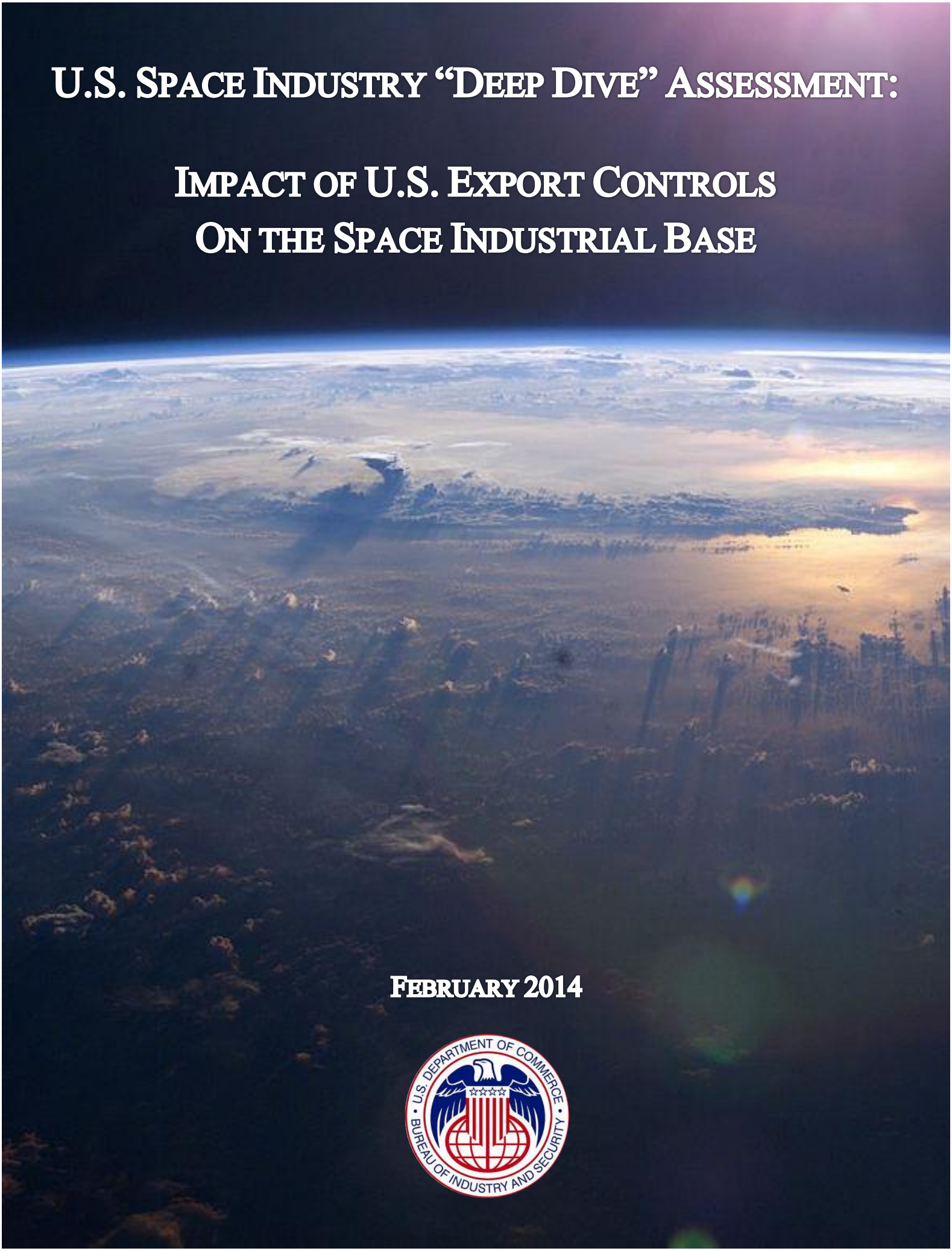
U.S. Space Industry "Deep Dive" Assessment:

Impact of U.S. Export Controls On the Space Industrial Base



February 2014

U.S. SPACE INDUSTRY "DEEP DIVE" ASSESSMENT:

IMPACT OF U.S. EXPORT CONTROLS ON THE SPACE INDUSTRIAL BASE

February 2014

PREPARED BY
U.S. DEPARTMENT OF COMMERCE
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EXECUTIVE SUMMARY

The United States Air Force, National Aeronautics and Space Administration (NASA), and the National Reconnaissance Office (NRO) requested that the U.S. Department of Commerce, Bureau of Industry and Security (BIS) lead a collaborative effort to study the U.S. space industrial base. The effort, called the U.S. Space Industry "Deep Dive" Assessment, sought to map the space industrial base supply chain in unprecedented detail. The project would provide all stakeholders with a single, consistent source of information, highlight interdependencies between agencies and programs, and reduce the survey reporting burden on industry.

BIS utilized its authority delegated under the Defense Production Act of 1950, as amended (50 U.S.C. app. Sec. 2155) to design, distribute, and collect surveys of commercial companies, universities, non-profit organizations, and U.S. Government agencies with equities in the space industrial base. In all, 3,780 organizations provided a completed survey response, which detailed the products and services they provided, their critical suppliers, their financial health and investment expenditures, and many other topics.

BIS developed the following reports based on survey responses, independent research, and field interviews:

- Overview Report of the U.S. Space Industrial Base
- Financial Health of the U.S. Space Industrial Base
- Employment in the U.S. Space Industrial Base
- Small Businesses and the U.S. Space Industrial Base

- Challenges Facing the U.S. Space Industrial Base

This report details the impact of U.S. export controls, which includes the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR), on the U.S. space industrial base. Respondents detailed the frequency of their use of the U.S. export control system for space-related products and services, lost sales opportunities due to space-related export controls, and adverse impacts of space-related export controls on their organizations' competitiveness. Respondents using the U.S. export control system for space-related products and services are very diverse, providing a wide-range of products and services, supporting many U.S. Government programs, and exporting to over 75 countries.

BIS developed the following report findings:

- Overall, 995 (26 percent) survey respondents use the U.S. export control system to export their space-related products and services.

- Respondents indicated numerous areas where the U.S. export control system has adversely impacted their organization's health and competitiveness.

- Many respondents do not understand the U.S. export control regulations on space-related products and services.

- The Export Control Reform (ECR) Initiative, once fully implemented, may have a positive impact on the competitiveness of the U.S. space industrial base.

- ECR will alleviate some specific concerns cited by survey respondents with regard to the export of space-related products and services.

- Continued outreach efforts are critical in order to update and inform organizations about the U.S. export control system and ECR.

For more detail on the findings of this report, refer to the Report Findings chapter.

I. BACKGROUND ON THE U.S. SPACE INDUSTRY "DEEP DIVE" ASSESSMENT

The United States has continually recognized that "a resilient, flexible, and healthy space industrial base must underpin all of our space activities."[1] In recent years, the U.S. has grown increasingly reliant upon space-based technologies for its economic and national security. From communications to environmental monitoring, space-related technologies are vital to our everyday lives. As this reliance has grown, so has the interdependency between the civil, commercial, and national security space sectors. Programmatic decisions made by the National Aeronautics and Space Administration (NASA), for example, can have a significant impact on the U.S. Department of Defense's space interests, and vice versa.

In 2011, the U.S. Department of Commerce, Bureau of Industry and Security (BIS) completed an assessment of the U.S. space industry based on a review of 27 existing space-related studies covering the period 2006 to 2010.[2] Through this effort, BIS found that there have been many studies of different facets of the space industrial base in recent years, some very narrow in scope and others relying on anecdotal data. Individual government agencies, industry groups, and research organizations have all attempted to isolate key issues affecting the health and competitiveness of the space industrial base. In many cases, these efforts have been conducted independently, without collaboration or coordination between stakeholders. The end result has often been duplication of effort and an increased reporting burden on industry, while providing minimal benefit to U.S. Government (USG) strategic planners.

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[1] *National Security Space Strategy (Unclassified Summary)*, January 2011, p. 4, http://www.defense.gov/home/features/2011/0111_nsss/docs/NationalSecuritySpaceStrategyUnclassifiedSummary_Jan2011.pdf.

[2] Presidential Policy Directive/PPD-4, National Space Policy.

These studies did, however, depict the many challenges that face the U.S. space industry. Some studies focused on the uncertain budgetary environment and the potential for adverse industrial base impacts resulting from modifications (or cancellations) to space programs. Other studies highlighted increasing international competition that has eroded the U.S. competitive advantage in the space sector. Several studies also mentioned the difficulties facing lower tier suppliers as they attempt to navigate a procurement environment with long lead times and inconsistent production rates. Finally, these studies touched on common issues, such as finding skilled workers, dealing with complex export control regulations, handling government purchasing requirements, and many other challenges.

Based on previous studies of the space industrial base and experience with other sectors, BIS proposed that there be a single, collaborative effort to study the U.S. space industrial base. Such a study would provide all stakeholders with a single, consistent source of information, highlight interdependencies between agencies and programs, and reduce the survey reporting burden on industry.

In 2011, the U.S. Air Force (USAF), NASA, and the National Reconnaissance Office (NRO), partnered with BIS to initiate the U.S. Space Industry "Deep Dive" assessment. The principle goal of the assessment was to gain an understanding of the intricate supply chain network supporting the development, production, and sustainment of products and services across the defense, intelligence, civil, and commercial space sectors.

BIS and the partner agencies set the following objectives for the assessment:

a) Map the space industrial base supply chain in unprecedented detail;
b) Identify interdependencies between respondents, suppliers, customers, and USG agencies;
c) Benchmark trends in business practices, competitiveness issues, financial health, and other areas, across many tiers of the industrial base; and
d) Share data with USG stakeholders to better inform strategic planning, targeted outreach, and collaborative problem solving.

The assessment was also designed to be repeatable. BIS will be able to expand this approach to other sectors of the U.S. industrial base by incorporating lessons learned from this study.

This report focuses on the impact of U.S. export controls, including the International Traffic in Arms Regulations (ITAR) and the Export Administration Regulations (EAR), on the U.S. space industrial base. In spring 2014, information regarding other aspects of this "Deep Dive" assessment will be available. These areas will include:

- Overview Report of the U.S. Space Industrial Base
- Financial Health of the U.S. Space Industrial Base
- Employment in the U.S. Space Industrial Base
- Small Businesses and the U.S. Space Industrial Base
- Challenges Facing the U.S. Space Industrial Base

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 (50 U.S.C. App. Sec. 2155), and Executive Order 13603. These authorities enable BIS to conduct mandatory surveys, study defense-related industries and technologies, and monitor economic and trade issues affecting the U.S. industrial base. For example, BIS recently completed the following assessments: NASA's Human Space Flight Industrial Base in the Post-Space Shuttle/Constellation Environment, National Security Assessment of the Cartridge and Propellant Actuated Device (CAD/PAD) Industry, and Consumers of Electro-Optical Satellite Imagery.[3]

Upon initiation of the assessment, BIS took a number of steps over several months to better understand the U.S. space industrial base. With the assistance of our USG agency partners, BIS collected information on relevant space programs and their known suppliers. BIS also held discussions with other government agencies with an interest in space, including the U.S. Army, U.S. Navy, U.S. Air Force's Space and Missile Systems Center, National Oceanic and Atmospheric Administration (NOAA), and others. BIS conducted outreach with space-related industry associations, such as the Aerospace Industries Association, Satellite Industry Association, and the American Institute of Aeronautics and Astronautics.

