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Commercial and Defense Vendor Management: A Comparison of Competitive Procurement Below the Prime—Subcontract Competition—How Real is It?

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Abstract

This research looks at how the rates of competition at the subcontractor level compare to commercial norms across a wide data set. A quantitative analysis of a large number of commercial parts (~5 million) compare to a statistically similar number of parts from the DoD will be conducted to compare how frequently items are single or sole sourced in each space. The findings will help assess whether the rate of subcontract competition is similar or dissimilar and the degree to which acquisition strategies may need to be adjusted to account for those differences. Then, a qualitative study will be performed assessing the differences and similarities in the data. Generally, acquisition in the DoD leans heavily on competition to drive improvements to cost, schedule, and performance. GAO reports (<https://www.gao.gov/products/gao-15-484r>), reports by the DoD (<https://media.defense.gov/2022/Feb/15/2002939087/-1/-1/1/STATE-OF-COMPETITION-WITHIN-THE-DEFENSE-INDUSTRIAL-BASE.PDF>) and from news outlets (<https://www.defensenews.com/pentagon/2022/04/12/kathleen-hicks-warns-of-substantial-decline-in-defense-industrial-base-competition/>) have all pointed to reduction in competition in the defense industrial base. These sources look primarily to competition at the prime contract level and with very large subcontracts that trigger reporting requirements. Currently, the Competition in Contracting Act (CICA), signed into law in 1984, is the driving force behind using competition as a driver for fair prices in Government acquisition. In that same year, “The Japanese Way” (<https://hbr.org/1984/07/simple-truths-of-japanese-manufacturing>) was brought into mainstream manufacturing in the United States and management practices that encouraged lean manufacturing and closer relationships with single and sole source vendors.



The qualitative analysis of the results will be used to assess the business and vendor management strategies deployed by both commercial and defense acquisition personnel with a focus on enriching a more sophisticated understanding of both competition and collaboration within the vendor base.

Subcontract Competition—How Real is It?

Introduction and Research Question(s):

This research explores variation in rates of competition at the subcontractor level between commercial norms and Department of Defense (DoD) industrial base norms across large data sets from both markets. A quantitative analysis of a large number of commercial parts (~2.3 million) are compared to a large number of parts from the DoD (over 29,000 line items/1.3 million discrete parts) was conducted to compare how frequently items are single or sole sourced or competitively sourced in each space. This exploratory information gives way to a list of recommendations and future research agenda(s) presented by the authors.

Acquisition regulation and policy in the DoD leans heavily on competition to drive improvements to cost, schedule, and performance. The Competition in Contracting Act (CICA), signed into law in 1984, drives the use of competition as a means to obtain fair and reasonable prices in Government acquisition. In that same year CICA was enacted, “The Japanese Way” was brought into mainstream manufacturing and general business management in the United States (Weiss, 1984). This new way of managing suppliers landed in stark contrast to CICA, encouraging lean manufacturing and closer relationships with smaller contractor pools. Generally, this management style leverages longer duration contracts and partnering with suppliers to achieve cost, performance, and schedule improvements through collaborative improvements versus the constant threat of competitive replacement.

This presents a stark contrast in DoD acquisition policy and commercial management trends. Given this contrast, we should expect the rate of competition with suppliers to be higher in the defense base than in the commercial space. However, reductions in the supply base and less scrutiny placed on CICA compliance for prime contractors, in comparison to Government acquirers, could lower the rate of competition in the defense industrial base.

GAO reports (OUSD/A&S, 2022), the DoD, and news outlets (Gould, 2022) have all pointed to a reduction in competition and number of contractors in the defense industrial base. They primarily assess competition at the prime contract level and with very large subcontracts subject to reporting requirements. The availability of data assessing competition rates for subcontracts and materials purchased by prime contractors is generally more difficult to acquire and analyze than for prime contracts and high dollar subcontractors.

This study provides some indication of the differences in the rate of competitive sourcing in commercial and defense markets with a focus on enriching a more sophisticated understanding of both utilization of competition and collaboration within the contractor base for both sectors. This study finds similarities and differences in both market subcontract competition rates. The DoD sample subcontract competition rates are higher overall, yet discrete programs show as low or lower subcontract competition rates as the commercial market based on our data samples. What follows is a discussion of the history of competition in federal public procurement, how the commercial market is faring in terms of competition, an analysis and discussion of the data and initial propositions and areas for further research to explain this phenomenon.

