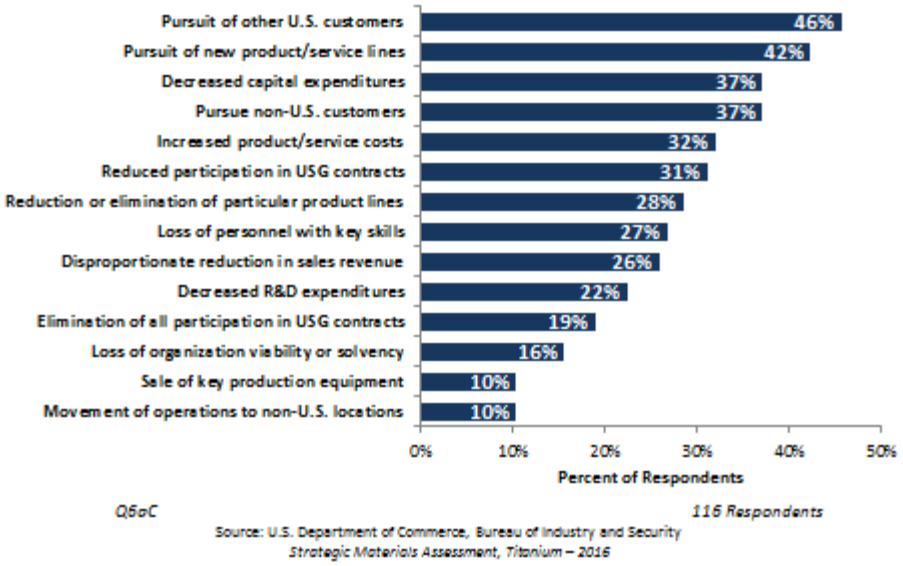
program technical requirements, and/or austerity measures like the Budget Control Act (BCA).[26] However, rarely are such USG decisions informed by an evaluation of the supply chain risks related to a modification to the schedule of procurements. For this reason, and to improve DLA's response to related supply chain risks, BIS asked respondents to identify impacts (from a provided list) that any sudden decrease in USG demand would have on their organizations.[27]

If faced with a sudden decline in USG demand, nearly half of all respondents (45 percent) indicated they would pursue alternative U.S. customers, while 42 percent would pursue new product or service lines (see Figure VII-6). Based on results from previous BIS assessments, these top two categories, along with the pursuit of non-U.S. customers (37 percent), are typical reactions but hard to implement quickly. An immediate decline in capital expenditures (37 percent), an increase in product/service cost (32 percent), and a reduction in product lines (28 percent) are more readily implemented when facing such demand reductions.

[26] Description of Public Law 112 – 25 – Budget Control Act of 2011 linked herein: https://www.gpo.gov/fdsys/pkg/PLAW-112publ25/pdf/PLAW-112publ25.pdf

[27] List impacts: Decreased capital expenditures; decreased R&D expenditures; Disproportionate reduction in sales revenue; Elimination of all participation in U.S. Government contracts; Increased product/service costs; Loss of organization viability or solvency; Loss of personnel with key skills; Movement of operations to non-U.S. locations; Pursuit of new product/service lines; Pursue non-U.S. customers; Pursuit of other U.S. customers; Reduced participation in USG contracts; Reduction or elimination of particular product lines; Sale of key production equipment; Other

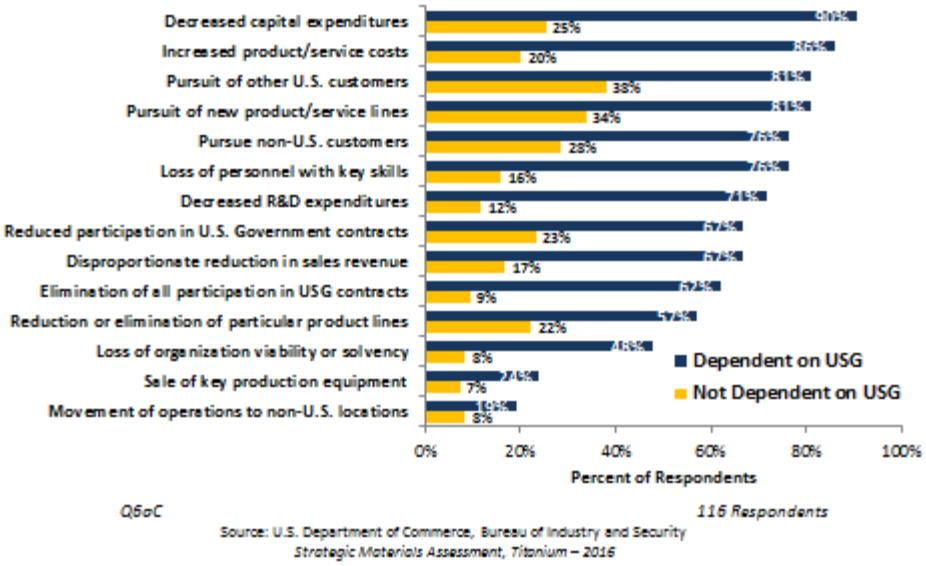
Figure VII-6: Impact of Decline in USG Demand



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Not surprisingly, the suppliers most acutely affected by any sudden decline in USG demand are those most dependent on USG business for sustained viability. Consequently, results show that a large portion of the dependent respondents (90 percent) would respond to a reduction in USG demand by decreasing capital expenditures. Many dependent respondents (86 percent) also anticipated increased product or service costs resulting from any reduction in USG demand. Additional reported impacts included the loss of personnel with key skills (76 percent) and reduced overall participation in USG contracts (67 percent) (see Figure VII-7).

Figure VII-7: Impact of Decline in USG Demand



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

The contrast in customers and revenue contribution explains much of the disparity in anticipated impacts between the dependent and not dependent respondents. For example, many of the respondents dependent on the USG for viability rely on affiliated USG contracts to attract and retain personnel with key skills. This helps explain the aforementioned outcome of lost personnel with key skills. These same contracts can also serve as a source of funding for R&D investment. Accordingly, in the wake of a decline in USG demand, respondents also anticipate reductions in R&D expenditures (71 percent).

RATED ORDERS

To promote the national defense, Section 101 of the Defense Production Act (DPA) authorizes the President of the United States to require the acceptance and prioritization of contracts by industry. Rated orders comprise of prime contract, subcontract, or purchase orders subject to an industrial prioritization rating by the U.S. Government. However, these expedited procurements

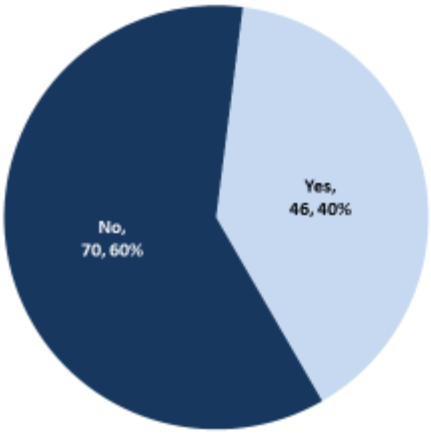
can support only an approved program issued in accordance with the provisions of the Defense Priorities and Allocation System (DPAS). If an order receives a rated order of DO, the order must be given production preference over nongovernment, commercial orders. DX rated orders, reserved for programs of the highest national importance, receive preference over both DO and nongovernment, commercial orders.[28]

To better determine the overall level of respondent involvement in contracts of high USG priority, BIS asked respondents to indicate whether or not they had received a rated order (DO or DX) since 2010. Forty percent of the sample, or 46 companies, reported having received either a DO or DX order since 2010. Most of the companies that received a rated order (30 of 46 respondents) were in fact not dependent on USG-based sales for viability. By respondent size, the proportions were consistent with the overall dataset, as roughly half of the respondents receiving a rated order (24 respondents or 52 percent) were small businesses, consistent with the proportions of small business overall—54 percent, or 63 of 116 respondents (see Figure VII-8).

[28] Defense Contract Management Agency (DCMA) Defense Priorities and Allocations System (DPAS) description located at: http://www.dcma.mil/DPAS/

Figure VII-8: Rated Orders

Respondents in receipt of a DO/DX rated order, 2010-2014



Leading business lines represented by 46 respondents receiving a DO/DX rated order since 2010	
Business Line/Operation	**Frequency**
Machining	31
Finishing	25
Fabrication	20
Testing/Evaluation/Validation	20
Research & Development	15
Forging	14
Recycling	8
Stamping	7
Melting	6
Processing and Refining	5

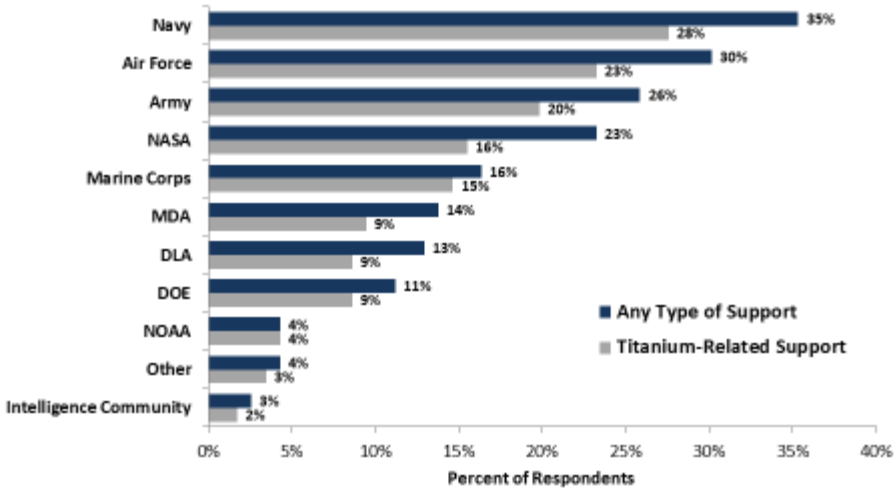
Q6aD Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*
Strategic Materials Assessment, Titanium – 2016

SUPPORT FOR U.S. GOVERNMENT—BY AGENCY

Since 2010, 41 percent of respondents provided titanium-related goods either directly or indirectly to U.S. Government agencies. Leading among the agencies supported, whether with titanium or non-titanium-related products, were the Navy, Air Force, Army, and NASA (see Figure VII-9).

Figure VII-9: Support for U.S. Government by Agency

USG Agencies to which Respondents Provide Products and Services, 2010-2014

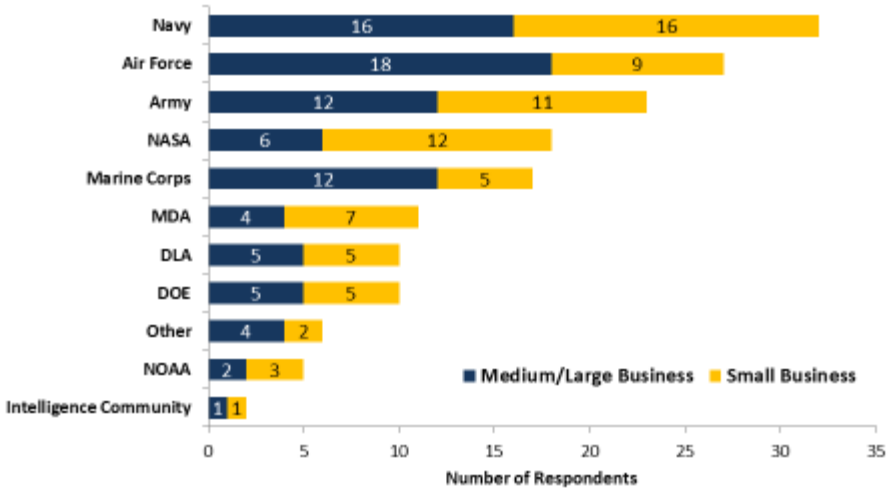


Q6bC Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*
Strategic Materials Assessment, Titanium – 2016

Proportionally, the level of Navy and Army support between small and larger respondents was relatively balanced, while the Air Force received more than double the support from larger respondents than smaller respondents (see Figure VII-10). This contrasts with NASA, who received titanium-related product primarily from smaller respondents.

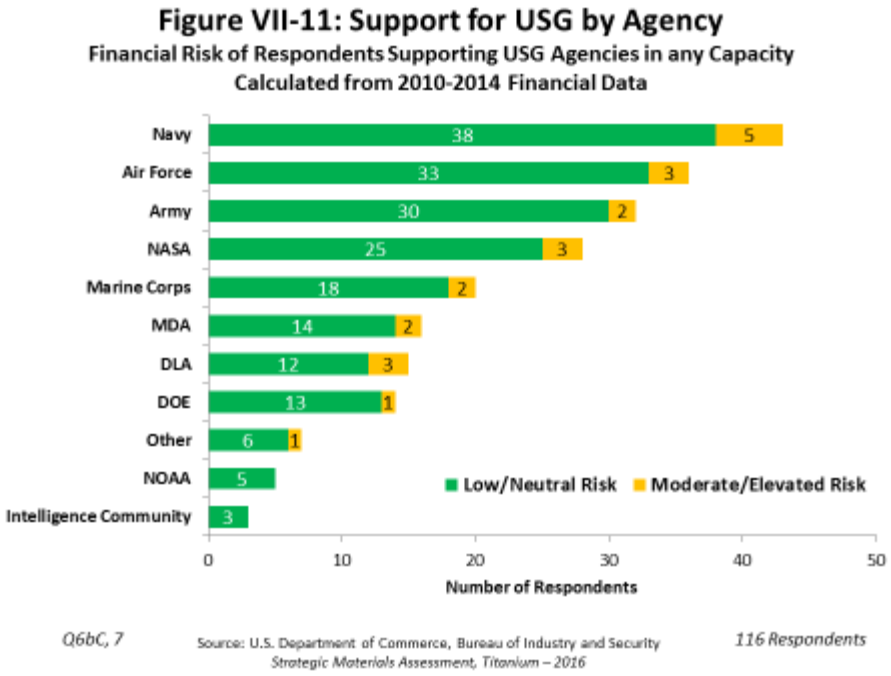
Figure VII-10: Titanium-Related Support for USG by Agency

USG Agencies to which Respondents Provide Products and Services, 2010-2014



Q6bC Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*
Strategic Materials Assessment, Titanium – 2016

To measure the potential consequences of respondents' financial risk on USG program performance, BIS analyzed agency participation by respondents' financial risk designation. Results indicated that agencies on average maintained a nine percent rate of exposure to respondents operating at moderate-to-elevated financial risk (see Figure VII-11). This nine percent rate of exposure is almost double the proportion of moderate-to-elevated risk represented in the overall sample (five percent). A more detailed discussion of respondents' financial indicators can be found in Chapter IX.