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

In addition, BIS conducted site visits with companies and universities across the country involved in different aspects of the space industrial base, from consortia of small machine shops, such as the Southern California Manufacturing Group, to dedicated space-related companies. These discussions highlighted many of the diverse challenges in maintaining a healthy and competitive space industrial base.

With cooperation and feedback from our partner agencies, BIS developed a survey template that covered respondents' current space-related business operations. The core of the survey is a customized Product and Service List, which served to connect various sections of the survey together in a uniform manner. Based on experience, BIS noted that many respondents were unable to identify specific USG programs they participate in, particularly at the lower tiers of the supply chain. However, all organizations do have an understanding of what products and services they provide. The Product and Service List was created to focus on what respondents were most accustomed to—what they buy and sell in the marketplace.

The Product and Service List consists of 16 general segments comprised of 360 individual products and services. The list was used to identify and categorize relevant respondents; organizations that did not provide a product or service on the list were exempted from the survey requirement. The 16 Product and Service List segments are:

A. Spacecraft & Launch Vehicles
B. Propulsion Systems & Fuels
C. Navigation & Control
D. Communications Systems

E. Space Survivability, Environmental Control/Monitoring, and Life Support

F. Payload Instruments & Measurement Tools

G. Ground Systems

H. Non-Earth Based Surface Systems

I. Power Sources & Energy Storage

J. Electronic Equipment

K. Computer Hardware & Robotics

L. Software

M. Materials, Structures, and Mechanical Systems

N. Manufacturing Tools & Specialty Equipment

O. Services

P. Research & Development

Respondents identified whether they manufactured, distributed, or provided any of the products and services on the list. They then identified their critical suppliers and customers for the selected products and services.

Additionally, if known, respondents identified their participation in any of over 205 USG space-related programs from 2009 to 2012. This program list, assembled with the assistance of our partner agencies, included programs from the U.S. Air Force, U.S. Army, U.S. Navy, Missile Defense Agency, NASA, and NOAA. Respondents were provided fields to identify any additional programs they participated in that were not on the list.[4] Respondents identified the

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

level of participation in each program (prime contractor, sub-contractor, or other type of support) and selected the specific products and services provided based on the Product and Service List.

The use of a uniform Product and Service List and network analysis software allowed BIS and partner agencies to link together respondents' products and services, critical suppliers, customers, and USG space programs in order to map the space industrial base. Without such a list, it would be exceedingly difficult to meet the objectives of this assessment and the individual needs of members of the USG space community.

The survey also included a series of questions on how frequently respondents used the U.S. export control system for space-related products and services. In addition, respondents reported the lost sales opportunities resulting from space-related export controls and the adverse impacts of space-related export controls on their organizations' competitiveness.

BIS distributed the survey in June 2012 to respondents identified by our partner agencies, previous BIS survey efforts, and independent research. The data collection period was divided into three, three-month long waypoints. At the end of each waypoint, the data was collected, compiled, and analyzed for preliminary results. The data was also disseminated to our partner agencies in order to facilitate their analysis and strategic planning. Aggregated results were made publically available and presented to the space industry.

In April 2013, the data collection period ended. In total, BIS received 3,780 completed survey responses from commercial companies, universities, non-profit organizations, and U.S. Government agencies (see Figure I-1).

Figure I-1: Respondents by Type of Organization	
Commercial Companies	3,585
Universities	125
Non-Profit Organizations	49
U.S. Government Agencies	21
Total	**3,780**

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

II. THE U.S. EXPORT CONTROL SYSTEM AND SPACE-RELATED PRODUCTS/SERVICES

The primary mission of BIS is to advance U.S. national security, foreign policy, and economic objectives by ensuring an effective export control and treaty compliance system and promoting continued U.S. strategic technology leadership. A central part of that mission is administering the Export Administration Regulations (EAR), which control items on the Commerce Control List (CCL). The CCL sets forth regulations governing the export of dual-use technologies—items that have both commercial and military applications.[5]

The U.S. State Department, Directorate of Defense and Trade Controls, administers the International Traffic in Arms Regulations (ITAR), an export control regime for munitions items identified on the United States Munitions List (USML). The EAR and ITAR are the foundation of the U.S. export control system. Through the licensing process, the Commerce, State, Defense, and Energy Departments and other stakeholders review transactions of controlled commodities and technologies and attempt to balance national security and economic objectives.

As will be discussed in detail in Chapter V, the control of space-related commodities has shifted between the EAR and ITAR over the past 20 years. Since 1999, space-related commodities have been controlled under the USML's Category XV: Spacecraft and Associated Equipment.[6] Based on outreach with industry and several previous studies, many organizations find that the control of space-related commodities under the ITAR has eroded U.S. competitiveness in the international space market.

[5] Export Administration Regulations, §772. According to this section, while dual-use is "used informally to describe items that are subject to the EAR, purely commercial items are also subject to the EAR."
[6] 22 C.F.R. §121.1

In 2007, BIS, in coordination with the U.S. Air Force Research Laboratory, completed a study of the impact of export controls on the U.S. space industry. Specifically, the report examined the consequences of ITAR control of space-related products for U.S. companies competing in the global marketplace. The study found the U.S. share of global satellite manufacturing revenue decreased after the ITAR changes were implemented in 1999, from 63 percent in 1996-1998 to 41 percent in 2002-2005. The report estimated that lost foreign sales attributed to the ITAR process in 2003-2006 averaged $588 million annually. Additionally, respondents indicated that foreign competitors were portraying ITAR controls as an impediment to U.S. company effectiveness with "ITAR-free" advertising. That report concluded that "ITAR has impacted U.S. competitiveness by encouraging other nations, in many cases our allies, to develop indigenous space capabilities and industries that now market globally."[7]

To update industry views from the 2007 study, the Space "Deep Dive" survey included multiple questions regarding the impacts of U.S. space-related export control regulations, relating both to ITAR and the EAR. This report will provide a profile of the 995 respondents that have been using the export control system, including the products/services they provide, U.S. Government agencies and programs they support, and their non-U.S. based customers. A discussion of the impacts and lost sales opportunities due to space-related export controls is included in Chapter IV.

Additionally, this report reviews the President's Export Control Reform (ECR) Initiative in Chapter V, which includes the transfer of many space-related commodities and technologies

[7] U.S. Department of Commerce, Bureau of Industry and Security, *Defense Industrial Base Assessment: U.S. Space Industry*, August 2007, pp. xi.

from the ITAR to the EAR.[8] Chapter V outlines the proposed changes and discusses the potential positive impacts on U.S. companies.

[8] For more information on ECR, see http://export.gov/ecr/index.asp.

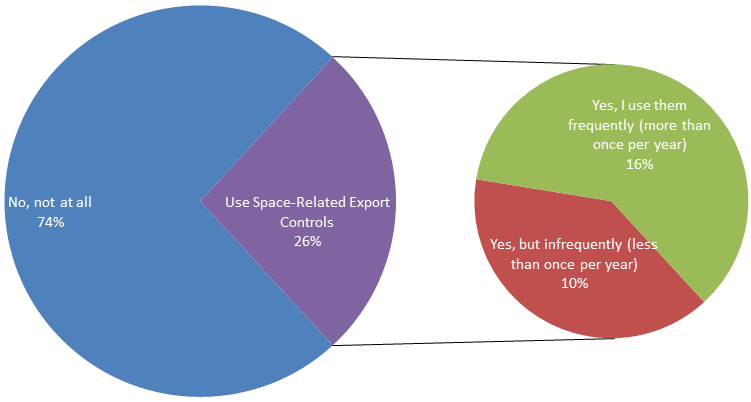
III. USE OF THE U.S. EXPORT CONTROL SYSTEM

Survey respondents were asked a series of questions related to their experience with the U.S. export control system for space-related products and services. Respondents identified the frequency with which they used the export control system for space-related products and services (ITAR and EAR), lost sales opportunities due to space-related export controls, and the adverse impacts of space-related export controls on their organization. Through this survey, BIS was able to create the largest existing dataset on the impact of space-related export controls on U.S. companies, universities, and other organizations.

Of the 3,780 total survey respondents, 995 (26 percent) used the export control system (ITAR and/or EAR) to export space-related products/services from 2009 to 2012 (see Figure III-1). Of these, 519 respondents were small businesses, as classified by Small Business Administration regulations.

Respondents were asked to identify the frequency with which they used the export control system for space-related products and services. Of these 995 respondents, 61 percent used the export control system more than once per year, while 39 percent used space-related export controls less than once per year.

Figure III-1: Use of U.S. Export Control System (ITAR/EAR) for Space-Related Products/Services



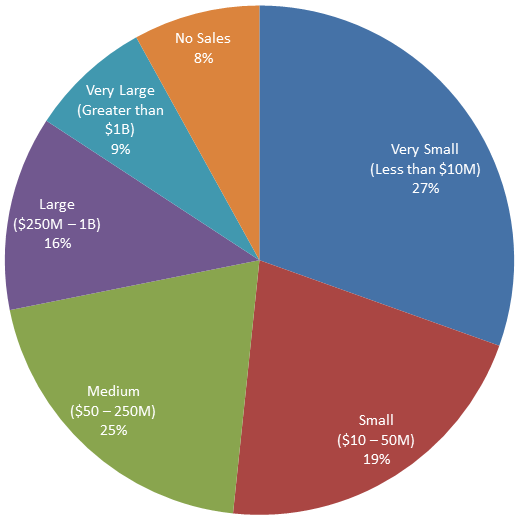
Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Based on average annual net sales, respondents of all sizes use the export control system for space-related products and services (see Figure III-2). Twenty-seven percent of respondents that use export controls are very small organizations, with average annual net sales from 2009 to 2012 of less than $10 million. However, the larger the organization, the more likely they are to use the U.S. export control system. Forty-seven percent of very large respondents use the export control system for space-related products and services compared to 18 percent of very small respondents. Based on conversations with many companies, smaller organizations often rely upon their larger customers to handle export licensing for them. These companies may have limited insight into the direct impact of export control regulations on their organization.

Figure III-2: Use of Export Control System by Organization Size	
Respondent Size	# of Organizations
Very Small (Less than $10 Million)	303
Small ($10 – $50 Million)	211
Medium ($50 - $250 Million)	201
Large ($250 Million - $1 Billion)	123
Very Large (Greater than $1 Billion)	77
No Sales	80

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Figure III-3: Size of Respondents Using the U.S. Export Control System (ITAR/EAR) for Space-Related Products/Services*



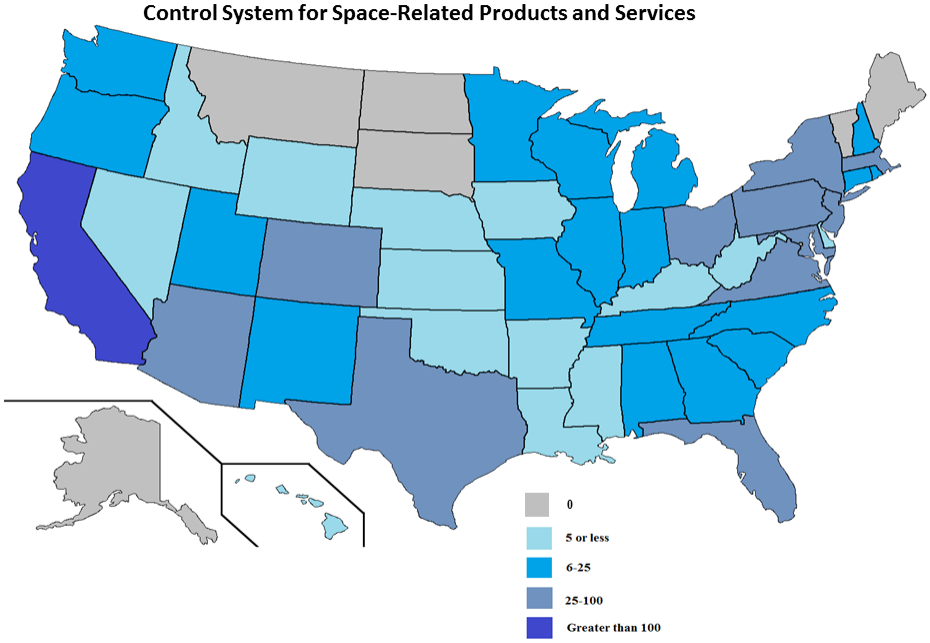
* Based on 995 respondents that selected "Yes" to utilizing U.S. export controls for space-related products/services.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Survey respondents were asked to identify information about their geographic location. Using this data, it was possible to identify the concentration of respondents using space-related export controls by state (see Figure III-4). This geographic information provided BIS and its partner

agencies the ability to better target outreach efforts related to export controls and the current Export Control Reform (ECR) Initiative (see Chapter V).

