NATIONAL SECURITY ASSESSMENT of the U.S. CARTRIDGE and PROPELLANT ACTUATED DEVICE INDUSTRY

FOURTH REVIEW

AUGUST 2013

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Fourth Review

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PREPARED BY

U.S. DEPARTMENT OF COMMERCE
BUREAU OF INDUSTRY AND SECURITY
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EXECUTIVE SUMMARY

This report is the Bureau of Industry and Security's (BIS) fourth National Security Assessment of the Cartridge and Propellant Actuated Device (CAD/PAD) industry. BIS published previous assessments in 1995, 2000, and 2006. All four assessments were initiated at the request of the U.S. Department of the Navy, CAD/PAD Joint Program Office (JPO), located at Naval Surface Warfare Center, Indian Head, Maryland. The JPO is one of the leading United States Government (USG) organizations in understanding the CAD/PAD industrial supply chain, which supports critical Department of Defense (DOD) and non-defense applications. The JPO's ongoing efforts effectively promote industry/government cooperation to meet the ultimate needs of the U.S. warfighter.

CAD/PADs are explosive devices used in aircraft and missiles to perform a variety of functions such as aircrew escape, stores release, ignition elements, and detonators. There are approximately 2,800 different design configurations in use by the military services, U.S. Government (USG) agencies such as NASA and other private entities. Many CAD/PADs are aircrew-rated and thus must function at a high standard of performance and reliability.

The U.S. Department of Commerce (DOC), BIS, is delegated authority under Section 705 of the Defense Production Act (DPA) of 1950, as amended, and Executive Order 12656, to survey and analyze economic and industrial data from U.S. organizations in preparing detailed assessments. The survey data, combined with additional information collected from site visits, discussion with industry experts, and independent research, was utilized to assess the overall health and competitiveness of this critical defense-related sector of the U.S. industrial base.

The Office of Technology Evaluation (OTE) is the operating unit within BIS assigned the responsibility for survey design, data collection, research, and analysis. With the U.S. Navy and other government organizations, BIS has an established history of collaborative industrial base efforts that has resulted in more than 50 assessments in the past twenty-five years.

This assessment reviewed economic and industrial data from the five-year period 2007-2011; the previous CAD/PAD assessments covered the five-year periods from 1991-1995, 1995-1999, and

2001-2005. The stated objective of this study was to provide the JPO with an updated statistical profile of the U.S. CAD/PAD industry in light of the changing global economic and political environment, the ending of major U.S. operations in Iraq and Afghanistan, the U.S. economy, and declining U.S. defense budgets.

Recommendations:

- **Conduct the Next CAD/PAD Report "For Official Use Only."** With fewer and fewer companies, it is more difficult to provide a detailed analysis of the health and competitiveness of the CAD/PAD industry as significant portions of the data cannot be publicly released without disclosing business-confidential information.

- **Maintain Indian Head's Status as "Producer of Last Resort."** A high percentage of survey respondents manufacture only one CAD/PAD product, and many stated they were unable to initiate new or reconstitute prior production.

- **Monitor the Impact of DOD Budget and Policy Changes.** A decline in defense-sector CAD/PAD sales could have a significant financial impact on a number of companies and lead to further contraction of the industry.

- **Mandate Second-Sourcing of F-35 Joint Strike Fighter (JSF) and T-6 Joint Primary Aircraft Training System (JPATS) Related CAD/PADs.** The inability of U.S. CAD/PAD companies to second-source JSF and JPATS-related CAD/PADs, combined with the continued retirement of U.S. Air Force aircraft (F-15, F-16), will force a further reduction in the number of U.S.-based CAD/PAD manufacturers, workforce, and related supply chain.

- **The JPO Should Clearly Communicate the Second-Sourcing Process and the Product Improvement Program to Industry.** The second-sourcing process and the Product Improvement Program should both be topics at the next series of Technical Exchange Workshops.

- **Work With Foreign Military Sales (FMS) Program Offices to Address Industry Concerns.** Respondents reported delays in FMS shipments combined with confusing and late shipping instructions from FMS managers.

- **Encourage Participation in USG and University Recruitment Programs.** USG and university recruitment programs such as career and internship fairs, and military outplacement efforts could help address future employment gaps and fill positions that are difficult to hire, such as Design Engineers.

- **Work with the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) to Expand the Number of Neutron Radiation (N-ray) Testing Facilities.** There are few facilities overall in the U.S. that can safely handle CAD/PAD explosive materials which has made N-ray testing very expensive.

- **Work With the Department of Transportation (DOT) to Meet Security and Safety Requirements While Lessening the Burden on Industry.** DOT's shipping classifications, Competent Authority, and testing requirements have been an issue for the CAD/PAD industry since the 1995 BIS CAD/PAD report.

- **Continue Movement Toward Performance Specifications Instead of Build-to-Print.** Permitting companies to use performance specifications would allow for more innovation and potentially more cost savings.

- **Offer Assistance to Industry on Complying With Many USG Regulations.** Information sharing, through the use of briefings by State, the Environmental Protection Agency and other USG agencies responsible for these regulations, could reduce industry frustration and alert JPO to issues related to the regulations.

Detailed Report Findings and Recommendations are detailed in Chapter 10.

1. INTRODUCTION

1.1 Methodology and Scope

In designing the industry survey, BIS staff worked closely with JPO staff and conducted a site visit to their Indian Head, Maryland facility. A JPO representative also joined BIS staff during field visits to multiple CAD/PAD companies and facilities in Arizona, California, and Illinois, where they provided background support and technical guidance to BIS. These domestic visits were supplemented with BIS site visits to leading CAD/PAD and propellant providers in the United Kingdom.

BIS staff also hosted a one-day CAD/PAD summit at the U.S. Department of Commerce headquarters in Washington, D.C., where input on the current and future status of the industry was solicited from major CAD/PAD producers, suppliers, and government consumers. Finally, additional information to support survey design, development of an industry mailing list, and resolution of technical issues was garnered from contact with independent CAD/PAD experts via telephone and email and a review of previous BIS CAD/PAD reports.

In February 2012, the BIS CAD/PAD survey was distributed to 28 U.S. and non-U.S. companies determined to be involved in the U.S. CAD/PAD industry. Some companies were later exempted from the mandatory survey for various reasons, including recent mergers and acquisitions and withdrawal from participation in the defense CAD/PAD market.[1]

In total, BIS received 22 completed surveys from U.S.-based CAD/PAD companies. Two non-U.S. CAD/PAD companies also submitted voluntary survey responses requested by BIS. The majority of the industry analysis in this report relies on the data and related comments provided by the 22 U.S.-based companies.

[1] In previous BIS CAD/PAD reports, exclusively non-defense automotive airbag and gas generator manufacturers were surveyed. These manufacturers/producers were excluded from this assessment.

2. PRODUCT AND INDUSTRY DESCRIPTION

2.1 Product Description

CAD/PADs are specialized work-performing components used in many modern weapons and space systems, including the successful National Aeronautics and Space Administration's (NASA's) Mars Curiosity Rover. The cartridges use precisely measured propellant and explosive mixtures of varying compositions and burning characteristics to perform a wide variety of jobs critical to safety, survivability, and weapons system performance.[2] There are approximately 2,800 different design configurations in use by the military services, U.S. Government (USG) agencies such as NASA and other private entities. CAD/PAD products relevant to this assessment were broken into 14 product lines, with the impulse cartridge product line further divided into two subcategories:

- Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges
- Aircrew Escape Propulsion Systems
- Automatic Inflators
- Catapults, Thrusters and Removers
- Cutters
- Delay Cartridge and Initiators
- Detonating Cords and Charges
- Gas Generators
- Impulse Cartridges
  - Electrically-Initiated
  - Percussion-Initiated
- Impulse Initiators
- Laser-Initiated Cartridges, Detonators and Initiators
- Rocket Motor Igniters
- Thermal Batteries and Components
- Other

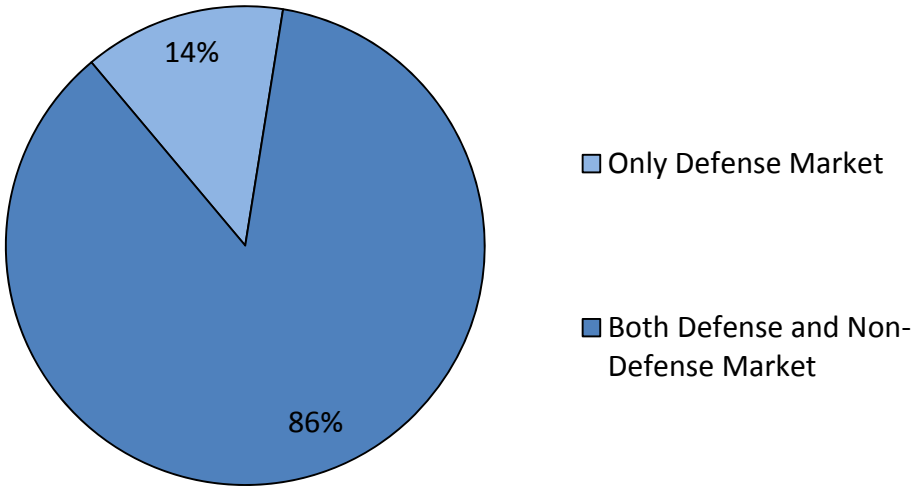
The CAD/PAD industry is divided into defense and commercial sectors. With a larger array of products, lower volume orders, and shorter production runs, defense CAD/PADs are generally produced using a more labor-intensive batch manufacturing process. Conversely, the bulk of commercial CAD/PADs (e.g. automotive airbags) use automation-intensive manufacturing for longer production runs, resulting in higher volumes across a narrower range of goods.

[2] An in-depth CAD/PAD product description is in Appendix D.

2.2 Industry Description

The surveyed U.S. CAD/PAD industry consists of 22 manufacturers across 11 states. Of these, three manufacturers (14 percent) only produce defense products. Nineteen companies (86 percent) are involved in mostly defense work, with smaller amounts of commercial orders (non-defense USG and some airbag initiators/gas generators) taken to maintain a steady workflow in between defense orders (see Figure 2.1).[3] None of the companies surveyed solely work in the commercial sector supplying non-defense USG needs and other commercial markets.

Figure 2.1: U.S. CAD/PAD Companies Defense and Non-Defense Market Participation 2007-2011



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

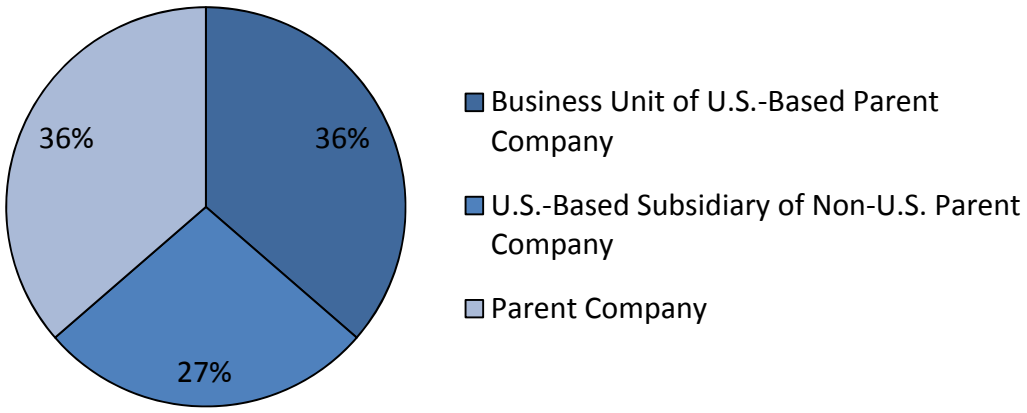
As discussed in previous BIS CAD/PAD reports, the defense and commercial portions of the CAD/PAD industry have continued to diverge since the initial assessment in 1995. The 1991 Intermodal Surface Transportation Efficiency Act mandated that all passenger vehicles sold in the United States be equipped with driver and front-seat airbags by the end of the 1990s, resulting in many CAD/PAD manufacturers leaving the defense market to concentrate on the

[3] In previous reports all USG non-defense-related agencies (e.g. NASA) were defined as defense, while in this 2013 assessment they are defined as non-defense.

larger volume commercial sector. Additionally, numerous mergers and acquisitions have contributed to the decline in number of CAD/PAD manufacturers over the years. The number of defense-related CAD/PAD manufacturers has therefore decreased over the years: 35 U.S. companies completed the survey in 1995, 26 companies in 2000, 25 in 2006, and 22 in 2013.

The surveyed CAD/PAD companies were primarily U.S.-based companies or subsidiaries of U.S.-based companies, with 27 percent (six companies) having a non-U.S. parent company (see Figure 2.2). Additionally, 77 percent of the respondents (17) were privately-held firms while the remaining 23 percent (five) were publicly-held.

Figure 2.2: U.S. CAD/PAD Company Type 2007-2011



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

To provide greater insight into the health and competitiveness of the U.S. CAD/PAD industry, BIS calculated each respondent's CAD/PAD sales as a percentage of their overall net sales and other revenue. Nineteen respondents provided the information required to perform this analysis. The group was then divided into those classified as dependent on CAD/PAD sales (dependent) and those considered not dependent on CAD/PAD sales (non-dependent). Eight respondents were considered dependent, with CAD/PAD sales comprising greater than 50 percent of their net sales over the 2007-2011 period.

Additionally, BIS asked survey respondents to provide information on the other non-CAD/PAD business lines in which they participate. Ultimately, there were 39 mentions of different business lines amongst the 22 respondents. Of those 39 mentions of business lines, 41 percent were related to manufacturing products other than CAD/PADs. Thirteen percent of survey respondents (five) indicated that they have no additional product lines (see Figure 2.3).

Figure 2.3: Respondents With Additional Non-CAD/PAD Business Lines 2007-2011

Additional non-CAD/PAD Business Lines	Companies Performing Other Business Lines (All Respondents)		Respondents Dependent on CAD/PAD Sales	
	Percent	Number	Percent*	Number
Manufacturing (to include Assembly)	41%	16	19%	3
Research and Development	18%	7	14%	1
Testing/Evaluation/Validation	15%	6	17%	1
Maintenance/Aftermarket	8%	3	0%	0
Material Finishing (Machining, Coating, Plating, Assembly, etc.)	5%	2	0%	0
Product and Design Engineering (Tooling, New Processes, etc.)	3%	1	0%	0
Distribution/Brokerage/Reseller/Retail	3%	1	0%	0
No Additional Business Lines	13%	5	80%	4

22 Respondents

*Percent of dependent respondents out of number of respondents participating in business line.

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

2.3 Manufacturing

To update the dataset from the previous BIS CAD/PAD report, survey respondents were asked to identify the CAD/PAD products they manufactured, integrated, and/or assembled since 2006. Additionally, companies were asked to identify the specific facility where each CAD/PAD product was manufactured. Finally, the companies were asked to report if they had ceased production of any of the identified products since 2006. The survey respondents were given 14 categories, with two additional sub-categories of CAD/PAD-related products, developed by the JPO and field-tested with industry, from which to choose.

The 22 survey respondents identified 89 CAD/PAD products in the 14 product lines (and two sub-categories). Impulse Cartridges, Cutters, and Electrically Initiated Impulse Cartridges were the most widely-produced CAD/PAD products (see Figure 2.4). Three respondents produced more than 10 types of CAD/PADs, and 11 respondents produced between two and seven CAD/PAD products. Thirty-six percent (eight) of respondents identified only one CAD/PAD product that their company manufactures; half of those respondents were also categorized as dependent on CAD/PAD sales. The number of companies that produce only one CAD/PAD product has increased from six to eight companies from the 2006 BIS CAD/PAD report.

Figure 2.4: Respondents Manufacturing CAD/PAD Products 2007-2011

Product Type	Percent of Companies Currently Manufacturing Products	Percent of Companies Dependent on CAD/PAD Sales*
Impulse Cartridges	50%	27%
Electrically Initiated Impulse Cartridges	45%	20%
Percussion Initiated Impulse Charges	18%	25%
Cutters	45%	20%
Delay Cartridges and Delay Initiators	36%	38%
Gas Generators	36%	38%
Initiators (Impulse)	36%	38%
Aircraft Stores/Flares/Chaff /Sonobuoy Ejection Cartridges	27%	17%
Other (specify)	27%	50%
Catapults, Thrusters, and Removers	18%	25%
Detonating Cords and Charges, and Linear Charges	18%	25%
Automatic Inflators	14%	33%
Rocket Motor Igniters	14%	33%
Aircrew Escape Propulsion System	9%	0%
Automotive Airbag Initiators	5%	100%
Laser Initiated Cartridges, Detonators, and Initiators	5%	100%

22 Respondents

*Dependent companies based on number of companies currently manufacturing product.

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Eight of the 22 survey respondents reported 33 total instances of facilities discontinuing the production of 14 CAD/PAD product types (see Figure 2.5). The top products mentioned included Gas Generators, Catapults, Thrusters, and Removers, Cutters, and Rocket Motor Igniters. As a result, there are fewer suppliers in each category which can lower overall competition and increase costs for the Department of Defense (DOD).

Figure 2.5: Facilities Ceasing Production by Product Type 2006-2011

Product	Number of Facilities Ceasing Product Production	Percent of Facilities of CAD/PAD Dependent Companies Ceasing Production
Gas Generators	4	75%
Automotive Airbag Initiators	3	67%
Catapults, Thrusters, and Removers	3	100%
Cutters	3	100%
Detonating Cords and Charges, and Linear Charges	3	100%
Rocket Motor Igniters	3	67%
Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges	2	50%
Delay Cartridges and Delay Initiators	2	100%
Electrically Initiated Impulse Cartridges	2	100%
Impulse Cartridges	2	100%
Other	2	100%
Percussion Initiated Impulse Charges	2	100%
Aircrew Escape Propulsion System	1	100%
Initiators (Impulse)	1	100%
Total	**33**	**88%**

8 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

BIS further evaluated the survey respondents who were both categorized as dependent on CAD/PAD sales and also ceased production in each product type (see Figure 2.5). Twenty-nine of the 33 instances (88 percent) of facilities ceasing production of CAD/PAD products were mentioned by companies dependent on CAD/PAD sales. This decline in production of specific product lines affected four of the eight companies dependent on CAD/PAD sales. For example, 100 percent of the three facilities ceasing production of Detonating Cords and Charges, and Linear Charges were dependent on CAD/PAD sales. Across all product lines where facilities ceased production, at least 50 percent of those facilities belonged to CAD/PAD dependent companies.

One respondent said the irregularity of USG contracts affected their product lines:

> "We manufacture various impulse cartridges for the Navy and Air Force and often these programs are only funded for certain years, or else one of our competitors wins the contract for one year and we win it the next year. Consequently, we often cease production for various reasons, but always have the ability to restart the line."

To highlight the potential responsiveness of the CAD/PAD industrial base, survey respondents were asked if they could initiate production for the first time or reconstitute or reestablish previously ceased production for each of the CAD/PAD product lines. Overall, the 22 respondents reported 65 instances of being able to initiate production. The product types with the highest numbers of respondents indicating a capability to initiate production were Cutters, Electrically Initiated Impulse Cartridges, Impulse Initiators, Percussion Initiated Impulse Charges, and Rocket Motor Igniters (see Figure 2.6). One respondent said the ability to initiate production was "Dependent on government funding availability and JPO specifications."

There were 33 instances of the respondent's ability to reconstitute reported. The product types with the highest number of respondents indicating an ability to reconstitute production were Delay Cartridges and Delay Initiators, Impulse Cartridges, and Automotive Airbag Initiators.

Figure 2.6: Respondents that Could Initiate/Reconstitute Production by Product Type			
Product Type	**Could Initiate**	**Could Reconstitute**	**Currently Produced**
Cutters	7	2	10
Electrically Initiated Impulse Cartridges	6	2	10
Initiators (Impulse)	6	2	8
Percussion Initiated Impulse Charges	6	1	4
Rocket Motor Igniters	6	1	3
Gas Generators	5	2	8
Automatic Inflators	4	2	3
Delay Cartridges and Delay Initiators	4	4	8
Detonating Cords and Charges, and Linear Charges	4	1	4
Impulse Cartridges	4	4	11
Laser Initiated Cartridges, Detonators, and Initiators	4	1	1
Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges	3	1	6
Catapults, Thrusters, and Removers	3	1	4
Aircrew Escape Propulsion System	2	1	2
Other	1	5	6
Automotive Airbag Initiators	0	3	1
TOTAL NUMBER OF INSTANCES	**65**	**33**	

22 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Survey respondents that indicated they could initiate or reconstitute a CAD/PAD product were asked to provide an estimated lead time. Of the 65 mentions where production of a product could be initiated, respondents indicated 52 percent could be manufactured within one year (see Figure 2.7). For the 33 instances where a respondent could reconstitute production, 82 percent were reported to have lead times of one year or less. One respondent that could reconstitute production said the lead time was needed because, "Previous production was handled by automatic systems/machines which would have to be redesigned, built, tested, and certified."

Figure 2.7: Lead Time to Initiate/Reconstitute by Respondent Mentions		
Lead Time Consolidated	**Could Initiate**	**Could Reconstitute**
1 Year or Less	34	27
1-2 Years	13	2
3 Years	2	0
7 Years or More	10	0
Not Sure	6	4

22 Respondents, 65 mentions could initiate, 33 mentions could reconstitute

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Additionally, lead time approximations vary by CAD/PAD product, based on product complexity and testing requirements. The majority of products could be initiated or reconstituted within three years (see Figure 2.8). Cutters were the CAD/PAD product respondents most frequently cited as being able to initiate/reconstitute, and also the product with the shortest lead time (seven out nine survey respondents indicated they could initiate or reconstitute production within one year). Rocket Motor Igniters were identified as having the longest lead times with 29 percent of the seven survey respondents that could initiate/reconstitute indicating a lead time of greater than three years.

Figure 2.8: Lead Time to Initiate/Reconstitute Production by Product Type					
Product	**1 Year or Less**	**1-2 Years**	**3 years**	**7+ years**	**Not Sure**
Aircrew Escape Propulsion System	100%	0%	0%	0%	0%
Other	100%	0%	0%	0%	0%
Cutters	78%	0%	0%	11%	11%
Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges	75%	25%	0%	0%	0%
Electrically Initiated Impulse Cartridges	75%	0%	0%	13%	13%
Impulse Cartridges	75%	13%	0%	13%	0%
Automatic Inflators	71%	29%	0%	0%	0%
Automotive Airbag Initiators	67%	33%	0%	0%	0%
Detonating Cords and Charges, and Linear Charges	60%	20%	0%	20%	0%
Percussion Initiated Impulse Charges	57%	14%	0%	14%	14%
Rocket Motor Igniters	57%	0%	14%	14%	14%
Initiators (Impulse)	50%	13%	0%	13%	25%
Gas Generators	43%	29%	0%	14%	14%
Laser Initiated Cartridges, Detonators, and Initiators	40%	40%	20%	0%	0%
Delay Cartridges and Delay Initiators	38%	25%	0%	13%	25%
Catapults, Thrusters, and Removers	25%	25%	0%	25%	25%

22 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Survey respondents were also asked to identify if they lacked capacity or willingness to initiate production of each CAD/PAD product. The 22 survey respondents identified 221 instances of lacking the ability to initiate production. Seventy-seven percent of respondents could not initiate production of Aircrew Escape Propulsion Systems, while 73 percent could not initiate production of several products such as Detonating Cords and Charges, and Linear Charges; Catapults, Thrusters, and Removers; and Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges (see Figure 2.9).

Figure 2.9: Survey Respondents that Could Not Initiate Production by Product Type	
Product	**Could Not Initiate**
Aircrew Escape Propulsion System	77% (17)
Automotive Airbag Initiators	77% (17)
Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges	73% (16)
Catapults, Thrusters, and Removers	73% (16)
Detonating Cords and Charges, and Linear Charges	73% (16)
Laser Initiated Cartridges, Detonators, and Initiators	73% (16)
Gas Generators	68% (15)
Percussion Initiated Impulse Charges	68% (15)
Automatic Inflators	64% (14)
Delay Cartridges and Delay Initiators	64% (14)
Electrically Initiated Impulse Cartridges	64% (14)
Initiators (Impulse)	64% (14)
Rocket Motor Igniters	64% (14)
Impulse Cartridges	59% (13)
Cutters	55% (12)
Other	0% (0)

22 Respondents, 221 instances of respondents not able to initiate/reconstitute a product
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

2.4 Facilities

CAD/PAD Facilities

The 22 U.S. survey respondents operated 30 CAD/PAD facilities that were primarily in the U.S. Of those 30, three facilities were located outside the U.S., in France, Thailand, and the United Kingdom.

Respondents were asked if they had closed or sold any CAD/PAD facilities since 2006, and the reasons for closure. Of the 22 survey respondents, four respondents closed six CAD/PAD facilities since 2006. The primary reasons for closure were declining demand, financial viability, and business consolidation. Ten different CAD/PAD product lines had been manufactured at the closed facilities: Catapults, Thrusters, and Removers; Cutters; Delay Cartridges and Delay Initiators; Electrically Initiated Impulse Cartridges; Gas Generators; Impulse Cartridges; Initiators (Impulse); Percussion Initiated Impulse Charges; and Rocket Motor Igniters.

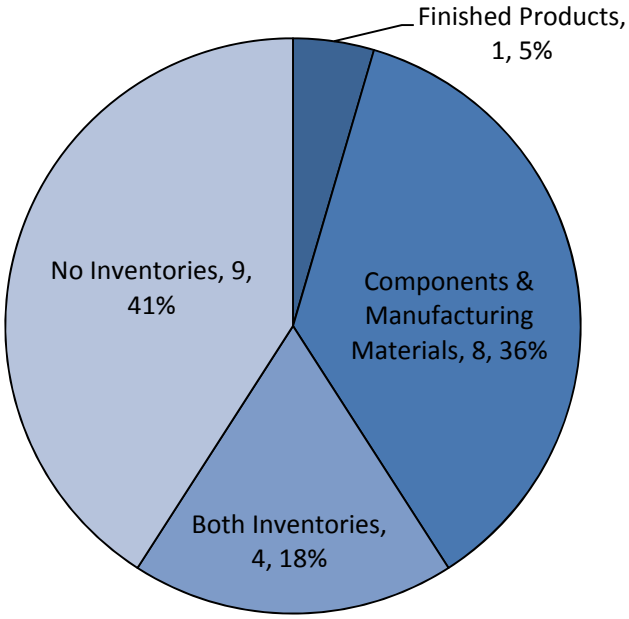
2.5 CAD/PAD Inventory

Respondents were asked a series of questions about their manufacturing operations, specifically about inventories, order backlogs and annual capacity utilization rates for the 2007-2011 period. All 22 respondents provided information regarding their inventories and order backlogs, while 21 provided capacity utilization rates for the five-year period.

Inventory Levels

When asked if they maintain inventories of materials and components used in CAD/PAD manufacturing, and/or inventories of finished CAD/PAD products, nine respondents reported no inventories of either type, 12 reported inventories of components and materials, and five reported inventories of finished products. A subgroup of four respondents reported inventories of both components and materials and finished products (see Figure 2.10).

Figure 2.10: CAD/PAD Inventories by Respondent



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Of the eight respondents dependent on CAD/PAD sales, seven reported inventories of some type.[4] Six dependent respondents held inventories of components and manufacturing materials while three held inventories of finished products. Two of those dependent respondents held inventories of both components and manufacturing materials and finished products.

Respondents holding no inventories generally indicated they procured manufacturing materials and components on a per-order basis, also explaining why no finished product inventories were maintained by those respondents. One respondent said, "There are some common energetics inventoried. But the hardware of the component and the packaging is unique to the product and is not inventoried at all. It is ordered for the contract." Another respondent commented, "Parts are made when orders are received, parts are not made to stock."

[4] Respondents considered dependent on CAD/PAD sales for their viability are those with a ratio of CAD/PAD sales to overall net sales and other revenue of greater than 50 percent.

Respondents only reporting inventories of components and manufacturing materials (eight) reflected a similar approach to keeping very low inventory levels for defense customers but maintained some inventory for commercial customers. One respondent said, "Most of our inventory is job-specific and the parts inventory is ordered for specific contracts. We build to a forecast for our commercial customers only." A second respondent commented, "Some inventory is maintained for common parts between programs. All other materials needed to produce CAD/PAD products are ordered and manufactured once a contract is received." Another respondent cited the age-sensitive nature of finished CAD/PAD products to explain why the organization does not maintain an inventory:

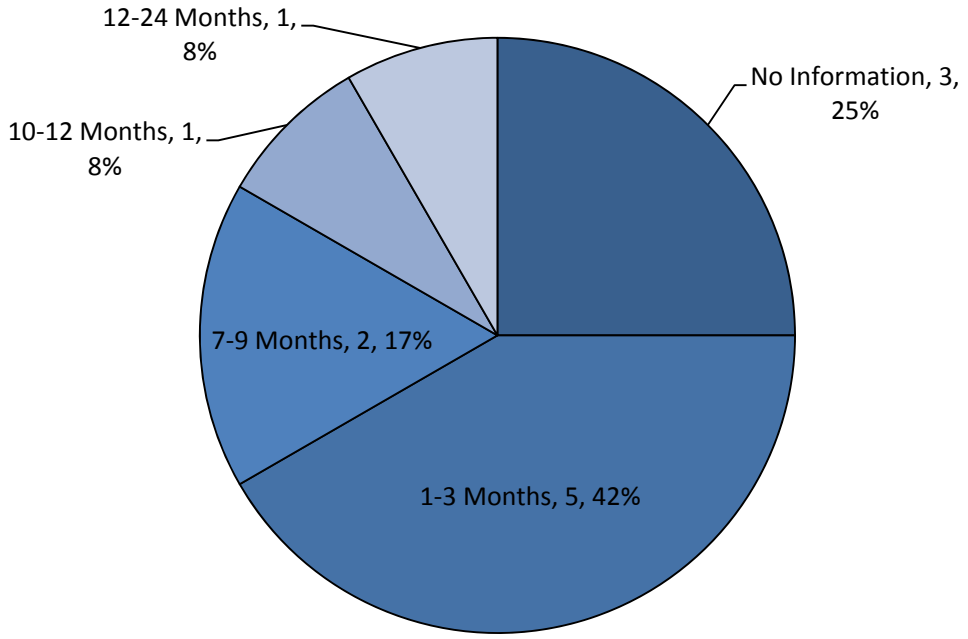
> "Since energetics are age-sensitive, we cannot keep an inventory of finished [products] or components of energetic items. We do usually keep inventory of glass, leads and bodies for some of the lines that have a history of continuous production buys."

Of the four respondents holding inventories of both components and materials and finished products, two maintained an inventory of finished products for distribution, while one maintained an "overage" of finished products, but not quantities sufficient enough to be considered inventory. One respondent said, "We maintain overage of finished goods but we do not manufacture to maintain inventory."

Respondents were then asked about the quantity of inventories held (measured in months) for both components and manufacturing materials used in their CAD/PAD operations and for finished CAD/PAD products.

Respondents maintaining inventories of components and manufacturing materials generally held them for relatively short periods of time. Of the 12 respondents holding those inventories, 41.7 percent (five) held three or fewer months' worth, 66.7 percent (eight) held less than one year's worth in inventory, and two did not provide information. (see Figure 2.11). Of respondents dependent on CAD/PAD sales reported to be holding inventories of components and manufacturing materials (six), five reported holding less than one year's worth and one did not provide information.

Figure 2.11: Respondent Inventories of CAD/PAD Components & Manufacturing Materials



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

When asked to provide additional information regarding their inventory levels, respondents again cited both the age-sensitive nature of CAD/PAD products and the manufacture-to-contract nature of their operations to explain why no inventories of materials and components, or finished products were maintained.

One respondent said, "Explosives are age-sensitive, consequently the customer does not want aged product. We usually 'scrap' these types of inventory after six months." Another respondent commented, "[We] maintain a strong backlog for CAD/PAD products (backlog means booked firm orders) but typically ship immediately upon completion of production." One respondent explained that one month of materials and components were held in inventory to support its CAD/PAD operations, but no inventories of finished products were held.

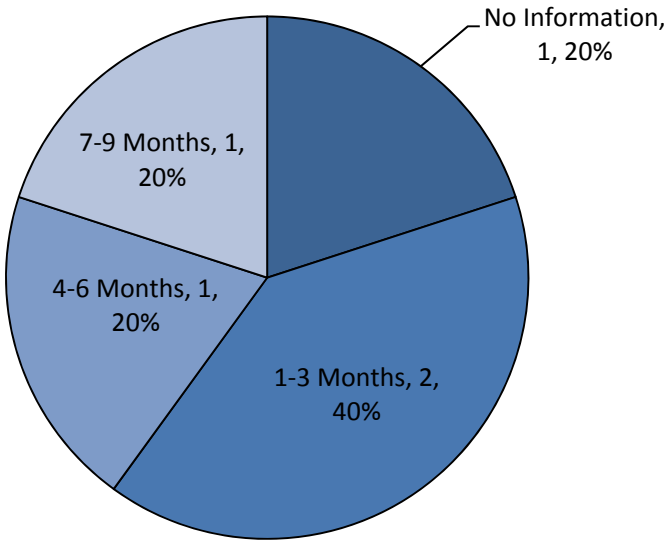
Respondents holding three or fewer months' worth of components and manufacturing material in inventory generally suggested this level was used to support "just in time" manufacturing operations or allowed for a "one-month buffer stock." One respondent said, "This inventory

level supports monthly production needs in addition to one month of buffer stock" in supplies. Another suggested that frequent changes in final product requirements creates risk in maintaining larger quantities of inventory, "Maintaining inventories beyond this period is not cost effective and there is an added risk the parts would not be usable based on revision letter of a released drawing."

Those holding larger quantities of components and manufacturing materials in inventory suggested this was the result of internal procurement efforts. One respondent commented, "Piece part inventory is held until all of the parts have arrived to complete the contract. Procurement of parts usually begins within 30 days of receipt of the contract."

Of respondents maintaining inventories of CAD/PAD finished products (five), two reported holding one to three months, two reported holding four to nine months and one provided no information (see Figure 2.12).

Figure 2.12: Company Inventories of CAD/PAD Finished Products



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

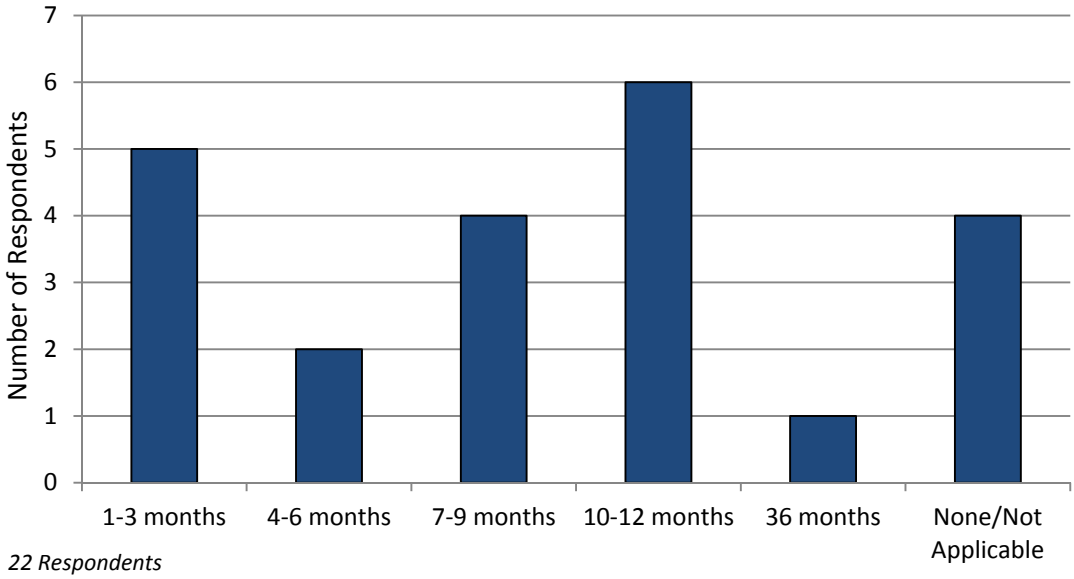
Respondents' again cited both the age-sensitive nature of CAD/PAD products and the build-to order nature of the industry for the relatively low inventory levels. One respondent maintaining

a larger quantity of finished product inventory cited foreign military sales as the primary reason, "The inventory is finished items awaiting Custom's Bill of Lading to move to foreign countries. More accurately, the waiting time can be anywhere from one to 18 months while transportation is arranged by the foreign entity."

Order Backlog

When respondents were asked about their CAD/PAD product order backlog (in months), 17 of the 18 respondents with a backlog reported it to be one year or less, while one respondent reported a backlog of three years (see Figure 2.13). The greatest number of respondents with backlogs (six) reported an order backlog of between 10 and 12 months, citing a variety of reasons including the annual nature of customer contracts. The second most common level of order backlog was between one and three months (five respondents), followed by seven to nine months (four respondents) and four to six months (two respondents).

Figure 2.13: CAD/PAD Product Order Backlog



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

One respondent reporting an order backlog of four to six months suggested the backlog level was primarily dependent on their cartridge supplier(s), "This is determined by the cartridge manufacturer lead time, which is four to six months. As soon as the products are received, they

are typically incorporated into our products and shipped." Another respondent, with a seven to nine month backlog, indicated that level varies depending on a number of factors, "We schedule our factory manufacturing capability as much into the future as possible. This varies depending upon budget cycles, funding delays, etc."

Of eight respondents categorized as dependent on CAD/PAD sales, seven maintain an order backlog ranging from a period of one to 12 months. Two dependent respondents maintain an order backlog of between one and three months, three maintain an order backlog of between seven and nine months, and two maintain an order backlog of between 10 and 12 months.

2.6 Capacity Utilization Rates

Another way to understand industry health and competitiveness is to review the annual capacity utilization rate of survey respondents' operations.[5] CAD/PAD respondents were asked to provide the average production capacity utilization rate for their CAD/PAD manufacturing, integration, and/or assembly operations for the 2007-2011 period; 21 completed the section.

The average capacity utilization rate reported over the 2007-2011 period was 41.8 percent, and the yearly values stayed within three percentage points of that average. The industry average started at 43 percent in 2007 and 2008 but then fell to 39.3 percent in 2009, recovering in 2010 (41.4 percent) and 2011 (42.1 percent) (see Figure 2.14).

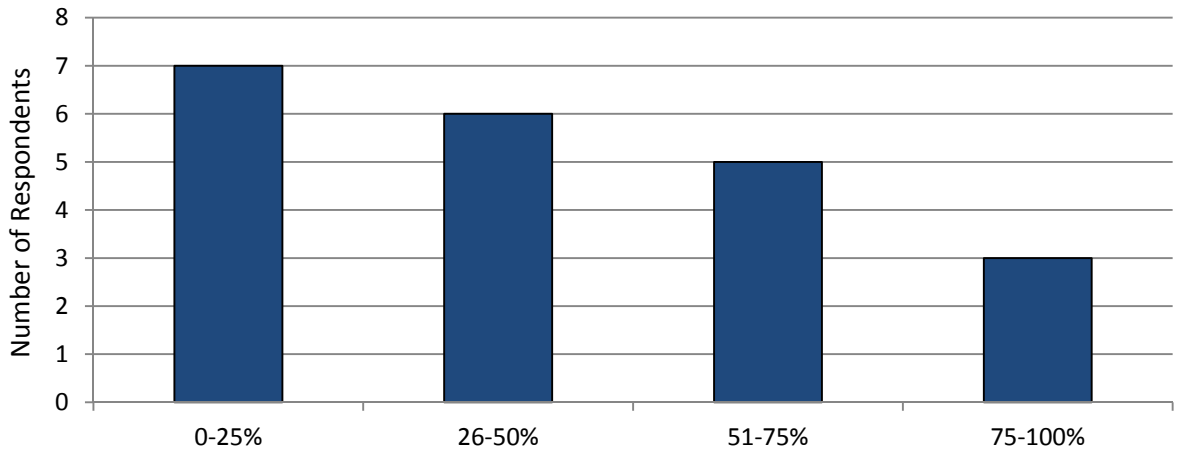
As a subset, seven of the eight respondents categorized as dependent on CAD/PAD sales reported capacity utilization rates for the 2007-2011 period. Their five-year average rate of 56.9 percent was 15 percentage points higher than that of the larger CAD/PAD industry. The rate reported by dependent respondents followed a trend similar to the overall surveyed CAD/PAD industry but was more volatile in nature. Dependent respondents' average rate grew from 57.1 to 58.1 percent 2007-2008, but then fell to 50.7 percent in 2009 before recovering to 59.9 percent in 2011 (see Figure 2.14).

[5] The capacity utilization rate is the extent to which an organization uses its total installed manufacturing capacity (measured on an annual basis). This rate can be calculated as a percentage of an organization's potential output that is being used for production, where potential output is the quantity produced by the organization if it were to operate seven days a week with three, eight-hour shifts.

Figure 2.14: Average CAD/PAD Manufacturing, Integration and/or Assembly Capacity Utilization Rate, 2007-2011 (Percent of Potential Output)		
Year	**All Respondents**	**Dependent Respondents**
2007	43%	57%
2008	43%	58%
2009	39%	51%
2010	41%	59%
2011	42%	60%
2007-2011 Average	41.8%	56.9%
21 Respondents, 7 Dependent Respondents		
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013		

Overall, seven of the 21 respondents (33 percent) reported capacity utilization rates of 25 percent or lower, while six respondents (29 percent) reported rates of between 26 and 50 percent. Of respondents categorized as dependent on CAD/PAD sales, one reported a rate below 25 percent and two reported rates between 26 and 50 percent (see Figure 2.15). While capacity utilization rates are a helpful measure of industry performance, as one respondent points out: "Market fluctuations result in product segmentation variances as a percentage of overall facility production capacity."

Figure 2.15: CAD/PAD Industry Average Capacity Utilization Rate for CAD/PAD Manufacturing, Integration and/or Assembly Operations, 2007-2011
(Percent of Potential Output)



21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The U.S. Census Bureau (Census) conducts a quarterly survey of plant capacity utilization in the manufacturing sector. In calculating these rates, Census utilizes the ratio of a manufacturer's actual production to their full capability. Full production capacity is as "the market value of the maximum level of full production that an establishment could reasonably expect to attain under normal and realistic operating conditions fully utilizing the machinery and equipment in place."[6]

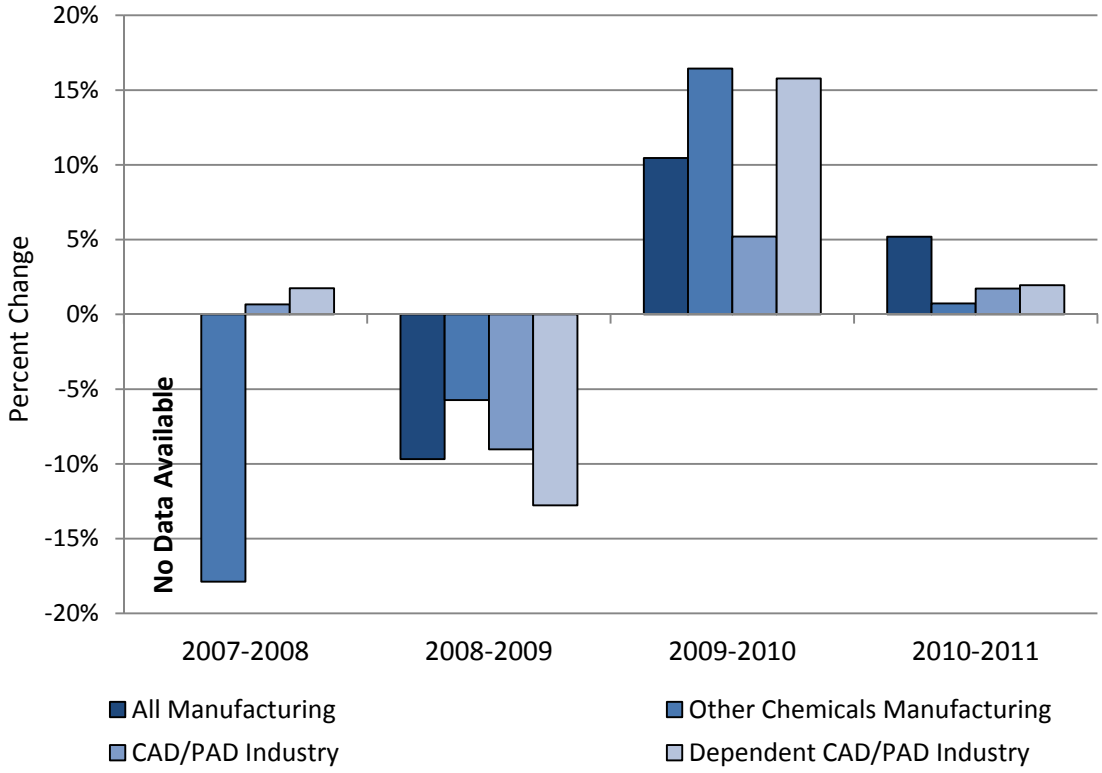
This calculation of capacity utilization is slightly different than that utilized in BIS CAD/PAD reports (see Footnote 5). As a result, comparing the percent change in the surveyed CAD/PAD industry's capacity utilization rates across the 2007-2011 period to those of the "Manufacturing" sector and the "Other Chemicals Manufacturing" sector – the sector most closely aligned with CAD/PAD manufacturing provides the most accurate analysis.

Capacity utilization rates remained stable within the surveyed CAD/PAD industry in 2008 while the rate declined 17.9 percent in the "Other Chemicals Manufacturing" sector. Capacity utilization rates then declined in 2009 across the CAD/PAD industry (nine percent decline), the "Other Chemicals Manufacturing" sector (5.7 percent decline), and the "Manufacturing" sector

[6] More information the Census Bureau's Survey of Plant Capacity Utilization can be found at: http://www.census.gov/manufacturing/capacity/index.html. No data were available for 2007.

(9.7 percent decline). Those rates then recovered in 2010, as the "Manufacturing" sector reported 10.5 percent increase in capacity utilization and the "Other Chemicals Manufacturing" sector reported a 16.4 percent increase. The surveyed CAD/PAD industry's average rate increased by 5.2 percent in 2010, while the rate reported by respondents categorized as dependent on CAD/PAD sales was more in line with the broader industry growth rate, at 15.8 percent (see Figure 2.16).

Figure 2.16: Percent Change in Capacity Utilization Rates 2007-2011



21 Respondents

Sources: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

U.S. Census Bureau,Survey of Plant Capacity Utilization: http://www.census.gov/manufacturing/capacity/index.htm

3. SALES AND EXPORTS

3.1 CAD/PAD Industry Sales

Respondents were asked to report total CAD/PAD defense and non-defense sector sales for 2007-2011 and provide an estimate for the 2012-2016 period. They were also asked to provide information on both defense and non-defense sector exports for the same periods and specify the destination of the exports. As previously discussed, products relevant to this assessment were broken into 14 product lines, and the impulse cartridge product line was further divided into two categories.

Of the 22 survey respondents, 19 provided complete sales information. In addition, automotive airbag initiators/propellants was initially a product line covered by this assessment, but was removed as all reported sales in this product line were to the non-defense sector and significantly greater than sales reported within all other product lines.[7]

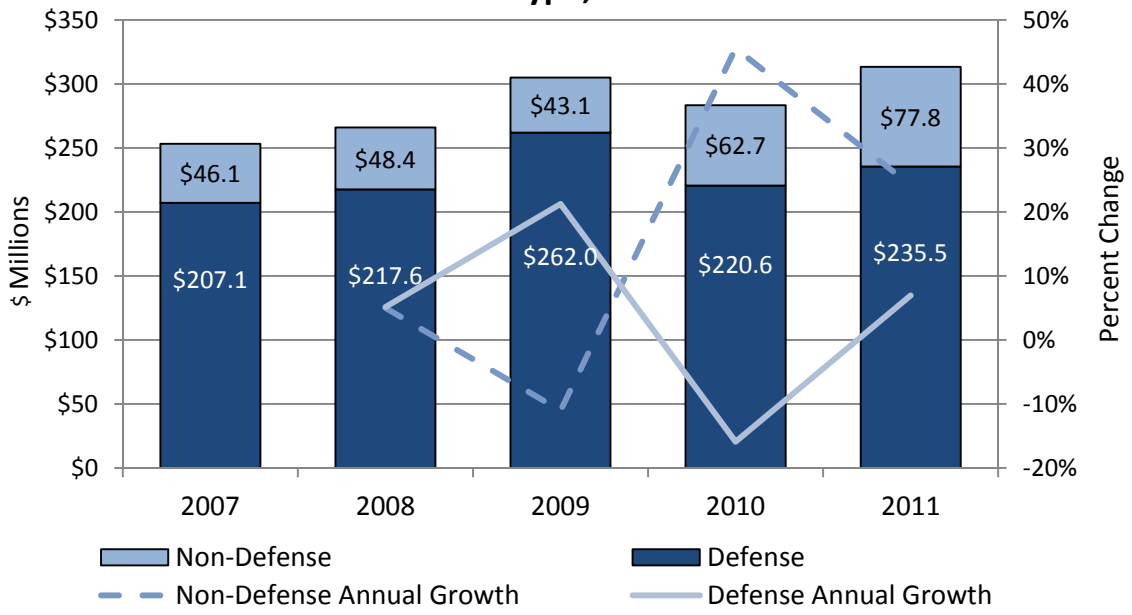
Total Sales

Total U.S. CAD/PAD sales as reported by 19 respondents averaged $284.2 million per year and split 81.4 percent/18.6 percent between the defense and non-defense sectors, respectively. Overall sales grew 23.7 percent over the five-year period from $253 million in 2007 to $313.3 million in 2011. Sales increased each year except 2010, when they declined 7.1 percent from $305 million in 2009 to $283.3 million.

Defense-sector sales grew by 13.7 percent over the period, from $207.1 million in 2007 to $235.5 million in 2011. However, similar to overall CAD/PAD sales, defense sector sales declined in 2010, down 15.8 percent from $262 million in 2009 to $220.6 million. The non-defense sector reported the strongest sales growth over the five-year period, growing 68.8 percent from $46.1 million in 2007 to $77.8 in 2011. Non-defense sector sales fell 11.1 percent from $48.4 million in 2008 to $43.1 million in 2009; however, sales ended the period in 2011 at $77.8 million (see Figure 3.1).

[7] All data for the 1995-1999 and 2001-2005 periods covers the defense sector only, while data for the 2007-2011 period includes both defense and non-defense sectors, unless otherwise stated. In previous BIS CAD/PAD reports, all USG non-defense-related agencies (e.g. NOAA, NASA) were defined as defense, while in this 2007-2011 assessment, they are defined as non-defense.

Figure 3.1: Total U.S. CAD/PAD Sales and Sales Growth by Customer Type, 2007-2011



19 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

For a broader perspective, the sales performance of the CAD/PAD industry can be compared to sales reported in the overall "Manufacturing" sector of the economy, sales in the more specific "Chemicals Manufacturing" sector, and sales within the "Explosives Manufacturing" sub-sector.[8] Sales in the broader "Manufacturing" and "Chemicals Manufacturing" sectors rebounded after declining significantly in 2009 (declining 19.4 percent and 16.9 percent, respectively). Both the "Manufacturing" and "Chemicals Manufacturing" sectors reported growth rates between 11 and 12 percent in 2010 and 2011, resulting in cumulative sales growth rates for the 2007-2011 period of three percent and 7.3 percent, respectively.

In contrast, sales reported in the "Explosives Manufacturing" sector, the sub-sector most closely aligned with the surveyed CAD/PAD industry, grew 19.8 percent over the 2007-2011 period, but declined in 2011 by 4.2 percent (see Figure 3.2). The "Explosives Manufacturing" sector

[8] Information on manufacturing industry sales, available through 2011, was obtained from the U.S. Census Bureau's Annual Survey of Manufacturers (ASM), which can be found at http://www.census.gov/manufacturing/asm/. The ASM findings are reported by North American Industry Classification System (NAICS) codes. The NAICS code best aligned with CAD/PAD manufacturing is 325920, "Explosives Manufacturing," which is under NAICS code 325, "Chemical Manufacturing," and NAICS code 31-33, "All Manufacturing."

experienced sales growth similar to that of the surveyed CAD/PAD industry, at 19.8 percent and 23.7 percent, respectively, over the five-year period.

Figure 3.2: Relative Sales Performance of the CAD/PAD Sector 2007-2011

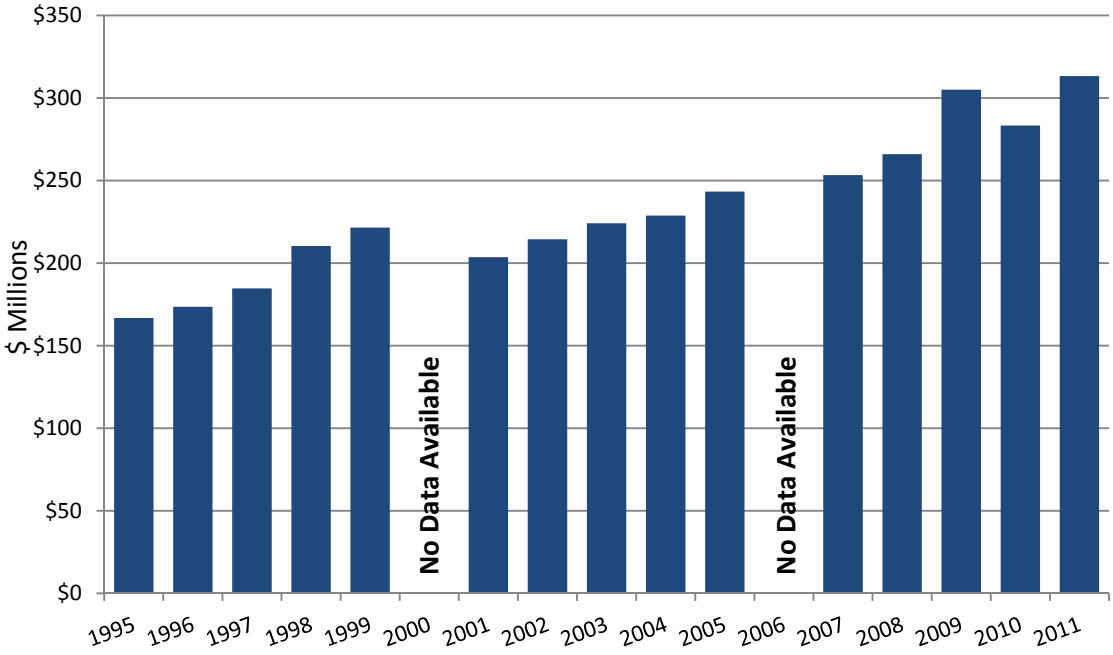
Sector	NAICS Code(s)	Average Annual Sales/Shipments ($ millions)	2007-2011 Sales/Shipment Growth
Manufacturing	31-33	$5,131,860	3.0%
Chemical Manufacturing	325	$714,820	7.3%
Explosives Manufacturing	325920	$1,977	19.8%
CAD/PAD Industry	N/A	$284.2	23.7%

19 Respondents
**CAD/PAD Source*: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013
**Manufacturing Sectors Source*: U.S. Census Bureau, Annual Survey of Manufacturers 2007-2011: http://www.census.gov/manufacturing/asm/

Using data collected from the previous two BIS CAD/PAD reports, CAD/PAD sales have grown over the 1995-2011 period but were marked by a drop in reported sales as data moves between assessment periods.[9] Average annual sales calculated over each period (1995-1999, 2001-2005, and 2007-2011) increased steadily across the 16-year period, from an average $191.4 million per year over the 1995-1999 period to an average $222.8 million per year over the 2001-2005 period, and finally to an average $284.2 million per year over the 2007-2011 period. Five-year sales growth over the 2007-2011 period (23.7 percent) was similar to that of the 2001-2005 period (19.5 percent), but below the 1995-1999 average (32.8 percent) (see Figures 3.3 and 3.4).

[9] All data for the 1995-1999 and 2001-2005 periods covers the defense sector only, while data for the 2007-2011 period includes both defense and non-defense sectors, unless otherwise stated. In previous BIS CAD/PAD reports, all USG non-defense-related agencies (e.g. NASA) were defined as defense, while in this 2007-2011 assessment, they are defined as non-defense.

Figure 3.3: Total Reported CAD/PAD Sales, 1995-2011



2000 BIS CAD/PAD Report: 27 Respondents; 2006 BIS CAD/PAD Report: 25 Respondents; 2013 BIS CAD/PAD Report: 19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry— 2000, 2006, 2013

Figure 3.4: Total CAD/PAD Sales, 1995-2011		
BIS CAD/PAD Report	**Average Annual U.S. Sales ($ millions)**	**5-Year Sales Growth**
2000	$191.4	32.8%
2006	$222.8	19.5%
2013	$284.2	23.7%
2000 Review: 27 Respondents; 2006 Review: 25 Respondents; 2013 Review: 19 Respondents *Source:* U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2000, 2006, 2013		

3.2 Respondent Dependency on CAD/PAD Sales

Respondents were asked to provide data on overall organization net sales and other revenue over the 2007-2011 period. Calculating CAD/PAD sales as a portion of net sales provides a measure of organizational dependence on CAD/PAD operations. CAD/PAD sales comprised an average 35.9 percent of net sales for the industry; however, the calculated median was 14.4 percent. Ten

respondents reported CAD/PAD sales as less than 20 percent of net sales and revenue over the five-year period, while seven reported CAD/PAD sales as over 80 percent of net sales (see Figure 3.5). For this analysis, respondents are divided into two groups, those with CAD/PAD sales comprising less than 50 percent of net sales (non-dependent) and those with CAD/PAD sales comprising more than 50 percent of net sales (dependent). Eleven respondents fall into the non-dependent category, while eight fall into the dependent category.

Figure 3.5: Respondent CAD/PAD Sales as a Percent of Net Sales, 2007-2011

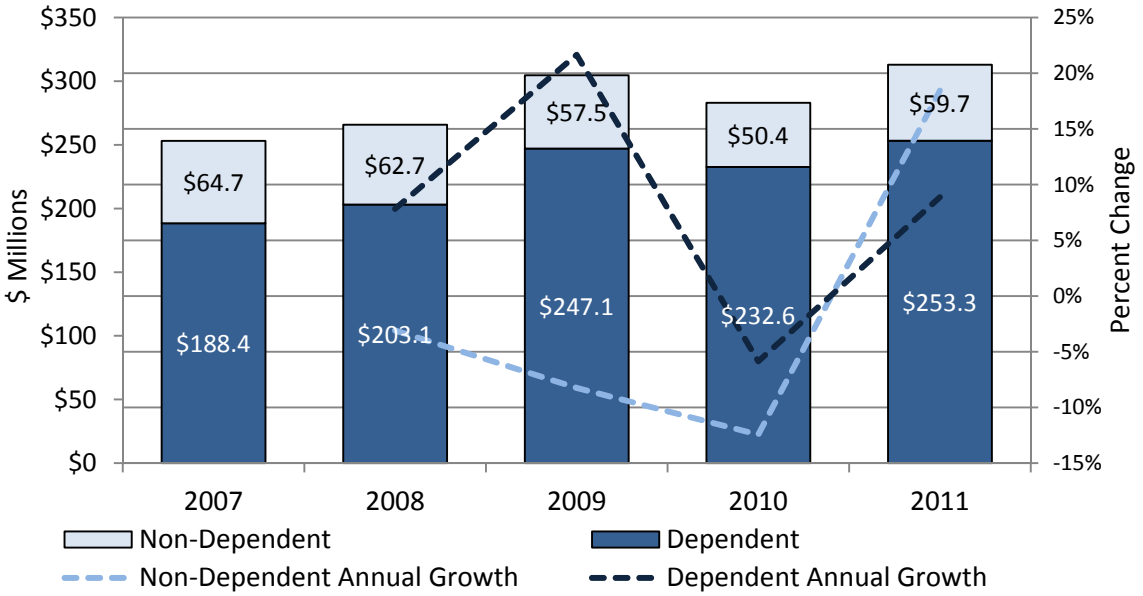
Percent	Number of Respondents
0%-20%	10
21%-40%	1
41%-60%	1
61%-80%	0
81%-100%	7

19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

The eight respondents categorized as dependent on CAD/PAD sales accounted for 79.1 percent of sales over the 2007-2011 period ($225.2 million annually), while the 11 non-dependent respondents accounted for 20.9 percent of all sales ($59 million annually). These percentages remained relatively stable over the five-year period.

Dependent respondents experienced stronger CAD/PAD sales growth over the 2007-2011 period than their non-dependent counterparts. The sales of dependent respondents grew 34.5 percent over the five-year period, while non-dependent respondents' sales fell by 7.8 percent (see Figure 3.6).

Figure 3.6 : Total U.S. CAD/PAD Sales by Respondent Type, 2007-2011



19 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

BIS evaluated respondents' CAD/PAD sales performance over the 2007-2011 period by comparing CAD/PAD sales growth to growth in net sales and other revenue. Gross CAD/PAD sales growth outperformed the net sales growth of four respondents. Net sales and CAD/PAD sales of three respondents performed equally, and 12 respondents' net sales outperformed their CAD/PAD sales (see Figure 3.7). CAD/PAD sales of five of dependent respondents and three non-dependent respondents performed at least as strong as overall net sales over the 2007-2011 period.

