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www.spadeindex.com / defense

SPADE Defense Index Statistics

12/31/18 Close	5754.86
12/29/17 Close	6265.24

All-time Intraday High:
3 October 2018 7228.54

All-time Closing High:
3 October 2018 7193.30

	SPADE Defense	S&P500
4Q18	-19.49%	-13.97%
3Q18	11.94%	7.20%
2Q18	[3.11%]	2.93%
1Q18	5.20%	[1.22%]
2018	-8.15%	-6.24%

Commentary

Market volatility in 4Q18 soared as the broader market went from all-time highs earlier in the quarter to bear market levels by the end of December, preventing the typical end-of-year rally. The Aerospace & Defense (A&D) sector was not spared the carnage and the SPADE Defense Index declined nearly 20%, its biggest single quarterly decline since the index inception in 1997. On the heels of multiple (six consecutive) years of outperformance, a decline was not a surprise though the magnitude in such a short time definitely was. When investors exit the market they tend to do so in securities and sectors with the largest gains in the belief (fear?) that there is greater room to fall than in areas that have seen recent declines or smaller gains.

Sector-specific news directly impacting the sector was limited as much of the volatility was due to concerns over the Fed’s plans for interest rates, a potential global economic slowdown, and international and policy matters including a trade (can we say battle if not war) with China. There were concerns about a Lion Air incident that traced back to Boeing aircraft changes and a President Trump December 3rd tweet stating, “a \$716 billion Defense Department budget for fiscal 2019 is ‘crazy” (he had signed it on August 13th). Although he also stated the need to put a halt to the uncontrollable arms race with China and Russia, reports indicate that a \$750 billion budget is being planned for FY-2020 so these comments quickly became a non-issue. It is an important one to monitor since the sector derives significant revenues from the annual DoD budget.

The other major news event in 4Q18 were the U.S. election results. These went as anticipated with the Democratic party regaining control of the House of Representatives while failing to gain control of the Senate. The results will have implications for the defense sector but in the near term it is more headline risk and changes to forecasts that any actual impact on revenues and earnings. As investors in the sector are well aware, the FY19 budget is already in place and the FY20 budget has been essentially agreed to. Based on comments from the Democratic party and the White House, I expect that there will be calls to reduce spending in the sector however I anticipate that it will be used as a bargaining chip by the House to reduce spending only moderately in exchange for the White House’s support in other budget areas. Significant cuts in defense spending prior to the 2020 Presidential election would be discouraged by the Democratic Party leadership as they would not want to give the Republican Party a platform to run on.

Over the past several quarters (and years) the SPADE Investor newsletter has continued to cite the same factors driving A&D investments issue after issue. Even with the recent 20% decline in the value of the index, the same factors that have driven the sector will help it rebound from the recent lows--solid government defense spending, expanding international defense sales, a commercial aircraft upcycle, and growing space and cybersecurity spending.

From a return standpoint, the SPADE Defense Index continued to prove that investing in the

**SPADE Defense Index
December 2018 Rebalance**

VSE Corporation (VSEC) was removed from the Index as it no longer met our liquidity requirements.

Corporate Actions Affecting the Index During the Quarter

United Tech’s acquisition of Rockwell Collins closed

**Licensed Products
Exchange Traded Fund (ETF)**

The SPADE Defense Index has been licensed to Invesco and serves as the underlying index for the ~\$1 Billion Invesco Aerospace & Defense ETF (NYSE Arca: PPA).

During 2Q18, Invesco renamed its Invesco Powershares Aerospace & Defense ETF, the Invesco Aerospace & Defense ETF.

4Q18 Leaders

1	Esterline	33.53%
2	Sparton	26.06%
3	Ball Corp	4.52%
4	Aerojet Rocketdyne	3.65%
5	Rockwell Collins	0.41%
6	OSI Systems	-3.94%
7	FireEye	-4.65%
8	Kratos Defense	-4.67%
9	Viasat	-7.82%
10	Woodward	-8.13%

4Q18 Laggards

1	Maxar Technologies	-63.83%
2	Triumph Group	-50.64%
3	AeroVironment	-39.42%
4	BWX Technologies	-38.87%
5	AXON International	-36.07%
6	Textron	-36.65%
7	Perspecta	-33.05%
8	Comtech	-32.89%
9	Vectrus	-30.81%
10	FLIR Systems	-29.17%