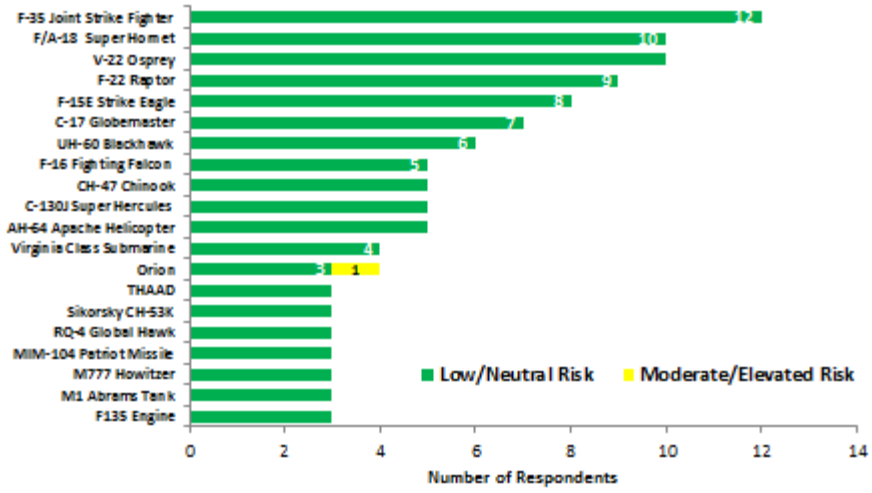
SUPPORT FOR U.S. GOVERNMENT—BY PROGRAM

Specific to programs administered by USG agencies and their affiliated contractors, 47 respondents (41 percent) identified 155 unique USG programs. These programs supported primarily the Navy, Air Force, Army, Marine Corps, and NASA. Leading among the identified programs supplied by respondents with titanium-related products were the F-35 Joint Strike Fighter, F/A-18 Super Hornet, V-22 Osprey, F-22 Raptor, F-15E Strike Eagle, and C-17 Globemaster (see Figure VII-12).

Each of these six programs, most of which were fixed wing aircraft programs, was supported by between 6-12 respondents. Additionally, among the leading programs documented by respondents, the vast majority faced little to no financial risk (see Figure VII-12).

Figure VII-12: Leading USG Programs by Titanium Related Sales

Financial Risk of Respondents with Sales to USG Programs
Calculated from 2010-2014 Financial Data



Q6bC

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

Several kinds of titanium-related products were reported by respondents in support of these leading defense programs. For application in the F-35 JSF program, alloyed bar, rod, billet, plate, and sheet of 6-4 composition were identified by respondents, as were alloyed pipe, tube, coil, and strip of 3-2.5 composition. Many of these same products were also sold into the F/A-18 Super Hornet and V-22 Osprey programs, among other products like semi-finished parts of 10-2-3 composition, machine parts, and castings.

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VIII. SALES

OVERVIEW

Sales information from respondents allowed BIS to determine the leading end-uses for respondents' products and services, and to assess any variability in revenue contribution between 2010 and 2013.

Types of sales recorded included:

- U.S.-based domestic sales;
- Non-U.S. export sales from U.S. locations;
- Titanium-related government and non-government sales;
- Titanium-related defense and civilian government sales; and
- Material sales related to titanium.

U.S. AND NON-U.S. SALES

In the aggregate, across all sales to all customers, respondents' sales grew 30 percent over the period, from $21.6 billion in 2010 to $28.2 billion in 2013. The largest individual year-over-year increase in sales occurred in 2010 to 2011 (19 percent) while the average annual change in the period was nine percent.[29]

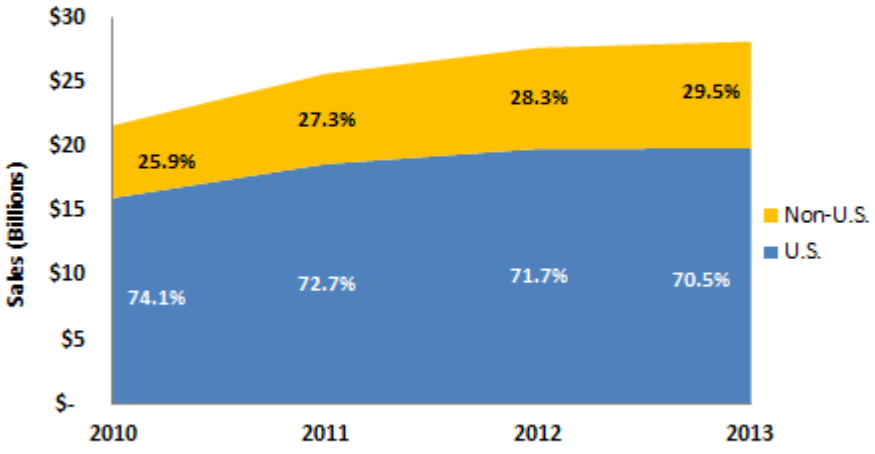
Results also indicated that respondents' export sales growth rates overtook domestic sales growth rates from 2010 to 2013. Domestic sales grew by 24 percent over the period yet export sales

[29] In any given year, overall titanium-related sales accommodated for 19 percent of aggregate respondent sales.

increased by 48 percent. In 2010 export sales (including titanium) represented 26 percent of all recorded sales and in 2013 reached 30 percent of revenues (see Figure VIII-1).

Figure VIII-1: Overall Respondent Sales

All Sales, Including Titanium, Domestic and Exported, 2010-2013

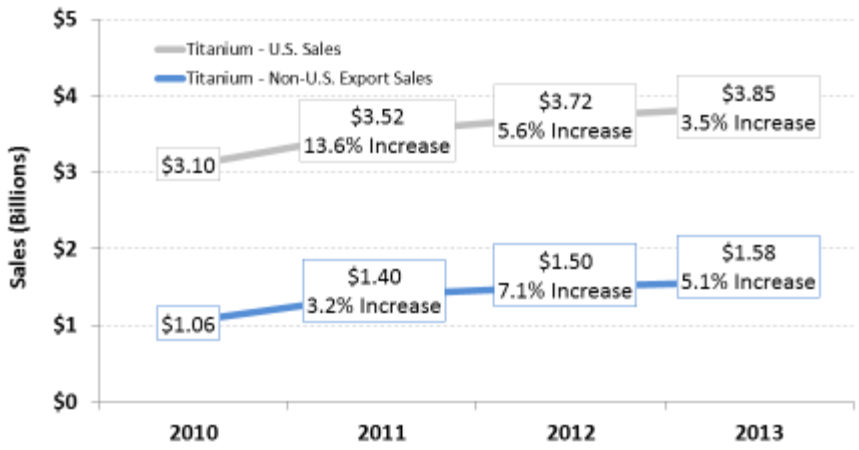


Q7A1, 7A2 Source: U.S. Department of Commerce, Bureau of Industry and Security *Strategic Materials Assessment, Titanium – 2016* *116 Respondents*

During 2010-2013, for every dollar generated by respondents' domestic-based sales of titanium-related products and services, roughly 40 cents is made through their export of similar titanium-related product and services (see Figure VIII-2).

Figure VIII-2: Titanium-Related Sales Change

Annual Increase of Titanium-Related U.S. and Export Sales, 2010-2013



Q781, 782 *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Respondent data also highlighted that much of the growth in such export sales was attributed to increases in commercial demand abroad for titanium-related products and services. During 2010-2013 respondent exports of titanium-related items from U.S. locations to commercial interests abroad increased 55 percent from $975 million to $1.5 billion.

GOVERNMENT AND NON-GOVERNMENT SALES

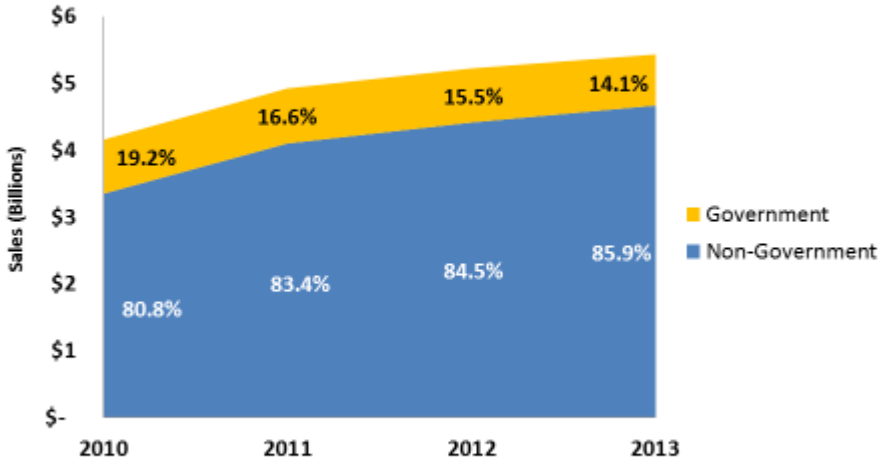
BIS asked respondents to provide a break-out of their titanium-related sales by government and non-government customer segments. Response data indicate that 41 percent, or 48 of 116 respondents, generated sales involving government customers.

The sale of titanium-related goods to government customers remained relatively constant at $800 million annually from 2010-2013. Proportionately, however, as a percent of overall titanium-related sales, results show a year-over-year and periodic reduction in titanium-related

government sales, declining from 19.2 percent in 2010 to 14.1 percent in 2013. Non-Government sales over the same period increased from 80.8 percent to 85.9 percent of overall titanium-related sales (see Figure VIII-3).

Figure VIII-3: Titanium-Related Sales

Titanium-Related Government and Non-Government Sales Increases, 2010-2013



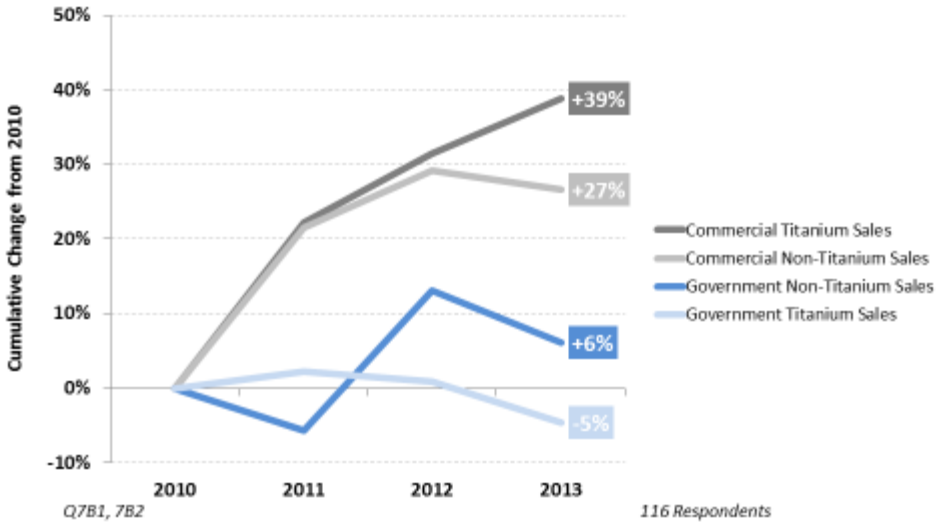
Q781, 782 *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Despite respondents' clear reliance on non-titanium products and services—mean and median proportions of individual respondent sales related to non-titanium business lines were 71 and 95 percent, respectively—the highest rates of period and year-over-year sales growth were among titanium-related products, specifically those sold to commercial customers (see Figure VIII-4).

Figure VIII-4: Titanium and Other Sales Change by Sector

Respondent Sales to Government and Commercial Sectors, 2010-2013

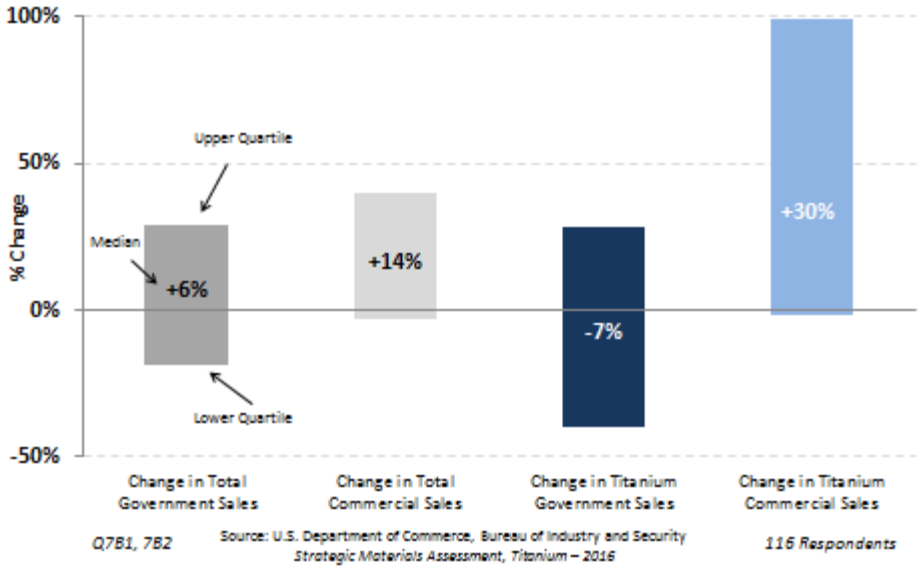


Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Furthermore, the distribution of periodic sales changes across the dataset illustrates the clear influence of commercial rather than government-based consumption in shaping respondent revenues. This trend applied to both respondents' sale of titanium-related products and other materials (see Figure VIII-5).

Figure VIII-5: Distribution of Sales Change

Percent Change in Sales to Government and Commercial Sectors, 2010-2014



Q7B1, 7B2 Source: U.S. Department of Commerce, Bureau of Industry and Security *Strategic Materials Assessment, Titanium – 2016* *116 Respondents*

DEFENSE SALES

Respondents were also asked by BIS to disaggregate their titanium-related sales by defense and non-defense customers. Results indicate only 38 of 116 respondents (33 percent) sold titanium-related products or services to defense customers in 2010-2013. These specific defense sales increased 11 percent over the period with an average year-over-year gain of four percent, reaching from $605 million in 2010 to $673 million in 2013.