Figure III-4: State Locations of Respondents Using the U.S. Export Control System for Space-Related Products and Services

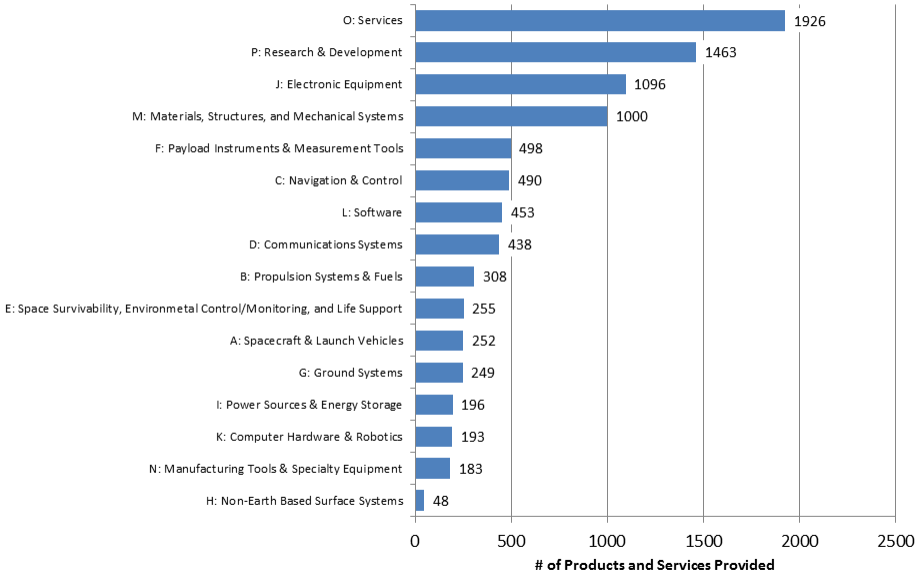


The Product and Service List included in the survey provided a consistent way to identify what each respondent is supplying. However, the survey template did not specifically ask respondents to identify which of their products and services are subject to space-related export controls. An evaluation of the products and services provided by respondents may indicate what these organizations export under U.S. space-related export controls.

Respondents that use the export control system are providing products and services in all 16 Product and Service List segments in the survey. In particular, these respondents are providing a wide range of services and research and development (R&D) (see Figure III-5). Beyond these

product/service segments, respondents are predominantly providing products in the electronic equipment and materials, structures, and mechanical systems segments.

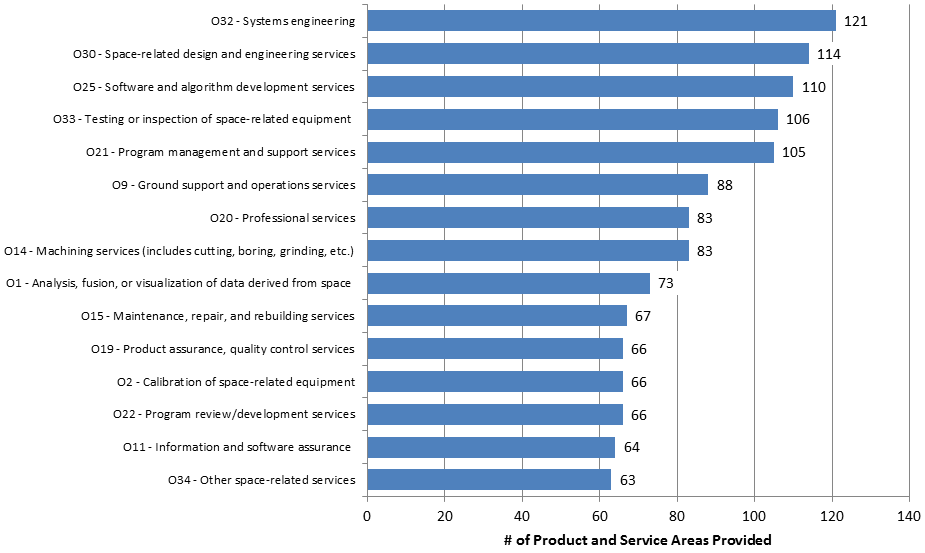
Figure III-5: Products/Services Provided by Respondents Using the U.S. Export Control System – by Segment



Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Examining the top product/service segments in detail, Figure III-6 outlines the top 15 product/service areas in the service segment provided by respondents that use the export control system. The most commonly cited product/service area is systems engineering, followed by space-related design and engineering services.

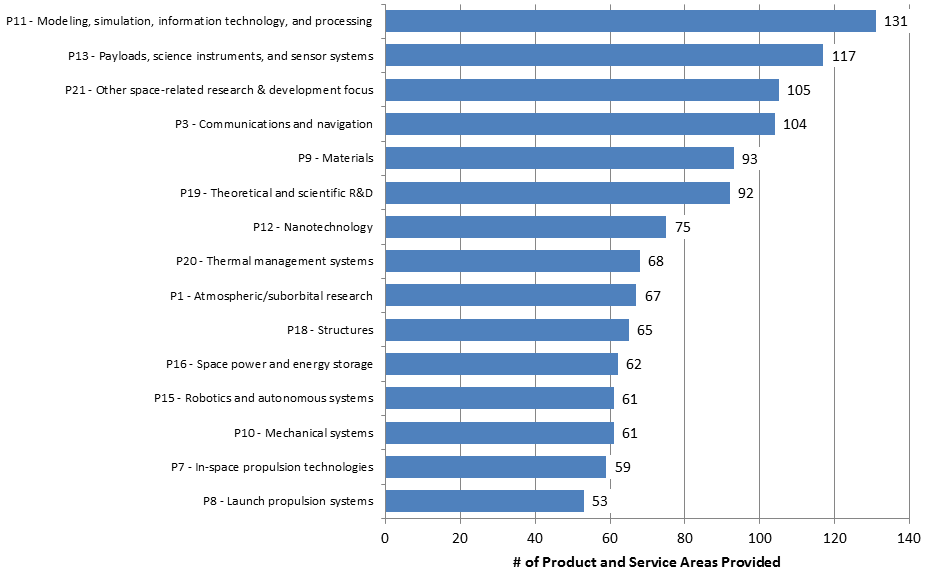
Figure III-6: Top 15 Service Areas Provided by Respondents Using U.S. Space-Related Export Controls



Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Figure III-7 shows the top 15 R&D product/service areas provided by respondents that use the export control system.

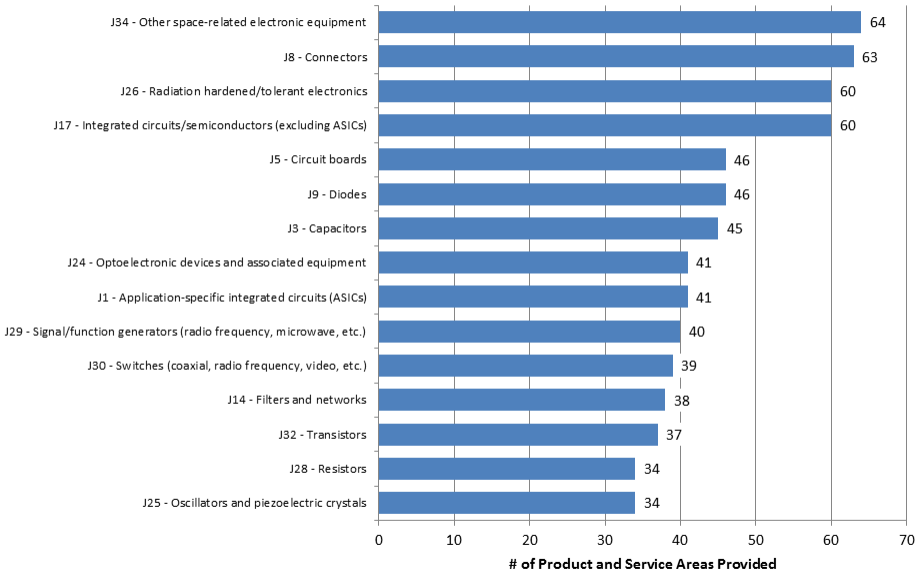
Figure III-7: Top 15 Research & Development Areas Provided by Respondents Using U.S. Space-Related Export Controls



Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Figure III-8 shows the top product/service areas provided in the electronic equipment segment.

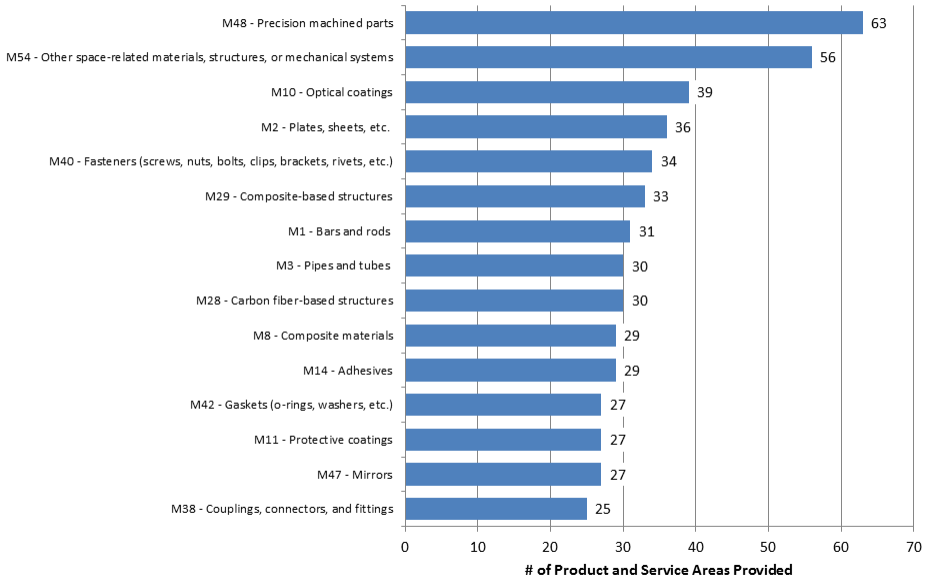
Figure III-8: Top 15 Electronic Equipment Areas Provided by Respondents Using U.S. Space-Related Export Controls



Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Figure III-9 shows the top product/service areas in the materials, structures, and mechanical systems segment.