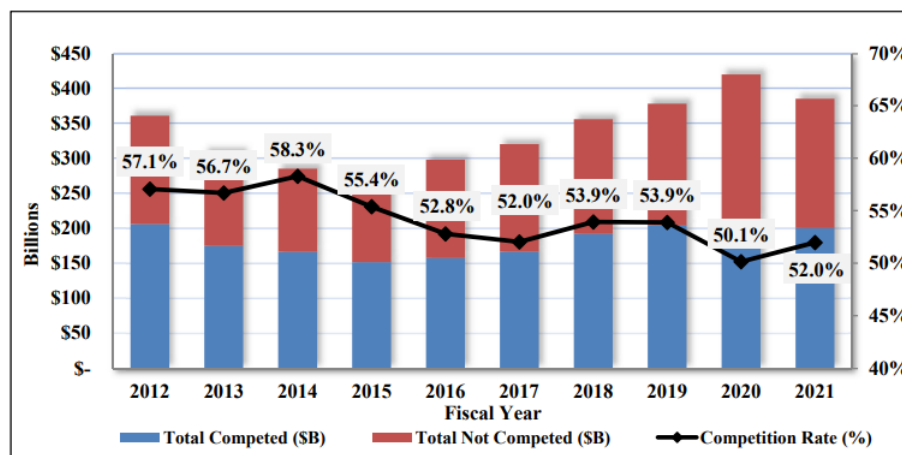


Competition in Contracting Act and Subcontract Competition

The three primary objectives of public procurement are generally seen to be meeting requirements on time, obtaining value for money, and maintaining public trust (Finkenstadt & Hawkins, 2016; Gilbert et al., 2009). Competition provides more opportunities for public agencies to meet these goals. Competition has been found to save money, curb cost growth, promote innovation, provide more small business opportunity, provide insights into industrial capability and capacity, and maintain integrity in the expenditure of public funds (Cohen, 1983; OUSD/A&S, 2022). Competition in federal contracting has been around since the early 1800s (Cohen, 1983). Despite this requirement, researchers found that, as of 1982, a majority of federal procurements were completed via non-competitive acquisition (Cohen, 1983).

The Competition in Contracting Act (CICA) was enacted in 1984 in response to these competition concerns based on legislation brought forth by Senators Roth, Levin, and Cohen in 1982. It mandated the use of full and open competitive acquisition procedures unless an exemption was authorized by law. Currently the Federal Acquisition Regulation Part 6 governs competitive mandates for federal acquisition and provides for only seven exceptions to this rule: 1) only one responsible source, 2) unusual and compelling urgency, 3) industrial mobilization, 4) international agreement, 5) authorized by statute, 6) national security, or 7) public interest. Soliciting for full an open competition does not always mean that the government will receive multiple offers, in many cases they only receive one offer to evaluate. This may be the result of market conditions, consolidation activities, or could be the result of the government’s own solicitation methods or requirements definition (GAO, 2010).

Figure 1 from OUSD/A&S’s 2022 report on the competition in the defense industrial base shows the ten-year trend in competition rates in the DoD’s acquisition portfolio. While OUSD/A&S reports this as a “relatively stable” pattern (OUSD/A&S, 2022, pg. 3) it shows two interesting patterns regarding competition: 1) the overall competition rate has been in decline since 2015 and 2) in 2020, the year of COVID’s initial outbreak, we saw the highest dollars spent under the lowest competition rate in a decade. This may mean that we are losing ground on defense competition in general while also being unable to respond to massive supply chain disruptions using competitive procedures.



Note: Dollars shown in billions

Figure 1. Ten Year Trend for DoD Competitive Actions Against the Fiscal Year Budget. (OUSD/A&S, 2022).



While the DoD specifically has focused on increasing competition at the prime contract level with questionable success, it, like many federal agencies, have never really focused on competition below the prime contract level. Subcontract competition is not a primary area of interest for many federal acquisitions. FAR Part 44 does mandate the flow down of a subcontract competition clause for subcontracts that exceed the simplified acquisition threshold, but consent to subcontract and randomized audits are the only practical means the government has to enforce that flow down. Consent to subcontract is not expressly required if the contractor has an approved purchasing system and even then, only for cost-reimbursement, time-and-materials, labor-hour, or letter contracts, and also for unpriced actions (including unpriced modifications and unpriced delivery orders) under fixed-price contracts that exceed the simplified acquisition threshold (FAR Subpart 44.2).