2018 Results

1	Intelsat	530.97%
2	AXON International	65.09%
3	Kratos Defense	62.58%
4	Ducommun	33.05%
5	Transdigm	27.66%
6	Ball Corp	23.83%
7	Aerovironment	21.48%
8	Booz Allen	20.99%
9	Teledyne Tech	18.20%
10	FireEye	14.31%
11	KEY W Holdings	14.15%
12	OSI Systems	13.97%
13	Aerojet Rocketdyne	13.86%
14	Comtech	12.92%
15	Boeing	10.04%
16	CACI	9.36%
17	Mantech Intl	8.83%
18	Rockwell Collins	4.18%
19	Engility	4.00%
20	Woodward	0.32%
21	Kaman	-2.94%
22	Harris	-4.67%
23	AAR	-4.94%
24	FLIR Systems	-4.96%
25	Hexcel	-6.61%
26	Mercury Computer	-7.29%
27	Cubic Corp	-7.91%

28	MOOG	-8.84%
29	L-3 Communications	-10.79%
30	Honeywell	-12.23%
31	Elbit Systems	-13.85%
32	Curtiss Wright	-14.46%
33	United Technologies	-16.19%
34	SAIC	-16.81%
35	Heico	-17.88%
36	Leidos	-18.35%
37	Raytheon	-18.37%
38	Lockheed Martin	-18.44%
39	Textron	-18.73%
40	Huntington Ingalls	-19.26%
41	Northrop Grumman	-20.20%
42	Sparton	-21.12%
43	Viasat	-21.24%
44	General Dynamics	-22.73%
45	KBR	-23.45%
46	Vectrus	-30.05%
47	Perspecta	-30.73%
48	Oshkosh Truck	-32.54%
49	BWX Technologies	-36.80%
50	VSE Corporation	-38.24%
51	Triumph Group	-57.72%
52	Maxar Technologies	-81.41%

Holdings

Consumer Cyclical	4.28%
Communications Serv.	0.71%
Industrials	78.89%
Technology	16.12%

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

Exchange / Ticker Symbol: NYSE / PPA
 Assets (12/31/18) \$775 M
 Closing Price (12/31/18) \$49.45
 Yield (TTM)* 1.14%
 4Q18 Volume** 6,763,100
 Turnover* 7%

source: * Morningstar & ** Yahoo Finance 12/31/18

Portfolio Price / Earnings*	18.34			
Portfolio Price / Book*	4.25			
Portfolio Price / Sales*	1.71			
Portfolio Price / Cash Flow*	15.69			
Beta (3-year) *	1.11			
Alpha (3-year)*	5.63			
R-squared (3 years)*	61.31			
source: * Morningstar 12/31/18				
Capture Ratio	1-Yr	3-Yr	5-Yr	10-Yr
Upside	167.68	137.17	120.32	108.33
Downside	126.62	104.92	76.01	81.18

Index Holdings (By Size)

Giant	30.19%
Large	21.2%
Medium	40.49%
Small	7.52%
Micro	0.56%

PPA Dividend History

2018	\$0.4441
2017	\$0.3635
2016	\$0.7082
2015	\$0.5019
2014	\$0.2196

**US Marine Corps
Top Contractors Forecast 2018-2023**

Lockheed Martin	\$26.02B
Bell Boeing JV	\$8.90B
Contractor TBD	\$7.15B
United Technologies	\$3.92B
Oshkosh Corp	\$2.97B
Textron	\$2.56B
US Navy	\$1.31B
Other/Classified	\$18.32B
Total	\$71.15B

source: Avascent Analytics
Defense News, 24 Sept 18, 30

**US Marine Corps
Top Programs Forecast 2018-2023**

F-35B Joint Strike Fighter	~\$17.50B
CH053K Heavy Lift Helicopter	~\$12B
MV-22 Osprey	~\$7.5B
Joint Light Tactical Vehicle (JLTV)	~\$2.5B
Radio Systems	~\$2B
Amphibious Combat Vehicle 1.2	~\$1.25B

source: Avascent Analytics
Defense News, 24 Sept 18, 30

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



Commentary (continued from page 1)

defense sector has benefitted both long-term and short-term investors. Over the past two decades, declines in the sector have always been buying opportunities. The SPADE Defense Index has never seen declines in two consecutive calendar years and when reinvesting dividends has rebounded from bottoms within a 3 year timeperiod (and usually much quicker). Unlike the S&P500, there was no lost decade when investing in A&D stocks.