Figure III-9: Top 15 Materials, Structures, and Mechanical Systems Areas Provided by Respondents Using U.S. Space-Related Export Controls



Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

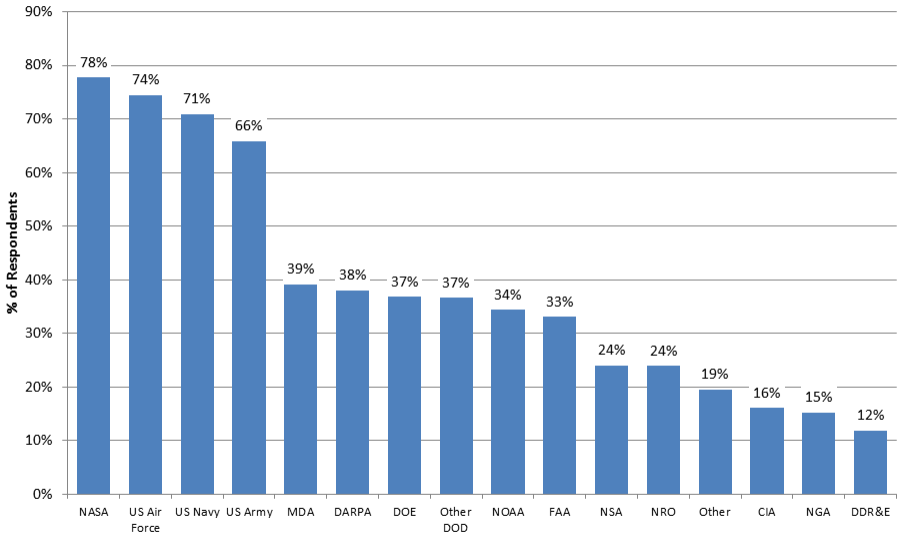
SUPPORT FOR U.S. GOVERNMENT AGENCIES

The 995 respondents that currently use the export control system support a wide range of USG agencies with their products and services. Respondents were asked to identify whether they provided space-related, non-space related, or unknown types of support to USG agencies.[9] Overall, 94 percent of respondents that use the export control system support at least one USG

[9] Respondents were also able to select "Both" if they provided space- and non-space related support.

organization in some capacity. The top organizations supported are NASA, USAF, U.S. Navy, and U.S. Army (see Figure III-10).

Figure III-10: Percent of Respondents Using U.S. Export Controls That Support USG Agencies*



* Based on any type of support provided by 995 respondents that utilize U.S. export controls.

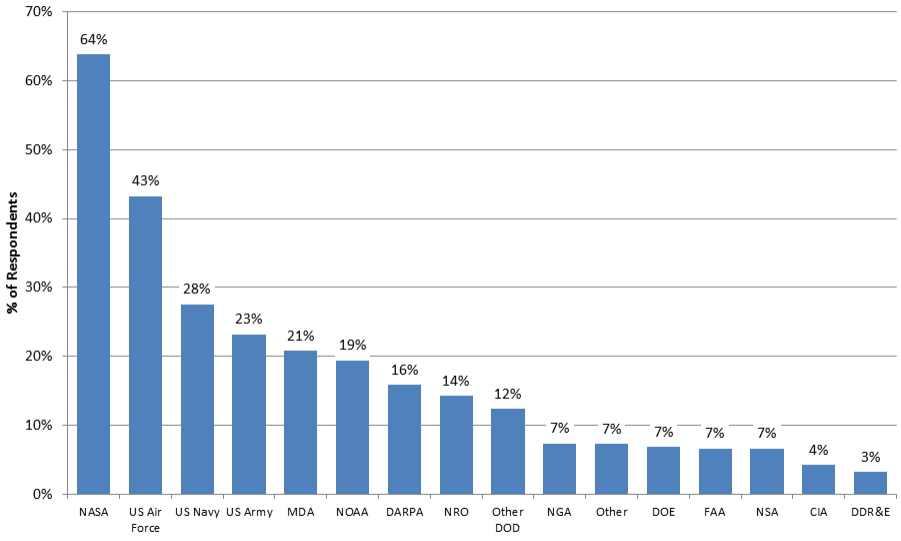
Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

These USG agencies rely heavily on a common industrial base to support their programs. In fact, 795 of 995 respondents provide some type of support to three or more USG agencies, nearly 80 percent of those using export controls. Furthermore, 181 respondents provide 10 or more USG agencies with some type of support, space-related or otherwise. According to survey results, only 74 of 995 respondents using export controls support a single USG agency.

Focusing on space-related support, 73 percent of respondents that use the export control system provide space-related support to at least one USG agency. By a notable margin, NASA and the USAF are the top USG agencies supported (see Figure III-11). Space-related support is more

likely to be provided to a single USG agency than non-space or unknown types of support. Even so, only 192 respondents provide space-related support to a single USG agency while 414 provide space-related support to three or more USG agencies.

Figure III-11: Percent of Respondents Using U.S. Export Controls Providing Space-Related Support to USG Agencies*



* Based on any type of support provided by 995 respondents that utilize U.S. export controls.

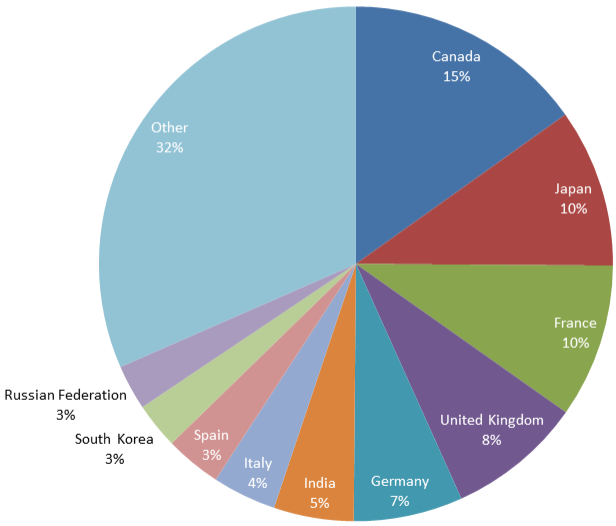
Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

In general, exports can allow companies to expand markets and increase sales. Given the uncertain USG budgetary environment, organizations may seek additional opportunities to sell their products and services outside the U.S. to remain profitable and competitive. Under the ECR Initiative, which will be discussed in Chapter V, there may be more opportunities for these respondents to sell space-related products and services.

SPACE-RELATED NON-U.S. CUSTOMERS

Respondents were asked to identify their non-U.S. space-related customers. For each customer, respondents indicated the particular product/service area they supplied. The definition of "space-related" products and services was left open to the respondents' interpretations. Figure III-12 shows the locations of non-U.S. based space-related customers for respondents that used the export control system. The top countries are Canada, Japan, France, United Kingdom, and Germany. As will be discussed in the chapter on ECR, export license requirements may be relaxed to many of these top destinations.

Figure III-12: Location of Non-U.S. Based Space-Related Customers - Respondents Using Space-Related Export Controls*



* As a percentage of the total number products and services provided,

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

IV. IMPACT OF U.S. EXPORT CONTROLS ON THE SPACE INDUSTRIAL BASE

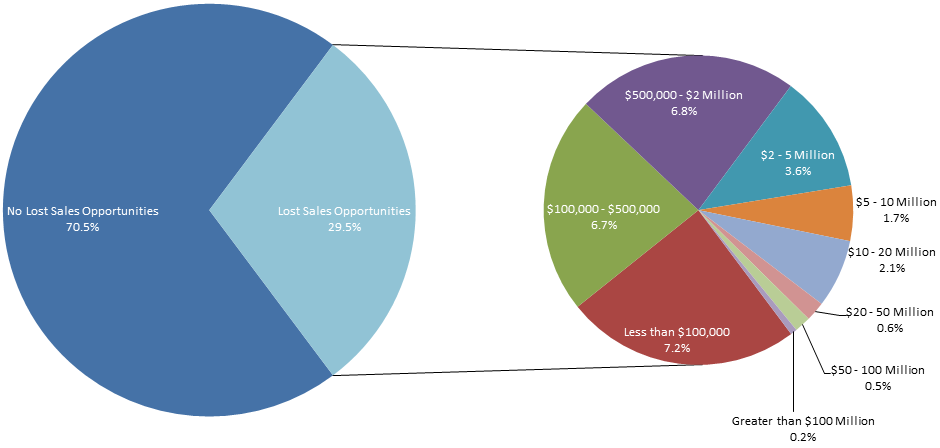
Survey respondents identified the impacts of U.S. export control regulations on their organization in a number of ways. First, respondents indicated whether they lost export sales opportunities for space-related products and services to non-U.S. competitors due to U.S. export control regulations (ITAR and EAR). If so, they were asked to estimate the dollar value range of their total lost sales opportunities from 2009 to 2012. Next, respondents were prompted to select any relevant adverse impacts of U.S. space-related export controls from a list of eight provided in the survey template. For each impact selected, organizations provided a detailed explanation further describing the issue.

LOST SALES OPPORTUNITIES

Respondents identified lost sales opportunities from 2009 to 2012 from a list of dollar value ranges. Thirty-five percent of the 995 respondents that used the export control system for space-related products and services identified lost sales opportunities during this period. Overall, respondents estimated lost sales opportunities between approximately $988 million and $2 billion from 2009 to 2012.[10] The majority (226) of these respondents reported lost sales opportunities of less than $2 million (see Figure IV-1). Thirty-four respondents stated that their lost sales totaled greater than $10 million, with two organizations estimating their lost opportunities were greater than $100 million.

[10] Respondents provided lost sales opportunities in dollar ranges. To establish the low and high approximations, BIS added the ranges together for all respondents.

Figure IV-1: Lost Export Sales Opportunities due to U.S. Space-Related Export Controls (2009-2012)*



* Based on 995 respondents that selected "Yes" to using U.S. export controls for space-related products/services.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

TYPES OF IMPACTS

Survey respondents indicated whether any of the eight listed impacts of U.S. export control regulations applied to their organization. The list of issues focused on different aspects of ITAR and EAR regulations that would have an adverse impact on organizational health and competitiveness. The list was assembled based on basic research, feedback from industry, previous industrial base assessments, and BIS experience.

The following table shows the number of respondents that identified each of the impacts. (see Figure IV-2). Overall, 514 respondents identified at least one adverse impact of U.S. export control regulations. Of these respondents, 118 listed an adverse impact but do not currently use the export control system for space-related products and services. For some of these 118

respondents, negative experiences with space-related export controls in the past may have prompted them to avoid their use.

Figure IV-2: Impacts of U.S. Export Regulations on Space-Related Products and Services

Impact	% of Respondents*	# of Respondents
Avoided the export of space-related products or services subject to ITAR-related controls	25.7%	336
Incentivized non-U.S. organizations to "design-out" or avoid buying U.S. origin space-related products or services	22.5%	257
Incentivized non-U.S. organizations to offer "ITAR-free" space-related products or services	19.7%	223
Avoided the export of space-related products or services subject to EAR-related controls	15.2%	201
Contributed to the creation of non-U.S. companies/business lines in direct competition with the organization's space-related products or services	12.9%	148
Altered space-related R&D expenditures	10.1%	116
Caused the abandonment or alteration of space-related business lines	8.3%	100
Caused relocation of space-related production/R&D facilities outside the United States due to regulatory burdens	1.9%	23

* Based on 995 respondents that selected "Yes" to using U.S. export controls for space-related products.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Different types of organizations are affected by U.S. export control regulations in various ways. BIS examined what type of respondents cited particular adverse impacts at different rates. Universities, for example, are much more likely to alter their R&D expenditures due to export controls than are commercial organizations. Twenty-eight percent of universities using export controls altered their R&D, compared with just nine percent of commercial organizations. Similarly, 24 percent of these universities avoided space-related products/services subject to EAR-related controls, while only 15 percent of commercial respondents did so.

