

October 2021

---

# Mapping the AI Investment Activities of Top Global Defense Companies

CSET Issue Brief



## AUTHORS

Ngor Luong

Rebecca Gelles

Melissa Flagg

## Executive Summary

As a dual-use technology, artificial intelligence (AI) has the potential to transform a nation's economy, national security, and society. Militaries across the globe, including the U.S. Department of Defense (DOD), are increasingly treating AI as a technology that is central to their long-term strategies and planning. One of the most significant paths of acquisition and integration of emerging technologies, including AI-enabled technology, into defense systems and platforms is through the largest global defense companies. As militaries around the world are ramping up their capabilities and capacity to harness AI, it is important to begin to understand the state of AI innovation within the major global defense companies.<sup>1</sup>

With tech giants such as Google and Amazon at the forefront of AI innovation, major global defense companies are pressed to step up their innovation-related activities to keep pace with the larger commercial market. In addition to expanding their internal research and development (R&D) programs and collaborations with leading research institutes and universities, another way the largest defense companies might maintain their competitiveness in the emerging technology market is through investments and mergers and acquisitions (M&A). If done correctly, these approaches may give these defense giants a leg up against competitors that predominantly rely on in-house R&D. Looking specifically to the U.S. defense innovation ecosystem, major defense companies that invest in or acquire AI companies could potentially serve as a bridge between DOD and the commercial innovation ecosystem. In doing so, these companies might help the U.S. military adapt and leverage commercial technology for defense applications.

Within this context, this paper looks at the state of AI investments and M&A by the top 50 global defense companies—as determined by their military revenue—to further understand their use of these approaches to access external AI innovation. Our key findings include the following:

- Few of the top 50 global defense companies are investing in or acquiring privately-held AI companies. This suggests that

these companies are not relying on these approaches to access AI technology in the private sector.

- Defense companies that have a corporate venture capital (CVC) subsidiary have invested more in AI companies than those without such organizations. These CVC subsidiaries also tend to make more AI investments than their parent companies.
- The largest global defense companies often bought and invested in AI companies based in the United States. Despite concerns about foreign entities leveraging American innovation, within the defense industry, U.S.-based AI companies are still more likely to receive investments from U.S.-based defense companies.

## Table of Contents

Executive Summary .....	1
Introduction .....	4
Understanding the AI Investment and M&A Activities of the Largest Global Defense Companies .....	6
The Role of Corporate Venture Capital Subsidiaries.....	9
Investing and Buying Within U.S. Borders.....	12
Conclusion.....	14
Authors.....	16
Acknowledgments.....	16
Appendix 1: Top 50 Defense Companies and Their Defense Revenue in 2019 .....	17
Appendix 2: Methodology and Data .....	20
Appendix 3: Domestic and International AI M&A and Investment Activity.....	21
Appendix 4: Defense Corporate Venture Capital Subsidiaries .....	22
Endnotes .....	23

## Introduction

The major global defense companies are significant suppliers and integrators of high-tech capabilities for militaries around the world, including the U.S. military.<sup>2</sup> As the rhetoric around the importance of AI to military superiority ramps up across the globe, it is vital to understand the state of AI innovation among these leaders of the defense industry.

Major global defense companies such as Northrop Grumman and Boeing increasingly offer technology hardware and services alongside their traditional delivery of aerospace products and conventional military systems. The cutting-edge advances in emerging technologies such as AI, however, are predominantly taking place in the commercial space. While expanding in-house research and development (R&D) efforts and broadening collaborations with leading universities are important paths for staying competitive, defense giants must also be able to access commercial innovation.

One potential pathway by which major defense companies can access the commercial innovation base is through private equity investments and mergers and acquisitions.<sup>3</sup> Large U.S.-based defense industry players such as Lockheed Martin, for example, have “been on a mission to create partnerships [e.g., investments in AI startups] and get access to certain types of AI technology,” executive director and general manager of Lockheed Martin Ventures Chris Moran emphasized in 2020.<sup>4</sup> Other major international defense companies appear to have followed a similar approach—for example, according to the company’s website, Netherlands/France-based Airbus is “interested in those [technology] start-ups that operate in areas of strategic interest to the Group [and] investing in . . . a vision where humans and AI together create solutions that guarantee more efficiency and safety in the aerospace sector.”<sup>5</sup> If leveraged properly, the investment and M&A approaches have the potential to help these large defense industry players expand their emerging technologies portfolios as well as maintain market relevance in the broader commercial AI innovation space.

This paper is a first step, intended to assess the degree to which the largest global defense companies use investment and M&A approaches to access AI technology from smaller, privately-held companies—that is, companies not traded publicly on the stock market exchanges. By investing in or acquiring privately-held AI companies, large defense companies may be seeking to capitalize on the speed and agility characteristics of tech startups, cultivate talent, and help shape emerging technologies for commercial and defense applications.<sup>6</sup> But the investment and M&A approaches are not without limitations—for example, investing in or acquiring a company does not necessarily guarantee successful integration of relevant technologies.<sup>7</sup> A more comprehensive assessment of defense companies' AI capabilities would also need to account for other mechanisms such as internal research through industrial research and development (IRAD) investments, investments directly into universities, or subcontract relationships. These limitations notwithstanding, a closer look into the investment and M&A activity of the major global defense companies can still provide meaningful insights into their efforts to access AI innovation from private markets for use in next-generation defense systems.