Figure 3.7: CAD/PAD Sales Performance, 2007-2011

CAD/PAD Sales Growth Relative to Net Sales Growth	Number of Respondents
Outperform	4
Equal Performance	3
Underperform	12

19 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

Sales by CAD/PAD Product Line

Respondents were asked to provide sales data for the 14 product lines (and two sub-categories) previously outlined in this chapter. U.S. sales were reported for all product lines at least once over the 2007-2011 period.[10] The majority of respondents (ten) reported sales of only one CAD/PAD product line over the period (see Figure 3.8). Respondents categorized as dependent on CAD/PAD sales reported an average 5.1 product lines each, while non-dependent respondents reported an average 1.9 each.

Figure 3.8: Number of Product Lines Provided per Respondent, 2007-2011

Number of Product Lines	Number of Respondents
1	10
2-3	3
4-5	3
6 or More	3

19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

The product line identified by the largest number of respondents (11) was Impulse Cartridges (including Electrically- and Percussion-Initiated Cartridges), followed by Cutters (eight), and Gas Generators (seven) (see Figure 3.9).

[10] Sales data for automotive airbag initiators/propellants was removed from this report.

Figure 3.9: Total U.S. CAD/PAD Sales by Product Line, 2007-2011*				
Product Line	**Number of Respondents Supporting**	**Annual Sales 2007-2011 ($ thousands)**	**Share of Total Sales**	**Total Change 2007-2011**
Impulse Cartridges	8	46,280	16.3%	84.1%
Electrically-Initiated	6	12,120	4.3%	-21.0%
Percussion-Initiated	2	6,780	2.4%	67.2%
Detonating Cords & Charges	5	36,820	13.0%	70.1%
Gas Generators	7	34,580	12.2%	-44.8%
Cutters	8	23,200	8.2%	56.3%
Impulse Initiators	3	22,620	8.0%	136.4%
Laser-Initiated Cartridges, Detonators, & Initiators†	-	-	-	13.0%
Catapults, Thrusters, & Removers	4	16,620	5.8%	67.7%
Rocket Motor Igniters†	-	-	-	3.9%
Delay Cartridges & Initiators	4	12,620	4.4%	28.6%
Thermal Batteries & Components	2	4,720	1.7%	48.0%
Aircrew Escape Propulsion Systems†	-	-	-	50.0%
Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges	2	1,920	0.7%	-33.7%
Automatic Inflators	3	1,830	0.6%	-77.2%
Other	3	32,140	11.3%	-12.8%

*Sales data for automotive airbag initiators/propellants was removed from this report.
†Data was removed to protect proprietary data; totals reflect CAD/PAD defense sector sales for all product lines, including those removed.
19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

Ten CAD/PAD product lines experienced sales growth over the five-year period ending in 2011, while the remaining four experienced a decline over the same period (Electrically-Initiated and Percussion-Initiated Impulse Cartridges were considered subcategories of the Impulse Cartridge product line and not included in this total). The Impulse Initiator product line experienced the largest percentage increase in sales over the 2007-2011 period, growing 136.4 percent from $11.4 million in 2007 to $26.8 million in 2011. Sales of Impulse Cartridges and Detonating Cords and Charges also performed strongly over the 2007-2011 period. Sales of both product

lines surpassed Gas Generators in 2009 to become the largest product areas covered by the assessment.

Sales of Impulse Cartridges grew 84.1 percent from $35.7 million in 2007 to $65.7 million in 2011, accounting for 16.3 percent of total CAD/PAD sales over the period. The Electrically-Initiated Impulse Cartridge subcategory experienced declining sales over the same period, falling 21 percent from $14.1 million in 2007 to $11.2 million in 2011. The Percussion-Initiated Impulse Cartridge subcategory experienced sales growth of 67.2 percent over the period, growing from $4.7 million in 2007 to $7.8 million in 2011.

Detonating Cords and Charges reported sales nearly doubling between 2007 and 2009, growing from $25.1 million in 2007 to $47.3 million in 2009. However, sales of the product line then fell to $42.6 million in 2011, resulting in a five-year sales growth rate of 70.1 percent. Sales of Detonating Cords and Charges comprised 13 percent of reported CAD/PAD sector sales over the 2007-2011 period.

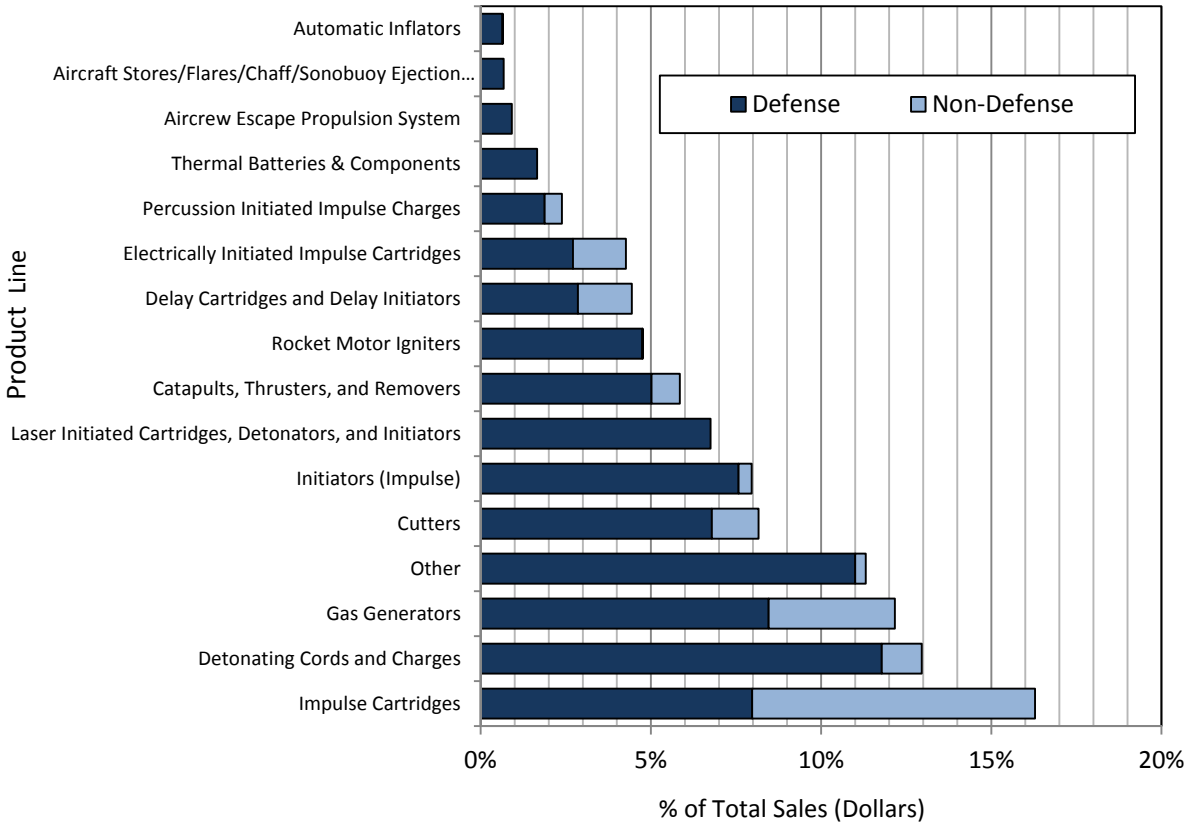
Other product lines with strong sales growth over the five-year period included Catapults, Thrusters and Removers (five-year cumulative sales growth of 67.7 percent to end 2011 with $18.6 million in reported sales), Cutters (five-year cumulative sales growth of 56.3 percent to end 2011 with $31.7 million in reported sales), and Thermal Batteries and Components (five-year cumulative sales growth of 48 percent to end 2011 with $6 million in reported sales).

The Automatic Inflator product line experienced the largest percentage decline in sales over the five-year period, falling 77.2 percent from $3.1 million in 2007 to $700,000 in 2011, while gas generator sales experienced the greatest dollar value decline, falling from $45.4 million in 2007 to $25 million in 2011 (or 44.8 percent). Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges sales also declined 33.7 percent over the five-year period to end 2011 with $2.2 million in sales. Respondents indicating “Other” sales were asked to specify a product type, and responses included: Valves and Pyrovalves; Electronic Controllers; and Inert Devices, Hardware and Consumables. Reported “Other” sales declined 12.8 percent over the five-year period, to $30.1 million in 2011.

Figure 3.10 shows CAD/PAD product lines, their share of total U.S. sales (in dollars), and the portion of each product area sold to the defense/non-defense sectors.[11] All product lines reported a greater portion of sales to the defense sector with the exception of Impulse Cartridges, which were nearly equally divided between the defense and non-defense sectors. Of reported Impulse Cartridge sales over the 2007-2011 period, 49 percent went to the defense sector and 51 percent went to the non-defense sector. Other product lines with a significant portion of sales to the non-defense sector included Delay Cartridges and Initiators (35.6 percent non-defense, 64.4 percent defense), Electrically-Initiated Impulse Cartridges (36.4 percent non-defense, 63.6 percent defense) and Gas Generators (30.5 percent non-defense, 69.5 percent defense). At least 70 percent of sales reported in all remaining product lines went to the defense sector over the 2007-2011 period.

[11] All data for the 1995-1999 and 2001-2005 periods covers the defense sector only, while data for the 2007-2011 period includes both defense and non-defense sectors, unless otherwise stated. In previous BIS CAD/PAD reports, all USG non-defense-related agencies (e.g. NOAA, NASA) were defined as defense, while in this 2007-2011 assessment, they are defined as non-defense.

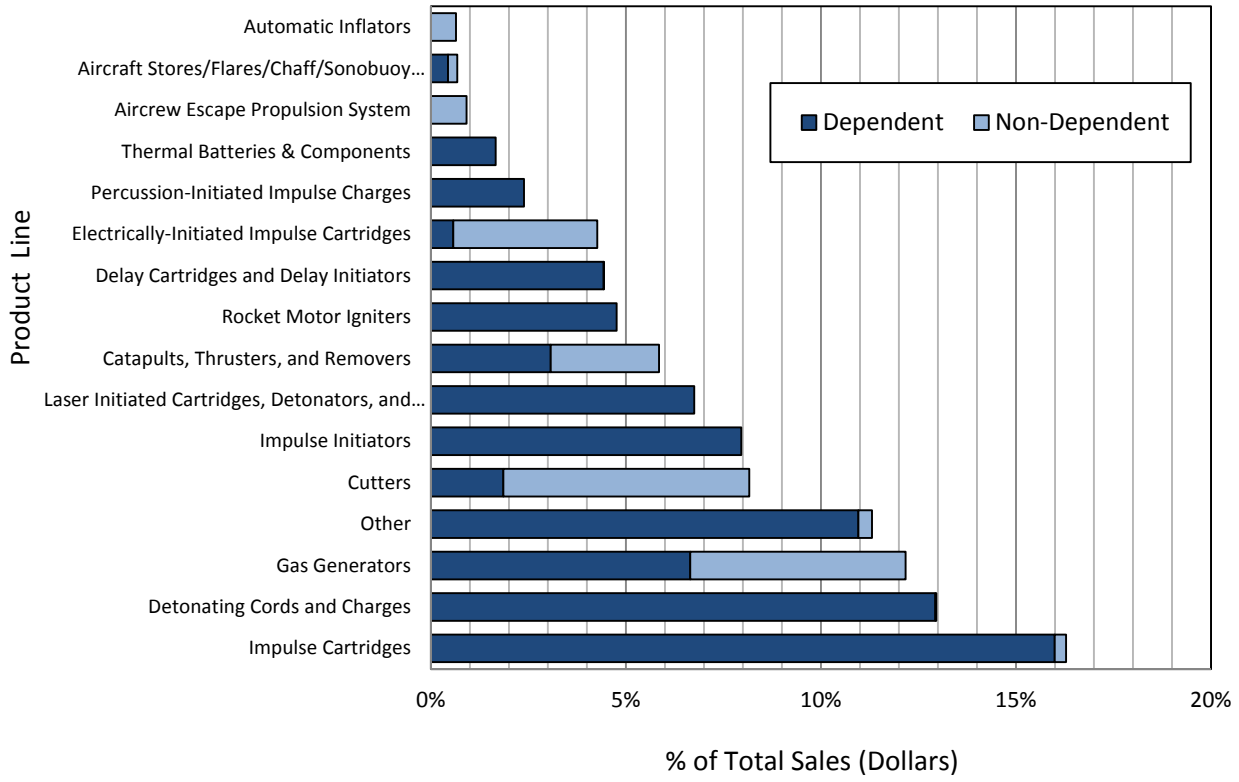
Figure 3.10: Total U.S. CAD/PAD Sales by Product Line - Defense/Non-Defense, 2007-2011



*Sales data for automotive airbag initiators/components was removed
19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Reviewing sales by respondent dependence on CAD/PAD sales provides another perspective. The eight respondents categorized as dependent on CAD/PAD sales accounted for 79.1 percent of all CAD/PAD sales for the 2007-2011 period, and were responsible for more than 95 percent of sales in eight product lines: Delay Cartridges and Initiators; Detonating Cords and Charges; Impulse Cartridges and sub-category Percussion-Initiated Impulse Charges; Impulse Initiators; Laser-Initiated Cartridges, Detonators and Initiators; Rocket Motor Igniters; Thermal Batteries and Components; and "Other" (see Figure 3.11). Those same dependent respondents reported less than 25 percent of all sales of Cutters and Electrically-Initiated Impulse Cartridges. Sales of Aircrew Escape Propulsion Systems and Automatic Inflators were not reported by respondents categorized as dependent on CAD/PAD sales.

Figure 3.11: Total U.S. CAD/PAD Sales by Product Line - Dependent/Non-Dependent, 2007-2011



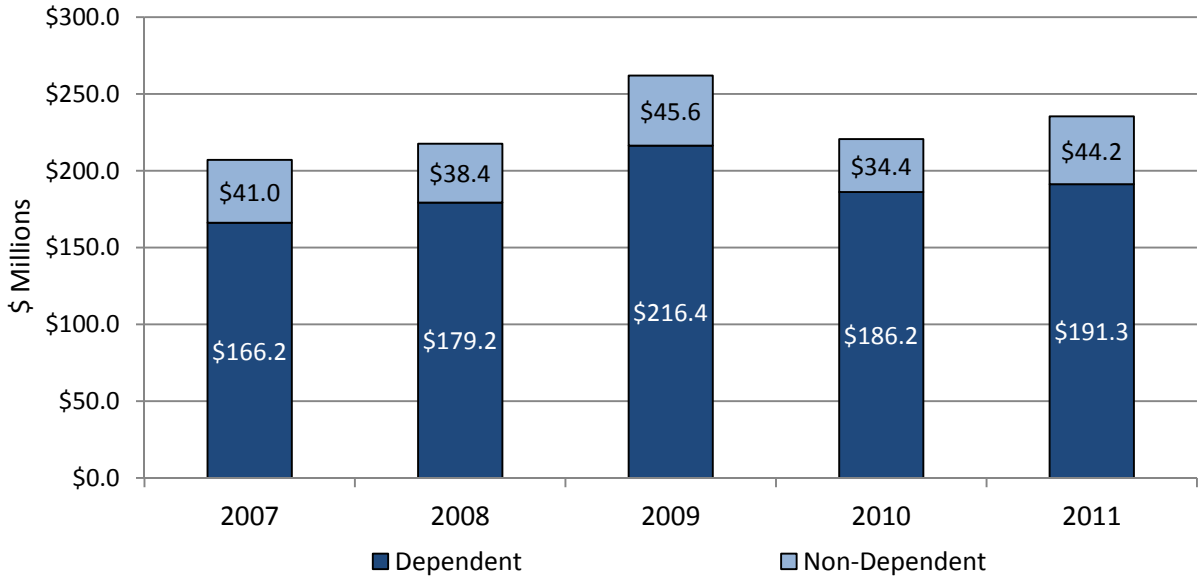
*Sales data for automotive airbag initiators/propellants was removed from this report
19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Reported sales of three product lines were split equally between respondents categorized as dependent and non-dependent respondents: Aircraft Stores/Flares/Chaff/ Sonobuoy Ejection Cartridges; Catapults, Thrusters and Removers; and Gas Generators. Of total Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridge sales over the 2007-2011 period, 64.9 percent were reported by respondents categorized as dependent on CAD/PAD sales, while 52.5 percent of Catapult, Thruster and Remover sales, and 54.6 percent of Gas Generator sales were reported by those respondents over the period.

3.3 Defense Sales

While overall CAD/PAD industry sales as reported by the 19 respondents increased 23.7 percent over the 2007-2011 period, sales to the defense sector grew 13.7 percent over that five-year period. Defense sector sales grew from $207.1 million in 2007 to $262 million in 2009, but fell to $220.6 million in 2010 before rebounding to $235.5 million in 2011. As such, the defense sector share of overall reported CAD/PAD sales fell from 81.8 percent in 2007 to 75.2 percent in 2011 (see Figure 3.12).

Figure 3.12: Total U.S. CAD/PAD Defense Sales - Dependent/Non-Dependent, 2007-2011



19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

Respondents categorized as dependent on CAD/PAD sales accounted for 82.2 percent of defense sector CAD/PAD sales over the five-year period (an average $187.8 million of $228.6 million, annually). Dependent respondents also reported a higher reliance on defense sector sales than their non-dependent counterparts. Defense sector sales comprised 83.4 percent of dependent respondents' sales over the 2007-2011 period, ranging from a high of 88.1 percent in 2007 and 2008 to a low of 75.4 percent in 2011.

In contrast, non-dependent respondents reported defense sector sales comprising 69 percent of their total sales over the five-year period, ranging from a low of 61.2 percent in 2008 to a high of 79.3 percent in 2009. Non-dependent respondents accounted for 17.8 percent of the defense sector CAD/PAD sales (an average of $40.8 million of $228.6 million annually). Over the period, the share of dependent respondents' sales destined for the defense sector declined, while that same share reported by non-dependent respondents increased (see Figure 3.14).

Figure 3.14: U.S. CAD/PAD Sales

Respondent Type	Customer Type	2007	2008	2009	2010	2011
Dependent	Defense	88.1%	88.1%	87.4%	79.9%	75.4%
	Non-Defense	11.9%	11.9%	12.6%	20.1%	24.6%
Non-Dependent	Defense	63.3%	61.2%	79.3%	68.3%	74.1%
	Non-Defense	36.7%	38.8%	20.7%	31.7%	25.9%

19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

Defense Sales by Product Line

Defense sector sales increased in eight product lines over the 2007-2011 period and declined in the remaining six (see Figure 3.15). Sales of the two subcategories of Impulse Cartridges to the defense-sector were split, with Electrically-Initiated Impulse Cartridges reporting a decline in sales and Percussion-Initiated Impulse Cartridges reporting sales growth.

Figure 3.15: U.S. CAD/PAD Defense-Sector Sales, 2007-2011			
Product Line	**2007-2011 Average ($ thousands)**	**Share of Total Defense Sales**	**Percent Change 2007-2011**
Detonating Cords & Charges	33,480	14.6%	76.9%
Gas Generators	24,030	10.5%	-33.4%
Impulse Cartridges	22,670	9.9%	-13.6%
Electrically-Initiated	7,710	3.4%	-36.9%
Percussion-Initiated	5,340	2.3%	52.2%
Impulse Initiators	21,530	9.4%	131.3%
Cutters	19,300	8.4%	57.4%
Laser-Initiated Cartridges, Detonators & Initiators†	-	-	13.0%
Catapults, Thrusters, & Removers	14,260	6.2%	61.7%
Rocket Motor Igniters†	-	-	3.9%
Delay Cartridges & Initiators	8,120	3.6%	-7.6%
Thermal Batteries & Components	4,720	2.1%	48.0%
Aircrew Escape Propulsion Systems†	-	-	50.0%
Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges	1,920	0.8%	-33.7%
Automatic Inflators	1,820	0.8%	-78.1%
Other	31,270	13.7%	-12.9%
Total CAD/PAD Defense†	**$228,560**	**100.0%**	**14.6%**

*Sales data for automotive airbag initiators/propellants was removed from this report.
†Data was removed to protect proprietary data; totals reflect CAD/PAD defense sector sales for all product lines, including those removed.
19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

The Impulse Initiator product line reported the strongest defense sector sales growth over the five-year period, increasing 131.3 percent from $10.8 million in 2007 to $25 million in 2011. The product line's share of total defense sector sales grew from 5.2 percent in 2007 to 10.6 percent in 2011.

Defense sector sales of Detonating Cords and Charges; Catapults, Thrusters and Removers; and Cutters also exhibited strong growth. Sales of Detonating Cords and Charges to the defense sector grew 76.9 percent over the five-year period to reach $40.5 million in 2011 (14.6 percent of total defense sector sales). Defense sector sales of Catapults, Thrusters and Removers grew by 61.7 percent to reach $16.1 million in 2011 (6.2 percent of total defense sector sales). Defense sector sales of Cutters grew by 57.4 percent to reach $27.2 million in 2011 (8.4 percent of total

defense sector sales). Of product lines that reported declining defense sector sales over the 2007-2011 period, Automatic Inflators experienced the largest percentage decline, 78.1 percent. Sales of Automatic Inflators to the defense sector fell from $3.1 million in 2007 to $675,000 in 2011, and comprised 0.8 percent of defense-sector sales over the five-year period.

Gas Generators posted the largest dollar value decline in defense sector sales over the 2007-2011 period, falling from $27.9 million in 2007 to $18.6 million in 2011 (33.4 percent). The Gas Generator product line's share of defense sector sales fell from 13.4 percent to 7.9 percent over the five-year period.

Sales of Impulse Cartridges reported the second largest dollar value decline over the 2007-2011 period, falling 13.6 percent from $22.2 million in 2007 to $19.2 million in 2011, and the product line's share of defense-sector sales fell from 10.7 percent in 2007 to 8.2 percent in 2011. The Electrically-Initiated subcategory experienced a greater percentage decline in defense-sector sales than the overall Impulse Cartridge product line, falling 36.9 percent over the five-year period. Only the Percussion-Initiated subcategory reported strong defense-sector sales growth over the five-year period, growing 52.2 percent.

Respondents were also allowed to specify "Other" CAD/PAD-related products that did not fit into the pre-determined product lines. Defense-sector sales of "Other" products categories fell from $34.0 million in 2007 to $29.6 million in 2011 (12.9 percent).

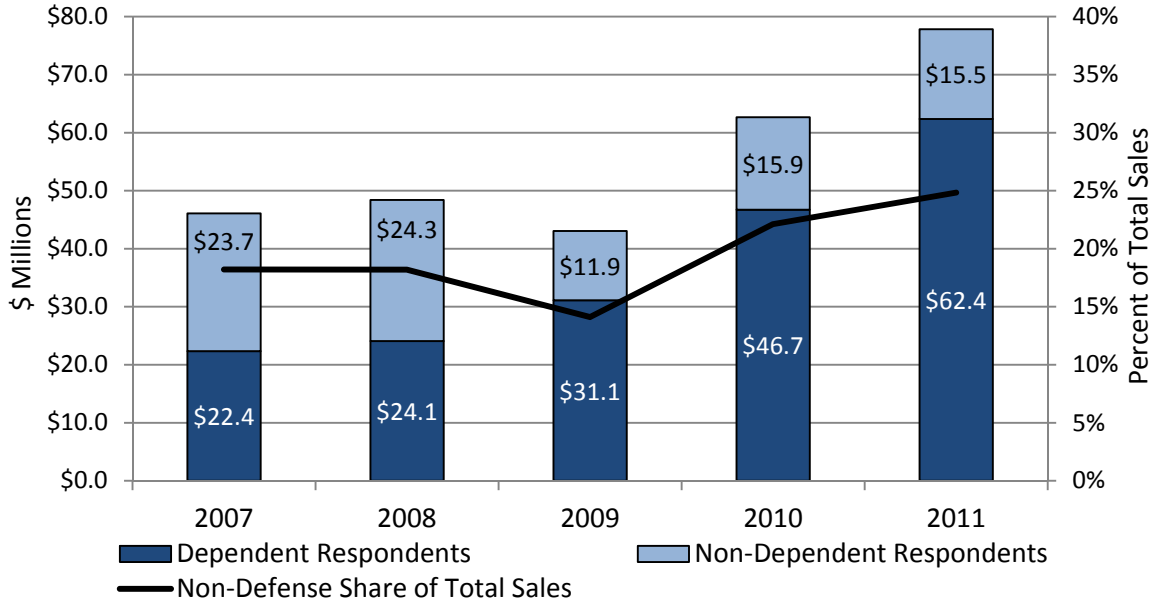
3.4 Non-Defense Sales

Fourteen respondents reported non-defense sector sales across ten product lines over the 2007-2011 period.[12] Non-defense sector sales include those to commercial organizations and non-defense/civil USG agencies (such as NASA, NOAA, and the EPA). Non-defense sector sales were not reported for four product lines: Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges; Aircrew Escape Propulsion Systems; Laser-Initiated Cartridges, Detonators and Initiators; and Thermal Batteries and Components.

[12] Sales data for automotive airbag initiators/propellants was removed from this report.

Non-defense sector sales grew significantly over the 2007-2011 period, from $46.1 million in 2007 to $77.8 million in 2011 (68.8 percent) (see Figure 3.16). As such, the non-defense share of total CAD/PAD sales grew from 18.2 percent in 2007 to 24.8 percent in 2011.

Figure 3.16: Reported U.S. CAD/PAD Non-Defense Sector Sales, 2007-2011



14 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

Respondents categorized as dependent on CAD/PAD sales accounted for 67.1 percent of non-defense sector sales over the five-year period. Their portion of non-defense sector sales grew from 48.5 percent in 2007 to 80.1 percent in 2011. Dependent respondents' non-defense sector sales grew from $22.4 million in 2007 to $62.4 million in 2011 (increasing 179 percent).

At the same time, non-defense sector sales reported by non-dependent declined from $23.7 million in 2007 to $15.5 million in 2011 (falling 34.9 percent). Non-dependent respondents' share of reported non-defense sector sales fell from 51.5 percent in 2007 to 19.9 percent in 2011 (see Figure 3.16).

Non-Defense Sector Sales by Product Line

Non-defense sector sales increased over the 2007-2011 period in five product lines (Catapults, Thrusters, and Removers; Cutters; Delay Cartridges and Initiators; and Impulse Cartridges, including Electrically- and Percussion-Initiated; and Impulse Initiators) and declined in three (Detonating Cords and Charges; Gas Generators; and "Other"). Non-defense sector "Other" product lines included inert devices, hardware and consumables, and other miscellaneous CAD/PADs. Non-defense sector sales were not reported in four product lines (as previously discussed) and were reported intermittently over the five-year period in two additional product lines: Automatic Inflators and Rocket Motor Igniters.

The Impulse Cartridge product line experienced the largest gain in non-defense sector sales over the 2007-2011 period, growing 244.6 percent. Non-defense sector sales Impulse Initiators reported the second largest percentage gain among non-defense sector product lines, growing 239.1 percent over the five-year period. Delay Cartridges and Initiators, and Catapults, Thrusters and Removers also reported five-year sales growth of over 100 percent.

Similar to reported defense sector sales, non-defense sector sales of Gas Generators fell 63 percent over the 2007-2011 period. Additionally, Detonating Cords and Charges reported a 2.1 percent decline in non-defense sector sales over the 2007-2011 period (see Figure 3.17).

Figure 3.17: Reported U.S. CAD/PAD Non-Defense-Sector Sales, 2007-2011			
Product Line	**2007-2011 Average ($ thousands)**	**Share of Total Non-Defense Sales**	**Percent Change 2007-2011**
Impulse Cartridges†	-	-	244.6%
Electrically-Initiated	4,410	7.9%	24.3%
Percussion-Initiated	1,440	2.6%	134.8%
Gas Generators†	-	-	-63.0%
Delay Cartridges & Initiators†	-	-	117.9%
Cutters	3,900	7.0%	50.1%
Detonating Cords & Charges	3,340	6.0%	-2.1%
Catapults, Thrusters, & Removers†	-	-	120.7%
Impulse Initiators†	-	-	239.1%
Rocket Motor Igniters†	-	-	N/A
Automatic Inflators†	-	-	N/A
Other	870	1.6%	-10.9%
Total CAD/PAD Non-Defense	**$55,610**	**100%**	**69.2%**

*Sales data for automotive airbag initiators/propellants was removed from this report.
†Data was removed to protect proprietary data; totals reflect CAD/PAD defense sector sales for all product lines, including those removed.
14 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

3.5 Sales Projections – 2012-2016

Respondents were asked to provide a sales projection for the 2012-2016 period by indicating if they anticipated an increase, no change, or a decrease in defense and non-defense sector sales. Eight of the 12 respondents providing information indicated their defense sector sales would decrease, while three projected sales would increase. At the same time, only two respondents projected their non-defense sector sales would decline over the 2012-2016 period, while seven projected those sales would increase (see Figure 3.18).

Figure 3.18: Projected CAD/PAD Industry Sales, 2012-2016		
Projection	**Defense**	**Non-Defense**
Increase	3	7
No Change	1	3
Decrease	8	2
12 Respondents *Source:* U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013		

3.6 CAD/PAD Industry Exports

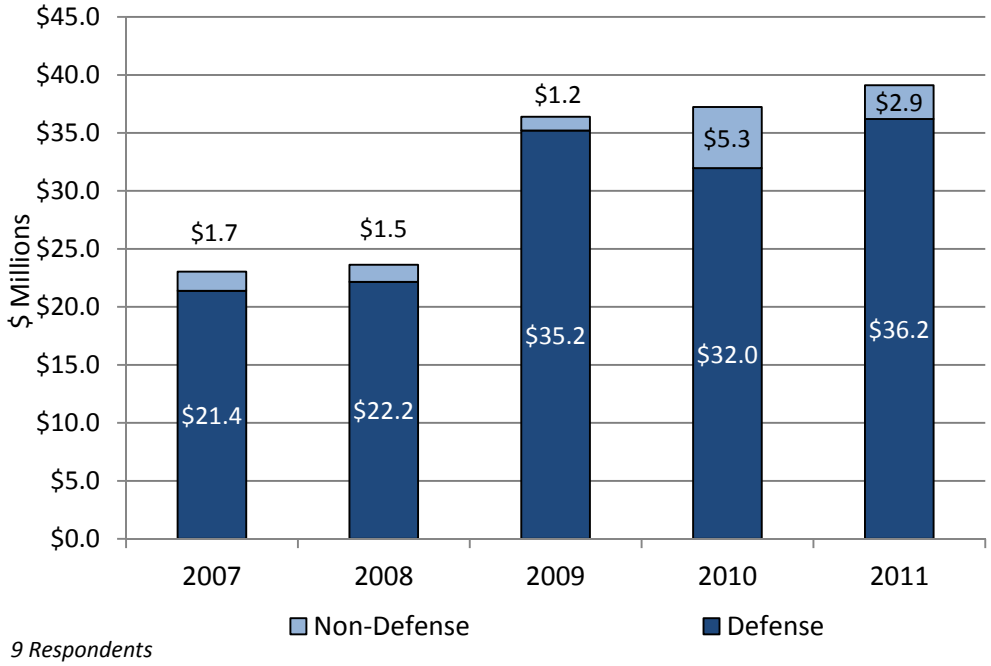
Respondents were asked to report exports across the 14 product lines over the 2007-2011 period. Nine of the 22 respondents reported CAD/PAD exports, with exports in every product line reported at least once over the five-year period.

Total Exports

Total CAD/PAD exports averaged $31.9 million per year over the 2007-2011 period, growing from $23.0 million in 2007 to $39.1 million in 2011 (a 69.8 percent increase). Defense sector exports accounted for 91.4 percent and non-defense sector exports accounted for 8.6 percent of total exports (an average $29.4 million and $2.5 million annually, respectively). Defense sector exports grew from $21.4 million in 2007 to reach $35.2 million in 2009, before declining to $32 million in 2010. Those exports then rebounded by 13.2 percent in 2011 to end the period at $36.2 million.

Non-defense exports experienced greater volatility over the 2007-2011 period, falling from $1.7 million in 2007 to $1.1 million in 2009. Those sales then increased dramatically to $5.3 million in 2010, finishing the period in 2011 at $2.9 million (see Figure 3.19).

Figure 3.19: Total CAD/PAD Exports - Defense/Non-Defense, 2007-2011



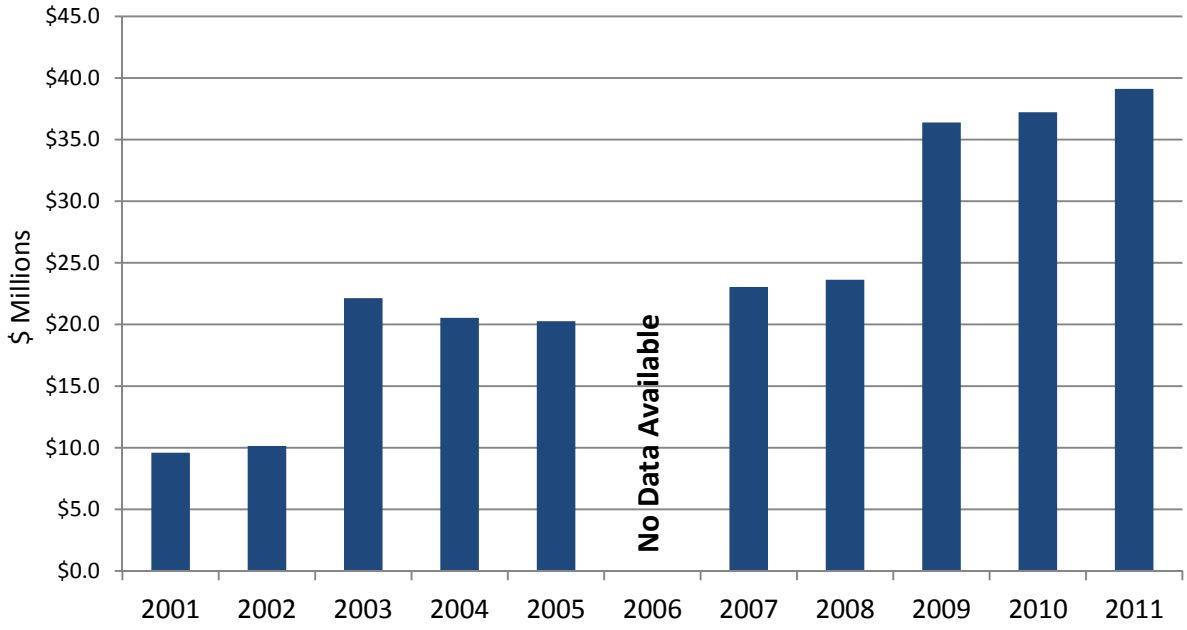
9 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

Utilizing export data collected from the previous BIS CAD/PAD report covering the 2001-2005 period allows the long-term trend in CAD/PAD industry exports to be analyzed.[13] Average annual exports nearly doubled from the 2001-2005 period to the 2007-2011 period, averaging $16.5 million from 2001-2005 and $31.9 million from 2007-2011. However, the 2001-2005 period experienced a larger percent increase in exports than the 2007-2011 period. Over the 2001-2005 period, exports grew 111.4 percent, while they increased 69.8 percent over the 2007-2011 period (see Figures 3.20 and 3.21).

[13] Data for the 2007-2011 period includes defense and non-defense exports as USG non-defense-related agencies (e.g. NASA and NOAA) were classified as non-defense, while data for the 2001-2005 period includes defense exports only. Export data is not available for the 1995-1999 period.

Figure 3.20: Total CAD/PAD Exports, 2001-2011

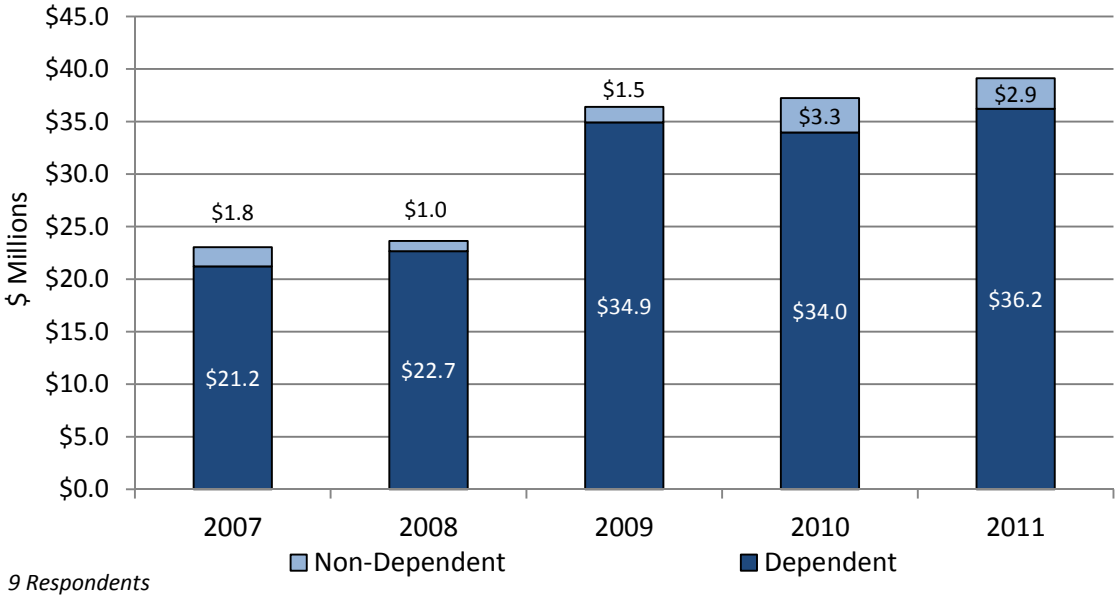


2006 Review: 25 Respondents Total; 2013 Review: 9 Respondents Exporting
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2006, 2013

Figure 3.21 – Total CAD/PAD Exports, 2001-2011		
BIS CAD/PAD Report	**Average Reported Exports ($ millions)**	**Five-Year Export Growth**
2001-2005	$16.5	111.4%
2007-2011	$31.9	69.8%
2006 Review: 25 Respondents Total; 2013 Review: 9 Respondents Exporting *Source:* U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2006, 2013		

Four of the eight respondents categorized as dependent on CAD/PAD sales reported exports over the 2007-2011 period. Three reported both defense sector and non-defense sector exports and one reported only defense sector exports. Of the non-dependent respondents, two reported defense sector exports and three reported non-defense sector exports. Respondents categorized dependent on CAD/PAD sales accounted for 93.4 percent of the five-year period's cumulative export total ($149 of $159.4 million), 97.6 percent of defense sector exports ($143.5 of $146.9 million), and 44.1 percent of non-defense sector exports ($5.5 of $12.5 million) (see Figure 3.22).

Figure 3.22: Total CAD/PAD Exports - Dependent/Non-Dependent 2007-2011



9 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

CAD/PAD Exports by Product Line

Exports were reported across all 14 product lines. Top exported products included: Catapults, Thrusters and Removers; Delay Cartridges and Initiators; Detonating Cords and Charges; Impulse Initiators; and Delay Cartridges and Initiators. Nine product lines reported increasing exports over the 2007-2011 period:

- Aircrew Escape Propulsion Systems
- Automatic Inflators
- Catapults, Thrusters and Removers
- Delay Cartridges and Initiators
- Detonating Cords and Charges
- Gas Generators
- Impulse Cartridges (including Electrically- and Percussion-Initiated)
- Impulse Initiators
- Rocket Motor Igniters

The self-defined "Other" category also reported growth in exports. Cutters were the only product line to report declining exports over the five-year period, while exports of aircraft

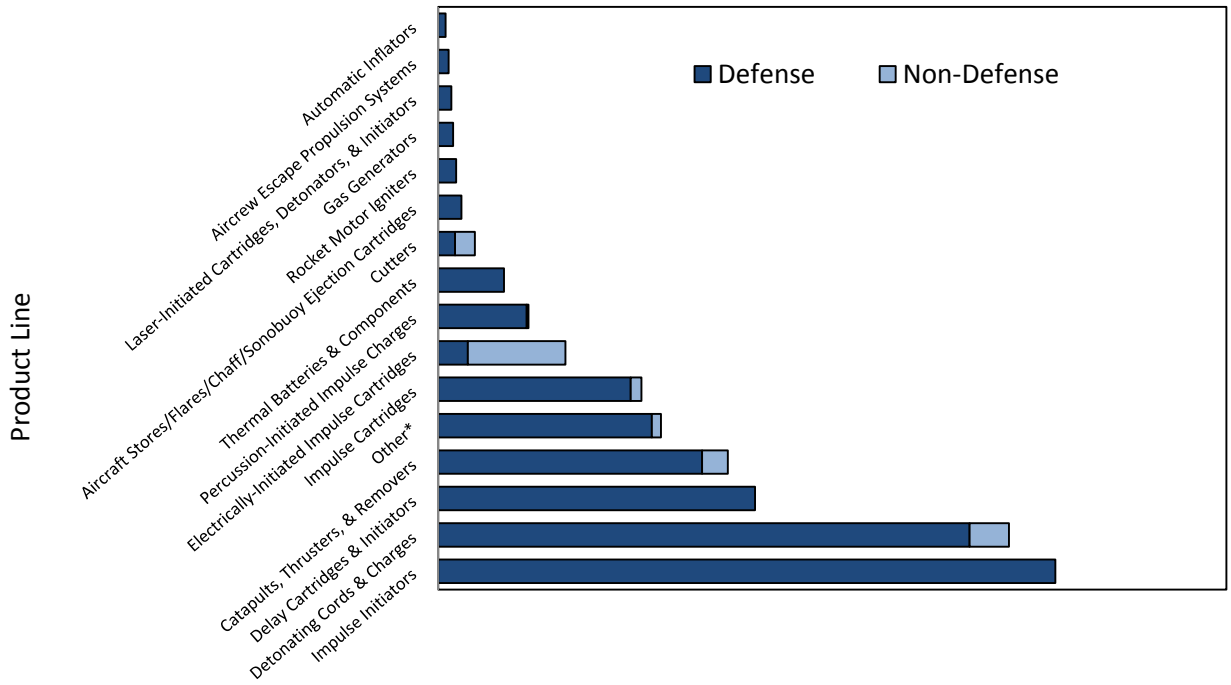
stores/flares/chaff/sonobuoy ejection cartridges and laser-initiated cartridges, detonators and initiators were not reported across all five years.

Over the 2007-2011 period, 91.4 percent of exports were destined for defense sector customers, and all exports of nine product lines were to the defense sector:

- Aircraft Stores/Flares/Chaff/Sonobuoy Systems
- Aircrew Escape Propulsion Systems
- Automatic Inflators
- Delay Cartridges and Initiators
- Gas Generators
- Impulse Initiators
- Laser-Initiated Charges, Detonators and Initiators
- Rocket Motor Igniters
- Thermal Batteries and Components

Exports of Catapults, Thrusters and Removers; Detonating Cords and Charges; Impulse Cartridges (including Percussion-Initiated) and "Other" products (including electronic cables, controllers and ordnance; and inert devices) were over 90 percent to the defense sector. The only product lines with less than 50 percent of exports destined for the defense sector were Cutters (45.7 percent to the defense sector) and Electrically-Initiated Impulse Cartridges (23.3 percent to the defense sector) (see Figure 3.23).

Figure 3.23: CAD/PAD Product Line Exports by Defense/Non-Defense 2007-2011*

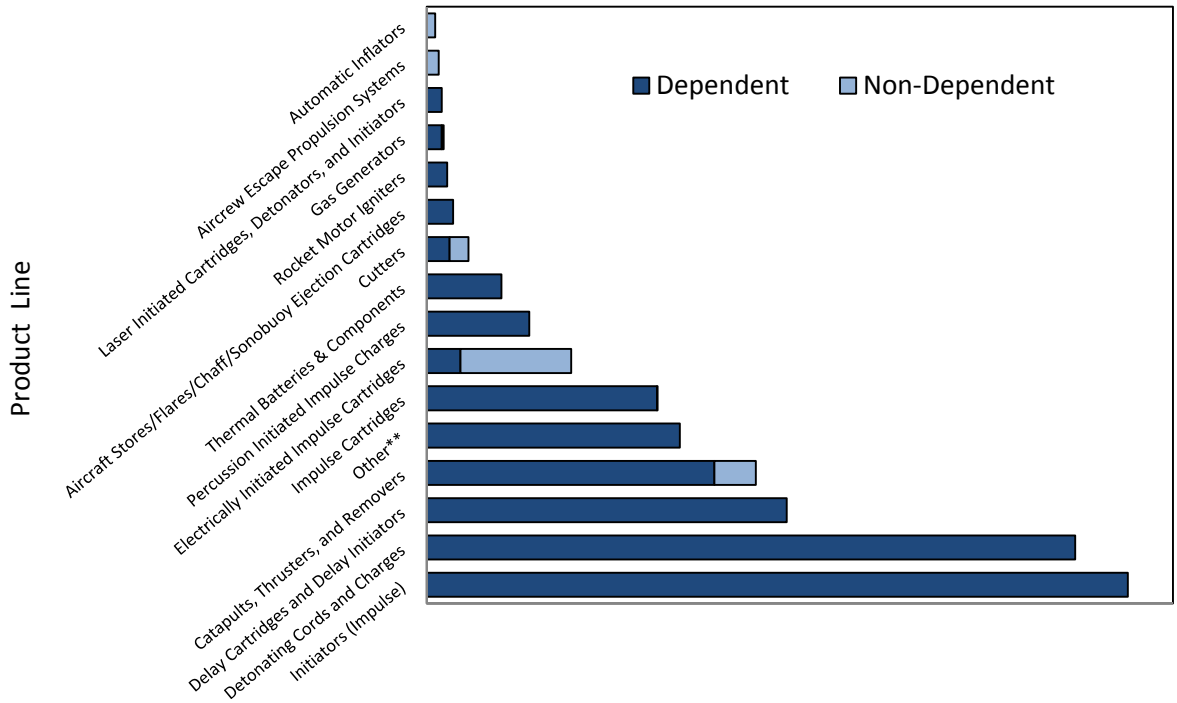


*X-axis removed to protect respondent data
**Other includes electronic controllers, cables ordnance and detonators; inert devices and valves
9 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The respondents categorized as dependent on CAD/PAD sales accounted for 93.4 percent of exports for the 2007-2011 period. Six product lines were exported only by dependent respondents: Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges; Delay Cartridges and Initiators; Detonating Cords and Charges; Impulse Initiators; Laser-Initiated Cartridges, Detonators and Initiators; Rocket Motor Igniters; and Thermal Batteries and Components. Percussion-Initiated Impulse Cartridges were also exported only by dependent respondents, as was the "Other" category. Conversely, two product lines, Aircrew Escape Propulsion Systems and Automatic Inflators, were exported only by non-dependent respondents.

Three product lines were exported by both respondents categorized as dependent and non-dependent respondents. Dependent respondents exported 87.4 percent of Catapults, Thrusters and Removers; 54.7 percent of Cutters; 99.7 percent of Impulse Cartridges (23.3 percent of Electrically-Initiated Impulse Cartridges) and 89 percent of Gas Generators (see Figure 3.24).

Figure 3.24: CAD/PAD Product Line Exports by Dependent/Non-Dependent 2007-2011*



*X-axis removed to protect respondent data

**Other includes electronic controllers, cables ordnance and detonators; and inert devices

9 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Country of Export Destination

The nine respondents that provided export information for the 2007-2011 period also provided details regarding the destination of their exported products in 2011, identifying 20 countries. Those nine respondents identified export destinations for 11 product lines. The top four countries of destination for exports were the United Kingdom, Germany, Japan and Canada. All other countries receiving shipments of U.S. CAD/PAD sector exports were the destination of fewer than five product lines (see Figures 3.25 and 3.26).

Figure 3.25: Destination of Reported U.S. CAD/PAD Exports, 2011

Destination Country	Number of Product Lines Exported
United Kingdom	9
Germany	8
Japan	6
Canada	5
Australia	4
Israel	4
Sweden	4
Jordan	3
Italy	2
Norway	2
Taiwan	2
Belgium	1
Brazil	1
China	1
France	1
Greece	1
Morocco	1
Singapore	1
South Korea	1
Thailand	1

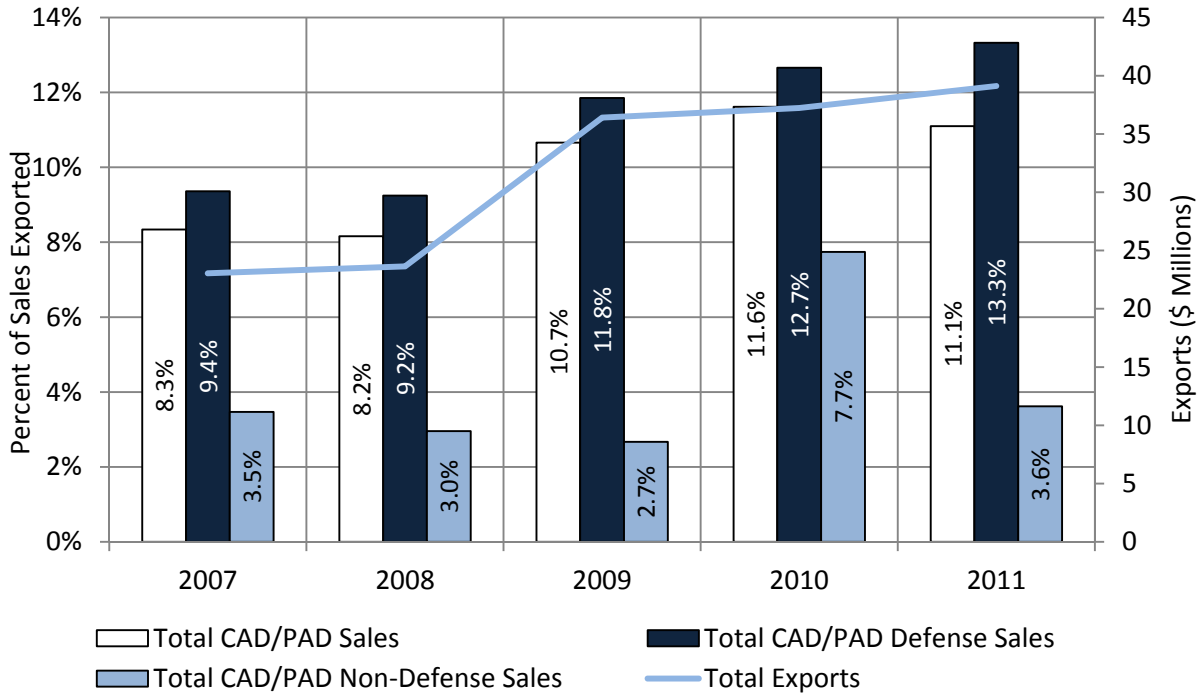
9 Respondents
*Includes sub-product lines Electrically- and Percussion-Initiated Impulse Cartridges as product lines.
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Figure 3.26: CAD/PAD Export Destination by Product Line, 2011	
Product Line	**Number of Countries**
Delay Cartridges & Initiators	5
Detonating Cords & Charges	10
Other - Inert Devices, Hardware & Consumables; CADs, PADs, Deflagrating Devices, Raw Materials	8
Impulse Cartridges	5
Electrically-Initiated	7
Percussion-Initiated	3
Thermal Batteries & Components	3
Catapults, Thrusters, & Removers	5
Cutters	4
Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges*	*
Rocket Motor Igniters*	*
Gas Generators*	*
Laser-Initiated Cartridges, Detonators & Initiators*	*
Aircrew Escape Propulsion Systems*	*
Automatic Inflators*	*
Impulse Initiators*	*
*Number of countries removed to protect proprietary information. *13 Respondents* *Source:* U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013	

Domestic and Export Sales

The export share of total CAD/PAD sales (U.S. sales plus exports) illustrates the importance of non-U.S. customers to the U.S. CAD/PAD industry. Overall, 10.1 percent of total CAD/PAD sales were exported ($159.4 million of $1.6 billion over the five-year period), ranging from a low of 8.2 percent in 2008 ($23.6 million of $289.6 million) to a high of 11.6 percent in 2010 ($37.2 million of $320.5 million) (see Figure 3.27). A greater portion of defense sector sales were exported as compared to non-defense sector sales (11.4 percent as compared to 4.3 percent, respectively, over the five-year period).

Figure 3.27: Export Share of CAD/PAD Sales, 2007-2011*



*Total sales is the sum of U.S. sales and exports
19 respondents U.S. sales, 9 respondents export sales
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

Figure 3.28 is an overview of the CAD/PAD product lines, showing the sales of each product line as a percent of total sales. It also shows the percentage of each product line's sales that were to defense customers and that were U.S. sales, as well as the change in sales from 2007-2011.

Figure 3.28: CAD/PAD Product Line Overview, 2007-2011

Product Line	% of Total Sales (U.S. and Export)	% to the Defense-Sector	% to Domestic Customers	2007-2011 Sales Growth
Impulse Cartridges	15.4%	51.3%	94.9%	81.4%
Electrically-Initiated	4.3%	59.0%	88.6%	-16.3%
Percussion-Initiated	2.5%	81.5%	86.0%	77.3%
Detonating Cords & Charges	13.9%	91.3%	84.1%	70.3%
Gas Generators	11%	69.7%	99.5%	-44.5%
Impulse Initiators	9.5%	96.4%	75.0%	137.3%
Cutters	7.5%	82.5%	98.1%	51.4%
Catapults, Thrusters, & Removers	6.4%	86.7%	82.4%	71.7%
Laser Initiated Cartridges, Detonators, and Initiators†	-	100%	99.2%	13%
Delay Cartridges & Initiators	5.2%	72.8%	76.5%	23.2%
Rocket Motor Igniters†	-	99.8%	98.4%	6.9%
Thermal Batteries & Components	1.7%	100%	0.0%	39.8%
Aircrew Escape Propulsion Systems†	-	100%	95.3%	61.8%
Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges	0.7%	100%	87.1%	-50.5%
Automatic Inflators	0.6%	99.7%	95.3%	-71%
Other	11%	97.2%	92.2%	-2.8%
Grand Total	**100%**	**81.6%**	**89.9%**	**27.6%**

†Data was removed to protect proprietary data; totals reflect CAD/PAD defense sector sales for all product lines, including those removed.

19 respondents U.S. sales, 9 respondents export sales

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry—2013

3.7 Foreign Military Sales

The Foreign Military Sales (FMS) program is a USG program for transferring defense articles, services, and training to other sovereign nations and international organizations. Under the FMS program, the USG procures defense products and services on behalf of the foreign customer. There are 160 countries eligible to participate in the program.[14]

The DOD's Defense Security Cooperation Agency (DSCA) oversees program administration for the FMS program. However, DSCA works closely with the U.S. Department of State, the department responsible for supervising the FMS program.[15] The FMS program supports U.S. foreign policy and national security objectives.[16]

Previous BIS assessments of the U.S. CAD/PAD industry had not fully examined the FMS program. However, industry feedback received during BIS's initial consultation for this assessment included concerns about the FMS program, specifically regarding FMS payment and shipping problems.[17]

CAD/PAD FMS Program

Management of the Air Force's CAD/PAD FMS program is coordinated by the Air Force Security Assistance and Cooperation Directorate. Every July, the directorate invites all countries participating in USAF programs to join the USAF's annual buy of CAD/PADs.[18] Purchases outside the annual buy are handled by Ogden Air Logistics Complex at Hill Air Force Base on an "as required" basis.

[14] The FMS Advantage, Department of Defense's Defense Security Cooperation Agency, http://www.dsca.mil/PressReleases/fmsadvantagev2.pdf

[15] U.S. Government Accountability Office. (2012, November). DOD's Ongoing Reforms Address Some Challenges, but Additional Information Is Needed to Further Enhance Program Management. (Publication No. GAO-13-84). http://www.gao.gov/assets/660/650159.pdf.

[16] DoD 5105.38-M Security Assistance Management Manual (SAMM), 2003. https://acc.dau.mil/adl/en-US/24594/file/2905/Foreign%20Military%20Sales%20Program%20General%20Information.pdf

[17] See Appendix F for more details on the Foreign Military Sales process.

[18] Vilches, Orlando. "The Call Letter: CAD/PAD Purchase Via FMS." The DISAM Journal of International Security Cooperation Management. http://www.disamjournal.org/articles/the-call-letter-cadpad-purchase-via-fms-813

Naval Air Systems Command PMA-201 manages CAD/PAD procurements for FMS customers flying United States Navy (USN) active and retired aircraft platforms. Customers are provided with USN requirements predictions for the upcoming five-year period, enabling them to align their procurements with the USN for better economies of scale, and allowing them to budget for anticipated costs. Procurements for items no longer in USN inventory are executed as discrete requirements and are subject to increased costs and longer lead times.

3.7.1 Payment and Shipment

In response to industry concerns about delays in FMS payments and shipping during the survey design process, BIS included questions about the FMS program in the survey. Respondents were asked the method they use to ship FMS CAD/PADs, if their business has been impacted by any delays in FMS shipping, and if revenue has been affected by delayed FMS shipping or payment. In addition, respondents were asked to provide the dollar values and durations of FMS shipments held at their facilities. Companies were also asked for recommendations to streamline the process.

Eight of the 22 survey respondents indicated that their CAD/PAD exports have been impacted by delays in FMS shipping. These respondents expressed frustration with what they characterized as confusing and often late shipping directions provided by both the U.S. Department of Transportation and the U.S. Department of Defense. One respondent stated, "We have been unable to receive shipping instructions on several occasions," while another commented that "FMS ship-to addresses/instructions, which allow us to ship, are often quite late coming from the government."

Respondents also raised concerns regarding the financial impacts resulting from delayed FMS payments. One respondent stated, "Our customer delays programs so [CAD/PAD products] schedules are impacted. As a small business, we are not able to finance the delays but our customers have been cooperative."

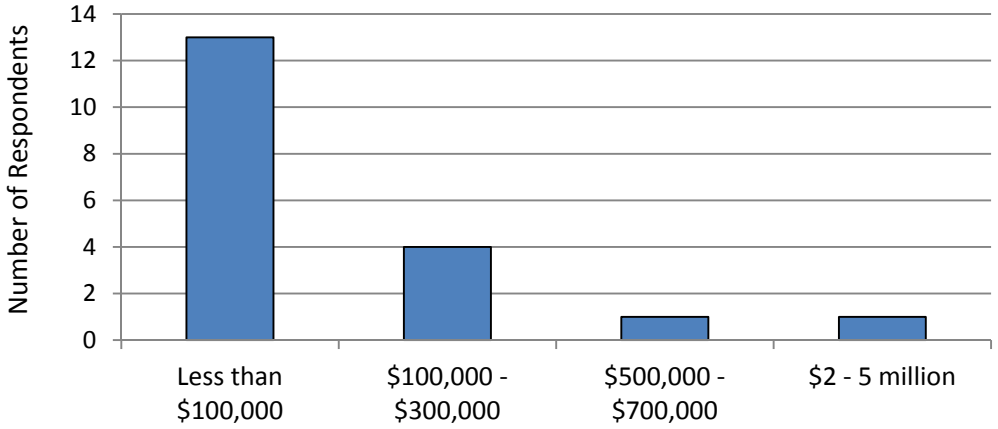
A few respondents indicated that they use a "ship-in-place" modification which allows them to receive payment for the items even though they are still storing the shipment on behalf of the customer. One respondent indicated that even with the "ship-in place" modification, "Payments

are delayed a minimum of 30-plus days." Other respondents indicated that they are not able to recognize the revenue from the sale, due to corporate mandated accounting practices, until the items leave the facility.

In addition, respondents said they are required to store the items before shipment, "which due to the nature of the products has its financial implications." Federal and other regulations control how much explosive material can be stored at a facility, as well as what types of explosive material can be stored together. When a company is forced to store CAD/PAD products longer than expected, it can impact their ability to produce CAD/PADs for other customers due to regulatory limitations. This has led companies to incur additional expenses by obtaining temporary storage sites.

Respondents were asked to report the value of the CAD/PAD-related FMS products they were currently storing for transport at their facility. Of the 19 respondents providing data, a majority were storing less than $100,000 of CAD/PAD-related FMS products for transport (see Figure 3.29). One respondent was storing between $500,000 and $700,000, and another respondent was storing between $2 million and $5 million.

Figure 3.29: Average Value of CAD/PAD-Related FMS Products Stored at Facility

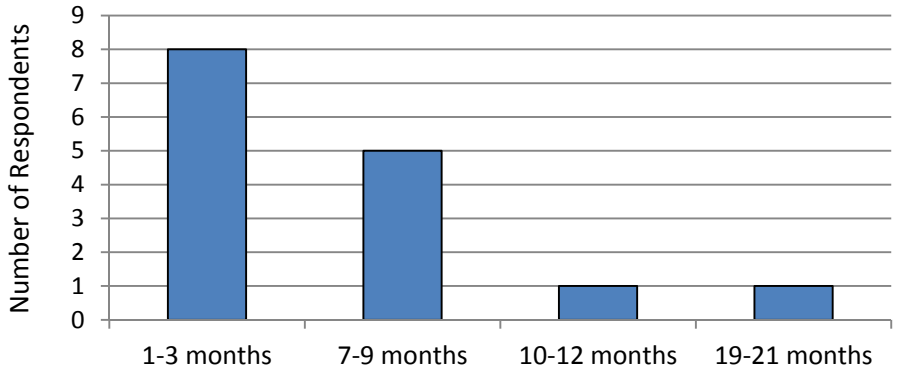


19 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Respondents were asked the average time, in months, they maintain FMS shipments in storage. Eight respondents store CAD/PAD-related FMS products an average of one to three months

before transport (see Figure 3.30). Five respondents store products an average of seven to nine months before transport, and two respondents reported storing CAD/PAD-related FMS products for one year up to almost two years.