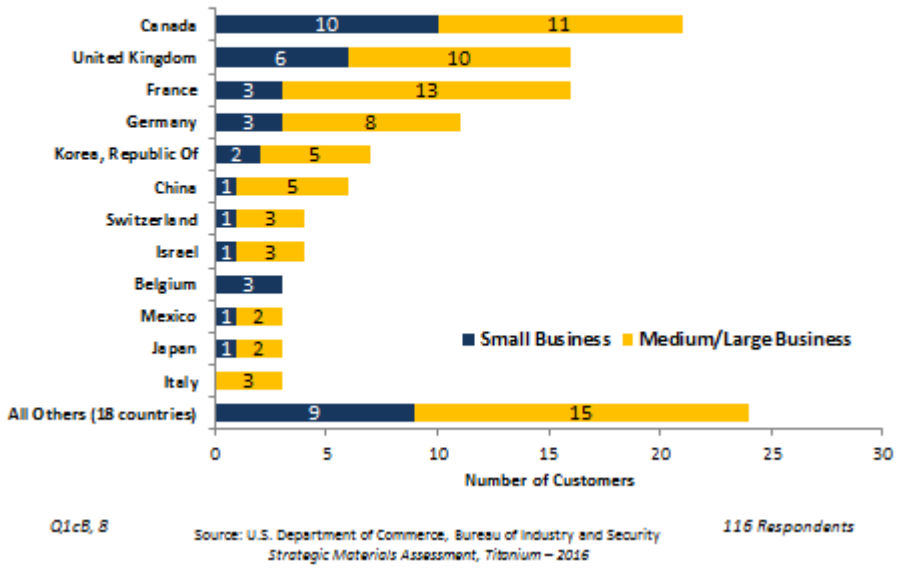
CUSTOMERS

BIS asked respondents to record their leading direct customers supported by their titanium-related business lines. Respondents reported 713 customer relationships (487 unique customers) involving the procurement of titanium-related products in 2010-2013. These customers were

located in 31 countries and 44 states, and included top aerospace and defense (A&D) firms and industry leading metals manufacturers and distributors (see Figure VIII-6).

Figure VIII-6: Non-U.S. Titanium Customer Location

Respondents Customers, 2010-2013



Q1cB, B *116 Respondents*

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

Data also suggest a clear concentration of demand for titanium-related product among select manufacturers in the A&D and metals segments. For instance, 10 individual companies represented 15 percent of the 713 customers identified by respondents. And 10 other companies identified by respondents accounted for nearly half of all annual sales in 2010-2013.

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IX. FINANCIAL HEALTH AND PERFORMANCE

OVERVIEW

Respondent financial indicators are crucial in evaluating the overall health and viability of the titanium supply chain. Accordingly, BIS collected income statement and balance sheet information for 2010-2013, which was subsequently collated and analyzed using a scorecard model to generate each respondent's financial risk profile, among other designations.

FINANCIAL RISK SCORECARD MODEL

The custom financial risk scorecard employed by BIS is based on a basket of standard financial ratios covering select company performance indicators, such as profitability, liquidity, leverage/indebtedness, and default probability (see Figure IX-1).

Figure IX-1: BIS Financial Risk Scorecard
Performance Measures by which Ti-Related Respondents are Evaluated

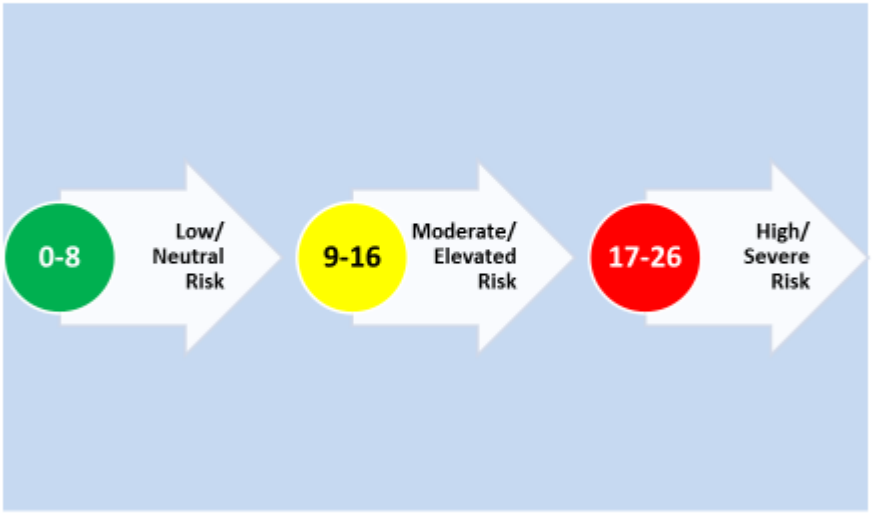
Performance Category	Ratio/Measure
Profitability	Operating Profit Margin
	EBIT/Pre-Tax Margin
	Net Profit Margin
Liquidity/Solvency	Current Ratio
	Quick Ratio
Leverage	Debt Ratio
	Debt-To-Equity
Business Activity	Inventory Turnover
	R&D Intensity
	CapEx Intensity
Dependency on Sales to USG Programs	Self Declared
	Calculated
Default Probability	Z-Score A
	Z-Score B

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

This multi-factor scorecard approach to risk measurement allowed BIS analysts to portray a more comprehensive profile of each survey respondent, in sharp contrast to analytical methods reliant only on a single metric of merit.

Each field and corresponding measure was allocated a weight in the scorecard model. After inserting a respondent's financial information, the model would generate a risk score between 0-26 for each recorded year. If the score fell between 0-8, the respondent was deemed to be at low-to-neutral financial risk; if between 9-16, then at moderate-to-elevated financial risk; and if between 17-26, then at high-to-severe financial risk. The mean of the annual scores across the period determined the respondent's overall calculated risk (see Figure IX-2).

Figure IX-2: Risk Designations
From Mean of Annual Scores Based on Reported Ti-Related Financial Data



Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

This methodology allowed BIS to interpret several categories of the survey, such as employment, R&D expenditures, or investments in property, plant, and equipment, from a financial risk perspective.

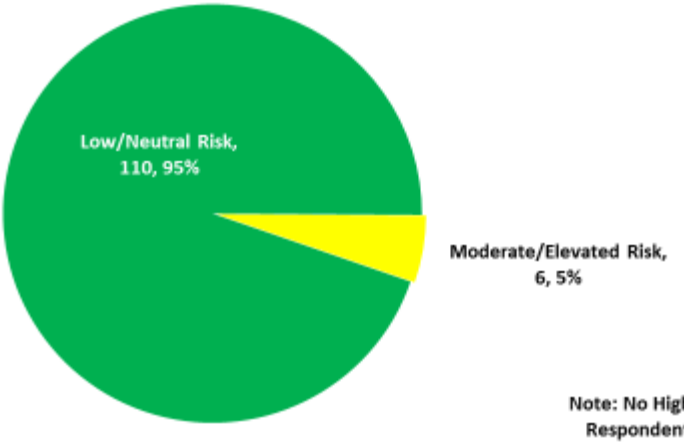
Risk designations were made based on average annual scores. The level of risk among the high-to-severe risk vendors, as with the low-to-neutral risk and moderate-to-severe risk batches may fluctuate between years. For example, in any given year, a high-to-severe risk supplier may have a score of less than 17 but not on an average annual basis from 2010-2013.

Additionally, while the financial risk levels merit significant consideration, particularly with regards to the risk of either respondent insolvency or lost capability, several additional risk indicators remain, such as an aging workforce, declining STEM levels/investment, hiring impediments, and obsolescence of parts/components.

FINANCIAL RISK SCORECARD RESULTS

Results from BIS's scorecard analysis indicated that no respondents were deemed to be at high-to-severe financial risk, while six of 116 (five percent) were at moderate-to-elevated financial risk, and the remaining 110 (95 percent) at low-to-neutral risk (see Figure IX-3).

Figure IX-3: Ti Respondents Financial Risk Designations
Based on Several Financial Metrics, 2010-2013



Note: No High/Severe Risk Respondents Reported

Q9 Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*
Strategic Materials Assessment, Titanium – 2016

Despite the financial strength of most respondents, 16 of the 110 companies designated as low-to-neutral risk were within three points of the moderate-to-elevated risk threshold. However, the 2013 scores among 15 of these 16 borderline companies were much lower, an indicator of improved performance and therefore a lower risk score than their average annual score. This 2013 improvement in rating over their average annual result reaffirms their designation as low-to-neutral risk because they demonstrated less risk in the most recent financial year reported.

This same comparative logic between respondents' static 2013 score and their annual average result is valid for determining the acuity of risk. BIS learned that the 2013 scores for five of the six moderate-to-elevated risk respondents were more than double that of their average annual score. This means that the risk of insolvency for most moderate-to-elevated risk respondents actually grew more acute in the reporting period.

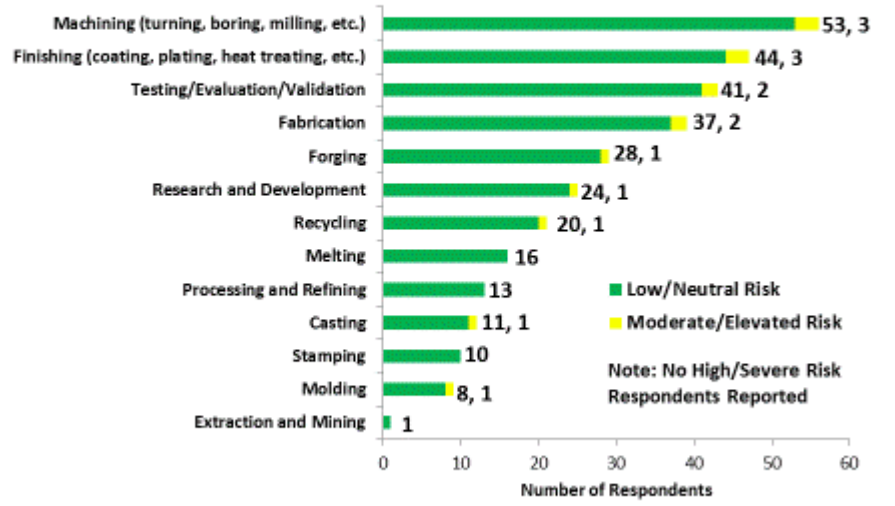
FINANCIAL RISK BY OPERATIONS

By analyzing respondents' operations data on a financial risk basis, BIS was able to isolate particular capabilities subject to increased risk of supplier default. However, due to the small number of respondents designated as moderate-to-elevated risk (five percent of overall sample), most respondent operations categories maintained little to no apparent risk of supplier disruption.

Among the 13 operations categories documented in the survey, BIS found on average only four percent of participating respondents are at increased financial risk. Molding was the operation reported with the highest degree of financial risk, at 11 percent, with one of nine companies at risk (see Figure IX-4).

Figure IX-4: Financial Risk of Titanium-Related Operations

Risk of 2014 Operations Based on 2010-2013 Financial Data



Q1c.A, 9

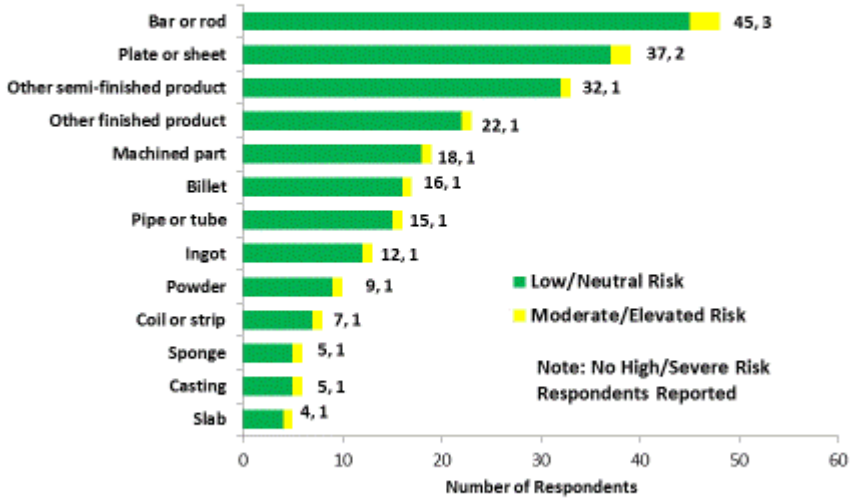
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

FINANCIAL RISK BY PRODUCTS

Much like the risk-based operations results, product exposure to financial risk was relatively minimal across respondents. Proportionally, five of 13 product areas contained 10 or more participating respondents at the moderate-to-elevated risk level. Titanium-related product areas most acutely subject to increased financial risk include slab, casting, and sponge products (see Figure IX-5).

Figure IX-5: Financial Risk of Ti-Related Products



Q1c.B, 9 Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*
Strategic Materials Assessment, Titanium – 2016

PROFITABILITY

In any given year during the reporting period, between 16 and 25 respondents were operating at a loss, meaning they reported negative net income on their income statement. Data indicate that a six percent rise occurred in the number of respondents operating at a loss between 2010 (16 percent or 18 respondents) and 2013 (22 percent or 25 respondents) (see Figure IX-6).

Figure IX-6: Titanium Profitability

Frequency of Positive and Negative Net Income, 2010-2013

Q9 Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*

Strategic Materials Assessment, Titanium – 2016

Included among respondents' financial line item disclosures were net sales (and other revenue), total operating income, earnings before interest and tax (EBIT), and net income for 2010-2013. BIS used this data to calculate respondent profitability by net profit margin (after tax) and EBIT profit margin (pre-tax).

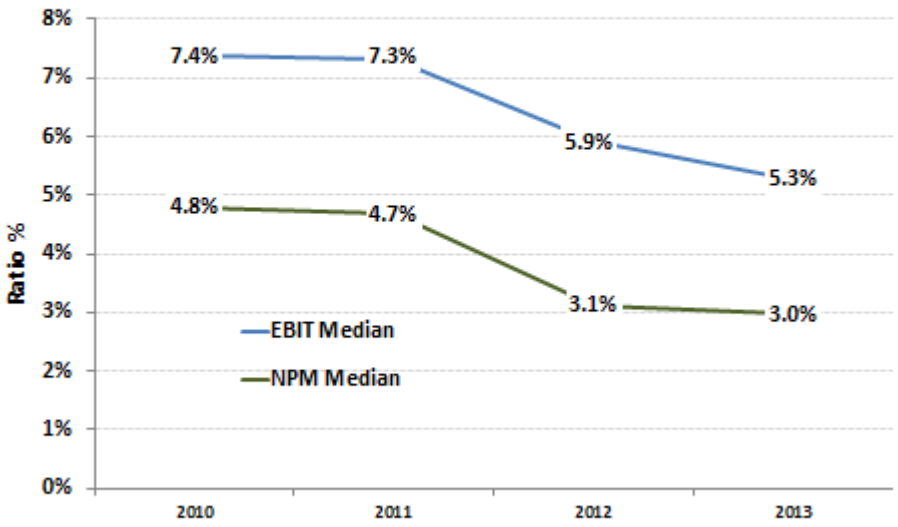
The net profit margin (NPM) was also calculated from the income statement, representing, as a percentage of net sales (and other revenue), the remaining income after accommodating for all relevant expenses. The EBIT profit margin, alternatively, excludes interest and tax expense from the measure of profitability.