Insight into subcontracts in general is poor within the federal government procurement system. Since 2006 federal contractors have been required to submit information about first-tier subcontracts to the Federal Funding Accountability and Transparency Act (FFTA) Subaward Reporting System (FSRS). This reporting was mandated by the FFTA of 2006 and consisted of a phased approach that was to have all subcontracts in excess of \$30,000 reported to the government by October 2015. However, this requirement does not require deeper tier reporting for subcontracts and does not include any requirement to show or report competition at subcontract levels. Therefore, the requirement to flow down competition requirements in certain instances in one part of its regulations consequently misses the opportunity to obtain valuable data on the state of those first-tier competitions via other parts and contractors. Publicly available data on government subcontracts in USASpending.gov is supposed to leverage this data as well. However, our exploration of the data finds it to be extraordinarily poor and inaccurate. As an example, a query of first-tier subcontracts from FY17 to present was conducted in April 2023 and found that the data reported subcontract values in certain years at levels that exceeded the federal budget entirely. As an example, FY20 reports one quintillion dollars in reportable first-tier subcontracts yet only \$670.6 billion in prime obligations.

The State of Commercial Competition and the “Japanese Way”

Competition in commercial exchanges seem to be dwindling as well. The White House Counsel of Economic Advisors released a post in 2021 pointing to market consolidations in the American economy. They list a series of issues such as food packaging market concentrations, domination of commercial air by four major firms and limited to zero localized competition for broadband services for many Americans (Boushey & Knudsen, 2021). Macro-economic evidence is mounting that market power is growing on the part of a small group of consolidated firms such as record high corporate profits during a time of hampered innovation and suppressed wages (Autor et al., 2020; Boushey & Knudsen, 2021). Studies of mergers in commercial markets show that price increases related to mergers can be substantial (Ashenfelter et al., 2014; Kwoka, 2017). They find that the average price effects of mergers are around 7.2%. Figure 2 shows that this price effect is essentially in line with inflation rates since 2021 (BLS, 2023). Unsurprisingly, we have price inflation during a time of mass market consolidation and supply chain disruption. But is a lack of competition always bad for prices? Should we treat all competition at every level the same?



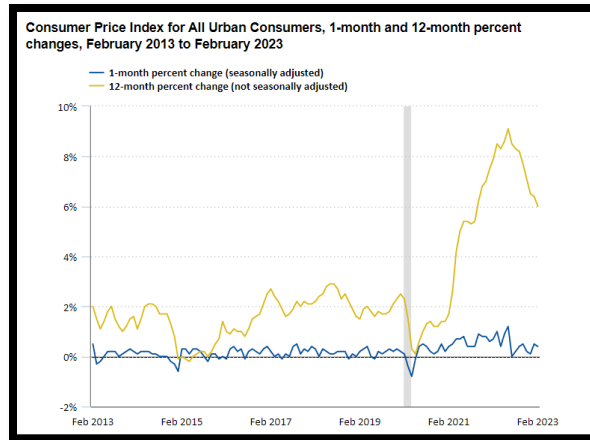


Figure 2. CPI for All Urban Consumers from February 2013 to February 2023. (BLS, 2023).

Ironically, in the same year that the federal Government enacted CICA, effectively establishing competition as the primary means of controlling cost, price, performance, and schedule, “The Japanese Way” was brought into mainstream manufacturing and general business management in the United States (Weiss, 1984). Often, business management professionals in the United States focus on lean manufacturing as the core principle of The Japanese Way and, of late some have blamed this principle for supply chain disturbances, like those experienced during COVID, where greater inventories would have prevented disruptions. This however is far from reality, as deployment of The Japanese Way as demonstrated by the Toyota Production System proved during the pandemic that strategic contractor management deployed in combination with lean led to greater resiliency (Shih, 2022).

