



2017 State of the VITA Technology Industry



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by: Ray Alderman, Chairman of the Board, VITA

This report provides the reader with updates on the state of the VITA Technology industry in particular and of the board and system industry in general, from the perspective of Ray Alderman, the Chairman of the Board of VITA. VITA is the trade association dedicated to fostering American National Standards Institute (ANSI) accredited, open system architectures in critical embedded system applications. The complete series of reports can be found at [Market Reports](http://www.VITA.com/MarketReports). (www.VITA.com/MarketReports)

Introduction

Well, we have a new president, but not the one that was predicted by the polls. And, we have a new Congress, but not the one predicted by the polls. We have a new Cabinet; Secretary of State, Attorney General, Secretary of Education, Secretary of Defense, etc., but not the ones predicted by anyone. Every government organization except the Department of Agriculture has submitted a list of new weapons platforms and increased military spending recommendations to the Pentagon. U.S. corporations are dropping their plans to offshore their manufacturing and announcing new plants and hiring in our country. The new minimum wage hikes are inspiring industrial engineers to burn the midnight oil, designing completely automated burger-making machines, to replace the newly-expensive workers in the fast food industry. But those displaced workers could soon find better paying jobs in manufacturing, especially at the companies building those burger-making machines. So, in the end, it all balances out. We'll explore these amazing events and more in this report.

Business Conditions

The U.S. experienced anemic growth in 4Q2016 with a 1.9% gain in the second estimate. Q3/2016 growth was 3.5%, so Q4 was a big disappointment. That brings total 2016 U.S. GDP growth to a paltry 1.6%, a full 1% below last year's 2.6% growth.¹ Consumer spending increased in Q4, but mostly for health care. Also, soybean exports dragged the Q4 numbers down.² The U.S. debt-to-GDP ratio is 104%.

1 Lucia Mutikani, "U.S. economy slowed in fourth quarter despite robust consumer spending", Reuters, February 28, 2017, <http://www.reuters.com/article/us-usa-economy-idUSKBN1671KL>

2 Bob Bryan, "GDP misses, despite a surge in healthcare spending", Business Insider, February 28, 2017, <http://www.businessinsider.com/us-gdp-fourth-quarter-2016-second-estimate-2017-2>

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China grew at an amazing 6.8% in 4Q2016, 6.7% for the whole year. They “promise” that the numbers are real.³ That is hard to believe when you look at other statistics, like their debt-to-GDP ratio of 400%, when including their shadow banking industry.⁴ Their official debt-to-GDP number, however, is 44%. So far, they have kept their economy from blowing up. Scared money is leaving the country in huge amounts, capital controls were put in place by the government, and the money trapped inside the country is creating asset price bubbles.⁵

The European Union (EU) came in with 0.5% growth in Q4, and 1.7% growth for 2016.⁶ That’s not much worse than the U.S. GDP growth of 1.9% for last year. But, the UK is leaving the union, Greece is financially wobbling again after three bail-outs,⁷ Italy is trying to keep their banks out of insolvency, and France and the Netherlands are having elections with anti-EU candidates doing well in the polls. There are lots of other problems on the EU’s horizon too, like NATO, but we’ll get to that in the military section. Europe has been muddling along for the past few years, but that muddling could turn into something worse in 2017. It’s best that you look at each EU country’s debt-to-GDP ratio to get an idea of who is in trouble.⁸

Japan’s Q4 GDP came in at 0.2% growth, and at 1% for all of 2016. But, their trend is down: 0.6%, 0.4%, 0.3% and 0.2% for the four quarters of 2016 respectively.⁹ Japan’s debt-to-GDP ratio is a list-leading 229%.

South Korea’s GDP grew at 0.4% in Q4, and 2.7% for all of 2016 (over 2015’s numbers).¹⁰ But, they have a lot of internal political and corruption problems. They impeached their president in December and they indicted the chief of Samsung for bribery and embezzlement charges, along with four other top company executives, in February.¹¹ South Korea’s debt-to-GDP ratio is 38%.

The Russian economy has been in recession for a few years, and showed -0.2% decline in 2016. But, they are expected to grow at 0.6% in 2017.¹² They still have a mess on their hands and need money. Only 10 of their 85 regions are financially stable.¹³ Their debt-to-GDP ratio is 18%. However, just consider that Russia’s economy is about the same size as Italy’s.

World GDP growth was forecast to be 3.4% in 2016, after showing 3.1% growth in 2015. The official 2016 numbers were not released by press time for this report. The 2017 forecast is for 3.6% growth, so the trend is in the right direction.

