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www.spadeindex.com / defense

SPADE Defense Index Statistics

6/28/19 Close	7545.44
12/31/18 Close	5754.86

All-time Intraday High:
 20 June 2019 7603.99

All-time Closing High:
 20 June 2019 7595.36

	SPADE Defense	S&P500
2Q19	11.92%	3.79%
1Q19	17.15%	13.07%
2019 YTD	31.11%	17.35%

Commentary

I. The Changing Landscape of Defense

The top firms in the defense sector have remained relatively steady over the past decade as consolidation, especially among the larger prime contractors, has been discouraged by the Department of Defense who must provide their approval for any transactions. The past year however has seen several deals that are reshaping the landscape.

It is reminiscent of the 1990s. Following the fall of the Soviet Union, defense firms were encouraged to consolidate by Deputy Defense Secretary

William Perry who saw forthcoming defense budgets too small to support the number of existing defense firms [the July 1993 dinner is known as “The Last Supper”].* However, compared to 30 years ago, today’s deals are happening more from a position of strength than weakness.

In any given year, there might be 400+ transactions, typically between a large or mid-size defense firm and a smaller firm. This is one means for firms to obtain multi-year contracts, new or innovative technologies and expertise,

*See page 5

continued on page 3

SPADE Defense Index June 2019 Rebalance

Parsons (NYSE: PSN) and Jacobs Engineering (NYSE: JEC) were added to the Index.

Corporate Actions Affecting the Index During the Quarter

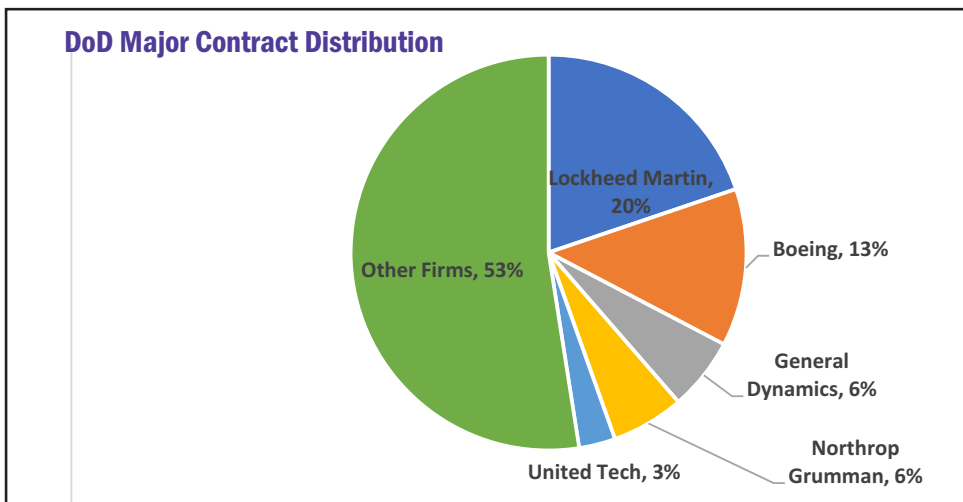
KeyW Holdings was acquired by Jacobs Engineering.

L3 and Harris merged to become L3 Harris.

Licensed Products

Exchange Traded Fund (ETF)

The SPADE Defense Index has been licensed to Invesco and serves as the underlying index for the Invesco Aerospace & Defense ETF (NYSE Arca: PPA).



Competition Rates by Service

	Competed	Not Competed
Air Force	38%	62%
Army	24%	76%
Navy	28%	72%
DoD-Wide	50%	50%

GAO analysis of 183 currently reported major contract programs in the DoD portfolio. Data Source: Federal Procurement Data System-Next Generation

Defense News, 3 June 2019, 30.