These trends are likely explained by the relationship between universities and the U.S. export control system. The universities surveyed in this assessment are generally research intensive and do not necessarily export products and services. In fact, only 8 of 46 universities that use the export control system manufacture products identified in the Product and Service List.[11] Universities are most likely to deal with export controls with regard to their domestic interaction with foreign nationals (students and professors), particularly "deemed exports." A deemed export, subject to the EAR, occurs when software or technology subject to EAR licensing requirements is released to a foreign national. The reliance on research and these export requirements are potentially why universities are more likely to have altered their R&D expenditures due to U.S. export controls.

EXPLANATION OF IMPACTS

Avoided the export of space-related products or services subject to ITAR-related controls

In total, 336 respondents indicated that they have avoided the export of space-related products or services that are subject to ITAR-related controls. The primary reasons noted in respondent comments for avoiding ITAR-related controls are the complexity of the regulations and hesitation on the part of foreign customers to purchase ITAR-related products and services. One small company captured the sentiments of many, stating that "the complexity of understanding ITAR regulations exceeds the potential value of the opportunities." Misinterpreting or lack of understanding of ITAR can also lead to avoiding exports all together. Some respondents have turned down sales to foreign customers if there is a possibility that the product or service may be subject to ITAR. A large company provided the following anecdote:

[11] The other universities are only providing services and/or conducting research and development.

> We had an opportunity to sell magnets to a Canadian producer of products for use in satellites. They claimed the parts they wanted to buy were not…controlled, but the rules are hard to decipher at times so we took a conservative view at our own loss…and decided not to sell them.

Another respondent has attempted to avoid ITAR by using the EAR wherever possible. They stated that they "have product substituted items for which we have [commodity jurisdictions] to Commerce to avoid the hassles of licensing." In other words, this respondent has substituted products that may fall under ITAR with products determined to be covered by the EAR in order to reduce their burden. The time and cost involved to export ITAR-related products and services is also a deterrent for many respondents. A medium-sized company stated that they "do not offer any USML items for export, specifically to avoid ITAR-related compliance costs and regulatory exposure."

Other respondents have stopped exporting ITAR-related products and services because foreign customers are not interested in dealing with these regulations. One small company stated that "we have been specifically requested by foreign primes [contractors] to not include ITAR-related equipment in our bids." Another said that "customers in allied countries will do everything possible to avoid ITAR-related controls. We are the supplier of last choice." Universities and non-profit organizations have had similar problems. One university stated that these regulations have "completely eliminated our ability to launch U.S. educational payloads on international launch vehicles because our foreign counterparts do not want to deal with ITAR."

* * *

Incentivized "design-out" or avoided buying U.S. space-related products and services

The next most common impact of export controls noted by survey respondents was incentivizing non-U.S. organizations to "design-out" or avoid buying U.S. origin space-related products and

services. Respondents provided many examples of this practice, and predominantly cited ITAR controls as the main cause. Non-U.S. organizations familiar with U.S. export control restrictions commonly look elsewhere for space-related products, and in some cases are "willing to pay a higher price to avoid dealing with a U.S. supplier that is under EAR or ITAR restrictions." In other instances, foreign "customers are often surprised to hear that there may be an additional six months of waiting before we can support their contract" due to license processing times. One respondent captured the sentiments of many respondents on "design-out" of U.S.-origin space products, particularly with regard to European companies:

> European companies prefer not buying U.S. designed and manufactured products because they are afraid of ITAR. They will ask local European suppliers to design similar products to the ones designed by [us]. These products made by competitors are then available on the U.S. market and compete directly with our product lines…These competitors benefit from economies of scale by being able to sell their product in many different markets, including the U.S.

A very large respondent noted that, "nearly all other countries have moved to alternate designs that do not include our products. The main reason for this is the restrictions and uncertainty that our export controls cause."

* * *

Incentivized non-U.S. organizations to offer ITAR-free space-related products and services

Another impact related to "design-out" is non-U.S. organizations specifically offering ITAR-free space-related products and services. Respondents specifically mentioned "ITAR-free" related products and services 71 times within the export control section of the survey and respondents provided detailed accounts of ITAR-free being a major selling point for non-U.S. organizations. Some specific examples include:

- "Europe has ITAR-free satellites to specifically avoid U.S. products." – Medium company
- "A non-U.S. based company has developed an 'ITAR-free' version of their [product] satellite platform to provide customers [the] option of launching on the Chinese Long March launcher." – Very large company
- "European and Japanese companies are working with us on licensing our technology and building their own thrusters because of our difficulty in selling to non-U.S. markets." – Very small company

Non-U.S. organizations in Europe, Japan, South Korea, Turkey, and Israel were mentioned as marketing ITAR-free space-related products and services.

There were also survey respondents that cited their own efforts to offer ITAR-free space-related products and services. One very large company owned by a non-U.S. parent "developed a non-U.S. bypass circuit to avoid ITAR in [their] French product." Another respondent is seeking to partner with European companies for image sensors on their NASA programs "in order to be ITAR-free and thus [be able to] sell worldwide." Another very large company created "non-U.S. based R&D facilities that are evaluating the development of 'ITAR-free' space-related products to grow [their] global space business."

* * *

Avoided the export of space-related products and services subject to EAR controls

There were 201 respondents that avoided the export of space-related products and services that are subject to the U.S. Department of Commerce administered EAR controls. From the comments provided, there is a subset of respondents that view U.S. export controls as monolithic

and do not understand and/or differentiate ITAR and EAR. In their explanation for this impact, 27 respondents mentioned ITAR in place of or in conjunction with the EAR.

Criticisms of the EAR are generally associated with lack of understanding and perceived regulatory burden. Concerns about the penalties for accidentally violating the EAR also caused respondents to avoid the export licensing process altogether. One large respondent stated that "due to concerns on exporting the wrong things/information, we shy away from exporting specific products in the realm." Another respondent said that "in gauging which prospects to follow up with, if there is a likelihood of needing an export license, we usually drop the transaction and send the prospect to look for a solution somewhere else."

Another theme in this area is avoiding the EAR due to a presumption of denial or regulatory requirements. A small respondent said that they avoid exporting space-related products/services subject to the EAR because they "did not feel that we could get approval." Multiple respondents specifically cited abandoning exports to China and India due to the EAR. The combination of uncertainty of a license approval, cost of compliance, and fear of enforcement action led one respondent to avoid exporting items subject to the EAR and "just watch European companies and China make the sales."

* * *

Contributed to the creation of non-U.S. companies/business lines

A total of 128 respondents indicated that space-related export controls had contributed to the creation of non-U.S. companies/business lines in direct competition with their organization's space-related products or services. Many of these respondents tied this development directly to

the ITAR. A medium-sized respondent said that "ITAR regulation of our space products has been very successful in creating a global network of companies making competing products while ensuring U.S. companies cannot compete." Another stated that "had ITAR not been in place and so restrictive, it is unlikely that the European space industry would have grown so significantly, so quickly."

Respondents identified a number of products for which they face non-U.S. competition due to U.S. export control regulations. These included antennas, aluminum rings, remote imaging capabilities, atomic clocks and many others. According to respondents, export control regulations have incentivized organizations in other countries, such as the United Kingdom (U.K.), France, Israel, China, and Taiwan, to create new product lines. In order to mitigate the lack of export opportunities under the U.S. export control system, some companies have sold their intellectual property (IP) to non-U.S. entities. To this point, one respondent said,

> The overseas licensing of our IP portfolio to keep us alive today inevitably creates future direct competition overseas with our space-related products and services. This is a trade we feel somewhat coerced by ITAR policy to have to consider.

* * *

Altered space-related R&D expenditures

One hundred respondents noted that they altered their space-related R&D expenditures due to export control regulations. As mentioned previously, universities were much more likely to alter their R&D expenditures due to export controls than commercial organizations. Two themes dominated why respondents were changing their R&D practices. First, some chose not to invest in space-related product lines that had inherently limited access to international markets due to export controls. One respondent simply said, "why develop products with limited customers?"

Another stated that, "because of ITAR concerns we are less committed to developing certain products that would have a [limited] international customer group."

Secondly, respondents either terminated or did not engage in R&D once they identified that their work may be subject to U.S. export control regulations, particularly ITAR. One large respondent "discontinued a development project with a U.K. company because the end product was expected to be ITAR-controlled." Another large respondent has "not identified a business case that would justify allocation of internal R&D funding to technologies that may be subject to control under ITAR." Many universities have not pursued certain R&D projects due to export control restrictions in collaborating with international universities or restrictions on non-U.S. citizens working on the effort. On this point, one university stated that they have "found it more difficult to participate in space research after satellite oversight was moved from the Commerce Department to the State Department."

* * *

Abandoned or altered space-related business lines

Eighty-three respondents have abandoned or altered their space-related business lines due to U.S. export control regulations. Some respondents have left the space industry due to export controls. One respondent stated that their "foreign space business has been essentially abandoned due to the ITAR regulatory constraints." Another said that "ITAR was one of the considerations for us to leave the R&D business."

Generally, more respondents sought to alter their products or operations than abandon space-related products altogether. Some respondents isolated the business lines that would be subject

to export controls in order to immunize their main business from regulatory burdens. One respondent "split the company into two subsidiaries to attempt to handle export restricted sales…[which] increased complexity and cost of doing business." Other respondents have attempted to "design-out" ITAR-controlled products from their business lines. A large company said that "components in new designs have been selected to reduce the number of components subject to ITAR-related controls."

* * *

Relocated space-related production/R&D facilities outside U.S.

The final and least common impact of U.S. export controls has been the relocation of space-related production/R&D facilities outside the United States. Only 19 respondents identified this as an impact, which may be because such relocation requires significant resources. For the most part, these respondents set up a standalone facility outside the U.S. to handle all foreign business transactions. By doing so, they can avoid dealing with U.S. export control regulations. A very large company said that they have "a full production capability in France to handle all non-U.S. business because it is nearly impossible to sell space-related products from the U.S. due to ITAR." Other locations cited by these respondents included Northern Ireland, Europe more generally, Canada, and East Asia.

OUTREACH AND ASSISTANCE

At the end of the survey, respondents were offered an opportunity to request more information on any of the 14 topics identified that may be able to assist them to better compete in the global marketplace. These topics included patents and trademarks, global export opportunities,

business development, training opportunities and others.[12] For each area, BIS developed a resource to distribute to the respondents, which included an overview of existing government programs and points of contact for each topic. One of the topics included in this outreach section was export licensing (ITAR/EAR).

Overall, 405 respondents requested more information about export licensing. Interestingly, 44 percent of these respondents are currently using U.S. space-related export controls in some fashion. The fact that so many current exporters require more information on licensing may further indicate that companies find the export control regulations difficult to navigate and understand. There were 227 respondents that do not currently use the export control system that requested more information on export licensing. Of these, 79 percent were very small or small organizations.