With that, this paper focuses specifically on the AI investment and M&A activities of the top 50 global defense companies—as determined by military revenue—assessing the investment patterns of their corporate venture capital subsidiaries (where such exist), as well as the geographic breakdown of these defense companies and their AI target companies.<sup>8</sup>

## Understanding the AI Investment and M&A Activities of the Largest Global Defense Companies

As the commercial sector has forged ahead in AI innovation, militaries around the world, including the U.S. DOD, are increasingly looking outside of the traditional military-industrial relationship and toward nontraditional suppliers of emerging technologies such as tech startups, creating linkages through government programs such as the U.S. Defense Innovation Unit (DIU).<sup>9</sup> To stay relevant and remain ahead of their competitors, large defense companies are also trying to tap into AI technologies being developed in the commercial space, including through the investment and M&A approaches. Major defense companies have the benefit of experience navigating government and military bureaucracies, an understanding of warfighters' needs, and the know-how to identify those cutting-edge technologies that can be effectively integrated into combat systems. As such, some of these long-time traditional suppliers see their investments in privately-held AI companies not only as a way to diversify their emerging technologies portfolio, but also as an opportunity to “act as a translator” between the fast-paced world of commercial innovation and the rigid bureaucracy of military acquisition.<sup>10</sup>

To better understand the degree to which the largest defense companies are accessing external AI innovation, we analyzed the top 50 global defense companies' investment and M&A activities in private AI markets from 2013 to 2020. These global defense giants span across Europe, Asia, and the United States; their cumulative revenue in 2019 amounted to \$1.197 trillion, including \$475 billion in defense revenue.<sup>11</sup> The time frame for our analysis corresponds to big AI breakthroughs, driven in large part by progress in deep learning and machine learning methods in late 2012.<sup>12</sup> To identify AI target companies specifically, we ran a keyword-based search query against business descriptions provided by CSET's financial databases.<sup>13</sup> Appendix 2 offers further detail on the methodology and the data used in this paper.

Our analysis shows that between 2013 and 2020, 11 of the top 50 global defense companies made a total of 52 investment transactions into AI companies with \$1.06 billion in disclosed

value.<sup>14</sup> Over the same period of time, five defense companies struck M&A deals with six AI companies, with one deal disclosing a transaction value of \$350 million.<sup>15</sup> Only two of the top 50 global defense companies—Huntington Ingalls Industries and Boeing—made both AI investments and M&A deals. These trends show that few of the major global defense companies are investing in or acquiring privately-held AI companies.

A number of factors can help explain why the largest global defense companies seem to rarely use the investment and M&A approaches to access AI innovation in the private sector. For one, some of these major defense industry players may not believe AI is mature enough for integration into embedded systems and products, or for investment with high financial returns at this point in time.<sup>16</sup> It is also possible that simple subcontract relationships on a project-by-project basis or internal development of integrated AI are easier approaches to manage. While beyond the scope of this paper, data on subcontracts and IRAD investments can provide further insights.

While the data shows that the majority of the world's top 50 defense companies have not invested in or directly acquired AI companies, those that did made significant investments. More specifically, the 11 global defense companies that made investments into privately-held AI companies between 2013 and 2020 dedicated a quarter of their total investments to these ventures. It is also worth noting that 65 percent of these AI investments are spread across ten defense companies (seven of which are U.S.-based companies), while the rest came solely from the Dutch/French Airbus which stands out as more active than other defense company investors. Airbus sources its revenue primarily from commercial markets, and therefore may be better positioned to spread its AI investments internationally.<sup>17</sup> These results indicate that a sizable number of the AI investment transactions analyzed in this paper are clustered in U.S.-based defense companies, and that most of the major defense companies outside of the United States, excepting Airbus, are not leveraging private equity investments to access AI companies in the private sector.



Figure 1: Total Top Global Defense Company AI and Non-AI Investments and Mergers & Acquisitions (M&A), 2013-2020.

Companies are ranked by the number of AI investment transactions.

COUNTRY	DEFENSE COMPANY	INVESTMENTS		M&A	
		AI	Non-AI	AI	Non-AI
Netherlands/France	Airbus	19	38		
United States	Honeywell	7	14		
United States	Lockheed Martin	7	31		
United States	Science Applications International Corp.	6	13		
United States	Boeing	5	30	1	10
South Korea	Hanwha	2	14		
Israel	Rafael Advanced Defense Systems	2	12		
United States	Huntington Ingalls Industries	1		1	1
United States	Jacobs	1			
United States	Northrop Grumman	1			
France	Safran Corporate	1	9		
United Kingdom	BAE Systems		2	2	6
United States	United Technologies Corp.		2	1	1
United States	General Dynamics Corp.			1	3
<b>Total</b>		<b>52</b>	<b>165</b>	<b>6</b>	<b>21</b>

Source: Analysis by CSET using Crunchbase and Refinitiv.