2Q19 Leaders

1	Maxar	94.53%
2	Vectrus	52.54%
3	Kratos	46.45%
4	Heico	41.05%
5	KBR	30.64%
6	Key W Holdings	30.28%
7	OSI Systems	28.57%
8	Aerojet Rocketdyne	26.01%
9	Leidos	24.59%
10	Intelsat	24.20%

2Q19 Laggards

1	Aerovironment	-17.02%
2	FireEye	-11.79%
3	Boeing	-4.56%
4	Raytheon	-4.50%
5	United Tech	2.57%
6	Ducommun	3.56%
7	ViaSat	4.28%
8	Textron	4.70%
9	BWX Technologies	5.08%
10	Transdigm	6.57%

Holdings

Giant	27.32%
Large	32.35%
Medium	32.79%
Small/Micro	7.52%

**ETF Statistics (NYSE Arca: PPA)
Invesco Aerospace & Defense**

Exchange / Ticker Symbol:	NYSE / PPA
Assets (6/28/19)	\$ 983.7M
Closing Price (6/28/19)	\$64.94
Yield (TTM)*	1.48%
2Q19 Volume**	4,097,100
Turnover*	7%

source: * Morningstar & ** Yahoo Finance 7/1/19

YTD Results

1	Triumph Group	99.13%	27	Elbit Systems	31.13%
2	Vectrus	87.95%	28	Aerojet Rocketdyne	27.08%
3	KeyW Holdings	67.86%	29	Mantech	25.93%
4	KBR	64.30%	30	Curtiss Wright	24.49%
5	Kratos	62.46%	31	FLIR	24.25%
6	OSI Systems	53.66%	32	United Technologies	24.15%
7	Woodward	52.32%	33	Ducommun	24.09%
8	Ball Corp	52.22%	34	Moog	20.82%
9	Leidos	51.46%	35	Cubic	19.99%
10	Mercury Systems	48.76%	36	Huntington Ingalls	18.09%
11	Booz Allen	46.80%	37	General Dynamics	15.65%
12	Axon	46.77%	38	Comtech	15.49%
13	Transdigm	42.27%	39	Textron	15.33%
14	CACI	42.05%	40	Kaman	13.55%
15	LLL	41.18%	41	Raytheon	13.39%
16	Hexcel	41.05%	42	Boeing	12.87%
17	Harris	40.46%	43	AAR Corp	-1.47%
18	Lockheed Martin	38.84%	44	FireEye	-8.64%
19	ViaSat	37.10%	45	Intelsat	-9.07%
20	BWX Technologies	36.28%	46	Aerovironment	-16.45
21	Oshkosh	36.18%	47	Maxar	-34.62%
22	Perspecta	35.95%			
23	SAIC	35.89%			
24	Teledyne	32.26%			
25	Honeywell	32.15%			
26	Northrop Grumman	31.94%			

Portfolio Price / Earnings*	18.50
Portfolio Price / Book*	3.89
Portfolio Price / Sales*	1.67
Portfolio Price / Cash Flow*	15.13

Beta (3-year) *	1.19
Alpha (3-year)*	8.38
R-squared (3 years)*	61.88

source: * Morningstar 7/1/19

Capture Ratio	1-Yr	3-Yr	5-Yr	10-Yr
Upside	160.17	142.66	133.70	115.47
Downside	116.89	103.74	76.68	74.87

PPA Dividend History

YTD	\$0.2134
2018	\$0.4441
2017	\$0.3635
2016	\$0.7082
2015	\$0.5019
2014	\$0.2153
2013	\$0.3825
2012	\$0.4435
2011	\$0.1988

Commentary *(continued from page 1)*

and staff with high level security clearances or specialized capabilities.

The past year however has seen a number of consolidations between mid-size and large defense sector firms that represent the 100 largest companies operating in the sector. This includes SAIC acquiring Engility in 2018; General Dynamics buying CSRA to bulk up its IT offerings; Northrop Grumman acquiring Orbital Sciences, a manufacturer of missile engines and space rockets and satellites; the combination of Transdigm and Esterline; the merger creating L3 Harris, and the recent announcement that United Technologies and Raytheon will become Raytheon Technologies.

