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High-Technology and Cosmopolitan Companies in the Federal Supply Chain

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High-Technology and Cosmopolitan Companies in the Federal Supply Chain

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Abstract

Using a combination of USASpending.gov, SAM.gov, and BLS.gov data, the following research investigates two aspects of the defense industrial base. The first, a recognizable yet little operationalized concept, innovation, is often associated with new technologies and has become an important focus of defense acquisition in recent years. Unfortunately, research and policy efforts have been hindered by a lack of rigorous definition and application to present-day industry classifications. To address this shortcoming the author applied a STEM-occupation methodology developed by the U.S. Bureau of Labor Statistics to identify core and peripheral high-technology industries (as a surrogate for innovation). The second concept, newly introduced in this study, describes the existence of companies that perform work for both defense and non-defense agencies. Borrowing a term from biogeology, these contractors are dubbed "cosmopolitan," as in having a broad operating range as opposed to those contractors that are endemic to only one contracting environment. Key characteristics of these cosmopolitan contractors are presented, and their potential importance to future research is highlighted. Finally, the results of both research efforts are used to produce a report to show how these concepts can serve a practical purpose and potential follow-on empirical research is discussed.

Keywords: Innovation, High-technology, STEM, Cosmopolitan, Defense Industrial Base

Background

The composition of the U.S. defense industrial base (DIB) has recently attracted much scholarly and policy interest. The DIB is defined by the Congressional Research Service as "all organizations and facilities that provide [Department of Defense] DOD with materials, products, and services" (Congressional Research Service, 2023, p. 1). There has been a particular focus on the concept of innovation within the DIB, most obviously embodied in the proliferation of rapid acquisition programs and policies to adopt commercial technologies. The DoD has also pursued efforts to increase the participation of small businesses and non-traditional contractors because they are often viewed as a source of fresh thinking and innovation. This view is broadly supported by the federal government that believes stronger supply chains can be built through a "greater focus on new and recent contractors that—along with established contractors—can regularly provide fresh innovative thinking and seasoned expertise to support agencies in addressing national priorities" (U.S. Office of Management and Budget, 2023, p. 1).

Two observations, at least germane to this paper, can be made about the present situation. First, innovation and technology are often used interchangeably or in combination in many DoD departments, policies, and resources. For example, the DoD's "defense innovation policy aims to improve warfighting capabilities through adopting technologies and processes" (DoD, n.d.), and the Defense Innovation Board is focused on "emerging technologies and innovative approaches" (Defense Innovation Board, n.d.). Despite the obvious emphasis on technology, there are limitations for research and policy development because at an industry level the concept has not been well defined or operationalized. Second, the clear focus of these programs is on commercial companies that exist outside the federal contracting sphere; little attention has been paid to existing non-defense federal contractors that have at least already learned how to operate in the world of federal contracting. This represents both a gap in conceptual understanding and a potential missed resource.

The following paper details two research efforts that seek to address these issues. The first is focused on the idea of "high-technology" as a surrogate for innovation, and the other introduces the concept of "cosmopolitan" companies that do both defense and non-defense work.[1] The aim of the first research effort involving "high-technology" is to provide a framework for more rigorous research, policy development, and acquisition efforts. The aim of the second research effort involving "cosmopolitan" is to introduce a new concept that appears to offer promising avenues of future research. Each research effort is first independently described in full (background, data source, method, and results). The two efforts then converge with an example report that exemplifies their potential benefit, and the paper concludes with a series of recommendations for how the concepts can be applied in future research.

Research Effort #1: High-Technology Industries

Innovation: Concept and Practice

Innovation as a concept is a pervasive yet ubiquitous term, often used to describe everything ranging from outcomes, products, processes, business models, organizational structures, or even mindsets (Kahn, 2018). To that end, there is no single, unitary theory of innovation but rather different theories that seek to explain different aspects of innovation (Downs Jr. & Mohr, 1976). A large number of typologies for innovation have been developed: radical vs. incremental, original vs. borrowed, expansionary vs. evolutionary vs. developmental, administrative, product, process, and technological (Jaskyte, 2011). Innovation also features prominently in large scales that rely on measures like number of patents; for example, the Global Innovation Index (World Intellectual Property Organization, 2024) and the National Innovative Capacity Index (Porter & Stern, 2001). At the scholarly level, there are often strict parameters for how innovation is defined and measured, but because there are hundreds of potential conceptual distinctions it can be difficult to apply to daily decision-making.

In the defense world, the concept of innovation is most strongly associated with the adoption of new technologies, with a recent emphasis on commercial and dual-use technologies. For example, the Congressional Research Service has defined the defense innovation ecosystem as "the set of organizations, activities, functions, and processes that develop, produce, and field new or improved *technologies* [emphasis added] and capabilities for military use" (Congressional Research Service, 2025, p. 1). To that end, dozens of defense-sponsored innovation initiatives such as the Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) program have sought to increase the presence of innovative companies in the military's industrial base. Indeed, so many separate organizations have been established that the Defense Innovation Unit has recently become the focal point for commercial technologies, responsible for coordinating efforts in this area across more than 100 other military service organizations (United States General Accounting Office, 2025).