A critical element of The Japanese Way is the different notion of supplier management. This presents an alternative strategy to one of constant competition among contractors utilized to control supplier pricing. Instead of utilizing short-term contracts leveraging competition to drive supplier behaviors, long-term contracts with smaller pools of contractors and close collaboration with contractors are utilized as the primary means of improving supply base outcomes. By 1995, MIT Sloan Management Review published these findings:

Supplier-customer relationships in the United States are changing rapidly. Where once contracts were short-term, arm’s-length relationships, now contracts have increasingly become long term. More and more, suppliers must provide customers with detailed information about their processes, and customers talk of “partnerships” with their suppliers. (Helper & Sako, 1995)

A traditional Japanese supply system, keiretsu, was used and modified to manage contractors strategically for long-term success. This system is based on trust, cooperation, education and long-term commitment with suppliers. In these cases, contracts are longer in duration with generally ambiguous terms. These contracts mostly enforce specific requirements to reduce cost over time with some share of cost efficiencies retained by suppliers, long-term relationships and cost targets set by leveraging the global marketplace, and procurement of integrated systems of components (instead of individual parts) to encourage contractor development of high-quality products (Aoki & Lennerfors, 2013).

This system does not fully discard competitive processes. Instead of short-term competitions for individual lots of parts, companies like Toyota use long-term relationships and future products as the primary application of competition. Contractors invest their money, people, and technology development into cost, schedule, and performance improvement for the purpose of securing future long-term contracts.

Many firms view dual sourcing primarily as a way to drive down costs by making suppliers compete in bidding wars. But Toyota takes a very different view: Having two suppliers means it can enjoy resilient capabilities. (Shih, 2022)

Toyota also looks at dual sourcing differently and its approach is very distinct from multi-sourcing that is used by some firms. Multi-sourcing involves buying the same component from multiple sources—say the steering wheel for Model A from contractors 1 and 2. This creates direct competition for a larger share of the requirements for Model A. Generally, Toyota opts to dual source for steering wheels with a different framework. Contractor 1 may produce a steering wheel for Model A and Contractor 2 may produce a steering wheel for Model B. Though there is not direct competition for the current models, both contractors will be indirectly competing to be the preferred contractors for next year's models and for new vehicles under development. This effectively increases resiliency and incentivizes product and manufacturing innovations for future models. At the same time, both contractors can maximize the efficiencies of scale on current production to keep current model costs as low as possible. The massive supply chain problems that have proliferated the news since 2020 has many firms now considering multi-sourcing as a means to increase supply chain resiliency and reduce dependence on overseas markets that may be at risk based on other factors than cost, such as geopolitical or weather-related disruptions. But what does the current data show?

Data and Methods

We conducted an exploratory analysis of competition at sub-tier levels within commercial and defense markets. Our analysis utilizes data from the Air Force's Life Cycle Management Center Cost and Pricing Division and compared it with commercial data from the Resilinc Corporation, a multi-tiered supply chain mapping firm. Resilinc works with its clients and the clients' contractors to map out multiple tiers of supply networks, to proactively identify and manage risks, to provide continuous monitoring at all tiers of the network, and to use a common communication platform to rapidly respond to and fix disturbances when they occur. They have found that, in collecting the necessary mapping data, it is critical that parts and sites are viewed independently, even when they come from the same contractor. 3M is a good example of why. They manufacture in at least 37 countries with 70 manufacturing sites in the United States alone (3M, n.d.). Supply chain risks vary dramatically by country, whether due to geopolitical, weather, climate or natural disaster risks. Supply chain risks also vary dramatically by sourcing strategies for individual components. Components that are sole sourced, single sourced, or competitively sourced all carry very different risk profiles. Sole sourced components, due to specific nature of use or highly tailored design, can only be produced by an individual contractor and generally carry the greatest risk. Single sourced items can or are produced by more than one contractor but are deliberately sourced from one contractor to leverage greater economies of scale and to simplify contractor management (i.e., the Japanese way). These components generally carry less risk than sole source items. Competitively sourced parts can be acquired from two or more contractors for two general reasons. The first is for parts that are less complex and easily producible by multiple contractors in the marketplace. The second, is to reduce risk for critical items of supply or to maintain competition where selecting only one contractor, due to



highly tailored design, would effectively eliminate the competitive base for future procurement. Competitively sourced components generally carry the lowest risk. By collecting data for more than 800,000 contractors and clients, Resilinc has a very large volume of parts and the sourcing methodology utilized for those parts from the commercial space.