Whether this is a security concern is open for discussion, but most of these deals represent firms expanding into areas with little overlap. Still in an industry which has just two large shipbuilders (General Dynamics and Huntington Ingalls) and three firms capable of designing and building military aircraft (Boeing, Lockheed Martin, and Northrop Grumman), military policymakers and procurement staff are beginning

to consider awarding contracts to firms that can expand its supplier base. This could prove to benefit smaller firms like Aerovironment, Kratos, Maxar, and Textron and private firms like General Atomics and Sierra Nevada.

II. Paris Air Show

During the summers ending in an odd number, the global aerospace and defense community gathers to show off their latest systems, meet, and sign and announce deals (even years are held at a smaller event in Farnborough UK). It is a major event drawing hundreds of thousands of people, business executives, and military officials from around the world.

Overall, business announced at the 2019 Paris Air Show was a bit slower than normal, much of it because Boeing was focused on communicating safety vs. announcing commercial aircraft sales as they continue to work through the issues with their 737-Max aircraft and receive flight approval from the various regulatory agencies. In total less than 900 orders were announced vs. the roughly 1400 at Farnborough in 2018.

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Two-year chart comparing SPADE Defense Index (DXS) (black) with the S&P500 (gold)



Commentary (continued from page 3)

Overall, European manufacturer Airbus booked a total of 383 orders and commitments along with 375 conversions of existing orders. This included 48 firm orders and 89 commitments for its new A321XLR, a long range variant of its A321neo that can fly 8700km (4700 nm) without stopping.

Boeing, in a surprise to many, received a Letter of Intent for 200 - 737Max aircraft (including the Max8 and Max10) from International Airlines Group. This is the 1st and only commitment since the 737 Max family was grounded. Overall, they announced 242 orders and commitments. This included orders for cargo planes [China Airlines – 6, 777F and Qatar – 5, 77F]; and the 787 Dreamliner [Korean Air (10, 787-9; 10, 787-10; and leasing 10, 787-10 from Air Lease Corp). Air Lease also ordered 5 additional 787s and Turkmenistan ordered one 777-200LR (the only order since Boeing delivered the last of this type in 2014).

Updated Commercial Aviation Forecast

At the Air Show, Boeing released its latest commercial aviation market forecast; \$6.8 Trillion or 44,040 new aircraft over the next 20 years. This was up 3% from last year's forecast.

New Tech on Display

Four technologies were on prominent display by U.S., European, and firms around the globe—**Cyber, AI, drones, and electric and hybrid electric propulsion.**

The first three should not be a surprise to anyone who has read about broader technology trends. The 4th—electric and hybrid electric propulsion is getting increasing attention in the A&D community. As technologies make materials stronger and electronics and batteries lighter, the reduced cost and increased reliability of electric propulsion systems is making the technology feasible. For smaller general aircraft that are not required operate at its maximum range, a 60-80% reduction in operating costs is considered incredibly attractive.

Gaining attention among a number of systems displayed, were those from United Technologies Pratt & Whitney division and the Paris debut of the first electric commuter aircraft, Eviation Alice.

Another intriguing technology was Raytheon's Skyler AESA multipurpose radar. Lightweight and compact enough to fit on buildings

or cell phone towers, it can provide coverage under 3000 ft with applications that include counter UAS, microweather, and safety and deconfliction in urban areas for urban taxis and drones especially at night and in bad weather—each a market expected to see significant growth over the next decade.

Increasing European Demand

Stories in the economic press talk about weakening global demand especially in infrastructure. Comments out of the Paris Air Show however indicated that, at least in the near term, this may not impact the aerospace and defense sector as much as it will other industries. Among the comments:

Reuters: European demand for fighter jets, missile defenses, and other weapons is growing fast amid heightened concerns about Russia and Iran.

Lockheed Martin and Boeing: Seeing accelerating demand for US weapons in Paris despite escalating trade tensions between the US and EU.

Lockheed Martin: Stated Europe is their fastest growth market.