While the concept of innovation is clear, and its association with technology made evident, it is often not rigorously defined or adequately operationalized in practice, especially at the industry level. This shortcoming means that practical-minded research that touches on this topic often must take methodological shortcuts. For example, Bresler and Bresler (2020) noted

[1] According to the Congressional Budget Office, DoD spending accounts for nearly all the nation's defense budget (Congressional Budget Office, n.d.). Therefore, the term "defense" in this paper is synonymous with DoD and "non-defense" refers to all other federal agencies combined.

that associating product and services codes (PSCs) with innovation is subjective, and only briefly considered the “most obvious ‘non-innovative’ PSCs” to get a sense that the majority of new DIB vendors were not innovative commercial technology companies. This cursory approach, almost certainly born out of necessity, highlights the need to more rigorously distinguish “innovation” in defense acquisition research. Thankfully, the close association between innovation and technology offers a way forward. Although it is dated, some work has been done in this realm by the U.S. Bureau of Labor Statistics (BLS) relying on employment statistics. This paper therefore adopts “high-technology” as a surrogate for innovation and uses the BLS method to identify those industries that would be of keenest interest to DoD practitioners and researchers.

Technology: A Surrogate for Innovation

Previous research has made efforts to define and measure high-technology industries; one such approach relies on measures of the proportion of technical jobs in science, technology, engineering, and mathematics (STEM) within an industry. STEM occupations heavily involve the fields of computers, mathematics, architecture, engineering, and life and physical sciences, as well as managerial and postsecondary teaching occupations related to these functional areas and sales occupations requiring scientific or technical knowledge at the postsecondary level (U.S. Bureau of Labor Statistics, 2024b). Computer-related occupations such as computer support specialists, systems analysts, and software engineers have historically made up roughly half of all STEM employment (Cover et al., 2011; Fayer et al., 2017). The Occupational Employment and Wage Statistics (OEWS) program at BLS annually produces employment and wage estimates, including for STEM and non-STEM occupations, for approximately 830 occupations. See *Appendix 1* for the list of STEM occupations according to the 2018 Standard Occupational Classification (SOC) system.

The North American Industry Classification System (NAICS), which is the business classification standard used by federal agencies since 1997 to conduct statistical analyses related to the U.S. business economy (U.S. Census Bureau, 2022), does not itself distinguish high-technology industries. However, relying on BLS STEM data, high-technology industries can be identified as industries having a higher-than-average concentration of workers in STEM occupations. The philosophy underpinning this approach is that “a country’s competitive position will be largely determined by the quality of its investment in human and capital resources dedicated to science and technology” (National Science Foundation, 1989, p. vii). Indeed the outsized importance of high-technology industries for the U.S. economy has been noted in various studies; for example, in 2014 while they accounted for about 12% of total national employment those industries contributed almost 23% to output (Wolf & Terrell, 2016). Based on this, a National Science Foundation report on science and technology resources considered the employment and utilization of scientists, engineers, and technicians as one of the most important parameters of innovation and used it, along with measures of R&D activity, as surrogates for the broader concept of innovation (National Science Foundation, 1989).

This framework has been used by BLS researchers and others in a series of publications on the topic (Economic and Labor Market Information Bureau, New Hampshire Employment Security, n.d.; Hecker, 1999, 2005; Workforce Information Council, 2015). Hecker (2005) defined an industry as high-technology if the proportion of employment in technology-oriented occupations (i.e., STEM occupations) within that industry accounted for at least twice the 4.9% average for all industries at that time. He then established three levels of high-technology based on 2.0 to 2.9 times the average, 3.0 to 4.9 times the average, and at least 5 times the average. The result was 46 total industries identified as high-technology. The Workforce Information Council (2015) similarly calculated two levels of high-technology: core concentration defined as industries with at least 5 times average concentration in STEM occupations and peripheral concentration as industries with at least 2.5 times the national average. The result was 33 industries identified as high-technology, which was later replicated by Wolf and Terrell (2016) when they used the same threshold of two and a half times the national average. High-technology industries are therefore similarly defined in this study as those industries with a high proportion of STEM occupations compared to the national average.

There are two issues worth noting about the usefulness of prior research in this area, both dealing with datedness. One issue is that the nationwide average STEM employment has changed over time, as well as the proportion of STEM employment within individual industries. For instance, Hecker (2005) reported a 4.9% average for all industries, Cover et al. (2011) reported about 6% (nearly 8 million jobs) in 2009, and Fayer et al. (2017) reported 6.2% (nearly 8.6 million jobs) in 2015. This means that high-technology industries have likely shifted to some extent over time as STEM employment naturally fluctuates. The other issue is that NAICS codes undergo updates every five years; the most recent update was conducted in 2022. Hecker (2005) used the 2002 NAICS list, a list of high-technology titles built by the Economic and Labor Market Information Bureau, New Hampshire Employment Security (n.d.) adjusted the industries to accommodate the 2017 NAICS revision but did not re-run Hecker's underlying analysis, and the Workforce Information Council (2015) presumably used the 2012 list (although it was not specified) and reran the analysis using different levels than Hecker (2005). Therefore, to the author's best knowledge, no recent analysis has applied the BLS methodology to current employment data, taking into account up-to-date NAICS, which means that the prior, limited work done to identify high-technology industries is likely outdated.

Data and Method

First, the author downloaded the most recent set of BLS OEWS occupation profiles and tables, released on April 3, 2024, including an aggregated STEM data set containing national and industry-level STEM employment data (U.S. Bureau of Labor Statistics, 2024a). These files incorporate current NAICS, thereby ensuring the raw data reflect present day industry classifications. The author also downloaded files related to the SOC Policy Committee recommendations to the Office of Management and Budget (OMB) that provided a framework for defining STEM occupations under the 2018 SOC system (U.S. Bureau of Labor Statistics, 2019a, 2019b). The author then applied the STEM-occupation methodology used in previous research to identify peripheral and core high-technology industries using two thresholds of STEM concentrations: two and a half times and five times the national average of STEM employment, respectively.