As Figure 1 illustrates, mergers and acquisitions as a method to access external AI resources seems even less common than private equity investments. Between 2013 and 2020, only five defense companies—four based in the United States and one in the United Kingdom—used this approach to access private-sector AI technology. Each of the six transactions made by these five major defense companies targeted AI companies based in the United States. Moreover, of the five defense companies that used acquisitions of any sort, two—Huntington Ingalls and United Technologies—rarely made either investment or M&A deals during the period of time we examined. However, when these two companies did acquire other firms, half of the deals were with an

AI company. Among other reasons, major defense companies may be reluctant to pursue AI M&A deals due to the challenges that come with strategic acquisitions, including the difficulties and costs of identifying targets that are financially sound and possessing valuable technology.<sup>18</sup> Private equity investment strategies, on the other hand, appear more favorable to investors, in part because these strategies allow them to scope out opportunities with lower risks than acquiring a company.<sup>19</sup>

## The Role of Corporate Venture Capital Subsidiaries

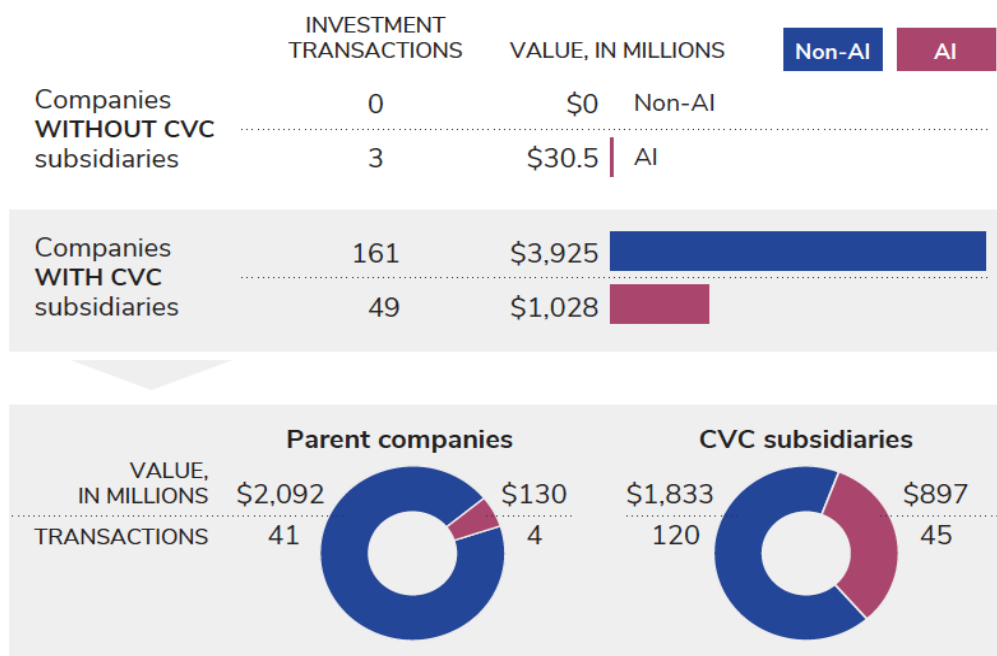
One major difference between defense companies that made AI investments and those that did not is the presence of a corporate venture capital (CVC) subsidiary. In fact, as we elaborate below, the majority of the top defense companies' AI investment activity between 2013 and 2020 can be traced back to these CVC subsidiaries, rather than the defense companies themselves.

CVC organizations can serve as intelligence gatherers, helping a company understand its competitors and scan for emerging technologies such as AI that are developing rapidly.<sup>20</sup> By establishing a CVC division, a large defense company may also be signaling an interest in obtaining these cutting-edge technologies which they may later integrate into larger defense systems and platforms.<sup>21</sup> For example, Lockheed Martin established Lockheed Martin Ventures to “tap into these startups, and ultimately serve as a [market/ bridge] for the emerging technology being created outside the walls of the defense industry.”<sup>22</sup> One of the key functions Lockheed Martin Venture performs is screening up to 1,000 startups annually.<sup>23</sup> Other defense players such as Honeywell have also set up their own CVC organizations to proactively engage in venture capital investments in emerging technologies.<sup>24</sup>

Thirteen of the top 50 global defense companies have a CVC subsidiary (see Appendix 4).<sup>25</sup> Between 2013 and 2020, 11 of these 13 CVC subsidiaries made investments in a variety of companies, and eight of those 11 invested in AI companies.<sup>26</sup> As Figure 2 demonstrates, of the 52 AI investment transactions examined in the previous section, 95 percent (49 transactions)

involved the eight defense companies that have CVC subsidiaries, amounting to around \$1 billion in disclosed value. By contrast, the three defense companies without CVC organizations made three investment transactions into privately-held AI companies which totaled \$30.5 million in disclosed value. In other words, defense companies with CVC subsidiaries made more investments into AI companies than those major defense firms without corporate venture capital divisions.

Figure 2: Investments in AI and Non-AI by Eleven Defense Companies with and without Venture Capital Subsidiaries (CVC), 2013-2020.



Source: Analysis by CSET using Crunchbase and Refinitiv.

We further parsed the investment activity of defense companies with CVC subsidiaries by parent-subsubsidiary relationship—treating the defense company as the parent and the CVC organization as the subsidiary—to compare their investment trends. Of the eight defense companies with CVC subsidiaries that made investments into AI companies, five had both themselves (as parent companies) and their CVC subsidiaries make investments into AI companies, while three defense companies relied exclusively on their

subsidiaries to invest in AI-related ventures. To be clear, over the period of time under our review, the parent companies have made investments in a variety of companies, but they did not prioritize investments into AI companies as much as their CVC subsidiaries did. As Figure 2 demonstrates, CVC subsidiaries dedicated 27 percent of their total investment transactions to AI companies, while their parent companies committed only about 9 percent of their total investments to AI.