The Air Force Life Cycle Management Center (AFLCMC) executes and manages contracts for a myriad of major weapons systems platforms and programs: manned and unmanned aircraft platforms, command, control, communication, intelligence and networks, battle management systems, digital platforms, major service acquisitions, air munitions, propulsion, cyber security, business systems and multiple Federally-Funded Research and Development Centers (Air Force Materiel Command, n.d.). This includes more than \$45 billion in annual contract obligations for acquisition and sustainment activities of weapons systems platforms and programs. These contracts require cost and pricing data analysis that give some insight into the competitive nature of sourcing for parts below the prime contract level. We utilized data from 11 major sources covering three major weapons programs that fall under two major prime contractors in the DoD industrial base. The two major prime contractors are large businesses, have held and currently hold contracts across multiple services within the DoD including other major weapon systems, and have commercial business segments. The utilized data from bill of material (BOM) data files consisting of more than 29,000 line items and 1.3 million discrete parts accounting for more than \$3.6 billion in material. The BOM data files had between seven and 407 unique suppliers per file. The BOM data files included multiple lot buys for one major weapon system that is also procured and used by other services within the DoD. The utilized data from the AFLCMC did not identify if the subcontract data was for sole source or single source parts. However, it did distinguish parts sourced competitively versus those sourced non-competitively. The basis for the BOM data files were largely determined based on estimating methodologies to include historical data.

We compare rates of competition within BOM data files to Resilinc's supply chain mapping alternative sourcing data. This allows us to compare relative competition and sourcing strategy for DoD major weapons systems with the private marketplace's day-to-day competition strategies for commercial supply chains.

We treat Resilinc's "sole" and "single" supplier data counts as non-competitive data as these suppliers are selected and then utilized for future sourcing for the parts they are assigned. The single sourced parts can be sourced from other contractors, so even without direct competition on individual lots, the threat of contractor replacement creates some competitive cost control. However, we cannot confirm that such pressures exist in our data, so we elected to only treat their "multi-sourced" data as competitive data as a comparison to the DoD data. These parts demonstrate the potential for competitive pressures within each customer supply chain profile. The Air Force data contains labels indicating competition vs. the mix of available sources. The data is either coded with price basis codes that denote competition or directly list parts price basis as "competition." We compare these rates for competitive Air Force parts data within the BOMs to Resilinc's multi-sourced data within their customer repositories.

Analysis and Results

The Air Force data consisted of 11 separate program efforts across three weapons platforms, two major defense primes, and one foreign military sales data set. Table 1 below shows a summary of the number of line items, parts and suppliers by program data file analyzed, how many line items were competitive in nature, the total value of those actions



and the amount and percentage of that subcontract bill of materials (BOM) that was based on competitive pricing. The BOM data utilized represents various programs during the course of negotiation of contracts, each at different lifecycle stages. As a result, the sourcing strategy listed by part is not perfectly representative of what may have occurred during contract performance or that of prior or future lifecycle stages. The BOM data utilized does represent what the contractor deemed to be a sufficient basis for price reasonableness, which was overwhelmingly non-competitive. Some of the data is from Undefined Contract Actions (UCAs) where performance and procurement for the effort was underway during negotiations, in these instances the BOM data does reflect actual performance. The 11 programs have been numbered with names removed to protect the anonymity of the firms. As can be seen in Table 1 and Figure 3, most of the items were acquired using non-competitive means and a majority of the program values are not based on competitive procurements. Figure 3 provides a scatter plot of the relative percentage of competitive line items and value by each of the 11 program initiatives analyzed.

Table 1. Air Force Program Analysis Summary Data

Prgm Effort	Suppliers	Parts	Line Items	Competitive	CompPct	TotalVal	CompVal	CompValPct
1	407	652781	12780	2	0.02%	\$ 486,708,547.00	\$ 1,560,695.00	0.32%
2	212	19360	3703	3036	81.99%	\$ 47,434,562.21	\$ 3,591,030.45	7.57%
3	135	48064	1215	0	0.00%	\$ 357,927,004.70	\$ -	0.00%
4	12		12	1	8.33%	\$ 15,971,026.00	\$ 817,655.00	5.12%
5	124	19697	4267	0	0.00%	\$ 156,155,972.00	\$ -	0.00%
6	7		8	0	0.00%	\$ 36,351,733.00	\$ -	0.00%
7	113	8587	1195	0	0.00%	\$ 186,930,689.00	\$ -	0.00%
8	26		54	12	22.22%	\$ 782,950,000.00	\$ 385,610,000.00	49.25%
9	160	472722	3435	0	0.00%	\$ 829,173,269.00	\$ -	0.00%
10	123	90506	2384	0	0.00%	\$ 392,424,764.04	\$ -	0.00%
11	25		48	0	0.00%	\$ 353,623,000.00	\$ -	0.00%
Total (Avg for Pct)	1344	1311717	29101	3051	10.23%	\$ 3,645,650,566.95	\$ 391,579,380.45	5.66%