US Defense Security Cooperation Agency: The European Union accounted for nearly a quarter of \$55.7B in foreign arms sales handled by the agency in 2018.

Raytheon: Is attempting to deliver Patriot missile systems and other weapons in half the previously typical 5-year delivery period.

Aerospace & Defense: An Engine for Growth

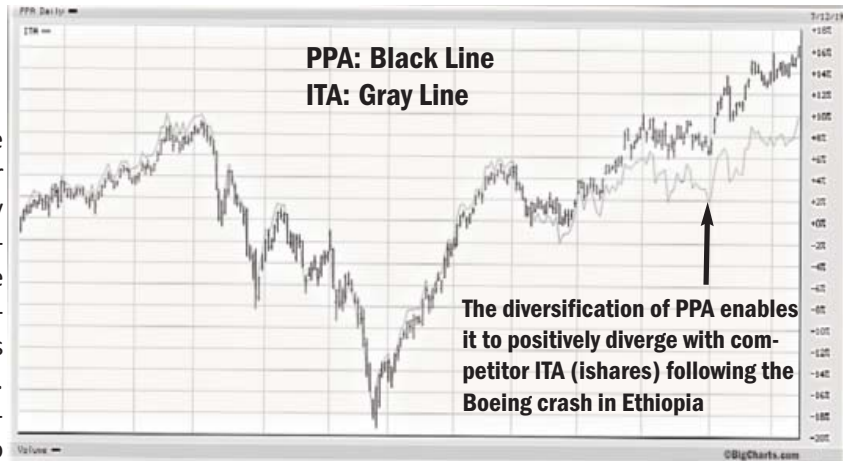
The U.S. Aerospace Industries Association released its annual economic forecast in Paris. Among the key results of the 2018 report:

- Total exports were \$151B, up 5.8% over 2019.
- The US exported \$90B in Aero and defense goods and services more than it imported.
- Overall, A&D represented 9% of all US Exports.
- Contributed \$324B to US GDP
- Employment of 2.5M jobs: 20% of all US manufacturing— 881,575 in end-use and 1.67 in supply chain.
- Average A&D wage: \$92,742, up 1.36% over 2017, 87% higher than the average US worker's wage.

Commentary (continued from page 4)

III. Boeing Update

Boeing continues to make progress getting the 737 Max re-certified, however they hit a number of roadblocks during the quarter which will likely delay its return to service until 4Q19. As mentioned earlier, the firm did receive a surprise order for 200 aircraft at the Paris Air Show, however, although terms were not announced, it is rumored to have been at a significant discount. The firm still has a number of lawsuits and partner airlines seeking compensation in addition to the \$100M they proposed to distribute to families of the 346 people killed in the two 737Max crashes in Ethiopia and Indonesia. It will be interesting to hear what color the firm provides to investors when it reports quarterly earnings on July 24th. We also anticipate the plane to revert to a previous designation, it 737-8 and eliminate the “Max” part of the name or redesignate it entirely as a customer relations initiative. While we’d like to say the worst is behind then, until the plan is re-certified and flying there are still many unknowns to consider.



More Diversification = Lower Risk

	PPA	ITA
# holdings	48	36
ETF Weight Boeing	8.14%	12.98%
Weight of firms with 737 Max exposure	24.71%	37.73%
Post-crash, portfolio return (10-day)	(0.05%)	(1.70%)
Post-crash, portfolio return (1-mo)	2.72%	(0.70%)
Post-crash, portfolio return (through 7/12/19)	+14.8%	+8.7%

Selected 1990s Defense M&A

Lockheed [1993] General Dynamics military jets [1995] Merged with Martin Marietta	Northrop Grumman [1992] LTV Aircraft [1994] Grumman [1996] Westinghouse Defense	Loral [1991] Ford Aerospace [1992] LTV Missiles [1994] IBM Federal Systems [1995] Unisys Defense	Martin Marietta [1993] GE Aerospace [1994] General Dynamics rockets [1995] Lockheed
Boeing [1995] Rockwell Defense & Space [1996] McDonnell Douglas	Raytheon [1996] Hughes Aircraft [1997] Texas Instruments defense	Hughes Aircraft [1992] General Dynamics missiles [1994] CAE Link [1995] Magnavox defense [1995] E-Systems	Lockheed Martin [1996] Loral defense