Results

According to BLS OEWS data, the national average for STEM occupations was 6.7% of total employment, representing 10,165,900 jobs. Two levels of high-technology industries were calculated, (a) peripheral: two and a half to five times the national average, which constitutes 16.74% to 33.47% of industry employment, and (b) core: greater than 5 times the national average, which represents more than 33.47% STEM employment in the industry. Twenty-six high-technology industries (15 peripheral and 11 core) were identified (see Table 1). For interested readers, a second table displaying the same core industries but with 26 peripheral industries defined at two times the national average (constituting 13.39% to 33.47% of industry employment) is provided in Appendix 2.

Table 1. High-Technology Industries (Core=5x, Peripheral=2.5x)

NAICS code	Industry	STEM % of employment	High-Tech Level
541500	Computer Systems Design and Related Services	59.7	Core
541300	Architectural, Engineering, and Related Services	59.5	Core
541700	Scientific Research and Development Services	55.9	Core
513200	Software Publishers	55.8	Core
334100	Computer and Peripheral Equipment Manufacturing	49.8	Core
518200	Computing Infrastructure Providers, Data Processing, Web Hosting, and Related Services	47.2	Core
519200	Web Search Portals, Libraries, Archives, and Other Information Services	44.7	Core
334500	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	38.1	Core
334200	Communications Equipment Manufacturing	37.8	Core
334400	Semiconductor and Other Electronic Component Manufacturing	34.9	Core
334600	Manufacturing and Reproducing Magnetic and Optical Media	33.9	Core
336400	Aerospace Product and Parts Manufacturing	32.2	Peripheral
423400	Professional and Commercial Equipment and Supplies Merchant Wholesalers	29.5	Peripheral
334300	Audio and Video Equipment Manufacturing	27.1	Peripheral
521100	Monetary Authorities-Central Bank	27.0	Peripheral
325400	Pharmaceutical and Medicine Manufacturing	26.6	Peripheral
516200	Media Streaming Distribution Services, Social Networks, and Other Media Networks and Content Provide	24.7	Peripheral
517000	Telecommunications	22.5	Peripheral
333600	Engine, Turbine, and Power Transmission Equipment Manufacturing	22.0	Peripheral
333300	Commercial and Service Industry Machinery Manufacturing	20.3	Peripheral
551100	Management of Companies and Enterprises	18.9	Peripheral
211100	Oil and Gas Extraction	17.9	Peripheral
541600	Management, Scientific, and Technical Consulting Services	17.8	Peripheral
4240A2	Merchant Wholesalers, Nondurable Goods (4242 and 4246 only)	17.4	Peripheral
999100	Federal Executive Branch (OEWS Designation)	17.1	Peripheral
221100	Electric Power Generation, Transmission and Distribution	16.8	Peripheral

Note. Core = Industries with at least five times the national average concentration in STEM occupations; Peripheral = Industries with at least two and a half times the national average concentration in STEM occupations.

In short, this industry list provides a way to systematically identify suppliers that operate in high-technology, or innovative, fields that are deemed critical to the health of the DIB.

Research Effort #2: "Cosmopolitan" Companies

Background

Various aspects of the depth and extent of company participation in the federal workplace have been investigated to-date. Josephson et al. (2019) examined the performance implications of companies with varying levels of government customer breadth and depth across federal agencies. In their study, Carril and Duggan (2020) concluded that industry concentration resulting from company mergers has caused the DoD procurement process to become less competitive and to induce a shift from the use of fixed-price towards cost-plus contracts, although these impacts did not appear to produce a significant increase in acquisition costs. A study by the Baroni Center for Government Contracting relied on a large-scale survey of presumably exited contractors to investigate reasons for declining contractor participation in the DIB (Hyatt & Everhart, in press). The following research effort described here extends this limited work but is exploratory in nature. It introduces a new concept, a "cosmopolitan" contractor, and explores some of the basic characteristics of this type of contractor to justify its potential importance for future research.

This effort leans on concepts from biogeology, an integrative field that studies the distribution of species across space and time. A cosmopolitan species is one that can survive in a range of climates or environments. As examples, pigeons can be found in most urban areas around the world, and migratory animals such as orcas, blue whales, and great white sharks range across every major oceanic body on Earth (Wikipedia, 2024). Alternatively, an endemic species, like the snow leopard of Central Asian mountain ranges, is found in a single environment and is usually specifically adapted to exist in only that environment. Borrowing these terms, the author defines a “cosmopolitan” company as one that does both defense and non-defense work (i.e., performs on contracts for both DoD and non-DoD agencies). Endemic companies are those that work exclusively on either defense or non-defense contracts. The intimation here is that cosmopolitan companies can work in a broader range of environments, as there are unique requirements, policies, and standards for being a defense contractor above and beyond being a federal contractor.

Data and Method

The author relied on several data sources for the raw data to conduct the analysis. USASpending.gov contains contract transaction data for nearly all federal government prime contract awards since Fiscal Year 2001. These data for all fiscal years were downloaded in early 2024 using the Award Data Archive. SAM.gov provides data on all active contractors as well as contractors that have become inactive during the previous six months. These data were downloaded in early 2024 to obtain the primary NAICS reported by companies. All computations were run using IBM SPSS Statistics (Version: 29.0.0.0), and all figures and tables were created using Microsoft Excel 360. None of the dollar figures in this section have been adjusted for inflation since the important calculations are proportions. A complete list of unique companies and their defense and non-defense obligations in every fiscal year from FY2001 to FY2023 was generated, thereby identifying cosmopolitan and endemic companies over the time period.