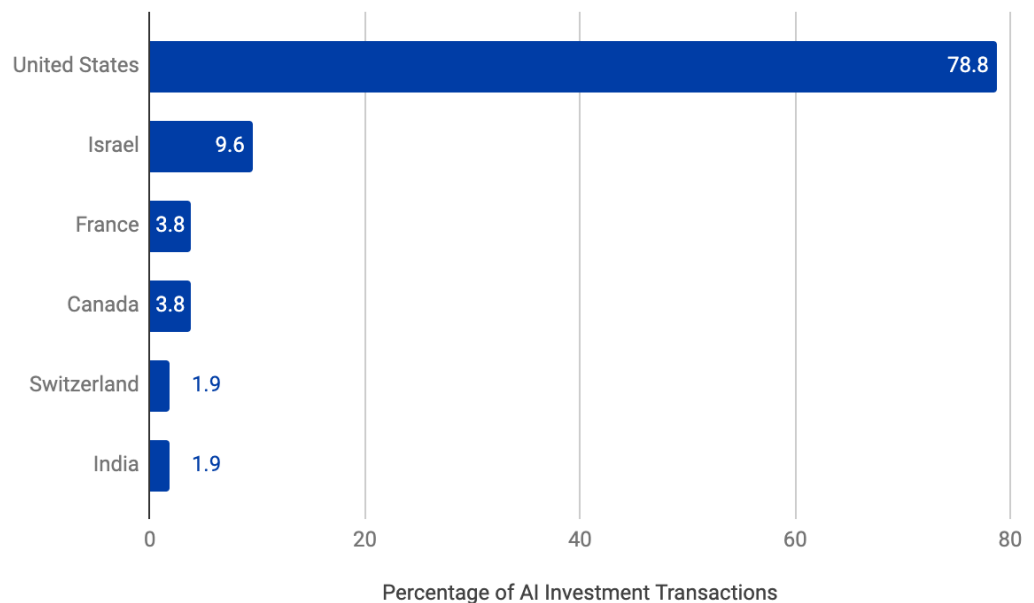
Looking more closely into the role of CVC subsidiaries also revealed a particularly interesting insight: between 2013 and 2020, the majority of AI investments came from CVC subsidiaries rather than the major defense companies themselves. Specifically, 92 percent (45 investment transactions) of AI investments were conducted by CVC subsidiaries such as Airbus Venture and Honeywell Venture Capital, compared to the 8 percent (four investment transactions) made by parent companies, namely defense leaders such as Airbus and Honeywell.

In sum, establishing a CVC subsidiary may become a real advantage for the major defense industry players that are interested in accessing private-sector AI technology. It is unknown, though, if and how these major defense companies leverage and integrate the capabilities of the AI companies invested in by the CVC subsidiaries. Establishing this with certainty requires firms' internal data, which is beyond the scope of this paper.

## Investing and Buying Within U.S. Borders

The majority of private equity AI investments made by the 11 major global defense companies between 2013 and 2020 was concentrated in the United States. This finding is perhaps not surprising considering that the United States has the world's largest investment market for AI companies.<sup>27</sup> Figure 3 shows that AI target companies based in the United States attracted 79 percent of the AI investment transactions from the major defense companies, while Israeli (10 percent), French (4 percent), Canadian (4 percent), Swiss (2 percent), and Indian (2 percent) AI target companies accounted for the rest. Similarly, the five defense companies with AI M&A activity exclusively bought American AI companies.

Figure 3: U.S.-based AI Companies are the Top 50 Global Defense Companies' Primary AI Investment Targets, 2013-2020.



Source: Analysis by CSET using Crunchbase and Refinitiv.

Not only do U.S.-based AI companies tend to attract the majority of AI investments made by the major global defense companies, U.S.-based defense companies predominantly invested in U.S.-based AI companies. American defense companies such as Lockheed Martin and Honeywell accounted for over 60 percent of investments (25 transactions) into U.S.-based AI target companies, with the rest of

the transactions tracing back to the Dutch/French giant, Airbus, (37 percent/15 transactions) and the South Korean leading defense company, Hanwha (3 percent/1 transaction). Similarly, in our findings for the AI M&A activity of the largest global defense companies, of the six U.S.-based AI companies acquired, two struck a deal with BAE Systems, a UK-based defense company, and four were bought by U.S.-based defense companies. These AI investment and M&A patterns may moderate some recent concerns that foreign entities—especially those affiliated with the militaries of U.S. competitors and adversaries such as China—are investing in and buying U.S.-based AI companies.<sup>28</sup>

U.S. innovation in the commercial sector may have the potential to help bolster U.S. defense systems. As the majority of AI investments and M&A made by the largest global defense companies remain within U.S. borders, it is crucial for the United States to continue fostering a vibrant innovation ecosystem and AI private markets at home. Small AI companies and startups based in the United States may be the driving force of AI advances and breakthroughs. However, in order for the AI-enabled capabilities developed in the commercial sector to become usable in fielded military systems and platforms, traditional defense companies are often needed to build and integrate them into large, complex systems.<sup>29</sup> As important suppliers and integrators, the major defense companies have shown interest in accessing AI-enabled capability from AI companies in the private sector. For example, Lockheed Martin's investment in Fiddler, a company specializing in AI explainability, may help the defense giant develop trustworthy AI systems.<sup>30</sup> There is potential for the major defense companies to capitalize on American innovation in the commercial sector. However, as shown in this paper, the major global defense companies are not currently leveraging investment and M&A as significant tools to harness AI-enabled technology in the private sector.