This approach removed debt financing and tax expense from the formula in order to focus the measure of profitability on core business activities. NPM conveys the amount of profit to be

held by the respondent, whereas EBIT margin represents the total amount of profit before interest and tax expense eligible to be shared first with investors, including the company's parent or holding entity in some instances.

Echoing the increased number of respondents operating at a loss, survey results indicate a periodic decline in the profitability of respondents across the four year period.[30]

Figure IX-7: Titanium Profitability
Based on Net Profit Margin and EBIT Margin, 2010-2013



Q9 Source: U.S. Department of Commerce, Bureau of Industry and Security *Strategic Materials Assessment, Titanium – 2016* *116 Respondents*

[30] Both EBIT and NPM declined nearly 200 basis points in the period (see Figure IX-7).

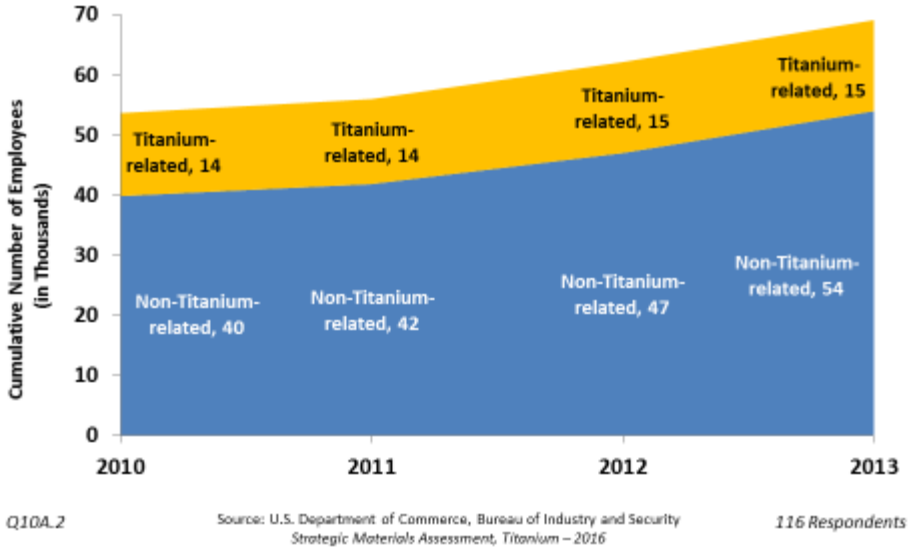
X. EMPLOYMENT

OVERVIEW

Each respondent was asked by BIS to document select statistical information on personnel necessary to support their titanium-related business lines. Manufacturers, representing 61 percent of overall respondents, accounted for 87 percent of the number of employees reported. Their cumulative rate of growth in 2010-2013 was 30 percent. Distributor personnel, in contrast, reported a growth rate of 23 percent over the same period, while representing 39 percent of the respondent sample and only 13 percent of aggregate employees.

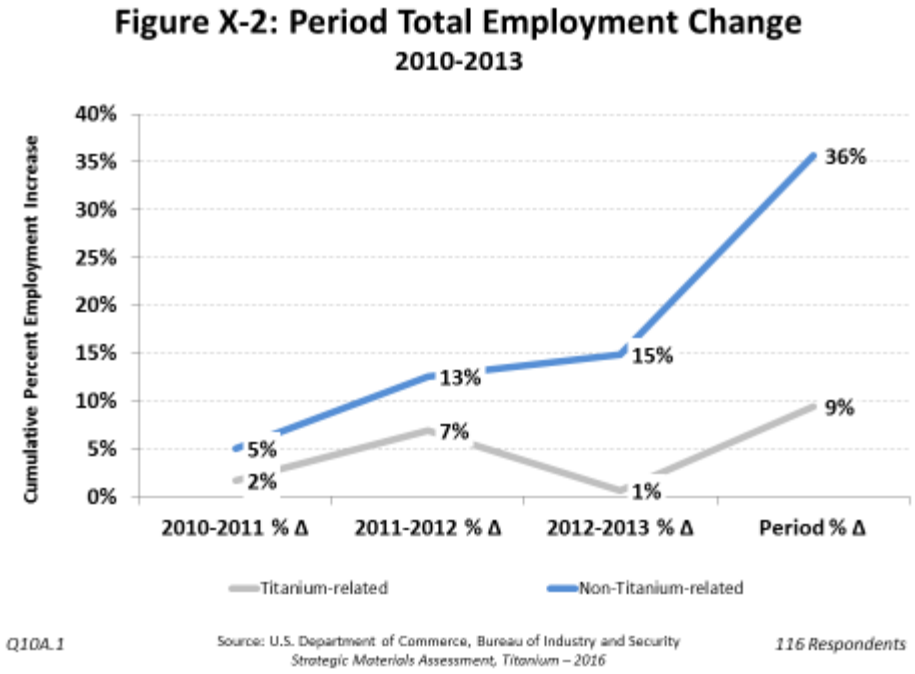
Across the four year period, each respondent maintained on average 20 percent of aggregate personnel affiliated with their titanium-related business lines. This respondent specific proportion is slightly smaller than the cumulative annual proportion of nearly 24 percent (see Figure X-1).

Figure X-1: Total Employment
2010-2013



Q10A.2 Source: U.S. Department of Commerce, Bureau of Industry and Security *Strategic Materials Assessment, Titanium – 2016* *116 Respondents*

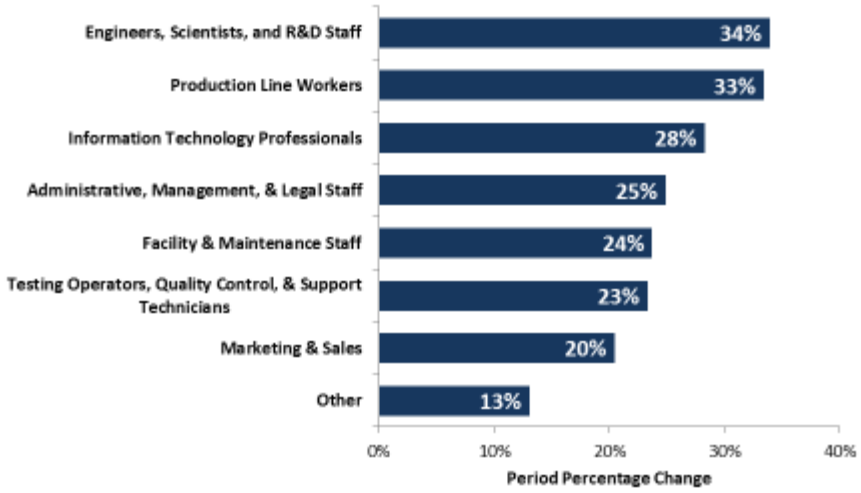
Cumulatively, annual fluctuations in the number of titanium-related workers proved inconsistent. The rates of annual increase ranged from one to seven percent. However, from 2010-2013 the total number of titanium-related workers increased nine percent, from 13,909 to 15,220. During the same period, the number of non-titanium-related among respondents workers increased 36 percent, from 39,742 to 53,910 (see Figure X-2).



Each of the occupational categories in the survey incurred cumulative 2010-2013 rates of growth higher than 20 percent. Those occupations with the most change were the following: engineers, scientists, and R&D staff (34 percent increase); production line workers (33 percent increase); and information technology professionals (28 percent increase). Such increases in the number of highly trained personnel across diverse occupation areas is an indicator of growth and sustainability in the titanium supply chain (see Figure X-3).

Figure X-3: Period Total Employment Change by Occupation

Titanium and Non-Titanium Related Occupations, 2010-2013



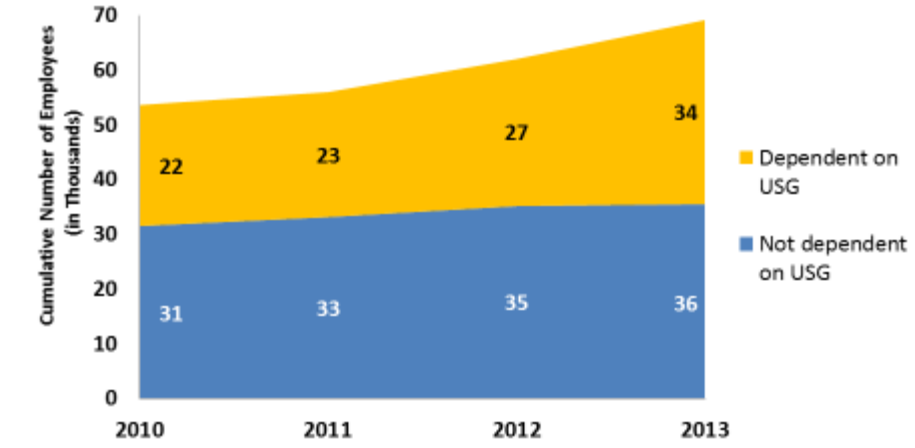
Q10A.1

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

Survey results also indicate a higher employee growth rate among respondents dependent on U.S. Government (USG) demand for ongoing viability. For USG dependents, the cumulative 2010-2013 employee growth rate (52 percent increase) is four times that of non-dependent firms (13 percent increase). A significant portion of the personnel growth reported by USG-dependent respondents was incurred by only two of 21 respondents (see Figure X-4).

Figure X-4: Total Employment
Employees by Dependency on Overall USG Sales, 2010-2013



Q10A.1

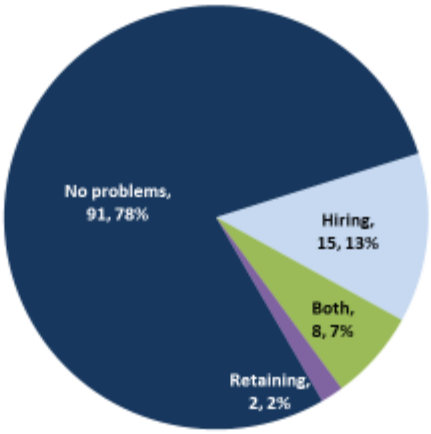
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

HIRING AND RETENTION DIFFICULTIES

BIS sought to determine the general level of difficulty respondents faced in their employment practices. Data indicate that 22 percent of respondents currently face hiring or workforce retention problems, with seven percent reporting both hiring and retention problems. When asked by BIS to describe their difficulties, most respondents emphasized an inability to replace highly skilled personnel, especially those with mechanical backgrounds (see Figure X-5).

Figure X-5: Employee Hiring/Retention Problems



Q10B Source: U.S. Department of Commerce, Bureau of Industry and Security *Strategic Materials Assessment, Titanium – 2016* *116 Respondents*

Representative examples of respondents' hiring and retention difficulties include:

- "Difficulty hiring qualified employees to operate complex thermal processing vacuum furnaces and associated equipment;" *Manufacturer*
- "Finding technical personnel is extremely difficult in recent times;" *Manufacturer*
- "[There are] not as many people interested in manufacturing. Therefore, it is difficult to find good employees with experience. Hard to find second shift workers;" *Manufacturer*
- "We do not have a lot of turnover, but when we need to hire someone it is hard to find individuals who have mechanical training;" *Manufacturer*
- "We have trouble finding qualified CNC operators;" *Manufacturer*
- "The work ethics and moral principles of young adults coming out of high school have declined considerably. I believe this is because our schools spend more time teaching theory and not enough time with practical and technical education;" *Distributor*
- "It is difficult to hire experienced production line workers;" *Manufacturer* and
- "Difficulty hiring people with non-destructive testing (NDT) skills;" *Manufacturer*

SKILLS/COMPETENCIES

Each respondent was asked by BIS to declare any titanium-related unique skill or competency perceived to be essential to their organization. In the aggregate, 144 examples were identified by the 116 respondents. Reported skills fell into three leading categories: production/ manufacturing (28 percent), quality control/testing (19 percent), and engineering (18 percent) (see Figure X-6).

Figure X-6: Unique/Essential Skills

Essential Titanium-Related Employee Skills

Unique/Essential Skills	
Skill/Competency	**Frequency**
Production/manufacturing	41 or 28%
Quality control/testing	27 or 19%
Engineering	25 or 17%
Scientific	12 or 8%
Analytical	11 or 8%
Management	10 or 7%
Other service	7 or 5%
Other	6 or 4%
Design	5 or 3%

Q10C

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

Respondents reported several examples of the titanium-related skills and competencies they perceived as both unique and essential to their companies. Most examples submitted to BIS relate to respondents' manufacturing competencies and their relationships to titanium-related product lines.

Representative examples of declared unique or essential skills critical to respondents' titanium-related operations include:

- "Blue print reading and interpretation;" *Manufacturer*
- "Flat rolling—understanding of physical metallurgy principles of rolling different titanium alloys;" *Manufacturer*
- "Knowing how the furnace and certain specialty gases interact with titanium;" *Manufacturer*
- "Knowledge of operating parameters, fixtures/jigs, programming of CNC machines;" *Manufacturer*
- "Manufacturing fully dense/porous sheets and plates;" *Manufacturer*
- "Melt operations (vacuum arc re-melting and electron beam furnaces);" *Manufacturer*
- "Rolling mills, annealing lines and other equipment;" *Manufacturer* and
- "Ultrasonic inspection/non-destructive testing (NDT);" *Manufacturer*

XI. RESEARCH AND DEVELOPMENT (R&D)

Investment in R&D is both an important and often necessary step in determining a manufacturer's overall competiveness in the marketplace. These R&D expenditures, whether internally funded or realized through investments by customers, often lead to new or improved product lines, more efficient manufacturing techniques, and the creation of new intellectual property.

Drawing from respondents' 2010-2013 R&D expenditure and funding records, BIS benchmarked the level of R&D activity occurring in the titanium supply chain. Respondents also described their specific R&D activities to supplement their annual expenditure and funding line items.

Thirty-four of 116 respondents (29 manufacturers; 5 distributors) were identified by BIS as performing R&D of any kind in 2010-2013.