Results

First, the number of unique endemic companies performing either only defense work or only non-defense work, and the number of cosmopolitan companies working in both realms, from FY2001–2023 were calculated (see Figure 1). Then, the number of endemic and cosmopolitan contractors and the amount of dollars obligated to each group for each Fiscal Year was assessed (see Table 2). Finally, the author identified key characteristics of all three types of companies, although the analysis was limited to only FY2023 for ease of computation (see Table 3). Characteristics that were identified include average and median amount of contract obligations, company size (small vs. other-than-small), organization type, commodity (based on PSC), and industry (based on NAICS).

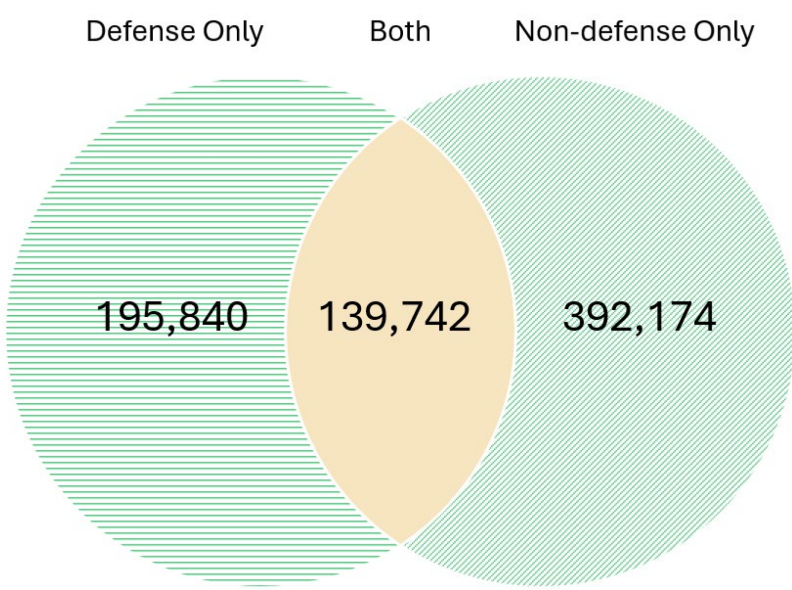

Figure 1. Unique Contractors: Defense Only, Non-Defense Only, and Both (FY2001–2023)

One of the most important conclusions from these numbers is that cosmopolitan contractors that provide products or services to both the DoD and other federal agencies (rather than exclusively to one or the other) have constituted approximately 16% of the total federal contractor base since FY2012, but they have accounted for roughly 60% of all federal obligations during that time. Their outsized presence in the federal supply chain indicates the importance of investigating cosmopolitan contractors and their unique experiences of contracting for both civil and defense agencies. The cohort of cosmopolitan companies is also clearly different from the other two endemic groups of contractors in some respects. For example, they appear more likely to not only provide services but also provide a higher proportion of R&D work, and they are more likely to be a not-tax-exempt corporation. Observations like these should be investigated further to see if there are other effects that result from these differences.

Table 2: Endemic and Cosmopolitan Companies per Year, FY2001–FY2023

	Endemic								Cosmopolitan			
	Defense Only				Non-defense Only				Both			
Year	Contractors (#)	Contractors (% of total)	Obligations ($ in millions)	Obligations (% of total)	Contractors (#)	Contractors (% of total)	Obligations ($ in millions)	Obligations (% of total)	Contractors (#)	Contractors (% of total)	Obligations ($ in millions)	Obligations (% of total)
FY2001	29,623	39%	72,548	33%	38,198	50%	46,518	21%	8,089	11%	103,892	47%
FY2002	40,483	45%	81,920	31%	39,253	44%	52,873	20%	9,814	11%	129,383	49%
FY2003	50,987	45%	105,318	32%	49,754	44%	60,964	19%	12,576	11%	158,635	49%
FY2004	57,353	39%	106,579	31%	70,694	48%	55,557	16%	18,451	13%	177,064	52%
FY2005	68,376	38%	116,305	30%	85,867	48%	59,109	15%	24,483	14%	215,722	55%
FY2006	62,121	33%	131,518	31%	97,383	52%	66,874	16%	27,417	15%	232,612	54%
FY2007	62,796	32%	140,127	30%	101,667	53%	65,605	14%	29,135	15%	263,887	56%
FY2008	61,619	31%	158,166	29%	105,991	54%	63,544	12%	30,035	15%	320,154	59%
FY2009	62,613	33%	161,262	30%	100,196	52%	77,771	14%	28,690	15%	301,746	56%
FY2010	60,316	31%	148,431	26%	103,371	54%	97,033	17%	28,924	15%	315,885	56%
FY2011	57,312	30%	139,479	26%	102,889	55%	76,462	14%	28,183	15%	323,907	60%
FY2012	52,914	31%	146,847	28%	91,888	53%	69,137	13%	27,160	16%	304,718	59%
FY2013	46,697	30%	109,770	24%	86,187	55%	68,232	15%	25,110	16%	285,547	62%
FY2014	44,207	29%	109,927	25%	84,355	55%	71,886	16%	24,703	16%	264,437	59%
FY2015	43,270	29%	103,346	24%	82,903	55%	73,050	17%	24,498	16%	263,297	60%
FY2016	41,784	28%	108,247	23%	82,082	56%	78,484	17%	23,886	16%	288,403	61%
FY2017	39,531	26%	117,622	23%	88,282	58%	87,712	17%	24,016	16%	305,148	60%
FY2018	38,398	28%	135,160	24%	75,610	56%	83,406	15%	22,104	16%	337,250	61%
FY2019	36,777	29%	144,122	24%	68,002	54%	84,184	14%	20,378	16%	361,871	61%
FY2020	34,702	28%	149,178	22%	68,104	56%	120,660	18%	19,180	16%	401,330	60%
FY2021	33,539	29%	139,539	22%	64,956	56%	127,010	20%	18,501	16%	378,820	59%
FY2022	30,787	28%	167,193	24%	62,493	56%	131,589	19%	17,745	16%	395,500	57%
FY2023	30,466	28%	182,101	24%	61,231	56%	145,225	19%	17,699	16%	431,768	57%