## Conclusion

The top 50 global defense companies play a critical role as suppliers and integrators of essential capabilities, including AI-enablers, into fielded military systems. As militaries around the world, including the U.S. Department of Defense, continue to prioritize AI, it is necessary to understand the state of AI capabilities and capacity within the major global defense companies.

Analyzing AI investment and M&A trends involving the top 50 global defense companies provides insights into the reality of access to commercial AI by the leading suppliers of defense systems and platforms. To summarize, our key findings are as follows:

- The top 50 global defense companies conducted a relatively small amount of AI investment or M&A activity, suggesting they do not rely heavily on these approaches to access AI technology in the private sector.
- Defense companies that have a corporate venture capital (CVC) subsidiary more frequently invest in AI companies than those without such organizations. These CVC subsidiaries also tend to make more AI investments than their parent companies.
- The largest global defense companies often bought and invested in AI companies based in the United States. Despite concerns about entities associated with foreign militaries leveraging American innovation, within the defense industry, U.S.-based AI companies are still most likely to receive investments from U.S.-based defense companies.

The findings presented in this paper suggest that there is little AI investment and M&A activity initiated by the largest global defense companies since the major AI/ML breakthroughs in late 2012. It is important to understand that the lack of dependency on investment and M&A to access commercial AI technology is not equivalent to the absence of AI capabilities and capacity within the

major defense companies. It is possible that major global defense companies are accessing AI either using subcontract relationships on a project-by-project basis or by developing integrated AI internally. It is also possible that major global defense companies may not believe AI is mature enough for integration into embedded systems and products at this point, or that defense company investors are perhaps not ready to tolerate the risk and uncertainty of investment returns associated with emerging technologies and early-stage investment.

Beyond the assessment of AI investment and M&A activities in the private sector, there are other mechanisms that should be further analyzed to achieve a comprehensive understanding of the current state of AI capabilities and capacity within the major global defense companies. For instance, having a corporate venture capital subsidiary appears to be a real advantage for the largest defense companies in accessing external AI technology in the private sector. These defense companies should further examine not only the magnitude of their subsidiaries' investments into AI privately-held companies, but also how well the acquired companies' technology has been integrated into the parent company. Such findings may prove to be significant for the defense companies to decide on whether to ramp up or scale down their investment and M&A efforts to, in part, access AI innovation in the private sector. For the U.S. DOD, conducting internal research on IRAD investments or major defense companies' subcontract relationships may provide a more comprehensive view of the AI acquisition and integration capabilities useful to defense systems.



## Authors

Ngor Luong is a research analyst with CSET, where Rebecca Gelles is a data scientist and Melissa Flagg was a senior fellow.

## Acknowledgments

Thanks to Catherine Aiken, David Bonfili, Jaymie Durnan, Zigfried Hampel-Arias, Margarita Konaev, and Igor Mikolic-Torreira for helpful feedback, Ilya Rahkovsky for technical assistance, Dale Brauner, Melissa Deng, and Alex Friedland for editorial support, as well as Farhana Hossain for help with data visualization. The authors are solely responsible for the views expressed in this piece and for any errors.



© 2021 by the Center for Security and Emerging Technology. This work is licensed under a Creative Commons Attribution-Non Commercial 4.0 International License.

To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc/4.0/>.

Document Identifier: doi: 10.51593/20210015

## Appendix 1: Top 50 Defense Companies and Their Defense Revenue in 2019

This appendix includes the top 50 global defense companies analyzed in this report, ranked according to their defense revenue, and lists their 2019 total revenue, defense revenue—that is, revenue from their defense divisions—and proportion of defense revenue to total revenue.

Rank	Company	Country	2019 Defense Revenue (in millions)	2019 Total Revenue (in millions)	Proportion of Defense Revenue
1	Lockheed Martin	United States	\$56,606.00	\$59,812.00	95%
2	Boeing	United States	\$34,300.00	\$76,559.00	45%
3	General Dynamics	United States	\$29,512.00	\$39,350.00	75%
4	Northrop Grumman	United States	\$28,600.00	\$33,841.00	85%
5	Raytheon Company	United States	\$27,448.00	\$29,200.00	94%
6	Aviation Industry Corporation of China	China	\$25,075.38	\$66,858.02	38%
7	BAE Systems	United Kingdom	\$21,033.27	\$23,370.30	90%
8	China North Industries Group Corporation Limited	China	\$14,771.60	\$68,074.15	22%
9	L3Harris Technologies	United States	\$13,916.98	\$18,074.00	77%
10	United Technologies Corp.	United States	\$13,090.00	\$77,000.00	17%
11	China Aerospace Science and Industry Corporation	China	\$12,035.25	\$37,610.17	32%
12	Airbus	Netherlands/ France	\$11,266.57	\$78,916.36	14%
13	Leonardo	Italy	\$11,109.27	\$15,429.55	72%
14	China Shipbuilding Industry Corporation	China	\$11,019.56	\$55,097.78	20%
15	China Electronics Technology Group	China	\$10,148.87	\$32,951.25	31%
16	Thales	France	\$9,251.68	\$20,596.61	45%