EXPENDITURES

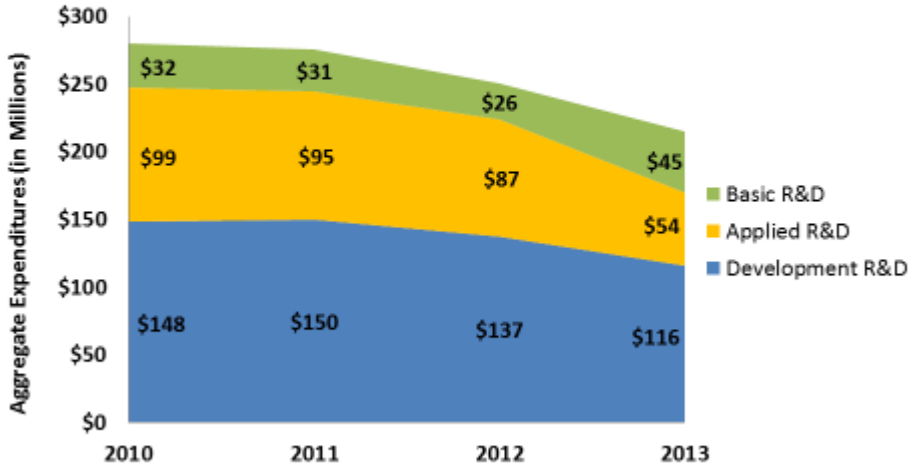
BIS learned that among the 34 of 116 respondents (29 percent) conducting R&D in 2010-2013, 20 respondents (17 percent) conducted R&D expenditures related specifically to titanium; 15 respondents were small business; and 5 were dependent on the U.S. Government for viability. Proportionally, the numbers of both small business and USG-dependent companies performing R&D resembled those of the overall respondents.

Additionally, only two of the 34 respondents were deemed to be at moderate-to-elevated financial risk. Overall, 15 of the 34 (44 percent) conducted R&D specifically involving defense applications.

R&D expenditures in the aggregate declined by 23 percent in 2010-2013 from $267 to $230 million. By type of R&D, overall applied research spending declined by 45 percent while product/process development fell by 22 percent. Basic research expenditures, in contrast, grew 38 percent in 2010-2013 (see Figure XI-1).

Among respondents performing basic research, median basic R&D expenditures fluctuated with 16 respondents recording percentage increases, 11 recording decreases, and the remaining 7 indicating no change.

Figure XI-1: Research and Development Expenditures
All Respondents By Type of R&D, 2010-2013



Q11A

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

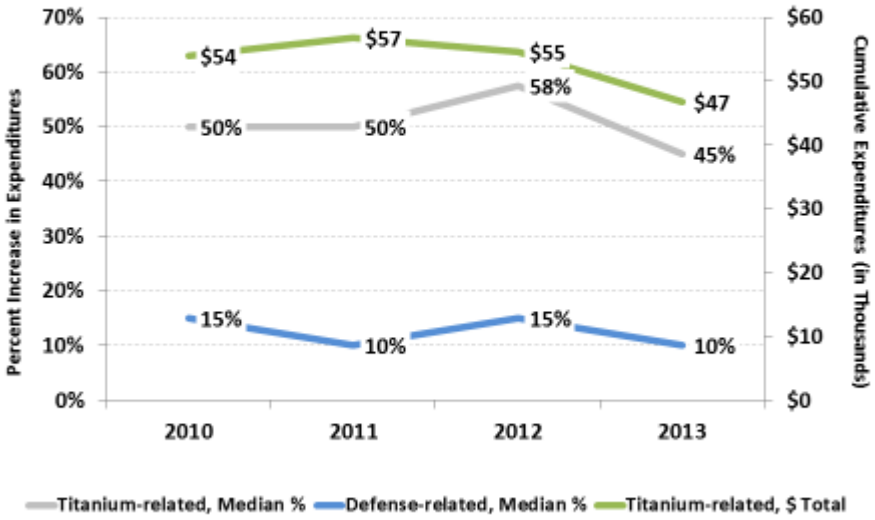
34 Respondents

Results indicated that among the 20 respondents actually performing titanium-related R&D, relatively little change occurred in the proportion of titanium-related expenditures to other R&D investments. For example, median annual allocation percentages fluctuated between 50 percent in both 2010 and 2011, 58 percent in 2012, and 45 percent in 2013. In aggregate dollar terms, however, titanium-related R&D spending declined 13 percent from $54 million in 2010 to $47 million in 2013 (see Figure XI-2).

Regarding defense-related R&D, in proportion to overall R&D expenditures, the fluctuations in median investment between years were slight while overall defense-related R&D spending increased 15 percent from $8.5 to $9.8 million.

Figure XI-2: R&D Expenditures

Titanium and defense-related proportion of R&D expenditures, 2010-2013



Q11A4, 11A5

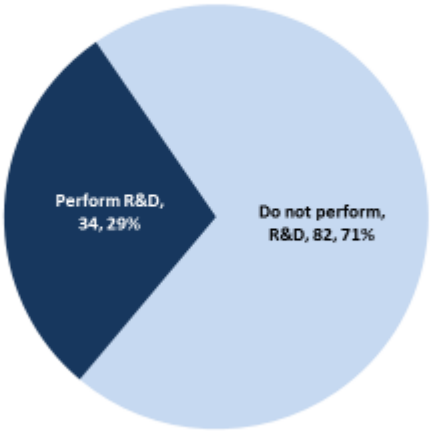
Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

In addition to R&D expenditure dollars and category proportions, respondents were asked by BIS to describe the specific kinds of R&D performed by their organization. These activities

included the research of powder metal manufacturing technology, development of melting processes, and material reduction through design of experiments (see Figure XI-3).

Figure XI-3: R&D Performance
By level of participation and R&D description, 2010-2013



Q11 Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*
Strategic Materials Assessment, Titanium – 2016

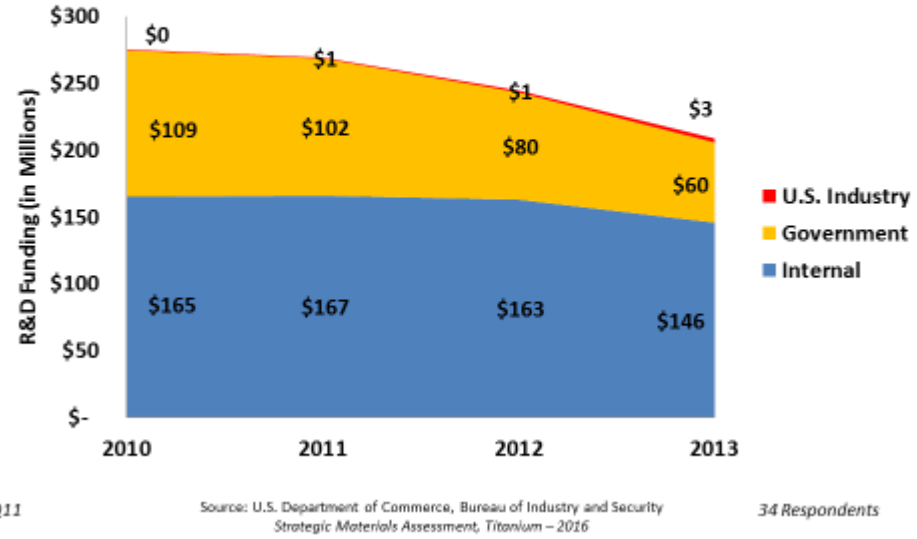
Representative examples of R&D conducted by respondents include:

- "All of our R&D efforts come from various customer requests and not from a formalized program;" *Manufacturer*
- "Development of novel titanium compositions and powder metal manufacturing technology;" *Manufacturer*
- "Material reduction through simulation and Design of Experiments (DOE);" *Manufacturer*
- "Our R&D activities usually related to product strength, ductility, and weight. Also, improving our internal processes for both efficiency and environment impact are researched;" *Manufacturer*
- "R&D activities are focused on developing innovative titanium melting processes, new alloys, and new products with existing alloys;" *Manufacturer*
- "R&D activities include degas, stress relieve, hydride, dehydride, and grain growth;" *Manufacturer*
- "Shell and wax material selection and titanium alpha case analysis;" *Manufacturer* and
- "Technology development for aerospace gas turbine engines." *Manufacturer*

RESULTS—FUNDING

Most of the R&D performed by respondents was funded internally (65 percent) with select investments made by domestic industry (1 percent) and U.S. Government (34 percent) sources.[31] Non-U.S. investment in respondent R&D was not evident in the data, nor was funding by non-profits or universities (see Figure XI-4).[32]

Figure XI-4: R&D Funding
2010-2013



Q11 Source: U.S. Department of Commerce, Bureau of Industry and Security, *Strategic Materials Assessment, Titanium – 2016* 34 Respondents

RESULTS—R&D INTENSITY

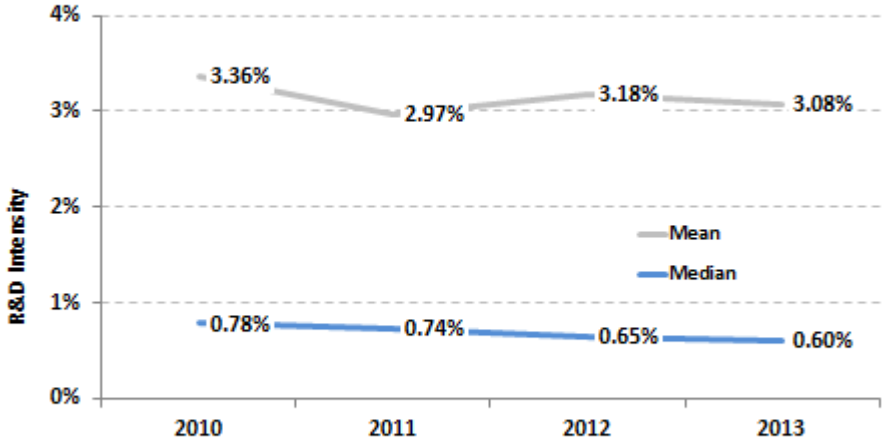
In proportion to annual revenues on an individual respondent basis, investments in R&D are relatively flat, in contrast to the aggregate dollar expenditure and funding declines over the

[31] Ninety-eight percent of the U.S. Government-funded R&D was reported by a single respondent.
[32] Expenditure and funding annual dollar totals are not the same due to the discrepancy in annual investment and R&D spending by select respondents.

period.[33] R&D intensity data—a measure commonly adopted in the assessment of a company's investment in innovation—points to only a slight decrease in R&D investment in proportion to respondents' revenues (see Figure XI-5).[34]

Figure XI-5: R&D Intensity

R&D intensity = Total R&D expenditures / Net Sales (and other revenue), 2010-2013



Q11

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

34 Respondents

[33] Much of the aggregate dollar-based expenditure and funding period declines are attributed to a select few respondents.

[34] The relatively low ratio measure among respondents is consistent with the one to three percentage rates of heavy industry and other mature material sectors.

XII. CAPITAL EXPENDITURES

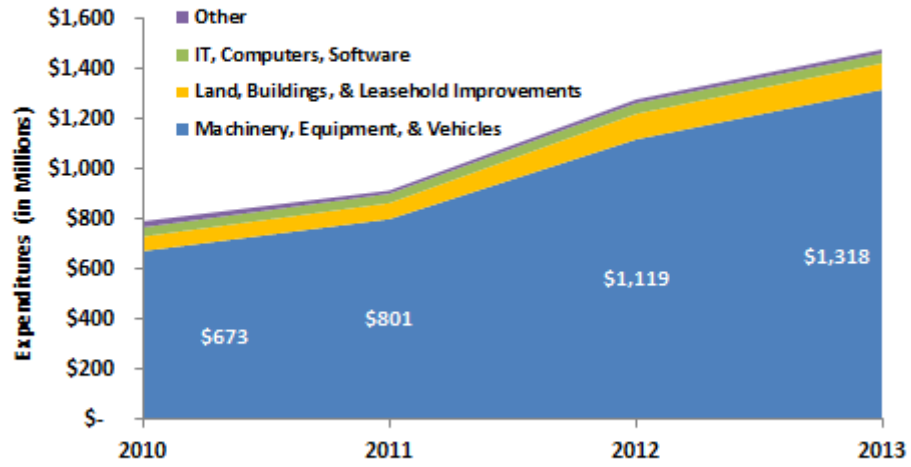
Investment in capital goods, particularly among manufacturers and other companies reliant on property, plant, and equipment (PP&E) in their respective business models, is generally a necessary step to remaining competitive in the marketplace.

Accordingly, BIS sought to (1) benchmark the level of capital investment made by respondents in 2010-2013; (2) learn if reductions in U.S. Government defense spending adversely affected respondents' willingness to invest in various PP&E; and (3) catalogue any unique or critical PP&E items supporting respondents' titanium-related operations.

RESULTS—EXPENDITURES

During the four year period, 2010 to 2013, aggregate capital expenditures increased 86 percent from $792 million to nearly $1.5 billion. Each year, machinery, equipment, and vehicles proved the largest kind of capital expenditure, constituting between 85-89 percent of overall outlays and representing the highest full period growth rate (96 percent). Land, buildings, and leasehold improvements maintained the second highest period growth rate at 83 percent, rising from $58 million to $106 million (see Figure XII-1).

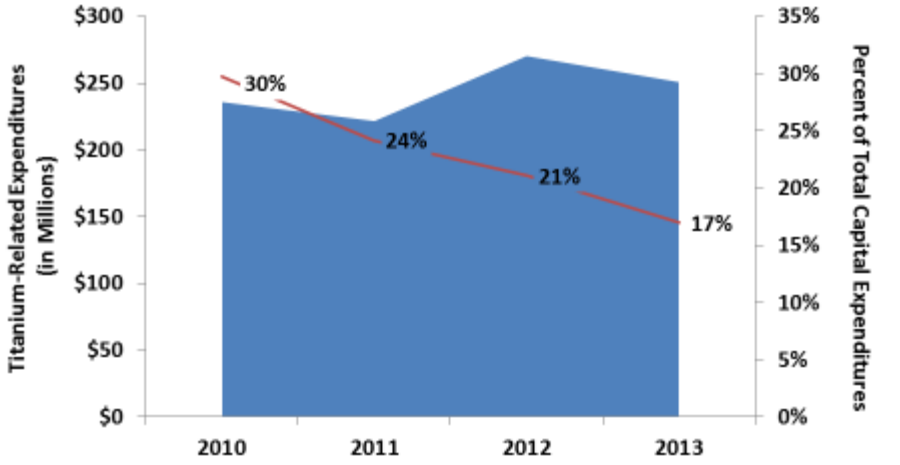
Figure XII-1: Total Capital Expenditures



Q12A Source: U.S. Department of Commerce, Bureau of Industry and Security *Strategic Materials Assessment, Titanium – 2016* *116 Respondents*

In contrast to respondents' overall capital expenditures, those directed specifically at titanium-related operations (made by 47 respondents) proved largely unchanged, growing only six percent in 2010-2013. This disparity in growth rates between categories led BIS to further evaluate the proportion of annual capital expenditure dedicated to titanium-related operations. BIS learned that the annual titanium-related proportion of aggregate expenditures declined 13 percent from 30 percent in 2010 to 17 percent in 2013 (see Figure XII-2).