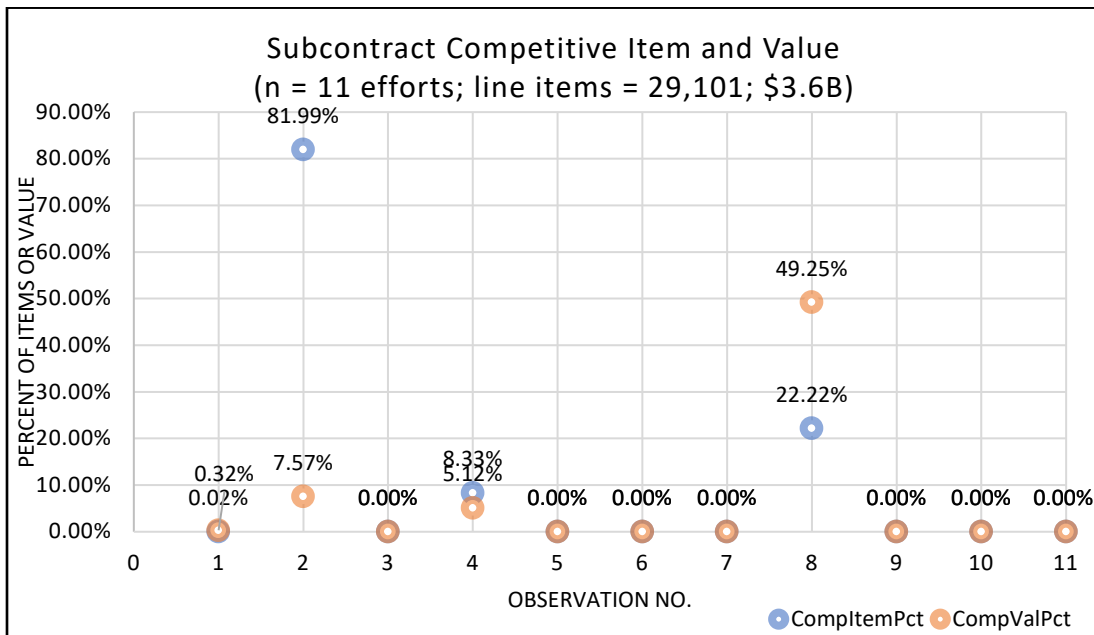


Figure 3. Subcontract Competitive Percentages from AFLCMC Program Bill of Materials



Across a sampling of the 11 program initiatives, we see a low competitive value percentage (equal to total dollars in competitive awards divided by the total value of all costs in the BOM). There is one outlier that had 49% of total BOM value competed. It was of smaller item counts (only 54 items) but was for the second largest BOM cost listed at \$782.9 million (roughly 10.6% of observed costs in this study). Further analysis would be required to determine why this one spare buy for a large, new weapons platform in an earlier life cycle stage utilized more competitive sourcing than others, especially given that it was by a prime and program that utilized very little competitive buying at the subcontract level for other initiatives analyzed. We are aware that it was for a program on UCA that was experiencing major cost control issues.

The Resilinc data includes part sourcing labeling for 2,308,781 parts. This data spans industry verticals including High Tech, Consumer Electronics, Life Sciences, Medical Devices, Semiconductors, Pharma, Auto, Industrial, Healthcare, and Aerospace. In total, very little direct competition is utilized in the commercial space, with only .84% of components multi-sourced. Additionally, very few sole source parts are present (.63%) indicating that even when direct competition is not utilized, the ability to replace contractors is likely. We cannot determine this level of alternative sourcing from the Air Force data. The very high degree of single-sourced parts (98.53%) in Resilinc data is indicative of The Japanese Way utilized in the commercial space, particularly as it relates to moving away from direct competition as the primary means of controlling cost.