US Air Force Space Systems

Air Force Budget Deputy Carolyn Greason stated that the budget in FY19 is \$11.B and it is requesting a 19.5% increase (\$2.3 Billion) in FY20 which includes \$200M to start up three new organizations: US Space Force, US Space Command, and the Space Development Agency.

Top USAF Space Program Spending (2019-2024)

Evolved Expendable Launch Vehicle	\$7.43 B
GPS III Space Segment	\$6.20 B
Next Generation Launch System Investment	\$1.89 B
Next Generation Overhead Persistent	\$9.64 B
Space Based Infrared Systems	\$424 M

Top USAF Space Contractors (2019-2024)

Lockheed Martin	43%
United Launch Alliance	20%
Others/Unknown	22%
Northrop Grumman	6%
Mantech International	1%
Contractor Not Yet Selected	8%

Avascent Analytics estimate. Defense News, June 17, 2019, 8.

Index Performance (ex div)

Total Price Return

(w/o dividends)

	SPADE Defense Index
3-Yr	39.67%
5-Yr	61.15%
10-Yr	260.55%
20-Yr	573.19%

Data through 1/1/19

	SPADE Defense Index	S&P500	Alpha (bps)
YTD	31.11%	17.35%	1376
2018	[8.15%]	[6.24%]	191
2017	28.92%	19.42%	950
2016	17.95%	9.53%	842
2015	3.23%	[0.73%]	396
2014	11.77%	11.39%	38
2013	48.27%	29.60%	1867
2012	16.30%	13.41%	289
2011	[2.75%]	[0.00%]	[275]
2010	9.62%	12.78%	[316]
2009	21.71%	23.45%	[174]

	SPADE Defense Index	S&P500	Alpha (bps)
2008	[38.03%]	[38.49%]	46
2007	22.17%	3.53%	1864
2006	19.33%	13.62%	571
2005	5.30%	3.00%	230
2004	20.47%	8.99%	1148
2003	37.27%	26.38%	1089
2002	[2.87%]	[23.37%]	2050
2001	0.94%	[13.04%]	1488
2000	4.98%	[10.14%]	1512
1999	15.31%	19.53%	[422]
1998	6.63%	26.67%	[2004]

Since the market selloff in 2008, the SPADE Defense Index is up 343.55%, outgaining the 225.57% return for the S&P500--an alpha of nearly 118%

Without reinvesting dividends...\$10,000 invested when the index began calculating in 1998 would be \$94,113.37 at the end of 2Q19.

Since the fund launch in 2005, \$4.43 has been returned via dividends, 29.5% of the initial \$15 share price.

About the SPADE Defense Index

The SPADE Defense Index (NYSE: DXS) provides an investment benchmark for the value that the market ascribes to companies involved with defense and its homeland security, and space components.

The Index is designed to reflect the broad diversity of activities that is representative of companies involved with the sector – including industrial firms that manufacture aircraft, tanks, ships, and missiles; and those involved with current and next generation systems related to network centric warfare and information technology; intelligence, surveillance, and reconnaissance; satellites; border security; and defense systems that protect the lives of our servicemen and servicewomen.

SPADE Indexes specializes in designing and managing equity benchmarks for ETF and other products.

Rules

The Index was designed to be RIC (registered investment company) compliant for the purpose of enabling financial products. Companies are required to meet a variety of eligibility criteria including market valuation, liquidity, and listing on a major U.S. exchange. Each firm is considered to be systematically important to the defense of the United States and defense is systematically important to the business, revenues, and health of the firm.

Full details are available on our website.