Figure XII-2: Titanium Capital Expenditures
In support of titanium-related operations



Q12A

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

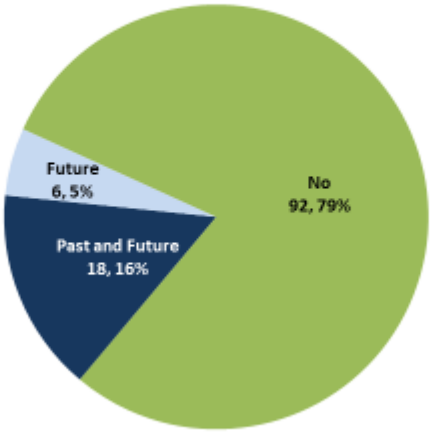
116 Respondents

The annual decline in the proportion of respondents' capital expenditures dedicated to titanium-related operations, accompanied by a relatively constant titanium-related expenditure, highlights that the titanium-related supply chain is anticipating greater demand in non-titanium segments in the near term. For PP&E specific to titanium-related operations, there seems to be no urgent need for increased capital expenditure beyond normal replacements and upgrades.

In addition to the collection of capital expenditure dollar information, BIS also asked respondents whether or not any of their capital investments had been, or would be, adversely impacted by reductions in U.S. Government defense spending. Ninety-two respondents (79 percent) indicated that no adverse impacts involving capital expenditures were apparent. Nonetheless, 24 respondents had been affected by such reductions. Their explanations of said impacts included (1) reductions in capital expenditures attributed to fluctuations and delays in

program spending and (2) the renewed emphasis of industry on commercial-related spending in the wake of defense drawdowns (see Figure XII-3).

Figure XII-3: Capital Expenditures Adverse Impacts
Past, 2010-2013, and Anticipated Impact from USG Defense Spending Reduction



Q12B Source: U.S. Department of Commerce, Bureau of Industry and Security *116 Respondents*
Strategic Materials Assessment, Titanium – 2016

Representative examples of respondents' adverse impacts from USG spending reductions include:

- "Growth in commercial aircraft has more than offset reductions in USG spending, as sales attest. However, with major programs like F-18 and F-35 uncertain, and with probable leveling off or reductions in commercial, we are likely to curtail expenditures in the years ahead unless USG spending shows only modest reductions;" *Manufacturer*

- "Impact is tied to USG expenditures as most of our equipment is tied to providing our customers who in turn supply the USG with their products. Approximately 25% [reduction] is an estimated figure;" *Manufacturer*

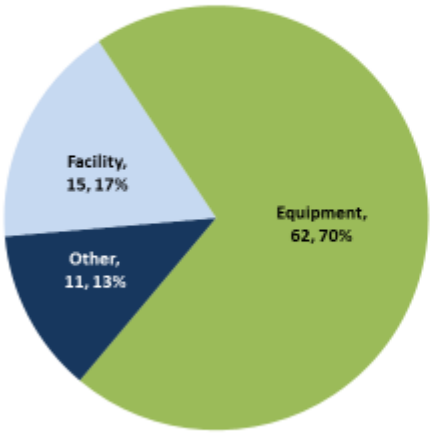
- "Investment in melting capacity expansion has been reduced in part due to delays and reductions in defense spending, including the JSF, C17, and armor programs;" *Manufacturer* and

- "The thermal processing industry usually lags the manufacturing industry on downturns in the economy. We expect that we will be seeing significant down turn in business due to reductions in USG spending. Therefore, we will likely reduce capital expenses until we see a clearer picture of longer term economic trends." *Manufacturer*

BIS supplemented its collection of time series capital expenditure dollar and "adverse impacts" information with a detailed catalogue of PP&E deemed by respondents to be unique or critical to

their titanium-related operations. Eighty-eight individual PP&E items were identified by 52 respondents or 45 percent of the sample. Most of the reported unique or critical items reside in the equipment sub-category and comprise of casting equipment, furnaces, machining centers, forging presses, and die tooling, among others (see Figure XII-4).

Figure XII-4: Property, Plant, and Equipment (PP&E)
Types of PP&E deemed unique or critical to titanium-related business lines



Representative PP&E	
Billlet-casting equipment	Equipment
Electron beam and vacuum arc remelt furnace	Equipment
Hi temperature furnace	Equipment
Machining center	Equipment
Sheet inspection probe	Equipment
Etch and phosphate fluoride process line	Equipment
Forging press for airframe products	Equipment
Die tooling	Equipment
Premium sponge plant	Facility
Investment casting	Facility
Thermal processing plant	Facility
Metallurgical and operational IP in processing titanium alloys	Other

Q12C

Source: U.S. Department of Commerce, Bureau of Industry and Security
Strategic Materials Assessment, Titanium – 2016

116 Respondents

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XIII. REPORT FINDINGS

- Of the 116 survey respondents, 93 (80 percent) participated in the defense sector. Due to the large number of companies supporting the aerospace sector, the aircraft segment proved to be the most common defense-related market served, with 81 companies (70 percent) participating. The defense, space, missile, and ship sectors had the next largest participation, with each constituting 45, 40, and 38 percent of respondents, respectively.

- Each of the reported titanium product compositions are manufactured and distributed domestically. However, fewer than 10 respondents are currently able to manufacture each of the 3-2.5, 6-6-2, 10-2-3, and 6-2-4-6 grade material.

- Nearly half of the total number of products identified by respondents (315 of 650 products, 48 percent) support aerospace segments primarily. These application areas include fasteners, housings, vibration isolators, rotating blades, and structures.

- Of the 650 titanium-related products reported to BIS, 139 products (21 percent) were deemed sole source. These products include 97 "sole U.S. source" products and 42 "sole global source" products provided by 25 and 10 respondents, respectively.

- The leading products that were U.S. sole sources were bar or rod, plate or sheet, and machined parts. The leading material composition in all three categories was 6-4. Leading bar or rod and plate or sheet products had aerospace applications while the 6-4 machined parts aided the production of optics and sensors.

- Among the identified 249 unique suppliers, 201 (81 percent) were located in the U.S. Respondents had on average three suppliers affiliated with their titanium-related product lines, most of which were domestic (84 percent).

- Respondents recorded 92 inputs procured from 18 countries in support of their titanium-related product lines. China, Russia, and Japan were the top three sources. The vast majority (87, 95 percent) of non-U.S. sourced procurements were for materials rather than services.

- Among manufacturers, 77 percent of all raw material inputs were purchased domestically, which is less than quantities bought domestically by distributors (89 percent).

- Finished metal is the leading category of material sourced from China. This category's prominence contrasts sharply with raw material's prominence among non-U.S. origin procurements overall and from Russia specifically as the number two non-U.S. supplier.

- Respondents identified several non-U.S. suppliers that support their titanium-related product lines, most of which reside in China, Russia, Japan, and Germany. Suppliers located in these four countries constitute 65 percent of all inputs acquired abroad by respondents for titanium-related applications.

- The ratio of input to individual vendor varies significantly between countries. Countries like Russia, Japan, and Germany maintain a relatively consolidated titanium supplier base with multiple inputs procured from only a handful of companies. This contrasts sharply

with China, where survey respondents identified multiple vendors that offer the same or nearly the same precursors.

- Among the 543 reported inputs supporting respondents' titanium-related product lines, 105 were single source and 18 were sole source (19 and 3 percent, respectively).

- Despite several countries maintaining single source supplier relationships with respondents (including China, Russia, Canada, Germany, the United Kingdom, Ukraine, and Israel) respondent sole source relationships were evident only in China. These particular sole source purchases of Chinese origin included stainless steel piping for commercial use and titanium powder integrated in a U.S. Department of Defense application.

- Depending on the materials type, respondents would require between two and 16 weeks to reconstitute spent inventories to current levels. The materials requiring the greatest lead time to replace would be finished metal (16 weeks), followed by raw materials (10 weeks) and semi-finished materials (seven weeks). However, chemicals and precursor materials like lubricants and industrial gases could be replaced in two to three weeks.

- China accounts for 14 percent of the non-U.S., non-titanium inputs sold directly to respondents, yet China accounts for 26 percent of such inputs on a source origin basis.

- Of the 116 respondents that submitted surveys, only seven respondents, or six percent, are concerned about input availability. The specific materials posing concerns are helium and vanadium (each mentioned twice) and magnesium, molybdenum, nickel, steel, and tantalum.

- This limited number of documented disruptions in the supply of precursor materials for respondents' titanium-related products (one percent of reported inputs) is indicative of the reliability of associated vendors, their adequate number, and the overall health of the related supply chains.

- Across the 544 material inputs documented by respondents for their titanium-related products, only eight were subject to disruption since 2012. Examples of the causes of these disruptions included helium shortage, plant shutdown, late delivery, labor strike, and equipment failure.

- Data indicates that, on average, respondents would require 12 weeks to maximize their production levels. The smaller respondents would need nine weeks to ramp up production while larger respondents would require 16 weeks.

- While small businesses represent 54 percent of all respondents, they constituted 71 percent of the 21 companies that selected government purchase volatility as an issue affecting their titanium-related operations since 2010. This difference indicates that smaller respondents operating in the titanium market are generally more vulnerable to USG procurement instability than their larger counterparts.

- Taxes, U.S. material availability, and proximity to both customers and suppliers represent other issue areas where greater than 54 percent of the respondent sample—between 58-75 percent of respondents in each case—were small businesses.

- Manufacturers represent 57 percent of all small business respondents; however, among issue categories recorded by 10 or more respondents (16 of 26 issue categories) an average of 72 percent comprise of manufacturers. Labor/skills retention (86 percent) and reduction in U.S. Government demand (75 percent) are particularly problematic for small manufacturers.

- Investments in capital goods frequently involve large outlays by the purchasing company and therefore necessitate significant liquidity or creditworthiness to secure the cash or credit used to make such purchases. Consequently, the projected increases in capital improvement actions by respondents over the next five years indicate a rise in producer confidence, as compared to the previous five years, while signaling the overall viability of this strategic materials segment.

- Respondents identified Pratt and Whitney Rocketdyne (28 percent), Rolls Royce (25 percent), and General Electric (GE) Aviation (22 percent) as the primary sources of industry impact among aircraft engine suppliers.

- Most titanium-related distributor support for USG customers is highly tailored and not readily adapted for commercial applications. Such insight suggests USG buyers should not focus solely on manufacturers but rather also on distributors when planning for industrial base impacts resulting from titanium-related procurement fluctuations.

- If faced with a sudden decline in USG demand, nearly half of all respondents (45 percent) indicated they would pursue alternative U.S. customers, while 42 percent would pursue new product or service lines.

- The suppliers most acutely affected by any sudden decline in USG demand are those most dependent on USG business for sustained viability. Consequently, results show that a large portion of the dependent sample (90 percent) would respond to a reduction in USG demand by decreasing capital expenditures. Many dependent respondents (86 percent) also anticipated increased product or service costs resulting from any reduction in USG demand. Additional reported impacts included the loss of personnel with key skills (76 percent) and reduced overall participation in USG contracts (67 percent).

- Since 2010, 41 percent of respondents provided titanium-related goods either directly or indirectly to U.S. Government agencies. Leading among the agencies supported, whether with titanium or non-titanium-related products, were the Navy, Air Force, Army, and NASA.

- Specific to programs administered by USG agencies and their affiliated contractors, 47 respondents (41 percent of the sample) identified 155 unique USG programs. These programs supported primarily the Navy, Air Force, Army, Marine Corps, and NASA. Leading among the identified programs supplied by respondents with titanium-related products were the F-35 Joint Strike Fighter, F/A-18 Super Hornet, V-22 Osprey, F-22 Raptor, F-15E Strike Eagle, and C-17 Globemaster.

- Respondent data also highlighted that much of the growth in such export sales was attributed to increases in commercial demand abroad for titanium-related products and services. During 2010-2013 respondent exports of titanium-related items from U.S.

locations to commercial interests abroad increased 55 percent from $975 million to $1.5 billion.

- The sale of titanium-related goods to government customers remained relatively constant at $800 million annually from 2010-2013. Proportionately, however, as a percent of overall titanium-related sales, results show a year-over-year and periodic reduction in titanium-related government sales, declining from 19.2 percent in 2010 to 14.1 percent in 2013.

- Despite respondents' clear reliance on non-titanium products and services—mean and median proportions of individual respondent sales related to non-titanium business lines were 71 and 95 percent, respectively—the highest rates of period and year-over-year sales growth were among titanium-related products, specifically those sold to commercial customers.

- Data also suggest a clear concentration of demand for titanium-related product among select manufacturers in the Aerospace and Defense (A&D) and metals segments. For instance, ten companies accounted for 15 percent of all 713 identified customers while another selection of 10 customers represented nearly half of all reported average annual sales in 2010-2013.

- Eighty-one percent of the respondents (94 organizations) were privately held with the remaining 22 organizations publicly traded.

- Results from BIS's scorecard analysis indicated that no respondents were deemed to be at high-to-severe financial risk, while six of 116 (five percent) were at moderate-to-elevated financial risk, and the remaining 110 (95 percent) at low-to-neutral risk.

- Among the 13 operations categories documented in the survey, BIS found on average only four percent of participating respondents to be at increased financial risk. Molding was the operation reported with the highest degree of financial risk, at 11 percent, with one of nine companies at risk.

- In any given year from 2010-2013, between 16 and 25 respondents were operating at a loss, meaning negative net income was reported on their income statement. Data indicate that a six percent rise occurred in the number of overall respondents operating at a loss between 2010 (16 percent or 18 respondents) and 2013 (22 percent or 25 respondents).

- Manufacturers, representing 61 percent of overall respondents, accounted for 87 percent of the number of employees reported. Their cumulative rate of growth in 2010-2013 was 30 percent.

- From 2010-2013 the total number of titanium-related workers increased nine percent, from 13,909 to 15,220.

- Each of the occupational categories in the survey incurred cumulative growth rates of 20 percent or higher during 2010-2013.

- Data indicate that 22 percent of respondents currently face hiring or workforce retention problems, with seven percent of the sample reporting both hiring and retention problems.

When asked by BIS to describe their difficulties, most respondents emphasized an inability to replace highly skilled personnel; especially those with mechanical backgrounds.

- Most of the R&D performed by respondents was funded internally (65 percent) with select investments made by domestic industry (<1 percent) and U.S. Government sources (34 percent).

- In proportion to annual revenues on an individual respondent basis, investments in R&D appeared relatively flat, in contrast to the aggregate dollar expenditure and funding declines over the period.