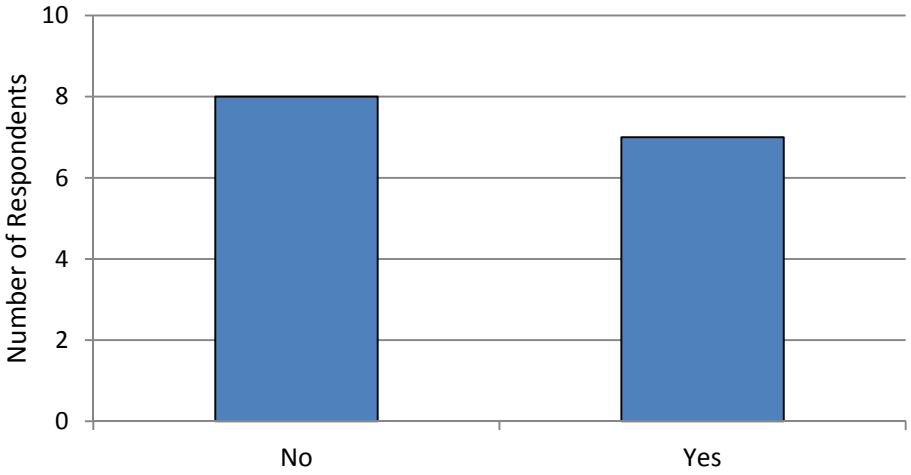
Figure 3.30: Average Storage Time for CAD/PAD-Related FMS Products before Shipment



15 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Seven respondents reported that their FMS revenue recognition was affected by delays in transporting the product to the customer (see Figure 3.31). While the CAD/PAD production and storage costs were incorporated into their financial statements, they were forced to delay recording the revenue in the same period. One respondent stated, "We have unrecorded revenue now for 12 months with no end in sight." Another commented, "Revenue is not financially recognized on FMS shipments until the product physically leaves the facility." Other respondents have to wait even longer to record their revenue, as one respondent stated that, "revenue cannot be recognized until the Shipping Instructions Request has been submitted to the government for 30 days."

Figure 3.31: Revenue Affected by Delays in Transporting CAD/PAD FMS Product



15 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Respondents were also asked to provide recommendations for streamlining the FMS payment and shipping process. Multiple respondents indicated that adjustments could be made to the shipping instruction process. One respondent stated that the USG needs to "allow more time to process the shipment once shipping instructions are received." The delay in getting the instructions once the order is complete was an issue raised by respondents, with one recommending that DOD "maintain a point of contact who can provide timely shipping instructions."

Each open FMS case has a manager assigned who is responsible for all aspects of the FMS case including f nancial, logistical, and acquisition matters.[19,20] One respondent commented, "Get the DOD FMS Item Manager more involved so they know when the product is ready. We have started to inform these people when the product is nearing completion and it has helped with getting the product moved in a timely manner."

[19] "Case management may entail different terminology depending upon the implementing agency's case management philosophy." (Defense Security Cooperation Agency)
[20] Defense Security Cooperation Agency. "Chapter 5, Foreign Military Sales Process" Security Assistance Management Manual. http://www.disam.dsca.mil/documents/greenbook/v31/05_Chapter.pdf

Another respondent indicated that "ship-in-place" clauses should be incorporated into FMS contracts, stating that it would help "facilitate invoicing upon government product acceptance prior to shipment." An additional respondent recommended that DOD should "allow ship-in-place and payment for all FMS units, then ship via DD1149 as FMS instructions become available." The DOD Form 1149, Requisition and Invoice Shipping Document, is used to transfer government property from one party to another. This may allow a company to consider the product "shipped" and record the revenue.

Respondents also urged DOD to make shipping arrangements when the order is placed to avoid delays. They would also like to see the location identified when the order is placed, instead of receiving it at a later date.

Method of FMS Shipment

Respondents raised concerns about FMS shipments and the USG's ability to effectively transport the products in a timely manner. Due to the nature of CAD/PADs, shipping and transporting them requires additional care, which can also increase the cost. FMS shipments can be sent to the customers using either the Defense Transportation System (DTS) or through freight forwarders. DOD policy states that the purchaser is responsible for transportation and delivery of its purchased products and encourages the use of FMS freight forwarders. A FMS freight forwarder is a private company under contract to the FMS purchaser to coordinate, receive, consolidate, and arrange for shipment to a final destination.[21]

However, not all foreign governments have the resources to perform their own transportation or hire a freight forwarder. Therefore, DOD also provides the DTS, where it will arrange transportation on a reimbursable basis. DTS is part of the worldwide transportation infrastructure that supports DOD transportation needs and consists of both military and commercial resources.[22]

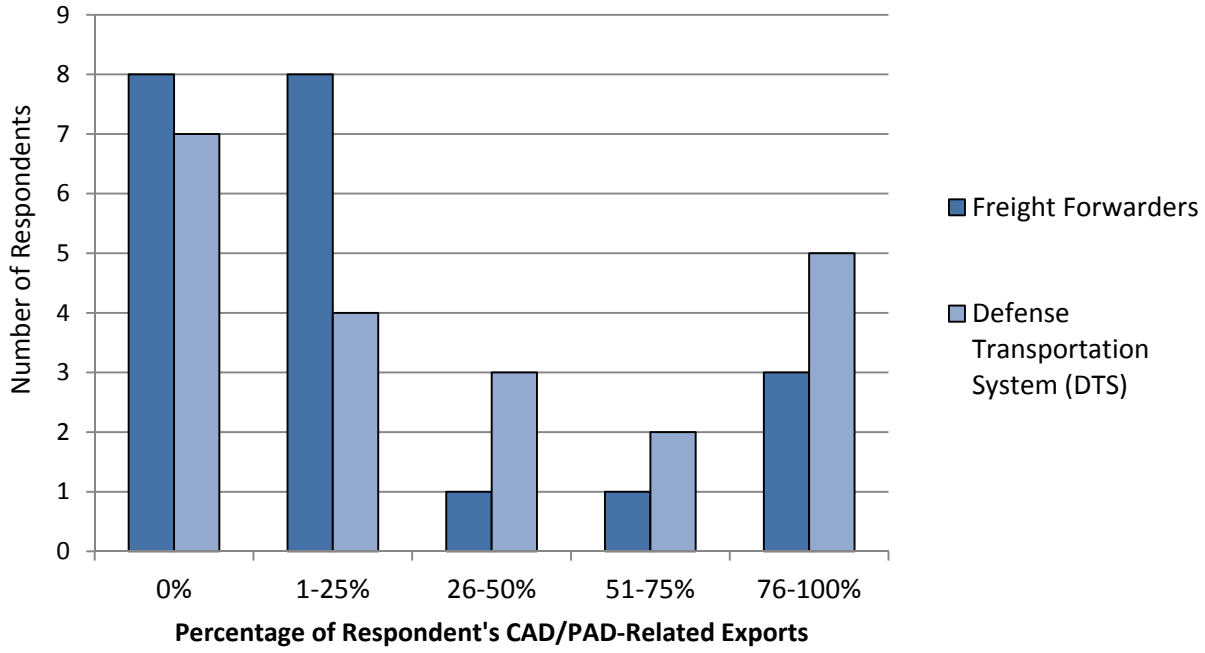
[21] Defense Security Cooperation Agency. "Chapter 7, Transportation." Security Assistance Management Manual. http://www.dsca.osd.mil/samm/ESAMM/C00/0.02.htm
[22] Ibid.

Five respondents ship 76 percent or more of their CAD/PAD-related exports through DTS; one of those respondents ships 100 percent of its CAD/PAD-related exports that way (see Figure 3.32). Most respondents ship less that 25 percent of their CAD/PAD-related exports through DTS, with seven respondents shipping no products using DTS.

Similarly, most respondents ship less than 25 percent of their CAD/PAD-related exports through freight forwarders, with eight respondents shipping no products through freight forwarders. Two respondents ship 76 percent or more of their FMS sales through freight forwarders, and two respondents indicated that they ship all of their FMS products through freight forwarders.

Eleven companies reported using both DTS and freight forwarders to ship their CAD/PAD-related exports. Of those respondents, a higher percentage of their CAD/PAD-related exports went through DTS than freight forwarders.

Figure 3.32: Shipping of CAD/PAD-Related Exports



21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

3.7.2 FMS Outlook

Total U.S. FMS sales have exceeded $30 billion in each of the past four fiscal years, reaching more than $60 billion in fiscal year 2012.[23] A large portion of these export sales were due to the sale of military aircraft. However, while CAD/PADs make up a very small percent of total FMS sales, they are vital components to aircraft and other large defense procurements. In addition, CAD/PADs are continuously procured by foreign governments. The U.S. Department of State has publicly stated that it wishes to promote FMS purchases.[24] The U.S. Department of Defense has also expressed its goal to have a more effective FMS program.[25] The USG must work to make the FMS program more accessible and manageable for the U.S. CAD/PAD industry. Shipping, payment, and transportation issues have created obstacles and/or deterred companies from wanting to participate in the FMS program.

[23] Shapiro, Andrew. "Remarks to the Defense Trade Advisory Group." Washington, DC. 28 November 2012. From, http://www.state.gov/t/pm/rls/rm/201157.htm
[24] Ibid.
[25] "The Force of the 21st Century." (National Press Club). *As Delivered by Secretary of Defense Leon E. Panetta, Washington DC, Tuesday, December 18, 2012*
From., http://www.defense.gov/speeches/speech.aspx?speechid=1742

4. FINANCIALS

4.1. Revenue

Survey respondents were asked to provide financial information from 2007-2011 for their entire company, including their CAD/PAD-related operations. In addition, respondents that had CAD/PAD-related business units or divisions were asked to provide select financial information for those entities. This information was used to help determine the health and competitiveness of the CAD/PAD industry.

Twelve of the 22 respondents provided baseline data at the corporate level, while the remaining 10 provided business unit data. Eight respondents provided additional financial data for their CAD/PAD-related divisions (see Figure 4.1). The data furnished by respondents thus enables two levels of financial analysis: the first level, which includes a significant amount of non-CAD/PAD operations, and the second level, which contains financial data as narrowly focused on CAD/PAD operations as respondents were able to provide. For simplicity, the level of data focused on a respondent's CAD/PAD operations will be referred to as CAD/PAD-level data, although it contains some limited amount of unrelated activities.

Figure 4.1: Respondent Reporting Levels

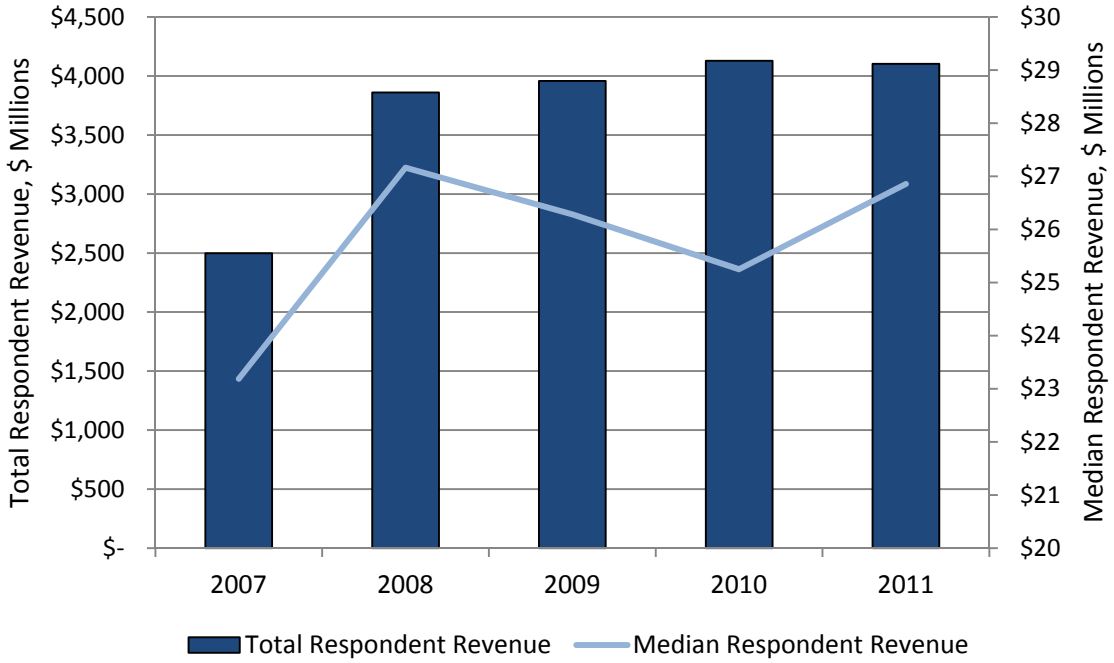
	Corporate Only	Business Unit Only	Corporate and Business Unit	Business Unit and Sub-Business Unit
Number of Respondents	7	7	5	3

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The first level aggregate revenue of all respondents – which includes a significant amount of non-CAD/PAD revenue – totaled $4.1 billion in 2011, up from $2.5 billion in 2007 (see Figure 4.2). This 64 percent increase is heavily influenced by a few larger respondents, as median respondent revenue rose just 16 percent over the period to $26.9 million. By comparison, average revenue was nearly seven times the median level in 2011 ($186.5 million).[26]

[26] Another factor in the discrepancy between the group's aggregate and median performance was that two respondents did not provide sales data for 2007; as a result, sales at the aggregate level are not easily comparable across the entire period.

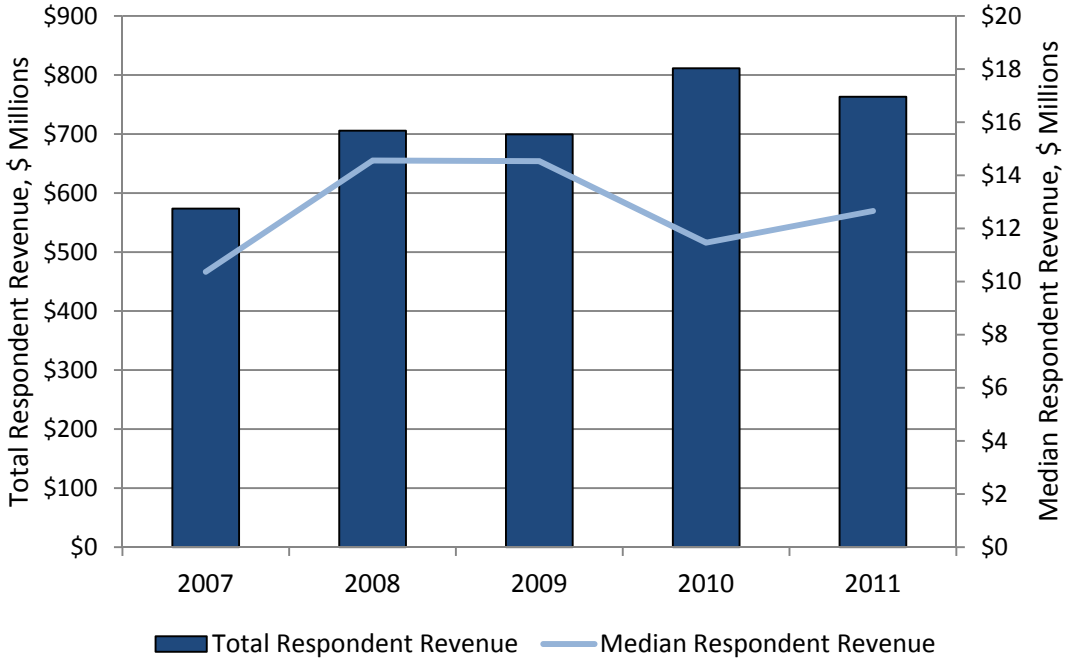
Figure 4.2: Corporate Level CAD/PAD Respondent Revenue, 2007-2011



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

CAD/PAD level revenue accounted for roughly 20 percent of the first level revenue reported by all respondents. Aggregate revenue at the CAD/PAD level rose from $573 million in 2007 to $763 million in 2011, while median revenue at this level rose from $10.4 million to $12.7 million (see Figure 4.3). As at the first level, a few large respondents have an outsized effect on aggregate CAD/PAD level revenues, though the effect is not as large: average revenue was under three times higher than the median at the CAD/PAD level in 2011 ($34.7 million).

Figure 4.3: CAD/PAD Level Respondent Revenue, 2007-2011



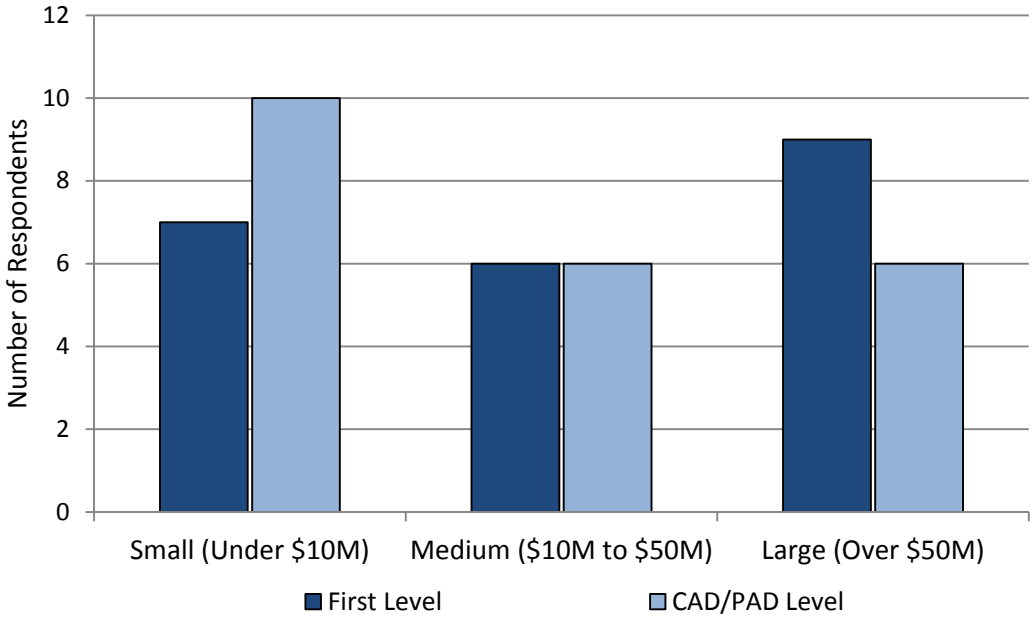
22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Respondents at both the first level and the CAD/PAD level vary greatly in size. Grouping respondents based on their revenue enables analysis of size-specific characteristics without exposing company proprietary information. Respondents were classified into three categories based on their average revenue over the 2007-2011 reporting period: those with under $10 million in annual revenue fall into the Small category; those between $10 million and $50 million make up the Medium category; and the remaining respondents with over $50 million in average annual revenue make up the Large category.

Of the 22 first level responses, seven are Small, six are Medium, and nine are Large (see Figure 4.4). Average annual revenues reflected the broad array of respondent types, ranging from under $1 million to over $2.5 billion. At the CAD/PAD level, respondent sizes tended toward the smaller end of the scale, with 10 of the 22 respondents being classified as Small and some reporting average annual revenue under $500,000. Six CAD/PAD level respondents are still in the Large category, with the largest CAD/PAD-level responses showing nearly $150 million in annual revenue. Medium CAD/PAD level respondents tend to be units of larger parent

companies, and tend toward the lower end of the income range, with most reporting between $10 and $25 million in average annual revenue.

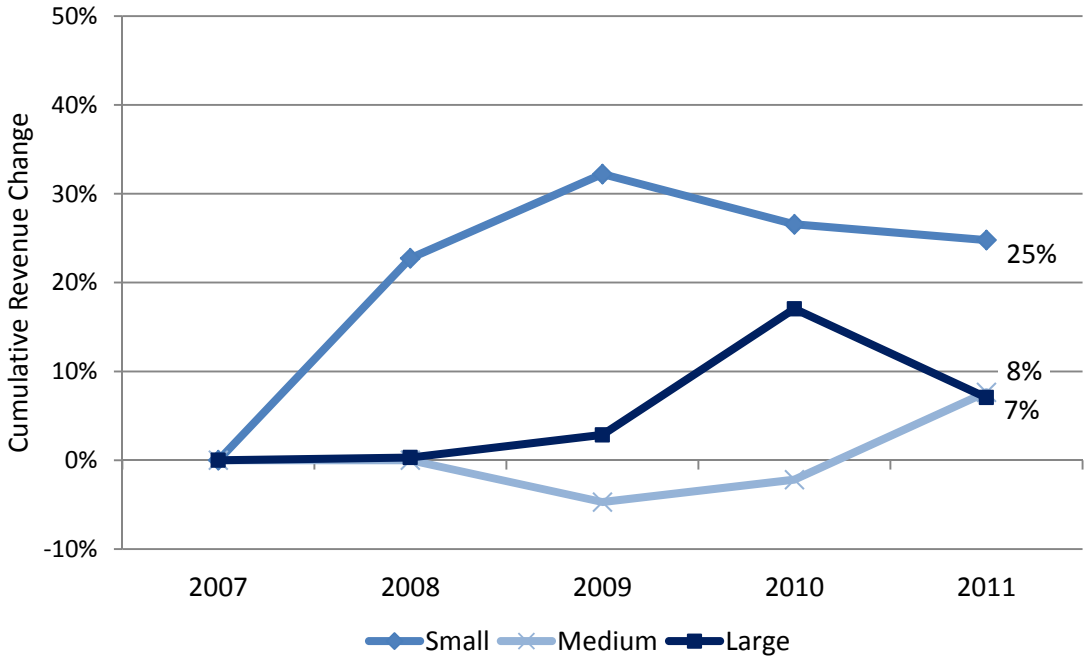
Figure 4.4: Respondent Sizes by Average Revenue, 2007-2011



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Revenue at the CAD/PAD level grew over the period for all sizes of respondents, although there was some volatility in the pace of growth (see Figure 4.5). Small CAD/PAD level respondents had a median cumulative revenue change of 25 percent for the period. Medium and Large CAD/PAD respondents were somewhat lower, with eight percent and seven percent median revenue growth reported between 2007 and 2011, respectively. In each group, average revenue changes were marginally higher than median, reflecting the strong revenue growth of a few respondents.

Figure 4.5: CAD/PAD-level Median Revenue Change, 2007-2011



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

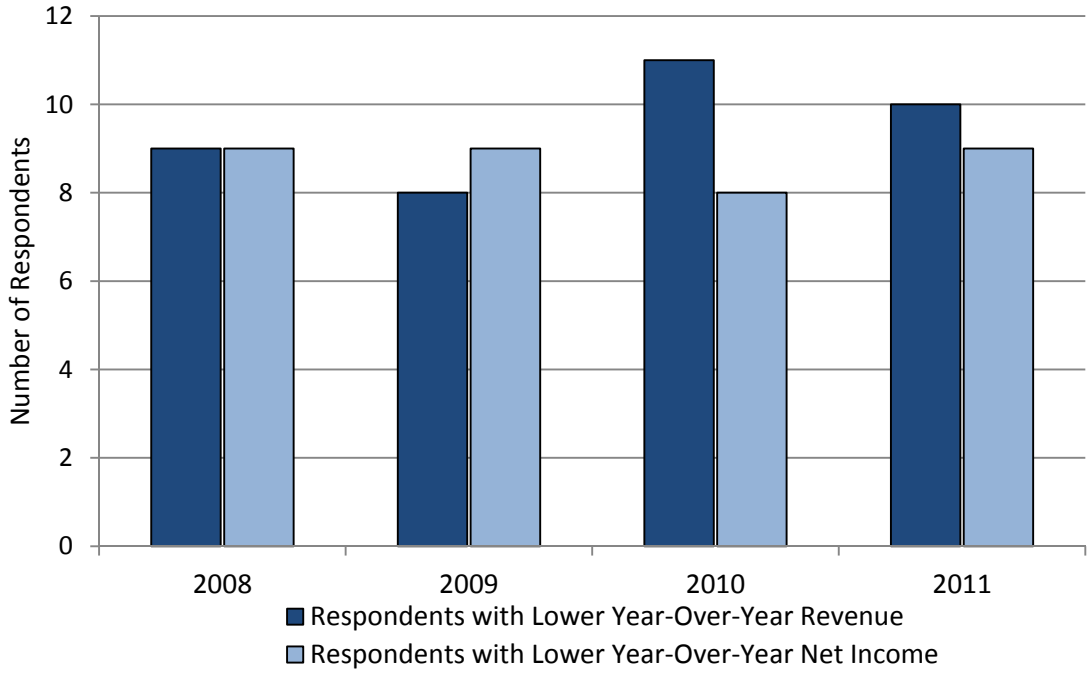
As implied by the differences between mean and median performance, the distribution of revenue changes over the period reflects a wide range of performances for respondents, both at the first level and the CAD/PAD level. At the first level, seven respondents – nearly one third of the total – reported revenue gains of over 50 percent between 2007 and 2011, while three respondents – roughly 15 percent of the total – reported lower revenue. CAD/PAD level respondents showed a starker contrast, with five respondents reporting revenue growing at over 50 percent and the same number reporting revenue shrinking between 2007 and 2011. Even among those with revenue gains, the change was inconsistent; just two CAD/PAD level respondents reported revenue growth every year in the reporting period. In order to provide the most relevant information for this report, the remainder of the financial section is focused primarily on CAD/PAD level financial data.

4.1.1 Profitability

Four respondents were unable to provide data on their net income at the CAD/PAD level, leaving 18 responses for most income-related metrics. Respondents' profitability, as measured by net income, showed a similar level of volatility to revenue. Only four respondents reported increasing net income every year, and in any given year roughly half of the respondents reported a lower net income than the previous year (see Figure 4.6).

While average net income rose 50 percent over the reporting period – from $2.2 million to $3.4 million – median net income was stagnant, declining slightly from $1.41 million in 2007 to $1.39 million in 2011. As a further reflection of the volatility of CAD/PAD earnings, 11 respondents reported improvements in net income in 2011 relative to 2007, seven respondents reported lower net income by the end of the period, and five had a cumulative net loss in the five-year reporting period.

Figure 4.6: Number of Respondents with Declining CAD/PAD Revenue and Net Income, 2008-2011



22 Respondents provided revenue data, with 4 missing in 2007. Net income data provided by 13 respondents in 2007, 16 in 2008, 17 in 2009, and 18 in 2010-2011

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Profit margins – income as a percentage of revenue – often provide a better picture of the state of a business than dollar figures alone. Despite the volatility in revenue and net earnings, both mean and median profit margins showed improvement across the period and were generally in line with broader industry standards (see Figure 4.7).[27]

Figure 4.7: Comparison of Profit Margins, Average for 2007-2011

	Total Manufacturing**	All Chemicals**	All Other Chemicals**	CAD/PAD (mean)*	CAD/PAD (median)*
Operating Margin	0.09	0.15	0.16	0.12	0.15
Net Margin	0.07	0.07	0.07	0.07	0.10

Sources:
*U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013
**Census Bureau Quarterly Financial Reports (http://www.census.gov/qfr)

There are three broadly used measures of profit margin: gross, operating, and net, each reflecting a different level of business expense. Gross profit margins, which exclude costs not directly related to production, were in the 35 percent to 39 percent range for the average respondent, indicating that roughly 65-70 cents of each dollar of sales went to cover the cost of manufacturing.

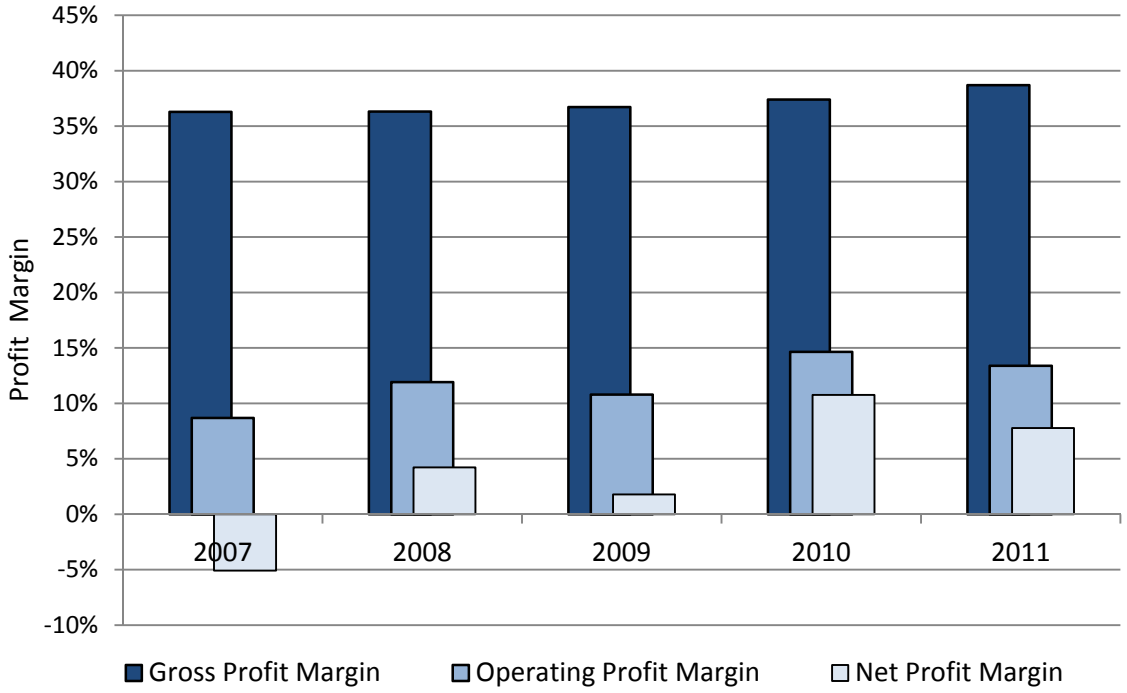
Operating margins provide a better picture of the overall structure of a business, as they portray profit excluding interest expenses, taxes, and any non-operating costs or profits. CAD/PAD operating margins improved incrementally over the period, from 8.7 percent in 2007 to 13.4 percent in 2011, down from a peak of 14.6 percent in 2010 (see Figure 4.8). By comparison, operating margins in the chemical manufacturing industry as a whole ranged from 12.7 percent to 16.1 percent across the period.

Average net profit margin – generally a more volatile measure, as it includes all sources of profit and expense – also showed the same trend of improvement. Average net profit margin in 2007

[27] Industry standards are from the Census Bureau's Quarterly Financial Reports (QFR), available at http://www.census.gov/qfr/. Comparisons were based on both the Specialty/Other Chemical Industry as well as the broader Chemical Manufacturing category.

was -5.1 percent (the median measure was positive at 6.4 percent), and rose to 7.8 percent by 2011. Average profit margins on the whole tended to be somewhat lower than median measures, as a handful of respondents skewed the distribution lower. The years 2007-2009 in particular contained a number of respondents with significant net losses.

Figure 4.8: Mean CAD/PAD Level Profit Margins, 2007-2011 (Gross, Operating, Net)



16 Respondents in 2007, 18 Respondents in 2008-2011

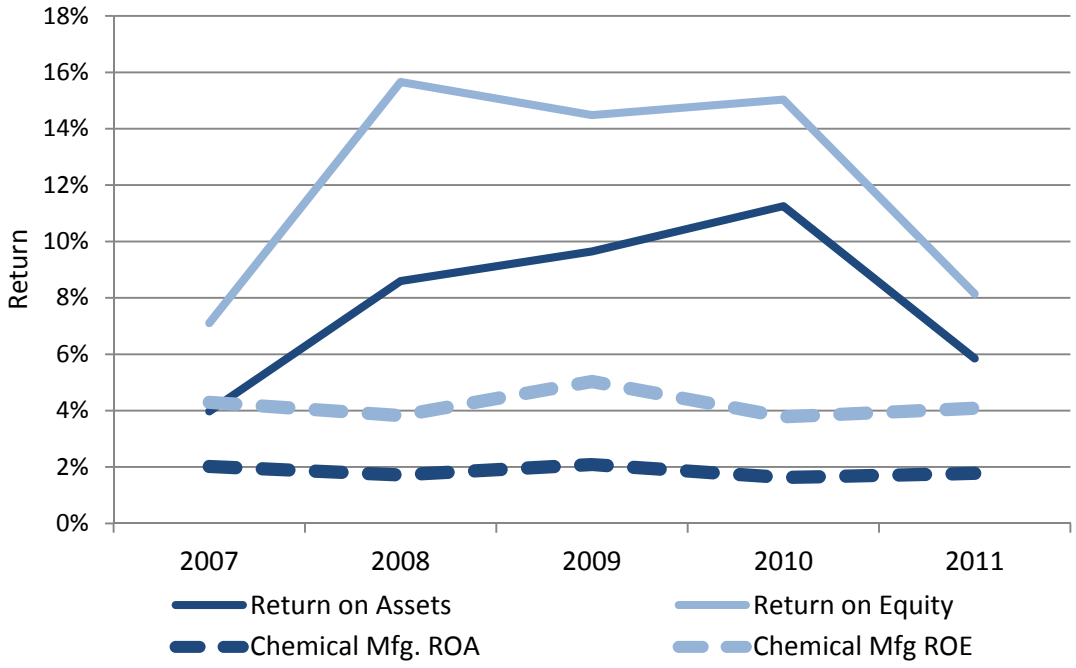
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

On the whole, CAD/PAD level average profit margins were consistent with a solid and slowly improving level of profitability. Averages of three measures of profit ended the period higher than in 2007, and near the top of their five-year ranges. Underneath the steadiness portrayed by the CAD/PAD level as a whole, individual respondents reported more variable results, with six respondents reporting lower net profit margins in 2011 than in 2007, and several reporting significant losses, primarily in the 2007-2009 period.

When measured by returns on equity and assets, respondents show a relatively positive profitability profile. Return on Assets (ROA) – or net income as a percent of a respondent's total

assets – provides a measure of the efficiency of a company's use of assets to produce profits. A higher ROA means the company is creating more profit per dollar of assets they hold. Median CAD/PAD level ROA rose to six percent in 2011, up from four percent in 2007 but down sharply from the 2010 peak of 11 percent (see Figure 4.9). In all years, the CAD/PAD level median ROA exceeded the average ROA of the broader chemical manufacturing industry.

Figure 4.9: CAD/PAD Level Median Return on Assets and Equity, 2007-2011

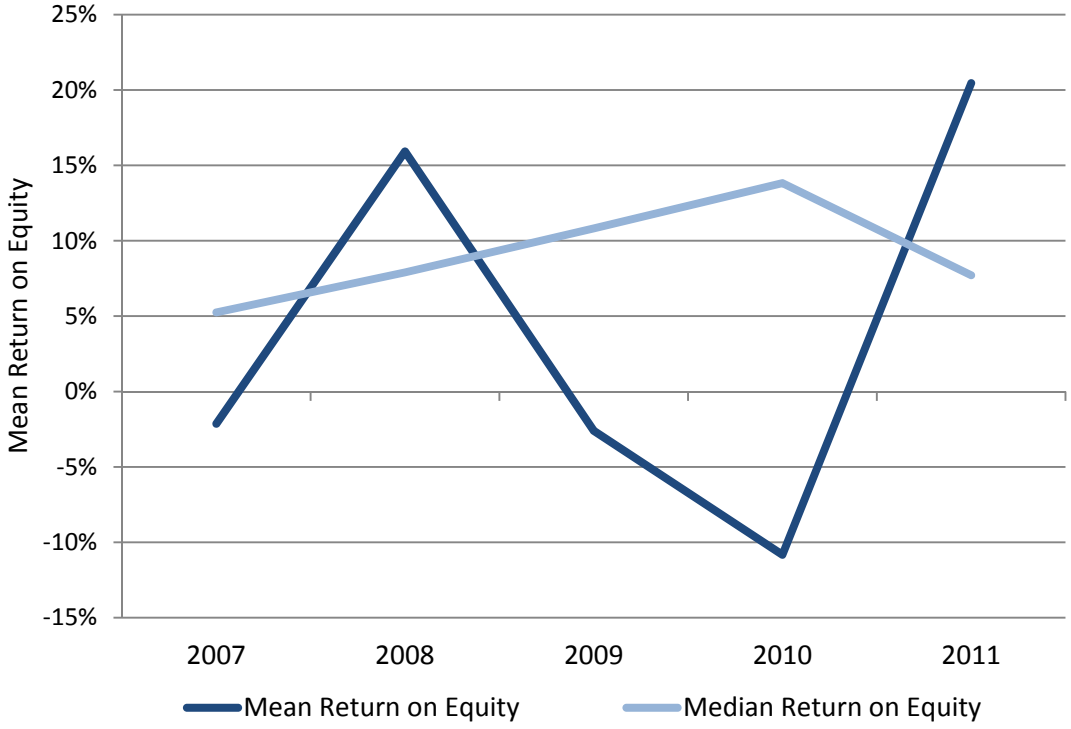


12 Respondents in 2007, 14 in 2008, 15 in 2009-2011

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Return on Equity (ROE) – the proportion of money invested in the company by owners and stockholders that profits represent – showed the same general trend as ROA, though with more volatility (see Figure 4.10). While median ROE figures were elevated in 2009 and 2010, mean ROE was negative in both years as a few respondents reported net losses that represented a higher percentage of their reported equity. By 2011, average ROE was sharply higher as fewer respondents had losses and several reported strong profit growth. As with ROA, the CAD/PAD level median ROE exceeded the average ROE of the broader chemical manufacturing industry.

Figure 4.10: CAD/PAD Level Mean and Median Return on Equity, 2007-2011



12 Respondents in 2007, 14 in 2008, 15 in 2009-2011

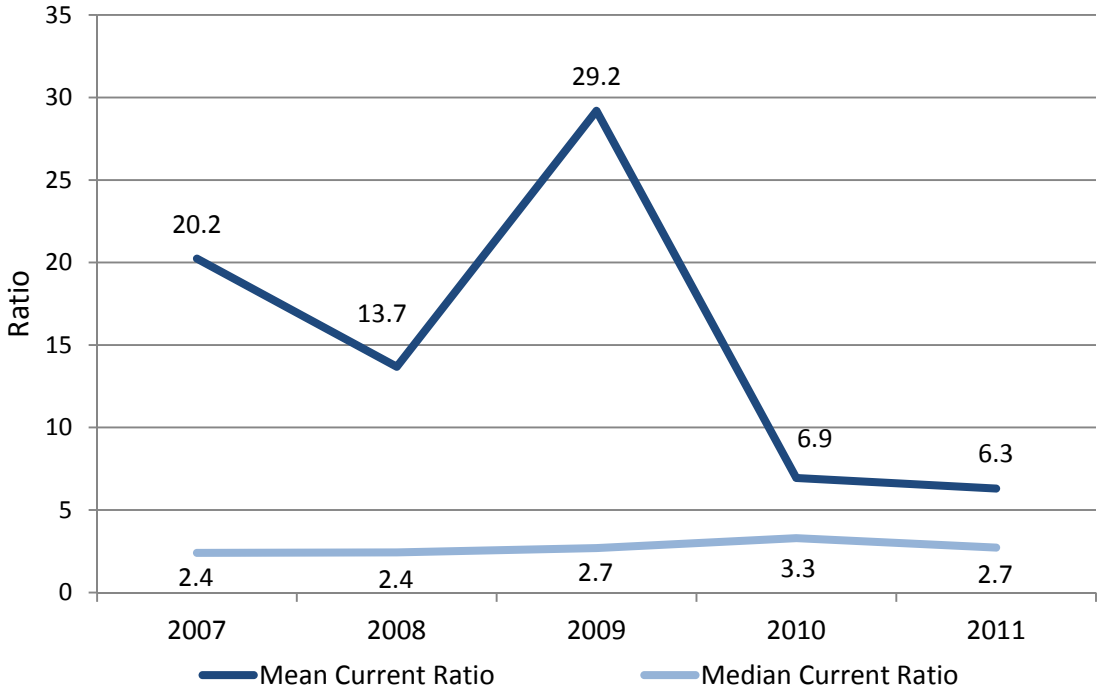
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

4.1.2 Liquidity

Measures of liquidity, in particular the current ratio and quick ratio, provide an indication of respondents' abilities to cover their short-term debt obligations. A sufficient level of liquidity is important, as a company without enough liquid assets (cash or other assets than can quickly be converted to cash) is at risk of defaulting on its debts and losing its viability or solvency.

The current ratio – current assets as a percentage of current liabilities – gives a general idea of the respondents' financial strength by measuring the ability of a company to pay its debts with its existing resources over the next 12 months. A current ratio below 1.0, therefore, indicates that a company's current liabilities exceed its current assets, a potentially financially vulnerable position. Average current ratios for the survey respondents were quite mixed, as a number of respondents had very few liabilities, though the median current ratio ranged from 2.4 to 3.3, a relatively safe range (see Figure 4.11).

Figure 4.11: CAD/PAD Level Mean and Median Current Ratio, 2007-2011

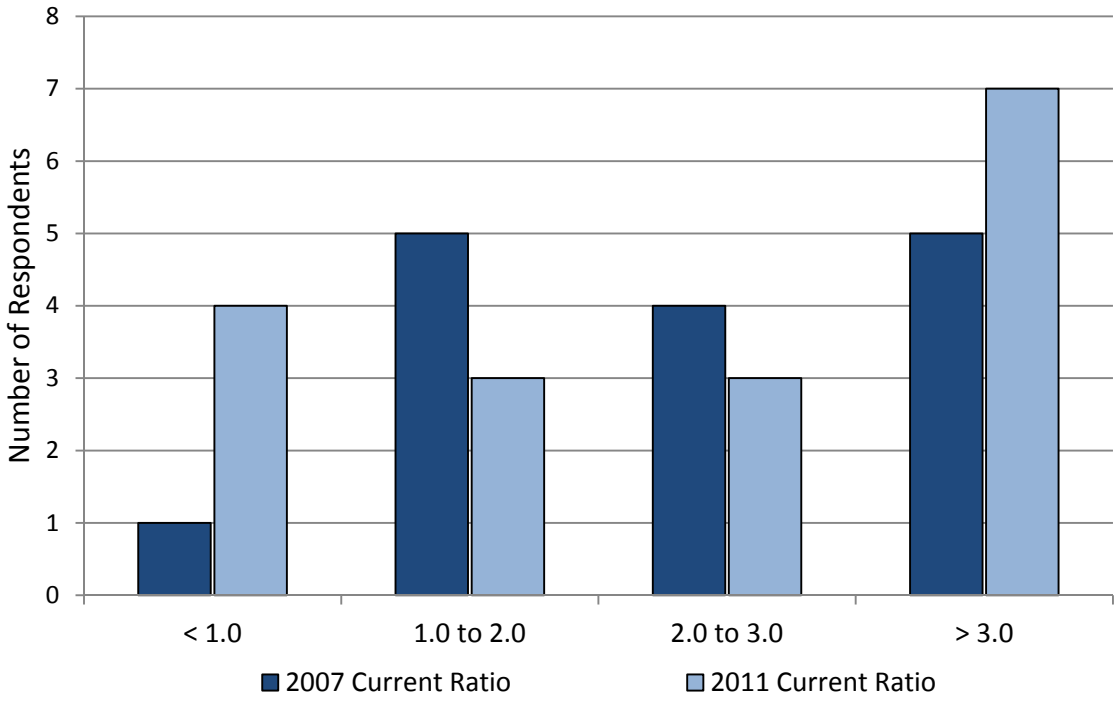


15 Respondents in 2007, 17 respondents in 2008-2011

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

At the individual respondent level, however, six companies had current ratios below 1.0 at some point during the reporting period. In 2011, four respondents had current ratios less than 1.0, with an additional three having current ratios between 1.0 and 2.0. These figures were in contrast to the beginning of the reporting period, when just one respondent had a current ratio less than 1.0 and five reported a current ratio between 1.0 and 2.0 in that year (see Figure 4.12).

Figure 4.12: Current Ratio by CAD/PAD Respondents 2007 and 2011



16 Respondents in 2007, 18 respondents in 2008-2011

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The quick ratio is a more conservative measure of liquidity than current ratio, as it excludes inventory from the calculation.[28] The quick ratio shows the ability of a company to pay its short-term debts in the event that inventory cannot be sold; a quick ratio below 1.0 indicates a company cannot meet its obligations in such a situation, and is generally used as a liquidity benchmark. Like the current ratio, the average quick ratio from this survey was quite mixed, but the median stayed in a range between 1.3 and 2.1. Over the reporting period, eight respondents reported a quick ratio below 1.0 at some point, though just five were below that threshold in 2011. Six respondents had a quick ratio below 1.0 for the majority of the reported years.

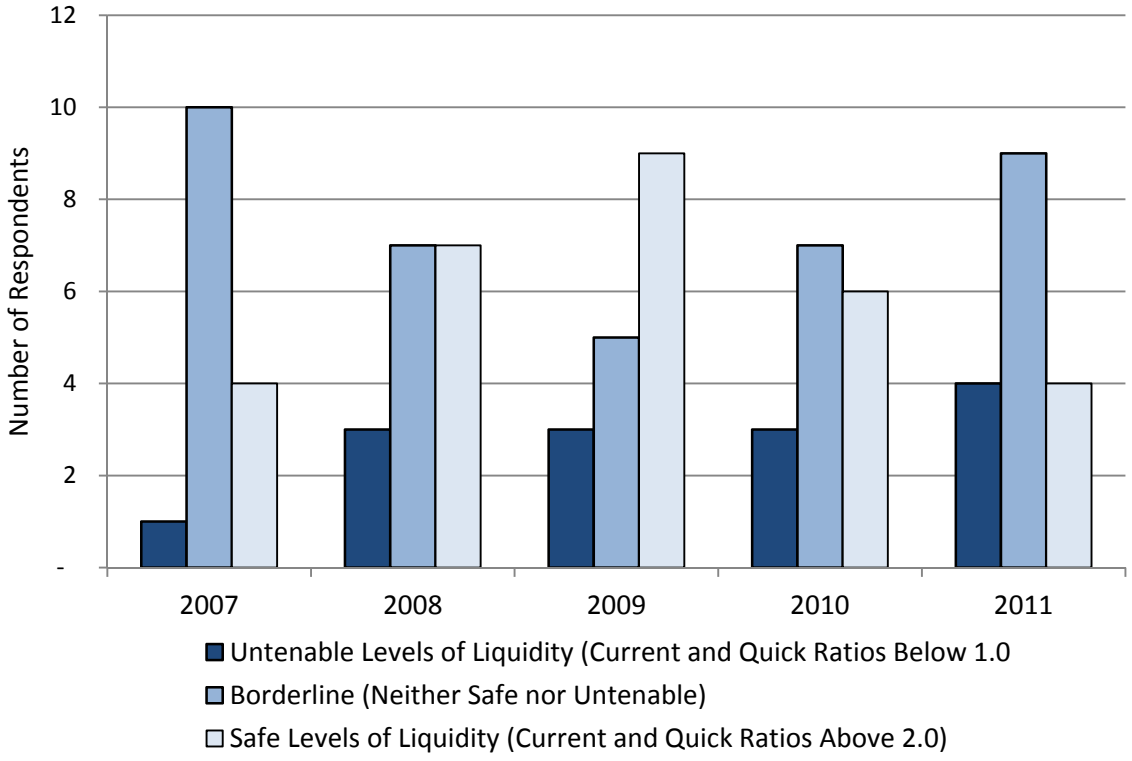
Overall, the number of respondents with an untenable level of liquidity – defined here as having both a current ratio and a quick ratio below 1.0 – increased somewhat across the period (see Figure 4.13). The number of respondents with a relatively safe level of liquidity – defined here

[28] The quick ratio is also known as the acid-test ratio.

as having both a current ratio and a quick ratio above 1.0 – ended the period unchanged after having peaked in 2009.

The number of respondents with neither untenable levels of liquidity nor safe levels, considered "Borderline," fell from 2007 to 2009, with more moving into the "Safe" category than "Untenable." This trend reversed in 2010 and 2011, with the number of "Borderline" respondents rising to almost the 2007 level. Ten respondents indicated that their current and quick ratios were lower in 2011 than in 2007, while seven respondents reported increases in these ratios (five respondents did not have calculable ratios).

Figure 4.13: Respondents' CAD/PAD Liquidity Conditions 2007-2011



15 Respondents in 2007, 17 respondents in 2008-2011

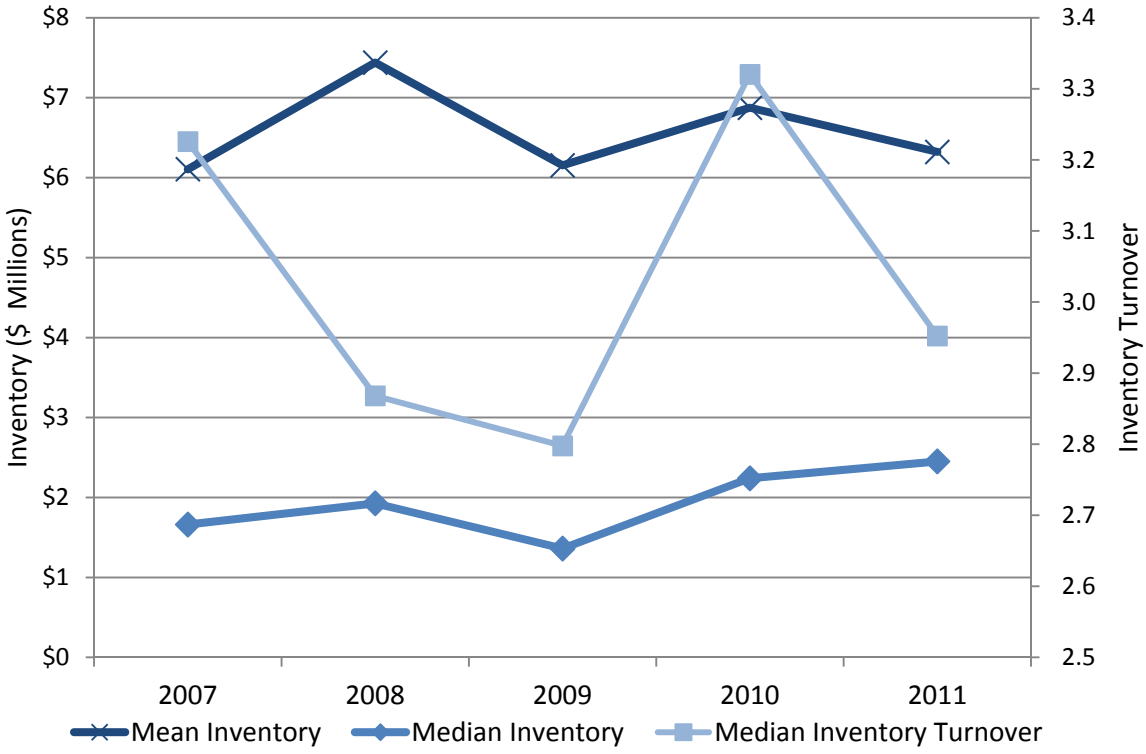
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

4.1.3 Inventory Levels

Inventory levels, turnover, and weeks of inventory highlight how efficiently respondents are using their inventories. Companies generally try to keep as little inventory on hand as needed to sustain their expected level of business, as inventory sitting in a warehouse for long periods of time ties up capital and increases storage costs.

Median inventory levels rose 47 percent over the period, while average inventory levels rose just four percent. Both measures showed sharp increases between 2007 and 2008, as sales slowed, followed by declines in 2009. Inventory turnover – the number of times per year a company goes through its average level of inventory – dropped sharply from 2007 to 2009 recovered in 2010 and fell again in 2011 (see Figure 4.14).

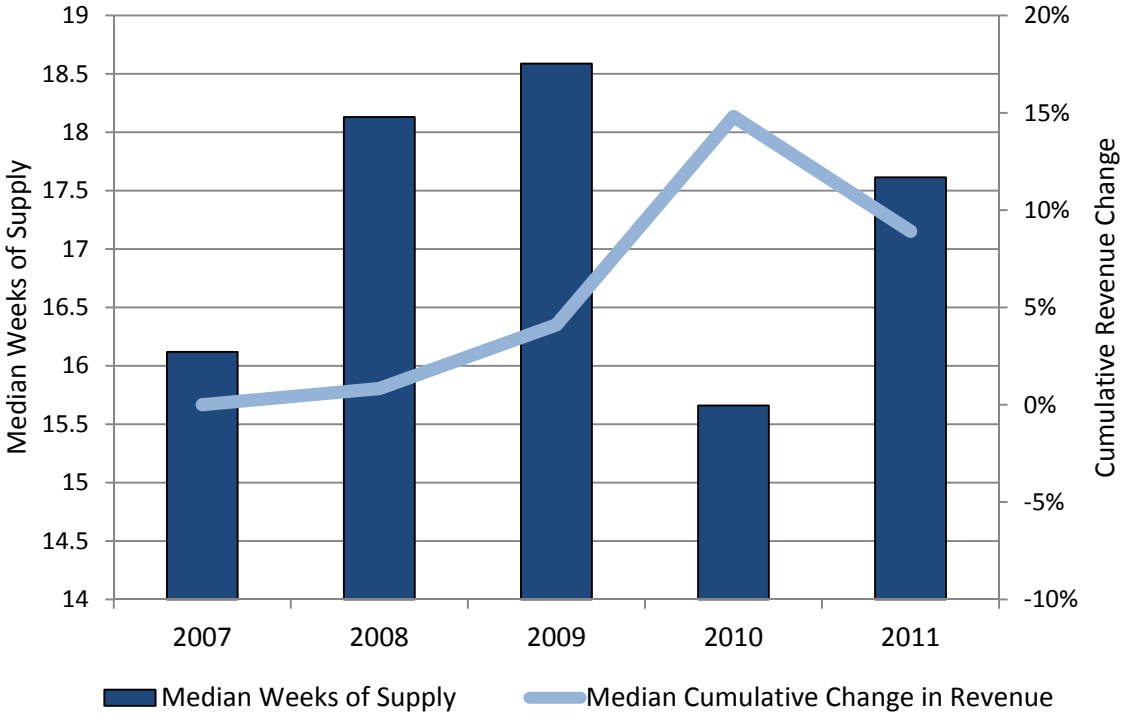
Figure 4.14: Mean and Median Inventory Levels, 2007-2011



16 Respondents in 2007, 18 respondents in 2008-2011
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Another measure of inventory is "weeks of inventory", which represents how long a company's inventory would last if it was not replenished. Lower weeks of inventory generally indicate that a company is operating more efficiently, with fewer assets tied up in inventory not sold immediately. However, a very low level can result in lost sales if the company is unable to fill orders with existing inventory. Median weeks of inventory showed a sharp jump from 2007 to 2008, from 16 weeks to more than 18 weeks, as revenue stagnated relative to expectations (see Figure 4.15). Overall, most respondents were able to reduce their inventory levels relative to sales, with 11 respondents ending the period with fewer weeks of supply than in 2007, while five respondents reported increased weeks of inventory.

Figure 4.15: Weeks of Inventory Supply and Revenue Changes for CAD/PAD Respondents, 2007-2011



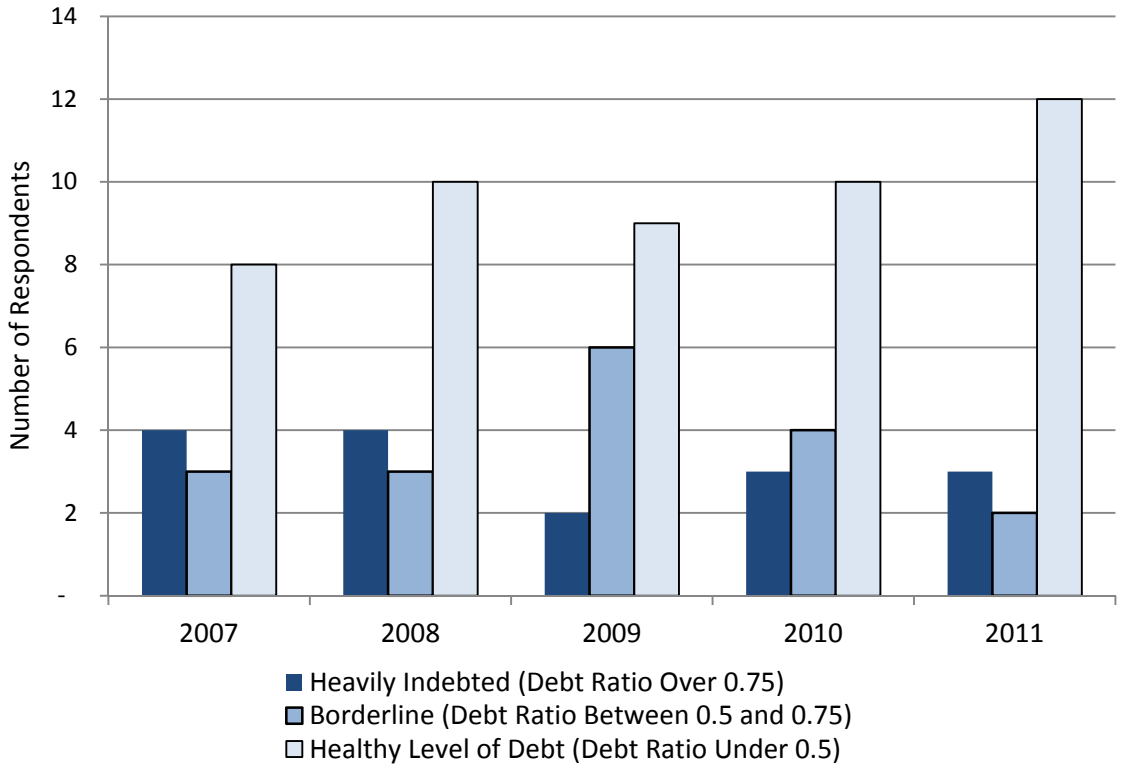
16 Respondents in 2007, 18 respondents in 2008-2011
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

4.1.4 Debt Levels

A company's level of debt provides insight into the level of risk it is willing to take. Higher levels of debt relative to assets and equity increase the chances of defaulting on that debt, but they also increase leverage, or the use of debt to finance a company's assets. Higher levels of debt can increase returns on equity, but can also increase the risk of not being able to repay that debt. The debt ratio, or liabilities per dollar of assets, indicates the level of leverage in a company; a higher number indicates a higher level of risk. A debt ratio of 0.5 indicates a company has twice as many assets as debts, and ratios below that level are considered to be adequate.

Overall, the mean and median debt ratios of respondents stayed under 0.5 and declined between 2007 and 2011. The number of respondents with a debt ratio greater than 0.75 – a riskier position, meaning they held liabilities for three out of every four dollars in assets – was consistent over the period, while the number of respondents with lower debt ratios rose slightly. In 2009, a lower number of respondents reported higher debt ratios and a greater number reported borderline cases, most likely because of the global economic downturn. By 2011 however, more respondents had a debt ratio of less than 0.5 than at any other time in the reporting period (see Figure 4.16).

Figure 4.16: CAD/PAD Debt Ratio Levels, 2007-2011

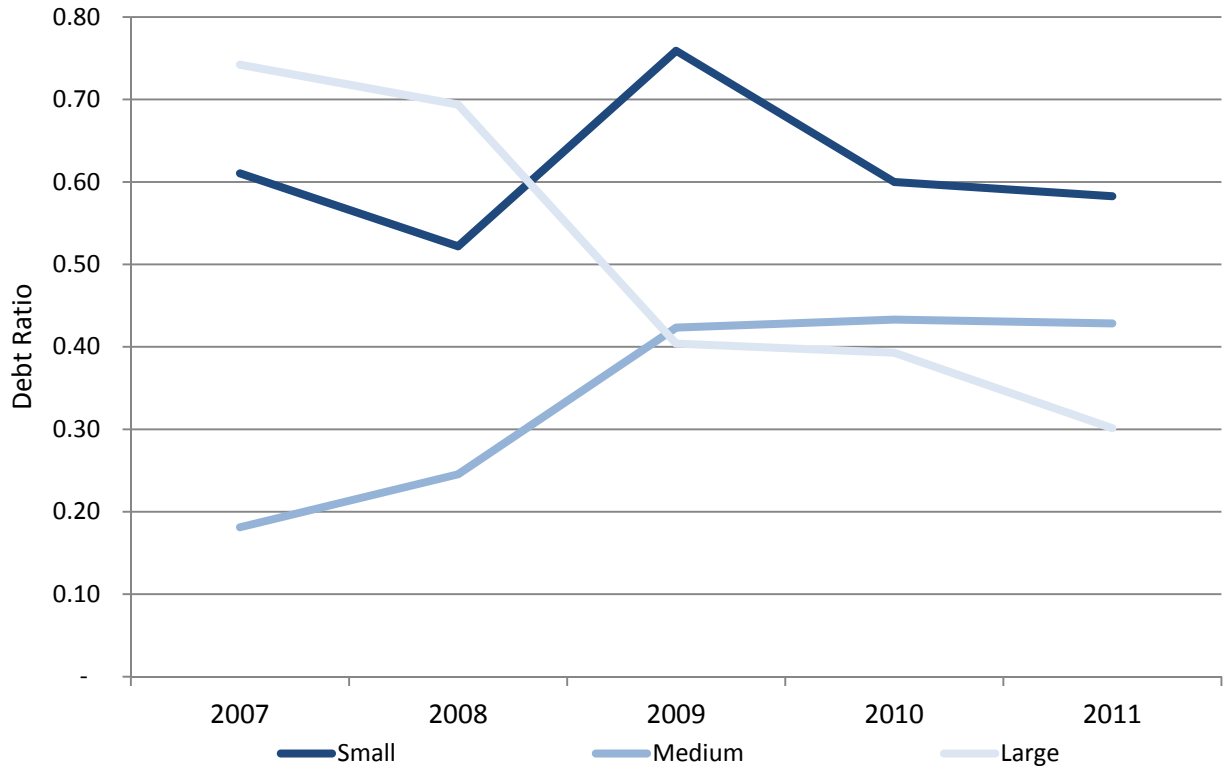


15 Respondents in 2007, 17 in 2008-2011
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Small respondents tended to have higher debt ratios than Medium and Large respondents (see Figure 4.17). Across the period, the average debt ratio of Small respondents was consistently above 0.5, and rose as high as 0.76 in 2009. The average debt ratio of Medium respondents rose between 2007 and 2009, from 0.18 to 0.42, and stayed constant for 2010 and 2011. Large respondents showed a steadily improving average debt ratio, dropping from nearly 0.75 in 2007 to under 0.3 in 2011.