With the change of control in the House of Representatives, Democrats will undoubtedly fight President Trump on funding to build a border wall, however the likelihood of defense spending remaining stable is high. The DoD budget is not likely to become an issue in advance of the 2020 presidential elections. A slowing global economy represents something to watch in 2019, however long-term contracts should limit the near-term impact on the sector's manufacturing and services activities.

M&A Roundup

Aerospace and Defense companies saw merger and acquisition activity pick up during the quarter. Highlighting some of the deals from the past six months that impact companies in the Index:

December 2018

Spartan (SPA) was acquired by private equity firm Cerberus Capital for \$18.50 in cash. It is expected to close in 1Q19.

November 2018

United Technologies received clearance from the Department of Justice to purchase Rockwell Collins (\$30 Billion deal) in October and final regulatory approval from China in late November. It plans to split into three firms once the deal is complete with the Aerospace assets being held inside Collins Aerospace Systems (which will include Pratt & Whitney). The other two spin-

offs will be Otis (elevators), and Carrier (building automation and refrigeration systems).

Possible IPO candidate -- E3 Federal Solutions and The Sentinel Company merged to form a company with 700+ employees that will provide IT, systems engineering, mission consulting, program management, and other tech services to defense, intelligence, and other federal agencies.

October 2018

Textron (TXT) acquired Howe & Howe, a robotic ground vehicle manufacturer as TXT seeks to expand its autonomous vehicle capabilities. Terms were not disclosed.

Harris (HRS) and L3 Technologies (LLL) agreed to an all-stock deal to merge and become the 6th largest defense company. The new company will be known as L3 Harris Technologies. Combined the firm will have end-to-end capabilities across the five operational domains: ground, maritime, air, cyber, and space. It will also have a presence in spectrum and radio frequency technologies. Harris will own 54% of the combined firm.

Boeing (BA) closed its \$3.2B cash acquisition of KLX, an aviation parts and service provider

AM General, a private military ground vehicle manufacture has put itself up for sale. It is estimated that after its \$562M contract win from the Army, the firm could be worth \$2B. Possible bidders and firms operating in the space include Oshkosh (OSK), General Dynamics (GD), and BAE Systems (London: BA).

September 2018

SAIC (SAIC) announced plans to acquire Engility (EGL) in a \$2.5 billion all-stock deal. When it closes it would create the second largest independent technology integrator serving govern-

ment clients according to *Washington Technology*. The deal is not expected to close until 1Q19 with a shareholder vote by both firms to be held on January 11, 2019.

L3 Communications (LLL) bought ASV Global, an unmanned surface vessel developer. Terms were not disclosed.

August 2018

Boeing (BA) bought Millennium Space Systems, a 260 employee firm involved with building high performance satellites with masses ranging from 50 to 6,000 kg. It will report to the Boeing's Phantom Works business. Terms were not disclosed.

CACI (CACI) bought the former CSRA Systems Engineering unit from General Dynamics for \$84 million. The unit performed work for Naval Sea Systems Command.

Possible IPO candidate, Alion Science & Technology bought MacAulay Brown for an undisclosed amount. Alion was bought by Veritas Capital in 2015 and the MacB deal adds 1500 employees focused on cyber, cloud engineering, IT and R&D related to defense, intel, and federal agencies.

Possible IPO candidate, Integrity Applications (Chantilly VA) bought Dependable Global Solutions for an undisclosed sum. DGS works with defense and intel communities to counter cyber threats and attacks. IAI, which was bought earlier in 2018 by Arlington Capital Partners, now has 1100 employees with technical capabilities related to cybersecurity, intelligence, missile defense, and space

Mercury Systems (MRCY) acquired Germane Systems for \$45M in cash to expand its rugged servers and command, control, and information processing technologies.