Table 3: Endemic and Cosmopolitan Companies, Characteristics, FY2023

Attribute	Characteristic	Defense Only	Non-defense Only	Both
Obligation	Dollars (average)	$101,856	$315,958	$97,649
	Median (median)	$494	$969	$315
Size	Small Business	21,817 (67%)	42,719 (65%)	14,548 (63%)
	Other than Small Business	10,715 (33%)	22,581 (35%)	8,551 (37%)
Organization Type	Corporate (not tax exempt)	18,782 (61%)	33,311 (54%)	13,370 (70%)
	Corporate (tax exempt)	1,475 (5%)	3,308 (5%)	831 (4%)
	Foreign government	45 (0%)	49 (0%)	5 (0%)
	International organization	662 (2%)	645 (1%)	103 (1%)
	Partnership	4,090 (13%)	7,811 (13%)	2,063 (11%)
	Sole proprietorship	3,011 (10%)	10,343 (17%)	749 (4%)
	US government entity	660 (2%)	1,752 (3%)	292 (2%)
	Other	2,166 (7%)	4,259 (7%)	1,748 (9%)
Commodity	Product	33,188 (59%)	65,181 (56%)	10,207 (39%)
	Service	20,507 (36%)	49,546 (43%)	13,994 (53%)
	Research and Development	2,783 (5%)	1,827 (2%)	2,280 (9%)
Industry	Agriculture, Forestry, Fishing and Hunting	113 (0%)	3,569 (4%)	330 (0%)
	Mining, Quarrying, and Oil and Gas Extraction	217 (0%)	190 (0%)	206 (0%)
	Utilities	517 (1%)	954 (1%)	554 (1%)
	Construction	3,995 (6%)	6,698 (8%)	5,792 (7%)
	Manufacturing	43,282 (62%)	15,602 (19%)	37,946 (43%)
	Wholesale Trade	407 (1%)	1,504 (2%)	1,956 (2%)
	Retail Trade	381 (1%)	518 (1%)	852 (1%)
	Transportation and Warehousing	1,527 (2%)	2,518 (3%)	1,661 (2%)
	Information	1,203 (2%)	4,004 (5%)	4,929 (6%)
	Finance and Insurance	44 (0%)	534 (1%)	118 (0%)
	Real Estate and Rental and Leasing	694 (1%)	1,627 (2%)	949 (1%)
	Professional, Scientific, and Technical Services	7,482 (11%)	21,734 (26%)	18,782 (21%)
	Management of Companies and Enterprises	2 (0%)	5 (0%)	3 (0%)
	Administrative & Support and Waste Management & Remediation Services	3,625 (5%)	8,241 (10%)	5,865 (7%)
	Educational Services	1,125 (2%)	2,244 (3%)	2,003 (2%)
	Health Care and Social Assistance	560 (1%)	4,813 (6%)	1,189 (1%)
	Arts, Entertainment, and Recreation	318 (0%)	647 (1%)	189 (0%)
	Accommodation and Food Services	1,728 (2%)	879 (1%)	370 (0%)
	Other Services (except Public Administration)	2,576 (4%)	4,843 (6%)	4,109 (5%)
	Public Administration	268 (0%)	1,054 (1%)	377 (0%)

Note. The numbers within each attribute are inflated because companies may exhibit more than one characteristic depending on their contracts. For example, some companies have contracts designating them alternatively as a "Small Business" and an "Other than Small Business"; those companies are therefore counted in both categories. Totals may not add to 100% due to rounding.

Output Combining Both Research Efforts

Non-Defense Companies in High-Technology Industries: An Untapped Resource

In lieu of further empirical exploration, the following is offered as an example of what can be done practically with the concepts of high-technology industries and cosmopolitan companies. It has been noted that 75% of SAM.gov registered entities do not receive an award in any given fiscal year (U.S. Office of Management and Budget, 2023). Given the importance of experience for companies to be competitive for RFPs, even more potentially valuable for DoD officials would be those companies that have at least received non-defense awards in their past. If it were possible to identify these companies, they would represent a more viable, immediate source of "new blood" than purely commercial companies. To that end, the author generated a report of companies that are solely in non-defense work and thereby represent potential future suppliers for DoD. This kind of report can facilitate both outreach and acquisition efforts; it is probably most useful for defense policy makers interested in targeted industry engagement and for contract officers who conduct market research for new contractors to notify of bidding opportunities. It should be noted that the following is a static report, and thereby best treated as a proof of concept because its usefulness will diminish with time. If it proves useful, a dynamic version could be built using real-time SAM.gov data to accompany other market research tools available for contract officers (e.g., Government-wide Procurement Equity Tool and the Periodic Table of Acquisition Innovations (PTAI)).