These trends are also evident at the individual respondent level, with virtually all Small respondents carrying a heavier debt load than their Large counterparts. Three respondents with debt ratios more than 0.75 in 2011 were in the Small category, while all but one Large respondents had a debt ratio less than 0.5 in 2011.

Figure 4.17: Average Debt Ratio by Respondent Size, 2007-2011



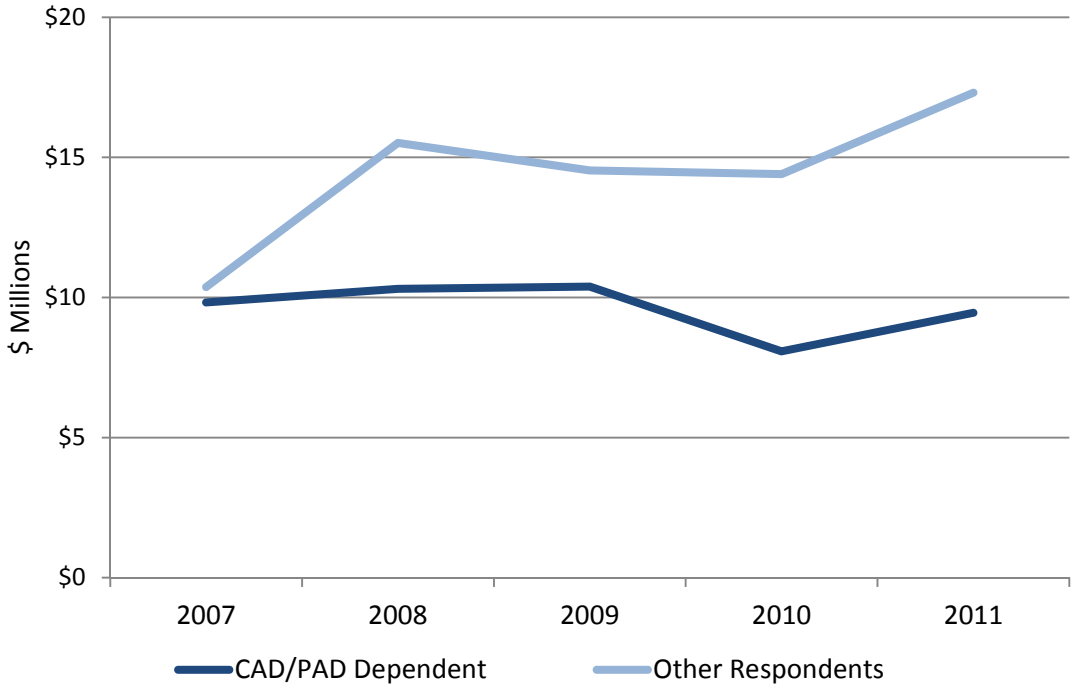
15 Respondents in 2007, 17 respondents in 2008-2011
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

4.1.5 CAD/PAD-Dependent Respondents

Eight respondents were categorized as dependent on CAD/PADs, with more than half of their net sales comprised of CAD/PAD sales. These dependent respondents generally reported lower levels of revenue growth than the other respondents, but otherwise showed solid and gradually improving financial performance. All dependent respondents who reported net income had higher levels of income in 2011 than in 2007.[29] However, five of the eight reported higher net sales at the end of the period than the start, and the median revenue of dependent respondents fell nearly four percent across the period. In comparison, median revenue of other respondents rose 67 percent to a significantly higher level (see Figure 4.18).

[29] Two CAD/PAD-dependent respondents did not provide net income data.

Figure 4.18: Median Revenue, 2007-2011

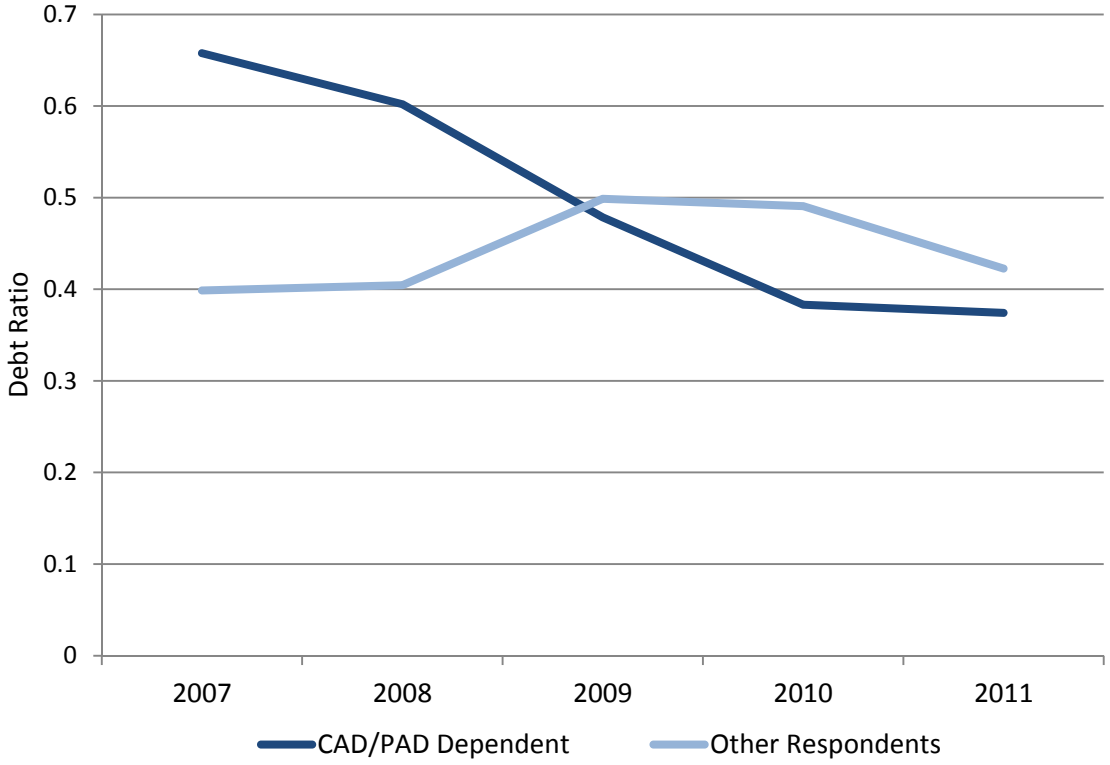


22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The financial ratios of respondents categorized as dependent on CAD/PAD sales were generally strong. Both mean and median profit margins improved for gross, operating, and net margin measures, though operating and net profit margins were slightly lower than for non-dependent respondents. Five of the eight dependent respondents reported improvements in all three profit margins between 2007 and 2011, as well as in returns on assets and equity. Of the non-dependent respondents, one showed improvement in all five profitability measures between 2007 and 2011.

Most dependent respondents also had strong balance sheets, with ample liquidity and relatively little debt. Just one dependent respondent had a current ratio below the 1.0 level in 2011, and two had a quick ratio below that level. For total debt, six of the eight had debt ratios below 0.5, indicating they had more than twice as many assets as debts. As with the other financial measures, average debt ratios of dependent respondents improved over the period, both in absolute terms and relative to non-dependent respondents (see Figure 4.19).

Figure 4.19: Average Debt Ratios, 2007-2011



15 Respondents in 2007, 17 in 2008-2011
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

4.1.6 Financial Assessment

Overall, the financial measures examined in this section show almost all CAD/PAD-level respondents to be in a generally healthy financial condition, though performance was varied. Revenue growth from year to year was inconsistent but broadly positive. Most respondents had higher profits in 2011 than in 2007, but only a handful reported that net profits grew every year. ROA and ROE were similarly mixed: more respondents had higher returns to end the period than to start the period, but barely so. Similar results are evident from liquidity and debt reporting, with no clear trends either by respondent or across all respondents.

The profit growth trends in the 2007 to 2011 period are largely consistent with those reported in the previous CAD/PAD review, which covered defense sector CAD/PAD financial data for the 2001-2005 period. Operating profits have continued to grow strongly, though at a lower rate than reported in 2001-2005. The average operating margin is down three points from 14.9

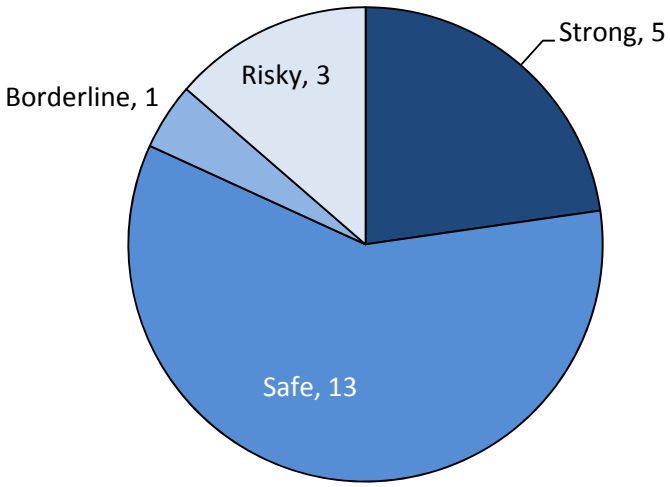
percent in the 2001-2005 period to 11.9 percent. While overall operating income grew at 80.9 percent between 2001 and 2005, average cumulative growth from 2007 to 2011 was 61.5 percent. Net profits, however, have grown at a faster pace; from 2001 to 2005 net profit grew 27.0 percent, compared to 42.1 percent growth in average net profit from 2007 to 2011.

In order to provide a fuller picture of the current financial state of the survey respondents, BIS produced a composite financial condition index based on 2011 net income, profit margins, quick ratio, and debt ratio. Respondents failing to exceed basic thresholds for each condition were considered to be in a more precarious financial condition.[30]

Based on an array of financial measures examined in this section, almost all CAD/PAD-level respondents were in financially stable shape in 2011, surpassing basic thresholds in all or all but one category (see Figure 4.20). Three respondents presented a risky financial profile, failing to meet the thresholds in all or all but one category. Additionally, three of the four respondents in a borderline or risky financial condition had a cumulative net loss over the reporting period. None of the dependent respondents fell into the "risky" category; four were in the "strong" category, having exceeded each of the four thresholds.

[30] Thresholds are: (1) positive net income; (2) increased net margin in 2011 relative to 2007; (3) a quick ratio over 1; and (4) a debt ratio under 0.5.

Figure 4.20: Overall Financial Condition by Respondent, 2011



22 Respondents in 2007, 17 in 2008-2011
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

4.2 Mergers, Acquisitions, and Joint Ventures

Survey respondents were asked to identify any mergers, acquisitions, or joint-ventures they participated in between 2006 and 2011. However, to protect business confidential responses, all company-specific information in this section was obtained from independent research of publicly available information.

While most CAD/PAD companies were not part of a merger or acquisition, three companies were purchased during the reporting period and two others acquired a total of five companies. This is a slightly higher level of acquisition activity than found in the 2006 BIS CAD/PAD report, in which much activity involved the purchase or sale of business units by companies seeking to streamline their core CAD/PAD business. The 2007-2011 period, by contrast, featured larger deals that would enable the purchasing companies to expand their number of product lines or market access.

The largest transaction was the 2012 purchase of Goodrich by United Technologies Corporation (UTC), which was valued at $16.5 billion.[31] UTC planned to merge their subsidiary Hamilton Sundstrand with the newly purchased Goodrich to create a new business unit named UTC Aerospace Systems.[32] UTC stated that the purchase of Goodrich would increase the scale and array of complementary products and better position them for leadership in the commercial aerospace industry.

Another company, Ameron Global, Inc. was purchased in 2009 by AMETEK, Inc., a publicly traded manufacturer of electronic and electromechanical devices. AMETEK expected the purchase of Ameron Global would enable them to increase the size of their aerospace maintenance, repair, and overhaul business.[33]

The final acquisition of a CAD/PAD producer was Hi-Shear Technology Corporation, which was purchased by the British Chemring Group, PLC in 2009 for $132 million. According to *The Financial Times*, the Chemring Group was pursuing expansion into the energetics market in response to the slowing growth of its countermeasures business.[34] Chemring Group also expected that its acquisition of Hi-Shear would enable the expansion of Hi-Shear's space and satellite separation business into Europe through incorporation of Chemring Group technologies.[35]

Ensign-Bickford Industries was the most active company making acquisitions during the period, purchasing three companies. Shock Tube Systems, which Ensign-Bickford purchased in 2008, was a manufacturer of shock tube initiators and firing devices.[36] Special Devices Incorporated's Defense and Aerospace Group, acquired in 2010, provided "an array of critical components

[31] Scott, M. United Technologies closes $16.5 billion Goodrich takeover |Reuters. *Business & Finance News.* From http://www.reuters.com/article/2012/07/26/us-unitedtech-goodrich-close-idUSBRE86P1BP20120726
[32] From UTC Aerospace Systems, News
[33] From AMETEK's 2009 10-K report
[34] Financial Times – Jeremy Lemer, September 17, 2009, "Chemring agrees to buy Hi-Shear" From, http://www.ft.com
[35] Acquisition of Hi-Shear Technology Corporation – Chemring Group PLC. Home- *Chemring Group PLC.* From, http://www.chemring.co.uk/media/press-releases/2009/2009-09-16.aspx
[36] Ensign-Bickford Aerospace & Defense Company acquires Shock Tube Systems Inc. *Ensign-Bickford Industries, Inc.* From, http://www.ensign-bickfordind.com/subpages/news12_08.html

complimentary to [Ensign-Bickford's] core product lines".[37] Ensign-Bickford's final acquisition, also in 2010, was of NEA Electronics. NEA focuses on non-explosive separation mechanisms and battery cell bypass switches used in satellites, missiles, and space vehicles.[38]

In 2007, Norway-based Nammo AS purchased Talley Defense Systems; the purchase was expected to increase Nammo's access to U.S. markets.[39] The company continues to operate as a subsidiary of Nammo AS. Nammo Talley focuses primarily on CAD/PADs, including aircrew escape systems and airbag components, as well as shoulder-fired weapons. Nammo Talley subsequently purchased Composite Solutions in 2009, a producer of machined composite and metallic parts, in order to expand their aerospace and defense capabilities.[40]

There were no reported joint ventures for the 2007-2011 period.

4.3 Capital Expenditures

Respondents were asked to record their total corporate capital expenditures for the 2007-2011 period, as well as to provide percentage breakdowns by four capital expenditure categories: Machinery, Equipment, and Vehicles; IT, Computers, and Software; Land, Buildings, and Leasehold Improvements; and "Other". Respondents were also asked to estimate the percent of capital expenditures that related to their CAD/PAD business lines.

Corporate Capital Expenditures

Total corporate capital expenditures for 20 of the 22 respondents amounted to $142.4 million over the period; three respondents accounted for more than half of the total. Machinery, Equipment, and Vehicles accounted for the largest portion, amounting to between 60 and 66

[37] Ensign-Bickford Industries, Inc. Completes acquisition of Special Devices, Incorporatedâs Defense and Aerospace Group. (n.d.). *Ensign-Bickford Industries, Inc*. From, shttp://www.ensign-bickfordind.com/subpages/news3_10.html

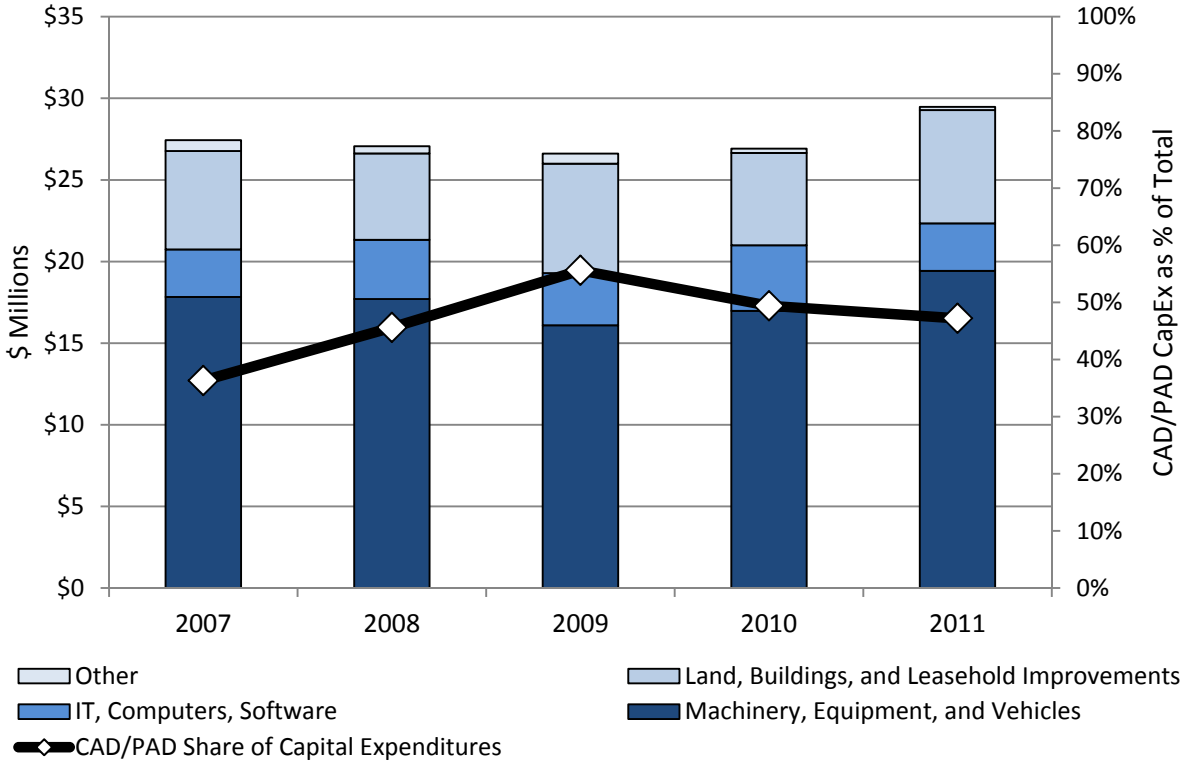
[38] Ensign-Bickford Industreis Inc. Subsidiary Completeds Acquisition of NEA Electronics, Inc. | Business Wire. *Press release distribution,*From, http://www.businesswire.com/news/home/20100528005888/en/Ensign-Bickford-Industries-Subsidiary-Completes-Acquisition-NEA-Electronics

[39] NAMMO's Talley Acquisition Takes Effect. *Daily Defense News for Military procurement managers, contractors, policy makers.* From, http://www.defenseindustrydaily.com/nammos-talley-acquisition-takes-effect-02914/

[40] NAMMO Talley acquires Composite Solutions | Reuters. *Business & Financial News, Breaking US & International News.* From, http://www.reuters.com/article/2009/02/12/idUS295985+12-Feb-2009+MW20090212

percent of all capital expenditures (see Figure 4.21). Land, Buildings, and Leasehold Improvements ranged from 20 to 25 percent of total capital expenditures and IT-related expenses from 10 to 15 percent. As a whole, expenditures were consistent, shrinking slightly between 2007 and 2009 and rising modestly by 2011. By the end of the period, total corporate capital expenditures were 7.5 percent higher than in 2007.

Figure 4.21: Total Capital Expenditures by Category, 2007-2011



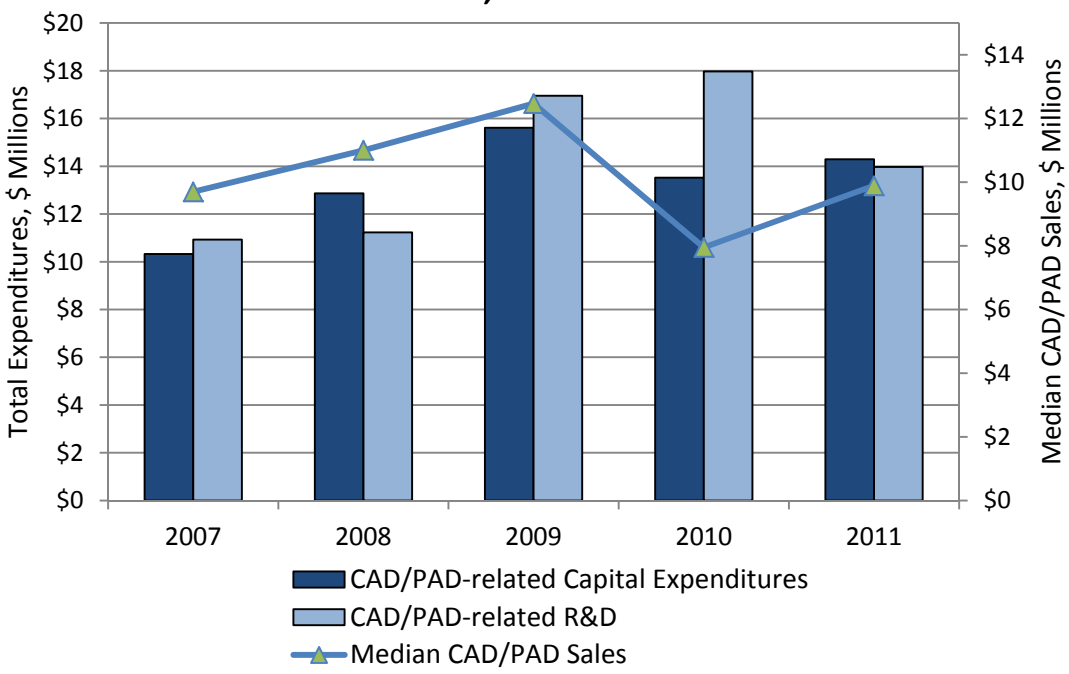
20 Respondents reported Capital Expenditures, 13 reported CAD/PAD-related expenditures
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

CAD/PAD Capital Expenditures

Total capital expenditures related to CAD/PAD business lines totaled $66.7 million over the 2007-2011 period, or 47 percent of total reported capital expenditures. These expenditures came from 13 of the 22 respondents, as nine respondents did not indicate having any CAD/PAD-related capital expenditures. CAD/PAD-related capital expenditures rose from 36 percent of all expenditures in 2007 to nearly 56 percent in 2009, and ended the period at 47 percent in 2011.

Comparing capital expenditures to research and development (R&D) expenditures, which are both highly responsive to expected changes in revenue, gives insight into companies' views of the future. Total CAD/PAD-related capital expenditures and R&D rose sharply along with median CAD/PAD sales from 2007 to 2009 (see Figure 4.22). While R&D continued to grow in 2010, capital expenditures shrank along with median sales. Despite median CAD/PAD sales ending the reporting period at the same level as at the start, both expenditure types were sharply higher. CAD/PAD capital expenditures rose from $10.3 million to $14.3 million and CAD/PAD R&D also rose from $10.9 million to $14. million.[41]

Figure 4.22: CAD/PAD-Related Capital Expenditures and R&D, 2007-2011



13 Respondents reported CAD/PAD-related Capital Expenditures; 19 Respondents reported CAD/PAD-related Sales; Nine Respondents reported CAD/PAD-related R&D Expenditures.
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

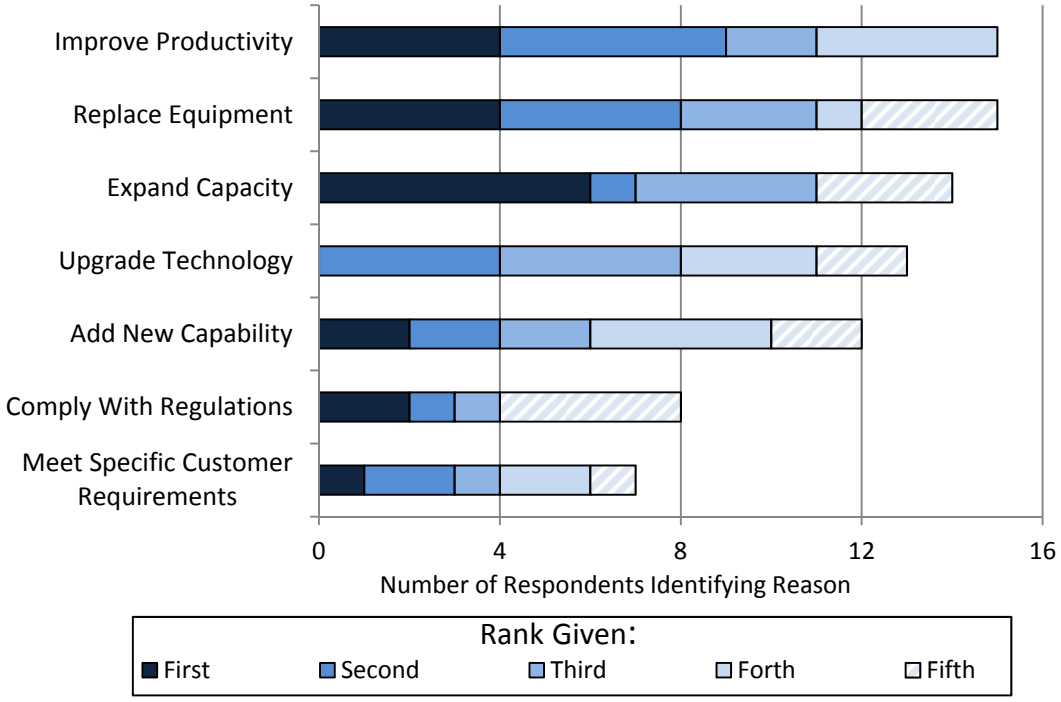
[41] For more detailed information on R&D expenditures, please see Chapter 5.

Reasons for Capital Expenditure

In addition to providing capital expenditure figures, respondents were also asked to rank their top five reasons for making these investments. The eight possible choices included Replace Old Equipment, Comply with Environmental or Safety Requirements, and Other.

Sixteen of the 22 respondents provided rankings. The top two reasons for capital expenditures were to Improve Productivity and Replace Old Equipment, with 15 respondents identifying both in their top five reasons for investment (see Figure 4.23). However, Expand Capacity was chosen as the top reason for investment more often than Improve Productivity and Replace Equipment. The only selected reason not ranked number one by respondents was Upgrade Technology, though this was the fourth most identified reason overall.

Figure 4.23: Reasons For Capital Expenditure



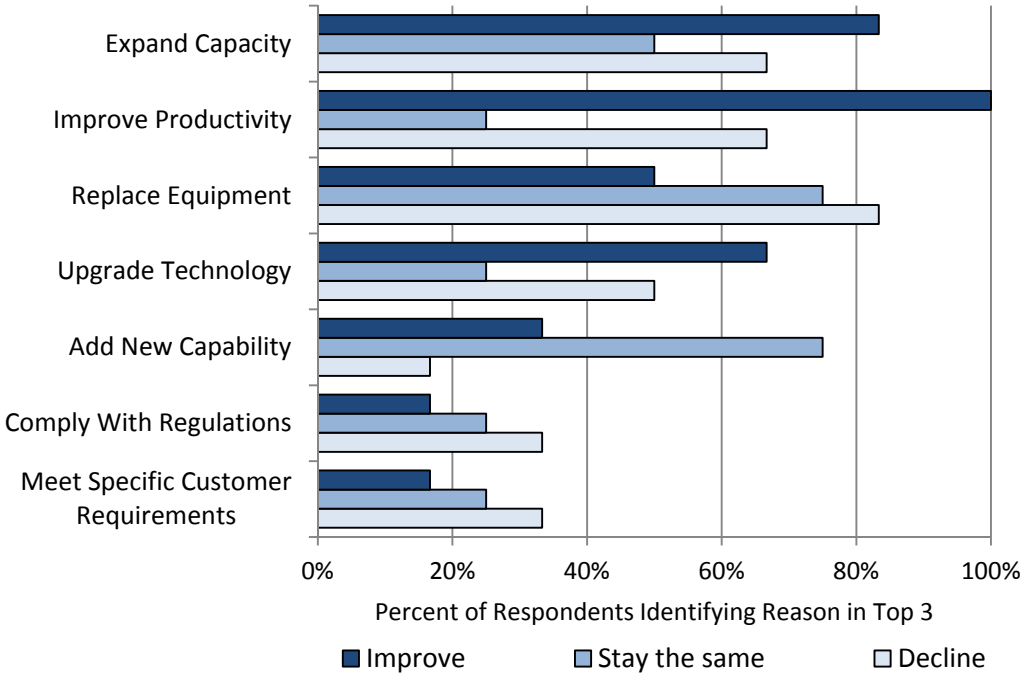
16 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

In another portion of the BIS survey, respondents were asked "How do you foresee the competitive prospects for your firm's U.S.-based CAD/PAD production operations over the next five years?" Respondents were able to select from the following choices: Decline, Decline

Somewhat, Stay the Same, Improve Somewhat, or Improve Greatly.[42] Cross-referencing respondents' expectations for growth in the CAD/PAD industry with their reasons for capital expenditure provides additional insight.

Respondents who expected their competitive prospects to improve were significantly more interested in investing to Improve Productivity, while those who expected declining competitive prospects were focused on Replacing Old Equipment (see Figure 4.24). Respondents who expected their competitive prospects to stay the same were most interested in adding new capability. It is important to note that given the small set of respondents, the answers of a few companies can have a large impact on results.

Figure 4.24: Top Reasons For Capital Expenditure by Expected Competitive Prospects, 2007-2011



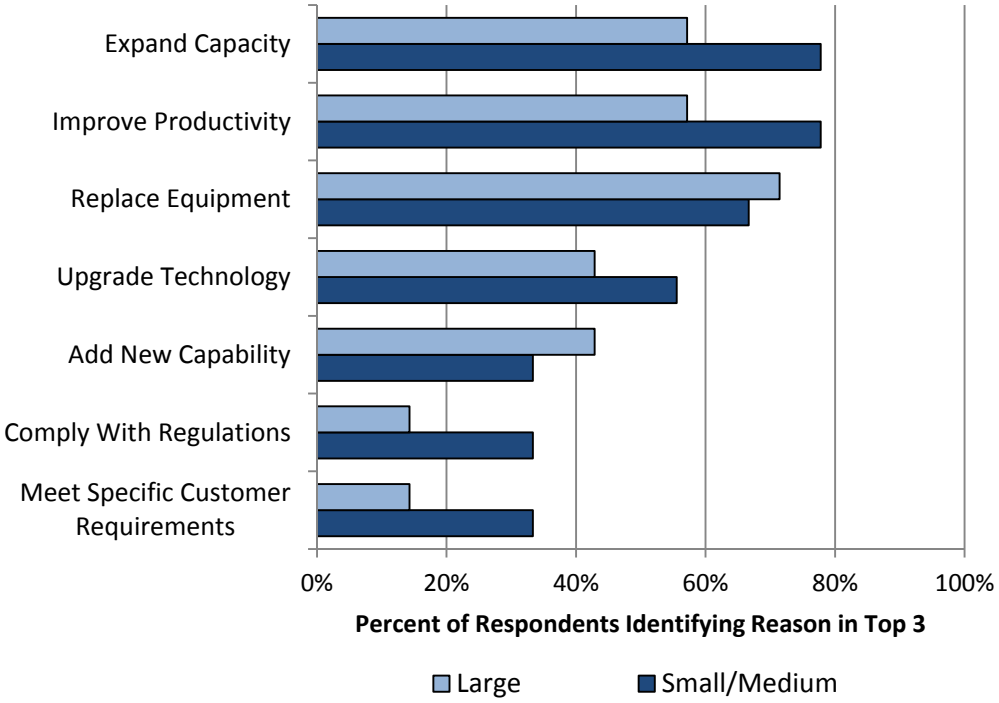
16 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Examining reasons for investment based on the size of respondents provides another perspective (see Figure 4.25). The dollar amount of a respondent's CAD/PAD-related capital expenditures

[42] See Chapter 7 for further analysis on how respondents foresee their competitive prospects.

appear to have little relation to its reasons for investment, but some differences arise in comparing company size based on net revenue. Small and Medium companies (those with net revenue under $50 million per year) were more interested in Expanding Capacity and Improving Productivity, while Large companies were more focused on Replacing Old Equipment and Adding New Capability.

Figure 4.25: Top Reasons For Capital Expenditure by Total Respondent Size



16 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The reasons for capital expenditures among respondents categorized as dependent on CAD/PAD sales were quite similar to those of non-dependent respondents, though dependent respondents were less interested in adding new capabilities. Dependent respondents were most interested in expanding capacity; half of these respondents ranked expanding capacity as their number one reason for capital expenditure, compared to three in ten non-dependent respondents.

5. RESEARCH AND DEVELOPMENT (R&D)

Respondents were asked to provide information regarding their R&D activities for 2007-2011, categorizing them by type and by the source of funding for both the defense and non-defense sectors.[43] Types of R&D were broken into three categories: basic research, applied research, and product/process development. Sources of R&D funds were divided into six categories: internal/self-funded, federal government, state/local government, universities, U.S. industry/non-profit, and non-U.S. investors. BIS also asked respondents to estimate the percentage of R&D expenditures dedicated to CAD/PAD-related business lines. Information collected from respondents for 2007-2011 was compared to data from two previous BIS CAD/PAD reports, covering the years 1995-1999 and 2001-2005, to better understand long-term trends in R&D.[44]

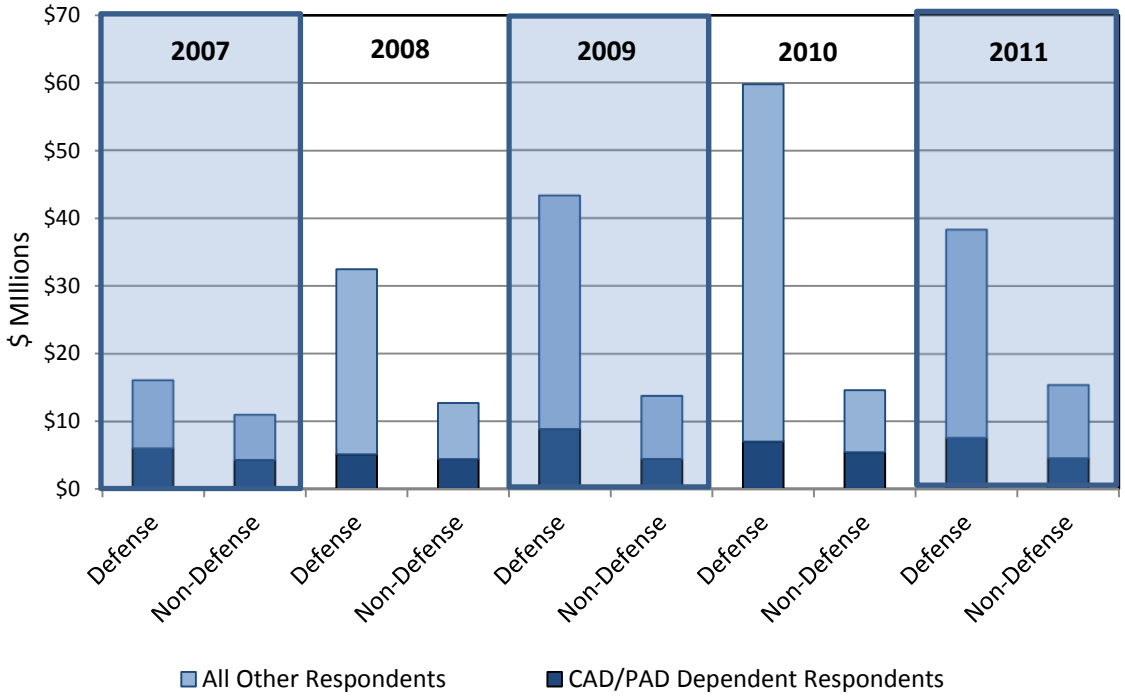
5.1 Total R&D Expenditures

Seventeen respondents provided information regarding their R&D activities over the five-year period. Eight respondents reported only defense-related R&D activities, four reported only non-defense-related R&D activities, and five reported both defense-related and non-defense-related R&D activities. Total R&D expenditures grew from $27 million in 2007 to $74.4 million in 2010, before falling back to $53.8 million in 2011 for a five-year cumulative total of $257.5 million.

Defense-related R&D expenditures accounted for 73.8 percent ($190.1 million) of all reported expenditures over the 2007-2011 period, ranging from 59.4 percent ($16.1 million) of total expenditures in 2007 to 80.4 percent ($59.8 million) in 2010. Defense-related expenditures grew more quickly than non-defense expenditures over the five-year period (138.8 percent and to 40.4 percent, respectively). However, defense-related expenditures experienced greater volatility, increasing 102.1 percent into 2008 (to $32.5 million), and declining 35.8 percent into 2011 (to $38.4 million), while non-defense expenditures grew consistently across the five-year period from $11.0 million in 2007 to $15.4 million in 2011 (see Figure 5.1).

[43] For the purposes of this assessment, data for USG non-defense-related agencies (e.g. NOAA, NASA) are included in the non-defense category for the 2007-2011 period.
[44] All data for the 1995-1999 and 2001-2005 periods covers the defense sector only, while data for the 2007-2011 period includes both defense and non-defense sectors, unless otherwise stated.

Figure 5.1: Total R&D Expenditures, 2007-2011



17 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

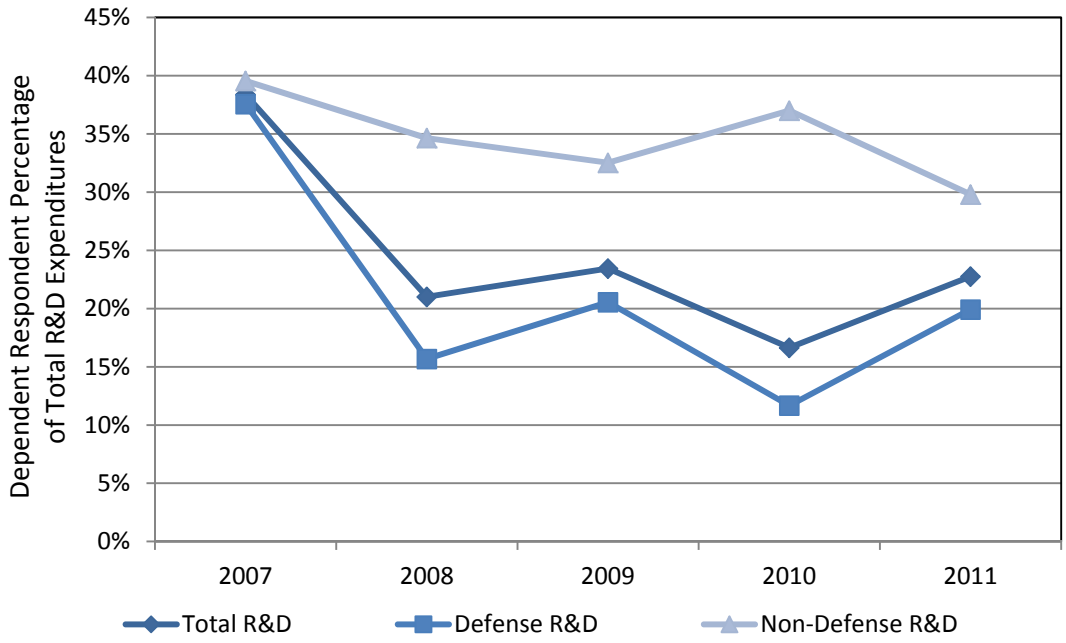
R&D Expenditures by Respondent Dependence on CAD/PAD Sales

Five of the eight respondents categorized as dependent on CAD/PAD sales reported R&D expenditures for 2007-2011.[45] While CAD/PAD dependent respondents' share of total reported CAD/PAD sales averaged 79.2 percent over the five-year period, their share of total R&D expenditures averaged 22.5 percent ($11.6 million per year), suggesting a much lower focus on R&D activities than the industry as a whole. Non-dependent respondents' total R&D expenditures averaged $30.2 million per year over the 2007-2011 period (58.6 percent of total R&D expenditures). Three remaining respondents provided R&D information, but no sales data to determine their dependency on CAD/PAD operations. Those respondents' total R&D expenditures averaged $9.8 million per year over the 2007-2011 period (18.9 percent of total R&D expenditures).

[45] Respondents categorized as dependent on CAD/PAD sales are those with a ratio of CAD/PAD sales to overall net sales and other revenue of greater than 50 percent.

Respondents categorized as dependent on CAD/PAD sales reported R&D spending remained relatively constant over the period, ranging from $9.5 million in 2008 to $13.4 million in 2009. However, all other respondents' R&D expenditures grew significantly across the five-year period, from $16.7 million in 2007 to $62.4 million in 2010. As a result, dependent respondents' share of total R&D expenditures declined from 38.4 percent in 2007 to 22.8 percent in 2011 (see Figure 5.2).

Figure 5.2: Dependent Respondent Share of R&D Expenditures, 2007-2011



9 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

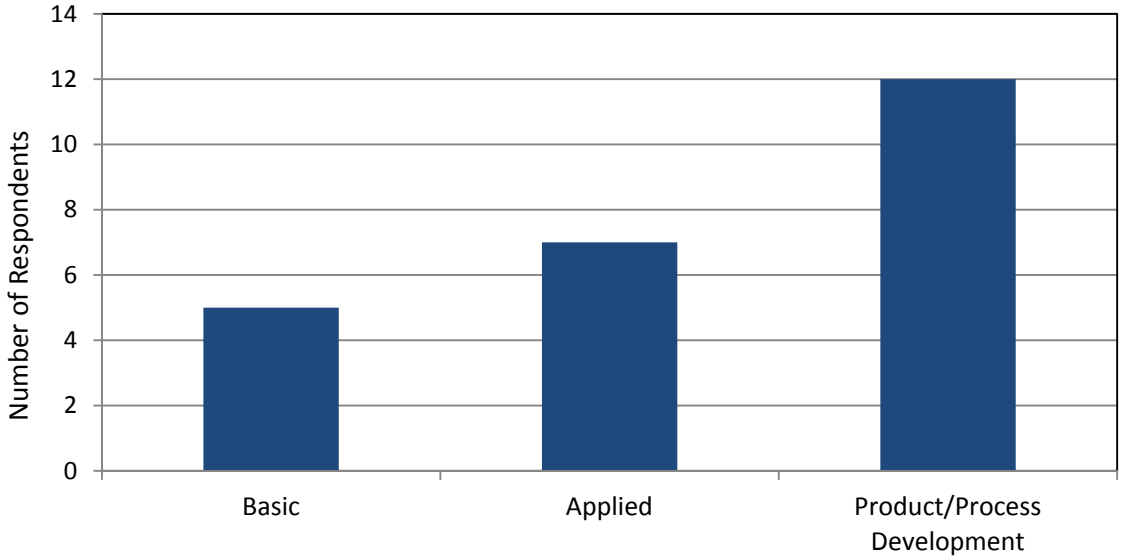
As defense-related R&D spending more than doubled over the five-year period, dependent respondents' share declined significantly, from 37.6 percent ($6 million) of total defense expenditures in 2007 to 20 percent ($7.6 million) in 2011. CAD/PAD dependent respondents' share of non-defense R&D did not fall as significantly since non-defense R&D spending did not increase as much as defense R&D spending. CAD/PAD dependent respondents' share of non-defense spending fell from 39.6 percent ($4.4 million) in 2007 to 29.8 percent in 2011 ($4.6 million).

R&D Expenditures by Type

Respondents were asked to provide a breakdown of their R&D activities according to three broad categories: basic research, applied research, and product/process development.[46] Twelve respondents provided information regarding the use of $179.1 million in R&D expenditures over the five-year period.

Five respondents conducted basic research, seven conducted applied research, and 12 conducted product/process development-related R&D. All five respondents conducting basic research activities also conducted both applied research and product/process development work (see Figure 5.3).[47]

Figure 5.3: R&D Expenditures by Type, 2007-2011



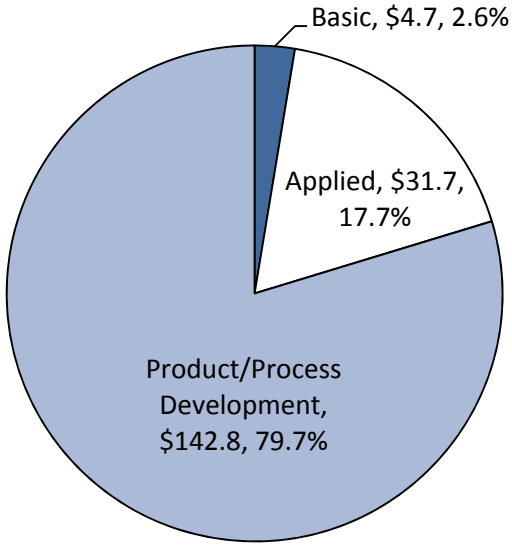
*Respondents could report R&D expenditures in more than one category.
12 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Of the $179.1 million in reported R&D expenditures, 79.7 percent ($142.8 million) was spent on product/process development activities, 17.7 percent ($31.7 million) on applied research, and 2.6 percent ($4.7 million) on basic research (see Figure 5.4). As subcategories of overall R&D

[46] See Survey Instrument in Appendix C for definitions of basic research, applied research, and product/process development.
[47] Respondents could report R&D expenditures in more than one category.

expenditures, defense and non-defense sector expenditures were allocated similarly across the three categories (see Figure 5.5).

Figure 5.4: Total R&D Expenditures by Type ($ Millions) 2007-2011*



*Respondents could report R&D expenditures in more than one category.
12 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Figure 5.5: Total Defense and Non-Defense R&D Expenditures by Type*

Respondent Group	Basic	Applied	Product/Process Development
Defense	2.5%	18.1%	79.5%
Non-Defense	3.1%	16.1%	80.8%
CAD/PAD-Dependent Respondents	1.6%	11.4%	87.0%
All Respondents	**2.6%**	**17.7%**	**79.7%**

*Respondents could report R&D expenditures in more than one category.
12 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Respondents categorized as dependent reported R&D activities more focused on product/process development than the overall industry. Eighty-seven percent of R&D expenditures reported by dependent respondents over the 2007-2011 period were utilized for product/process development

($50.4 million), followed by 11.4 percent dedicated to applied research ($6.6 million) and 1.6 percent dedicated to basic research (less than $1 million).

Respondents were also asked to report the source of their R&D funds (internal, federal government, state/local government, universities, U.S. industry, and/or non-U.S. investors). The vast majority of respondents' R&D efforts were funded internally over the period (an average of 99.8 percent).

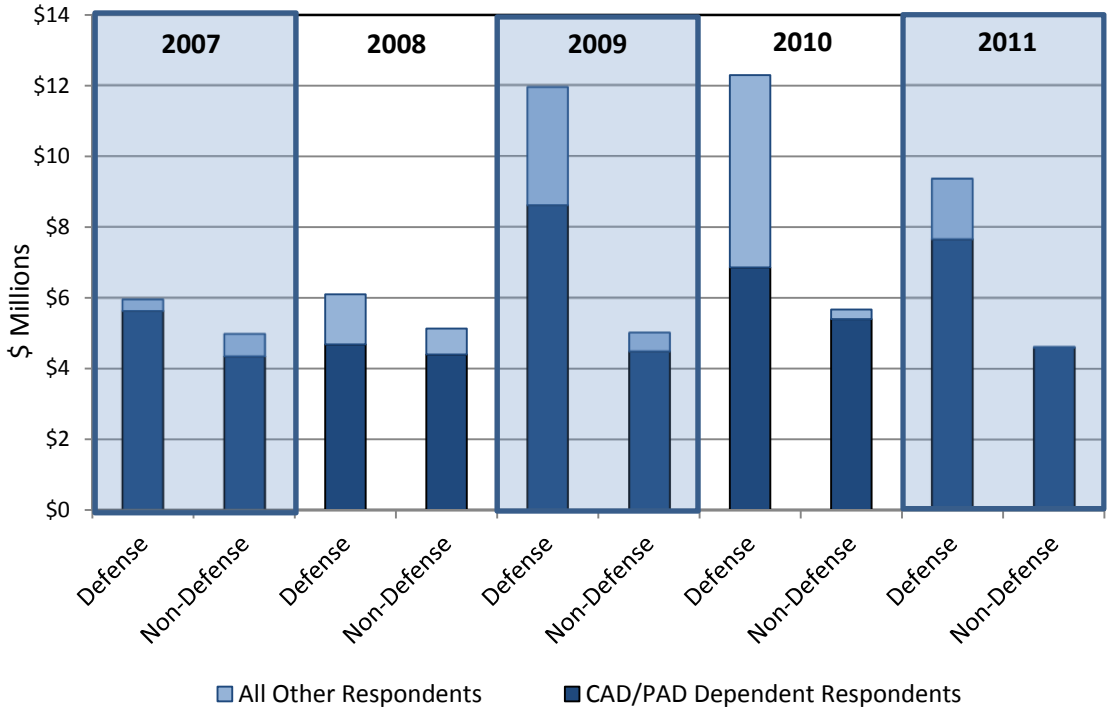
5.3 CAD/PAD-Related R&D Expenditures

Respondents were asked to report CAD/PAD-related R&D expenditures as a subset of their total R&D activities. Nine respondents reported CAD/PAD-related R&D expenditures over the 2007-2011 period. Their expenditures grew from $10.9 million in 2007 to $18 million in 2010 before declining to $14 million in 2011, averaging $14.2 million per year for a five-year total of $71.1 million.

Overall, CAD/PAD-related R&D expenditures comprised 27.6 percent of all reported R&D expenditures for 2007-2011 ($71.1 million of $257.5 million). The ratio of CAD/PAD-related R&D expenditures to total reported R&D expenditures ranged from 40.4 percent in 2007 to 24.2 percent in 2010.

Respondents categorized as dependent on CAD/PAD sales reported 79.7 percent of all CAD/PAD-related R&D expenditures over the 2007-2011 period, ranging from a high of 91.2 percent ($10 million) in 2007 to a low of 68.2 percent ($12.3 million) in 2010. Those respondents' share of CAD/PAD-related R&D expenditures was significantly higher than their share of overall R&D expenditures (22.5 percent), suggesting a greater focus in CAD/PAD-related R&D than the industry average. However, similar to overall R&D expenditures, dependent respondents' share of CAD/PAD-related R&D expenditures declined over the period as their actual expenditure values remained steady and all other respondents' R&D expenditures increased (see Figure 5.6).

Figure 5.6: Total CAD/PAD-Related R&D Expenditures, 2007-2011

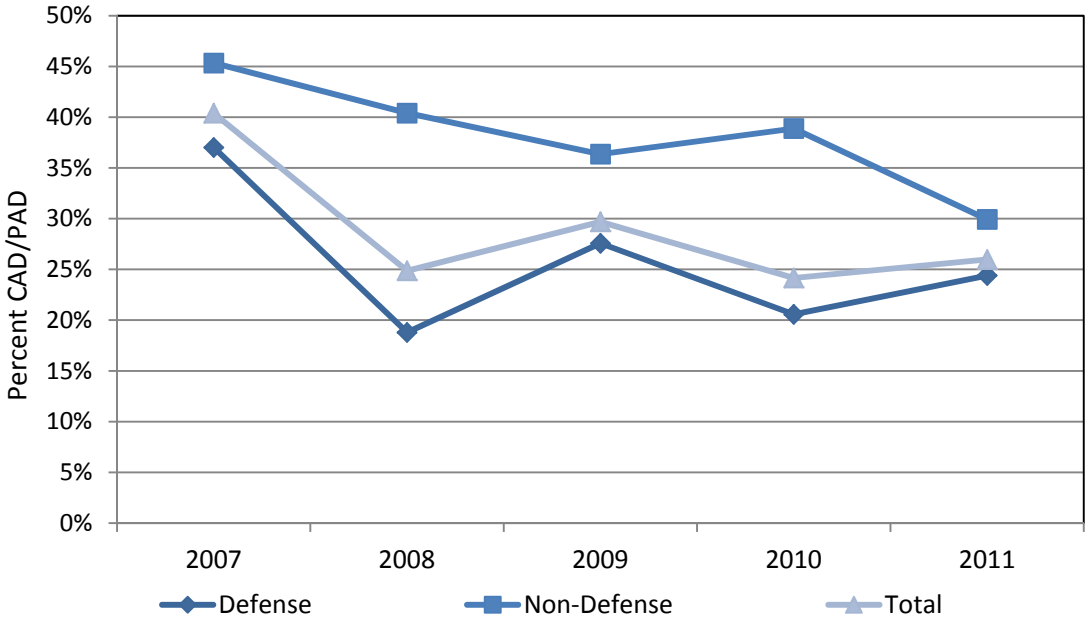


9 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Of the total CAD/PAD R&D expenditures reported over the 2007-2011 period, 64.2 percent ($45.6 million) were defense-related and 35.8 percent ($25.4 million) were non-defense-related. Despite significant changes in expenditures over the period, defense sector CAD/PAD-related R&D remained over half of all CAD/PAD-related R&D expenditures, peaking at 70.4 percent in 2009.

Defense sector CAD/PAD-related R&D expenditures fell from 37 percent of total defense-related R&D expenditures in 2007 to 18.8 percent in 2008, rebounding to 24.4 percent in 2011. Non-defense sector CAD/PAD-related R&D expenditures as a percentage of total non-defense-related R&D expenditures fell from 45.3 percent in 2007 to 29.9 percent in 2011 (see Figure 5.7).

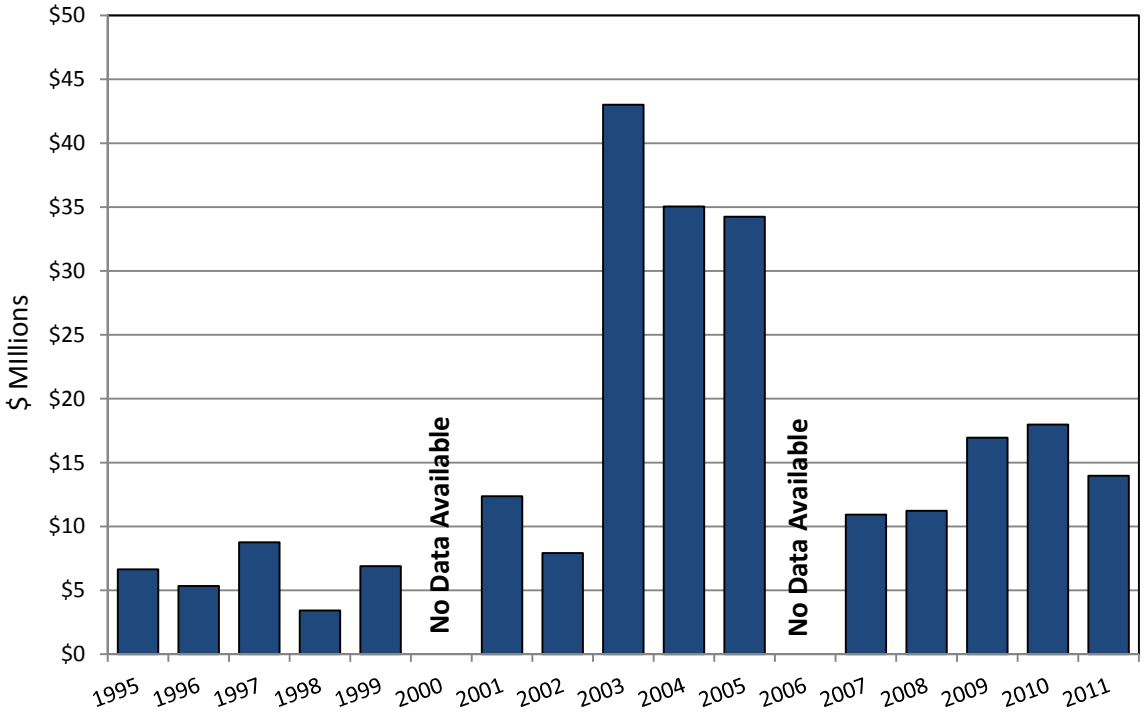
Figure 5.7: CAD/PAD Share of Total R&D Expenditures, 2007-2011



9 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Data from the previous two BIS CAD/PAD reports, covering 1995-1999 and 2001-2005, provided additional perspective on current R&D activities. Overall, the CAD/PAD-related R&D expenditures reported for 2007-2011 were less than those reported for 2001-2005, declining 46.4 percent from an average $26.5 million annually to $14.2 million annually. However, CAD/PAD-related R&D expenditures from 2007-2011 were higher than during the 1995-1999 period, when the annual average was $6.6 million (see Figures 5.8 and 5.9). The higher amount of CAD/PAD-related R&D expenditures over the 2001-2005 period is explained, in part, by higher investment by a small number of large companies.

Figure 5.8: CAD/PAD-Related R&D Expenditures, 1995-2011



2000 BIS CAD/PAD Report: 27 Total Respondents; 2006 BIS CAD/PAD Report: 25 Total Respondents; 2013 BIS CAD/PAD Report: 9 R&D Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013

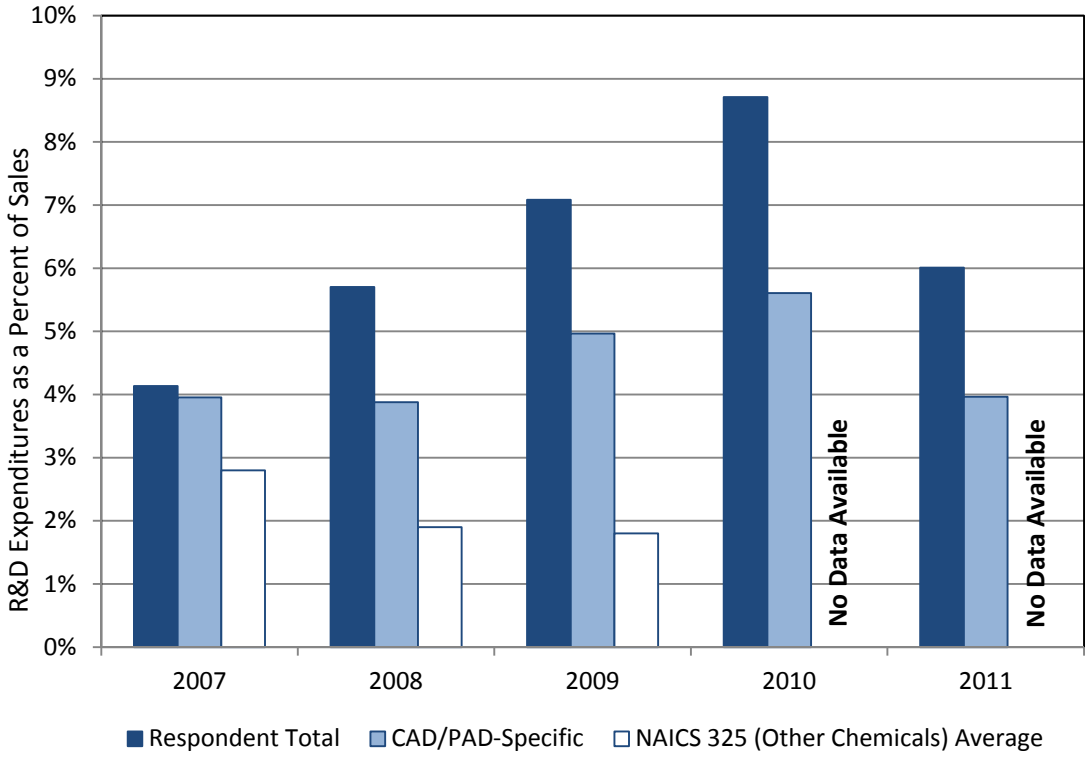
Figure 5.9: CAD/PAD-Related R&D Expenditures	
BIS CAD/PAD Report	**Annual Average (millions)**
2000	$6.6
2006	$26.5
2013	$14.2
2000 Review: 27 Total Respondents;2006 Review: 25 Total Respondents; 2013 Review: 9 R&D Respondents *Source*: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013	

CAD/PAD R&D Expenditures as a Percentage of Sales

CAD/PAD-related R&D spending was compared to CAD/PAD sales to provide greater insight into the importance of R&D to the CAD/PAD industry and measures the sales revenue allocated toward generating new and innovative products. Over the five-year period, CAD/PAD-related R&D as a percentage of CAD/PAD sales averaged 4.5 percent, ranging from 3.9 percent in 2008

to 5.6 percent in 2010. In comparison, total R&D expenditures as a percentage of net sales averaged 6.4 percent over the five-year period, ranging from 4.1 percent in 2007 to 8.7 percent in 2010 (see Figures 5.10 and 5.11).