Index Performance (ex div)

	SPADE Defense Index
1-Yr	[8.15%]
3-Yr	39.67%
5-Yr	61.15%
10-Yr	260.55%
20-Yr	573.19%

	SPADE Defense Index	S&P500	Alpha (bps)
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]
2008	[38.03%]	[38.49%]	46

	SPADE Defense Index	S&P500	Alpha (bps)
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]

Even after December 2018's ~20% decline,
the value of the SPADE Defense Index is still up roughly 40% over a three-year period!

*Without factoring in reinvested dividends, the SPADE Defense Index is up
260%+ over a decade and 573%+ over two decades!*

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, homeland security, and space.

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. Full details are available on our website.

- * Market Cap: Minimum \$100M
- * Share Price: Minimum \$5.00
- * Sufficient Liquidity

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End of 4Q18		100.000%						Market	Forward	Price/	Price/	PEG	
								Cap	P/E	Sales	Book	5 yr	Div Ytd
		Percent	30-Sep-18	31-Dec-18	YTD	QTD		intraday	(ttm)	ttm	mrq	expected	forward %
Company	Ticker	12/31/18	Price	Price	% Ch	% Ch							
AXON International Inc.	AAXN	0.67%	68.43	43.75	65.09%	-36.07%		2.56		6.39	5.56	1.86	
AAR Corp	AIR	0.38%	47.89	37.34	-4.96%	-22.03%		1.28	12.32	0.68	1.38	0.94	0.81%
Aerojet Rocketdyne	AJRD	0.72%	33.99	35.23	12.92%	3.65%		2.76	44.09	1.39	6.83		
AeroVironment	AVAV	0.47%	112.17	67.95	20.99%	-39.42%		1.60	43.28	4.98	3.62	1.56	
Boeing Co	BA	7.22%	370.19	322.5	9.36%	-12.88%		183.14	17.71	1.89		0.92	2.59%
Booz Allen	BAH	1.87%	49.63	45.07	18.20%	-9.19%		6.42	15.49	1.01	9.94	1.06	1.70%
Ball Corp	BLL	4.08%	43.99	45.98	21.48%	4.52%		15.60	35.02	1.35	4.30		0.90%
BWX Technologies	BWXT	1.10%	62.54	38.23	-36.80%	-38.87%		3.77	15.29	2.15	9.62	1.52	1.72%
Caci Intl	CACI	1.03%	184.15	144.03	8.83%	-21.79%		3.58	13.51	0.79	1.63		
Comtech	CMTL	0.17%	36.27	24.34	10.04%	-32.89%		0.58	16.87	0.95	1.15		1.67%
Rockwell Collins	COL	0	140.47	141.04	4.00%	0.41%		23.18	23.21	2.70	3.41		0.93%
Cubic Corp	CUB	0.42%	73.05	53.74	-8.84%	-26.43%		1.67	16.95	1.39	2.09		0.50%
Curtiss Wright	CW	1.30%	137.42	102.12	-16.19%	-25.69%		4.47	15.00	1.88	2.76		0.59%
Ducommun	DCO	0.12%	40.84	36.32	27.66%	-11.07%		0.41		0.68	1.62		
Engility	EGL	0.30%	35.99	28.46	0.32%	-20.92%		1.05	12.82	0.55	1.51	2.49	
Esterline Technologies	ESL	1.04%	90.95	121.45	62.58%	33.53%		3.60	51.86	1.77	1.95		
Elbit Systems	ESLT	1.41%	125.52	114.02	-14.46%	-9.16%		4.79	17.73	1.33	2.62		1.53%
FireEye	FEYE	0.88%	17	16.21	14.15%	-4.65%		3.14	85.32	3.97	4.82	1.76	
Flir Systems	FLIR	1.75%	61.47	43.54	-6.61%	-29.17%		6.02	45.54	3.31	3.1		1.49%