Two excerpts of the report are included in Appendix 3 and Appendix 4, and the full list is available upon request from the author (length and size limitations prohibit including it in this paper). The excerpts use the four six-digit NAICS (541511, 541512, 541513, 541519) that embody the most highly concentrated high-technology NAICS: 541500 (Computer Systems Design and Related Services) and only include companies that had FY2023 contract actions to reference the most recently existing companies. The initial list produced 5,643 total companies; these would probably be the companies of greatest interest for a defense contract officer conducting market research. This list was then compared against the list of companies that have only done non-defense work for their entire contractor life to remove any companies that might have done "Both" work at some point in their past. This further narrowed the list to 3,716 companies, of which 15 were pulled at random for presentation-sake in the excerpts. In short, the excerpts include examples of companies that (a) perform work in a high-technology industry, (b) have only done non-defense work their entire federal contractor life, and (c) have operated as recently as FY2023.

The first excerpt shows the simple presence of companies, with an "X" in a given Fiscal Year indicating that the company was present with contract action(s) in USASpending.gov data. What might be of more use to contract analysts, however, is the amount of money these companies have earned each year. This is because in any given year a company may not have earned any money even though they technically exist as a contractor in the dataset. For example, if an analyst were searching for contractors in 541512 (Computer Systems Design Services), one of the three companies in the sample (Z8W6PBA8MKY4) looks more promising than the other two (HP47D5ZH4U85 and CDKHHKUY4KK6) based on the total dollars earned, even though all three companies have some experience as federal contractors.

Limitations, Contributions, and Future Research

There are at least two study limitations worth highlighting. First, for ease of data exploration only the self-reported primary NAICS from SAM.gov was used to identify the industry in which a company was doing work, and therefore to determine if it operated in a high-technology industry. This information is certainly not as comprehensive as relying on contract-level data since companies may have completed actual work in a different industry or industries. Therefore, a more thorough examination would utilize all NAICS associated with companies based on USASpending.gov contract transaction data. While this is possible given the state of development of the files used for this study, it would require an extensive amount of additional work to complete. Second, the five largest DoD companies have accounted for roughly 30% of defense contractor obligations since 2013 (Semler, 2023). These companies almost certainly do non-defense federal work as well and would therefore be represented in the cosmopolitan pool of contractors. The weighty presence of these companies in defense work might sway the results; how much so remains a matter of conjecture at this point, but it should be investigated. All the exploratory tests above should be rerun without those five companies (and their child companies) to ensure the results still hold.

The first research effort makes an important contribution by applying an established method to present day employment statistics for defining high-technology industries, which is itself an acknowledged surrogate for innovative industries. This provides a rigorous foundation for future empirical research involving the concepts of technology and, importantly, innovation. The second research effort, given its relative nascency, is more limited in its immediate practical contribution. The usefulness of the concept of cosmopolitan companies to researchers and policymakers has yet to be fully explored through empirical research. The groundwork has been laid, but evidence of its full value remains in the unknown future with potential work described below. However, as an example of practical output of the research, a report was produced of companies in high-technology industries that are exclusively doing work for non-defense agencies. These high-technology endemic companies are ideal candidates to become future DIB suppliers through DoD outreach and notification of bidding opportunities.

The most intuitive recommendation for future research is to extend the existing study by fully capitalizing on the concepts of cosmopolitan and high-technology companies. This could be done in several ways, and some of this groundwork has already been developed by the author along with a colleague at the GMU Baroni Center for Government Contracting, Olivia Letts.

In one case, we have started work to investigate the cost differential for being a defense contractor above and beyond being a contractor for other federal agencies. There is an ongoing concern that DoD regulations represent a cost premium that limits the attractiveness of being a defense contractor, but there appears to have been little empirical research on the subject since the Coopers and Lybrand (1994) study. Cosmopolitan companies that straddle the defense and non-defense government contracting worlds are uniquely positioned to provide insight into the challenges and benefits of being a defense contractor. As a head start on this work, the author has identified those companies that shifted to both defense and non-defense work since FY2019 after only previously performing endemically on non-defense contracts. This initial result of 3,867 companies that became cosmopolitan during the last five years was then further narrowed to distinguish those companies working in high-technology industries, which has resulted in a final dataset of 1,358 recently transitioned cosmopolitan high-technology companies. Future research can involve surveys and/or interviews to investigate questions like what barriers to entry were uniquely difficult to overcome, what are the perceived and real costs of becoming a defense contractor, and which DoD-specific issues exist beyond baseline federal contracting challenges.

Another extension of the present research would be to conduct additional quantitative analyses on the existing cohorts of endemic and cosmopolitan companies to address questions like whether the longevity, depth of involvement (based on obligations), or mere presence as a government supplier in prior years is predictive of becoming a DoD supplier. Of specific interest for DoD officials would be whether and how cosmopolitan high-technology companies differ from non-defense endemic ones. This knowledge would help to predict which endemic companies might be most apt to become future DIB contractors, and would facilitate targeted outreach campaigns of innovative, non-defense contractors. The list of high-technology NAICS from research effort #1 can also be leveraged for future research, examining questions like how the DoD compares to the rest of the federal government and how the ebb and flow of contractors in these critical, innovative industries has evolved in recent years. In short, all the statistics presented in this paper are descriptive; they can be readily augmented with arguably more useful predictive statistics in the future.