Figure 5.10: R&D Expenditures as a Percentage of Sales, 2007-2011



19 Respondents

Sources:

U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Business R&D and Innovation Survey (BRDIS), 2009; National Science Foundation, U.S. Census Bureau

Figure 5.11: R&D as a Percentage of Total Sales – Industry Comparison, 2007-2009				
		2007	2008	2009
NSF Data	All Manufacturing (NAICS 31-33)	4.1%	4.4%	4.5%
	Other Chemicals Manufacturing (NAICS 325)	2.8%	1.9%	1.8%
CAD/PAD Data	Total R&D and Net Sales	4.1%	5.7%	7.1%
	CAD/PAD R&D and Sales	4%	3.9%	5%
19 Respondents *Sources*: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013 Business R&D and Innovation Survey (BRDIS), 2009; National Science Foundation, U.S. Census Bureau				

Respondents' CAD/PAD R&D expenditures as a percentage of CAD/PAD sales did not diverge significantly from that of the larger manufacturing industry as reported by the National Science Foundation (NSF) over the 2007-2009 period.[48] Respondents' total R&D expenditures as a percentage of net sales were comparable to both CAD/PAD-related R&D expenditures as a percentage of CAD/PAD sales and the larger manufacturing industry in 2007. However, respondents' total R&D spending as a percentage of net sales grew to 8.7 percent in 2010 in comparison to 5.6 percent for the more specific CAD/PAD subset.

Furthermore, R&D spending as a percentage of total sales in the "Other Chemicals Manufacturing" sector–the NSF categorization best aligned with CAD/PAD manufacturing–was significantly lower than both the general manufacturing sector percentage, and those related to the CAD/PAD industry (averaging just 2.2 percent 2007-2009).[49] This is likely due to the "Other Chemicals Manufacturing" sector being impacted by the global recession and declining exports, which led to a decline in R&D spending.

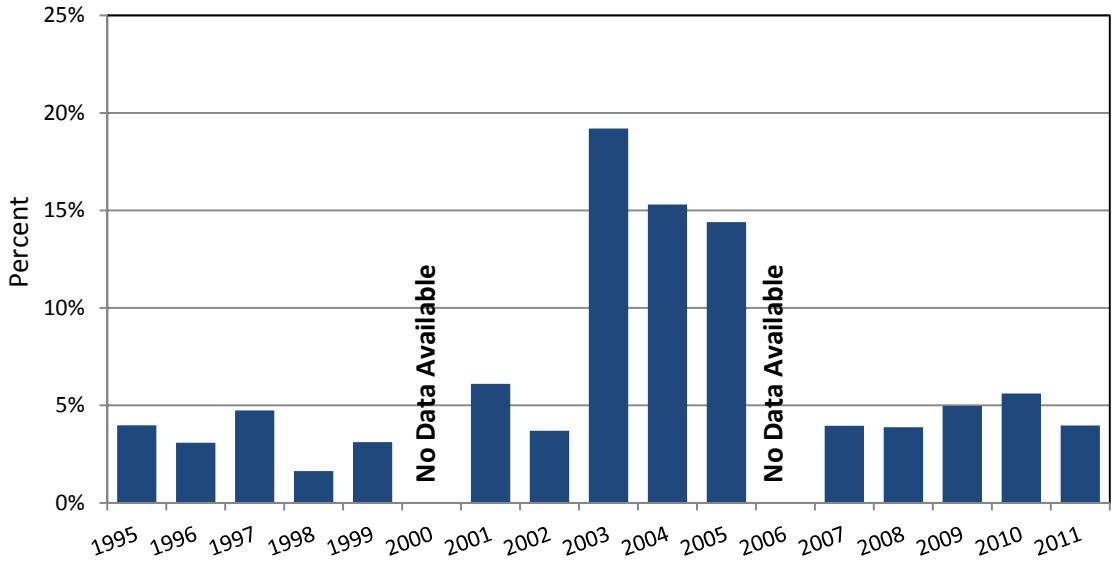
[48] Information on manufacturing industry R&D was obtained from the Business R&D and Innovation Survey (BRDIS), which is conducted by the National Science Foundation (NSF) in partnership with the U.S. Census Bureau. The most recent data available is from 2009. The survey's findings and can be found at http://www.nsf.gov/statistics/srvyindustry/about/brdis.

[49] The BRDIS findings are reported by North American Industry Classification System (NAICS) codes. The NAICS code best aligned with CAD/PAD manufacturing is 325, "Other Chemicals Manufacturing," which is under the broader NAICS code 31-33, "All Manufacturing." "Other Chemicals Manufacturing" consists of "Chemical Manufacturing" less "Pharmaceuticals/Medicines Manufacturing."

CAD/PAD-related R&D expenditures as a percentage of CAD/PAD sales averaged 4.4 percent for respondents categorized as dependent on CAD/PAD sales and 4.7 percent for all others.[50] CAD/PAD-related R&D expenditures as a percentage of CAD/PAD sales for dependent respondents was much more stable across the 2007-2011 period, staying within 0.5 percentage points of 4.5 percent; while the percentage was much more volatile for all remaining respondents, ranging from 1.4 percent in 2007 to 10.6 percent in 2010.

Over the longer term, CAD/PAD-related R&D expenditures as a percentage of CAD/PAD sales fell significantly from an average 11.7 percent over the 2001-2005 period to 4.5 percent over the 2007-2011 period. However, R&D expenditures as a percentage of sales for years 2007-2011 were similar to that of the 1995-1999 period, 3.3 percent (see Figures 5.12 and 5.13).

Figure 5.12: CAD/PAD R&D Expenditures as a Percent of CAD/PAD Sales 1995-2011



2000 BIS CAD/PAD Report: 27 Total Respondents; 2006 BIS CAD/PAD Report: 25 Total Respondents; 2013 BIS CAD/PAD Report: 9 CAD/PAD R&D Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-200, 2006, and 2013

[50] In this assessment, respondents were considered dependent on CAD/PAD sales if more than 50 percent of their net sales were CAD/PAD sales.

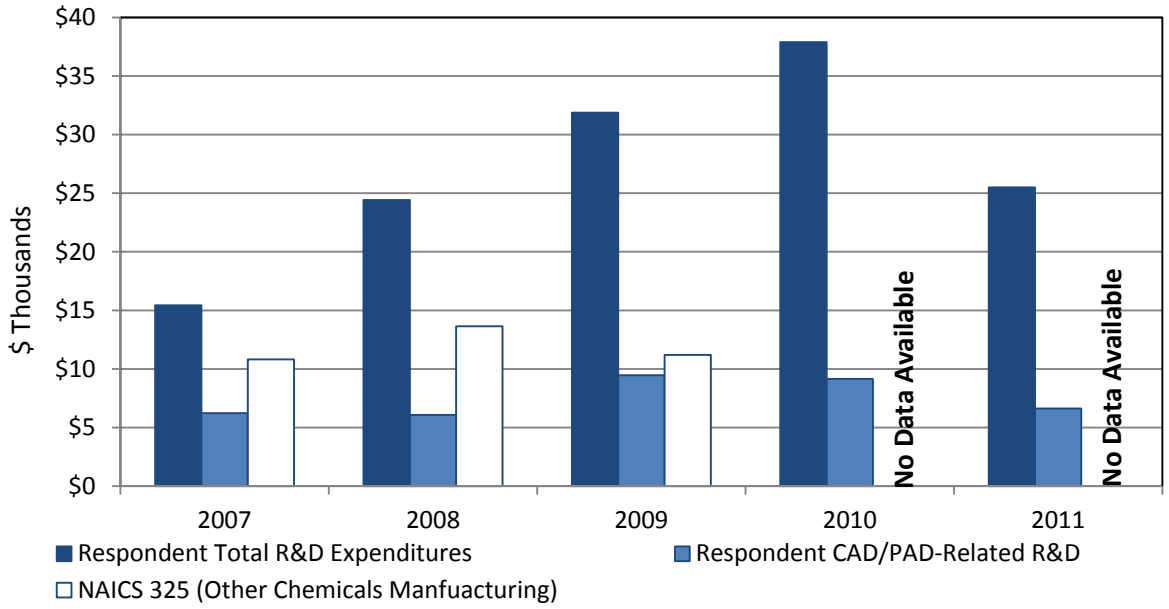
Figure 5.13: CAD/PAD-Related R&D Expenditures as a Percent of CAD/PAD Sales - Historic Comparison	
BIS CAD/PAD Report	**Average**
2000	3.3%
2006	11.7%
2013	4.5%
2000 CAD/PAD Report: 27 Total Respondents; 2006 CAD/PAD Report: 25 Total Respondents; 2013 CAD/PAD Report: 9 CAD/PAD R&D Respondents *Source*: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013	

R&D Expenditures Per Employee

CAD/PAD-related R&D expenditures per employee in U.S. CAD/PAD operations averaged $7,508 over the 2007-2011 period, ranging from $6,071 in 2008 to $9,461 in 2009. Reported CAD/PAD-related R&D spending per employee was more than three times lower than overall R&D spending per employee as reported by respondents over the same period ($27,021 annually). CAD/PAD related R&D spending per employee was also below the overall "Manufacturing" industry average, and the "Other Chemicals Manufacturing" industry average, as reported for the NSF's BRDIS survey.[51] The "Manufacturing" industry (NAICS 31-33) reported expenditures averaging $19,770 per employee over the 2007-2009 period and the "Other Chemicals Manufacturing" sector (NAICS 325) reported an average $11,885 per employee over that same period (see Figures 5.13 and 5.14).

[51] Information on manufacturing industry R&D was obtained from the Business R&D and Innovation Survey (BRDIS), which is conducted by the NSF in partnership with the U.S. Census Bureau. The most recent data available is from 2009. The survey's findings can be found at: http://www.nsf.gov/statistics/srvyindustry/about/brdis

Figure 5.14: R&D Expenditures Per Employee, 2007-2011



9 Respondents
Sources:
U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013
Business R&D and Innovation Survey (BRDIS), 2009; National Science Foundation, U.S. Census Bureau

Figure 5.15: R&D Expenditure Per Employee – Industry Comparison, 2007-2009

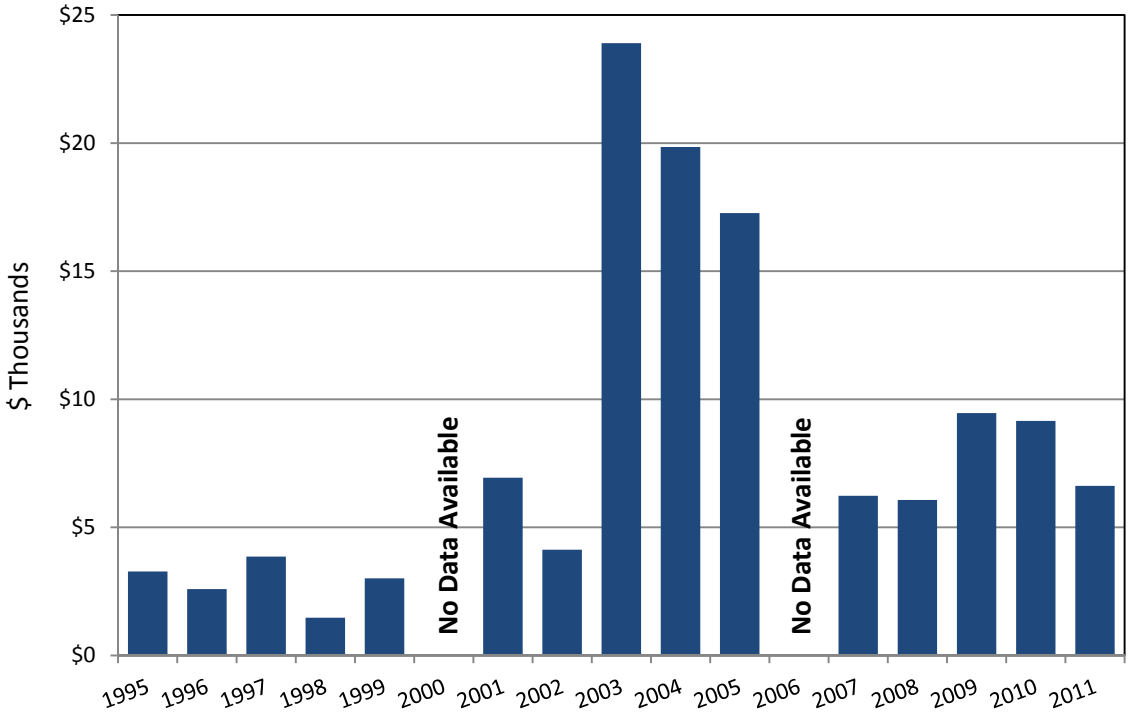
		2007	2008	2009
NSF Data	All Manufacturing (NAICS 31-33)	$19,533	$20,029	$19,747
	Other Chemicals (NAICS 325)	$10,814	$13,638	$11,204
CAD/PAD Data	Total Reported	$15,425	$24,423	$31,866
	CAD/PAD Reported	$6,230	$6,071	$9,461

17 Respondents
Sources:
U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013
Business R&D and Innovation Survey (BRDIS), 2009; National Science Foundation, U.S. Census Bureau

Average CAD/PAD R&D spending per employee from 2007-2011 was nearly 50 percent lower than 2001-2005 ($7,508 as compared to $14,416 per employee). However, per employee spending was more than double the 1995-1999 average of $2,842 (see Figures 5.16 and 5.17). In contrast to the 2001-2005 period, a majority of the decline in per employee CAD/PAD-related R&D spending from 2007-2011 was the result of reduced CAD/PAD-related R&D spending and not an increase in employment. Average annual spending declined 46.4 percent and average

annual employment increased 2.4 percent. In comparison to the 1995-1999 period, the increase in spending per employee was driven both by an increase in CAD/PAD-related R&D spending and a decline in employment. Average annual spending grew 128.8 percent and average annual employment declined by 13.7 percent.

Figure 5.16: CAD/PAD-Related R&D Expenditure Per Employee 1995-2011



2000 BIS CAD/PAD Report: 27 Total Respondents; 2006 BIS CAD/PAD Report: 25 Total Respondents; 2013 BIS CAD/PAD Report: 9 R&D Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013

Figure 5.17: CAD/PAD-Related R&D Expenditures Per Employee Historic Comparison

BIS CAD/PAD Report	Average
2000	$2,842
2006	$14,416
2013	$7,508

2000 BIS CAD/PAD Report: 27 Total Respondents; 2006 BIS CAD/PAD Report: 25 Total Respondents; 2013 BIS CAD/PAD Report: 9 R&D Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013

6. EMPLOYMENT

Respondents were asked to provide the number of full-time equivalent employees in their U.S. CAD/PAD operations from 2007-2011. This information was provided for 13 different professional occupations, which included Quality Control, Manufacturing/Production Line Workers, Program Management, and Testing. Survey respondents were then asked to provide information about their technical workforce by type and years of experience. Technical occupations included those in the Chemical, Design, Electrical, IT/Network, and Mechanical fields. Last, respondents reported research and development (R&D) staff for 2011 by type (Research/Scientist or Development/Engineer), age, citizenship, and education.

In addition to staffing levels, the BIS survey collected information regarding challenges the industry faces in hiring and retaining workers, competencies critical to the industry's continued viability, and the key skills workers have and how those skills are acquired. Also included in this chapter are employment statistics from the BIS CAD/PAD Reports covering the 1995-1999 and 2001-2005 periods.[52]

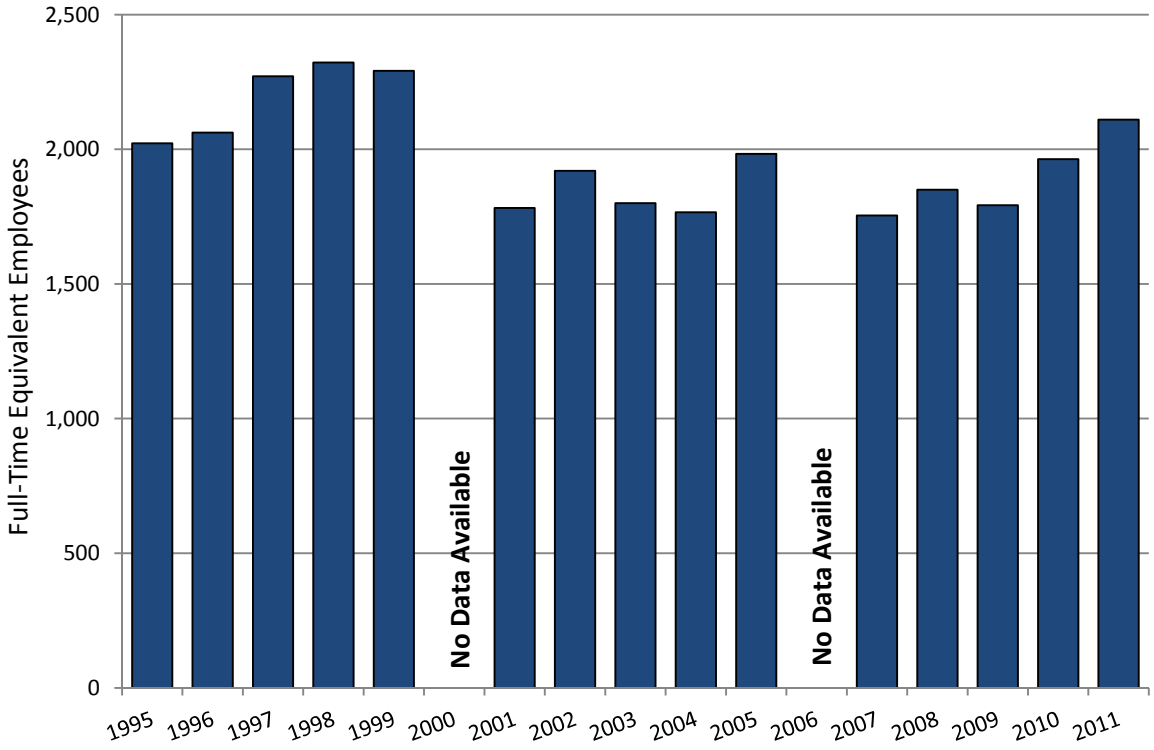
6.1 Total CAD/PAD Employment

Total employment for the 21 respondents' U.S. CAD/PAD operations grew 20.3 percent over the 2007-2011 period, from 1,754 full time employees in 2007 to 2,110 in 2011.[53] The industry reported stronger employment growth across the 2007-2011 period than both the 1995-1999 period (13.3 percent) and the 2001-2005 period (11.3 percent). Total reported employment surpassed 2,000 employees for the first time since 1999, when it was reported to be 2,291 (see Figure 6.1).

[52] All data for the 1995-1999 and 2001-2005 periods covers the defense sector only, while data for the 2007-2011 period includes both defense and non-defense sectors, unless otherwise stated. In previous reports all U.S. Government non-defense-related agencies (e.g. NASA) were defined as defense, while in this 2007-2011 assessment they are defined as non-defense.

[53] One CAD/PAD company did not provide full employment numbers.

Figure 6.1: Total CAD/PAD Industry Employment, 1995-2011



2000 BIS CAD/PAD Report: 27 Respondents; 2006 BIS CAD/PAD Report: 25 Respondents; 2013 CAD/PAD Report: 21 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013

Employment reported for both the CAD/PAD industry and the larger "Chemicals Manufacturing" sector declined from the 1995-1999 period through the 2007-2011 period (see Figure 6.2).[54] While employment in the broader "Chemicals Manufacturing" industry declined by 17.2 percent from an average of 986,900 employees annually over the 1995-1999 period to an average of 817,300 employees annually over the 2007-2011 period, employment in the CAD/PAD industry only declined 13.8 percent, from an average 2,194 over the 1995-1999 period to an average 1,894 employees over the 2007-2011 period. Although the CAD/PAD industry reported declining employment over the 15 year period, the decline has been less severe than the more commercially focused "Chemicals Manufacturing" industry.

[54] Information on the employment of the "Chemicals Manufacturing" sector was obtained from the Bureau of Labor Statistics: http://data.bls.gov/timeseries/CES3232500001?data_tool=XGtable. The NAICS code best aligned with CAD/PAD manufacturing is 325, "Chemicals Manufacturing."

Figure 6.2: CAD/PAD Workforce – Industry Comparison, 1995-2011					
Years	BIS CAD/PAD Report Data			NAICS 325 – Chemicals Manufacturing Employment	
	BIS CAD/PAD Report	Average Annual Employment	Five-Year Employment Growth	Average Annual Employment	Five-Year Employment Growth
1995-1999	2000	2,194	13.3%	986,900	-0.5%
2001-2005	2006	1,850	11.3%	910,300	-9.0%
2006-2011	2013	1,894	20.3%	817,300	-8.5%

2000 BIS CAD/PAD Report: 27 Respondents; 2006 BIS CAD/PAD Report: 25 Respondents; 2013BIS CAD/PAD Report: 21 Respondents

Sources:

U.S. Department of Commerce, Bureau of Industry and Security,
National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013

U.S. Department of Labor, Bureau of Labor Statistics, Employment, Hours and Earnings from the Current Employment Statistics survey: http://data.bls.gov/timeseries/CES3232500001?data_tool=XGtable.

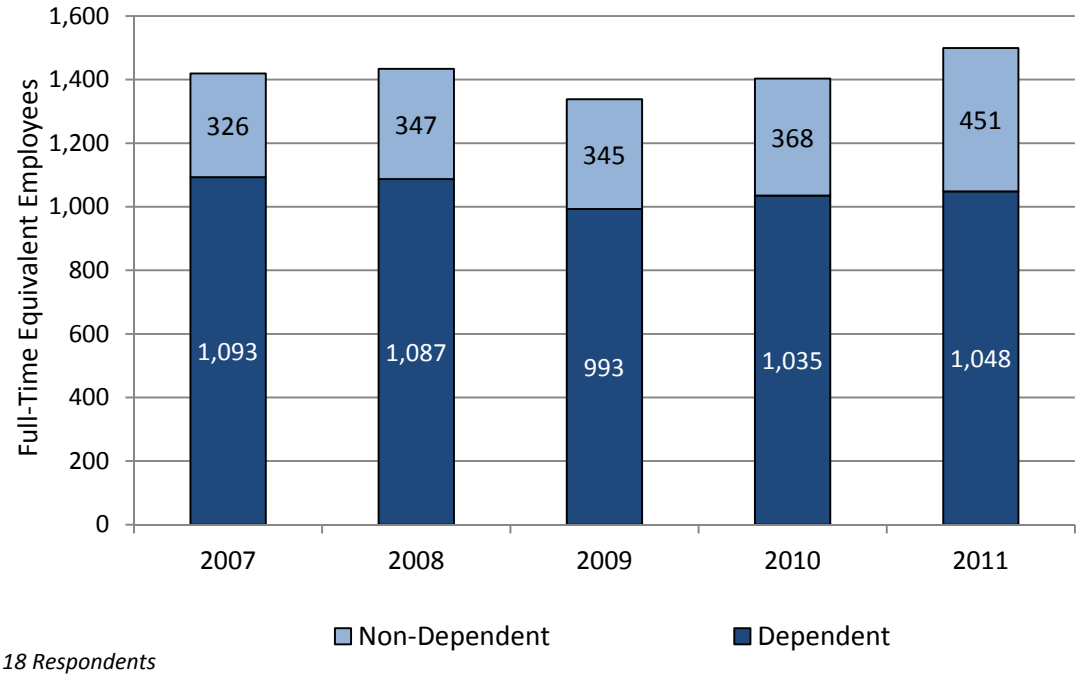
Total Employment by Respondent Type – 2007-2011

BIS further analyzed the employment data provided by respondents categorized as dependent on CAD/PAD sales.[55] Eighteen of the 22 respondents provided the sales and employment data necessary for this analysis, seven of which were determined to be dependent on CAD/PAD sales. The remaining four respondents did not provide the necessary employment or sales data to complete this calculation. Their employment figures have been kept separate from both dependent and non-dependent respondents' data in this sub-section. Employment reported by the 18 respondents whose dependency could be determined accounted for 74.9 percent of total reported employment over the five-year period ending in 2011, falling from 80.9 percent in 2007 to 71 percent in 2011.

The eight respondents dependent on CAD/PAD sales experienced a decline in total CAD/PAD-related employment from 1,093 in 2007 to 1,048 employees in 2011 (down 4.1 percent over the five-year period). The 11 non-dependent respondents experienced employment growth of 38.3 percent over the five-year period as staff levels increased from 326 full-time employees in 2007 to 451 in 2011 (see Figure 6.3).

[55] Respondents were considered dependent on their CAD/PAD operations if CAD/PAD sales comprised more than 50 percent of their net sales over the 2007-2011 period.

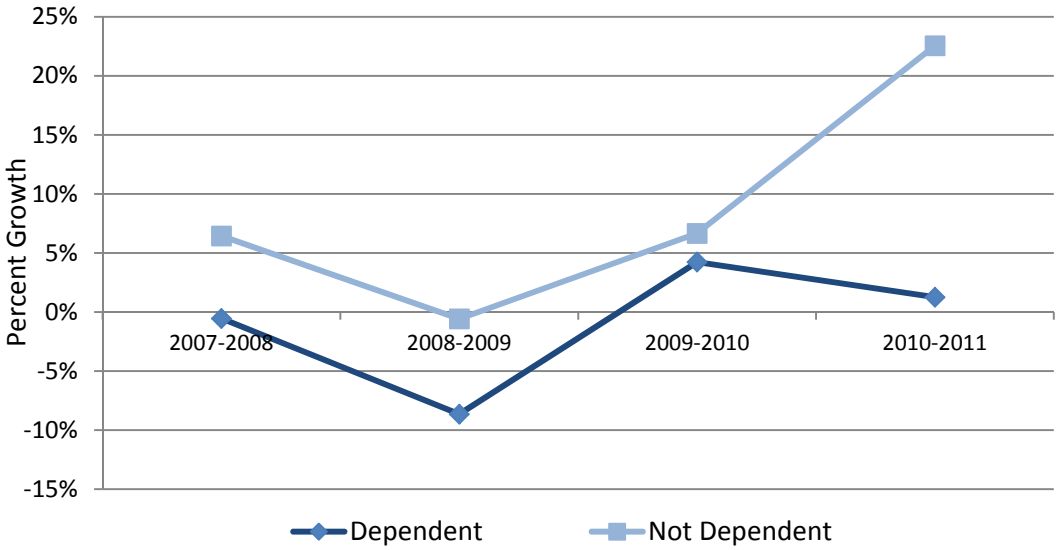
Figure 6.3: Total Employment by Respondent Type, 2007-2011



18 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Employment growth reported by both groups (dependent and non-dependent on respondents) followed a similar trend prior to 2011, when employment reported by respondents not dependent on CAD/PAD sales grew by 22.6 percent and employment reported by dependent respondents grew 1.3 percent (see Figure 6.4). Over the five-year period, 81.8 percent of non-dependent respondents (nine) reported CAD/PAD-related employment growth as compared to 28.6 percent of dependent respondents (two).

Figure 6.4: Employment Growth by Respondent Type, 2007-2011

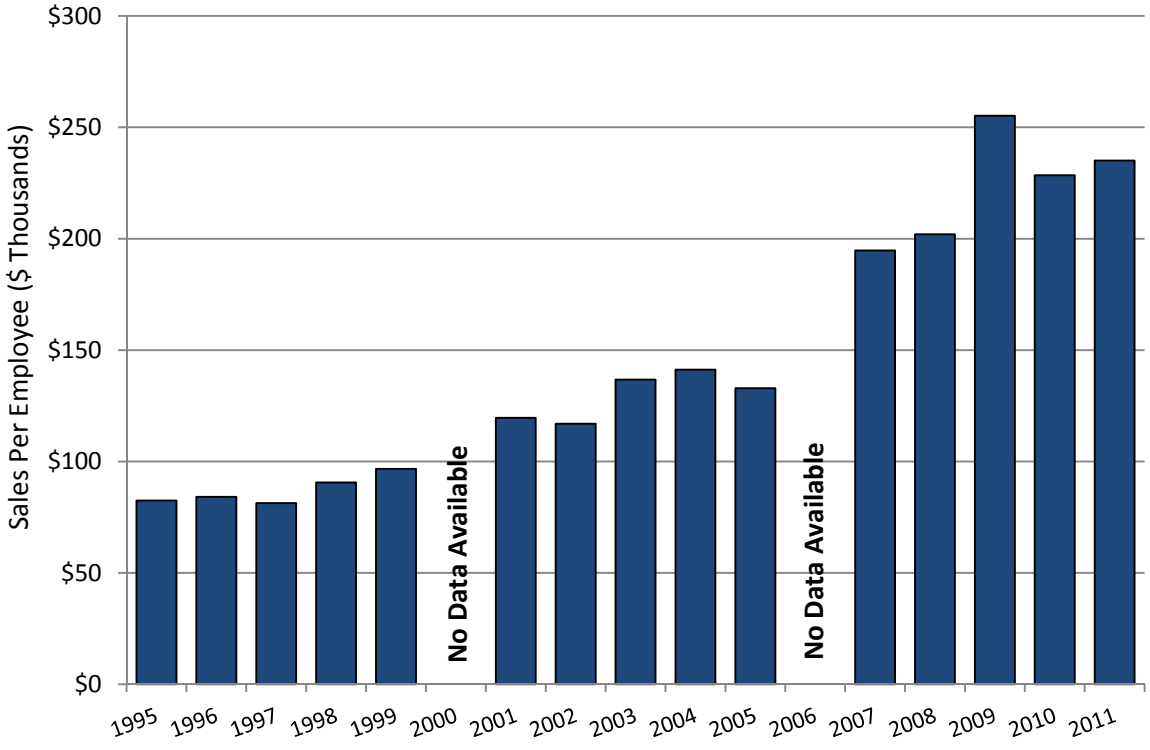


18 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

6.2 CAD/PAD Industry Productivity

Eighteen respondents reported data allowing for calculation of their productivity – defined as total sales (domestic and export) per employee. Productivity, measured as output per employee, is an important gauge of competitiveness. As productivity increases, costs per unit of output fall and companies become more efficient. Productivity over the five-year period averaged $222,790 annually, rising from $194,700 in 2007 to $255,170 in 2009 due to declining employment (down 6.7 percent) and increasing sales (up 17.9 percent). Productivity then fell to $228,450 in 2010 before rebounding to $235,100 in 2011 (see Figure 6.5).

Figure 6.5: CAD/PAD Industry Productivity, 1995-2011



2000 BIS CAD/PAD Report: 27 Respondents; 2006 CAD/PAD Report: 25 Respondents; 2013 BIS CAD/PAD Report: 18 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013

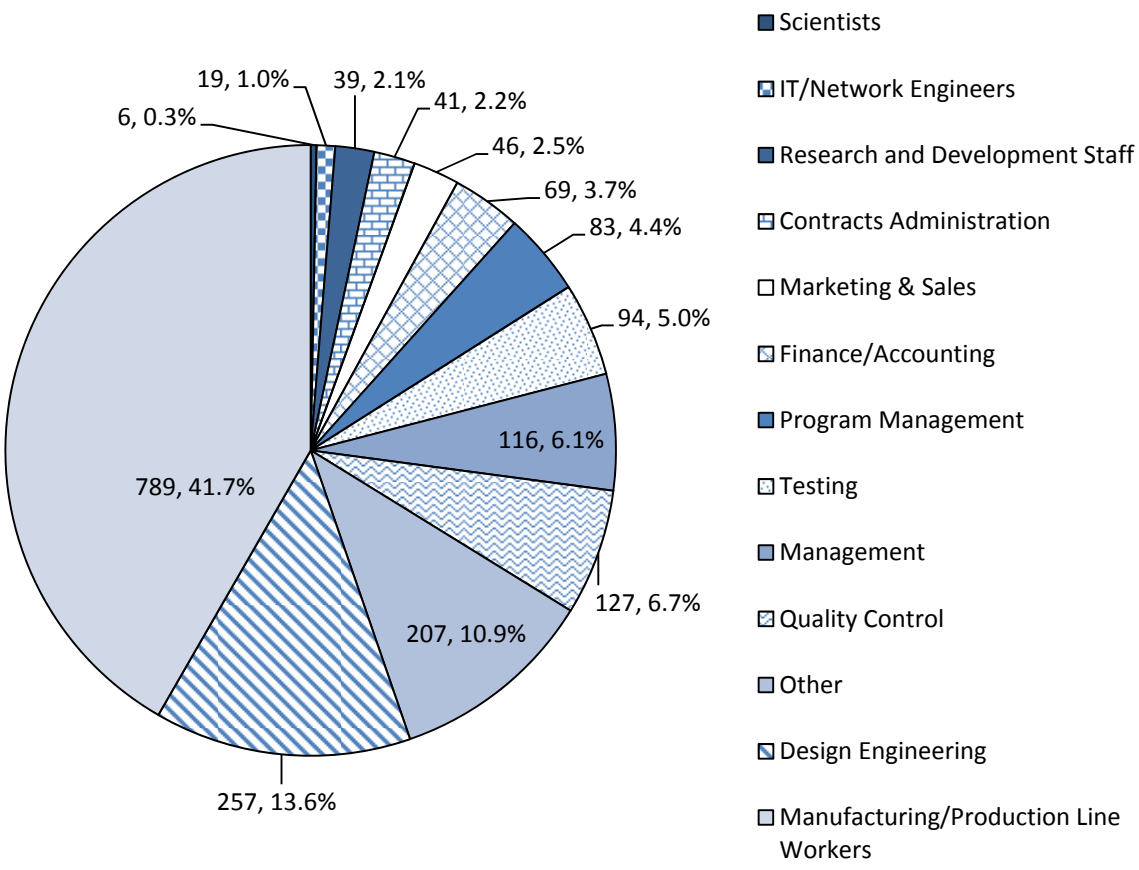
Over the long-term (1995-2011), productivity within the CAD/PAD industry has increased steadily. Total sales per employee averaged $87,000 over the 1995-1999 period, $129,500 over the 2001-2005 period and $222,790 over the 2007-2011 period, a gain of nearly 50 percent between the 2000 and 2006 BIS CAD/PAD reports and a gain of nearly 75 percent between the 2006 and 2013 CAD/PAD reports. Productivity gains across all three previous BIS CAD/PAD Industry Reports were driven primarily by stronger sales growth in contrast to declining employment.

6.3 Employment by Professional Occupation

Manufacturing/Production Line and Design Engineering occupations were held by the largest number of CAD/PAD industry employees over the 2007-2011 period (see Figure 6.6). Nearly 42 percent of the average 1,894 reported employees, or 789, held Manufacturing/Production Line

occupations, although, that proportion fell slightly from 42.4 percent in 2007 to 40.4 percent in 2011. This is significantly lower than the proportion reported for 2001-2005 (58.5 percent) and for years 1995-1999 (53.7 percent). Conversely, employment in Design Engineering grew from 12.7 percent of the total (223) in 2007 to 14.6 percent of total employment in 2011, or 308.

Figure 6.6: Total CAD/PAD Employment by Percentage of Professional Occupation, 2007-2011*



*Occupations are listed from smallest to largerst percentage
21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Of the 13 professional occupations, five had reported strong employment growth during the 2007-2011 period (see Figure 6.7). Marketing and Sales occupations had the strongest five-year growth rate of 91.4 percent, followed by Management occupations at 50 percent. The Quality

Control category also reported strong growth at 41.3 percent, followed by Design Engineering at 38.1 percent.

Three occupations reported five-year employment growth below the industry average for the 2007-2011 period: Manufacturing/Production Line Workers at 14.7 percent; Finance and Accounting occupations at 1.5 percent; and Research and Development occupations at 12.8 percent. Together these three occupations comprised 45.7 percent of the total CAD/PAD workforce in 2011, down from 48.4 percent in 2007.

Figure 6.7: CAD/PAD Employment By Professional Occupation 2007-2011 Average

Occupation Type	Total Employment	Percent of Total Employment (# of Employees)	Five-Year Employment Growth (2007-2011)	CAD/PAD-dependent Share of Total Employment
Total Employment	**1,894**	**100%**	**20.3%**	**55.5%**
Manufacturing/ Production Line Workers	789	41.7%	14.7%	55.0%
Design Engineering	257	13.6%	38.1%	48.5%
Quality Control	127	6.7%	41.3%	58.5%
Management	116	6.2%	50%	30.1%
Testing	94	5.0%	23.3%	43.9%
Program Management	83	4.4%	23.7%	49.8%
Finance/Accounting	69	3.7%	1.5%	64.8%
Marketing & Sales	46	2.5%	91.4%	37.5%
Contracts Administration	41	2.2%	21.6%	58.3%
Research & Development	39	2.1%	12.8%	48.7%
IT/Network Engineers	19	1.0%	35.3%	41.9%
Scientists	6	0.3%	20%	51.7%
Other	207	10.9%	-12.2%	89.2%

21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

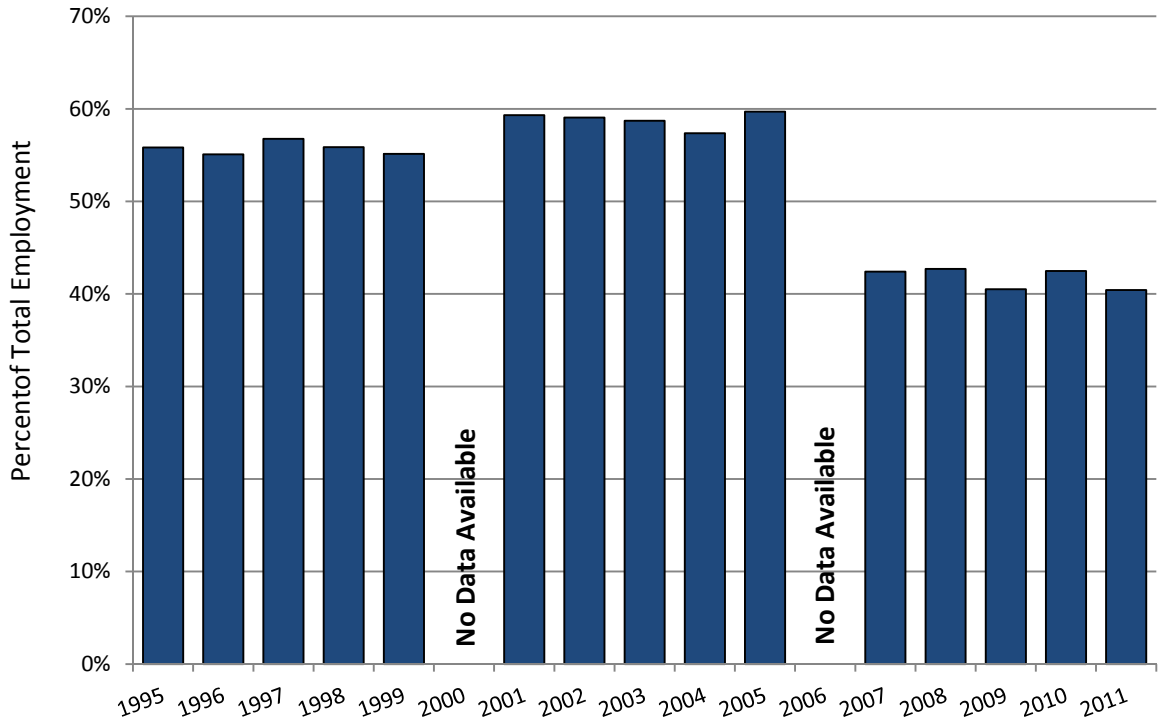
Employment by Professional Occupation by Respondent Type

As noted in Figure 6.3, overall employment reported by respondents categorized as dependent on CAD/PAD sales fell slightly over the 2007-2011 period. The group's share of total reported employment declined as well, from 62.3 percent in 2007 to 49.7 percent in 2011, for a five-year average of 55.5 percent. These respondents reported declining employment in Contracts Administration, Design Engineering, Finance and Accounting, Program Management, Research and Development, and Testing. Their reported employment in IT/Network Engineering and Management remained relatively stable.

Manufacturing and Production Line Worker Employment

The previous two BIS CAD/PAD reports also included statistics regarding Manufacturing and Production Line Workers' share of total reported employment. The proportion of positions held by those workers has declined from an average 55.7 percent over the 1995-1999 period to an average 41.7 percent over the 2007-2011 period (see Figure 6.8).

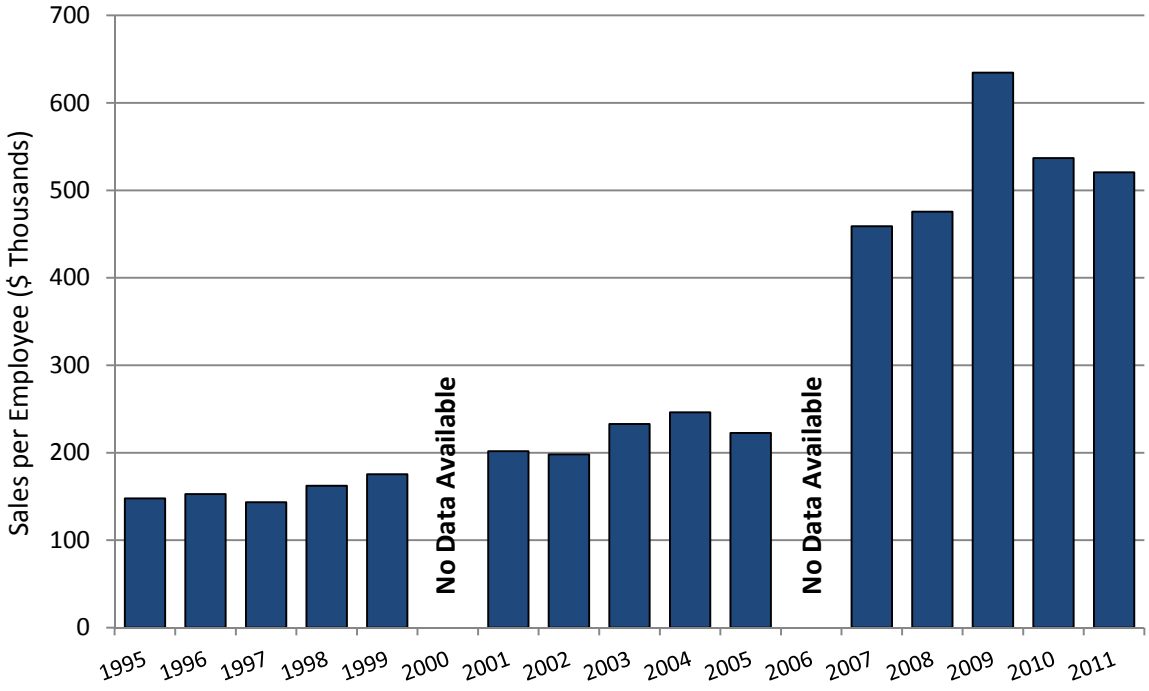
Figure 6.8: CAD/PAD Manufacturing and Production Worker Share of Employment, 1995-2011



2000 BIS CAD/PAD Report: 27 Respondents; 2006 BIS CAD/PAD Report: 25 Respondents; 2013 BIS CAD/PAD Report: 21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013

While overall productivity increased significantly between the 2006 and 2013 reports, the productivity of Manufacturing and Production Line Workers rose faster, from an average $156,260 per worker (1995-1999) to $220,280 per worker (2001-2005), and finally to an average of $525,320 per worker (2007-2011). The smaller increase in productivity between the 1995-1999 and 2001-2005 periods was the result of both lower reported manufacturing employment (down 10.9 percent) and an increase in reported sales (up 25.1 percent) in the 2001-2005 period. Similarly, the jump in productivity between the 2001-2005 and 2006-2011 periods was driven by both a decline in reported employment (down 44.5 percent) and reported sales growth (32 percent), (see Figure 6.9).

Figure 6.9: CAD/PAD Manufacturing and Production Line Worker Productivity , 1995-2011



2000 BIS CAD/PAD Report: 27 Respondents; 2006 BIS CAD/PAD Report: 25 Respondents; 2013 BIS CAD/PAD Report: 18 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, and 2013

6.4 Employment Challenges Related to Professional Occupations

Respondents were asked to report challenges in hiring or retaining staff in professional occupations. While Manufacturing/Production Line Workers and Design Engineers comprised more than 55 percent of the CAD/PAD workforce, significant challenges were reported in hiring and retaining both occupation types. Design Engineers were reported as difficult to hire by 61 percent of respondents, making it the most challenging professional occupation to hire staff for within the CAD/PAD industry. Design Engineers were also reported as difficult to retain in positions by 29 percent of respondents, making the occupation the second most difficult to retain workers in within the industry.

Fifty-seven percent of respondents indicated that Manufacturing/Production Line Workers were the most difficult of the professional occupations to retain within the CAD/PAD industry. Manufacturing/Production Line Workers were also the second most difficult occupation to hire

(33.3 percent). Additionally, four other professional occupations were reported as difficult to hire, but not retain – R&D Staff, Contracts Administration, Testing, and Management (see Figure 6.10).

Figure 6.10: CAD/PAD Professional Occupations by Difficulty in Hiring and Retaining Staff (Number of Respondents)

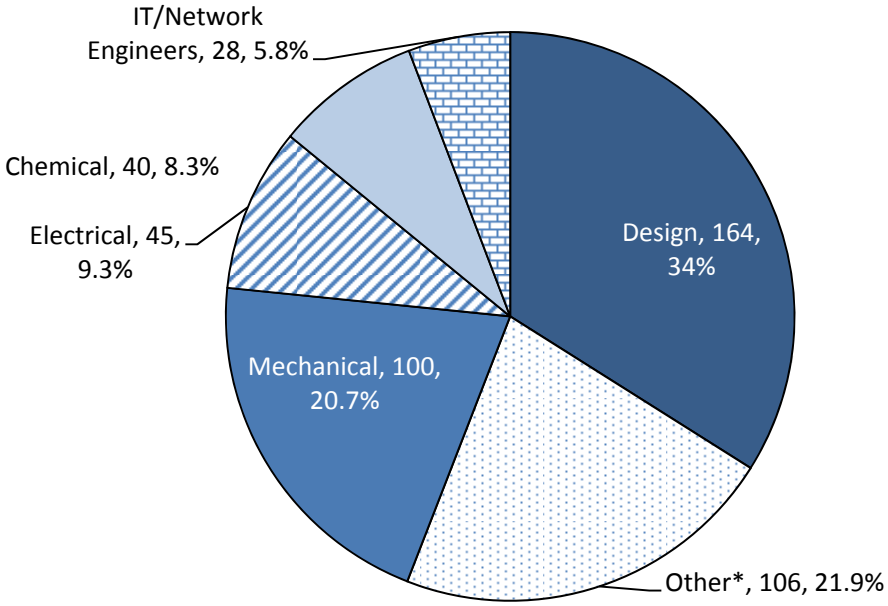
Professional Occupation	Difficult to Hire	Difficult to Retain
Design Engineering	11	4
Mfg/Prod. Line Workers	6	8
R&D Staff	3	0
Program Management	3	3
Contracts Administration	3	0
Testing	2	0
Management	2	0
Quality Control	1	1
Marketing & Sales	1	1
IT/Network Engineers	0	1
Total Respondents	**18**	**14**

Difficult to Hire: 18 Respondents
Difficult to Retain: 14 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

6.5 Technical Occupation

Respondents were asked to provide data regarding employment by technical field (Chemical, Design, Electrical, IT/Network Engineer and Mechanical). For 2011, the surveyed U.S. CAD/PAD industry reported 483 employees in these technical occupations. The largest share of the industry's technical workforce was in Design-related occupations (34 percent), followed by Mechanical occupations (20.7 percent) (see Figure 6.11). "Other" occupations comprised 21.9 percent of the total technical workforce and included occupations related to aeronautics, assembly, engineering support, physics, and quality control.

Figure 6.11: CAD/PAD Employment in Technical Occupations, 2011

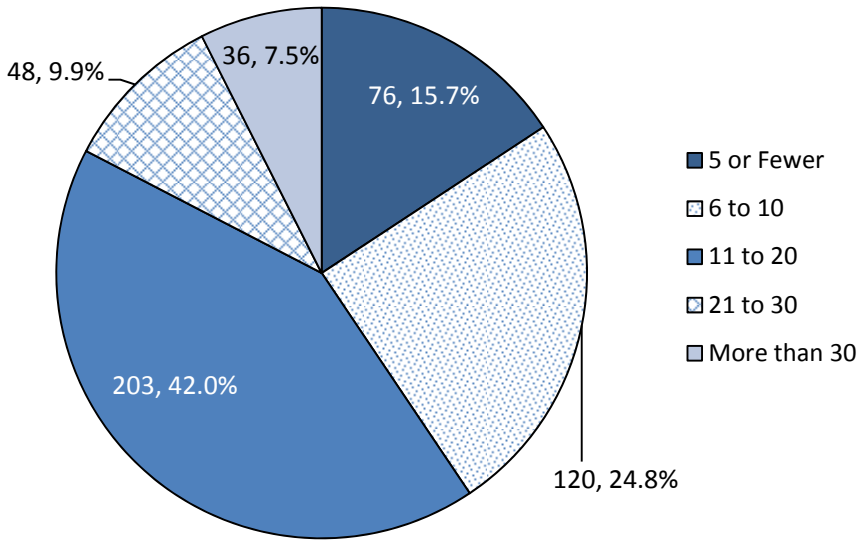


21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security,
National Security Assessment of the U.S. CAD/PAD Industry-2013
*Other included occupations related to aeronautics, assembly, engineering support, physics and quality control

Respondents categorized as dependent on CAD/PAD sales employed 251 staff in technical occupations in 2011, or 52 percent of the 483 reported. This level of employment was in line with employment levels of technical occupations reported by all respondents (55.5 percent). Thirty-eight percent of technical staff reported by dependent respondents were identified in "Other" categories and were primarily manufacturing occupations.

Respondents were also asked to identify the number of years of experience by each technical occupation. Forty-two percent of all technical employees had 11 to 20 years of experience in the various technical occupations (see Figure 6.12). However, after combining the experiences levels of technical staff with less than 10 years of experience (41 percent), the two experience levels become comparable as the majority of technical staff. The smallest share of respondents' technical employees, 17.4 percent, had more than 20 years of experience.

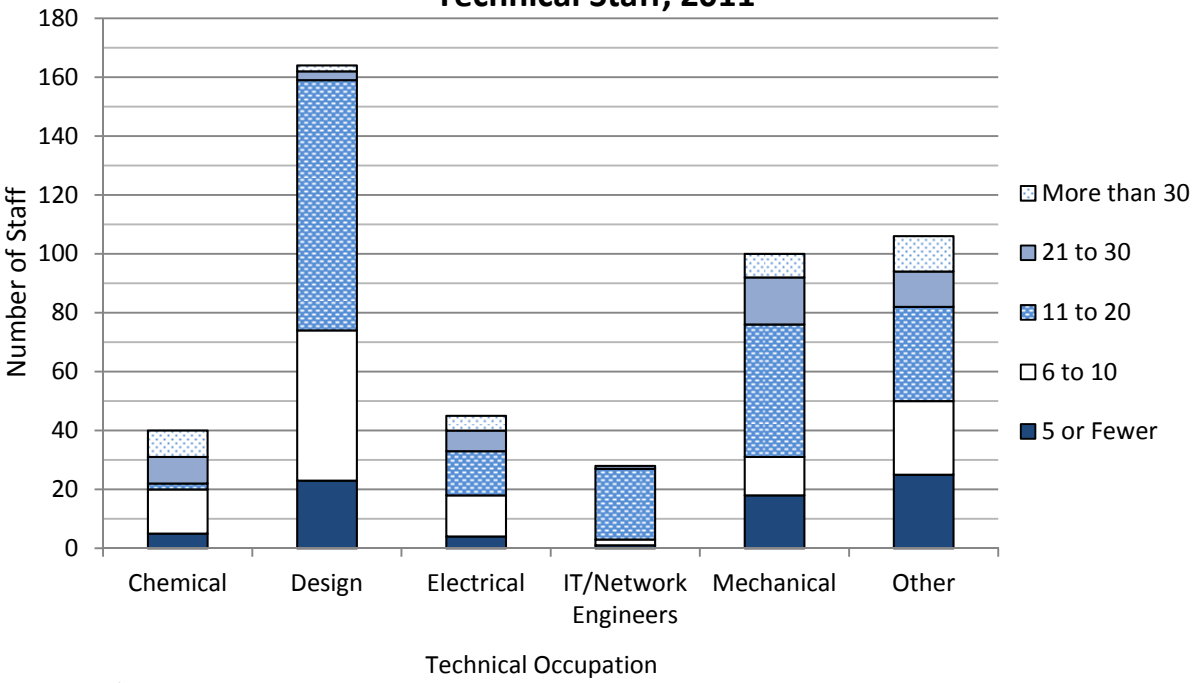
Figure 6.12: Experience Level (in years) of CAD/PAD Industry Technical Staff, 2011
(number of staff, percent of total)



21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Within most of the technical occupations, the majority of employees had 11 to 20 years of experience (see Figure 6.13). The exception was the Technical Occupation, where the majority of employees had six to 10 years of experience.

Figure 6.13: Experience Level (in years) of CAD/PAD Industry Technical Staff, 2011



21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

To estimate the average years of experience per employee in each technical occupation, a specific year was assigned to each experience level as follows:

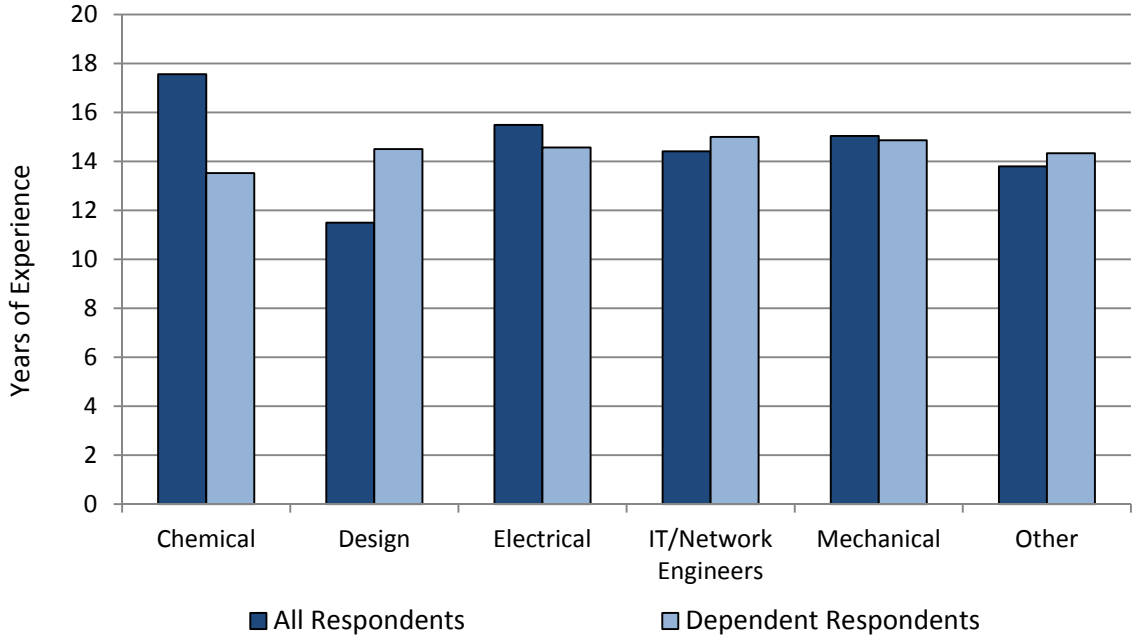
Less than five years:	2.5 years
6 to 10 years:	8 years
11 to 20 years:	15 years
21 to 30 years:	25 years
More than 30 years:	35 years

The number of employees in each technical occupation was multiplied by the assigned value for each experience level to determine total years of experience. That value was then divided by the number of employees to calculate average years of experience for each technical occupation.

The average experience level calculated for the 483 reported CAD/PAD technical employees was 13.8 years. The Design occupation had the lowest average experience level of 11.5 years; while the Chemicals occupation had the highest at 17.6 years per employee (see Figure 6.14). Experience levels reported by respondents categorized as dependent on CAD/PAD sales were

comparable to the overall CAD/PAD industry as covered by this assessment, averaging 14.5 years per technical employee.

Figure 6.14: Average Years Experience of Employees in Technical Occupations, 2011



21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The vast majority of employees (97 percent) in Design technical occupations had 20 or fewer years of experience, and nearly half had less than 10 years of experience. These employees were the least experienced of all the technical employees, with an average 11.5 years of experience per employee compared to the overall average of 13.8 years.

Approximately 75 percent of employees in both Electrical and Mechanical technical occupations had 20 or fewer years of experience, and 40 percent of Electrical positions were held by employees with less than 10 years of experience. The majority of employees in IT/Network Engineering technical occupations (85.7 percent) had 11 to 20 years of experience.

Respondents also provided the percentage of technical staff hired with the necessary basic skills to perform primary CAD/PAD operations. Responses ranged from zero to 100 percent, as some respondents hired experienced staff already trained in the necessary competencies, "Employees were recruited that were already trained in ordnance applications," while others recruited

inexperienced staff, preferring to train them internally, "These unique skills are not available in the regional area and training is conducted internally after the employee is hired."

6.6 R&D Employment

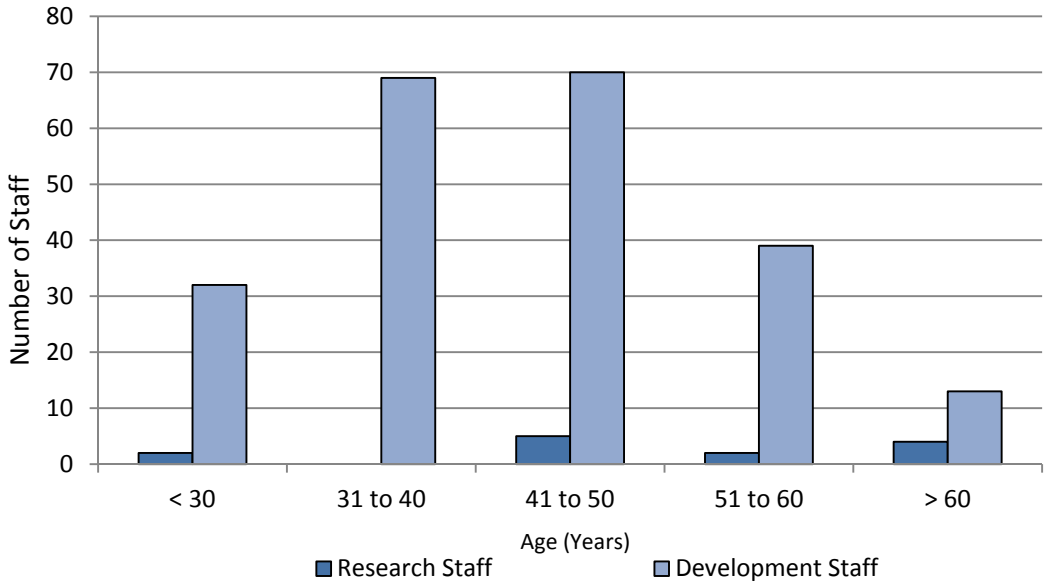
CAD/PAD respondents reported 223 employees in R&D positions in 2011; more than 99 percent were U.S. citizens and 91.9 percent focused on Development (engineers) as opposed to Research (scientists). R&D staff comprised 11.8 percent of average annual CAD/PAD employment, as total reported employment supporting CAD/PAD operations averaged 1,894 employees per year over the five-year period.

Respondents categorized as dependent on CAD/PAD sales reported a greater concentration of R&D staff focused in research (18.3 percent) than the industry as a whole (8.1 percent). In addition, CAD/PAD-dependent respondents reported 60 R&D staff (26.9 percent of all reported R&D staff).

R&D Employment by Age

Respondents also identified R&D employees by age. Overall, approximately 30 percent of all R&D staff were between 31 and 40 years old and also between 41 and 50 years old. Less than 25 percent were over 50 years old and less than 15 percent were under 30 years old. The largest percentage of Development staff (45.3 percent) was 40 years old or younger, while only 10 percent of Research staff were in the same age range (see Figure 6.15).

Figure 6.15: R&D Staff by Age, 2011



21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

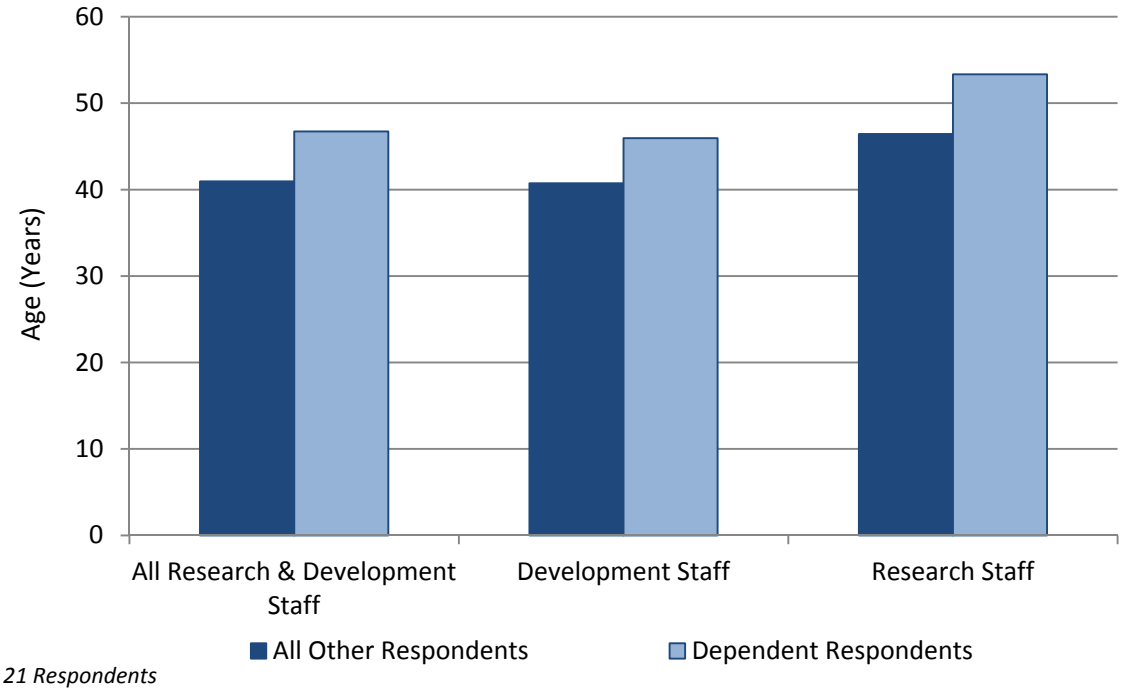
The average age of R&D staff in 2011 was calculated by assigning an average age for each age range available to survey respondents:

Under 30 years:	25 years old
31 to 40 years:	35 years old
41 to 50 years:	45 years old
51 to 60 years:	55 years old
Over 60 years:	65 years old

Using this calculation, the average age of all R&D staff was 42 years old. The average age of R&D staff reported by respondents categorized as dependent on CAD/PAD sales was 47 years, relatively comparable to the average age of all R&D staff (see Figure 6.16).