* Market Cap: Minimum \$100M

* Share Price: Minimum \$5.00

* Sufficient Liquidity

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End of 2Q19		89.071%					Market	Forward	Price/	Price/	PEG	
							Cap	P/E	Sales	Book	5 yr	Div Yld
		Percent	29-Mar-19	28-Jun-19	YTD	QTD	intraday	(ttm)	ttm	mrq	expected	forward %
Company	Ticker	6/30/19	Price	Price	% Ch	% Ch						
AXON International Inc.	AAXN	0.79%	54.41	64.21	46.77%	18.01%	3.80	48.28	8.73	7.90	2.19	
AAR Corp	AIR	0.27%	32.51	36.79	-1.47%	13.17%	1.29	13.14	0.66	1.41	0.94	0.83%
Aerojet Rocketdyne	AJRD	0.71%	35.53	44.77	27.08%	26.01%	3.52	25.58	1.86	7.4	1.20	
AeroVironment	AVAV	0.28%	68.41	56.77	-16.45%	-17.02%	1.36	33.39	4.32	2.91	0.82	
Boeing Co	BA	7.08%	381.42	364.01	12.87%	-4.56%	204.80	16.17	2.03	1638.42	1.30	2.26%
Booz Allen	BAH	1.95%	58.14	66.21	46.90%	13.88%	9.27	19.42	1.38	13.73	2.09	1.39%
Ball Corp	BLL	4.16%	57.89	69.99	52.22%	20.90%	23.43	23.10	2.01	6.60	1.80	0.88%
BWX Technologies	BWXT	1.04%	49.58	52.1	36.28%	5.08%	4.96	18.74	2.82	20.41	2.4	1.32%
Caci Intl	CACI	1.06%	182.02	204.59	42.05%	12.40%	5.09	17.11	1.06	2.18	4.02	
Comtech	CMTL	0.14%	23.22	28.11	15.49%	21.06%	0.68	22.85	1.02	1.29	1.85	1.45%
Cubic Corp	CUB	0.37%	56.24	64.48	19.99%	14.65%	2.01	15.92	1.52	2.18		0.43%
Curtiss Wright	CW	1.14%	113.34	127.13	24.49%	12.17%	5.44	16.79	2.23	3.43	2.46	0.51%
Ducommun	DCO	0.11%	43.52	45.07	24.09%	3.56%	0.52	16.51	0.80	1.96	0.92	
Elbit Systems	ESLT	1.34%	129	149.51	31.13%	15.90%	6.56	22.55	1.69	3.39		1.18%
FireEye	FEYE	0.62%	16.79	14.81	-8.64%	-11.79%	3.04	47.77	3.61	4.78	1.19	
Flir Systems	FLIR	1.54%	47.58	54.1	24.25%	13.70%	7.35	20.57	4.12	3.85	1.03	1.27%
General Dynamics	GD	5.26%	169.28	181.82	15.65%	7.41%	52.52	13.95	1.39	4.28	1.80	2.30%
Heico	HEI	3.73%	94.87	133.81	72.70%	41.05%	15.65	53.74	8.13	11.58	3.16	0.11%
Huntington Ingalls	HII	1.98%	207.2	224.74	18.09%	8.47%	9.34	13.13	1.11	5.98	1.72	1.54%
Honeywell Intl	HON	7.28%	158.92	174.59	32.15%	9.86%	127.06	19.71	3.15	6.77	3.11	1.89%
Harris Corp	HRS	Merged	159.71	189.13	40.46%	18.42%	22.34	20.56	3.38	6.19	1.31	1.45%
Hexcel	HXL	1.44%	69.16	80.88	41.05%	16.95%	6.87	20.69	3.04	5	1.99	0.75%
Intelsat	I	0.56%	15.66	19.45	-9.07%	24.20%	2.74	-8.38	1.27	-0.65	-0.09	
Kaman	KAMN	0.37%	58.44	63.69	13.55%	8.98%	1.78	20.41	0.95	2.77	2.24	1.25%