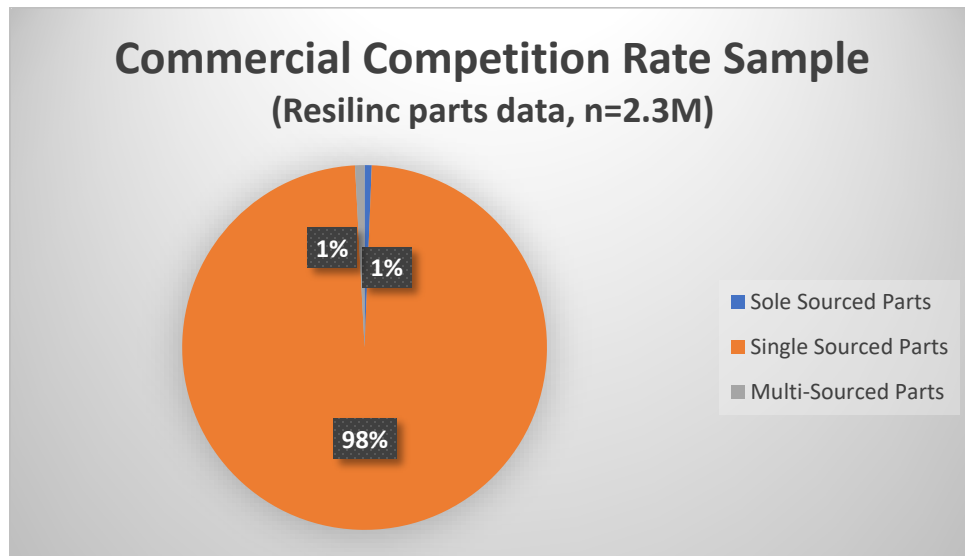


Figure 4. Commercial Competition Sample from Resilinc System

Table 2. Resilinc Parts Data

Sole Sourced Parts	14,513	0.63%
Single Sourced Parts	2,274,801	98.53%
Multi-Sourced Parts	19,467	0.84%
Total Parts	2,308,781	
Total Non-Competitive	2,289,314	99.16%
Multi-Sourced Parts	19,467	0.84%
Total Parts	2,308,781	



Discussion

The challenges of today and emergent threats of tomorrow continue to “transcend all boundaries and limits” (Liang & Xiangsui, 2020). These challenges will further shape the modernization of existing major weapons systems and the acquisition of future ones. The current acquisition landscape in the DoD comprised of low rates in competitive sourcing and resultant higher weapon system life cycle costs translates to lost capability that could be used to further increase our lethality and readiness. Acquisition strategies and teams within the DoD will need to consider competitive sourcing, especially for long-term acquisitions, at both the prime and sub-level in order to make capability (value) driven decisions. Likewise, contractors in the defense industrial base must also adapt to commercial approaches with strategic investments in their supply chains to maintain a competitive edge and create value. Sustainment costs alone within the DoD continue to represent an unsustainable “70% of the average weapon system’s total life cycle cost” (Serbu, 2022) and largely consist of non-competitive contracts including some contractor-locked major weapons systems. Moreover, matching the pace of our adversaries in modern warfare demands the mix of contractors within the defense industrial base also transcend traditional boundaries to deliver both agile and superior capabilities. This also requires services across the DoD to enhance traditional knowledge, skills, and abilities to foster enterprise-wide innovative and value-driven strategies capable of acquiring and sustaining major weapons systems at the “speed of relevance” (Dowling & Johnson, 2019). Essentially, knowing and acting when necessary, versus a day late and a dollar short.

In 2021 the GAO reported that estimated F-35 aircraft operation and sustainment costs across the services had increased to nearly \$1.27 trillion over 66 years—roughly \$6 billion beyond affordability thresholds—and further found “cost reductions become increasingly difficult as the program grows and matures” (GAO, 2021a). Consideration of future sustainment costs are generally not transparent or accurate when acquiring a major weapons systems leading to additional total life cycle costs and lost capability. One way to potentially reduce risk in future long-term major weapons systems acquisitions could be to adopt the traditional Japanese supply system, keiretsu, by incentivizing greater competition and sharing in cost efficiencies with the prime-level contractor. This could also further increase supply chain resiliency and diminishing manufacturing source(s) during sustainment. The first step in managing the defense industrial base is to discover what it looks like. Without better sub-tier visibility and more standardized reporting procedures we will be unable to systematically capture, track and take action on the competition rates below the prime contract level.

The DoD is examining “sustainment health strategies” (Serbu, 2022) and other initiatives to improve sustainment costs through competition in future acquisitions. Initiatives currently discussed include securing intellectual property at the forefront. Securing intellectual property would provide continuous opportunities for greater competition and strategic sourcing, in whole or part, throughout a weapon system’s life cycle and thus have a downward pressure on total life cycle costs. However, while it may sound appealing this approach could also inadvertently result in increased costs during the acquisition of major weapons systems as contractors try to recoup revenues typically realized during sustainment associated with IRAD or other proprietary investments.