- In contrast to respondents' overall capital expenditures, those directed specifically at titanium-related operations (made by 47 respondents) were largely unchanged, growing only six percent in 2010-2013.

- The annual decline in the proportion of respondents' capital expenditures dedicated to titanium-related operations, accompanied by a relatively constant titanium-related expenditure, highlights that the titanium-related supply chain is anticipating greater demand in non-titanium segments in the near term.

- Ninety-two respondents (79 percent) indicated that no adverse impacts involving capital expenditures were apparent by reductions in USG defense spending. Nonetheless, 24 respondents had been affected by such reductions. Their explanations of said impacts included (1) reductions in capital expenditures attributed to fluctuations and delays in

program spending and (2) the renewed emphasis of industry on commercial-related spending in the wake of defense drawdowns.

XIV. ATTACHMENTS

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

DEFENSE INDUSTRIAL BASE ASSESSMENT:
Strategic Materials - TITANIUM

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 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 challenges facing the industry. Over the long 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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Table of Contents

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/MetalSurvey. 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 **MetalSurvey@bis.doc.gov** or by calling survey support staff and team lead Matthew Sigmund 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: **MetalSurvey@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
Alloy 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 Sales/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 Sales/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.
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.
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 (in contrast 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 percent 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 no downtime with full employment.

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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 one corporate-level response, but all **titanium**-related activities must be included. All data in this response must be reported at the same organizational level.		

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 (number only)	
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		
	- Optics/Sensors		
	- Semiconductors		
	- Other electronics	(specify here)	
	Engineering		
	Food/Agriculture		
	Healthcare/Medical		
	Industrial		
	- Chemical		
	- Desalinization		
	- Energy/Power generation		
	- Petrochemical		
	- Other industrial	(specify here)	
	Marine (surface and underwater)		
	Research and Development		
	Telecommunication		
	Other	(specify here)	
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		
	Ground Vehicles		
	Missiles		
	Research and Development		
	Ships (surface and underwater)		
	Space		
	Other	(specify here)	
Comments:			

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Section 1c: Organization Information

A	From the list below, select all operations your organization currently performs:		
	Extraction & mining		
	Processing & refining		
	Melting		
	Recycling		
	Casting		
	Forging (including extrusion)		
	Molding		
	Machining (turning, boring, drilling, milling, electrochemical, electron beam, ultrasonic, etc.)		
	Stamping (punching, blanking, flanging, etc.)		
	Fabrication (cutting, bending, assembling, etc.)		
	Finishing (coating, plating, heat treating, etc.)		
	Research and Development		
	Testing/Evaluation/Validation		
	Other operation(s)	(specify here)	

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(s) below.	

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 **titanium**-related operations. Provide the **LOCATION** of the facility, indicate its primary **OPERATION**, and specify any changes that may impact that facility over the next five years.

	Facility Name	Location			Operations		Outlook	
		City	State	Country	Facility Primary Operation (select from dropdown)	Specify Additional Detail or "Other" Operation	Do you anticipate any significant changes in the operations at this facility over the next five years?	If yes or unknown, provide a brief explanation.
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2								
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14								
15								

Comments:

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Section 2a: Titanium-Related Products

Complete the table below to describe **ALL** your organization's **titanium**-related capabilities. Capabilities include items sold to external customers in addition to semi-finished items requiring further processing by your organization. For example, if your organization produces titanium sponge that it further processes into titanium ingot and/or bar, each related product must be included.

For each unique **titanium**-related product your organization produces, provide a **PRODUCT NAME**, indicate the **TYPE** of product, and whether your organization distributes or manufactures the product. Manufacturing includes all value-added operations beyond distribution. In the **PRODUCT COMPOSITION/GRADE** section, specify whether the product is an alloy, indicate the **COMPOSITION/GRADE,** and provide a brief **ADDITIONAL DESCRIPTION** with any additional information/unique properties of the product. Complete the **END USE** portion by selecting the **PRIMARY SECTOR END USE** to indicate the product's general end user type and select a **PRIMARY END USE APPLICATION**. If needed, provide an **ADDITIONAL/OTHER DESCRIPTION.**

In the **PRODUCTION/DISPOSITION** portion, provide your organization's **AVERAGE MONTHLY OUTPUT,** in kilograms, of each product and the **MAXIMUM MONTHLY OUTPUT,** in kilograms, your organization would be capable of producing with three eight-hour shifts operating seven days per week utilizing your current facilities and equipment. Next, specify the **PERCENTAGE UTILIZED WITHIN YOUR ORGANIZATION.** If exact percentages are not known, estimates are acceptable. Last, specify if your organization is a **SOLE SOURCE** of each product.

NOTE: You must use one row for each unique combination of product **TYPE** and **COMPOSITION/GRADE**. If **OTHER** is selected, provide a description in the applicable write-in section.

	Product Name (write-in)	Type (select from dropdown)	Manufacture/ Distribute (select from dropdown)	Product Composition/Grade			End Use			Production/Disposition (Output includes both manufacturing and distribution)			Sole Source (select from dropdown)
				Alloy/Unalloyed (select from dropdown)	Composition/Grade* (select from dropdown)	Additional/Other Description (write-in)	Primary Sector End Use (select from dropdown)	Primary End Use Application (select from dropdown)	Additional/Other Description (write-in)	Average Monthly Output** (kilograms)	Maximum Monthly Output** (kilograms)	Percentage utilized within your organization	
1													
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3													
4													
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28													
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30													

* Composition/Grade notes:

Composition/Grade	Approximate Description		Composition/Grade	Approximate Description
CP	Commercially Pure		6-2-4-6	6% Aluminum, 2% Tin, 4% Zirconium, 6% Molybdenum
10-2-3	10% Vanadium, 2% Iron, 3% Aluminum		6-6-2	6% Vanadium, 6% Aluminum, 2% Tin
6-4	6% Aluminum, 4% Vanadium		3-2.5	3% Aluminum, 2.5% Vanadium
6-2-4-2	6% Aluminum, 2% Tin, 4% Zirconium, 2% Molybdenum			

Comments:

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Section 2b: Other (Non-Titanium) Products

A	Does your organization provide **non-titanium**-related products? If no, proceed to Section 3a.	

For each **TYPE** of material your organization provides, indicate the **PRIMARY MATERIAL** of the product and whether your organization manufactures or distributes the product. Manufacturing includes all value-added operations beyond distribution. Next, provide a brief **PRODUCT DESCRIPTION** that includes additional materials in the product. Complete the **PRIMARY SECTOR END USE** to indicate the product's general end user type, select the **PRIMARY END USE APPLICATION** to specify the type of end use, and, if needed, provide an **ADDITIONAL/OTHER DESCRIPTION**.

NOTE: One row must be completed for each unique **TYPE** and **PRIMARY MATERIAL** combination. If **OTHER** is selected, provide a description in the applicable write-in section.

B

	Product Composition			Manufacture/ Distribute (select from dropdown)	End Use		
	Type (select from dropdown)	Primary Material (select from dropdown)	Product Description (write-in)		Primary Sector End Use (select from dropdown)	Primary End Use Application (select from dropdown)	Additional/Other Description (write-in)
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20							

Comments:

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Section 3a: Suppliers for Titanium-Related Operations

In the table below, identify the **EXTERNAL** suppliers for your organization's **titanium**-related product line(s) **since 2012**. For each of the products your organization identified in the **PRODUCTS** Section (2a), indicate the suppliers providing key inputs and/or services. Provide the **EXTERNAL SUPPLIER NAME** and indicate whether they provided your organization materials or services in the **TYPE OF SUPPLIER** column. In the **INPUT/SERVICE INFORMATION** section, choose the general **TYPE** of input/service the supplier provided, and add a brief **DESCRIPTION.** All items supplied internally should be identified in Section 2 as products your organization provides.

Next, select the **STATE** and **COUNTRY** where the supplier is located and indicate whether they are your **SINGLE/SOLE SOURCE**. In the remaining five columns, indicate where the supplied items are utilized in the products you identified in Section 2. If a supplier is utilized for more than the available product columns, repeat their information on an additional row.

NOTE: Scroll to the right to view all columns.

	Supplier Information		**Input/Service Information**		**Supplier Information** (select from dropdown)			**Product Use** (select from dropdown)				
	External Supplier Name	**Type of Supplier**	Type (select from dropdown)	Description (write-in)	Supplier State	Supplier Country	Single/Sole Source	Titanium Product 1	Titanium Product 2	Titanium Product 3	Non-Titanium Product 1	Non-Titanium Product 2
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Comments:

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Section 3b: Inventory of Titanium-Related Inputs

Detail the inventory levels of material inputs required for **titanium-**related operations that your organization maintains. Calculate inventory levels as the average level maintained (in weeks) under normal operating conditions since 2012.

The first column has been populated by the **MATERIALS** your organization indicated receiving from external suppliers for **titanium**-related operations in section 3a. In the middle three columns, specify **INVENTORY LEVELS** (in weeks) for each scenario; and in the remaining columns indicate whether a **SUPPLY DISRUPTION** has occurred since 2012.

	Titanium-Related Input (select from dropdown)	Inventory Levels (in weeks) (write-in)			Supply Disruptions Since 2012	
		A	B	C		
		Quantity of inventory (in weeks) maintained	How many weeks would the inventory listed in column A last if your utilization rate was 100%, given current facilities and equipment?	Given a 100% drawdown in inventory, how many weeks would it take to return to the level maintained in column A.	Has a disruption in supply occurred? (select from dropdown)	If yes, provide a brief description. (write-in)
1						
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4						
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Comments:

Section 3c: Inputs and Sourcing

A If your organization utilizes any of the materials listed in **part B** (below) for **titanium**-related operations, **non-titanium** operations, or **both,** complete this section. If not, proceed to section 4.

B For each material, indicate if it is utilized within **titanium**-related operations and/or n**on-titanium** operations, whether your organization **MAINTAINS** inventory of each, and if so, provide the **QUANTITY** with the associated **UNIT OF MEASURE.**

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

Material		Utilization in Titanium and/or Non-Titanium Operations	Inventory				Direct Source (select from dropdown)		Primary Original Source
			Maintain	Quantity	Quantity Unit of Measure	Quantity in kilograms	Type	Location (Country)	
Aluminum (AL)						0			
Ceramics & Carbon Fibers									
Carbon fibers	(specify here)					0			
Silicon carbide fibers	(specify here)					0			
Abrasives	(specify here)					0			
Refractories	(specify here)					0			
Other ceramics	(specify here)					0			
Cobalt (Co)						0			
Copper (Cu)						0			
Gallium (Ga)						0			
Lead (Pb)						0			
Lithium (Li)						0			
Magnesium (Mg)						0			
Molybdenum (Mo)						0			
Nickel (Ni)						0			
Niobium (Nb)						0			
Platinum Group & Precious Metals									
Palladium (Pd)						0			
Platinum (Pt)						0			
Gold (Au)						0			
Silver (Ag)						0			
Rare Earth Element (specify)									
						0			
						0			
						0			
						0			
						0			
Steel									
Alloys	(specify here)					0			
Carbon	(specify here)					0			
Stainless	(specify here)					0			
Tool	(specify here)					0			
Tantalum (Ta)						0			
Tin (Sn)						0			
Tungsten (W)						0			
Vanadium (V)						0			
Zinc (Zn)						0			
Zirconium (Zr)						0			
Other	(specify here)					0			
Other	(specify here)					0			
Other	(specify here)					0			

C Is your organization concerned about the availability of the inputs mentioned in part B (above) for your organization's operations?

If yes, which inputs? (select from dropdown)

Provide a brief description of your concern(s):

D Has your organization **experienced supply chain disruptions** regarding the inputs mentioned in part B (above) that have impacted operations?

If yes, which inputs? (select from dropdown)

Provide a brief description of your concern(s):

E What steps has your organization taken to minimize the impact of disruptions in the availability of these key inputs?

Comments:

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Section 4: Operations and Challenges

Describe your organization's utilization rates and constraints. "Utilization" is the fraction 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 no downtime with full employment.

A

1	What is your organization's current utilization rate? (select from dropdown)	
	What is your organization's current **titanium**-related utilization rate? (select from dropdown)	
	How many weeks would it take to raise your organization's **titanium**-related utilization rate to 100% in light of a surge in demand. (write-in)	

2 Identify the general constraints your organization would face in meeting a surge in demand for **titanium**-related products. Provide a brief description of each.

Type of Constraint	Yes/No	Description (write-in)
Capital: Equipment, Facilities, Infrastructure		
Workforce: Labor Availability, 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 **titanium**-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 and using each only one time. In column C, provide a brief explanation of at least 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			
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-US material availability			
15	Non-US 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 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 improvements; innovation, R&D, and design improvements; marketing improvements; qualitfy control improvements; staff adjustments.

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 of programs below, identify the key developments your organization anticipates will affect the U.S. **titanium** industry over the next five years. Utilize the **OTHER** options for programs and/or systems not listed. Provide a brief explanation of the impact.

	Program/System Name	Impact Yes/No	Explanation (write-in)
Military Aircraft			
1	F-35 Joint Strike Fighter		
2	Other fixed wing military aircraft (specify model)		
3	Other fixed wing military aircraft (specify model)		
4	Rotary wing military aircraft (specify model)		
5	Rotary wing military aircraft (specify model)		
Commercial Aircraft			
6	Boeing 787		
7	Other Boeing aircraft (specify model)		
8	Airbus A350		
9	Other Airbus aircraft (specify model)		
10	Other aircraft (specify manufacturer/model)		
11	Other aircraft (specify manufacturer/model)		
Aircraft Engines by Manufacturer (specify model)			
12	CFM International*		
13	Engine Alliance**		
14	General Electric Aviation		
15	Pratt & Whitney		
16	Honeywell		
17	Rolls Royce		
18	Other (specify)		
Non-Aerospace Programs/Systems (select general sector category from the dropdown and provide additional detail in comments).			
19			
20			
21			
22			

*CFM International is a joint venture between General Electric Aviation and Snecma. Models include CFM56 and LEAP.
**Engine Alliance is a joint venture between General Electric Aviation and Pratt and Whitney. Models include the GP7000 series.

Comments:

BUSINESS CONFIDENTIAL - Per Section 705(d) of the Defense Production Act

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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 (select from dropdown)		Provide a brief explanation (write-in)
		Titanium-Related	Non-Titanium Related	
A	U.S. Government defense demand			
	U.S. Government non-defense demand			
	Commercial demand			

B	In the event of a rapid decline in U.S. Government demand for **titanium**-related products/services, can your organization readily convert your U.S. Government business lines to commercial, non-government business lines? (select from dropdown)	
	Estimate the percentage of your U.S. Government **titanium**-related business lines that are readily compatible with commercial business lines. (select from dropdown)	
	Does your organization consider itself dependent upon current U.S. Government programs for its continued viability? Explain your response below.	