KBR	KBR	0.74%	19.09	24.94	64.30%	30.64%	3.53	13.13	0.68	1.99	1.45	1.30%
KEY W Holding	KEYW	Acquired	8.62	11.23	67.86%	30.28%						
Kratos Defense & Security	KTOS	0.50%	15.63	22.89	62.46%	46.45%	2.42	44.02	3.82	4.38	4.74	
Leidos	LDOS	2.45%	64.09	79.85	51.46%	24.59%	11.52	15.57	1.11	3.49	1.66	1.61%
L-3 Communications Hldgs	LLL	Merged	206.37	245.17	41.18%	18.80%	19.48	19.03	1.84	3.22	2.23	1.38%
Lockheed Martin	LMT	7.35%	300.16	363.54	38.84%	21.12%	102.71	14.55	1.82	11.67	1.25	2.45%
Mantech International'a'	MANT	0.55%	54.02	65.85	25.93%	21.90%	2.63	25.82	1.32	1.86	2.90	1.66%
Maxar Technologies	MAXR	0.10%	4.02	7.82	-34.62%	94.53%	0.47	1.57	0.22	0.80	1.25	0.55%
Moog Inc.	MOGA	0.68%	86.95	93.61	20.82%	7.66%	3.26	15.92	1.17	2.49	1.81	1.12%
Mercury Computer Sys	MRCY	0.69%	64.08	70.35	48.76%	9.78%	3.89	35.17	6.17	4.09	1.90	
Northrop Grumman	NOC	5.52%	269.6	323.11	31.94%	19.85%	54.86	14.51	1.74	6.28	2.22	1.66%
OSI Systems	OSIS	0.44%	87.6	112.63	53.66%	28.57%	2.04	24.48	1.76	3.88	1.49	
Oshkosh Truck	OSK	1.27%	75.13	83.49	36.18%	11.13%	5.84	10.69	0.73	2.33	2.24	1.33%
Perspecta	PRSP	0.80%	20.22	23.41	35.95%	15.78%	3.81	10.84	0.94	1.77	2.19	1.04%
Raytheon Co	RTN	4.91%	182.08	173.88	13.39%	-4.50%	48.43	13.33	1.76	4.16	1.21	2.12%
SAIC	SAIC	1.09%	76.95	86.56	35.89%	12.49%	5.11	13.89	1.00	3.49	3.08	1.74%
Transdigm	TDG	3.94%	453.99	483.8	42.27%	6.57%	25.73	23.17	6.10		2.17	
Teledyne Technologies	TDY	2.07%	237.01	273.87	32.26%	15.55%	9.92	26.46	3.36	4.22	0.96	
Triumph Group	TGI	0.24%	19.06	22.9	99.13%	20.15%	1.14	7.20	0.34	-1.99	0.65	0.75%
Textron	TXT	2.62%	50.66	53.04	15.33%	4.70%	12.35	13.06	0.90	2.36	1.20	0.15%
United Technologies	UTX	7.28%	128.89	132.2	24.15%	2.57%	112.35	14.91	1.61	2.80	1.88	2.28%
Vectrus	VEC	0.10%	26.59	40.56	87.95%	52.54%	0.46	10.19	0.36	2.02		
Viasat Inc	VSAT	1.03%	77.5	80.82	37.10%	4.28%	4.90	230.91	2.37	2.57	-10.31	
Woodward	WWD	1.47%	94.89	113.16	52.32%	19.25%	7.03	20.54	2.59	4.14	1.45	0.60%
Parsons	PSN	0.75%	30.65	36.86		20.26%	3.75	23.89	0.98	3.73		
L3HARRIS TECHNOLOGIES INC.	LHX	7.66%	Merger	189.13			43.33	25.96	3.57	12.01		1.40%
Jacobs Engineering	JEC	2.52%	73.87	84.39	44.36%	14.24%	11.64	31.1	0.74	2.13		0.80%

Data Provided by Yahoo Finance, Thomson Reuters (P/E, PEG), Morningstar (div)