The USAF Collaborative Combat Aircraft (CCA) program (Tirpak, 2022), an autonomous collaborative platform variant, initiated by Air Combat Command (Hadley, 2022) and captured in the Honorable USAF Secretary Frank Kendall’s “Operational Imperatives” (Department of the Air Force, n.d.) is another initiative that could prove successful in placing a downward pressure on a weapons systems total life cycle cost and increase competition.



Shorter life cycle periods would naturally result in an increased frequency of requirements being competed.

Our data analysis shows that some defense program efforts exceed the competition rates seen in the commercial market, while others demonstrate similarly low rates of competition below the prime level. As stated earlier, there does not seem to be a high rate of direct competition to create cost control in the commercial space, with single-sourced parts used in 98.53% of our sample. We did find that the data fidelity and analysis for DoD data was far lacking compared to commercial data. The DoD needs to start tracking single vs. sole to understand the amount of indirect competition present. The DoD should consider whether CICA has become outdated and if better contractor engagement, longer term contracts, and partnership in the contractor base could provide better long-term outcomes. Additionally, absent this type of engagement, it is important to consider how adoption of lean inventory management provides an incomplete adoption of The Japanese Way and introduces threats to resiliency in the defense industrial base. This study does offer interesting insights into how we monitor and analyze this data. This study found that analyzing discrete BOMs for competition is extremely difficult as none of the programs used similar data labeling and structural methodologies. Further, open-source data on federal and defense subcontracts is lacking and inaccurate and oversight has paid sufficient attention to subcontract data reporting issues in open-source data (GAO, 2014, 2021b, 2021c).

Limitations and Areas for Further Research

We admit that our analysis is a simple exploratory view of DoD and commercial markets. However, the samples do cover a large number of parts and spend which can offer direction for future research in this area.

Limitation 1: The DoD data only included current Air Force programs

Future Research: Future studies should explore similar trends in subcontract competition rates for other services and departments to determine if low competition rates and data issues are systemic to the federal government, DoD, or agencies themselves. Future research should also explore whether subcontract competition data is richer and more prevalent when new programs are being competed.

Limitation 2: DoD data does not contain sufficient details to analyze the differences in rates of sole vs. single sourced procurements

Future Research: Further research is needed within the DoD to assess whether single and sole source decisions in the supply base are tracked. Competition methods and sourcing during weapons systems life cycles should also be assessed given that diminishing manufacturing sources for parts/items generally increase toward the end of a weapon systems life cycle. This would improve the analysis of the state of sourcing in the defense base. If not being tracked, the DoD should start tracking single vs. sole sourcing to assess the supply chain management practices in the defense base and determine if more modern contractor management techniques should be instilled into large defense contractors through more hands-on management by Government personnel, through contractual terms, or potentially changes to current regulations. For example, DoD contractors are already required to maintain a database for each part number to include the name of the supplier, amongst other items. The increased administrative cost related to the monthly or quarterly delivery of this data would be insignificant compared to how it could better shape future acquisition strategies. With the current DoD drive for innovation, it is important to understand if the Toyota Production System's proven method of utilizing single sources for different components to exploit production scale, enhance contractor performance through indirect



competition, and incentivize product and manufacturing innovation is part of the current DoD contractor management framework.

Limitation 3: This analysis does not contain sufficient qualitative data to determine why we see certain patterns of competition in commercial and defense data.

Future Research: The DoD should consider whether CICA has become outdated and if better contractor engagement, longer term contracts, and partnership in the contractor base could provide better long-term outcomes. Additionally, absent this type of engagement, it is important to consider how adoption of lean inventory management provides an incomplete adoption of The Japanese Way and introduces threats to resiliency in the defense industrial base. As noted earlier, the program data with the highest level of competition in our sample was for a major weapons system that was facing incredible costs pressures. Further, analysis is needed to determine if the high levels of competition were a result of these cost control issues or a cause.

The DoD states that competition matters and improves outcomes. However, roughly half of the defense budget is executed using non-competitive prime awards. If the DoD truly believes competition matters perhaps they should gain a higher fidelity view of it at sub-tiers to truly understand the defense industrial base, its competitive pressures and how they lead to variations in mission outcomes. But, again, step one is visibility. You can't measure what you can't find, and our initial analysis shows that the DoD is walking in the dark when it comes to subcontract data.

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