In conclusion, further research in this vein would be significant to the acquisition community because any differences in government-wide contracting versus defense-only contracting are likely contributors to the broader issue of attracting and retaining critical suppliers in the defense industrial base.

Appendix 1: STEM Occupations

Type of Occupation	Occupation
Research, Development, Design, or Practitioner Occupations	15-1200 Computer Occupations, except 15-1230 Computer Support Specialists and *15-1299 Computer Occupations, All Other*
	15-2000 Mathematical Science Occupations, except *15-2099 Mathematical Science Occupations, All Other*
	17-2000 Engineers
	19-1000 Life Scientists
	19-2000 Physical Scientists
	19-3000 Social Scientists and Related Workers, except 19-3093 Historians
	17-1010 Architects, Except Naval
	29-1000 Health Diagnosing and Treating Practitioners
	29-9000 Other Healthcare Practitioners and Technical Occupations, except *29-9020 Health Information Technologists and Medical Registrars* and *29-9099 Healthcare Practitioners and Technical Workers, All Other*
Technologist and Technician Occupations	15-1230 Computer Support Specialists
	15-1299 Computer Occupations, All Other
	15-2099 Mathematical Science Occupations, All Other
	17-1020 Surveyors, Cartographers, and Photogrammetrists
	17-3000 Drafters, Engineering Technicians, and Mapping Technicians
	19-4000 Life, Physical and Social Science Technicians, except 19-4060 Social Science Research Assistants
	19-4060 Social Science Research Assistants
	29-2000 Health Technologists and Technicians
	29-9020 Health Information Technologists and Medical Registrars
	29-9099 Healthcare Practitioners and Technical Workers, All Other
Postsecondary Teaching Occupations	25-1020 Math and Computer Teachers, Postsecondary
	25-1032 Engineering Teachers, Postsecondary
	25-1040 Life Sciences Teachers, Postsecondary
	25-1050 Physical Sciences Teachers, Postsecondary
	25-1060 Social Sciences Teachers, Postsecondary
	25-1031 Architecture Teachers, Postsecondary
	25-1070 Health Teachers, Postsecondary
Managerial Occupations	11-3020 Computer and Information Systems Managers
	11-9040 Architectural and Engineering Managers
	11-9120 Natural Sciences Managers
	11-9110 Medical and Health Services Managers
Sales Occupations	41-4011 Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
	41-9030 Sales Engineers

Note. Table adapted from U.S. Bureau of Labor Statistics (2019b). SOC occupations based on 2018 SOC system. Occupations in italics are split between two occupation types.

Appendix 2: High-Technology Industries (Core=5x, Peripheral=2x)

NAICS code	Industry	STEM % of employment	High-Tech Level
541500	Computer Systems Design and Related Services	59.7	Core
541300	Architectural, Engineering, and Related Services	59.5	Core
541700	Scientific Research and Development Services	55.9	Core
513200	Software Publishers	55.8	Core
334100	Computer and Peripheral Equipment Manufacturing	49.8	Core
518200	Computing Infrastructure Providers, Data Processing, Web Hosting, and Related Services	47.2	Core
519200	Web Search Portals, Libraries, Archives, and Other Information Services	44.7	Core
334500	Navigational, Measuring, Electromedical, and Control Instruments Manufacturing	38.1	Core
334200	Communications Equipment Manufacturing	37.8	Core
334400	Semiconductor and Other Electronic Component Manufacturing	34.9	Core
334600	Manufacturing and Reproducing Magnetic and Optical Media	33.9	Core
336400	Aerospace Product and Parts Manufacturing	32.2	Peripheral
423400	Professional and Commercial Equipment and Supplies Merchant Wholesalers	29.5	Peripheral
334300	Audio and Video Equipment Manufacturing	27.1	Peripheral
521100	Monetary Authorities-Central Bank	27.0	Peripheral
325400	Pharmaceutical and Medicine Manufacturing	26.6	Peripheral
516200	Media Streaming Distribution Services, Social Networks, and Other Media Networks and Content Provid	24.7	Peripheral
517000	Telecommunications	22.5	Peripheral
333600	Engine, Turbine, and Power Transmission Equipment Manufacturing	22.0	Peripheral
333300	Commercial and Service Industry Machinery Manufacturing	20.3	Peripheral
551100	Management of Companies and Enterprises	18.9	Peripheral
211100	Oil and Gas Extraction	17.9	Peripheral
541600	Management, Scientific, and Technical Consulting Services	17.8	Peripheral
4240A2	Merchant Wholesalers, Nondurable Goods (4242 and 4246 only)	17.4	Peripheral
999100	Federal Executive Branch (OEWS Designation)	17.1	Peripheral
221100	Electric Power Generation, Transmission and Distribution	16.8	Peripheral
335300	Electrical Equipment Manufacturing	16.6	Peripheral
336500	Railroad Rolling Stock Manufacturing	16.2	Peripheral
3250A1	Chemical Manufacturing (3251, 3252, 3253, and 3259 only)	15.6	Peripheral
486100	Pipeline Transportation of Crude Oil	15.2	Peripheral
486200	Pipeline Transportation of Natural Gas	15.2	Peripheral
335900	Other Electrical Equipment and Component Manufacturing	14.6	Peripheral
524100	Insurance Carriers	14.5	Peripheral
3330A1	Machinery Manufacturing (3331, 3332, 3334, and 3339 only)	14.3	Peripheral
611300	Colleges, Universities, and Professional Schools	14.2	Peripheral
339100	Medical Equipment and Supplies Manufacturing	14.2	Peripheral
811200	Electronic and Precision Equipment Repair and Maintenance	13.5	Peripheral

Note. Core = Industries with at least five times the national average concentration in STEM occupations; Peripheral = Industries with at least two times the national average concentration in STEM occupations.