17	Almaz-Antey	Russia	\$9,191.60	\$9,651.71	95%
18	China South Industries Group Corporation	China	\$8,845.87	\$28,550.02	31%
19	Huntington Ingalls Industries	United States	\$8,119.00	\$8,899.00	91%
20	China Aerospace Science and Technology Corporation	China	\$7,745.57	\$36,223.21	21%
21	Mitsubishi Heavy Industries	Japan	\$6,570.00	\$37,670.00	17%
22	Dassault	France	\$5,708.84	\$8,171.48	70%
23	Leidos	United States	\$5,364.00	\$11,094.00	48%
24	China State Shipbuilding Corporation	China	\$5,356.75	\$33,495.61	16%
25	Honeywell	United States	\$5,326.00	\$36,709.00	15%
26	Booz Allen Hamilton	United States	\$5,182.96	\$7,463.84	69%
27	Rolls-Royce	United Kingdom	\$4,712.36	\$19,725.28	24%
28	Safran	France	\$4,413.05	\$27,581.55	16%
29	GE Aviation	United States	\$4,400.00	\$32,875.00	13%
30	Naval Group	France	\$4,155.14	\$4,155.14	100%
31	Elbit Systems Ltd.	Israel	\$4,056.00	\$4,508.00	90%
32	Hanwha	South Korea	\$3,976.23	\$42,900.00	9%
33	Rheinmetall AG	Germany	\$3,942.46	\$7,001.73	56%
34	CACI International Inc.	United States	\$3,489.85	\$4,986.34	70%
35	Tactical Missiles Corporation JSC	Russia	\$3,474.90	\$3,546.46	98%
36	SAIC	United States	\$3,317.08	\$6,379.00	52%
37	Perspecta Inc.	United States	\$3,300.00	\$4,504.00	73%
38	Textron Inc.	United States	\$3,271.20	\$13,630.00	24%
39	Babcock International	United Kingdom	\$3,233.92	\$6,220.17	52%
40	Saab AB	Sweden	\$3,185.19	\$3,747.29	85%
41	Israel Aerospace Industries Ltd.	Israel	\$3,006.00	\$4,108.00	73%
42	KBR	United States	\$2,852.62	\$5,639.38	51%

43	KNDS	Netherlands	\$2,798.45	\$2,798.45	100%
44	Rafael Advanced Defense Systems Ltd.	Israel	\$2,746.65	\$2,746.65	100%
45	Hindustan Aeronautics Ltd.	India	\$2,710.00	\$3,010.00	90%
46	Amentum	United States	\$2,700.00	\$4,100.00	66%
47	Bechtel	United States	\$2,303.00	\$21,800.00	11%
48	Aselsan A.S.	Turkey	\$2,172.57	\$2,290.61	95%
49	Jacobs	United States	\$2,115.00	N/A	N/A
50	Oshkosh Defense	United States	\$2,032.00	\$8,382.00	24%

## Appendix 2: Methodology and Data

**Identifying global defense companies:** We selected a list of the top 50 global defense companies based on their defense revenue in 2019 using Defense News' Top 100 list, compiled by Defense News and the International Institute for Strategic Studies.<sup>31</sup> Appendix 1 provides more detail on the selected companies and their defense revenue.

**Identifying AI investments and M&A:** We supplemented Crunchbase data with data from Refinitiv to identify all private equity investment and M&A transactions made by the top 50 global defense companies. We limited the data to 2013 to 2020 to accommodate the big AI breakthroughs and a surge in deep learning and machine learning in late 2012 and the inclusion of Refinitiv data after 2012. In this paper, M&A refers to investment transactions with 100 percent of the target company's equity sold, while private-market investments include venture capital and private equity funding rounds. Therefore, we excluded transactions where the investment target is classified in Crunchbase as "Post-IPO" or "Grant." In this paper, we did not attempt to identify undisclosed M&A transactions and thus, excluded deals that are labeled "Intended," "Pending," "Rumor," "Withdrawn," or "Unknown" in Refinitiv. These restrictions allow us to meaningfully capture the investment and M&A trends by the global defense companies with higher confidence.

To identify AI companies, we ran a regular expression-based search query against business descriptions of the target companies provided by Crunchbase and Refinitiv.<sup>32</sup>



## Appendix 4: Defense Corporate Venture Capital Subsidiaries

The following table contains the name of defense companies and their corporate venture capital subsidiaries, as well as the country in which they are headquartered/founded.