The average age of development-focused R&D staff was 42 years old while the average age of research-focused R&D staff was slightly higher at 47 years old. Respondents dependent on CAD/PAD sales had development-focused R&D staff that was four years older than the industry average (46 and 42 years, respectively). The research-focused R&D staff of dependent respondents was three years older than the industry average (53 and 47 years, respectively).

Figure 6.16: R&D Staff by Average Age, 2011



21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

R&D Employment by Level of Education

Respondents were asked to provide the education levels of their CAD/PAD-related R&D staff that held advanced degrees as of 2011. Of the 223 reported R&D staff in 2011, 65 percent held a Bachelor's degree (144), 31 percent held a Master's degree (70) and four percent held a Doctorate (nine). Less than two percent of Development staff held a Doctorate and 28 percent (five) of Research staff held a Doctorate (see Figure 6.17).

Respondents dependent on CAD/PAD sales reported 11 Research and 49 Development staff. Education levels of R&D staff reported by respondents dependent on CAD/PAD sales were generally higher than the levels reported by all respondents: 53.3 percent (32) held a Bachelor's degree, 35 percent (21) held a Master's degree, and 11.7 percent (seven) held a Doctorate.

Figure 6.17: R&D Staff by Education Level, 2011

21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

6.7 Skills and Training

Critical Skills and Competencies

Respondents were asked to identify skills and competencies critical to their CAD/PAD operations and the training necessary for staff to become competent in those areas. BIS categorized the skills and competencies reported by respondents into the following categories: energetics, explosives, and ordnance; USG contracting and compliance; and engineering.

Energetics, explosives, and ordnance competencies were of course noted as particularly important for the industry and as requiring a significant amount of training. As one respondent expressed, "explosive operations have many nuances that are learned over time," and another said, "[explosives training] requires classroom training and cumulative experience with products."

Government contracting and compliance skills was another critical competency reported by respondents, particularly knowledge of Federal Acquisition Regulations (FAR)/Defense Federal

Acquisition Regulations (DFAR) and International Traffic in Arms Regulations (ITAR). These were cited as necessary competencies for respondents hoping to work with the USG or foreign customers.[56]

Impacts of Reduced Defense-Related Work

Survey respondents were asked whether commercial/non-defense work would allow them to maintain their company's critical skills and competencies should defense-related work decrease. Ten of 18 respondents indicated they would not be able to maintain critical skills and competencies (see Figure 6.18). Several of those respondents pointed to a significant reliance on defense sector sales, with one stating: "we do not do enough non-government work to retain employees." Other respondents noted the greater degree of precision necessary for defense-related work, as another respondent confirmed that: "defense work requires a higher level of skill in all disciplines."

Figure 6.18: Impact of a Decline in Defense-Related Work on Critical CAD/PAD Skills and Competencies

Negative Impact?	Number of Respondents
Yes	10
No	8

18 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Eight respondents suggested commercial/non-defense work could allow them to maintain employment in areas critical to the continued viability of CAD/PAD operations, though none appeared certain that would be the case. One respondent said they could preserve those skills and competencies "to some degree but it would be difficult to maintain current staff levels due to the percentage of military business conducted on our site." Another respondent hoped to increase international orders to offset any declines that may occur in the USG defense-related business.

[56] For further analysis of the impact of USG policies and regulations, see Chapter 9.

Staff Training

When asked about the time required to successfully train new staff in these critical skills and competencies, respondents gave a wide array of time periods. These time periods depended on the initial experience level of hired staff and the particular skill or competency. Respondents indicated it could take up to two years to successfully train staff for occupations related to energetics, explosives and ordnance as well as train staff in highly-specialized trades such as welding and electrical engineering (see Figure 6.19). One respondent indicated it could take up to 18 months to train staff in CAD/PAD engineering stated, "Structural, Chemical and Design Engineering of CAD/PAD related devices are not very common and require previous experience or vast amounts of training."

Figure 6.19: Skills and Training Requirements for Critical CAD/PAD Competencies

Critical Skill/Competency Area	Months Training	Respondents Indicating Skills as Critical to Long-Term Viability
Engineering-related skills Mechanical, electrical, R&D	4-18 months	6
Government contracts, relations, regulations Export compliance, contracts management, quality standards, health and environment	4-18 months	8
Manual labor skills Assembly, operators, mechanical aptitude, hands-on	1-24 months	9
Research, design and test skills R&D, explosives, system design and testing	4-24 months	4

21 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Training

In an effort to recruit new staff, 19 percent of respondents (four) sponsor or participate in government and university hiring and recruitment programs, including career fairs, internship programs, and military outplacement efforts.

When hiring new employees for skilled positions (scientists and engineers), respondents looked for individuals with a basic skill set and then trained them to the organization's precise requirements. Thirteen respondents utilize unofficial on-the-job training by skilled personnel, four utilize official on-site training programs, and one utilizes official off-site programs.

Key skills taught to new employees during these training initiatives included those related to safety (taught by seven respondents), energetics and explosives (taught by six), and manufacturing operations and manual labor (taught by five).

When asked to briefly explain their official training programs, several respondents pointed to internal, structured training initiatives: "The company has established training standards and a matrix for each engineering specialty." When describing unofficial on-the-job training, respondents appeared to approach training in a variety of ways. Several respondents utilized mentorships, while others have extensive on-the-job programs such as:

> 1) Provide safety training with explosive devices;
> 2) Provide hands on training;
> 3) Send out to get offsite training or bring industry expert to provide explosive training;
> 4) Provide annual refresher training;
> 5) Work with employee on job specific training plan.

According to another respondent, "Learning energetics is an on-the-job training for both production and engineering. There really is not any schooling that teaches CAD design. We have success with mechanical engineers, physicists, and chemistry majors who have a hands-on mentality."

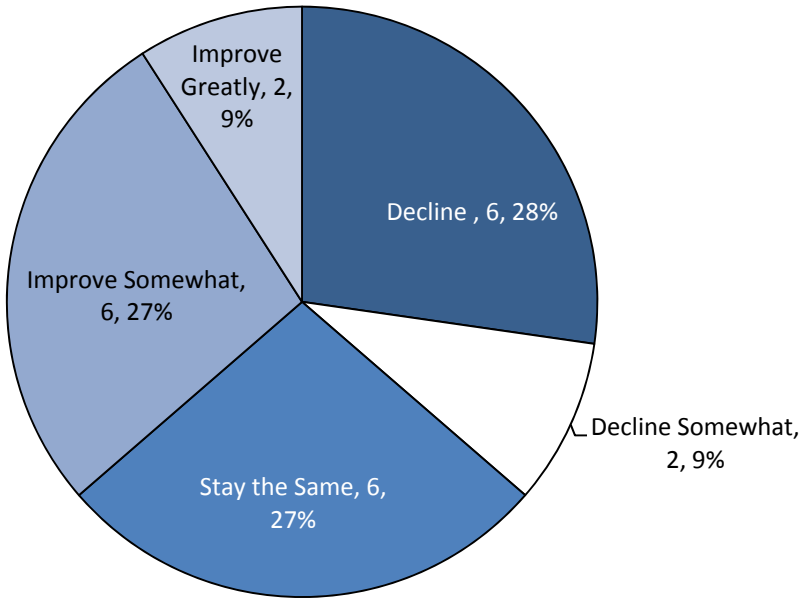
7. COMPETITIVE ASSESSMENT

7.1 Competitive Prospects: Company Views

Respondents were asked to assess their competiveness for the next five years (2013-2017) by providing information on specific issues impacting their operations, including those related to government regulations, policies, and spending. In addition, respondents were asked to identify key U.S. and non-U.S. competitors and actions taken by both categories of competitors. Lastly, they were asked to identify specific actions they have and are planning to undertake to improve their competitiveness.

In evaluating the competitiveness of their U.S. operations over the next five years, the 22 respondents were asked to provide a ranking on a five-step scale ranging from improve greatly to decline. Nearly equal numbers of respondents indicated they expect prospects to improve (improve greatly/improve somewhat) or decline (decline/decline somewhat). Nine percent of respondents estimate their competiveness will improve greatly as compared to 28 percent who noted their competitiveness will decline (see Figure 7.1).

Figure 7.1: Respondent Perspective on Future Competitiveness (2013-2017)
(Number and Percent of Respondents)



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Respondents categorized as dependent on CAD/PAD sales reported competitive prospects to be slightly more positive than the industry average.[57] Approximately 70 percent of dependent respondents anticipated their competitiveness to remain the same or improve over the next five years, while 64 percent of non-dependent respondents anticipated the same. A partial explanation for this differentiation may lie in the CAD/PAD sales data reported by the two respondent groups. Dependent respondents experienced sales growth of 34.5 percent over the 2007-2011 period, while non-dependent respondents experienced a 7.8 percent decline in sales of over the same period.[58]

Both the 2000 and 2006 BIS CAD/PAD reports asked respondents to assess their competitiveness over the next five years given a five-step scale similar to the one described above. Twenty-six respondents provided a response in the 2000 BIS CAD/PAD report and 17 respondents provided information for the 2006 BIS CAD/PAD report. Thirty-six percent (eight) of respondents in this 2013 assessment noted their future competitiveness would increase to some extent over the next five years. This is lower than the 2000 and 2006 BIS CAD/PAD reports, where 50 percent (13 of 26) of respondents and 71 percent (12 of 17) of respondents provided a similar outlook (see Figure 7.2).

Figure 7.2: Respondent Perspective on Future Competitiveness (# of Respondents)

Outlook	2000 Report	2006 Report	2013 Report
Improve Greatly	4	1	2
Improve Somewhat	9	11	6
No Change	7	2	6
Decline Somewhat	3	3	2
Decline/Decline Greatly	3	0	6

Respondents: Second Review: 26, Third Review: 17, Fourth Review: 22
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2000, 2006, 2013

Respondents to this 2013 BIS CAD/PAD report also provided a more pessimistic outlook regarding their competitive prospects than respondents to the 2000 and 2006 BIS CAD/PAD

[57] Respondents were categorized as dependent on CAD/PAD sales if their CAD/PAD-related sales for 2007-2011 were greater than 50 percent of total organization sales. See page X for an explanation of dependency on CAD/PAD sales.
[58] See Chapter 3 for additional information on sales.

reports. Thirty-six percent (eight of 22) of respondents to this assessment indicated their future competitiveness would decline to some extent, while only 23.1 percent (six of 26) of respondents in 2000 and 17.6 percent (three of 17) of respondents in 2006 shared the same outlook.

Respondents were particularly concerned with sales to government customers as four respondents cited expected cuts in defense spending and programs. According to one respondent, "With a reduction in 'new start' programs, we expect fewer development efforts leading to fewer production-based programs in the future."

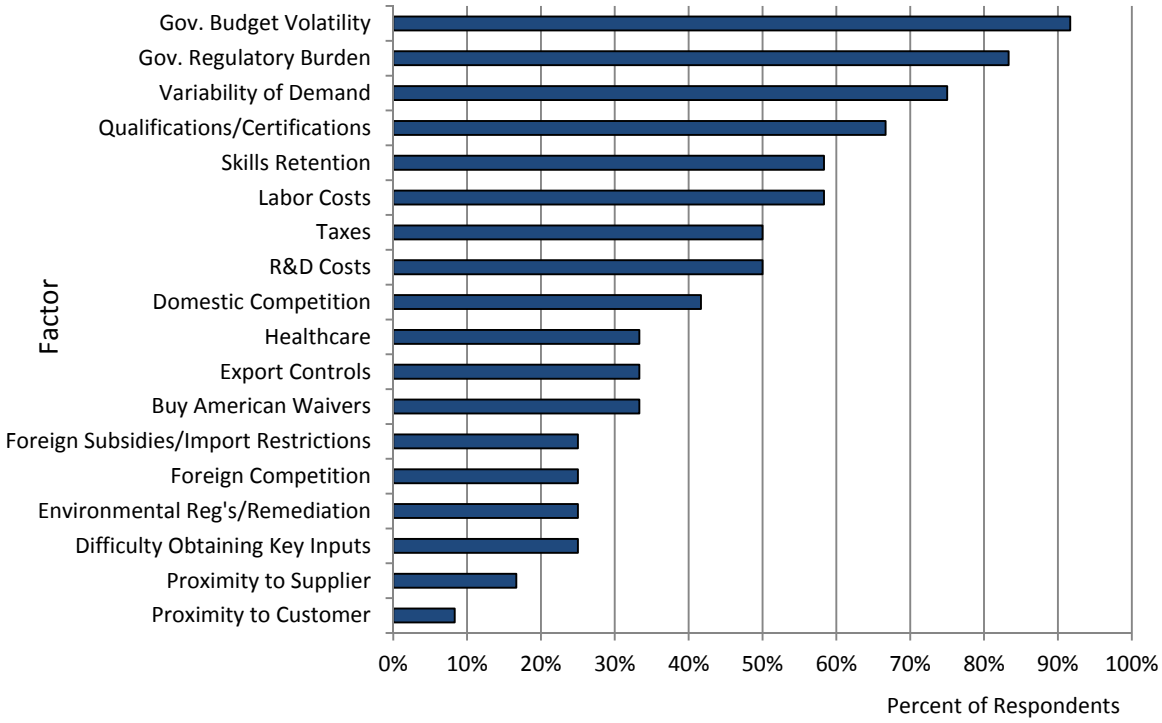
Respondents providing a positive outlook of their competitive prospects pointed to fewer competitors – not sales growth – as their primary reasoning. One respondent explained, "Since we are one of the few remaining small businesses there may be more opportunity for us."

7.2 Factors Affecting Industry Viability

Twelve respondents provided information on key issues affecting their long-term viability.[59] Government Budget Volatility and Government Regulatory Burden were the top two factors cited, as 91.7 percent and 83.3 percent of respondents identified those respective issues (see Figure 7.3). Export Controls (selected by 33.3 percent of respondents), Buy American Waivers (selected by 33.3 percent of respondents), and Environmental Regulations/Remediation (selected by 25 percent of respondents), were also frequently identified factors. Regarding workforce issues, 50 percent of respondents identified Labor Costs, Skills Retention, and Qualifications/Certifications as factors affecting long-term viability.

[59] Respondents could select multiple factors from a list of 18 provided.

Figure 7.3: Factors Impacting the Long-Term Viability of Respondent CAD/PAD Operations



12 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

7.3 Industry Consolidation and Changes

In addition to general issues impacting their long-term viability, respondents were asked how recent consolidations (mergers and acquisitions) within the industry may impact operations.[60] Seventy-three percent of respondents were either not impacted by or unsure of the impact of recent consolidations within the industry. An additional 18 percent reported negative impacts and nine percent reported positive impacts.

Of those reporting a negative impact, several respondents articulated a concern in sourcing key components for the systems they produce, similar to the concerns expressed in the 2006 BIS CAD/PAD report. One respondent expressed, "The consolidations have decreased the available competitive sources for the sub-component products we procure, such as …, therefore reducing

[60] For additional information on industry consolidations reported by respondents to this assessment, see Chapter 4.

our competitive position on open procurements." Another respondent stated, "The fact that there are fewer potential sources of [sub-components] in the supply chain minimizes [our organization's] ability to dual-source all items."

7.4 Changes at the Army Ammunition Plant in Radford, Virginia

Respondents were also asked how changes in management and/or operations at the Army Ammunition Plant in Radford, Virginia, a key supplier of propellant and explosive materials, would impact their CAD/PAD operations. Twenty-three percent of respondents suggested these changes would disrupt their access to propellants and other materials.

One respondent expressed a concern regarding the lack of a second U.S. source of some of the critical items obtained from Radford. Another respondent expressed concerns related to the installation of new management,

> "We could expect to experience propellant qualification delays and learning curve delays associated with the new contractor managing the facility. There is a concern that the new contractor may not possess all of the intellectual property required to produce the entire family of propellants we require."

7.5 U.S. and Non-U.S. Competitors

Other U.S. and non-U.S. organizations with CAD/PAD operations were identified as an important factor impacting the long-term competitiveness of respondents. When asked to identify their competitors, 21 respondents provided information on 25 unique U.S. competitors, nine unique non-U.S. competitors, and two competitors with both U.S. and non-U.S. operations. The largest number of U.S. competitors were in California and Arizona (six and five, respectively), while the largest number of non-U.S. competitors were in Europe (six). The 36 organizations reported as industry competitors over the 2007-2011 period was comparable to the 35 identified in the 2006 BIS CAD/PAD report covering the 2001-2005 period.

Respondents were also asked to assess their competitiveness vis-à-vis their non-U.S. competitors over the past five (2007-2011) and next five years (2013-2017). The largest number of respondents reported no significant change in competitiveness vis-à-vis their non-U.S.

counterparts over the past five years (9 of the 17 providing information) and do not anticipate a change over the next five years (8 of 18 providing information). However, while only one respondent indicated a decline in competitiveness vis-à-vis its foreign counterparts over the previous five years, four indicated they believe their competitiveness will decline over the next five years (see Figure 7.4).

Figure 7.4: U.S. CAD/PAD Industry Competitiveness with Non-U.S. Organizations

Outlook:	Previous Five Years (2007-2011)	Future Five Years (2013-2017
Improve greatly	0	1
Improve somewhat	4	4
Stay the same	9	8
Decline somewhat	3	1
Decline	1	4
No Response	5	4

22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Organizations responding to the 2006 BIS CAD/PAD Report provided a similar assessment of their international competitiveness over the 2001-2005 period. Fifty percent of respondents (six) reported no change, 33.3 percent (four) reported improved and, 16.7 percent (two) reported declining competitiveness over the five-year period ending in 2005.

When asked if CAD/PAD imports into the U.S. from these non-U.S. competitors have affected their domestic manufacturing operations, the primary impact identified by respondents was due to imported ejection seats, particularly those manufactured by Martin-Baker Aircraft, a U.K.-based company. One respondent stated, "[import] penetration of newer [Martin-Baker] platforms has reduced our opportunities to participate on those platforms," while another respondent directly cited a "loss of [its] business base due to foreign manufactured ejection seats."

The selection of Martin-Baker Aircraft to supply ejection seats for the F-35 Joint Strike Fighter (JSF) continues to be of significant concern to the surveyed U.S. CAD/PAD industry. The

company previously selected to supply ejection seats for the T-6 Joint Primary Aircraft Training System (JPATS) produced for the U.S. Air Force and Navy by Raytheon Aircraft Company (now Hawker Beechcraft).[61] To date, 446 of these two-seat training aircraft have been delivered to the U.S. Air Force, while the U.S. Navy has planned to acquire 328.[62]

Concern regarding the selection of Martin-Baker Aircraft to supply ejection seat systems for these major programs was also reflected in the 2006 BIS CAD/PAD report, as the F-35 JSF ejection seat contract was awarded in 2001 and production of the T-6 JPATS began in that same year. In addition, loss of revenue opportunities (ejection seats and related-items) associated with U.S. military aircraft to Martin-Baker Aircraft systems, and more generally international competitors, has remained an issue for the U.S. CAD/PAD industry since the release of the first BIS CAD/PAD report in 1995.

7.6 Customer Technical Capabilities

Respondents were asked to identify trends they have observed concerning work with USG and Prime Contractor customers. Of the 12 respondents providing information, five reported no significant difference between the two, with one respondent stating, "Different primes and government agencies are easier/harder to work with depending upon who/what they are."

Two respondents indicated a preference for prime contractor customers while four reported a preference for USG customers. Government customers were reported as easier to work with because of a unified procurement system and because prime contractors can add an additional layer of requirements onto the procurement process. One respondent stated, "The U.S. Government has one system for procurement. Prime Contractors each have individual systems that are not inter-related." Another respondent said, "Prime contractors impose their own additional commercial terms and conditions on top of the U.S. Government requirements. They often do not allow adequate time to respond to solicitations."

[61] Martin-Baker, "MK16 Ejection Seat". From, http://www.martin-baker.com/products/ejection-seats/mk16/jpats-us16la

[62] USAF T-6 Fact Sheet: http://www.af.mil/information/factsheets/factsheet.asp?id=124; USN T-6 Fact Sheet: http://www.navair.navy.mil/index.cfm?fuseaction=home.displayPlatform&key=1F548950-1B70-4720-B526-C81619FA087A

Respondents generally reported that the capability of both USG and Prime Contractor customers to prepare technical specifications, have knowledge of their products, discuss ordnance applications within the customer systems, and evaluate proposed designs had not significantly changed over the five-year period ending in 2011 (see Figure 7.5). Two respondents did report that Prime Contractor customers have lost capabilities related to knowledge of their products and the ability to evaluate proposed designs, while USG customers were not reported as having lost capabilities in those areas.

Figure 7.5: Changes in CAD/PAD Industry Customer Capabilities Since 2006

	Improved		No Change		Eroded	
Capability/Customer Type	**USG**	**Primes**	**USG**	**Primes**	**USG**	**Primes**
Preparation of technical specifications	3	3	7	7	2	2
Technical knowledge of respondent product(s)	2	2	10	8	0	2
Technical discussion of ordnance application within customer systems	2	3	8	8	2	1
Technical ability to evaluate proposed designs	3	3	9	7	0	2

12 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Several respondents also suggested that USG operations have expanded into areas previously left to industry, particularly specification development and testing.

> "[Our organization] continues to observe the U.S. Navy at Indian Head take competitive business opportunities [away from industry] by performing their own lot acceptance, and now qualification testing. Additionally, they are involving themselves in U.S. Department of Transportation Explosive Classification services and testing. These are opportunities industry could accomplish and has in the past."

7.7 Efforts to Improve Competitiveness

Key to assessing the competitiveness of the CAD/PAD industry is a review of current and future actions taken by companies to enhance their viability and competitive positioning. Respondents were asked about specific efforts to maintain their competitiveness over the past five years and the next five years in nine general business and operational areas (see Figure 7.6).

Nearly all respondents (21) indicated making at least one type of improvement over the past five years, while 18 have plans to make improvements over the next five years. Capacity and Property Investment was the most frequently cited effort, with 91 percent having made investments and 73 percent planning future investments. The second most frequently cited effort was Cost Reductions, with 86 percent of respondents reducing costs in the past five years and 73 percent planning to do so within the next five years.

Figure 7.6: Competitive Improvements
(Number of Respondents)

Improvement Made:	Previous Five Years (2007-2011)	Future Five Years (2013-2017)
Automation/Lean Manufacturing	20	14
Business Restructuring	13	6
Capacity and Property Investment (Plant and Equipment)	20	16
Cost Reduction/Efficiency	19	16
Customer Service/Quality Control	18	16
Innovation, R&D and Design	16	14
Marketing Improvements	13	13
Staff Adjustments	15	14
Training/Certifications	16	12

Past 5 Years: 21 Respondents
Next 5 Years: 18 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

While the industry has aggressively taken, or plans to take, steps to improve its competitiveness, several respondents highlighted cost as a potential downside of undertaking such actions. In an industry where the lowest cost competitor typically receives a contract, some respondents struggle to balance upgrading operations with holding costs at a competitive level, especially in a time of intermittent defense sales. One respondent stated, “In our industry it is usually low cost

wins. It is very hard to implement the above items and keep costs down when our competitors might not be investing in the same improvements."

Respondents also cited the low-volume and often intermittent nature of defense sector CAD/PAD work as a reason for their reluctance to invest heavily in improving the competitiveness of their CAD/PAD operations. One respondent explained, "Many of the cartridges that we are not currently manufacturing are too low of volume for our current business plan. Oftentimes some of these small purchases are less than $75,000 total contract value."

7.8 Certifications

Respondents were asked to report the CAD/PAD-related certifications their organization currently holds or is working toward (see Figure 7.7). The most commonly held certifications were ISO 9001 (seven hold, one working toward), J-STD-001DS (six hold) and SAE AS9100 (five hold).[63]

Figure 7.7: CAD/PAD Industry Certifications*

Certification	Have	Working Toward
AMS	1	0
ANSI/ASQC Z1.4	2	0
ANSI/ESD S20.20	1	0
DoD 5000	1	0
ISO 9000	3	0
ISO 9001	7	1
ISO 14000	2	0
J-STD-001DS	6	0
MIL-Q-9858	2	0
MIL-STD-45662 A	2	0
NADCAP	3	0
SAE AS9003	2	0
SAE AS9100	5	0

*ANSI/ISO/IEC 17025, ISO10012-1, ISO TS16948, and NCLS were additional certifications listed on this assessment; however, no respondents reported holding or working toward them.
12 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

[63] See Appendix E for a description of the specific certifications.

8. SUPPLIERS

Respondents were asked to identify their company's most important U.S. and non-U.S. suppliers/subcontractors for CAD/PAD operations. All 22 respondents completed this section, identifying 85 unique suppliers. In addition to identifying suppliers, respondents indicated which products or services suppliers provided, and if each supplier was a single or sole source. Overall, 120 products were identified by respondents, which were divided by BIS into 15 product groupings (see Figure 8.1).

Figure 8.1: Number of Unique Suppliers by Product Grouping

Product Grouping	Unique Suppliers
General Materials	33
Energetic Materials - Powders, Chemicals	19
Services	9
Initiators	8
Explosive Components	6
Batteries and Components	4
Connectors	4
Cutters	4
Detonators	4
Electrical Components	4
Propellants	3
Radiography	3
Impulse Cartridges	2
Casings/Housings	1
Gas Generators	1
TOTAL	**85**

22 respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The largest number of unique suppliers reported by respondents was in the General Materials and Energetic Materials product groupings. General Materials includes items such as machined components and subassembly parts. Energetic Materials includes substances such as Lead Azide and Zirconium.

8.1 Single/Sole Source Suppliers

Survey respondents were asked to indicate whether the supplier for each product was a sole source or a single source. For the purposes of this assessment, a single source supplier is defined as a company or facility 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. A sole source supplier is defined as a company or facility that is the only source for the supply of parts, components, materials, or services; no alternative U.S. or non-U.S. suppliers exist other than the current supplier.

Ultimately, the identification of sole source and single source suppliers was made at the discretion of the individual survey respondents. A supplier could be identified as both a sole and single source supplier depending on the respondent and the product or service provided. Overall, respondents mentioned 100 suppliers as single or sole source, consisting of 85 unique companies (see Figure 8.2). Thirty-eight percent of the survey respondents' most important suppliers were identified as single source, though the status of nearly as many key suppliers was unknown by respondents.

Figure 8.2: Suppliers Identified as Single/Sole Source

Type of Source	Number of Suppliers
Single Source	38
Sole Source	28
Not Sure	34
Total	**100**

22 respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

The suppliers for Energetic Materials that are essential in producing CAD/PADs were primarily single sources. Additionally, more than 50 percent of the suppliers for Casings/Housings, Gas Generators and Explosive Components were identified by respondents as single sources (see Figure 8.3).

Figure 8.3: Single/Sole Source Suppliers by Product Grouping			
Product Grouping	**Single Source**	**Sole Source**	**Not Sure**
General Materials	39% (13)	9% (3)	52% (17)
Energetic Materials - Powders, Chemicals	52% (11)	19% (4)	29% (6)
Explosive Components	67% (4)	17% (1)	17% (1)
Initiators	40% (4)	60% (6)	-
Services	50% (4)	22% (2)	33% (3)
Cutters	50% (2)	25% (1)	25% (1)
Casings/Housings	100% (1)	-	-
Detonators	25% (1)	75% (3)	-
Gas Generators	100% (1)	-	-
Propellant	33% (1)	67% (2)	-
Batteries and components	-	-	100% (4)
Connectors	-	100% (4)	-
Electrical Component	-	100% (4)	-
Impulse Cartridges	-	-	100% (2)
Radiography	-	33% (1)	67% (2)
22 Respondents *Source*: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013			

The products respondents received from sole source suppliers reflect the highly regulated industry and the difficulties in obtaining key energetic materials. The Initiators and Propellants product groupings were highly sole-sourced by respondents, with 60 percent and 67 percent of those suppliers identified as sole source, respectively. Another product grouping, Connectors and Electrical Components, also had high levels of sole sourcing, likely due to the constricting number of CAD/PAD manufacturers and fewer sales opportunities.

Survey respondents were also asked to identify if their key suppliers were U.S. or non-U.S. entities. The majority of the suppliers identified (92 percent) were U.S. companies, some with non-U.S. entities (see Figures 8.4 and 8.5). Only three CAD/PAD product groupings were imported, with the largest number of non-U.S. suppliers (33 percent) providing Energetic Materials. However, these categories do not take into account items with CAD/PADs already installed, such as aircraft ejection seats.

Figure 8.4: U.S./Non-U.S. Suppliers that are Single/Sole Source			
U.S./Non-U.S. Suppliers	**Single Source**	**Sole Source**	**Not Sure**
Non-U.S.	8% (3)	18% (5)	3% (1)
U.S.	92% (35)	82% (23)	97% (33)
TOTAL	**38**	**28**	**34**

85 unique suppliers, but 100 mentions of suppliers as single/sole sourced based on products or services supplied.
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Figure 8.5: U.S./Non-U.S. Suppliers by Product Grouping		
Product Grouping	**Non-U.S.**	**U.S.**
Energetic Materials - Powders, Chemicals	33% (7)	67% (14)
Connectors	25% (2)	75% (6)
Electrical Component	25% (1)	75% (3)
Batteries and components	-	100% (4)
Casings/Housings	-	100% (1)
Cutters	-	100% (5)
Detonators	-	100% (4)
Explosive Components	-	100% (7)
Gas Generators	-	100% (1)
General Materials	-	100% (34)
Impulse Cartridges	-	100% (2)
Initiators	-	100% (11)
Propellant	-	100% (3)
Radiography	-	100% (6)
Services	-	100% (9)
Grand Total	**8% (10)**	**92% (110)**

85 unique suppliers representing 120 products
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

8.2 Supply Chain Issues

Survey respondents were asked if they had experienced any shortages, drastic cost increases, or supply interruptions of materials, parts, components, and/or other essential supplies that adversely affected or continued to adversely affect their U.S. CAD/PAD operations. If they did experience one or more of these issues, respondents were asked to identify the type of CAD/PAD-related item affected, explain the adverse situation, and describe how it was managed or resolved.

Fourteen of the 22 total respondents indicated they had experienced at least one supply chain issue. Of the 37 total incidents cited, the largest number related to Explosive Components, Parts/Components, and Raw Materials (see Figure 8.6).

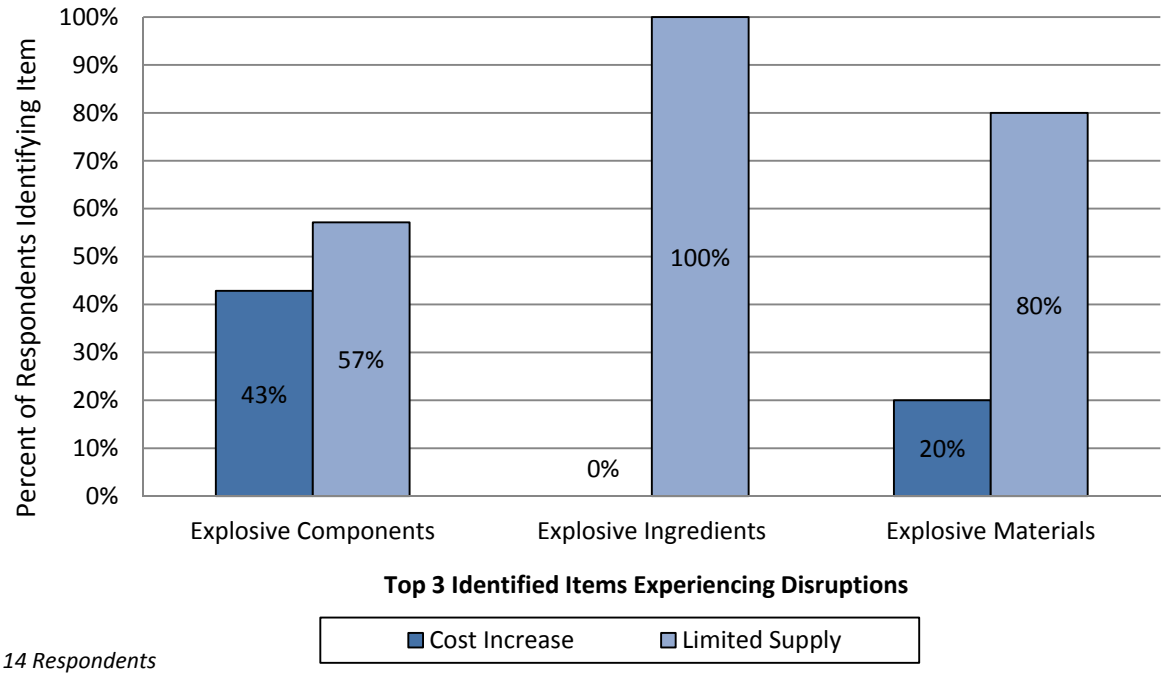
Figure 8.6: Incidents of Supply Chain Issues by Type of Item

Type of Item	Number of Incidents Identified 2007-2011
Explosive Components	7
Explosive Ingredients	5
Explosive Materials	5
Legacy Propellants	3
Parts/Components	7
Raw Materials	6
Subcomponents	3
Testing Materials	1
TOTAL NUMBER OF INCIDENTS	**37**

14 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Energetic Materials, such as Explosive Components, Ingredients, and Materials as well as Legacy Propellants, were reported by respondents to be the most difficult to obtain, maintain, and transfer to customers. Explosive Components, Ingredients, and Materials also created the most supply disruptions, with survey respondents citing significant cost increases and a severely limited supply as the major disruptions (see Figure 8.7).

Figure 8.7: Cause of Supply Disruption for Top Three CAD/PAD Items Experiencing a Supply Distruption



14 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

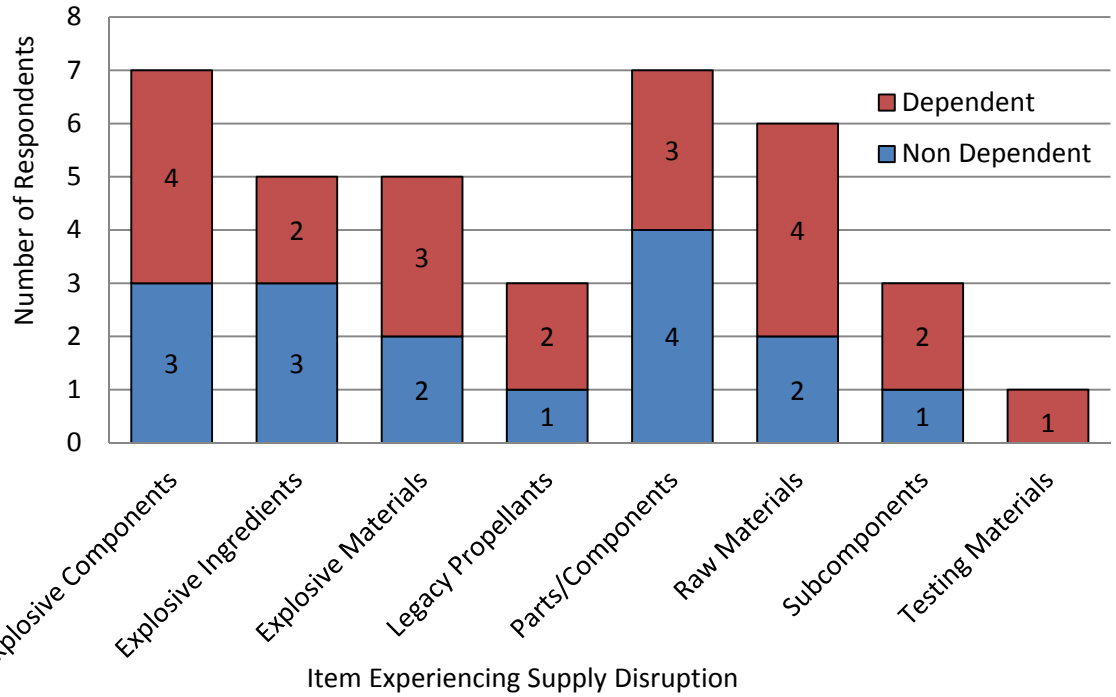
More specifically, quality and basic availability of materials were the key issues reported for many of the items that face a limited supply. Several materials were reportedly no longer being produced in the U.S. or produced with unacceptable quality issues. Survey respondents said they faced supply shortages of the following materials: Potassium Perchlorate, Black Magnesium, Phase Stabilized Ammonium Nitrate (PSAN), PVU primers, Zirconium, and Lead Azide. Some respondents have substituted materials from non-U.S. sources, though sometimes these substitutes do not meet the necessary military or weapons specifications required by DOD. Faced with a lack of suitable materials, some respondents have even begun to manufacture the materials they need.

There are several reasons why CAD/PAD manufacturers are facing such limited availability of materials, many of which seem to point to regulatory burdens and barriers to entry in providing these often low volume and specialty products. One respondent noted that, "the Radford [Arsenal] competition impacted propellant availability for one year and with the new operator it

is unknown what the long term impact will be." With the declining number of suppliers and manufacturers of CAD/PADs and related materials, uncertainty with the quality and availability of materials provided by any one supplier could create serious supply chain issues for CAD/PAD production. This will ultimately impact the final customer, the Department of Defense.

Five of the eight respondents categorized as dependent on CAD/PAD sales reported experiencing shortages, dramatic cost increases, or supply interruptions of materials, parts, components, and/or other essential supplies for all eight identified parts (see Figure 8.8). Overall, the five dependent respondents reported 21 of the 37 instances of supply disruptions, while non-dependent respondents accounted for 16. It is evident that supply disruptions of these critical items were experienced across the entire CAD/PAD industry.

Figure 8.8: Respondents Dependent on CAD/PAD Sales Facing Supply Disruptions



14 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Additionally, survey respondents were asked to identify factors that impacted their U.S. CAD/PAD operations and to explain the impact. Seventeen of the 22 respondents indicated they had been impacted by at least one of the factors listed (see Figure 8.9). A total of 56 incidents were reported by the 17 impacted respondents.

Figure 8.9: Incidents of Supply Chain Issues

Factors	Number of Incidents Identified
Department of Transportation (DOT) Regulations (e.g. "Competent Authority")	13
International Traffic in Arms Regulations (ITAR)	11
Neutron Radiation (N-ray) Testing	10
Environmental Protection Agency (EPA) Regulations	5
Foreign Military Sales	5
Obsolescence	4
Export Administration Regulations (EAR)	3
Testing Facilities	3
Other Factor	2
TOTAL NUMBER OF INCIDENTS	**56**

17 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Seventy-seven percent of the 17 respondents indicated experiencing problems with the Department of Transportation's (DOT) regulations, specifically "Competent Authority" and the new testing requirements. Every respondent identifying issues with the DOT's Competent Authority indicated that it drastically increases both cost and lead time of deliveries. Additionally, new requirements set forth by DOT have added to the burdens that respondents have been struggling with since the 1995 BIS CAD/PAD assessment, and some respondents believed the requirements exceed what is necessary.[64] One company stated, "Luckily we have not had to get a new Competent Authority since the rules have changed; however, what used to take 3 months will now take 1 to 2 years and be very expensive." Another company said, "This is a very big problem. We have appealed directly to DOT regarding the impact of schedule, cost, and business risk of current problems. They are deaf to criticism."

[64] An explanation of DOT regulations and testing requirements is in Chapter Nine.

In addition to burdensome DOT requirements, respondents criticized export controls administered by the Department of State through the International Traffic in Arms Regulations (ITAR) and by the Department of Commerce through the Export Administration Regulations (EAR) as being unclear and cumbersome, citing issues with consistency and clarity. Many companies mentioned a limited availability of information, and one company had shipments confiscated due to confusion over whether or not the items were ITAR controlled. One respondent stated, "We had to hire additional resources to comply with ITAR regulations."

Many respondents also expressed concern with the closure of Aerotest Operations, Inc. in California, which has severely limited the number of facilities capable of performing Neutron Radiography (N-ray) testing for CAD/PADs. Neutron radiography testing is a non-destructive testing (NDT) technique that allows imaging of hydrogenous materials (e.g. water, oil, plastic, rubber, and explosives) within components made of metals such as steel, brass, aluminum and nickel.[65] This NDT technology is applicable to various defense applications such as the inspection of high-reliability explosives for presence of transmitters and receivers and for explosive loading uniformity, reliability testing of detonators in explosive devices, and determining reliability of airbag or parachute initiators.

The non-destructive inspection of a material using neutron radiography is very similar to the process used in X-ray non-destructive testing; however, unlike X-rays, neutron radiography services allow the imaging of organic materials inside a component. Metals in the subject component take on a transparent appearance in neutron radiographic images. In many cases, X-ray and neutron radiography are complementary non-destructive testing inspection processes, offering a complete picture not only the integrity of the component, but also of the organics within that component.

N-ray testing is required of many CAD/PAD suppliers for regulating certain categories of explosives, but since the closure of Aerotest Operations, Inc. there are a limited number of N-ray testing providers that are U.S. companies. U.S. Government regulations require N-ray testing facilities in the U.S. to be U.S.-owned, which further decreases the number of available suppliers for testing. According to survey respondents, this has caused the process to increase the price

[65] Information on Neutron Radiography testing was obtained from X-R-I Testing; a NADCAP approved Non-destructive testing facility. http://www.xritesting.com/ndtservices_neutronradiography.html

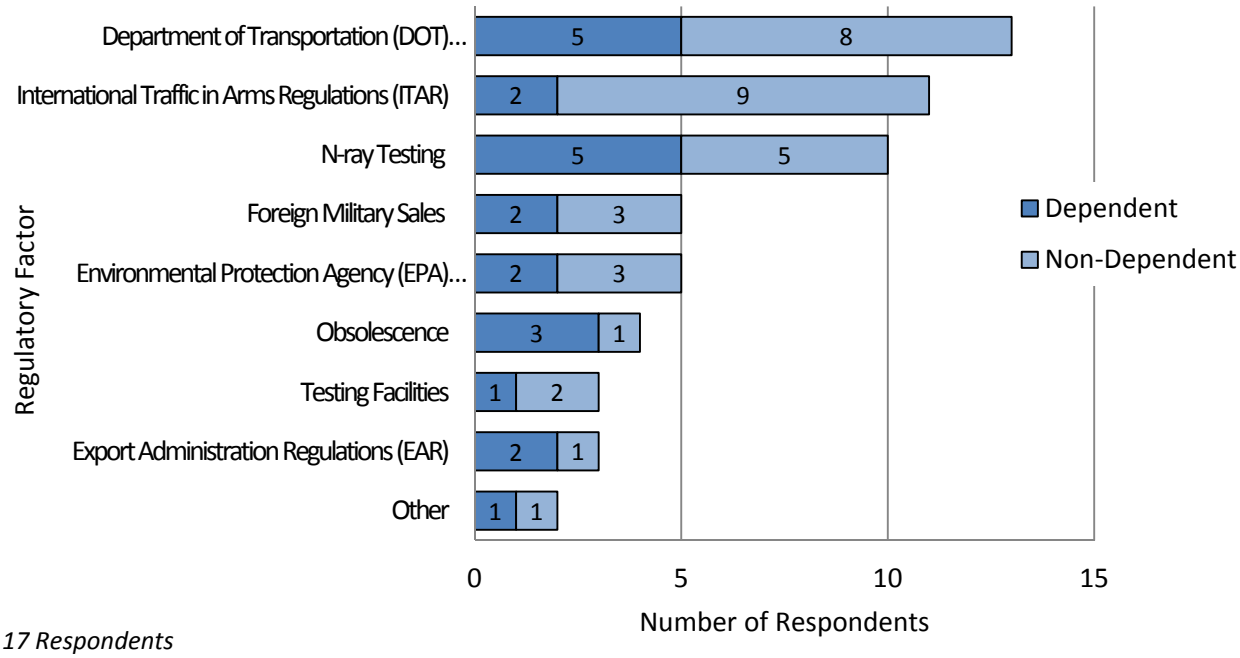
three to four times the normal amount. One respondent stated that finding an alternative testing source "caused significant delays and cost impacts to the prime customer," and another indicated testing costs have now tripled.

Additional factors that respondents commented on included the U.S. Environmental Protection Agency (EPA) regulations. Several respondents indicated they were negatively impacted by the expense and difficulty of complying with the EPA regulations, and some respondents claimed that state regulations went "above and beyond" those of the EPA.

Obsolescence issues were another important factor highlighted by respondents. Several complained about unobtainable materials as well as "dated" or "expired" specifications. One respondent stated, "Certain chemicals used in CAD/PAD propellants have become obsolete. [We] must create and qualify alternative propellant formulations."

Six of the eight respondents categorized as dependent on CAD/PAD sales reported being impacted by eight of the nine additional factors listed on the survey (see Figure 8.10). Overall, companies dependent on CAD/PAD sales reported 41 percent of incidents caused by additional factors, with the majority of incidents for each type of item reported by non-dependent respondents. This is further indication that problematic supply chain issues are experienced across the entire industry.

Figure 8.10: Regulatory Factors Impacting CAD/PAD Respondents



17 Respondents

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

9. GOVERNMENT-RELATED FACTORS AFFECTING THE CAD/PAD INDUSTRY

9.1 U.S. Government Policies, Laws and Regulations

During BIS discussions with industry at conferences, meetings, and site visits, companies raised concerns about several USG laws, policies, and regulations that were impacting their operations. Because of these concerns, survey respondents were asked to describe what reasonable adjustments could be made to 11 USG laws, policies, and regulations to mitigate any competitive disadvantages that U.S. companies might face.[66] Of the 11 areas listed in the survey, respondents suggested adjustments for ten in order to mitigate competitive disadvantages; no recommendations were provided for the Small Business Innovative Research Program (SBIR).

9.1.1 Shipping Classifications

Shipping classifications for CAD/PAD products remain a concern for many of the survey respondents. The U.S. Department of Transportation (DOT) regulates the transportation of hazardous materials. DOT's Pipeline and Hazardous Materials Safety Administration (PHMSA) is delegated the responsibility to write the hazardous materials regulations, which are contained in 49 CFR Parts 100-180.[67] In addition, the regulations require that new explosives must be examined and assigned a recommended shipping description, classification, and compatibility group by a person who has been approved by the Associate Administrator to do so. Currently, there are six explosive test labs approved by the Associate Administrator.[68] These labs are approved to examine and make recommendations concerning hazard classification of new explosives in accordance with 49 CFR 173.56(b)(1).

In previous BIS CAD/PAD assessments, Dr. Wei Shing Chang, of the Explosives Bureau company, was the main consultant who would test and analyze CAD/PAD products for shipping and prepare letters of recommendation for the DOT. With more than 30 years of experience, many CAD/PAD companies used his services. The 2006 BIS CAD/PAD report noted that

[66] For the full list of USG laws, policies, and regulations respondents were asked to comment on, see Appendix C.
[67] How to Comply with Federal Hazardous Materials Regulations – *Federal Motor Carrier Safety Administration*. From, http://www.fmcsa.dot.gov/safety-security/hazmat/complyhmregs.htm
[68] Ibid.

companies were starting to use competing contractors to fulfill this logistical step. Although Dr. Wei Shing Chang has since passed away, his explosives testing business is still one of the DOT-approved explosives test lab.

Many industry members voiced concern during meetings about the limited number of available explosives test labs and the new and more stringent regulations that DOT has implemented in the past few years. Companies continue to experience long waiting periods to get their products tested for shipments and are now facing added costs due to the new regulations.

For example, DOT regulations have changed so that products are no longer able to be classified by "comparison/similarity." In the past, an expert such as Dr. Wei Shing Chang could use his expertise to determine classification. Now every item, no matter how similar to a currently classified product, must be completely retested in order to receive classification. A small change to the cartridge with no corresponding change to the propellant formula can lead to a new test being required.

Several respondents recommended that DOT allow similar products, or "product families," to be classified together or allow the use of data from historical classifications, instead of requiring new classifications when small changes are made. As one respondent suggested, "Allow for higher level of analysis to be performed to mitigate current significant costs associated with DOT testing."

In addition, DOT regulations often require testing materials in a bigger lot size than the company plans to ship to the customer. These testing requirements result in companies having to fund all the extra cost for materials to meet the minimum lot testing size. Overall, companies are required to fund these extra classification and testing steps without assistance from the USG.

Respondents continued to comment on the difficulty, cost, and length of time it takes to receive a DOT shipping classification, particularly in light of new testing requirements. One respondent said, "Recent change in 1.4S testing requirements and shipping has delayed multiple orders for between 3-8 months depending on the items. Added requirements drive additional cost to both manufacturers and customers."

9.1.2 Export Controls

CAD/PAD products are subject to USG export controls, and generally require a license before a company is allowed to export them. Currently, most CAD/PAD items are on the United States Munitions List (USML) which is part of the International Traffic in Arms Regulations (ITAR) administered by the Department of State. Some CAD/PAD items, such as automotive airbags and airplane escape slides, are on the Commerce Control List (CCL) which is part of the Export Administration Regulations (EAR) administered by the Department of Commerce.

Export controls continue to be an issue for the CAD/PAD industry. Many respondents expressed frustration with the current export controls governing CAD/PAD items. They indicated that many of the CAD/PAD items controlled on the USML are older and widely available, and the controls make it harder to compete internationally. One exporter said, "In many cases our laws are much more stringent than the competition's." Many respondents recommended that the USG make it a priority to remove items from the USML that are no longer appropriately categorized, while some recommended these items be placed under the Department of Commerce's jurisdiction. Additionally, two respondents suggested shortening the license approval process.

Respondents also indicated that they would like more clarity about the export control process, especially about what is allowed to be exported and which companies can receive licensed exports. One respondent commented, "The USG should provide a single consolidated list of people and companies with which trade is prohibited." As part of a recent Export Control Reform Initiative, a Consolidated Screening List was created that combines the screening lists of the Department of State, Department of Commerce, and the Department of the Treasury.[69]

When asked about CAD/PAD-related business lost due to U.S. export controls, one respondent said they lost CAD/PAD-related export sales due to the ITAR while three were not sure if they lost sales due to the ITAR or EAR. However, some respondents indicated that while they have not lost sales, they do not seek out CAD/PAD-related export sales due to the regulatory burden. One respondent affected by export controls stated, "Many countries want U.S. DOD identical

[69] The Consolidated Screening List is available at http://export.gov/ecr/eg_main_023148.asp.

(using the U.S. DOD [Technical Data Package]) products and we chose not to bid as the U.S. DOD Technical Data Package is restricted."

The perceived difficulty and expense of complying with ITAR and the EAR have made exporting unattractive to some in the CAD/PAD industry. Their ability to compete in new markets and be an attractive supplier to non-U.S. customers is often hindered by regulations. One respondent commented that they, "have bid on some international … devices in which ITAR regulations limited our responsiveness to the non-U.S. customer."

9.1.3 Competitive Bidding and Procurement

Competitive bidding in government contracting is aimed at increasing innovation and helping lower costs. However, the primary focus of competitive procurement is seemingly not the quality of the product being offered. In addition, there is concern that the process reduces the incentive for companies to invest in research and development as this added cost might prevent them from having the lowest bid.

Eight respondents expressed concern about the competitive bidding process. Respondents voiced preference for the USG to consider "best value" over "lowest cost," relax cost disclosure rules, and stop renegotiations of competitive bids.

There is concern that quality and competition are compromised in the pursuit of lowest cost. One respondent stated:

> "Higher price doesn't mean the lower price won't cost more in the long run because of failures, poor quality, poor program management, etc. Stated a different way, some suppliers think ahead and provide best overall value even if you pay a little more. You won't have the change of scopes for every nickel and dime."

Another company said, "Small, private firms are penalized by cost disclosure rules," making it more difficult for them to compete with larger companies. Also regarding competition, one respondent stated, "Too often we bid very competitively, and the government wants to 'negotiate' our competitive bid because they did not get a bid from other suppliers, or didn't like the bids they received."

Respondents also reported issues with the solicitation process, indicating it is slow and inflexible. One respondent stated, "Solicitations and contracts are submitted multiple times and have multiple errors." A second respondent recommended that the USG, "Improve execution rate of contract awards. Currently 50-70 percent are awarded beyond the validity period."

Finally, a number of respondents expressed concern with the inability to bid upon the Joint Strike Fighter (JSF) F-35 CAD/PAD supply chain contracts. With the growing proportion of JSF aircraft in the USG's inventory, this issue will continue to raise concerns until it is resolved.

9.1.4 Government Competition and Lot Acceptance Testing (LAT)

LAT is the process DOD uses to determine whether to accept or reject CAD/PAD products. These tests are used to evaluate whether the products meet all required specifications as determined by the contract. Past BIS CAD/PAD assessments have shown that companies are concerned about the slow speed of testing and the burden and cost of requirements.

Respondents provided nine comments on government competition and lot acceptance testing. Some companies expressed concern about foreign government subsidies impacting fair competition. One survey respondent stating in some cases, "Foreign governments are propping up their industries, giving (them an) unfair advantage."

LAT continues to be an area of contention for CAD/PAD companies. Five survey respondents commented on the slow speed of testing, the amount of product tested, and the burden and cost of requirements. Several respondents stated the USG should not be conducting LAT. While the USG now allows some testing to be done at manufacturing facilities, respondents believe the USG should allow industry to better support testing requirements.

9.1.5 Second-Sourcing

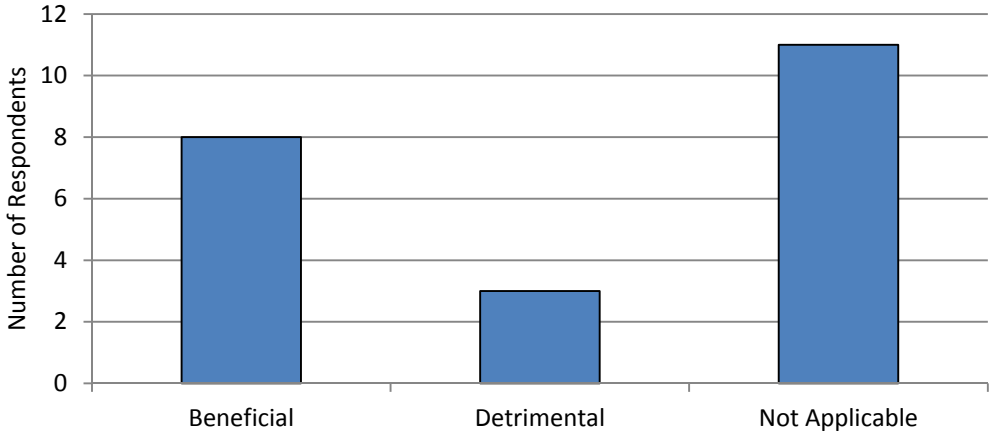
Second-sourcing is the production of a single design by two firms for DOD. The first source is usually the designer and developer of the product while the second source is typically established at the expense of the USG.[70] The goal of second-sourcing is to reduce the costs to the USG

[70] Birkler, J.L. et al; Issues Associated with Second-Source Procurement Decisions; RAND; R-3996-RC; December 1990, (RAND-90b).

through increased competition. Second-sourcing also provides a surge capability should production need to be expanded quickly and reduces the risk of supply delays due to production problems or labor disputes. In addition, second-sourcing allows the USG to maintain the technical and production expertise and capabilities in the United States.[71]

Eight of the respondents reported that they have found second-sourcing beneficial (see Figure 9.1). Respondents that have benefitted from second-sourcing noted it has helped them expand their portfolio and lower prices, with one respondent stating, "It has caused us to initiate new products and new ideas." One large company commented that, "Second-sourcing has been beneficial to our CAD/PAD-related business lines because it allows competitions and makes prices competitive." Another respondent stated second-sourcing, "lowers the price and reduces the risk of a line stoppage due to quality issues."

Figure 9.1: Respondent Views Regarding Second-Sourcing



22 Respondents
Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

However, some respondents expressed concern about second-sourcing in the CAD/PAD industry, with one respondent commenting, "In the CAD industry there have been several second sources that have failed miserably and wasted money, program time, and most importantly failed

[71] Ibid.

to get product to the warfighter." Another respondent was concerned about how second-sourcing affects profitability, stating it "drives the prices down so much that both sources get hurt."

Another concern expressed by respondents was the protection of intellectual property. One respondent stated the USG should ensure that second-sourcing is "based on a performance specification, not 'copying' another vendor's part." Another respondent indicated their concern stating, "If based on your specific part, there can be intellectual property issues being divulged if a competitor has the chance to 'dissect' rather than having to meet the performance."

Respondents were also asked what recommendations they would provide to improve the second-sourcing process; 11 respondents offered suggestions. The length and cost of the qualification process being run by the CAD/PAD Joint Program Office (JPO) were of the most concerned to survey respondents. One respondent stated:

> "Current multi-phased process embraced by the JPO takes 2-3 years to complete and results in the costs exceeding the payback period that many suppliers can justify to commit the investment to move forward on. [We] would recommend a streamlined process that could involve qualification and production to occur on one single contract."

Another respondent commented that, "The parts integrated into our equipment are qualified as sole source and cannot be changed unless re-qualified. This is a costly and lengthy process."

Respondents also urged the JPO to improve communications with industry regarding second-sourcing opportunities. One respondent stated that second-sourcing opportunities need to come with more well-written specifications, while another stated that the JPO needs to "communicate second source opportunities earlier to allow us time to review."

9.1.6 Build to Print versus Performance Specifications

Four respondents indicated that they would prefer the USG to use performance specifications instead of Build-to-Print Technical Data Packages (TDP). A performance specification states the required results with criteria for verifying compliance, but without stating the methods for

achieving the results.[72] Build-to-Print requires parts that are identical to the original parts with only USG-approved changes allowed to be incorporated into the new items.[73]

There was also concern about the quality of TDPs, with one respondent commenting that the USG needed to improve the "poor quality of Build-to-Print TDP's" and another respondent stating that "Build-to-Print is often wrong." Companies are confident they can meet the stringent technical and safety requirements, while at the same time allowing for improved innovation and the ability to compete internationally.

9.1.7 Environmental and Safety Regulations

Previous BIS CAD/PAD reports illustrated concerns that environmental and safety standards were burdensome and an added cost of conducting business. In addition, industry was concerned that they were not being applied evenly across states or localities. To evaluate developments in this area, BIS again requested information on the companies' suggested adjustments to USG policies, laws, and regulations regarding safety and the environment. Due to the sensitive nature of CAD/PAD products, the industry is heavily regulated for safety.

The CAD/PAD industry must adhere to a variety of safety and environmental laws and regulations regarding hazardous materials. Hazardous material is regulated by multiple federal, state and local agencies including the Department of Labor's Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA).

In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA) to protect human health and the environment from the potential hazards of waste disposal and to ensure that wastes are managed in an environmentally sound manner.[74] EPA was given the authority by Congress to develop the RCRA program.[75] The term "RCRA" is often used interchangeably to refer to the law, regulations, and EPA policy and guidance.

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[72] Department of Defense. "Guidelines for Engineering, Manufacturing and Maintenance Documentation Requirements for Unique Identification (UID) Implementation." 6 December 2004. http://www.dsp.dla.mil/app_uil/displayPage.aspx?action=content&accounttype=displayHTML&contentid=28

[73] Defense Standardization Program (DSP) Portal. Defense Standardization Program Portal. 2 February 2013. http://www.dsp.dla.mil/app_uil/displayPage.aspx?action=content

[74] The regulations can be found in Title 40 of the Code of Federal Regulations (CFR), Parts 238 through 282.

[75] Environmental Protection Agency. "RCRA: Reducing Risk From Waste." September 1997. http://www.epa.gov/epawaste/inforesources/pubs/risk/risk-1.pdf

RCRA encourages states, instead of the EPA, to assume primary responsibility for implementing the RCRA program.[76] States that want to adopt and implement a RCRA program must develop a system for the management of hazardous waste that is at least as stringent as the EPA's.[77] State programs can be more stringent or broader in scope, however. Currently, 50 states and territories have been granted authority to implement hazardous waste programs.[78] [79]

Congress enacted the Occupational Safety and Health Act in 1970 to regulate hazards in the workplace, including worker exposure to hazardous substances. The Act encourages states to develop and operate their own job safety and health programs which must be "at least as effective as" comparable federal standards.[80] Currently, 27 States operate OSHA-approved State Plans.[81]

Multiple respondents indicated that regulations should be standard throughout the industry and across the country. One respondent stated that regulations were "not enforced equally throughout the United States," while another noted that the USG "should take into consideration areas that have increased requirements."