Appendix 3: Non-defense Only Companies in High-technology Industries (Work Completed)

	Industry	Company		Work Completed*				
NAICS	Name	UEI	Name	FY2019	FY2020	FY2021	FY2022	FY2023
541511	Custom Computer Programming Services	JV2VNJQP6J89	TRUESCAPE LIMITED				X	X
541511	Custom Computer Programming Services	ZMJFM8EAJ2H8	STONEMILL CONSULTING LLC			X	X	X
541511	Custom Computer Programming Services	KGHLJM1178S7	DSG SYSTEMS, INC	X	X	X	X	X
541511	Custom Computer Programming Services	PE7HCR4CV495	BIODESIGN COMPANY LIMITED		X	X		X
541511	Custom Computer Programming Services	Q8TGJ4DS3CB5	THE RIGGS GROUP, P.C.		X	X	X	X
541512	Computer Systems Design Services	Z8W6PBA8MKY4	C&T TECHNOLOGIES LLC	X	X	X	X	X
541512	Computer Systems Design Services	HP47D5ZH4U85	DATA DYNAMICS, INC.	X	X	X		X
541512	Computer Systems Design Services	CDKHHKUY4KK6	GEN3 TECHNOLOGY CONSULTING LLC			X	X	X
541513	Computer Facilities Management Services	JX95KFNVMU35	WCJ CONSULTANTS, L.L.C.	X	X	X	X	X
541513	Computer Facilities Management Services	UNXHJZDJB315	CORDYACK BRIAN					X
541513	Computer Facilities Management Services	LGNZKY4RM3U3	WAVEMARK, INC	X	X	X	X	X
541519	Other Computer Related Services	GUCBYHJYTCR5	ALEUTIANSTAR JV, LLC					X
541519	Other Computer Related Services	L5C9GFPC8LY4	PARYMON CORP			X	X	X
541519	Other Computer Related Services	GAM2KTWKMFP8	GEE WHIZ SOFTWARE, LLC			X	X	X
541519	Other Computer Related Services	JL5MFBETQJ68	THE EARNEST ANALYTICS COMPANY, INC.			X	X	X

Note. NAICS = North American Industry Classification System. UEI = Unique Entity Identifier.
* An 'X' indicates a contract action record in that Fiscal Year.

Appendix 4: Non-defense Only Companies in High-technology Industries (Dollars Obligated)

Industry		Company		Dollars Obligated*				
NAICS	Name	UEI	Name	FY2019	FY2020	FY2021	FY2022	FY2023
541511	Custom Computer Programming Services	JV2VNJQP6J89	TRUESCAPE LIMITED	--	--	--	$827,472	$0
541511	Custom Computer Programming Services	ZMJFM8EAJ2H8	STONEMILL CONSULTING LLC	--	--	$0	$0	$0
541511	Custom Computer Programming Services	KGHLJM1178S7	DSG SYSTEMS, INC	$1,869,017	$2,955,683	$1,351,098	$705,357	$726,903
541511	Custom Computer Programming Services	PE7HCR4CV495	BIODESIGN COMPANY LIMITED	--	$47,892	-$4,512	--	$299,900
541511	Custom Computer Programming Services	Q8TGJ4DS3CB5	THE RIGGS GROUP, P.C.	--	$0	$0	$0	$0
541512	Computer Systems Design Services	Z8W6PBA8MKY4	C&T TECHNOLOGIES LLC	$250	$2,381,639	$1,434,321	$782,047	$0
541512	Computer Systems Design Services	HP47D5ZH4U85	DATA DYNAMICS, INC.	$0	$0	$0	--	$0
541512	Computer Systems Design Services	CDKHHKUY4KK6	GEN3 TECHNOLOGY CONSULTING LLC	--	--	$0	$0	$0
541513	Computer Facilities Management Services	JX95KFNVMU35	WCJ CONSULTANTS, L.L.C.	$1,496,732	$0	$1,257,600	$962,495	$2,710,269
541513	Computer Facilities Management Services	UNXHJZDJB315	CORDYACK BRIAN	--	--	--	--	$52,700
541513	Computer Facilities Management Services	LGNZKY4RM3U3	WAVEMARK, INC	$7,223,695	$4,231,608	$4,174,374	$4,704,730	$3,873,354
541519	Other Computer Related Services	GUCBYHJYTCR5	ALEUTIANSTAR JV, LLC	--	--	--	--	$1,079,058
541519	Other Computer Related Services	L5C9GFPC8LY4	PARYMON CORP	--	--	$0	$0	$0
541519	Other Computer Related Services	GAM2KTWKMFP8	GEE WHIZ SOFTWARE, LLC	--	--	$205,702	$56,090	$105,316
541519	Other Computer Related Services	JL5MFBETQJ68	THE EARNEST ANALYTICS COMPANY, INC.	--	--	$50,000	$47,500	$217,750

Note. NAICS = North American Industry Classification System. UEI = Unique Entity Identifier.
* A '$0' indicates a contract action, but $0 obligated dollars. An '--' indicates no contract action record in that Fiscal Year.

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