Defense Company	Corporate Venture Capital Subsidiary	Country
Airbus	Airbus Venture	Netherlands/France
BAE Systems	BAE Systems Ventures <sup>33</sup>	United Kingdom
Boeing	Boeing HorizonX Ventures	United States
China Aerospace Science and Industry Corporation	CASIC Capital	China
Hanwha	Hanwha Investment Corp	South Korea
Honeywell	Honeywell Venture Capital	United States
Lockheed Martin	Lockheed Martin Ventures	United States
Rafael Advanced Defense Systems Ltd.	Rafael Development Corporation	Israel
Saab AB	Saab Ventures	Sweden
Safran	Safran Corporate Ventures	France
SAIC	SAIC Venture Capital	United States
China South Industries Group Corporation	SIAMC Management Co., Ltd.	China
Thales	Thales Corporate Ventures	France

## Endnotes

<sup>1</sup> “The Final Report,” National Security Commission on Artificial Intelligence, *Final Report* (Washington, DC: NSCAI, March 2021), 7, <https://www.nsc.ai.gov/wp-content/uploads/2021/03/Full-Report-Digital-1.pdf>.

<sup>2</sup> Melissa Flagg and Jack Corrigan, “Ending Innovation Tourism: Rethinking the U.S. Military’s Approach to Emerging Technology Adoption” (Center for Security and Emerging Technology, July 2021), 4–5, <https://cset.georgetown.edu/publication/ending-innovation-tourism/>.

<sup>3</sup> In this paper, mergers and acquisitions refer to investment transactions with 100 percent of the target company’s equity sold. In our analysis, we grouped mergers and acquisitions together and focused on transactions that involve majority ownership. Investments include venture capital and private equity funding rounds. We excluded transactions where the target was classified by Crunchbase as Post-IPO or Grant. See Zachary Arnold, Ilya Rahkovsky, and Tina Huang, “Tracking AI Investment: Initial Findings from the Private Markets” (Center for Security and Emerging Technology, September 2020), <https://cset.georgetown.edu/research/tracking-ai-investment/>.

<sup>4</sup> Marjorie Censer, “Lockheed Martin Ventures invests in Fiddler,” *Inside Defense*, August 12, 2020, <https://insidedefense.com/insider/lockheed-martin-ventures-invests-fiddler>.

<sup>5</sup> “Artificial Intelligence,” Airbus, December 6, 2016, <https://www.airbus.com/newsroom/news/en/2016/12/Artificial-Intelligence.html>.

<sup>6</sup> Chris Moran, “Lockheed Martin seeks investments not acquisitions in dual-use technology startups,” Lockheed Martin, July 2020, <https://www.lockheedmartin.com/en-us/news/features/2020/the-win-win-of-corporate-backed-funds.html>; see further Thomas J. Chemmanur and Elena Loutschina, “The Role of Venture Capital Backing in Initial Public Offerings: Certification, Screening, or Market Power?,” *EFA 2005 Moscow Meetings Paper* (September 2006): 7–8, <http://dx.doi.org/10.2139/ssrn.604882>; Adil Khan, Steve Beckey, and Jim Adams, “After the Shock: Implications for M&A in the aerospace & defense market” (KPMG, 2020), <https://advisory.kpmg.us/articles/2020/after-shock-implications-ma-aerospace-defense-market.html>.

<sup>7</sup> Josh Lerner, “Corporate Venturing,” *Harvard Business Review*, October 2013, <https://hbr.org/2013/10/corporate-venturing>; Donald DePamphilis, *Mergers and Acquisitions Basics: All You Need To Know* (Cambridge, MA: Academic Press, October 2010), 43–44; Previous examples of major defense companies buying cyber firms but failing to effectively incorporate their employees and products into the larger company show the limits of the M&A element in particular, Aaron



Mehta, “The great industrial competition: Mergers, acquisitions and geopolitical events fuel revenue,” *Defense News*, July 22, 2019, <https://www.defensenews.com/top-100/2019/07/22/the-great-industrial-competition-mergers-acquisitions-and-geopolitical-events-fuel-revenue/>.

<sup>8</sup> “Top 100 for 2020,” *Defense News*, 2020, <https://people.defensenews.com/top-100/>. The top 50 global defense companies were selected based on their defense revenue. See Appendix 1 for additional details.

<sup>9</sup> Flagg and Corrigan, "Ending Innovation Tourism."

<sup>10</sup> Loren Thompson, “Raytheon And BAE Systems Are Drawing Nontraditional Suppliers Into Defense,” *Forbes*, January 24, 2020, <https://www.forbes.com/sites/lorenthompson/2020/01/24/how-top-military-contractors-raytheon-and-bae-systems-are-drawing-non-traditional-suppliers-into-defense/?sh=30a8abb06af2>.

<sup>11</sup> In this paper, we categorized the top 50 global defense companies’ geographic location based on the location of their headquarters.

<sup>12</sup> Md Zahangir Alom, Tarek M. Taha, Chris Yakopcic, and Stefan Westberg, et al., “The History Began from AlexNet: A Comprehensive Survey on Deep Learning Approaches,” arXiv preprint arXiv:1803.01164 (2018), <https://arxiv.org/pdf/1803.01164.pdf>.

<sup>13</sup> For more details on the methodology, see Arnold, Huang, and Rahkovsky, “Tracking AI Investment,” 33; replication data and code are available at <https://github.com/georgetown-cset/global-defense-companies>.

<sup>14</sup> The investment disclosed value refers to the amount raised by a company during a particular series of funding.

<sup>15</sup> Of the 6 M&A deals, 5 kept their transaction value confidential.