Five respondents expressed concern that some environmental and safety regulations hurt their U.S. and international competitiveness. One respondent stated, "[U.S.] laws are much more stringent than the competition." Other respondents described them as "restrictive and rigid" and "very burdensome."

9.2 U.S. Military Presence in Iraq and Afghanistan

Respondents were asked if the declining U.S. military presence in Iraq and Afghanistan would affect their CAD/PAD business. In the 2006 BIS CAD/PAD assessment, there was a significant increase in CAD/PAD shipments between 2001 and 2005, in part due to the commencement of

[76] Environmental Protection Agency. "RCRA State Authorization." http://www.epa.gov/wastes/laws-regs/state/
[77] Note: EPA's Subtitle C program establishes a regulatory framework for managing hazardous waste from generation until ultimate disposal.
[78] Environmental Protection Agency. "RCRA State Authorization." http://www.epa.gov/wastes/laws-regs/state/
[79] Note: Alaska and Iowa do not have RCRA programs. Guam and the District of Columbia have RCRA programs.
[80] "Occupational Safety and Health Act of 1970."
[81] Occupational Health and Safety Administration. "Occupational Safety and Health State Plan Association (OSHSPA)." http://www.osha.gov/dcsp/osp/oshspa/index.html.

U.S. military operations in Iraq and Afghanistan. In addition, the 2006 BIS CAD/PAD assessment showed that defense spending for the conflicts in Iraq and Afghanistan provided strong sales increases for companies selling CAD/PAD consumables.

For this 2013 BIS CAD/PAD assessment many respondents provided comments detailing how the declining U.S. military presence was affecting them. Of the 22 respondents, seven indicated that their CAD/PAD business would be affected and provided additional comments explaining their response.

Two respondents noted that a significant portion of their sales depended on DOD purchases. One respondent indicated that a large portion of their business was DOD-related, and therefore they would be heavily impacted by the military drawdown. Another respondent stated, "Some of our products have seen a significant uptick since the commencement of these conflicts – this will surely be reversed as we withdraw."

The effect of the declining U.S. military presence in Iraq and Afghanistan has already impacted some companies, with one commenting that "We have already seen reductions on orders to support the fleet." Another stated they "Expect a decrease in spending and less business" but have not yet experienced the full impacts. However, one respondent commented that even with the declining presence in Iraq and Afghanistan, threats from other countries might actually increase business levels.

Two respondents commented that the declining presence of the U.S. military will affect the sale of their CAD/PAD consumables such as electronic impulse cartridges, flares, and aircraft stores. One respondent stated, "Decline in U.S. war fighting results in decline in war fighting consumables consumed, which results in a decline in war fighting consumables purchased which leads to a decline in sales."

9.3 U.S. Government/Department of Defense Budget

Respondents were asked if they were concerned with proposed or potential defense and/or USG budget cuts. Seventeen of the 22 respondents indicated they were concerned, and 16 of those respondents provided additional comments.

One respondent already experiencing effects of USG and DOD budget cuts stated, “They are currently and will continue to have a significant impact to our business.” Another respondent voiced concern over the warfighters stating, “Our troops will not get the lifesaving equipment they require.”

CAD/PAD companies commented specifically about how a large portion of their business is heavily dependent on USG budgets, with one small company stating that their, “Business is 100 percent related to U.S. DOD weapons systems. Therefore, any USG budget cuts that affect the U.S. DOD affect [The Company]. Another respondent stated that potential cuts “Could result in a significant reduction in the company's business, as over 90 percent of the company's business is obtained directly or indirectly from U.S. Government funded programs.”

Three respondents were concerned about how the DOD budget cuts would affect them financially, with one respondent stating, “A reduced DOD budget will certainly mean a reduction across the board of energetic market. The same capacity will be competing for less volume which stresses both revenue and profit.” One large company is “concerned by reduction because of high fixed cost (safety, insurance, regulatory, etc.) of operating an energetics plant.” Another large company stated that “many of our products are spare/replacement parts. Reductions in maintenance budgets could result in lower sales.”

One respondent commented on how the cuts would affect their future business stating, “We are concerned with the development of new CAD/PAD systems. Without transitioning development programs into production it will be detrimental to our success.” Another respondent has tried to lessen the impact of the potential budget cuts by taking proactive measures stating, “We have expanded our business into several DOD areas so hopefully the loss of one area will not have a devastating effect on our entire business.”

Two respondents were concerned about how the budget cuts would impact their workforce. One respondent stated that “Budget cuts directly reduce the number of products procured, and ultimately can make it difficult to retain skilled personnel.” Another respondent, a small business, stated that they are “concerned about vulnerability of U.S. and our assets; but also from business decline potential where talent and suppliers are lost and then when needed, not able to recover quickly enough and we have to buy Chinese products.”

10. FINDINGS AND RECOMMENDATIONS

10.1 Report Findings

Chapter 2 – Product and Industry Description:

- The surveyed U.S. CAD/PAD industry consists of 22 manufacturers across 11 states. Three of these manufacturers only produce defense products, while 19 produce both defense and non-defense products.
- Thirty-six percent of the 22 companies were U.S.-based companies. Another 36 percent were business units of a U.S.-based company. Twenty-seven percent (six companies) were a U.S.-based subsidiary of a non-U.S. parent company. Additionally, 77 percent of the respondents (17) are privately-held firms while the remaining 23 percent (five) were publicly held.
- There were 39 unique mentions of business lines amongst the respondents. Of those 39 mentions, 41 percent (16) were unrelated to CAD/PADs.
- Eight survey respondents were categorized by BIS as dependent on CAD/PAD sales, as their CAD/PAD sales comprised greater than 50 percent of their net sales over the 2007-2011 period.
- The 22 manufacturers identified 89 CAD/PAD products in 14 different product lines and two subcategories.
- Eight companies reported 33 total instances of facilities discontinuing the production of 14 CAD/PAD product lines.
- Respondents reported only 65 instances (out of a possible 352) of being able to initiate production of CAD/PAD product lines, with 52 percent of those mentions able to begin manufacturing within one year.
- Respondents reported 33 instances of being able to reconstitute previously ceased manufacturing, with 82 percent of those instances able to begin manufacturing within one year.
- Nine of 22 respondents do not maintain inventories of materials and components used in CAD/PAD manufacturing and/or inventories of finished CAD/PAD products. Another eight respondents do maintain inventories of components and manufacturing materials

but for commercial customers only, as opportunities periodically arise for increased non-defense orders.

- Seventeen of the 18 respondents with an order backlog reported it to be one year or less; one respondent reported a backlog of three years.
- The average capacity utilization rate reported over the 2007-2011 period was 41.8 percent. The average capacity utilization rate for dependent respondents over the same period was 56.9 percent.

Chapter 3 – Sales and Exports:

- U.S. CAD/PAD industry sales averaged $284.2 million per year over the 2007-2011 period. This was higher than the average annual sales reported for the 1995-1999 period ($191.4 million) and the 2001-2005 period ($222.8 million).
- Overall sales grew by 23.7 percent over the 2007-2011 reporting period, while defense sales grew by 13.7 percent.
- Five-year cumulative sales growth over the 2007-2011 period (23.7 percent) was similar to that of the 2001-2005 period (19.5 percent) but below that of the 1995-1999 period (32.8 percent).
- CAD/PAD sales comprised an average 35.9 percent of net sales for surveyed respondents, but the calculated median was 14.4 percent. Ten respondents reported CAD/PAD sales as less than 20 percent of net sales, while seven reported CAD/PAD sales as more than 80 percent of net sales.
- The eight respondents categorized as dependent on CAD/PAD sales accounted for 79.1 percent of sales over the 2007-2011 period ($225.2 million annually), and experienced five-year sales growth of 34.5 percent.
- Impulse Cartridges and Gas Generators were the product lines with the largest share of CAD/PAD sales over the 2007-2011 period, comprising 16.3 percent and 13 percent of reported sales, respectively.
- Impulse Initiators had the largest increase in sales from 2007-2011 (136.4 percent), while Automatic Inflators experienced the largest decrease in sales (-77.2 percent).

- Only three product lines have non-defense sales that are more than 30 percent of the total product line sales: Impulse Cartridges (including Electrically-Initiated Impulse Cartridges), Delay Cartridges and Initiators, and Gas Generators.
- Defense sector sales grew 13.7 percent over the five-year period, while non-defense sector sales grew 68.8 percent.
- The defense sector's share of reported CAD/PAD sales was 75.2 percent in 2011.
- Respondents categorized as dependent on CAD/PAD sales accounted for 82.2 percent of defense sector CAD/PAD sales over the five-year period. Impulse Initiators experienced the largest percent increase in defense sector sales, rising 131.3 percent over the five-year period. Automatic Inflators experienced the largest percentage decline in defense sector sales, falling 78.1 percent over the same period.
- For non-defense sector sales, Impulse Cartridges experienced the largest percent increase from 2007-2011 (244.6 percent) while Gas Generators experienced the largest percent decrease (-63 percent).
- Eight of 12 respondents projected their defense sector sales would decline over the 2012-2016 period.
- Total CAD/PAD exports grew 69.8 percent from 2007 to 2011, and averaged 10.1 percent of total sales (the sum of U.S. sales and exports).
- Respondents categorized as dependent on CAD/PAD sales accounted for 93.4 percent of the five-year period's cumulative export total and 97.6 percent of defense sector exports.
- The top three reported destinations of CAD/PAD exports were the United Kingdom, Germany, and Japan.
- Eight respondents indicated that their CAD/PAD exports have been impacted by delays in FMS shipping and payment.
- Five respondents ship 76 percent or more of their CAD/PAD-related exports through the Defense Transportation System (DTS), while three ship 76 percent or more through freight forwarders. Eleven companies use both DTS and freight forwarders to ship their CAD/PAD-related exports.

Chapter 4 – Financials:

- The total CAD/PAD-level revenue of all respondents totaled $763.1 million in 2011, a 33 percent increase from $573.5 million in 2007.
- Average net income at the CAD/PAD-level rose 50 percent over the 2007-2011 reporting period, but median net income was stagnant.
- Four respondents at the CAD/PAD-level increased their net income every year, and in any given year roughly half of the respondents reported a lower net income than the previous year.
- Eleven respondents at the CAD/PAD-level reported improvements in net income in 2011 relative to 2007, while seven reported lower net income by 2011. Of those 18 respondents, five reported a net loss.
- CAD/PAD operating margins (profit excluding interest expenses, taxes, and any non-operating costs or profits) improved incrementally over the period from 8.4 percent in 2007 to 13.4 percent in 2011.
- CAD/PAD-level average profit margins were consistent with a solid and slowly improving level of profitability. Averages of the gross profit, operating profit, and net profit margins ended the period higher than in 2007, and near the top of their five-year ranges.
- Median CAD/PAD-level return on assets increased from 4 percent in 2007 to six percent in 2011.
- Six respondents at the CAD/PAD-level had current ratios below 1.0 at some point from 2007-2011, which indicates that a company's current liabilities exceed their current assets, a potentially financially vulnerable position. Eight respondents had a quick ratio below 1.0 at some point over the same period. A quick ratio below 1.0 indicates a company cannot meet its obligations in such a situation, and is generally used as a liquidity benchmark. Over the entire reporting period, 10 respondents indicated that their current and quick ratios were lower in 2011 than in 2007, while seven reported increases.
- Overall, both mean and median debt ratios at the CAD/PAD-level were below 0.5 between 2007 and 2011. A debt ratio of 0.5 indicates a company has twice as many assets as debts, and ratios below that level are considered to be adequate.

- All eight respondents categorized as dependent on CAD/PAD sales who reported net income had higher levels of net income in 2011 than in 2007; however, the median revenue of five dependent respondents fell nearly four percent across the period.
- Five of eight dependent respondents reported improvements in gross profit, operating profit, and net profit margins over the five-year period, as well as in returns on assets and returns on equity.
- Almost all CAD/PAD-level respondents were in relatively sound financial condition, surpassing the basic thresholds used by BIS in all (or all but one) category–net income, profit margins, quick ratio, and debt ratio–in 2011.
- Three respondents were in a potentially precarious financial situation in 2011, falling below the BIS thresholds in three or four of the basic financial measures.
- There was a slightly higher level of acquisition activity during 2007-2011 than in the 2006 BIS CAD/PAD report.
- Total corporate capital expenditures for 20 of the 22 survey respondents amounted to $142.4 million over the five-year period, though three respondents accounted for more than half the total. Machinery, equipment, and vehicles accounted for the largest portion of capital expenditures.
- Total capital expenditures for CAD/PAD business lines totaled $66.7 million, or just less than 47 percent of the total.
- The top two reasons for capital expenditures were to Improve Productivity and Replace Equipment, with 15 respondents identifying both in their top five reasons for investment.
- Respondents categorized as dependent on CAD/PAD sales were most focused on capital expenditures intended to Expand Capacity.

Chapter 5 – Research and Development (R&D):

- Total annual R&D expenditures by 17 of 22 respondents grew from $27 million in 2007 to $53.8 million in 2011, for a five-year cumulative total of $257.5 million.
- Five of the eight respondents categorized as dependent on CAD/PAD sales reported R&D expenditures, 22.5 percent of all R&D expenditures.

- Defense-related R&D expenditures accounted for 73.8 percent ($190.1 million) of all reported R&D expenditures and grew 138.8 percent over the 2007-2011 period.
- Dependent respondents' share of defense-related R&D expenditures decreased from 37.6 percent in 2007 to 20 percent in 2011.
- Five respondents conducted basic research, seven conducted applied research, and 12 conducted product/process development-related R&D. All five respondents that conducted basic research also conducted both applied research and product/process development work.
- Eighty-seven percent of R&D expenditures reported by dependent respondents over the 2007-2011 period were utilized for product/process development, followed by 11.4 percent for applied research and 1.6 percent for basic research.
- The vast majority of funding for R&D expenditures (99.8 percent) was internal.
- Nine respondents reported CAD/PAD-related R&D expenditures of $71.1 million from 2007-2011, comprising 27.6 percent of all reported R&D expenditures.
- Respondents categorized as dependent on CAD/PAD sales reported 79.7 percent of all CAD/PAD-related R&D expenditures over the five-year period.
- Of the total CAD/PAD-related R&D expenditures, 64.2 percent were defense-related and 35.8 percent were non-defense related.
- CAD/PAD-related R&D expenditures reported for 2007-2011 were less than those reported for 2001-2005, but were higher than during the 1995-1999 period.
- Overall, CAD/PAD-related R&D expenditures as a percentage of CAD/PAD sales averaged 4.5 percent over the five-year period, a decrease from an average 11.7 percent over the 2001-2005 period but higher than an average 3.3 percent for 1995-1999.
- For dependent respondents, CAD/PAD-related R&D expenditures as a percentage of CAD/PAD sales averaged 4.4 percent.
- CAD/PAD-related R&D expenditures per employee in U.S. CAD/PAD operations averaged $7,508 over the 2007-2011 period. This was nearly 50 percent lower than 2001-2005 ($14,416) but more than double the 1995-1999 average of $2,842.

Chapter 6 – Employment:

- Total employment for 21 respondents' U.S. CAD/PAD operations grew 20.3 percent over the 2007-2011 period, from 1,754 full time employees in 2007 to 2,110 in 2011.
- The sector reported stronger employment growth over the 2007-2011 period than over both the 1995-1999 (five-year growth of 13.3 percent) and 2001-2005 (five-year growth of 11.3 percent) periods, and total employment surpassed 2,000 for the first time since 1999.
- Respondents categorized as dependent on CAD/PAD sales experienced a decline in total CAD/PAD-related employment from 1,093 in 2007 to 1,048 in 2011, a 4.1 percent decrease.
- Over the five-year period, 81.8 percent of non-dependent respondents reported CAD/PAD-related employment growth as compared to 28.6 percent of dependent respondents.
- Productivity per employee over the five-year period averaged $222,790 annually. This was an increase from an average of $87,000 in 1995-1999 and $129,500 in 2001-2005.
- Nearly 42 percent of the reported employees held Manufacturing/Production Line occupations. This is lower than the proportion reported for 2001-2005 (58.5 percent) and 1995-1999 (53.7 percent).
- Of the 13 employment occupations, strong employment growth was reported in five over the 2007-2011 period. Marketing and Sales had the strongest employment growth, 91.4 percent over the five-year period.
- Three occupations reported employment growth below the industry total. The Finance and Accounting occupations reported the lowest five-year employment growth rate of 1.5 percent.
- Respondents categorized as dependent on CAD/PAD sales reported an average 55.5 percent of total employment over the 2007-2011 period.
- The proportion of positions held by Manufacturing/Production Workers declined from an average 55.7 percent over the 1995-1999 period and an average 58.5 percent over the 2001-2005 period to an average 41.7 percent over the 2007-2011 period.

- The productivity of Manufacturing/Production Line Workers increased from an average $156,260 per worker over the 1995-1999 period and $220,280 per worker over the 2001-2005 period to $525,320 per worker over the 2007-2011 period.
- While Manufacturing/Production Line Workers and Design Engineers comprised more than 55 percent of the CAD/PAD workforce by professional occupation, Design Engineers were reported as the most difficult to hire and Manufacturing/Production Line Workers were the most difficult to retain.
- Respondents reported 483 employees in technical occupations in 2011. The largest share of those workers were in Design occupations (34 percent), followed by Mechanical occupations (20.7 percent).
- Respondents categorized as dependent on CAD/PAD sales employed in 251 staff in technical occupations in 2011, or 52 percent of the 483 reported.
- The average experience level, as calculated by BIS, for the 483 reported CAD/PAD technical employees was 13.8 years. The Design occupation had the lowest average experience level of 11.5 years, while the Chemical occupation has the highest at 17.6 years.
- The vast majority of employees (97 percent) in Design technical occupations had 20 or fewer years of experience, and nearly half had less than 10 years of experience.
- Respondents reported 223 employees in R&D positions in 2011; more than 99 percent were U.S. citizens and 91.9 percent focused on development (engineers) as opposed to research (scientists). R&D staff comprised 11.8 percent of CAD/PAD employment.
- Dependent respondents reported 60 employees in R&D positions (26.9 percent of all R&D staff); 81.7 percent were focused on development.
- Overall, 35.9 percent of all R&D staff was between 41 and 50 years old.
- Of the 223 reported R&D staff in 2011, 64.6 percent held a Bachelor's degree, 31.4 percent held a Master's degree, and four percent held a doctorate.
- The most frequently identified skills/competencies critical to the long-term competitiveness of U.S. CAD/PAD operations were related to energetics, explosive, and ordnance and government contracting and compliance skills. Respondents indicated it could take anywhere from four months to two years to successfully train new staff in critical skills and competencies.

- Ten respondents reported that commercial/non-defense work would not allow them to maintain their critical skills and competencies should defense-related work decrease.
- Four respondents sponsor or participate in government and university recruitment programs.
- Eleven respondents said they provided training through unofficial on-the-job programs, five had official programs, and one utilized a mix of both official and unofficial programs.

Chapter 7 – Competitive Assessment:

- Nearly equal numbers of respondents indicated they expect their competitive prospects to improve (36 percent) or decline (37 percent) from 2013-2017.
- Approximately 70 percent of respondents categorized as dependent on CAD/PAD sales anticipated their competitiveness would remain the same or improve over the next five years, while 64 percent of non-dependent respondents anticipated the same.
- The current projected decline in their future competitiveness (36 percent) is higher than the 23 percent of respondents in the 2000 BIS CAD/PAD report and 18 percent of respondents in the 2006 BIS CAD/PAD report providing the same outlook.
- Government Budget Volatility and Government Regulatory Burdens were the top two factors cited by respondents as affecting their long-term viability.
- Seventy-three percent of respondents were either not impacted by or unsure of the impacts of recent consolidations within the industry. An additional 18 percent reported negative impacts and nine percent reported positive impacts. This outlook was more positive than that reported by respondents over the 2001-2005 period.
- Regarding changes in management and/or operations at the Army Ammunition Plant in Radford, Virginia, 23 percent of respondents suggested these changes would disrupt their access to propellants and other materials.
- The largest number of respondents reported no significant change in competitiveness compared to their non-U.S. counterparts over the past five years (nine) and do not anticipate a change over the next five years (eight). This is similar to the assessment of international competitiveness provided by respondents in the 2006 BIS CAD/PAD report.

- Seven respondents suggested that USG operations have expanded into areas previously left to industry, particularly specification development and testing.
- Nearly all respondents (21) indicated taking at least one action to improve their competitiveness over the past five years, while 18 have plans to make improvements over the next five years. Capacity and Property Investment was the most frequently cited improvement.

Chapter 8 – Suppliers:

- Respondents mentioned 100 U.S. and non-U.S. suppliers, 85 of which were unique.
- The identified suppliers were reported to provide 120 products in 15 product groupings. The largest numbers of unique suppliers reported by respondents were in the General Materials and Energetic Materials product groupings.
- Of the 100 supplier mentions, the majority (38 percent) were identified as single source, though the status of nearly as many suppliers (34 percent) was unknown by respondents.
- More than 50 percent of the suppliers for Energetic Materials, Casing/Housings, Gas Generators, and Explosive Components were identified as single sources.
- The majority of suppliers identified (92 percent) were U.S. companies, some with non-U.S. entities.
- Only three CAD/PAD product groupings were imported, with the largest number of non-U.S. suppliers (33 percent) providing Energetic Materials.
- Fourteen respondents indicated they had experienced at least one supply chain issue from 2007-2011. Those respondents reported 37 such incidents.
- The largest number of supply chain disruption incidents was related to energetic materials, such as Explosive Components, Ingredients, and Materials and Legacy Propellants.
- Some respondents have substituted energetic materials from non-U.S. sources when faced with no U.S. supplier, though sometimes these substitutes do not meet the necessary military or weapons specifications. Other respondents have begun to manufacture the materials they need when no U.S. source exists.

- Five of the respondents categorized as dependent on CAD/PAD sales reported 57 percent (21) of supply chain disruption incidents.
- Seventeen respondents indicated they had been impacted by at least one additional factor outside of supply chain disruption issues, reporting 56 incidents.
- The largest numbers of incidents associated with additional factors were related to Department of Transportation Regulations, International Traffic in Arms (ITAR) Regulations, and Neutron Radiation (N-ray) Testing.
- Dependent respondents reported 41 percent (23) of incidents caused by additional factors outside of supply chain disruption issues.

Chapter 9 – Government-Related Factors Affecting the CAD/PAD Industry:

- Department of Transportation shipping classifications remain a concern for many of the survey respondents. Those respondents stated the requirements increase costs and lead times.
- Many respondents expressed frustration with the current export controls governing CAD/PAD items, saying the controls make it harder to compete internationally.
- Some respondents indicated concern about the competitive procurement process, voicing a preference for the USG to consider "best value" over "lowest cost," to relax cost disclosure rules, and stop negotiations of competitive bids.
- Some companies expressed concern about foreign government subsidies and their impact on fair competition.
- Several respondents stated the USG should not be conducting Lot Acceptance Testing, and instead should allow industry to better support testing requirements.
- Eight respondents reported that they have found second-sourcing of production to be beneficial, while three said it was detrimental to their business.
- When asked for recommendations to improve the second-sourcing process, 11 respondents offered suggestions related to reducing the length and cost of the qualification process being run by the CAD/PAD Joint Program Office (JPO) and improving communication with industry.

- Four respondents indicated they would prefer the USG to use performance specifications instead of Build-to-Print Technical Data Packages (TDP).
- Multiple respondents stated that environmental and safety regulations should be standard throughout the industry and the country, instead of differing by state.
- Seven respondents indicated that their CAD/PAD business would be affected by the declining U.S. military presence in Iraq and Afghanistan, while 17 were concerned about proposed or potential defense and/or USG budget cuts.

10.2 Report Recommendations

- **Conduct the Next CAD/PAD Report "For Official Use Only."** The number of surveyed companies has dropped more than a third from the 1995 BIS CAD/PAD report. With fewer and fewer companies, it is more difficult to provide a detailed analysis of the health and competitiveness of the CAD/PAD industry as significant portions of the data cannot be publicly released without disclosing business-confidential information. A USG-only report would allow for better data analysis and will result in a more detailed report for the JPO. A summary report can be prepared for industry distribution.

- **Maintain Indian Head's Status as "Producer of Last Resort."** A high percentage of survey respondents manufacture only one CAD/PAD product, and many stated they were unable to initiate new or reconstitute prior production. Because of this, the closure of one company could have a significant effect on not only on the availability of needed CAD/PAD products, but also on necessary CAD/PAD manufacturing capabilities, workforce, and the related industrial supply chain. JPO/Indian Head must continue its status as "producer of last resort" in the event of a sudden production loss or company shutdown.

- **Monitor the Impact of DOD Budget and Policy Changes.** The defense sector accounted for 75.3 percent of reported CAD/PAD sales in 2011, making the CAD/PAD industry highly reliant on defense-related business. Almost all CAD/PAD producers are in stable financial condition, however a few are not. Survey respondents expressed concern about the impact of the declining U.S. military presence in Iraq and Afghanistan and potential defense and/or USG budget cuts. A decline in defense-sector CAD/PAD sales could have a significant financial impact on a number of companies and lead to further contraction of the industry.

- **Mandate Second-Sourcing of F-35 Joint Strike Fighter (JSF) and T-6 Joint Primary Aircraft Training System (JPATS) Related CAD/PADs.** Despite delays in fielding the JSF, it will become the primary aircraft for the U.S. Air Force, Navy, and Marines, as well as numerous international partner nations over the next decade. U.S. second-sourcing of JSF ejection seat-related CAD/PADs was recommended in the 2006 BIS CAD/PAD report, but never implemented by the JPO due to aircraft delays. In addition, the 2006 BIS CAD/PAD reports also recommended that the JPO second-source the JPATS CAD/PADs to protect the viability of the U.S. domestic industry. Those same recommendations are even more relevant today with the projected decline in U.S. defense budgets.

  The inability of U.S. CAD/PAD companies to second-source JSF and JPATS-related CAD/PADs, combined with the continued retirement of U.S. Air Force aircraft (F-15, F-16), will force a further reduction in the number of U.S.-based CAD/PAD manufacturers, workforce, and related supply chain. This scenario will increase overall CAD/PAD program risk for the JPO and the services utilizing the JSF and JPATS. JPO should allocate funds to license production of CAD/PADs that are currently sole-sourced from a non-U.S. supplier. In addition, funds should be made available to potential U.S. second-sources to assist them with the necessary testing and qualification requirements to become a second-source.

- **The JPO Should Clearly Communicate the Second-Sourcing Process and The Product Improvement Program to Industry.** Both processes should be clearly defined by the JPO and disseminated to all members of the industry. The JPO should also relay information to industry regarding current and future second-sourcing opportunities. The second-sourcing process and the Product Improvement Program should both be topics at the next series of Technical Exchange Workshops.

- **Work With Foreign Military Sales (FMS) Program Offices to Address Industry Concerns.** Respondents reported delays in FMS shipments combined with confusing and late shipping instructions from FMS managers. This has increased costs for exporters as well as deterred some companies from participating in the FMS program and exporting altogether. JPO should work directly with FMS program offices to address shipment, payment, and transportation problems that have created obstacles. Exports have the ability to make up some of the lost industry sales caused by DOD budget cutbacks.

- **Encourage Participation in USG and University Recruitment Programs.** The professional occupation held by the largest share of employees, Manufacturing and Production Line Workers, declined steadily from 2007 to 2011, and was below levels reported in the 1995 and 2001 BIS CAD/PAD reports. Approximately 36 percent of reported R&D staff was between 41-50 years old, indicating a large portion will retire in the near future. USG and university recruitment programs such as career and internship fairs and military outplacement efforts could help address future employment gaps and fill positions that are difficult to hire, such as Design Engineers.

- **Work with the Department of Energy (DOE) and the Nuclear Regulatory Commission (NRC) to Expand the Number of Neutron Radiation (N-ray) Testing Facilities.** N-ray testing, a type of non-destructive testing that allows the imaging of organic materials inside a component is required of many CAD/PAD suppliers for certain categories of explosives. There are few facilities overall in the U.S. that can safely handle CAD/PAD explosive materials which has made N-ray testing very expensive. This is further compounded by U.S. regulations requiring N-ray testing providers to be U.S.-owned and operated. JPO needs to work with DOE and NRC to identify potential sites for N-ray testing.

- **Work With the Department of Transportation (DOT) to Meet Security and Safety Requirements While Lessening the Burden on Industry.** DOT's shipping classifications, Competent Authority, and testing requirements have been an issue for the CAD/PAD industry since the 1995 BIS CAD/PAD report. JPO has worked with DOT in the past to remedy the issue of authorized classification and testing. However, survey respondents are now raising concerns about stricter DOT regulations. Respondents provided comments on the increasing costs and lengthy delays caused by DOT's recently revised regulations. JPO needs to work directly with DOT to identify opportunities to streamline DOT's regulations and address industry's concerns.

- **Continue Movement Toward Performance Specifications Instead of Build-to-Print.** As in the 2001 and 2006 BIS CAD/PAD assessments, survey respondents indicated problems with Build-to-Print requirements. Permitting companies to use performance specifications would allow for more innovation and potentially more cost savings. In cases where Build-to-Print is still maintained, steps should be taken by the JPO to improve the quality and accuracy of those specifications.

- **Offer Assistance to Industry on Complying With Many USG Regulations.** Survey respondents reported experiencing problems with USG export controls, second sourcing requirements, and environmental and safety regulations. Several commented on confusion in understanding these types of regulations and how to comply with them. Information sharing, through the use of briefings by the State Department, the Environmental Protection Agency, and other USG agencies responsible for these regulations, could reduce industry frustration and alert JPO to issues related to the regulations.

Appendices

Appendix A:

Letter Requesting Survey and Assessment

DEPARTMENT OF THE NAVY
INDIAN HEAD DIVISION
NAVAL SURFACE WARFARE CENTER
3767 STRAUSS AVENUE
SUITE 201
INDIAN HEAD, MD 20640-5150

4 Aug 2010

The Honorable Kevin Wolf
Assistant Secretary for Export Administration Bureau of
Industry and Security U.S. Department of Commerce
1401 Constitution Ave., NW, Room 3886C
Washington, DC 20230

Dear Assistant Secretary Wolf,

I am writing to request the support of the Bureau of Industry and Security (BIS), Office of Technology Evaluation in the initiation of an industrial base survey and assessment of the U.S. Cartridge Actuated Device/Propellant Actuated Device (CAD/PAD) industry. The purpose of this assessment would be to analyze the health and competitiveness of the CAD/PAD industry and to develop recommendations to ensure the ability of the industry to support defense missions and programs.

This is the fourth request for a CAD/PAD assessment by the CAD/PAD Joint Program Office (JPO). Previous assessments were successfully completed by BIS for the JPO in 1995, 2000 and 2006. These assessments have been an effective analytic tool, assisting the joint Navy/Air Force team manage the complexities and ever-changing nature of the CAD/PAD program while meeting the critical needs of the war-fighter.

For the purposes of conducting this assessment, the JPO is prepared to enter into a project Memorandum of Understanding with BIS. In addition, JPO will also provide the necessary funding and technical support needed to develop the requested industry survey and final assessment.

If you have any questions regarding this request, please contact Lt Col Jurgen Smith, Deputy Director CAD/PAD JPO at 301-744-6636 or Jurgen.Smith@navy.mil. Our mailing address is CAD/PAD Joint Program Office IHDIV, 3817 Strauss Ave Ste 230, Indian Head, MD 20640-5151.

We look forward to working with BIS once again on this important project.

Sincerely,

Paul J. McCafferty
CAD/PAD Joint Program Office
By direction of the Commanding Officer

Copy to:
Mr. Brad Botwin

Appendix B:

Letter Accepting Survey and Assessment

UNITED STATES DEPARTMENT OF COMMERCE
Assistant Secretary for Export Administration
Washington, D.C. 20230

OCT 0 4 2010

Mr. Paul J. McCafferty
Department of the Navy
CAD/PAD Joint Program Office
Indian Head Division
3817 Strauss Avenue, Suite 230
Indian Head, MD 20640

Dear Mr. McCafferty,

Thank you for your August 4, 2010 letter requesting Bureau of Industry and Security (BIS) support to conduct a renewed survey and assessment of the U.S. Cartridge Actuated Device/Propellant Actuated Device (CAD/PAD) industry. After previous successful assessments with the CAD/PAD Joint Program Office (JPO), BIS is eager to assist in this project.

Brad Botwin, Industrial Base Studies Director in BIS's Office of Technology Evaluation (OTE) (202-482-4060, Bbotwin@bis.doc.gov), will be my point of contact for this effort. OTE is responsible for conducting industry-wide surveys and assessments under the authority of the Defense Production Act of 1950, as amended, and related executive orders. Mr. Botwin will work with your staff in establishing a memorandum of understanding between our organizations, detailing survey objectives and milestones for this project.

BIS appreciates this opportunity to work again with the Department of Navy, Indian Head Division on an issue that has a broad impact on defense missions and programs.

Sincerely,

Kevin J. Wolf

Appendix C:

Survey Instrument

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OMB Control Number: 0694-0119
Expiration Date: September 30, 2012

NATIONAL SECURITY ASSESSMENT:
U.S. CARTRIDGE AND PROPELLANT ACTUATED DEVICE INDUSTRY
4th Report

SCOPE OF ASSESSMENT

The U.S. Department of Commerce, Bureau of Industry and Security (BIS), Office of Technology Evaluation (OTE), in coordination with the U.S. Department of the Navy, CAD/PAD Joint Program Office, Naval Surface Warfare Center, Indian Head Division, is conducting a national security assessment of the U.S. cartridge and propellant actuated device (CAD/PAD) industry and supply chain. The principal goal of this data collection is to update industry and government officials on the underlying health and competitiveness of this defense critical industry, and to ensure the ability of the industry to support 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 12 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information to BIS Information Collection Officer, Room 6883, Bureau of Industry and Security, U.S. Department of Commerce, Washington, D.C. 20230, and to the Office of Management and Budget, Paperwork Reduction Project (OMB Control No. 0694-0119), Washington, D.C. 20503.

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Section I	WHO MUST RESPOND TO THIS SURVEY	
A.	Has your company manufactured, integrated and/or assembled Cartridge and/or Propellant Actuated Devices for defense end-uses in the United States between 2005-2012?	
B.	Has your company manufactured, integrated, and/or assembled Cartridge and/or Propellant Actuated Devices for non-defense/commercial end-uses in the United States between 2005-2012? (For the purposes of this survey, include CAD/PAD applications by NASA and all other non-defense USG agencies as "non-defense/commercial" end-uses.)	

EXEMPTION FROM SURVEY

If you selected "No" to both the statements above, your company may be exempt from completing this U.S. Department of Commerce survey. If you think your company may be exempt, call the contacts listed in the General Instructions section of this survey.

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19	Effectiveness of Previous Assessments
20	Certification

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Section III	GENERAL INSTRUCTIONS
A.	Your company is required to complete this survey using the Excel-based survey template, which can be downloaded from the U.S. Department of Commerce, Bureau of Industry and Security (BIS) website at www.bis.doc.gov/cadpad_survey. For your convenience, a PDF version of the survey is available on the BIS website to aid internal data collection. **DO NOT use the PDF to submit your company's response to BIS.**
B.	If information is not available from your records in the form requested, you may furnish estimates.
C.	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 disrupt the data collection process. 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.
D.	Important: This survey may not be submitted in paper form. Submit the completed survey document in Microsoft Excel format to CADPADsurvey@bis.doc.gov
E.	Questions regarding this survey should be directed to: CADPADsurvey@bis.doc.gov or Anna Bruse, Trade and Industry Analyst, U.S. Department of Commerce, (202) 482-7418 Erika Maynard, Trade and Industry Analyst, U.S. Department of Commerce, (202) 482-5572 Andrea Chamarro, Trade and Industry Analyst, U.S. Department of Commerce, (202) 482-7980
F.	For questions regarding the overall assessment or the Office of Technology Evaluation (OTE), please contact: Brad Botwin, Director, Industrial Studies Office of Technology Evaluation, Room 1093 U.S. Department of Commerce 1401 Constitution Avenue, NW Washington, DC 20230 Phone: (202) 482-4060 Please do not submit completed surveys to this postal address; all surveys must be submitted electronically.

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Section IV	DEFINITIONS
Cartridge	An energy source utilizing one or more energetic materials such as pyrotechnic, propellant or explosive ingredients.
Cartridge Actuated Device (CAD)	A device releasing energy to perform a controlled system or work function.
Capacity Utilization	The extent to which an enterprise uses its total annual installed manufacturing capacity. Capacity utilization can also be calculated as the fraction of a facility'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.
Cost Premium	For the purposes of the survey, the percentage value above or below the base cost of the part/component.
Defense Shipments	Direct and indirect military shipments, including domestic and international shipments for military use. These include: 1) weapon systems, support equipment, and all other defense related end-use devices, identified by purchase orders bearing a DO or DX rating and/or a contract number from the Department of Defense, Nuclear Regulatory Commission, Central Intelligence Agency, or National Security Agency; 2) the orders of your customers which you can identify as producing products for defense purposes; 3) devices tested and certified to military specifications.
Defense Transportation System (DTS)	Includes any transportation services provided by the Department of Defense using USG-owned or controlled resources or DoD-contracted carriers.
Export Adminstration Regulations (EAR)	Regulations administered by the Bureau of Industry and Security (BIS) that provide specific instructions on the use and types of export licenses required for certain commodities, software, and technology.
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.
Manufacturing Materials (Raw Materials)	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 as a residue or impurity not by design or intent of the manufacturer.
Non-Defense	Commercial organizations and non-defense/civil U.S. Government agencies, such as NASA, NOAA, and the EPA.
Obsolescence	A lack of availability of an item or raw material resulting from statutory and process changes, as well as new designs. Obsolescence refers to the process or condition by which a piece of equipment becomes no longer useful, or a form and function no longer current or available for production or repair.
Offset and Defense Trade	Industrial or commercial compensation practices required by foreign governments as a condition of purchase of military imports. Common types of offsets include licensed production of the defense item (or parts thereof) in the purchasing country, technology transfer, foreign investment, and countertrade.
Order Backlog	Unfinished work or work for which you already have a contract in your facility's order book.
Propellant Actuated Device (PAD)	A rocket powered device releasing controlled propellant energy to perform a work function. This device provides propulsion for acceleration/deceleration, stabilization, divergence or deployment.
Research and Development (R&D)	Includes basic and applied research and product development in the sciences and in engineering, and design and development of prototype products and processes. For the purposes of this questionnaire, research and development included activities carried on by persons trained, either formally or by experience, in the physical sciences including related engineering, if the purpose of the activity is to do one or more of the following things: 1) Pursue a planned search for new knowledge, whether or not the search has reference to a specific application. 2) Apply existing knowledge to problems involved into the creation of a new product or process, including work required to evaluate possible uses. 3) Apply existing knowledge to problems involved in the improvement of a product or process.
Second-sourcing	Acquisition or procurement strategy where two producers or suppliers are qualified to supply the same item.
Shipments	Domestically produced products shipped by your firm during the reporting period. Such shipments should include inter-plant transfers, but should exclude shipments of products produced by other manufacturers for resale under your brand name. Do not adjust for returned shipments. (See definition of Defense Shipments above.)
Single Source	A company or facility 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 company or facility that is the only source for the supply of parts, components, materials, or services. No alternative domestic or foreign suppliers exist other than the current supplier.
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.

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Section V		PRODUCT CODES
1.	Aircrew Escape Propulsion System	A rocket powered device employed in aircrew escape systems to perform such functions as propulsion, acceleration, deceleration, ejection seat divergence, man-seat separation, parachute deployment, stabilization, etc., including rocket catapults and underseat rocket motors.
2.	Impulse Cartridges	A cartridge-type item employing propellant or explosive materials to release energy. This category includes fire extinguisher cartridges, ignition elements, squibs, detonators and blasting caps, but excludes cartridges that incoporate pyrotechnic delay material(s) to affect the timing of the output charge initiaion, see product code #4. Also exclude aircraft stores release cartridges and aircraft cartridges and aircraft countermeasure cartridges such as chaff and flare ejection cartridges and sonobouy ejection cartridges (see Product Code #5).
2.A	Electrically Initiated Cartridges	Devices using electrical energy to intiate the energetic material.
2.B	Percussion Initiated Charges	Devices using percussion primers to initiate the energetic material.
3.	Initiators (Impulse)	Devices employing energetic materials such as propellants or explosives to: generate the initial or sustaining pressure within a ballistic gas system or to initiate a signal transmission line such as shielded mild detonating cords, thin layered explosive transmission lines, etc. Exclude cartridge type devices which are employed in igniters or other explosive devices to ignite propellants or explosives, as well as, initiators which affect the timing of the output charge initiation by use of pyrotechnic delay material(s) (see #4, below).
4.	Delay Cartridges and Delay Initiators	Devices similar to the above #2A, #2B AND #3, that incorporates pyrotechnic delay material(s) to effect timing of the output charge initiation. This category includes electric and percussion primed delay cartridges and delay initiators.
5.	Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges	Cartridges and ignition elements, employing energetic materials such as propellants and explosives, used to eject bombs, sonobuoys, missiles, etc., from combat aircraft. This category includes cartridges to launch or eject aircraft flares or chaff for anti-aircraft missile countermeasures, but not the flares themselves.
6.	Detonating Cords and Charges	This category includes the following devices: shielded mild detonating cord, mild detonating cord, linear shape charge, flexible linear shape charge, mild detonating fuse, and thin layered explosive lines. Also included in this group are transfer assemblies and other assemblies that employ these type of cords or lines, (for example, window severance assemblies). Exclude bulk explosives.
7.	Cutters	Devices which employ energetic materials and a cutting blade to sever a bolt, wire, cable suspension line, etc.
8.	Catapults, Thrusters, and Removers	Devices using energetic materials and employing captured or ejected telescoping-type tubes to perform functions such as separation, ejection, thrusting, movement, etc.
9.	Automatic Inflators	Automatic Inflators
10.	Gas Generators	Gas Generators
11.	Automotive Airbag Initiators	Automotive Airbag Initiators
12.	Laser Initiated Cartridges, Detonators, and Initiators	Laser Initiated Cartridges, Detonators, and Initiators
13.	Rocket Motor Igniters	Rocket Motor Igniters
14.	Other	This category includes all other cartridges, cartridge actuated devices, and other pyrotechnic devices of similar design and used in a similar manner.

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Section 1.a **COMPANY INFORMATION**

A.	Company Name	
	Business Unit Responding to Survey (if applicable)	
	Respondent Street Address	
	Respondent City	
	Respondent State	
	Respondent Zip Code	
	Respondent Phone Number	
	Respondent Fax Number	
	Respondent Website	

B. Point of Contact(s) regarding this survey:

Name	Title	E-Mail	Phone Number

C.

My company is headquartered in:				
My company is:				
Parent Company Name, if applicable	Address	City	State/Province	Country
My company is Publicly traded/Privately held:				
My parent company is Publicly traded/Privately held:				

D.	Indicate what year your company or business unit was acquired by the parent company, if applicable.	

Comments:	

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Section 1.b **COMPANY INFORMATION (cont.)**

A.	Estimate the percent of your parent company/company's sales that are CAD/PAD-related?	
B.	Estimate the percent of your business unit/division sales operations that are CAD/PAD-related, if applicable?	
C.	Does your company or business unit/division participate in additional lines of business? If "Yes", indicate the business lines below and provide a short description of each.	

	Business Line(s)	Description of Business Line(s)
1.		
2.		
3.		

Comments:	

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Section 2 **FACILITIES**

A. Identify the location of each of your CAD/PAD manufacturing, integration, and/or assembly facilities currently operating **IN** the United States.

ID #	Facility Name	Street Address	City	State	Zip Code
US - 1					
US - 2					
US - 3					
US - 4					
US - 5					
US - 6					
US - 7					
US - 8					
US - 9					
US - 10					

B. Identify the location of each of your CAD/PAD manufacturing, integration, and/or assembly facilities currently operating **OUTSIDE** the United States.

ID #	Facility Name	Street Address	City	Country
Non-US - 1				
Non-US - 2				
Non-US - 3				
Non-US - 4				
Non-US - 5				
Non-US - 6				
Non-US - 7				
Non-US - 8				
Non-US - 9				
Non-US - 10				

Comments:	

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Section 3 **CLOSED/SOLD FACILITIES**

A. Identify the location of each of your CAD/PAD-related manufacturing, integration, and/or assembly facilities **IN** the United States that have been closed or sold since January 1, 2006. Provide the reason for the closure or sale.

ID #	Facility Name	City	State	Zip Code	Year of Closure/Sale	Reason for Closure/Sale
Closed/Sold US - 1						
Closed/Sold US - 2						
Closed/Sold US - 3						
Closed/Sold US - 4						
Closed/Sold US - 5						
Closed/Sold US - 6						
Closed/Sold US - 7						
Closed/Sold US - 8						
Closed/Sold US - 9						
Closed/Sold US - 10						

B. Identify the location of each of your CAD/PAD-related manufacturing, integration, and/or assembly facilities **OUTSIDE** the United States that have been closed or sold since January 1, 2006. Provide the reason for the closure or sale.

ID #	Facility Name	City	State/Province	Country	Year of Closure/Sale	Reason for Closure/Sale
Closed/Sold Non-US - 1						
Closed/Sold Non-US - 2						
Closed/Sold Non-US - 3						
Closed/Sold Non-US - 4						
Closed/Sold Non-US - 5						
Closed/Sold Non-US - 6						
Closed/Sold Non-US - 7						
Closed/Sold Non-US - 8						
Closed/Sold Non-US - 9						
Closed/Sold Non-US - 10						

Comments:	

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Section 4.a **PRODUCTION CAPABILITIES**

For each CAD/PAD product below, indicate whether you have manufactured, integrated, and/or assembled the product since January 1, 2006. Based on your answers from Sections 2 and 3, identify the facility or facilities where each product is/was manufactured. If your company has ceased production of a product since 2006, provide the year production ceased and the reason for doing so.

		CAD/PAD Product	Manufacture/Integrate/Assemble Product?	Facility of Manufacture/Integration/Assembly 1	2	3	Year Production Ceased	Reason for Cease in Production
A.	1.	Aircrew Escape Propulsion System						
	2.	Impulse Cartridges						
	2.A	Electrically Initiated Impulse Cartridges						
	2.B	Percussion Initiated Impulse Charges						
	3.	Initiators (Impulse)						
	4.	Delay Cartridges and Delay Initiators						
	5.	Aircraft Stores/Flares/Chaff/Sonobuoy Ejection						
	6.	Detonating Cords and Charges, and Linear Charges						
	7.	Cutters						
	8.	Catapults, Thrusters, and Removers						
	9.	Automatic Inflators						
	10.	Gas Generators						
	11.	Automotive Airbag Initiators						
	12.	Laser Initiated Cartridges, Detonators, and Initiators						
	13.	Rocket Motor Igniters						
	14.A	Other (specify)						
	14.B	Other (specify)						
	14.C	Other (specify)						

B.	Estimate the degree of compatibility of your Defense CAD/PAD-related ***product lines*** with Non-Defense/Commercial customers and applications.	

Comments:	

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Section 4.b **PRODUCTION CAPABILITIES (cont.)**

For the CAD/PAD products that your company does not currently manufacture, indicate whether your company could: a) reconstitute production if your company previously produced the product; or b) initiate production for the first time with your current equipment and facilities. Additionally, using your company's 2011 production as a baseline, estimate the lead time required to reconstitute or initiate production of each product area. Finally, explain the estimated lead time. For the purpose of this estimate, make the following assumptions:

1) Existing U.S. production facilities are to be operated at maximum practical production capacity;
2) Labor availability reflects normal local market conditions;
3) Material availability reflects normal local market conditions; and
4) Facilities operate at the maximum rate possible given technological constraints.

	CAD/PAD Product		Could Reconstitute or Initiate	Lead Time	Explain
1.	Aircrew Escape Propulsion System				
2.	Impulse Cartridges				
2.A	Electrically Initiated Impulse Cartridges				
2.B	Percussion Initiated Impulse Charges				
3.	Initiators (Impulse)				
4.	Delay Cartridges and Delay Initiators				
5.	Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges				
6.	Detonating Cords and Charges, and Linear Charges				
7.	Cutters				
8.	Catapults, Thrusters, and Removers				
9.	Automatic Inflators				
10.	Gas Generators				
11.	Automotive Airbag Initiators				
12.	Laser Initiated Cartridges, Detonators, and Initiators				
13.	Rocket Motor Igniters				
14.A	Other (specify)				
14.B	Other (specify)				
14.C	Other (specify)				

Comments:	

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Section 5 INVENTORY AND ORDER BACKLOG

A.	Does your company maintain inventory of CAD/PAD finished products, components/manufacturing materials, or both? Explain below.	
B.	What is the average inventory, in months, for CAD/PAD finished products maintained in inventory? Explain below.	
C.	What is the average inventory, in months, for CAD/PAD components/manufacturing materials maintained in inventory? Explain below.	
D.	What is your company's average order backlog for finished CAD/PAD products, in months? Explain below.	
E.	Estimate the average capacity utilization rate (see definitions) for your company's CAD/PAD manufacturing, integration, and/or assembly from 2007-2011.	2007
		2008
		2009
		2010
		2011

Comments:	

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Section 6 **U.S. SUPPLIERS/SUBCONTRACTORS**

A. Identify your company's most important **U.S. suppliers/subcontractors** for CAD/PAD operations. For each supplier name, indicate the product, service, manufacturing material and/or equipment supplied, the location of the supplier, and whether the supplier is single or sole source (see definitions).

Note: Include internal/same company suppliers.

	U.S. Supplier/Subcontractor Name	Product/Service/Material/Equipment	City	State	Single or Sole Source?
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

NON-U.S. SUPPLIERS/SUBCONTRACTORS

B. Identify your company's most important **Non-U.S. suppliers/subcontractors** for CAD/PAD operations. For each supplier name, indicate the product, service, manufacturing material and/or equipment supplied, location of the supplier, and whether the supplier is single or sole source (see definitions).

Note: Include internal/same company suppliers.

	Non-U.S. Supplier/Subcontractor Name	Product/Service/Material/Equipment	City	Country	Single or Sole Source?
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					

Comments:	

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Section 7 **SALES**

Report your total U.S. **defense and non-defense/commercial sales** for each of the CAD/PAD devices listed for the years 2007-2011. Then, indicate whether your 2012-2016 sales are projected to "increase", "decrease", or "remain the same" from the drop-down menu provided. Sales to NASA and other non-defense USG agencies should be included in non-defense/commercial sales.

Note: Record in $ Thousands, e.g. $12,000.00 = survey input of $12

A.

Products			Note: Record in $ Thousands, e.g. $12,000.00 = survey input of $12											
			2007		2008		2009		2010		2011		2012-2016	
			Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial
Total Defense and Non-Defense/Commercial Sales														
1.	Aircrew Escape Propulsion System													
2.	Impulse Cartridges													
2.A	Electrically Initiated Impulse Cartridges													
2.B	Percussion Initiated Impulse Charges													
3.	Initiators (Impulse)													
4.	Delay Cartridges and Delay Initiators													
5.	Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges													
6.	Detonating Cords and Charges													
7.	Cutters													
8.	Catapults, Thrusters, and Removers													
9.	Automatic Inflators													
10.	Gas Generators													
11.	Automotive Airbag Initiators													
12.	Laser Initiated Cartridges, Detonators, and Initiators													
13.	Rocket Motor Igniters													
14.A	Other (specify)													
14.B	Other (specify)													
14.C	Other (specify)													

Comments:

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Section 8.a **EXPORTS**

Report your total **defense and non-defense/commercial exports** from the U.S. to Non-U.S. destinations for each of the CAD/PAD devices listed for the years 2007-2011. Then, using the drop-down menu, indicate whether your 2012-2016 exports are projected to "increase", "decrease", or "remain the same", from the drop-down menu provided. Sales to foreign non-defense government agencies should be included in non-defense/commercial sales. Also, include U.S. exports to foreign defense or military applications (FMS) in defense sales.

Note: Record in $ Thousands, e.g. $12,000.00 = survey input of $12

A.

Products		Note: Record in $ Thousands, e.g. $12,000.00 = survey input of $12											
		2007		2008		2009		2010		2011		2012-2016	
		Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial
Total Defense and Non-Defense/Commercial Exports													
1.	Aircrew Escape Propulsion System												
2.	Impulse Cartridges												
2.A	Electrically Initiated Impulse Cartridges												
2.B	Percussion Initiated Impulse Charges												
3.	Initiators (Impulse)												
4.	Delay Cartridges and Delay Initiators												
5.	Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges												
6.	Detonating Cords and Charges												
7.	Cutters												
8.	Catapults, Thrusters, and Removers												
9.	Automatic Inflators												
10.	Gas Generators												
11.	Automotive Airbag Initiators												
12.	Laser Initiated Cartridges, Detonators, and Initiators												
13.	Rocket Motor Igniters												
14.A	Other (specify)												
14.B	Other (specify)												
14.C	Other (specify)												

Comments:	

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Section 8.b **EXPORTS (cont.)**

Using the drop-down menu provided, identify the top FIVE end-user countries for your company's total CAD/PAD exports (defense and non-defense/commercial) by total dollar sales for each product below. Inputs should reflect 2011 year data.

Note: Include foreign defense or military applications (FMS) as exports.

		Products	Country 1	Country 2	Country 3	Country 4	Country 5
A.	1.	Aircrew Escape Propulsion System					
	2.	Impulse Cartridges					
	2.A	Electrically Initiated Impulse Cartridges					
	2.B	Percussion Initiated Impulse Charges					
	3.	Initiators (Impulse)					
	4.	Delay Cartridges and Delay Initiators					
	5.	Aircraft Stores/Flares/Chaff/Sonobuoy Ejection Cartridges					
	6.	Detonating Cords and Charges					
	7.	Cutters					
	8.	Catapults, Thrusters, and Removers					
	9.	Automatic Inflators					
	10.	Gas Generators					
	11.	Automotive Airbag Initiators					
	12.	Laser Initiated Cartridges, Detonators, and Initiators					
	13.	Rocket Motor Igniters					
	14.A	Other (specify)					
	14.B	Other (specify)					
	14.C	Other (specify)					

Comments:

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Section 9.a **COMPETITIVE PROSPECTS**

A.	Do you expect the competitive prospects for your firm's U.S.-based CAD/PAD operations to improve or decline over the next five years? Explain below.	
B.	How is your company impacted by recent consolidations among CAD/PAD competitors? Explain below.	
C.	What potential impacts on your company's access to propellants and other materials would result from changes in management and/or operations at the Army Ammunition Plant in Radford, Virginia? Explain below.	

D. Select the actions your company has taken in the **LAST 5 years** to improve its competitiveness. If "Other", please specify.

	Action		Yes/No	Explain
a.	Automation/Lean Manufacturing			
b.	Business Restructuring			
c.	Capacity/Property, Plant and Equipment Investment			
d.	Cost Reduction/Efficiency			
e.	Customer Service/Quality Control			
f.	Innovation/R&D, Design			
g.	Marketing Improvements			
h.	Staff Adjustments			
i.	Training/Certifications			
j.	Other (specify)			
k.	Other (specify)			
l.	Other (specify)			

E. Select the actions your company will take in the **NEXT 5 years** to improve its competitiveness. If "Other", please specify.

	Action		Yes/No	Explain
a.	Automation/Lean Manufacturing			
b.	Business Restructuring			
c.	Capacity/Property, Plant and Equipment Investment			
d.	Cost Reduction/Efficiency			
e.	Customer Service/Quality Control			
f.	Innovation/R&D, Design			
g.	Marketing Improvements			
h.	Staff Adjustments			
i.	Training/Certifications			
j.	Other (specify)			
k.	Other (specify)			
l.	Other (specify)			

Comments:	

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Section 9.b **COMPETITIVE PROSPECTS (cont.)**

A. For your CAD/PAD business lines, list your primary domestic competitors and their location:

	Domestic Competitor Name	City	State
1.			
2.			
3.			
4.			
5.			

B. For your CAD/PAD business lines, list your primary non-U.S. competitors and their location:

	Non-U.S. Competitor Name	City	Country
1.			
2.			
3.			
4.			
5.			

C. How would you assess the competitiveness of your CAD/PAD-related business lines against non-U.S. competitors over the **LAST 5 YEARS**. Explain below.

D. How would you assess the projected competitiveness of your CAD/PAD-related business lines against non-U.S. competitors over the **NEXT 5 YEARS**. Explain below.

Comments:

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Section 10.a **SUPPLY CHAIN ISSUES**

A. How have imports of CAD/PADs into the United States (including those for your own use) positively and/or negatively affected your domestic manufacturing, integration, and/or assembly operations?

Effect	Explain
Positive Factors	
Negative Factors	

B. Since 2006, have you experienced any shortages, drastic cost increases, or supply interruptions of materials, parts, components, and/or other essential supplies that adversely affected, or continue to adversely affect your U.S. CAD/PAD operations? If "Yes", indicate the item(s) and explain the situation and how it was resolved.

	Item		Affected?	Explain
a.	Explosive Components			
b.	Explosive Ingredients			
c.	Explosive Materials			
d.	Legacy Propellants			
e.	Raw Materials			
f.	Parts/Components			
g.	Subcomponents			
h.	Testing Materials			
i.	Other (specify)			
j.	Other (specify)			
k.	Other (specify)			

C. Since 2006, have any of the following factors impacted your U.S. CAD/PAD operations? If "Yes", indicate which factors and explain the impact.

	Factor		Impacted?	Explain
a.	Export Adminstration Regulations (EAR)			
b.	Department of Transportation Regulations (e.g. "Competent Authority")			
c.	Environmental Protection Agency (EPA) Regulations			
d.	Foreign Military Sales			
e.	International Traffic in Arms Regulations (ITAR)			
f.	N-ray Testing			
g.	Obsolescence			
h.	Testing Facilities			
i.	Vibration Testing			
j.	Other (specify)			
k.	Other (specify)			
l.	Other (specify)			

Comments:	

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Section 10.b **SUPPLY CHAIN ISSUES (cont.)**

A. Are you required to utilize parts and/or components that are deemed obsolete for products you sell into the CAD/PAD supply chain? If "Yes", indicate the key obsolete parts/components below and the supplier's name and location. Then, estimate the percentage cost premium (see definitions) for each item and whether you have difficulty obtaining the part/component. Finally, explain your answer.

Note: For foreign supplier locations, only indicate country.

	Obsolete Part/Component	Supplier Company	State	Country	Cost Premium (%)	Difficulty Obtaining Part?	Explain
1.							
2.							
3.							
4.							
5.							

B. Identify the raw materials/chemicals that are difficult to obtain for the manufacture/integration/assembly of products you sell into the CAD/PAD supply chain. Indicate the material/chemical below and the supplier's name and location. Finally, indicate whether there is an alternate source available for each material and explain why you have difficulty obtaining the material/chemical.

Note: For foreign supplier locations, only indicate country.

	Manufacturing Materials/Chemicals	Supplier Company	State	Country	Alternate Source Available?	Explain
1.						
2.						
3.						
4.						
5.						

Comments:

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Section 11.a **CAD/PAD WORKFORCE**

Record the total number of full-time equivalent (FTE) employees, including consultants, for your **U.S. CAD/PAD operations** by occupational type for the 2007-2011 period. Do not double count personnel who may perform cross-operational roles. Estimates are acceptable.

Note: Lines b. through p. should equal a. (Total Full-Time Equivalent Employees)
Note: Calendar year data is preferred.

Source of Workforce Data:	
Reporting Schedule:	

A.

	Professional Occupations	2007	2008	2009	2010	2011
a.	Total Full-Time Equivalent (FTE) CAD/PAD Employees					
b.	Contracts Administration					
c.	Design Engineering					
d.	Finance/Accounting					
e.	IT/Network Engineers					
f.	Management					
g.	Manufacturing/Production Line Workers					
h.	Marketing & Sales					
i.	Program Management					
j.	Quality Control					
k.	Research and Development Staff					
l.	Scientists					
m.	Testing					
n.	Other (specify)					
o.	Other (specify)					
p.	Other (specify)					

B. For the technical occupations listed below, estimate the total number of FTE employees supporting your firm's **U.S. CAD/PAD operations**. Of the total employees identified for each technical occupation, estimate the number of employees who represent each of the experience profiles.

Note: The experience profiles of each "Technical Occupation" row should equal the total "Number Employed".

	Technical Occupations	Total Number Employed	Experience Profiles				
			≤ 5 Years of Experience	6 to 10 Years of Experience	11 to 20 Years of Experience	21 to 30 Years of Experience	> 30 Years of Experience
a.	Chemical						
b.	Design						
c.	Electrical						
d.	IT/Network Engineers						
e.	Mechanical						
f.	Other (specify)						
g.	Other (specify)						
h.	Other (specify)						

Comments:

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Section 11.b **CAD/PAD WORKFORCE (cont.)**

A. Provide the number of your company's CAD/PAD related research and development staff for 2011 that fall within the functions and age ranges listed in the table below.

Note: Non-U.S. Citizens include Green Card and H1-B Visa Holders.
Note: Do not include outside consultants not permanently employed by your firm.