General Dynamics	GD	5.92%	204.72	157.21	-22.73%	-23.21%		46.56	13.02	1.37	3.64	1.08	2.40%
Heico	HEI	2.98%	92.61	77.48	-17.88%	-16.34%		9.11	33.4	5.13	7.37	2.43	0.18%
Huntington Ingalls	HII	2.48%	256.08	190.31	-19.26%	-25.68%		8.17	12.01	1.03	4.48	0.87	1.83%
Honeywell Intl	HON	6.97%	159.49	132.12	-13.85%	-17.16%		97.81	16.70	2.28	5.36	2.46	2.49%
Harris Corp	HRS	3.98%	169.21	134.65	-4.94%	-20.42%		16.17	21.17	2.56	4.88		2.08%
Hexcel	HXL	1.49%	67.05	57.34	-7.29%	-14.48%		4.94	16.62	2.31	3.61		1.08%
Intelsat	I	0.74%	30	21.39	530.97%	-28.70%		2.95		1.37			
Kaman	KAMN	0.45%	66.54	56.09	-4.67%	-15.70%		1.57	35.93	0.85	2.46		1.46%
KBR	KBR	0.62%	21.03	15.18	-23.45%	-27.82%		2.14	9.14	0.47	1.3		2.12%
KEY W Holding	KEYW	0.10%	8.66	6.69	13.97%	-22.75%		0.33		0.65	1.12		
Kratos Defense & Security	KTOS	0.42%	14.78	14.09	33.05%	-4.67%		1.46	41.44	1.90	2.86		
Leidos	LDOS	2.30%	69.16	52.72	-18.35%	-23.77%		7.90	11.17	0.78	2.29		2.44%
L-3 Communications Hldgs	LLL	3.91%	212.62	173.66	-12.23%	-18.32%		13.67	12.93	1.36	2.42		1.89%
Lockheed Martin	LMT	7.03%	345.96	261.84	-18.44%	-24.31%		74.47	13.33	1.37	78.99		3.39%
Mantech International'a'	MANT	0.59%	63.3	52.29	4.18%	-17.39%		2.08	22.54	1.08	1.50		1.92%
Maxar Technologies	MAXR	0.19%	33.07	11.96	-81.41%	-63.83%		0.71	2.40	0.33	0.41	1.25	10.77%
Moog Inc.	MOGA	0.78%	85.97	77.48	-10.79%	-9.88%		2.84	28.91	1.05	2.20		1.31%
Mercury Computer Sys	MRCY	0.64%	55.32	47.29	-7.91%	-14.52%		2.29	23.53	4.31	2.87		
Northrop Grumman	NOC	5.41%	317.37	244.9	-20.20%	-22.83%		42.52	13.19	1.50	4.67	0.58	2.00%
OSI Systems	OSIS	0.40%	76.31	73.3	13.86%	-3.94%		1.33	17.54	1.21	2.73		
Oshkosh Truck	OSK	1.28%	71.24	61.31	-32.54%	-13.94%		4.33	8.14	0.56	1.77	0.66	1.78%
Perspecta	PRSP	0.83%	25.72	17.22	-30.73%	-33.05%		2.82	14.97	0.86	1.28		1.20%
Raytheon Co	RTN	5.60%	206.66	153.35	-18.37%	-25.80%		43.64	17.89	1.65	3.86		2.26%
SAIC	SAIC	0.79%	80.6	63.7	-16.81%	-20.97%		2.71	13.13	0.59	6.66	2.75	1.99%
Sparton	SPA	0.05%	14.43	18.19	-21.12%	26.06%		0.18		0.47	2.43		
Transdigm	TDG	4.06%	372.3	340.06	23.83%	-8.66%		17.94	20.99	4.71			
Teledyne Technologies	TDY	2.13%	246.68	207.07	14.31%	-16.06%		7.47	24.62	2.61	3.37		
Triumph Group	TGI	0.17%	23.3	11.5	-57.72%	-50.64%		0.57	5.56	0.17		167.75	1.36%
Textron	TXT	3.48%	71.47	45.99	-18.73%	-35.65%		11.17	12.99	0.78	2.02	0.83	0.17%
United Technologies	UTX	6.87%	139.81	106.48	-16.53%	-23.84%		98.58	13.70	1.54	2.62	1.70	2.78%
Vecrus	VEC	0.07%	31.19	21.58	-30.05%	-30.81%		0.24	6.66	0.2	1.15		
Viasat Inc	VSAT	1.01%	63.95	58.95	-21.24%	-7.82%		3.52		1.98	1.88	-1.86	
Woodward	WWD	1.33%	80.86	74.29	-2.94%	-8.13%		4.59	14.15	1.98	2.97	1.23	0.78%

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