Since the conclusion of the survey assessment, BIS has reached out to all of these respondents to provide more information on export licensing procedures and the other 13 areas of interest. Additionally, all respondents, regardless of their current use of export controls, will be receiving more information on the ECR Initiative. ECR, which has a major component concerning space-related products, will be discussed in the next chapter of this report.

[12] For a full list of topics see Appendix I

V. EXPORT CONTROL REFORM AND THE U.S. SPACE INDUSTRIAL BASE

In August 2009, President Obama requested a review of the U.S. export control system in an effort to strengthen and modernize the process. In doing so, the interagency review found that the U.S. export control system was "overly complicated, contains too many redundancies and, in trying to protect too much, diminishes our ability to focus our efforts on the most critical national security priorities."[13] As a result, the President launched the Export Control Reform (ECR) Initiative, a multi-phase process designed to modernize and enhance the U.S. export control system.

A key part of ECR entails the transfer of less sensitive munitions items controlled under the United States Munitions List (USML), administered by the U.S. Department of State, to the Commerce Control List (CCL), administered by the U.S. Department of Commerce. In general, respondents found it more difficult when their international business transactions were governed by the ITAR as opposed to the EAR. To make the changes, the Departments of Commerce, State, Defense, Energy and other U.S. Government stakeholders reviewed each of the USML's 20 categories, identifying parts and technologies that may be moved over to the CCL. Through this review process, using a U.S. Department of Defense (DOD) national security rationale, USML defense articles were identified that continue to merit control under the ITAR.

The revised USML will be "positive," in that it "establishes controls based on objective performance parameters that provide clarity to exporters, enforcement agents, and prosecutors to

[13] Export.gov, "President's Export Control Initiative." http://export.gov/ecr/.

determine the proper jurisdiction of an item."[14] Currently, the ITAR and EAR rely upon generally undefined catch-all provisions that make it difficult for industry to consistently and easily classify their products in relation to the export control regulations. A "positive" list would describe "items using objective criteria, such as qualities to be measured (e.g., accuracy, speed, and wavelength), units of measure (e.g., hertz, horsepower, and microns), or other precise descriptions, rather than broad, open-ended, subjective, catch-all, or design intent-based criteria."[15] The creation of a "positive" control list and a clear, common definition of "specially designed" in the ITAR and EAR will "provide objective criteria for exporters, licensing officers, and enforcement officials to determine whether an item is subject to control or eligible for decontrol."

In 2010, the U.S. Department of State and BIS began developing proposed rules outlining the changes to the ITAR and EAR based on each of the 20 USML categories. Once completed, each set of proposed rules are published in the Federal Register for public comment. At that point, the comments received are reviewed by USG stakeholders and agreed to modifications are made. The final rules for each category are publically released and implemented over a transitional period.[16]

* * *

The control of space-related exports presented some unique requirements in the ECR process. In 1996, commercial communications satellites were transferred from the USML to the CCL in an effort to reduce burden on industry. However, a catastrophic launch failure involving a Chinese

[14] U.S. Congress. House Committee on Foreign Affairs. "Hearing on Advancing Export Control Reform." (April 24, 2013).
[15] Export.gov. "Export Control List Review and Creating a Single Control List." http://export.gov/ecr/eg_main_027617.asp.
[16] As of this writing, this process is ongoing.

rocket carrying a U.S.-built Intelsat satellite drew attention to these regulations. After the launch failure, a review group consisting of Loral and Hughes Space & Communications and Chinese engineers identified the potential failure points of the Chinese launch vehicle. Based on a DOD investigation, this report likely led to China uncovering the source of the launch vehicle failure. This incident and other related issues prompted a Congressional review of technology transfers to China which culminated in the Cox Report. In it they concluded that "Loral and Hughes committed a serious export control violation by virtue of having performed a defense service without a license."[17]

As a result of this and other incidents, commercial satellites and related equipment were transferred back to the ITAR under Section 1513 of the Strom Thurmond National Defense Authorization Act for Fiscal Year 1999 (1999 NDAA). Since issuance of that legislation, control of "Spacecraft Systems and Associated Equipment" has been under USML Category XV (22 C.F.R. §121.1). As detailed in the previous chapters of this report, many in U.S. industry have expressed frustration and confusion with regard to the control of space-related exports, particularly the ITAR. Similar concerns were also expressed in a 2007 BIS study of the space industrial base, conducted with the U.S. Air Force Research Laboratory.[18]

Since the control of space-related exports was transferred to ITAR by an act of Congress, the President needed special authorization to revise the Category XV regulations as part of the ECR Initiative. In early 2013, Congress authorized the President to review the USML and "determine

[17] U.S. Congress. House Select Committee. *U.S. National Security and Military/Commercial Concerns with the People's Republic of China*. Ch. 5. www.house.gov/coxreport.
[18] U.S. Department of Commerce, Bureau of Industry and Security, *Defense Industrial Base Assessment of the U.S. Space Industry*, 2007. http://www.bis.doc.gov/index.php/forms-documents/doc_download/38-defense-industrial-base-assessment-of-the-u-s-space-industry-2007.

what items, if any, no longer warrant export controls" under the Arms Export Control Act (22 U.S.C. 2778 (f)).[19]

Once this authorization was provided, DOD reviewed all the items covered by the USML Category XV to determine whether they are either:

i. Inherently military and otherwise warrant control on the USML; or

ii. If common to non-military space applications, possess parameters or characteristics that provide a critical military or intelligence advantage to the United States, and that are almost exclusively available from the United States.

If an article satisfied one or both of those criteria, the article remained on the USML. All other satellites and related items are proposed to move to the export control jurisdiction of the EAR.[20]

The items removed from the USML would be included in a new "500 series" of Export Control Classification Numbers (ECCNs) on the EAR.[21] The ECCNs created by this change would begin with "9," which corresponds to the CCL category for "Propulsion Systems, Space Vehicles, and Related Equipment." The second character of the ECCN is a letter ranging from A through E that identifies the product group within a CCL category (see Figure V-1).

[19] Federal Register. Vol. 78, No. 101. Proposed Rules. May 24, 2013. http://www.gpo.gov/fdsys/pkg/FR-2013-05-24/pdf/2013-11986.pdf.
[20] Ibid.
[21] For more information on ECCNs see http://www.bis.doc.gov/index.php/forms-documents/doc_view/143-bis-eccn-pdf.

Figure V-1: Five Product Groups

A. Systems, Equipment and Components
B. Test, Inspection and Production Equipment
C. Material
D. Software
E. Technology

In the "500 series," the third character is the number 5. The final two characters of the ECCNs would be 15 to identify the corresponding USML category that had covered the items in the new ECCN. Overall, the new ECCNs will be 9A515, 9B515, 9D515, and 9E515. In addition to new ECCNs, some current ECCNs will be revised to reflect the transfer of items to the CCL.

Overall, the following items will be transferred over to the CCL:[22]

- **Satellites**
  - Commercial Communication Satellites
  - Lower-Performance Remote Sensing Satellites
  - Planetary Rovers
  - Planetary and Interplanetary Probes
- **Related systems for the above:**
  - Ground control systems
  - Training simulators
  - Test, inspection, and production equipment
  - Non-critical software for production, operation or maintenance

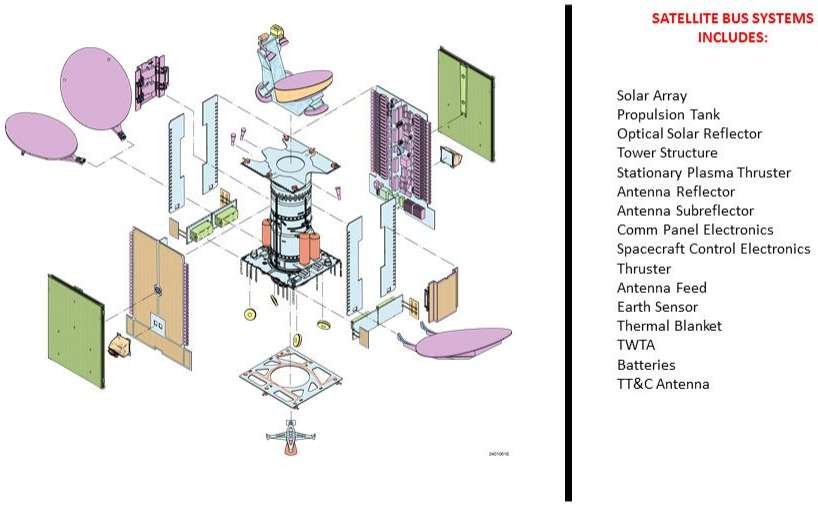
[22] The following is an illustrative list of technologies that will be covered under the CCL and USML. For the specific language, requirements, and regulations, please refer to: http://www.gpo.gov/fdsys/pkg/FR-2013-05-24/pdf/2013-11986.pdf.

- Non-critical technology for development, production, installation, operation or maintenance
- Radiation hardened microelectronics

- **Parts and components of satellite bus and payloads not listed on USML**
  - Thousands of *types* of parts and subsystems
  - Hundreds of thousands of specific parts

Figure V-2 shows an example of CCL satellite-related parts and components under the new regulations.

Figure V-2: CCL Satellite-Related Parts and Components



Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

The following items will remain on the USML:

- **Satellites and spacecraft**

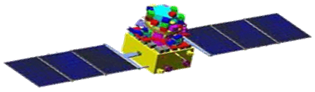
- Unique military and intelligence functions, including nuclear detection, intelligence collection, missile tracking, anti-satellite or space-based weapons, classified operation or equipment, and navigation
- Certain remote sensing with military applications
- Man-rated habitats

- **Ground control equipment**
  - Performs a uniquely military function for one of satellites above
- **Parts & components**
  - Sixteen specific technologies critical to military functions[23]
  - Any payload that performs one of military functions listed above
  - DOD funded payloads

Figures V-3 and V-4 show an illustrative list of USML spacecraft and related articles under the new regulations.

[23] See Appendix II for a listing of these specific technologies.

Figure V-3: USML - Spacecraft



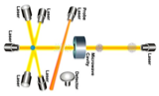
Proposed Category XV - Satellites

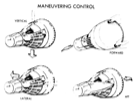
- Nuclear Detection
- Tracking – ground, airborne, missile using imaging, infrared, radar, or laser
- SIGINT
- MSINT
- Space-based logistics
- Anti-satellite or anti-spacecraft
- High Performance Remote Sensing
  - Electro-optical VNIR or IR with < 40 spectral bands and an aperature >0.35 m
  - Electro-optical Hyperspectral VNIR and SWIR with > 40 bands, with narrow spectral bandwidth of delta lamba < 20nmFWHM AND ground sample distance <200m
  - Same as above but for MWIR
  - Same as above but for LWIR
- Radar remote sensing, including AESA, SAR, ISAR, ultra-wideband SAR EXCEPT for those with center frequency of 1GHz<x<10GHz and BW <300MHz
- Position, Navigating, and Timing
- Constellation of satellites that form a virtual satellite performing any function listed here
- Man-rate sub-orbital, orbital, lunar, or inter-planetary
- Man-rated habitat
- Contained a classified system, subsystem or component
- Ground control systems for TM, tracking, and control of any satellite listed here

- Illustrative list only

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

Figure V-4: USML – Spacecraft-Related Articles





Proposed Category XV – Parts and Components

- Antennas with dia >25m
- Actively scanned antennas
- Adaptive beam forming antennas
- Interferometric radar antennas
- Space qualified optics including coating with active properties
- Space qualified optics including coating with largest lateral dimension >0.35 m
- Space qualified FPAs having peak response wavelength >900nm and associated ROICs
- Space qualified mechanical cryocooler, active coldfinger, and associated control electronics
- Space qualified active vibration suppression, including isolation and dampening, and associated electronics
- Optical bench assemblies and control electronics for satellites on previous page
- Control moment gyroscopes
- Certain space qualified MIMICs, oscillators for radar, star trackers
- Secondary or hosted payloads that perform any function listed on previous page
- DoD funded payloads
- Classified components
- Non-communication space-qualified directed energy designed for spacecraft on previous page
- Space-based kinetic energy systems
- Charged particle energy systems
- Attitude Determination and Control Systems with ground location points better than or equal to 5m (LEO), 30m (MEO), 150m (GEO), or 225m (HEO)
- Thrusters for orbit adjustment with .150lbf vacuum thrust
- Space qualified cesium, rubidium, hydrogen Master, or Quantum atomics clocks
- Space based thermoionic or non-nuclear thermoionic converters or generators

- Illustrative list only

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

CONTROLS AND DESTINATIONS

All items in the new space-related ECCNs would be subject to national security (NS Column 1) and regional stability (RS Column 1) controls, as well as antiterrorism (AT Column 1) controls. Some of the items would be subject to missile technology (MT) controls in certain cases. The licensing policy would be a case-by-case review to determine whether the transaction is contrary to the national security or foreign policy interests of the United States.