		< 30 Years Old	31 to 40 Years Old	41 to 50 Years Old	51 to 60 Years Old	> 60 Years Old
a.	U.S. Citizens (Development Staff, i.e. Engineers)					
b.	Non-U.S. Citizens (Development Staff, i.e. Engineers)					
c.	U.S. Citizens (Research Staff, i.e. Scientists)					
d.	Non-U.S. Citizens (Research Staff, i.e. Scientists)					

B. Provide the number of your company's CAD/PAD related research and development staff who hold advanced degrees as of 2011.

Note: Non-U.S. Citizens include Green Card and H1-B Visa Holders.
Note: Do not include outside consultants not permanently employed by your firm.

		B.A./B.S.	Masters	Ph.D.
a.	U.S. Citizens (Development Staff, i.e. Engineers)			
b.	Non-U.S. Citizens (Development Staff, i.e. Engineers)			
c.	U.S. Citizens (Research Staff, i.e. Scientists)			
d.	Non-U.S. Citizens (Research Staff, i.e. Scientists)			

Comments:

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Section 11.c **CAD/PAD WORKFORCE (cont.)**

			Difficult to Hire	Difficult to Retain
A.	For your company, identify what CAD/PAD-related professional occupations are the most difficult to hire and retain.	1.		
		2.		
		3.		
		4.		

B.	If your defense work were to decline or cease, would non-defense/commercial work help retain workforce skills/competencies needed for future defense work? Explain below.	

C.	In the last five years, have you experienced any labor concerns such as shortages of certain skills, excessive turnover, retirement of experienced workers, liability claims, etc. that adversely affect(ed) your CAD/PAD manufacturing or research and development operations? If "Yes", explain below.	

D. Identify your company's critical skills/competencies that are essential to the viability and long-term competitiveness of your CAD/PAD operations. Explain your response. Finally, on average, for the critical skills/competencies identified, how many months does it take to train a new employee?

		Skills/Competencies	Explain	Months Training
	1.			
	2.			
	3.			
	4.			
	5.			

Comments	

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Section 11.d **CAD/PAD WORKFORCE (cont.)**

A.	What is the typical process your company uses in training specialized engineers and scientists for CAD/PAD-related work? Explain below.	
B.	Estimate the percentage of your technical personnel that were hired with the necessary basic skills to perform primary CAD/PAD operations.	
C.	What are the primary skills that you most often have to teach on-the-job?	
D.	Is your company sponsoring or participating in any university, state, or U.S. Government programs to hire/recruit recent graduates for CAD/PAD-related work? If "Yes", explain below.	
E.	Are there institutions or programs that your company relies on to provide training/education for newly hired CAD/PAD-related employees? Explain below.	

Comments	

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Section 11.e **CAD/PAD WORKFORCE (cont.)**

A.	Has your company needed to increase staff to accommodate local, state, federal and/or foreign government regulations and/or policies? Explain below.	

B. Identify the certifications that your company currently has or is working toward below that are related to CAD/PAD operations:

AMS (specify)			J-STD-001DS		
ANSI/ASQC Z1.4			MIL-Q-9858		
ANSI/ESD S20.20			MIL-STD-45662 A		
ANSI/ISO/IEC 17025			NADCAP (specify)		
DoD 5000			NCLS (specify)		
ISO 9000			SAE AS9003		
ISO 9001			SAE AS9100		
ISO 10012-1			Other (specify)		
ISO 14000			Other (specify)		
ISO TS16948			Other (specify)		

* AMS (Aerospace Material Specifications)	* NADCAP (National Aerospace and Defense)
* ANSI (American National Standards Institute)	* Contractors Accreditation Program)
* ASQ (American Society for Quality)	* NCLS (National Clinical Lab Specialist)
* ISO (International Organization for Standards)	* SAE (SAE International, formerly the Society of Automotive Engineers)

Comments	

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Section 12.a **FINANCIALS**

For years 2007-2011, report the following select line items from your whole company's financial statements, including all CAD/PAD operations.

Note: Calendar year data is preferred.

Source of Financial Line Items:	
Reporting Schedule:	

	Income Statement (Select Line Items)	Record in $ Thousands, e.g. $12,000.00 = survey input of $12				
		2007	2008	2009	2010	2011
A.	Net Sales (and other revenue)					
B.	Cost of Goods Sold					
C.	Research and Development Expense					
D.	Total Operating Income (Loss)					
E.	Earnings Before Interest and Taxes					
F.	Net Income					

	Balance Sheet (Select Line Items)	Record in $ Thousands, e.g. $12,000.00 = survey input of $12				
		2007	2008	2009	2010	2011
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					

Comments:	

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Section 12.b **FINANCIALS (cont.)**

For years 2007-2011, report the following select line items for ONLY your **CAD/PAD-related** business unit/division. If your CAD/PAD-related business unit/division is also the whole company, only answer the financials in Section 12.a.

Note: Calendar year data is preferred.

CAD/PAD-related Business Unit/Division

Source of Financial Statement Line Items:					
Reporting Schedule:					

CAD/PAD Income Statement (Select Line Items)		Record in $ Thousands, e.g. $12,000.00 = survey input of $12				
		2007	2008	2009	2010	2011
A.	Net Sales (and other revenue)					
B.	Cost of Goods Sold					
C.	Research and Development Expense					
D.	Total Operating Income					
E.	Earnings Before Interest and Taxes					
F.	Net Income					

CAD/PAD Balance Sheet (Select Line Items)		Record in $ Thousands, e.g. $12,000.00 = survey input of $12				
		2007	2008	2009	2010	2011
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					

Comments:	

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Section 12.c	FINANCIALS (cont.)	
Use the space below to qualify with narrative any anomalies, transactions, litigation, or non-recurring one-time events reflected in your financial statement line items, e.g. reporting restatement, merger and acquisition, Chapter 11 filing, SEC investigation, etc.		
A.	2007	
B.	2008	
C.	2009	
D.	2010	
E.	2011	
Comments:		

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Section 13 **MERGERS & ACQUISITIONS/JOINT-VENTURES**

A. Did your company undergo any mergers and/or acquisitions from calendar years 2006-2011? If "Yes", identify your most significant mergers and/or acquisitions over the period. Then record the subject entity's name, transaction type, entity's location, calendar year, and the primary objective of the deal.

	Entity Name	Transaction Type	Entity's Location	Year	Primary Objective
1.					
2.					
3.					
4.					
5.					

B. Is your company currently participating in any CAD/PAD-related joint-ventures? If "Yes", identify your company's current CAD/PAD-related joint venture relationships, including public/private R&D partnerships. Provide the name of the company/entity involved, indicating whether it is a U.S. or non-U.S. enterprise, and a description of the joint venture's purpose, e.g. patent licensing, co-production, product integration, after-market support, etc.

	Entity Name	U.S./Non-U.S.	Primary Objective of Relationship
1.			
2.			
3.			
4.			
5.			

Comments:

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Section 14 CAPITAL EXPENDITURES

Record your capital expenditures corresponding to the select categories for the years 2007 to 2011.

Note: Lines b. through f. should equal 100%.
Note: Calendar year data is preferred.

		Source of Capital Expenditure Data:					
		Capital Expenditure Reporting Schedule:					
		Capital Expenditure Category	2007	2008	2009	2010	2011
A.	a.	Total Capital Expenditures					
	b.	Machinery, Equipment, and Vehicles *[as a percent of a.]*					
	c.	IT, Computers, Software *[as a percent of a.]*					
	d.	Land, Buildings, and Leasehold Improvements *[as a percent of a.]*					
	e.	Other (specify) *[as a percent of a.]*					
	f.	Other (specify) *[as a percent of a.]*					
	g.	% of Total Capital Expenditures relating to CAD/PAD business lines *[as a percent of a.]*					

From 2007-2011, rank the top five reasons for investment from 1 to 5 ("1" being the top reason). If additional reasons apply, indicate "Other" and specify.

B.	a.	Replace old equipment	
	b.	Improve productivity	
	c.	Expand capacity	
	d.	Add new capability	
	e.	Upgrade technology	
	f.	Meet specific customer requirements	
	g.	Comply with environmental or safety requirements	
	h.	Other (specify):	

Comments:	

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Section 15.a **RESEARCH AND DEVELOPMENT**

Estimate your company's total research and development (R&D) dollar expenditures and the percentage of total R&D expenditures relating to Defense and Non-Defense/Commercial CAD/PAD business lines for the years 2007 to 2011.

Note: Lines b. through d. should equal 100%.
Note: Calendar year data is preferred.

Source of R&D Reporting:	
R&D Reporting Schedule:	

		Defense and Non-Defense/Commercial Expenditures	2007		2008		2009		2010		2011	
			Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial	Defense	Non-Defense/ Commercial
A.	a.	Total R&D Expenditures										
	b.	Basic Research *[as a percent of a.]*										
	c.	Applied Research *[as a percent of a.]*										
	d.	Product/Process Development *[as a percent of a.]*										
	e.	% of Total R&D Expenditures relating to CAD/PAD business lines										

B.	Estimate the degree of compatibility of your Defense CAD/PAD-related ***R&D*** with Non-Defense/Commercial customers and applications.	

Comments:	

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Section 15.b **RESEARCH AND DEVELOPMENT (cont.)**

Record your company's total R&D dollar expenditures by funding sources, as a percent of total R&D dollars sourced. If your company's annual Total R&D Expenditures and Total R&D Funding Sources do not match, explain the discrepancy in the comment box provided.

Note: Lines b. through h. should equal 100%.
Note: Calendar year data is preferred.

Source of R&D Reporting:	
R&D Reporting Schedule:	

		CAD/PAD R&D Funding Sources	2007	2008	2009	2010	2011
A.	a.	Total R&D Funding Sources					
	b.	Internal/Self-Funded/IRAD *[as a percent of a.]*					
	c.	Total Federal Government *[as a percent of a.]*					
	d.	Total State and Local Government *[as a percent of a.]*					
	e.	Universities - Public and Private *[as a percent of a.]*					
	f.	U.S. industry, Venture Capital, Non-profit *[as a percent of a.]*					
	g.	Non-U.S. Investors *[as a percent of a.]*					
	h.	Other (specify)					

Comments:	

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Section 16		CUSTOMER CAPABILITIES	
A	Based on your experience, since 2006, what trends have you observed concerning the following technical capabilities within **U.S. Government customers** (including Department of Defense, Indian Head, Hill Air Force Base, and other USG customers)?		
	a.	Preparation of technical specifications	
	b.	Technical knowledge of your product	
	c.	Technical discussion of ordnance application in their system	
	d.	Technical ability to evaluate proposed design and compare	
B.	Based on your experience, since 2006, what trends have you observed concerning the following technical capabilities within **Prime Contractor customers**?		
	a.	Preparation of technical specifications	
	b.	Technical knowledge of your product	
	c.	Technical discussion of ordnance application in their system	
	d.	Technical ability to evaluate proposed design and compare	
C.	Does your company find it easier to work with Prime Contractors or U.S. Government customers? Explain below.		
Comments:			

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Section 17.a **U.S. GOVERNMENT POLICIES**

A. With respect to your CAD/PAD operations, describe what reasonable adjustments to the following U.S. Government laws, policies, and/or regulations you would recommend to mitigate any competitive disadvantages that U.S. firms might face.

	Policy/Law/Regulation	Recommended Adjustment
a.	Build to Print vs Performance Specifications	
b.	Competitive Bidding	
c.	Environmental and Safety Regulations	
d.	Export Controls	
e.	Government Competition	
f.	Lot Acceptance Testing	
g.	Procurement	
h.	Research and Development	
i.	Shipping Classifications	
j.	Small Business Set-Asides	
k.	Small Business Innovative Research Program	
l.	Other (specify)	

B. Identify the main issues and challenges affecting the long-term viability of your CAD/PAD product line(s) or service(s). Select "Yes", "No", or "Not Applicable" for each issue/challenge listed below.

Buy American Waivers		Labor Costs		
Difficulty Obtaining Key Inputs (Materials, Services, etc.)		Proximity to Customer		
Domestic Competition		Proximity to Supplier		
Environmental Regulations/Remediation		Qualifications/Certifications		
Export Controls		Research and Development Costs		
Foreign Competition		Skills Retention		
Foreign Subsidies/Import Restrictions		Taxes		
Government Budget Volatility		Variability of Demand		
Government Regulatory Burden		Other (specify)		
Healthcare		Other (specify)		

Comments:	

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Section 17.b **U.S. GOVERNMENT POLICIES (cont.)**

A.	Has your company experienced lost CAD/PAD-related export sales due to ITAR or EAR regulations between the years 2007 to 2011? Explain below.	International Traffic in Arms Regulations (ITAR)	
		Export Administration Regulations (EAR)	
B.	Has your company chosen not to bid, cancelled an existing contract, or terminated a CAD/PAD-related business line due to U.S. export controls? Explain below.		
C.	What recommendations would you provide for streamlining/improving U.S. export control processes? Explain below.		
D.	Has mandated second sourcing been beneficial or detrimental to your CAD/PAD-related business lines? Explain below.		
E.	What recommendations would you provide for improving the second-sourcing process? Explain below.		
F.	Will the declining U.S. military presence in Iraq and Afghanistan affect your company's CAD/PAD business? If "Yes", explain below.		
G.	Are you concerned with proposed or potential defense and/or U.S. Government budget cuts? If "Yes", explain below.		

Comments:	

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Section 18	Foreign Military Sales (FMS)	
A.	Has your CAD/PAD-related business been impacted by delays in Foreign Military Sales (FMS) payment and shipping? If "Yes", explain below.	
B.	Estimate the percent of your firm's CAD/PAD-related exports that are shipped through the defense transportation system (DTS).	
C.	Estimate the percent of your firm's CAD/PAD-related exports that are shipped through freight forwarders.	
D.	Select the dollar range value of the CAD/PAD-related FMS products you are currently storing for transport at your facility.	
E.	On average, how long do you store CAD/PAD-related FMS products before transport/shipping?	
F.	Is revenue recognized from FMS sales affected by delays in transporting the product to the customer? Explain below.	
G.	What recommendations would you provide for streamlining the FMS payment and shipping process?	
	Comments:	

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Section 19	EFFECTIVENESS OF PREVIOUS ASSESSMENTS	
The 1995, 2000, and 2006 Department of Commerce CAD/PAD Assessments made several recommendations. Please review the questions below regarding the previous recommendations.		
1.	Have you experienced an improvement in your relations with the CAD/PAD Joint Program Office?	
2.	Has the CAD/PAD Joint Program Office provided Defense Budget forecasts for CAD/PAD devices?	
3.	Has the CAD/PAD Joint Program Office briefed you on technical developments and new requirements?	
4.	Has the CAD/PAD Join Program Office provided a forum for you to discuss and address grivances?	
5.	Have you experienced an improvement in your relations with the U.S. Labor Department's Office of Saftey and Health Administration (OSHA)?	
6.	Have you experienced an improvement in your relations with the U.S. State Department's Directorate of Defense Trade Controls (DDTC)?	
7.	Have you experienced an improvement in your relations with the Environmental Protection Agency (EPA)?	
8.	Has the CAD/PAD Joint Program Office contracted out a larger portion of product development and improvement to the CAD/PAD industry?	
9.	Has the CAD/PAD Joint Program Office implemented other policies that improved the CAD/PAD procurement environment?	
10.	Have you experienced improvements in the lot acceptance testing process?	
11.	Does industry receive at least 90 percent of overall CAD/PAD orders?	
12.	Are the Technical Exchange Workshops hosted by the CAD/PAD Joint Program Office useful to you, or do they need improvement?	
13.	Does second-sourcing of CAD/PAD business help or hurt your company?	
Comments:		

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Section 20	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))	
Company Name	
Company'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.	
Would you like to receive a free copy of the final CAD/PAD report?	
How many hours did it take to complete this survey?	

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Appendix D:

Product Descriptions and Illustrations

Product Descriptions and Illustrations

Product descriptions and illustrations of several types and varieties of CAD/PAD products used by the military are presented here to give the reader a better appreciation of the nature and complexity of the items and how they perform their intended functions. Written product descriptions are given first; illustrations are shown at the end of the appendix. As described in the body of the report, CAD/PADs are used by the military for many aircraft from aircraft engine fire extinguishers and aircrew emergency escape systems, to aircraft anti-missile counter measures and many other uses.

* * * * *

Impulse Cartridges have numerous applications. For example, in the event of a fire, the aircraft fire extinguisher is activated by an impulse cartridge (**figure 1**), which releases a fire extinguishing agent into the area surrounding the aircraft engine. The fire extinguisher cartridge is electrically initiated. Pressure from the main propelling charge (initiator) forces the puncture device into motion. The contents of the fire extinguisher are retained by disc type plugs at the valve opening. Upon operation of the unit, the cartridge fires a slug which breaks the disk, permitting the fire retardant charge to be expelled through the valve.

Detonating Cords and Charges are used in aircraft canopy removal and included shielded mild detonating cords, linear shape charges, flexible near shape charges, mild detonating fuses, and thin layered explosive lines. Emergency jettisoning of the aircraft canopy can be accomplished internally by the aircrew or externally by rescue personnel. The canopy jettison system is also initiated automatically during the ejection sequence to provide a clear path for seat ejection. The ejection seats typically use impulse cartridges and delay initiators to position the occupant for ejection, initiating seat propulsion and stabilization devices, and to accomplish seat/occupant separation.

Flexible Confined Detonating Cord assemblies (**figure 2**) are used in the escape system of the aircraft to provide an explosive train linking the canopy hook removal subsystems in the cockpit. **Shielded Mild Detonating Cord** (SMDC) assemblies (**figure 3**) are explosive transmission lines, consisting of a metal sheathed explosive core, covered with a teflon coating, all contained within a thin walled stainless steel tube. SMDC is available in various lengths and bend configurations. SMDC’s are also used in the emergency canopy removal system.

Impulse Initiators are devices employing energetic materials such as propellants or explosives to generate the initial or sustaining pressure within a ballistic gas system, or to initiate a signal transmission line such as SMDC. The cartridge actuated initiator (**figure 4**) is a lanyard operated device used in the aircrew escape system. Seat ejection is initiated by pulling a seat-firing handle which actuates the initiator(s). When the lanyard initiator assembly handle is pulled, the firing pins are released igniting the initiator.

Percussion initiated impulse cartridges used percussion primers to initiate energetic material. The percussion initiated impulse cartridge (**figure 5**) is the power source that actuates the pilot's canopy unlatch thruster which unlocks the canopy before canopy jettison, and supplies gas pressure to actuate two propellant actuated initiators which initiate SMDC to the canopy jettison rocket motors. When the cartridge is fired by a SMDC, pressure builds up against the firing disc to push both firing pins into the primers, which ignites the ignition charge. The igniter charge then fires the propellant charge, which produces gas pressure. The gas pressure is routed through the canopy unlatch thruster, moving the canopy to the rear of the aircraft.

Catapults, Thrusters and Removers use energetic materials and employ telescoping-type tubes to perform functions such as separation, ejection, thrusting or movement.

The rocket catapult (**figure 6**) is designed to remove ejection seat and aircrew member from the aircraft and propel aircrew/seat to a height necessary for safe parachute deployment. The catapult is a gas actuated, solid propellant booster rocket, which provides the initial power for the ejection of the seat. The catapult consists of an outer barrel and an inner telescopic piston. The rocket catapult is a self-contained, mechanically initiated, two stage solid propellant booster rocket. The nozzle is positioned to provide rocket thrust through the center of gravity of the aircrew/seat combination during ejection.

As the seat travels up the guide rails, the auxiliary cartridges in the catapult are fired; the emergency oxygen supply is mechanically activated; the leg restraint lines are drawn tight; and, the rocket motor initiator is fired. The impulse cartridge in the rocket motor initiator fires the underseat rocket to provide sustaining thrust for the ejection seat. The underseat rocket is fired as the catapult reaches the end of its stroke and sustains the thrust of the catapult to carry the seat to a height sufficient to enable the seat to deploy. Timing of all events after rocket motor initiation is controlled by the electronic sequencer, which utilizes altitude and airspeed information to select the correct mode of operation.

Pullers and thrusters are basically the same, except they work in reverse. The motion of the puller is inward while the thruster is outward. Power derived form a ballistic cartridge moves a piston in the desired direction. Pullers are used primarily for releasing attached components (e.g., retaining rings, pins, etc) while thrusters, working in reverse, are moving mechanisms. The cartridge actuated thruster (**figure 7**) is used to force the integrated control system tray in an

upward position, providing a clear ejection path during the aircraft emergency escape sequence. It is triggered by gas pressure provided by a remote initiator.

The illustrated underseat rocket motor (**figure 8**) is used on F-14 aircraft; it is a self-contained, mechanically initiated, solid propellant rocket. The rocket motor contains 13 propellant tubes, six nozzles, and one firing unit tube. The six rocket nozzles are fitted underneath the center body and are angled outward to give maximum thrust at the center of gravity. When the seat is ejected from the aircraft, the static line, attached to the aircraft floor becomes taught and activates the firing mechanism to initiate the ignitor. The rocket motor provides thrust for approximately a half-second to propel the aircrew and seat to an altitude sufficient for safe parachute descent, even if ejection is initiated from the ground.

Delay Cartridges and Delay Initiators are items that incorporate pyrotechnic delay material to regulate the timing of the output charge initiation. These include electrically and percussion primed delay cartridges and delay initiators. The explosive actuated delay initiator (**figure 9**) is designed to provide a three second delay in the interseat sequencing system of the aircraft. The explosive energy from the SMDC forces the initiator firing pin to ignite a primer charge. The primer charge ignites an explosive mix which fires a fuse. The fuse provides a three-tenths second time delay before an explosive mix and booster charge is ignited. The explosive energy from the booster then fires an SMDC attached to the outlet port of the initiator.

The delay cartridge (**figure 10**) is used to actuate an automatic parachute release after a three-fourths second delay from the time it is actuated during the ejection sequence from an aircraft. As the seat is ejected from the cockpit, the firing cable is pulled, withdrawing a sear pin from the release mechanism. This action releases the firing pin which strikes the primer, igniting the delay column in sequence to the main charge. The gases actuate the parachute release actuator.

The parachute container is fitted with canopy breakers to enable the seat to eject through the cockpit canopy should the automatic canopy ejection system fail. After ejection, drogue deployment, aircrew/seat separation, and parachute deployment are automatically controlled by an on-board, electronic sequencer. A barostatic release unit provides backup in case of partial or total failure of the electronic sequencer, and a manual override system provides a further backup in the event of failure of the barostatic release.

Gas pressure from impulse cartridges extracts the drogue chute to stabilize the aircrew seat. A time release mechanism then provides a several second delay prior to seat-occupant separation. Time delay may vary depending on altitude and airspeed conditions. At the appropriate time an impulse cartridge then releases the drogue chute from the seat. The drogue chute then deploys the parachute to separate the occupant from the seat.

Cutters are devices which employ energetic materials and a cutting blade to sever objects such as a bolt, wire, or cable suspension lines. There are basically two types of cutters, guillotine type and punch type. A guillotine cutter is an axe or blade knife propelled internally by an energetic

material. They are used where there is a need for rapid, remote cutting of cable, wire rope, hose, or fuel line. They are designed for mechanical or electrical triggering of the cartridge. A cartridge actuated cutter, with a cartridge sealed-in, is used to sever nylon reefing line attached to a recovery parachute. This cutter consists of an aluminum tubular body containing a spring-loaded firing pin and a six second delay cartridge. Once the cartridge is fired the resulting expanding gases force the cutter blade forward, severing the reefing line, which permits full deployment of the recovery parachute.

Ejector Cartridges employ propellants and explosives to eject sonobouys, and to release bombs and missiles from aircraft. This category also includes cartridges that launch aircraft flares or chaff for anti-aircraft missile countermeasures. An aircraft flare ejection cartridge is designed to provide a power source for the ejection of the aircraft flares and chaff. This cartridge is electrically initiated. When fired, the resulting pressure operates the dispenser or pod

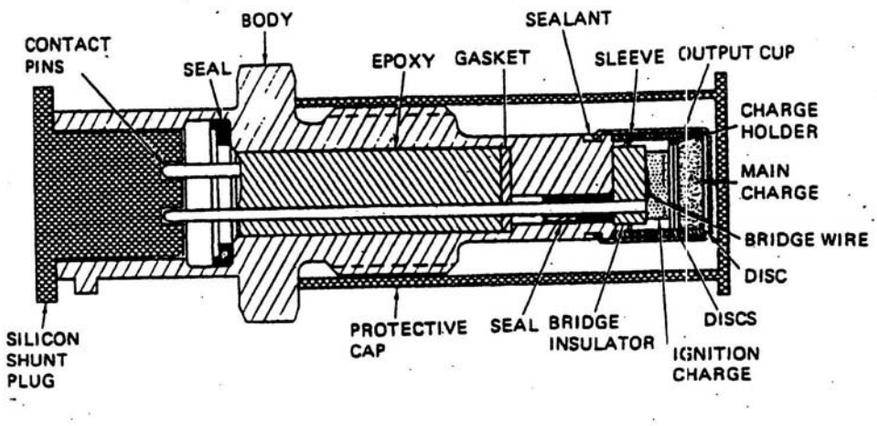


Figure 1. Electrically Initiated Impulse (Fire Extinguisher) Cartridge

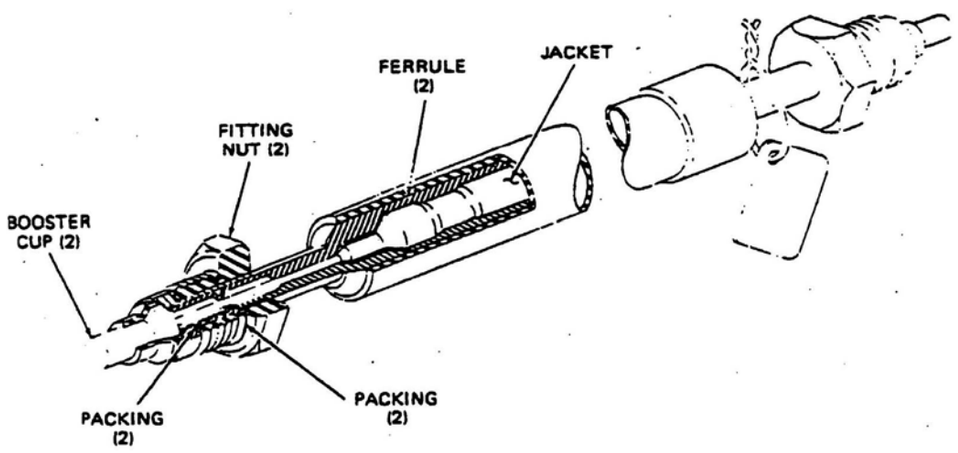


Figure 2. Flexible Confined Detonating Cord Assembly Cord

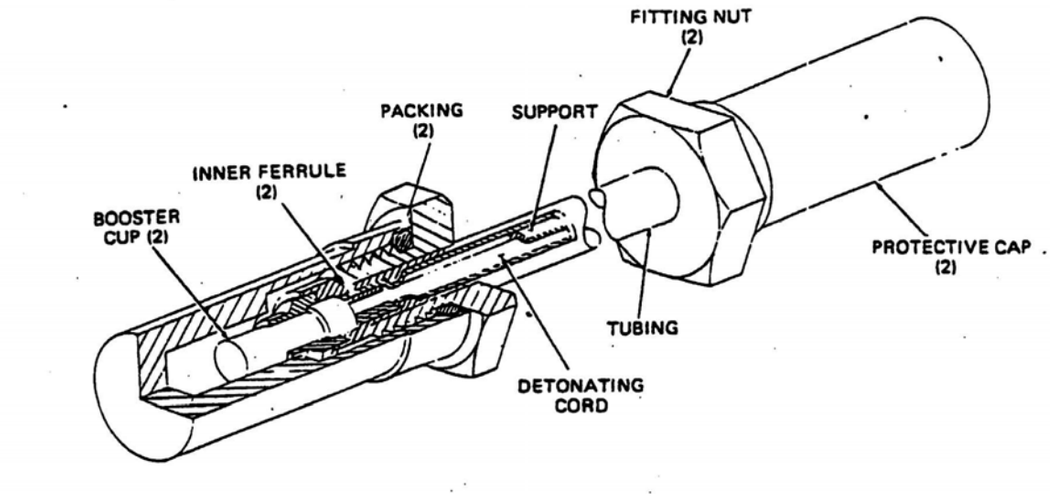


Figure 3. Shielded Mild Detonating Cord

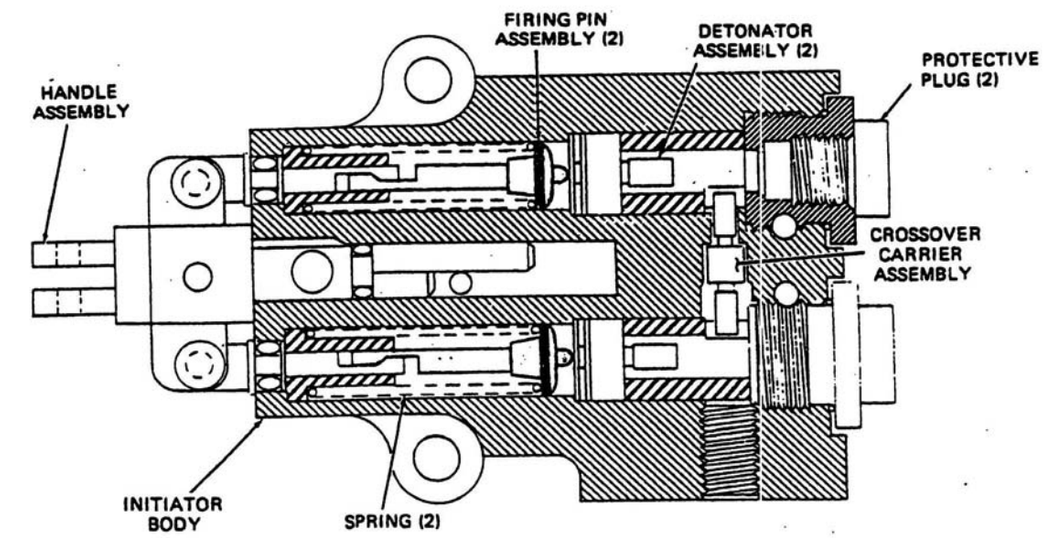


Figure 4. Impulse Initiator

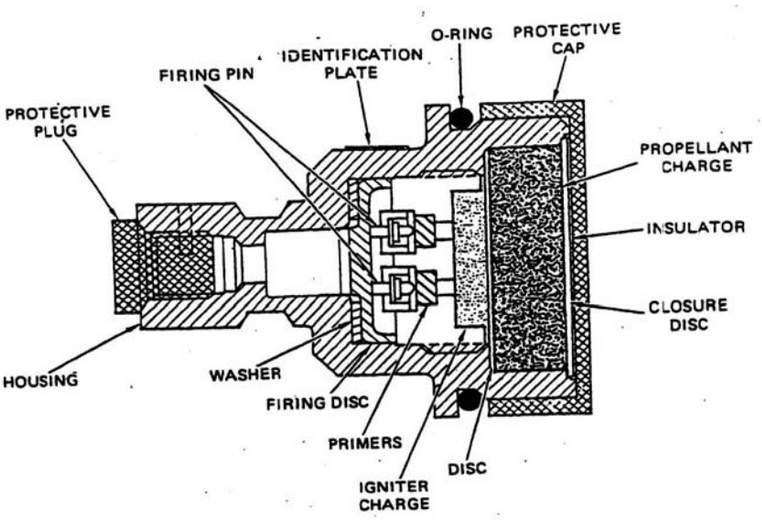


Figure 5. Percussion Initiated Impulse Cartridge

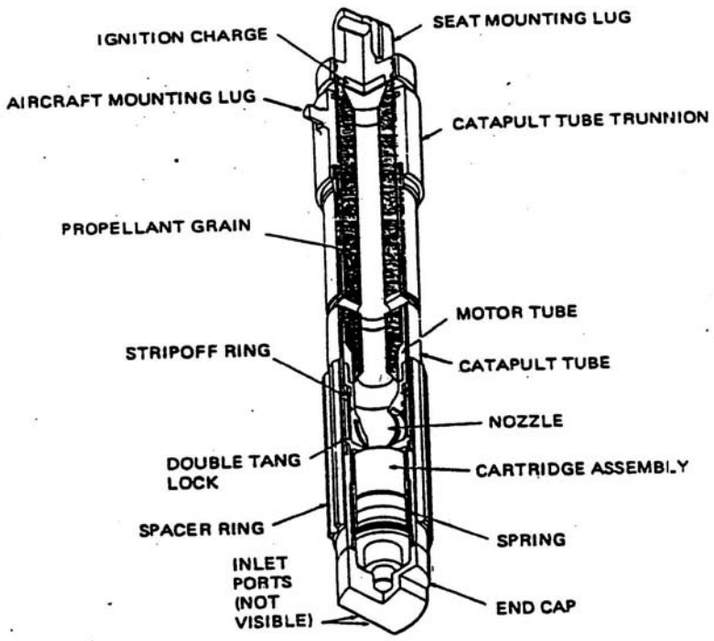


Figure 6. Rocket Catapult

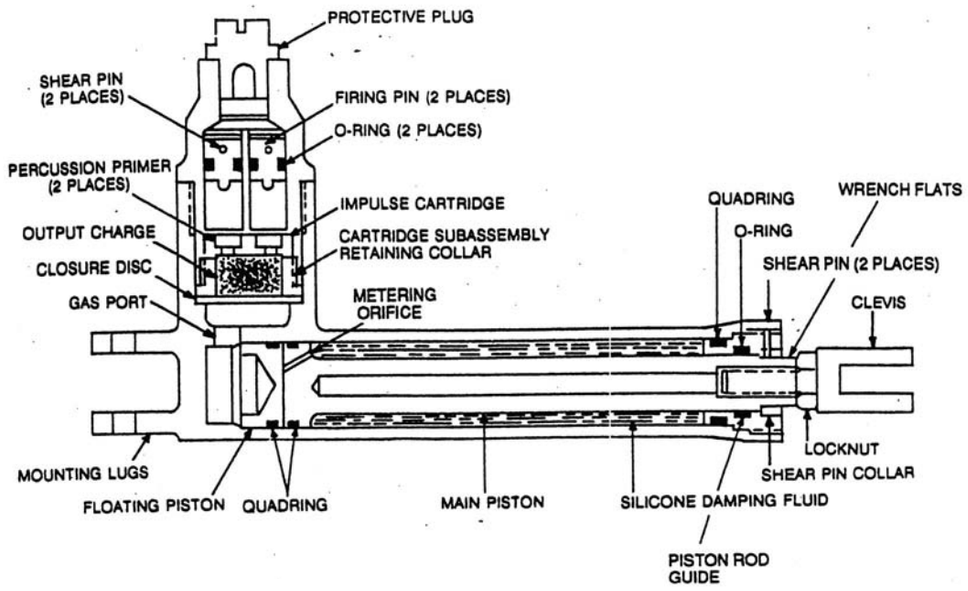


Figure 7. Thruster

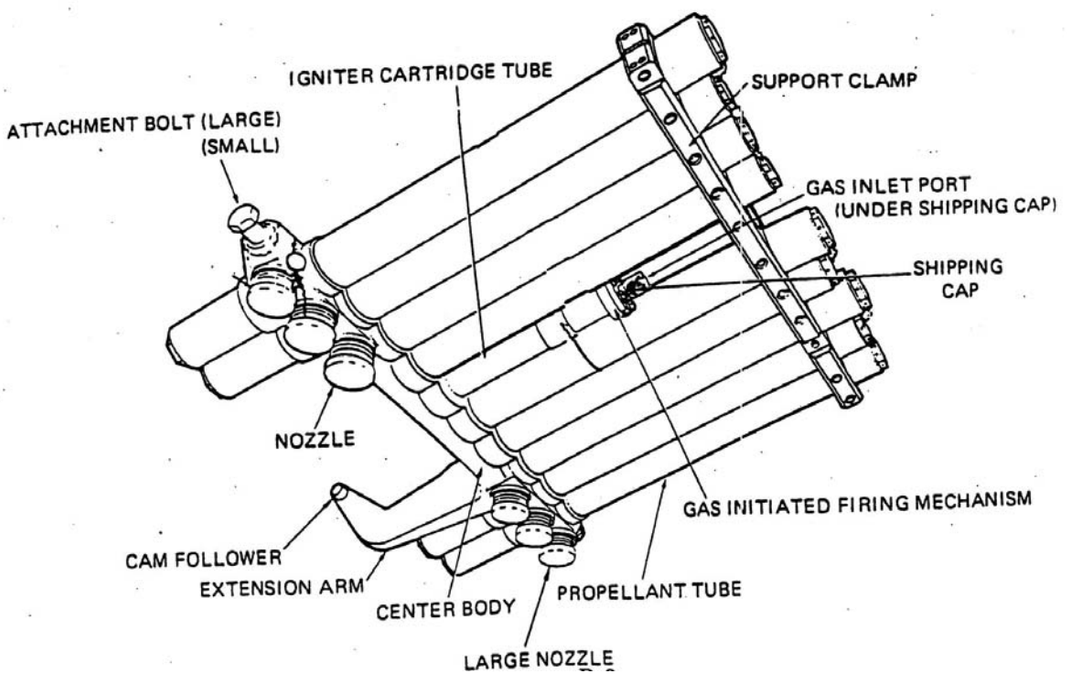


Figure 8. Underseat Rocket Motor

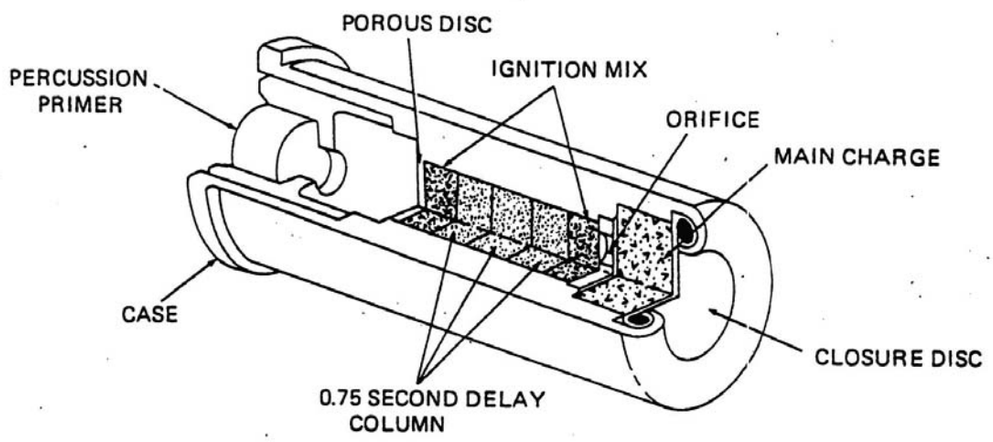


Figure 9. Delay Initiator

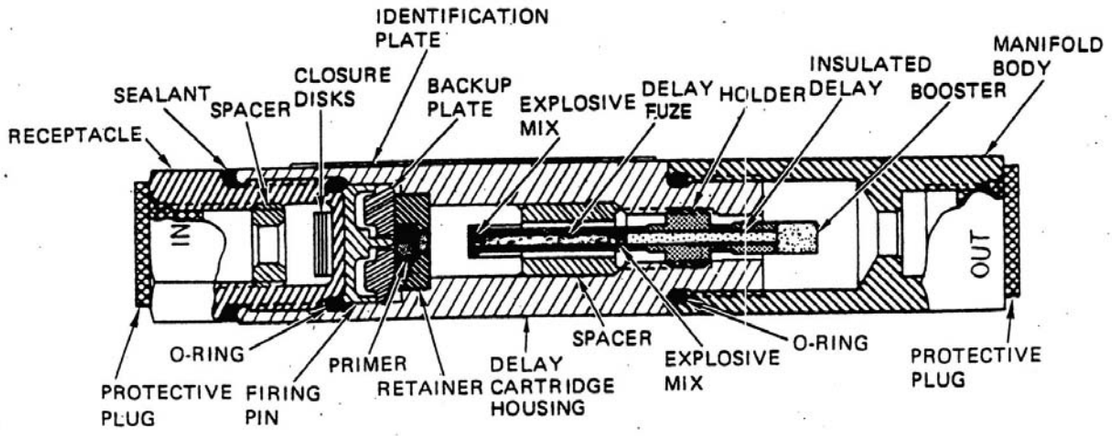


Figure 10. Delay Cartridge

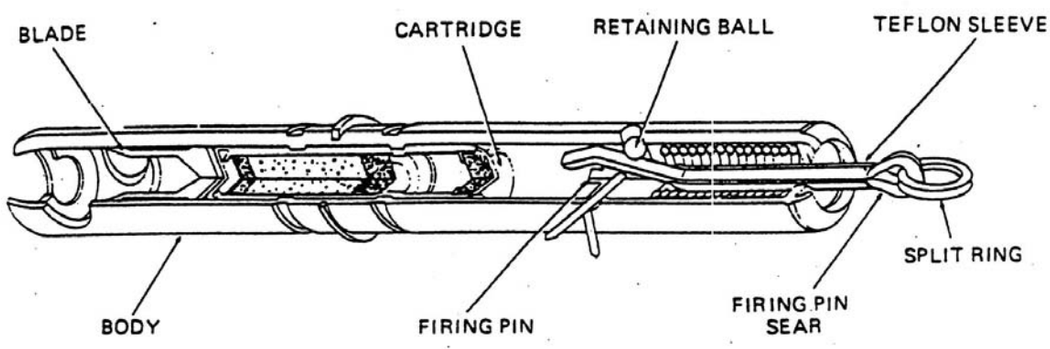


Figure 11. Cutter

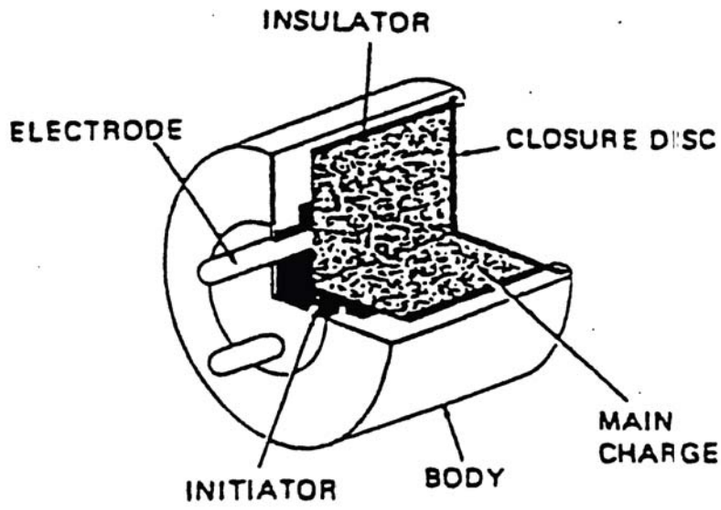


Figure 12. Aircraft Flare Ejection Cartridge

Appendix E:

Certification Index

AMS

- **Description:** The objective of the Aerospace Materials Specifications (AMS) are to provide guidelines and requirem ents for detailed production, interoperability and high quality manufacturing of parts and components used in aerospace technologies and equipment. AMS requirem ents clarify legal and regulatory grey areas; condense product development cycles and work to ensure consistency.
- **Source:** http://www.sae.org/standardsdev/aerospace/newamstd.htm

ANSI/ASQC Z1.4

- **Description:** The ANSI/ASQ Z1.4 standard, or Sampling Procedures and Tables Package, establishes sampling plans and procedures for inspection by variables and attributes for use in procurement, supply, storage and maintenance operations. Tables are provided to guide the process of measuring, examining and testing.
- **Source:** http://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2fASQ+Z1.4+and+Z1.9+-+Sampling+Procedures+and+Tables+Package

ANSI/ESD S20.2

- **Description:** The ANSI/ESD S20.2, Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices), developed by the Electrostatic Discharge Association, provides administrative and technical requirements for establishing, im plementing a nd m aintaining an Elect rostatic Discharge Control Program to protect electrical or electronic parts, assembles and equipment susceptible to ESD da mage from Hum an Body Model (HMB) discharges greater than or equal to 100 volts.
- **Source:** http://esda.org/Documents.html#s2020

ANSI/ISO/IEC 17025

- **Description:** The ANSI/ISO/IEC 17025 is a standard used by testing and calibration laboratories. It app lies to t hose organizations that produce testing and calib ration results using standard, non-standard and laboratory-developed methods. The requirements emphasize the responsibilities of senior management and provide requirements for continual improvem ent of the management syst em itself . The two main sections of the standard are Management Requirements and Technical Requirements. Management requirements are primarily related to the operation an deeffectiveness of the quality management system within the laboratory. Te chnical req uirements include factors that determine the corr ectness and reliability of the tests and calibrations performed in laboratory. Laboratories use ISO/IEC 17025 to implement a quality system aimed at improving their ability to consistently produce valid results.
- **Source:** http://webstore.ansi.org/RecordDetail.aspx?sku=ISO%2fIEC+17025%3a2005

DoD 5000

- **Description:** The DoD 5000, or the Defense Acquisition System, provides the management framework and mandatory policies/procedures for managing defense acquisition programs. An acquisition program is a directed, funded effort that provides a new, improved, or continuing material, weapon, information system, or service capability in response to an approved need. The Defense Acquisition System provides an event-based process where acquisition programs proceed through a series of milestones associated with significant program phases.
- **Source:** https://dap.dau.mil/aphome/das/Pages/Default.aspx

ISO 9000

- **Description:** The ISO 9000 family of standards, published by the International Organization for Standardization (ISO), addresses "quality management", providing guidance for organizations wanting to ensure their products and services fulfill customer needs and regulatory and statutory requirements, while quality is continuously improved. The ISO 9000 family of standards consists of standards and guidelines relating to quality management systems, how to make those systems more effective and efficient and how to conduct both internal and external audits of those systems.
- **Source:** http://www.iso.org/iso/iso_catalogue/management_and_leadership_standards/quality_management/iso_9000_essentials.htm

ISO 9001

- **Description:** ISO 9001 is an international standard that gives requirements for an organization's quality management system (QMS). The requirements cover a wide range of topics, including customer focus, organizational leadership, employee engagement, continual improvement efforts, decision making and supplier relationships. The ISO 9001 is the only standard in the ISO 9000 family that can be used for the purpose of conformity assessment.
- **Source:** http://www.iso.org/iso/iso_catalogue/management_and_leadership_standards/quality_management/more_resources_9000/9001supchain.htm#what_is_iso_9001

ISO 10012-1

- **Description:** ISO 10012 is an international standard that gives requirements and guidance for successful management of an organization's measurement processes and metrological confirmation of measuring equipment used to support and demonstrate compliance with metrological requirements. It specifies quality management requirements of a measurement management system that can be used by an organization performing measurements as part

of the overall management system. The ISO 10012 applies to testing laboratories, including those providing a calibration service, suppliers of products or services, and other organizations where measurement is used to demonstrate compliance with specified requirements.

- **Source:** http://www.iso.org/iso/iso_catalogue/catalogue_ics/catalogue_detail_ics.htm?csnumber=26033

ISO 14000

- **Description:** The ISO 14000 family addresses "Environmental management", providing tools to help organizations identify, control and improve their environmental performance. The standards deal with environmental management systems (EMS) by providing the requirements and guidelines for a successful EMS. Other standards in the ISO 14000 address specific environmental aspects, including: labeling, performance evaluation, life cycle analysis, communication and auditing.
- **Source:** http://www.iso.org/iso/home/standards/management-standards/iso14000.htm

J-STD-001DS

- **Description:** The J-STD-001DS standard is a "Space Applications Addendum" to J-STD-001D, Requirements for Soldered Electrical and Electronic Assemblies. The J-STD-001D standard describes materials, methods and verification criteria for producing high quality soldered interconnections and emphasizes process control and industry-wide consensus requirements for a broad range of electronic products. The standard works to ensure the quality and reliability of soldered electrical and electronic assemblies that must survive the vibration and thermal cyclic environments. The "Space Applications Addendum" ensures the reliability of said assemblies to survive the vibration and thermal cyclic environments required in getting to and operating in space.
- **Source:** http://www.ipc.org/4.0_Knowledge/4.1_Standards/J-STD-001DS-Amend1.pdf

MIL-Q-9858

- **Description:** MIL-Q-9858 was the standard in use prior to its cancellation in 1996 and subsequent replacement by ISO-9000/9001 and AS9100 for aerospace applications. MIL-Q-9858 required the establishment of a quality program by the contractor to assure compliance with the requirements of the contract. The program and procedures used to implement this specification were developed by the contractor. A government representative reviewed the quality program, including the procedures, processes and products. The specification required that the program assure adequate quality throughout all areas of contract performance including design, development, fabrication, processing, assembly, inspection, test, maintenance, packaging, shipping, storage, and site installation.
- **Source**: http://www.quality-control-plan.com/mil-q-9858-spec.htm

MIL-STD-45662A

- **Description:** The MIL-STD-45662A, cancelled in 1995, was the standard in use before the ISO-10012 and ANSI Z540.3 standards for Measurement and Calibration System Requirements. It provided guidance for selecting intervals for the frequency of calibrations, instrument checks, personnel, traceability, reference materials, environment, procedures, and records. The MIL-STD-45662A may still apply to legacy equipment and tooling.
- **Source:** http://www.kingsburycorp.com/?s=inav&p=mil-std_45662a

Nadcap

- **Description:** Nadcap, formerly the National Aerospace and Defense Contractors Accreditation Program, is a global cooperative that brings together experts from industry and government to develop standards for the aerospace and automotive industries. Nadcap establishes standardized accreditation and quality assurance requirements. These are meant to reduce redundant auditing and quality checks throughout the industry by both prime contractors and suppliers.
- **Source:** http://www.pri-network.org/Nadcap/

SAE AS9003

- **Description:** The AS9003, Inspection and Test Quality Systems, Requirements for Aviation, Space and Defense Organization standard contains the minimum requirements for an Inspection and Test Quality System and was intended for use by small build/machine to print organizations. The standard is a less-expensive alternative to SAE AS9100, designed for small suppliers providing "noncomplex" products, and the associated manufacturing processes. "Noncomplex" products are defined as those whose quality can be verified by the customer upon receipt, and associated processes.
- **Source:** http://standards.sae.org/as9003/

SAE AS9100

- **Description:** The SAE AS9100 standard includes ISO 9001 quality management system requirements and specifies additional requirements for quality management systems in the aerospace industry. The quality management system requirements specified in this standard are complementary (not an alternative) to contractual and applicable law and regulatory requirements AS9100 specifies requirements for a quality management system where an organization a) needs to demonstrate its ability to consistently provide product that meets customer and applicable regulatory requirements, and b) aims to enhance customer satisfaction through the effective application of the system, including processes for continual improvement of the system and the assurance of conformity to customer and applicable regulatory requirements.
- **Source:** http://standards.sae.org/as9100b/

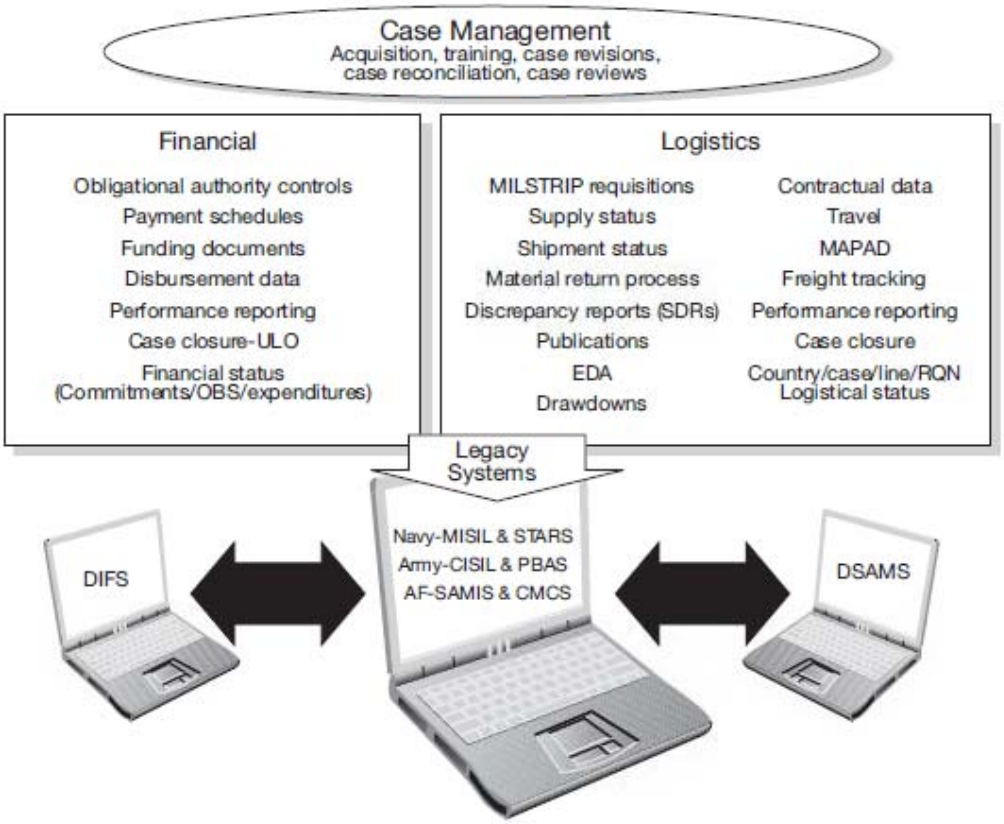
APPENDIX F:

Foreign Military Sales (FMS) Process

Foreign Military Sales (FMS) Process

The following chart illustrates the Foreign Military Sales Case Execution. Managing FMS cases includes acquisition, training, case revisions, case reconciliation, and case reviews. There are many financial and logistics transactions that occur during the life of an FMS case.

Figure 5-2
Foreign Miltary Sales Case Execution



Source: Defense Security Cooperation Agency. "Chapter 5, Foreign Military Sales Process" Security Assistance Management Manual. http://www.disam.dsca.mil/documents/greenbook/v31/05_Chapter.pdf

The following table outlines the stages of the FMS process.

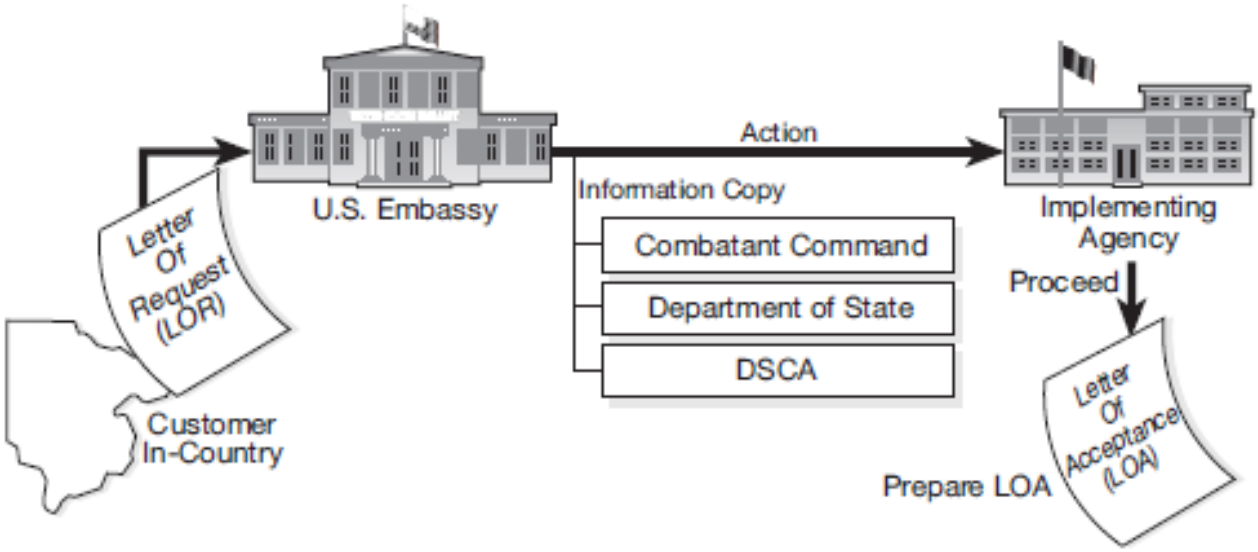
Table 5-1
Foreign Military Sales Process

Preliminary Indefinite Time Period	Customer identifies defense capability requirements Customer researches options/sources
Definition Indefinite Time Period	Customer refines requirements Customer and US exchange technical information
Request Indefinite Time Period	Customer prepares/submits Letter of Request (LOR) for Price and Availability (P&A) or LOA
Offer 75-120+ days Depends on complexity of case Congressional review 15-50 days	IA and DSCA receive and evaluate LOR IA develops LOA data (LOAD) DSCA Case Writing Division (CWD) "writes" LOA Congressional notification, if required, concurrent with LOA development DSCA-CWD countersigns LOA IA issues LOA to customer
Acceptance OED is generally 85 days from IA approval in DSAMS (by policy, includes at least 60 days for country review)	Customer signs LOA by Offer Expiration Date (OED) Customer sends signed LOA to the IA Customer sends signed LOA and Initial Deposit to Defense Finance and Accounting Service-Indianapolis (DFAS–IN)
Implementation 15 days average	DFAS–IN issues Obligational Authority (OA) IA issues implementing directive IA activates FMS computer systems
Execution Depends on delivery schedule Longest phase in the life of a case	Articles/services/training are ordered Articles shipped and services accomplished Training conducted IA reports performance to customer/DFAS–IN
Closure 2 years from supply/services complete (Accelerated Case Closure Procedures)	IA/DFAS/customer reconcile records IA sends closure certificate to DFAS–IN DFAS–IN issues final bill to customer

Source: Defense Security Cooperation Agency. "Chapter 5, Foreign Military Sales Process" Security Assistance Management Manual. http://www.disam.dsca.mil/documents/greenbook/v31/05_Chapter.pdf

The following figure shows the typical channels for a Letter of Request (LOR) for FMS Sales.

Figure 5-1. Channels of Request



Source: Defense Security Cooperation Agency. "Chapter 5, Foreign Military Sales Process" Security Assistance Management Manual. http://www.disam.dsca.mil/pubs/DR/05%20Chapter.pdf

Appendix G:

Effectiveness of Previous BIS CAD/PAD Assessments

Effectiveness of Previous BIS CAD/PAD Assessments

	YES	NO	NOT SURE
1. Have you experienced an improvement in your relations with the CAD/PAD Joint Program Office?	50% (11 of 22)	31.8% (7 of 22)	18.2% (4 of 22)
2. Has the CAD/PAD Joint Program Office provided defense budget forecasts for CAD/PAD devices?	27.3% (6 of 22)	54.5% (12 of 22)	18.2% (4 of 22)
3. Has the CAD/PAD Joint Program Office briefed you on technical developments and new requirements?	41% (9 of 22)	54.5% (12 of 22)	4.5% (1 of 22)
4. Has the CAD/PAD Joint Program Office provided a forum for you to discuss and address grievances?	36.4% (8 of 22)	36.4% (8 of 22)	27.3% (6 of 22)
5. Have you experienced an improvement in your relations with the Labor Dept.'s Office of Safety and Health Administration (OSHA)?	13.6% (3 of 22)	31.8% (7 of 22)	54.5% (12 of 22)
6. Have you experienced an improvement in your relations with the U.S. State Dept.'s Directorate of Defense Trade Controls (DDTC)?	31.8% (7 of 22)	36.4 (8 of 22)	31.8% (7 of 22)
7. Have you experienced an improvement in your relations with the Environmental Protection Agency (EPA)?	9.5% (2 of 21)	33.3% (7 of 21)	57.1% (12 of 21)
8. Has the CAD/PAD Joint Program Office contracted out a larger portion of product development and improvement to the CAD/PAD industry?	13.6% (3 of 22)	40.9% (9 of 22)	45.5% (10 of 22)
9. Has the CAD/PAD Joint Program Office implemented other policies that improved the CAD/PAD procurement environment?	9.1% (2 of 22)	50% (11 of 22)	40.9% (9 of 22)
10. Have you experienced improvements in the lot acceptance testing process?	22.7% (5 of 22)	68.2% (15 of 22)	9.1% (2 of 22)
11. Does industry receive at least 90 percent of overall CAD/PAD orders?	4.5% (1 of 22)	9.1% (2 of 22)	86.4% (19 of 22)
	Needs Improvement	Useful	
12. Are the Technical Exchange Workshops hosted by the CAD/PAD Joint Program Office useful to you, or do they need improvement?	35% (7 of 20)	65% (13 of 20)	
	Helps	Hurts	Neither
13. Does second-sourcing of CAD/PAD business help or hurt your company?	47.6% (10 of 21)	28.6% (6 of 21)	23.8% (5 of 21)

Source: U.S. Department of Commerce, Bureau of Industry and Security, National Security Assessment of the U.S. CAD/PAD Industry-2013

Appendix H:

U.S. Department of Commerce, BIS/OTE Publication List

OFFICE OF TECHNOLOGY EVALUATION (OTE)

PUBLICATIONS LIST

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

PUBLICATION TITLE	**Bold* indicate forthcoming studies
Strategic and Critical Materials Supply Chain Assessment – Spring 2014	
Cost-Metric Assessment of Diminishing Manufacturing Sources and Material Shortages (Update) – Winter 2013	
Defense Industrial Base Assessment of the U.S. Underwater Acoustics Transducer Industry – Fall 2013	
Assessment of the U.S. Space Industrial Base Supply Chain – Fall 2013	
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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