<sup>16</sup> Jacques Bughin, Eric Hazan, Sree Ramaswamy, and Michael Chui et al., “Artificial Intelligence: The Next Digital Frontier?” (McKinsey Global Institute, June 2017), 35, <https://www.mckinsey.com/~media/mckinsey/industries/advanced%20electronics/our%20insights/how%20artificial%20intelligence%20can%20deliver%20real%20value%20to%20companies/mgi-artificial-intelligence-discussion-paper.ashx>.

<sup>17</sup> See appendix 3 for details.

<sup>18</sup> Michael Richter, “Defense M&A is hot — but where are the targets?,” *Defense News*, July 17, 2018, <https://www.defensenews.com/newsletters/daily-news-roundup/2018/07/17/defense-ma-is-hot-but-where-are-the-targets/>; Matt Aaronson, Doug Belair, Paul DeLia, and Drosten Fisher et al., “Building Beachheads in the US Defense Market Through M&A,” Boston Consulting Group, July 23, 2020, <https://www.bcg.com/publications/2020/building-beachheads-us-defense-market-through-mergers-acquisitions>.

<sup>19</sup> Aaron Mehta, “Boeing’s venture fund boss talks venture capital and growing defense investments,” *Defense News*, January 30, 2020, <https://www.defensenews.com/smr/cultural-clash/2020/01/30/boeings-venture-fund-boss-talks-venture-capital-and-growing-defense-investments/>.

<sup>20</sup> Lerner, “Corporate Venturing”; Gary Dushnitsky and Michael J. Lenox, “When does corporate venture capital investment create firm value?,” *Journal of Business Venturing* 21, no. 6 (November 2006): 757; Doug Cameron, “Defense Industry Adds Venture Capital to Its Arsenal,” *The Wall Street Journal*, July 5, 2018, <https://www.wsj.com/articles/defense-industry-adds-venture-capital-to-its-arsenal-1530792001>.

<sup>21</sup> Mehta, “Boeing’s venture fund boss talks venture capital and growing defense investments.”

<sup>22</sup> Moran, “Lockheed Martin seeks investments not acquisitions in dual-use technology startups”; brackets in the original.

<sup>23</sup> Theresa Hitchens, “Lockheed Martin Ventures Scouts Next-Gen AI/ML Tech,” *Breaking Defense*, August 11, 2020, <https://breakingdefense.com/2020/08/lockheed-martin-ventures-scouts-next-gen-ai-ml-tech/>.

<sup>24</sup> Michael Vizard, “Honeywell lays down \$1.3 billion to drive AI and IoT into life sciences,” *VentureBeat*, December 23, 2020, <https://venturebeat.com/2020/12/23/honeywell-lays-down-1-3b-to-drive-ai-and-iot-into-life-sciences/>.

<sup>25</sup> BAE Systems Ventures is inactive. See “BAE Systems Ventures,” Pitchbook, accessed May 27, 2021, <https://pitchbook.com/profiles/investor/123753-97>.

<sup>26</sup> In this paper, we sorted the 52 investment transactions made by these 11 defense companies based on whether or not the company investor has established a CVC division.

<sup>27</sup> In 2019, privately held AI companies attracted nearly \$40 billion in disclosed equity investment. See further Arnold, Huang, and Rahkovsky, “Tracking AI Investment,” 7.

<sup>28</sup> For example, Chinese investments into U.S.-based privately-held AI companies have come with the goal of technology transfer, and Chinese defense companies with military contracts unquestionably hope to harness AI technology obtained through investments for military advantage. See e.g., William Hannas and Huey-Meei Chang, “China’s Access to Foreign AI Technology: An Assessment” (Center for Security and Emerging Technology, September 2019), <https://cset.georgetown.edu/publication/chinas-access-to-foreign-ai-technology/>; Michael Brown and Pavneet Singh, “China’s Technology Transfer Strategy: How Chinese Investments in Emerging Technology Enable A Strategic Competitor to Access the Crown Jewels of U.S. Innovation” (Defense Innovation Unit Experimental, January 2018), [https://admin.govexec.com/media/diux\\_chinatechnologytransferstudy\\_jan\\_2018\\_\(1\).pdf](https://admin.govexec.com/media/diux_chinatechnologytransferstudy_jan_2018_(1).pdf); Andrew Zaleski, “Lockheed Martin invests millions in defense start-ups to fast-track R&D,” *CNBC*, November 2, 2017, <https://www.cnbc.com/2017/10/31/lockheed-martin-places-big-bets-on-defense-start-ups.html>; in this paper, we did not attempt to identify undisclosed investment transactions unavailable in commercial datasets. Moreover, our analysis only focuses on the top 50 global defense companies, not smaller companies with military contracts. While there are companies with military contracts investing in AI companies, we leave this to future research.

<sup>29</sup> Flagg and Corrigan, “Ending Innovation Tourism”; Zaleski, “Lockheed Martin invests millions in defense start-ups to fast-track R&D.”

<sup>30</sup> Hitchens, “Lockheed Martin Ventures Scouts Next-Gen AI/ML Tech.”

<sup>31</sup> “Top 100 for 2020.”

<sup>32</sup> For more details on the methodology, see Arnold, Huang, and Rahkovsky, “Tracking AI Investment,” 33; replication data and code are available at <https://github.com/georgetown-cset/global-defense-companies>.

<sup>33</sup> BAE Systems Ventures is currently inactive. See note 25 above.