License applications for "500 series" items destined to a country subject to a U.S. arms embargo, listed in Country Group D:5 (Supplement No. 1 to Part 740), "will be reviewed consistent with United States arms embargo policies."[24] Country Group D:5 consists of: Afghanistan, Belarus, Burma, China, Congo, Cote d'Ivoire, Cuba, Eritrea, Fiji, Haiti, Iran, Iraq, North Korea, Lebanon, Liberia, Libya, Somalia, Sri Lanka, Sudan, Syria, Venezuela, Vietnam, and Zimbabwe.

In addition, as part of the 2013 NDAA, which provided authority to the President to change the USML Category XV, applications for "500 series" items destined to China, North Korea, or any country that is a state sponsor of terrorism, would be subject to a policy of denial.

LICENSE EXCEPTIONS

The items transferred to the CCL will be eligible for numerous license exceptions, with caveats for particular control types, shipment values, and country destinations. License exceptions

[24] Federal Register. Vol. 78, No. 101. Proposed Rules. May 24, 2013. http://www.gpo.gov/fdsys/pkg/FR-2013-05-24/pdf/2013-11986.pdf.

significantly reduce the time and energy required to export a controlled commodity. In particular, many of these items will be eligible for the Strategic Trade Authorization (STA) license exception, which would allow exports, re-exports, and transfers of items to go without a license to North Atlantic Treaty Organization (NATO) members and close allies (see §740.20). There are restrictions to this license exception—Missile Technology (MT) items are not permitted, all destinations within the transaction must be permitted countries, and other control types are restricted. The final rule on the "500 series," which is expected to be published in Spring 2014, should be consulted for details on the applicability of the STA license exception to particular items.

In addition, certain items under the proposed "500 series" proposed regulation would be eligible for license exceptions:

- Limited Value Shipments (LVS) for shipments up to a value of $1,500 (or $5,000 for ECCN 9B515.c)
- Temporary Exports (TMP)
- Shipments to the USG (GOV)
- Servicing and Replacement Parts (RPL)

The use of exceptions for the "500 series" items generally would be prohibited to any destination subject to a U.S. arms embargo, except to the USG under license exception GOV.

POTENTIAL IMPACTS OF SPACE-RELATED EXPORT CONTROL REFORM

The transition of certain USML Category XV items to the CCL is likely to have a positive impact on the ability of U.S. companies to export space-related products and services. While items moved to the CCL are not being "decontrolled," BIS licenses place fewer regulatory and administrative burdens on companies. Licenses for items moving from the USML to the CCL will have the following characteristics and benefits:

- There will be no cost associated with submitting a license application.[25]
- Licenses will be valid for a four-year period by default.
- Licenses allow for the export or re-export to and among end-users listed on the license.
- No purchase order is required for a license application to be filed.
- No large agreements to draft or lengthy agreement guidelines to follow.

In addition to the BIS licensing process, the availability of license exceptions, particularly STA, will significantly reduce the regulatory and administrative burden on U.S. industry. Based on BIS survey data, 13 of the top 20 country destinations for respondents' current space-related exports are eligible for the STA exemption.[26] There were 754 non-U.S. customers identified in these 13 countries. Figure V-5 lists the top 20 locations of non-U.S. customers for space-related exports, with those potentially eligible for STA license exception highlighted.

[25] ITAR requires registration fees in order to apply for a license.

[26] The countries identified are in Country Group A:5 (§740.20(c)(1)) and are eligible for the STA license exception for items that have NS, CB, NP, RS, CC, or SI reasons for control. If the item is controlled for NS reasons only, Country Group A:6 (§740.20(c)(2)) applies, which expands the countries eligible for STA to include Albania, Hong Kong, India, Israel, Malta, Singapore, South Africa, and Taiwan. The datapoint above only counts countries in Country Group A:5.

Figure V-5: Top Space-Related Customers*
Canada
France
United Kingdom
Germany
Japan
India
Italy
Spain
China
South Korea
Russia
Israel
The Netherlands
Australia
Sweden
Mexico
Brazil
Singapore
Turkey
Norway
* Based on total number of products/services sent to customers in each country.

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

To further identify the potential impact of ECR on the space industrial base, BIS cross-referenced the Space "Deep Dive" Product and Service List with the items proposed to move to the CCL. Taking a conservative approach to identification, BIS found 155 product/service areas that could be impacted by ECR.[27] Since the Product and Service List is more general than the proposed regulations, certain subsets of individual product/service areas would not be eligible to be moved to the CCL due to their technical specifications, military function, or general sensitivity.

Based on BIS's analysis, the reform of space-related export controls could provide significant opportunities for U.S. companies to export their products/services to close allies. Survey data show that 1,941 respondents provide at least one of the 155 product/service areas that may be

[27] See Appendix III for the list of 155 relevant product/service areas.

moved to the CCL. Of these, 1,288 respondents do not currently use the export control system. ECR may provide an opportunity for these respondents, of which 93 percent are small businesses as defined by the Small Business Administration (SBA), to export their products and services for the first time. Figure V-6 shows that these reforms could have a potential impact on all types of respondents, including many very small companies.

Figure V-6: Potential Impact of ECR on Survey Respondents

Respondent Size	# of Respondents	# of Respondents that Do Not Currently Use Space-Related Export Controls
Very small	804	599
Small	498	324
Medium	294	159
Large	134	73
Very Large	98	56
No Sales	110	77
Total	**1,941**	**1,288**

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

REPORT FINDINGS

BIS developed the following findings concerning the impact of U.S. export controls on the space industrial base. These findings are based on survey responses, independent research, analysis, and field interviews:

Overall, 995 (26 percent) survey respondents use the U.S. export control system to export their space-related products and services. Twenty-six percent of survey respondents use the export control system for their space-related products and services, including over 500 small businesses. These organizations, primarily commercial companies, provide a wide-range of products and services, support multiple U.S. Government programs, and export to over 75 countries.

Respondents indicated numerous areas where the U.S. export control system has adversely impacted their organization's health and competitiveness. The most common impact was the avoidance of exporting space-related products and services that are subject to the ITAR. Respondents also recognized that non-U.S. organizations have been incentivized to "design-out" or avoid buying U.S. origin space products and to offer "ITAR-free" space-related products and services.

Many respondents do not understand the U.S. export control regulations (ITAR and EAR) on space-related products and services. Some organizations do not understand or differentiate between the ITAR and EAR and their respective compliance requirements. Moreover, many

respondents have avoided the export of space-related products and services due to their perception of the complexity of the regulations, fear of penalties for inadvertent rules violations, and potentially inaccurate presumptions that their license applications would be denied.

The Export Control Reform (ECR) Initiative, once fully implemented, may have a positive impact on the competitiveness of the U.S. space industrial base. Based on BIS's analysis, 1,941 respondents provide products and services that may be impacted by ECR, including 1,288 respondents that do not currently use the export control system. In addition, 13 of the top 20 country destinations for space-related products and services are eligible for the Strategic Trade Authorization (STA) license exemption. This exemption, in particular, may provide many more business opportunities for U.S. exporters in the space sector.

ECR will alleviate some specific concerns cited by survey respondents with regard to the export of space-related products and services. In particular, many space-related products and services will qualify for export to NATO countries and close allies under Commerce Control List (CCL) license exceptions. Additionally, the licensing of commodities transferred to the CCL will not require purchase orders before a license application can be filed. This transfer will also eliminate the associated registration cost and extend the license validation period to four years.

Continued outreach efforts are critical in order to update and inform organizations about the U.S. export control system and ECR. Many organizations may not know of the opportunities and assistance programs available to export their space-related products and services. Outreach, particularly to small companies, may dispel misunderstanding, enhance

knowledge of the system, and/or introduce organizations to the export control system for the first time.

APPENDIX I: OUTREACH AND ASSISTANCE AREAS

Respondents Interested in Available USG Assistance Programs and Services	
Program	# of Respondents
Business development	715
R&D programs	527
SBIR and STTR contracts	492
Global export opportunities	443
Training Opportunities	416
Export licensing (ITAR/EAR)	405
Manufacturing technology development	395
Financing	353
Government procurement guidelines and e-commerce	346
Marketing assessment skills	329
Product/service development	314
Energy and environmentally conscious manufacturing	213
Patents and trademarks	196
Country Commercial Guides	60

Source: U.S. Department of Commerce, Bureau of Industry and Security, *U.S. Space Industry Deep Dive Assessment*, December 2013.

APPENDIX II: 16 CRITICAL TECHNOLOGIES REMAINING ON THE USML

1) Certain specified antennas having particular capabilities
2) Certain space qualified optics with particular properties
3) Space qualified FPAs having particular peak response wavelength
4) Space qualified mechanical cryocooler
5) Space qualified active vibration suppression
6) Certain optical bench assemblies
7) Certain non-communication space qualified directed energy systems
8) Space-based kinetic or charged particle energy systems
9) Certain space qualified atomic clocks
10) High performance attitude determination and control systems
11) Certain space-based thermoionic converters or generators
12) Certain thrusters for orbit adjustment
13) Control moment gyroscopes
14) Certain space qualified MIMICs
15) Certain space qualified oscillators
16) Certain high performing star trackers

APPENDIX III: PRODUCT/SERVICE AREAS RELEVANT TO SPACE-RELATED ECR

Note: This is a list based on the analysis of the authors of this report. It should not be considered comprehensive or authoritative.