From the list below, select the potential impacts that a sudden decrease in direct and/or indirect U.S. Government demand would have on your organization:

C	Decreased capital expenditures		Movement of operations to non-U.S. locations		
	Decreased research & development expenditures		Pursuit of new product/service lines		
	Disproportionate reduction in sales revenue		Pursue non-U.S. customers		
	Elimination of all participation in U.S. Government contracts		Pursuit of other U.S. customers		
	Increased product/service costs (ex. an increase in per unit cost)		Reduced participation in U.S. Government contracts		
	Loss of organization viability or solvency		Reduction or elimination of particular product lines		
	Loss of personnel with key skills		Sale of key production equipment		
	Other	(specify here)	Other	(specify here)	

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:	

BUSINESS CONFIDENTIAL - Per Section 705(d) of the Defense Production Act

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? If no, proceed to section 7. If yes, complete part B below.

B From the list of U.S. Government agencies below, select those your organization has supported since 2010. Indicate whether **titanium**-related support, **non-titanium** related supportm, or both types of support were provided.

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. In the first column, write-in the **GOVERNMENT PROGRAM/SYSTEM NAME.** Provide as much detail as possible and spell out all acronyms. The **AGENCY NAME** column dropdown will be populated with the agencies you identified above (in part B), select the applicable agency.

In the **TITANIUM-RELATED PRODUCT** columns, select the specific **titanium**-related products your organization provides in support of the specific program/system. In the final column, select a **NON-TITANIUM PRODUCT** your organization provides in support of that program. The dropdown options for the **TITANIUM-RELATED PRODUCT** and **NON-TITANIUM PRODUCT** 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. Do not disclose any classified information.

	Government Program/System Name (write-in)	Agency Name (select from dropdown)	Titanium-Related Product 1 (select from dropdown)	Titanium-Related Product 2 (select from dropdown)	Titanium-Related Product 3 (select from dropdown)	Titanium-Related Product 4 (select from dropdown)	Titanium-Related Product 5 (select from dropdown)	Non-Titanium 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. In part A, provide your organization's **total sales** and a breakout of those sales in lines 1 and 2 (should sum to 100%). In part B, provide your organization's total **titanium-related sales** and a breakout of those sales in lines 1 and 2 (should sum to 100%). For 2014, estimate the percentage change in **total sales** and **titanium-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. In other words, 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 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										
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 Titanium-Related Sales										
1	Titanium-Related Non-Government Sales [as a % of line B]										
2	*Titanium-Related Government Sales [as a % of line B]										
	Lines 1 & 2 must sum to 100%	0%	0%	0%	0%	0%	0%	0%	0%		
a	*Titanium-Related U.S. Government Defense Sales [as a % of line B]										
b	*Titanium-Related U.S. Government, Non-Defense Sales [as a % of line B]										

Comments:	

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Section 8: Customers

A

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

	Direct Customer Name (write-in)	City	State	Country	Average Annual Sales 2010-2013 (in $1,000's) (write-in)	Titanium Product Provided 1 (select from dropdown)	Titanium Product Provided 2 (select from dropdown)	Titanium Product Provided 3 (select from dropdown)
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	Total Current Assets				
D	Total Assets				
E	Total Current Liabilities				
F	Total Liabilities				
G	Retained Earnings				
H	Total Owner's Equity*				

*Total Owner's Equity (line H in the Balance Sheet) should equal Total Assets less 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. In other words, 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:						
		Professional Occupations		2010	2011	2012	2013
A	1	Total Full-Time Equivalent (FTE) Employees					
	a	Administrative, Management, & Legal Staff [as a % of line 1]					
	b	Engineers, Scientists, and R&D Staff [as a % of line 1]					
	c	Facility & Maintenance Staff [as a % of line 1]					
	d	Information Technology Professionals [as a % of line 1]					
	e	Marketing & Sales [as a % of line 1]					
	f	Production Line Workers [as a % of line 1]					
	g	Testing Operators, Quality Control, & Support Technicians [as a % of line 1]					
	h	Other	(specify here)				
	i	Other	(specify here)				
		Lines a through i must sum to 100%		0%	0%	0%	0%
	2	Estimate the percentage of your total FTEs that work on **titanium**-related business lines [as a % of line 1]:					
B		Does your organization have difficulty hiring and/or retaining any of your workforce? If so, provide a brief explanation.					

C — Identify any unique **titanium**-related skills/competencies that are essential to your organization. Identify the general type of skill/competency from the drop-down menu then describe it in the right hand box.

	Type of Skill/Competency (select from dropdown)	Explanation (write-in)
1		
2		
3		
4		
5		

Comments:	

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Section 11: Research and Development

Estimate your company'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 **titanium**-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. In other words, 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 Reporting:	
R&D Reporting 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	Titanium-related R&D Expenditures [as a % of A]				
5	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 here)				
	Lines 1 through 7 must sum to 100%	0%	0%	0%	0%
C	Please provide a brief description of your organization's **titanium**-related R&D activities.				

Comments:	

BUSINESS CONFIDENTIAL - Per Section 705(d) of the Defense Production Act

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. In other words, 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, & Vehicles [as a % of A]					
	2	IT, Computers, Software [as a % of A]					
	3	Land, Buildings, & Leasehold Improvements [as a % of A]					
	4	Other	(specify here)				
	5	Other	(specify here)				
		Lines 1 through 5 must sum to 100%		0%	0%	0%	0%
	6	**Titanium**-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 **titanium**-related applications. Provide a brief description of each.

	Type of Equipment, Infrastructure, or Facility (select from dropdown)	Description (write-in)
1		
2		
3		
4		
5		

Comments:	

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Section 13: 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?	

BUSINESS CONFIDENTIAL - Per Section 705(d) of the Defense Production Act

U.S. Department of Commerce,
Bureau of Industry and Security (BIS)
DIB Strategic Materials Assessment: Titanium

Dropdown Menu Options

Section 1a: Organization Information

A. Select the Description that best identifies your organization:

- Commercial Company
- Non-Profit Organization
- U.S. Government Organization
- University

B. Provide the following information for the level at which your organization is responding to this survey (Corporate / Whole Organization or Business Unit / Division)

- Corporate/Whole Organization
- Business Unit/Division

C/D. Provide the following information for your company.

- State - List of States
- Country - List of Countries

E. Is your organization publicly traded or privately held?

- Publicly Traded
- Privately Held

F. Point of Contact regarding this survey:

- State - List of States

Section 1b: Organization Information

A. Commercial market segment participation

- Yes
- No

B. Government/Defense market segments

- Yes
- No

Section 1c: Organization Information

A. Business Lines

- Yes
- No

B. Small Business

- Yes
- No

Section 1d: Organization Information

- Provide the following information for your company.
    - Location
        - State - List of States
        - Country – List of Countries
    - Operations
        - Facility Primary Operation
            - Dropdown of business lines from 1c.A

Section 2a: Key Products

Please complete the table below to describe your organization's **titanium** capabilities.

- Type
    - Ingot
    - Sponge
    - Slab
    - Powder
    - Billet
    - Other semi-finished
    - Bar or Rod
    - Plate or Sheet
    - Pipe or Tube
    - Coil or Strip
    - Casting
    - Machined Part
    - Other finished product

- Manufacture/Distribute
    - Manufacture
    - Distribute

- Product Composition/Grade

    - Alloy/Unalloyed
        - Alloy
        - Unalloyed

    - Grade/composition
        - List in table at bottom of tab
- End Use

    - Primary sector end use
        - Defense
        - Government, Non-Defense

        - Commercial/Industrial, Non-Defense
        - Academic/University
        - Other/Not Sure

    - Primary end use application
        - See list on tab 1b part A

- Production/Disposition

    - Percentage sold to external customers
        - Percentages

- Single/Sole Source
    - Sole U.S. Source
    - Sole Global Source
    - Not Sole Source
    - Not Sure

Section 2b: Additional Products

Please complete the table below for the **other products** offered by your organization.

- Product Composition

    - Type
        - Ingot
        - Sponge
        - Slab
        - Powder
        - Billet
        - Other semi-finished
        - Bar or Rod
        - Plate or Sheet
        - Pipe or Tube
        - Coil or Strip
        - Casting
        - Machined Part
        - Other finished product

    - Primary Material
        - List of Metals

- Manufacture/Distribute
    - Manufacture
    - Distribute

- End Use
    - Primary sector end use
        - Defense
        - Government, Non-Defense
        - Commercial/Industrial, Non-Defense
        - Academic/University
        - Other/Not Sure
    - Primary end use application
        - See list on tab 1b part A

Section 3a: Suppliers

Provide information on titanium-related suppliers

- Supplier Information
    - Type of Supplier
        - Material Provider
        - Service Provider
- Input information
    - Type
        - Ingot
        - Sponge
        - Slab
        - Powder
        - Billet
        - Other semi-finished
        - Bar or Rod
        - Plate or Sheet
        - Pipe or Tube
        - Coil or Strip
        - Casting
        - Machined Part
        - Other finished product
- Supplier Information
    - Supplier State - List of States
    - Supplier Country - List of Countries
    - Single/Sole Source
        - Single source supplier
        - Sole source supplier
        - Not single or sole supplier
        - Not sure
- Product use

- Titanium – dropdowns from tab 2a: Type, Alloy, Composition, Sector End Use
- Additional – dropdowns from tab 2b: Type, Material, Sector End Use

Section 3b: Inventory of Titanium-Related Inputs

Provide titanium-related inventory information

- Titanium-related input – dropdowns from tab 3a: Type, Description
- Supply distribution since 2012
  - Has disruption occurred?
    - Yes
    - No
    - Not Applicable

Section 3c: Inputs and Sourcing

A. Does your organization utilize any of the following critical materials for your titanium operations, your overall operations, or both?
   - No
   - Non-Titanium
   - Titanium
   - Both

B. Critical material details
   - Operation Utilization
     - Titanium
     - Non-Titanium
     - Both
     - No
   - Inventory – Maintain
     - Yes
     - No
   - Inventory – Quantity Unit of Measure
     - Ounces
     - Pounds
     - Tons
     - Grams
     - Kilograms
     - Metric Tons
   - Direct Source – Type

    - Distributor
    - Mine
    - Original Manufacturer
    - Recycler
    - Other

- Direct Source – Type
    - Country – List of Countries

C. Do you **maintain concern** regarding the availability of any key inputs for your organization's operations?
    - Yes/No
    - Dropdowns from list in part B.

D. Have you **experienced supply chain disruption** impacting your organization's operations?
    - Yes/No
    - Dropdowns from list in part B.

Section 4: Operations and Challenges

A. Utilization
    - Part 1: Percentages
    - Part 2: Yes/No

B. Challenges utilizing external suppliers
    - A: Yes/No

Section 5: Competitiveness and Outlook

A. Improve Competitiveness – Since 2010
    - Business restructuring
    - Capital investment
    - Customer service improvements
    - Innovation, R&D, and design improvements
    - Marketing improvements
    - Quality control improvements
    - Staff adjustments

B. Improve Competitiveness – Next 5 years
    - Business restructuring
    - Capital investment
    - Customer service improvements
    - Innovation, R&D, and design improvements
    - Marketing improvements

- Quality control improvements
- Staff adjustments

C. Program/System Impacts
    - Yes
    - No

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

A. Dependence of demand – Titanium/Non-Titanium Related
    - 1 Not dependent
    - 2 Minimally dependent
    - 3 Somewhat dependent
    - 4 Moderately dependent
    - 5 Highly dependent
    - Not applicable

B. Dependence on U.S. Government
    - 1 – Yes, No, Not Applicable
    - 2 - Percentages
    - 3 – Yes, No, Not Applicable

C. Select potential impacts of a decrease in U.S. Government demand
    - Yes
    - No

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

To the best of your knowledge, identify any U.S. Government agencies your organization **directly and/or indirectly** supports from the list below. *(Multiple Drop Downs)*

A. Supported a U.S. Government agency?
    - Yes
    - No

B. Specific agency support
    - Titanium-Related
    - Non-Titanium Related
    - Both
    - Unknown/No Visibility

C. Product specific support
    - Agency Name: Agencies from part B.
    - Products – dropdowns from tab 2a: Type, Alloy, Composition, Sector End Use

Section 7: Sales

- Source of Sales Data/Reporting Schedule
    - Source of Sales Data
        - Corporate/Whole Organization
        - Business Unit/Division
    - Reporting Schedule
        - Calendar year
        - Fiscal year

Section 8: Customers

- Customer location
    - State – list of states
    - Country – list of countries
- Products provided – lists populated from tabs 2a and 2b

Section 9: Financials

- Source of Financial Reporting/Financial Reporting Schedule
    - Source of Financial Reporting
        - Corporate/Whole Organization
        - Business Unit/Division
    - Financial Reporting Schedule
        - Calendar year
        - Fiscal year

Section 10: Employment

- Source of Employment Reporting/Employment Reporting Schedule
    - Source of Employment Reporting
        - Corporate/Whole Organization
        - Business Unit/Division
    - Employment Reporting Schedule
        - Calendar year
        - Fiscal year

B. Does your organization have difficulty hiring/retaining workers?

- Hiring
- Retaining
- Both
- No

C. Identify any unique titanium 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. *(Multiple Drop Downs)*

- Analytical skill/competency
- Design skill/competency
- Engineering skill/competency
- Management or development skill/competency
- Production or manufacturing skill/competency
- Quality control or testing skill/competency
- Scientific skill/competency
- Other service-related skill/competency
- Other type of skill/competency

Section 11: Research and Development

- Source of R&D Reporting/R&D Reporting Schedule
  - Source of R&D Reporting
    - Corporate/Whole Organization
    - Business Unit/Division
  - R&D Reporting Schedule
    - Calendar year
    - Fiscal year

Section 12: Capital Expenditures

- Source of Capital Expenditure Data/Capital Expenditure Reporting Schedule
  - Source of Capital Expenditure Data
    - Corporate/Whole Organization
    - Business Unit/Division
  - Capital Expenditure Reporting Schedule
    - Calendar year
    - Fiscal year

A. Total Capital Expenditures
   - Percentages

B. Organization's cap ex impacted due to reductions in USG defense spending?
   - Past
   - Future
   - Both
   - No

C. Identify any unique or critical equipment, infrastructure, and/or facilities owned and/or operated by your organization (e.g. space environmental simulation facilities,

wind tunnels, rocket test equipment, etc.) for titanium-related applications. Provide a brief description of each. *(Multiple Drop Downs)*

- Equipment
- Infrastructure
- Facility
- Other Type (Specify in comment box)

[End]