A1 - Astronomical satellites
A2 - Atmospheric balloon packages
A3 - Atmospheric probes
A4 - Communications satellites
A5 - Earth observation satellites (excluding meteorological, remote sensing, and imaging)
A6 - Landers
A8 - Meteorological satellites
A9 - Microsatellites
A10 - Navigation satellites
A11 - Remote sensing and imaging satellites
A12 - Satellite or spacecraft buses
A13 - Search and rescue satellites
A16 - Surface rovers
A17 - Unmanned space exploration spacecraft
B1 - Casings
B2 - Chambers
B10 - Nozzles
B12 - Propellant tanks
B16 - Thrusters not specified above
C1 - Accelerometers
C2 - Actuators
C3 - Altitude determination and control equipment and components
C4 - Altitude determination and control sensors (including altimeters)
C5 - Earth sensors
C6 - Entry, descent, and landing systems
C7 - Gimbal systems and equipment
C8 - GPS equipment
C9 - Guidance, navigation, and control equipment and components
C10 - Gyroscopes
C11 - Hazard detection and avoidance systems
C12 - Inertial navigations systems
C13 - Light Detection and Ranging (LIDAR) systems
C14 - Radar systems
C15 - Reaction/momentum wheels
C16 - Rendezvous and docking systems
C17 - Space object capturing systems

C18 - Star trackers
C19 - Sun sensors
C20 - Telemetry equipment and components
C21 - Thrust control systems
C22 - Other space-related navigation and control equipment and components
D1 - Antennas/antenna systems
D2 - Communications security/cryptologic equipment
D3 - Delay tolerant networking
D4 - Lunar wireless network
D5 - Microwave systems
D6 - Multiplexers and demultiplexers
D7 - Optical communications systems and components (excluding fiber optic cables)
D8 - Relay equipment
D9 - Routers
D10 - Signal amplifiers
D11 - Signal converters
D12 - Signal receivers and transmitters
D13 - Transponders
D14 - Other space-related communications equipment and components
E10 - Heat shields
F1 - Atomic clocks
F2 - Bulk plasma
F3 - Chemical analysis instruments
F4 - Cosmic ray sensors (1 MeV)
F5 - Electric field sensors
F6 - Electrical and electrical properties testing and measurement instruments
F7 - Energetic neutral imaging systems
F8 - Environmental chambers and related measuring equipment
F9 - Filtered photometers
F10 - Gas chromatograph
F11 - Geophysical instruments
F12 - Heavy atom detectors
F13 - High energy particle sensors (30 KeV - 2 MeV)
F14 - Hyper-spectral detectors
F15 - Infrared detectors
F16 - Low energy particle sensors (100 eV)
F17 - Low noise high frame rate detectors
F18 - LWIR detectors
F19 - Magnetic field sensors and magnetometers
F20 - Meteorological instruments and apparatus
F21 - Microwave detectors
F22 - Miscellaneous laboratory equipment and supplies
F23 - Multi-spectral detectors
F24 - MWIR detectors
F25 - Near-IR visible detectors
F26 - Nuclear detectors

F27 - Physical properties testing and inspection equipment
F28 - Radiometers
F29 - Single photon detectors
F30 - Spectrometers
F31 - SWIR detectors
F32 - Synthetic aperture radar systems
F33 - Telescopes
F34 - Visible detectors
F35 - X-ray optics
F36 - Other space-related instruments or sensors
G1 - Ground antennas
G2 - Ground-based communications equipment (terminals, relays, etc.)
G3 - Ground tracking, telemetry, and control equipment
G4 - Simulation and/or training machines
I1 - Batteries (lithium ion, nickel hydrogen, nickel cadmium, silver zinc, etc.)
I9 - Solar electrical power systems, equipment, and components
J1 - Application-specific integrated circuits (ASICs)
J2 - Attenuators
J3 - Capacitors
J4 - Charge couple devices
J5 - Circuit boards
J6 - Circuit breakers
J7 - Coils and transformers
J8 - Connectors
J9 - Diodes
J10 - Electrical insulators
J11 - Electron tubes
J12 - Fiber optics (conductors, cables, switches, assemblies, etc.)
J13 - Field programmable gate arrays
J14 - Filters and networks
J15 - Fuses, arrestors, absorbers, and protectors
J16 - Inductors
J17 - Integrated circuits/semiconductors (excluding ASICs)
J18 - Large format focal plane arrays
J19 - Lasers and laser systems
J20 - Lugs, terminals, and terminal strips
J21 - Memory
J22 - Modulators/demodulators
J23 - Non-volatile memory
J24 - Optoelectronic devices and associated equipment
J25 - Oscillators and piezoelectric crystals
J26 - Radiation hardened/tolerant electronics
J27 - Relays and solenoids
J28 - Resistors
J29 - Signal/function generators (radio frequency, microwave, etc.)
J30 - Switches (coaxial, radio frequency, video, etc.)

J31 - Synchros and resolvers
J32 - Transistors
J33 - Traveling wave tubes, amplifiers
J34 - Other space-related electronic equipment
L1 - Communications software
L2 - Data mining and knowledge management software
L3 - Environmental control and monitoring software
L4 - Ground system software
L5 - Mission automation and execution software
L6 - Mission planning software
L7 - Modeling, analysis, and visualization software
L8 - Navigation and control software
L9 - Payload instrument software
L10 - Propulsion system operating software
L11 - Simulation software
L12 - Other space-related software
M35 - Bearings
M36 - Castings
M37 - Compressors and vacuum pumps
M38 - Couplings, connectors, and fittings
M40 - Fasteners (screws, nuts, bolts, clips, brackets, rivets, etc.)
M41 - Forgings
M42 - Gaskets (o-rings, washers, etc.)
M43 - Gears and gear boxes
M44 - Hydraulics, valves, actuators, pumps
N18 - Rocket maintenance, repair, and checkout specialized equipment
N21 - Space vehicle maintenance, repair, and checkout specialized equipment

APPENDIX IV: BIS CONTACT INFORMATION RELATED TO EXPORT CONTROL REFORM

For more information related to space-related export controls and the Export Control Reform Initiative, please reference the following points of contact:

Outreach and Educational Services Division:

- Director: Rebecca Joyce

  Email: OESDseminar@bis.doc.gov

  Phone: (202) 482-4811

- Western Regional Office Director: Michael Hoffman

  Email: michael.hoffman@bis.doc.gov

  Phone: (949) 660-0144

Questions Specific to Space-Related Export Controls on the CCL:

- Office of National Security and Technology Transfer Controls: Dennis Krepp

  Email: dennis.krepp@bis.doc.gov

  Phone: (202) 482-1309

Appendix V: U.S. Department of Commerce, BIS/OTE Publications List

OFFICE OF TECHNOLOGY EVALUATION (OTE)
PUBLICATIONS LIST

February 2014

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

Publications
Strategic and Critical Materials Supply Chain Assessment – Summer 2014
Cost-Metric Assessment of Diminishing Manufacturing Sources and Material Shortages (Update) – Summer 2014
Defense Industrial Base Assessment of the U.S. Underwater Acoustics Transducer Industry – Spring 2014
Assessment of the U.S. Space Industrial Base Supply Chain – Spring 2014
Industrial Base Assessment of Consumers of U.S. Electro-Optical (EO) Satellite Imagery – August 2013
National Security Assessment of the Cartridge and Propellant Actuated Device Industry: Fourth Review – July 2013
Defense Industrial Base S2T2 Survey of C4ISR Sector – Spring 2013
Critical Technology Assessment: Night Vision Focal Plane Arrays, Sensors, and Cameras – October 2012
National Aeronautics and Space Administration (NASA) Industrial Base – Post-Space Shuttle – June 2012
Defense Industrial Base Assessment of the Telecommunications Industry Infrastructure – April 2012
Reliance on Foreign Sourcing in the Healthcare and Public Health (HPH) Sector – December 2011
Defense Industrial Base S2T2 Survey of Six Sectors –July 2011
Cost-Metric Assessment of Diminishing Manufacturing Sources and Material Shortages – August 2010
Critical Technology Assessment: Impact of U.S. Export Controls on Green Technology Items – August 2010
Technology Assessment of Fine Grain, High-Density Graphite – April 2010
Defense Industrial Base Assessment of Counterfeit Electronics – January 2010

Technology Assessment of 5-Axis Machine Tools – July 2009
Defense Industrial Base Assessment of U.S. Integrated Circuit Design and Fabrication Capability – March 2009
Defense Industrial Base Assessment of the U.S. Space Industry – August 2007
Technology Assessment of Certain Aromatic Polyimides – July 2007
Defense Industrial Base Assessment of U.S. Imaging and Sensors Industry – October 2006
National Security Assessment of the Cartridge and Propellant Actuated Device Industry: Third Review – August 2006
Economic Impact Assessment of the Air Force C-17 Program – December 2005
National Security Assessment of the Munitions Power Sources Industry – December 2004
National Security Assessment of the Air Delivery (Parachute) Industry – May 2004
Industry Attitudes on Collaborating with DoD in R&D – Air Force – January 2004
Industrial Base/Economic Impact Assessment of Army Theater Support Vessel Procurement – December 2003
A Survey of the Use of Biotechnology in U.S. Industry – October 2003
Industrial Base Assessment of U.S. Textile and Apparel Industries – September 2003
Technology Assessment of U.S. Assistive Technology Industry – February 2003
Heavy Manufacturing Industries: Economic Impact and Productivity of Welding – Navy – June 2002
The Effect of Imports of Iron Ore and Semi-Finished Steel on the National Security – October 2001
National Security Assessment of the U.S. High-Performance Explosives & Components Sector –June 2001
National Security Assessment of the U.S. Shipbuilding and Repair Industry - May 2001
Statistical Handbook of the Ball and Roller Bearing Industry (Update) - June 2001
National Security Assessment of the Cartridge and Propellant Actuated Device Industry: Update - December 2000

Archived Studies	
The Effect on the National Security of Imports of Crude Oil and Refined Petroleum Products - November 1999	National Security Assessment of the Antifriction Bearings Industry - February 1993
U.S. Commercial Technology Transfers to The People's Republic of China – January 1999	National Security Assessment of the U.S. Forging Industry - December 1992
Critical Technology Assessment of Optoelectronics - October 1998	The Effect of Imports of Gears & Gearing Products on the National Security – July 1992

National Security Assessment of the Emergency Aircraft Ejection Seat Sector - November 1997	Natl. Sec. Assessment of the Dom. and For. Subcontractor Base~3 US Navy Systems - March 1992
Critical Technology Assessment of the U.S. Semiconductor Materials Industry - April 1997	Natl. Sec. Assessment of the U.S. Semiconductor Wafer Processing Equipment Industry - April 1991
National Security Assessment of the Cartridge and Propellant Actuated Device Industry - October 1995	National Security Assessment of the U.S. Robotics Industry - March 1991
A Study of the International Market for Computer Software with Encryption – NSA -1995	National Security Assessment of the U.S. Gear Industry - January 1991
The Effect of Imports of Crude Oil and Petroleum Products on the National Security - December 1994	The Effect of Imports of Uranium on the National Security – Sept. 1989
Critical Technology Assessment of U.S. Artificial Intelligence - August 1994	The Effect of Imports of Crude Oil and Refined Petroleum on Natl. Security – Jan. 1989
Critical Technology Assessment of U.S. Superconductivity - April 1994	The Effect of Imports of Plastic Injection Molding Machines on Natl. Security – Jan. 1989
Critical Technology Assessment of U.S. Optoelectronics - February 1994	The Effect of Imports of Anti-Friction Bearings on the Natl. Security - July 1988
Critical Technology Assessment of U.S. Advanced Ceramics - December 1993	Investment Castings: A Natl. Security Assessment – Dec. 1987
Critical Technology Assessment of U.S. Advanced Composites - December 1993	An Economic Assessment of the U.S. Industrial Fastener Industry – Mar. 1987
The Effect of Imports of Ceramic Semiconductor Packages on the National Security - August 1993	Joint Logistics Commanders/DOC Precision Optics Study - June 1987
National Security Assessment of the U.S. Beryllium Industry - July 1993	Joint Logistics Commanders/DOC Bearing Study - June 1986

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