You probably noticed that I have mentioned each country’s debt-to-GDP ratio. That is a measure of a country’s ability to pay their debts, or the interest on their debts. In February, our new Secretary of Treasury initiated a study for the U.S. to issue 50 and 100 year bonds. If you can push your debt maturity out for many years and just pay the interest,

3 “China’s official 2016 GDP number is in, and the government promises it’s “authentic””, Quartz, January 19, 2017, <https://qz.com/890084/chinas-official-2016-gdp-growth-was-6-7-and-the-government-promises-its-authentic/>

4 Ivan Martchev, “Opinion: China’s economy is dangerously close to unraveling”, MarketWatch, February 20, 2017, <http://www.marketwatch.com/story/chinas-economy-is-dangerously-close-to-unraveling-2017-02-18>

5 Evelyn Cheng, “China’s economy doesn’t look so wonderful when you look at the really big numbers”, Yahoo! Finance, February 16, 2017, <http://finance.yahoo.com/news/chinas-economy-doesnt-look-wonderful-153708365.html>

6 “Economic Snapshot for the Euro Area”, Focus Economics, March 29, 2017, <http://www.focus-economics.com/regions/euro-area>

7 Karolina Tagaris, “After seven years of bailouts, Greeks sink yet deeper in poverty”, Reuters, February 20, 2017, <http://www.reuters.com/article/us-eurozone-greece-poverty-idUSKBN15Z1NM>

8 Trading Economics, <http://www.tradingeconomics.com/country-list/government-debt-to-gdp>

9 “Japan’s economy grew 1.0% in 2016 despite slower last quarter”, The Japan Times, February 13, 2017, <http://www.japantimes.co.jp/news/2017/02/13/business/economy-business/october-december-dip-caps-japans-2016-economic-growth-just-1/#.WLZcrhiZNE4>

10 “South Korea Q4 GDP rise 0.4% q-o-q, slightly higher than expected”, The Business Times, January 25, 2017, <http://www.businesstimes.com.sg/government-economy/south-korea-q4-gdp-rise-04-q-o-q-slightly-higher-than-expected>

11 Choe Sang-hun, “Samsung’s Leader Is Indicted on Bribery Charges”, The New York Times, February 28, 2017, https://www.nytimes.com/2017/02/28/world/asia/lee-jae-yong-samsung.html?_r=0

12 Trading Economics, <http://www.tradingeconomics.com/russia/gdp-growth-annual>

13 “Opinion: Russia is a mess — the poverty rate is soaring and only 10 of 85 regions are financially stable”, MarketWatch, January 31, 2017, <http://www.marketwatch.com/story/russia-is-a-mess-the-poverty-rate-is-soaring-and-only-10-of-85-regions-are-financially-stable-2017-01-31>

it gives the illusion that your country is financially stable.¹⁴ France and Canada, among others, already issue 50 and 100 year bonds.

While the U.S. GDP growth numbers are positive, things may be going the other way. In February, the Atlanta Federal Reserve downgraded Q1/2017 GDP growth estimates from 2.5% to 1.8%.¹⁵ Meanwhile, the stock market has been going nuts since the election, with the Dow Jones index up 1000 points in just 24 days during February, to over 21,000. We are receiving a lot of confusing financial data these days, and a lot of money is sloshing around in the markets looking for a profit. But, geopolitical risks are high for world economies if some country does something exceptionally stupid.¹⁶

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Markets

Military and Aerospace

Total U.S. defense spending has been declining since 2011,¹⁷ but that is about to change. President Trump is submitting the 2018 budget to Congress that increases military spending by 10% or \$54 billion.¹⁸ The money will come from cuts to foreign aid, reductions in the state department people and budgets, and severe cuts in people and budgets at the EPA. Just the rumors of the new military budget have started a fire storm of objections from congressional Democrats, who want equal amounts of money to be spent on social programs. So, there's going to a big fight before we see the results.

The new Secretary of Defense (Gen. James Mattis) is dealing with five basic military problems:

1. *China's aggression in the South China Sea;*
2. *Russia's aggression in far Eastern Europe;*
3. *North Korea's aggression with nuclear weapons and missiles against South Korea and Japan;*
4. *Iran's aggression with missiles and their nuclear weapons program against other Middle East countries;*
5. *ISIS and terrorism.*¹⁹

So far, we have deployed troops and weapons to Poland, Lithuania, Latvia, and Estonia to counter Russia.²⁰ The U.S. deployed THAAD antimissile systems in South Korea, to counter North Korea's actions, that irritates China²¹ A U.S.

14 Greg Robb, "Treasury seriously studying issuing 50-year or 100-year bonds: Mnuchin", MarketWatch, February 23, 2017, <http://www.marketwatch.com/story/treasury-seriously-studying-issuing-50-year-or-100-year-bonds-mnuchin-2017-02-23?siteid=yhoof2&ypr=yahoo>

15 Steve Goldstein, "GDP estimate cuts show divergence between economic activity and optimism", MarketWatch, March 1, 2017, <http://www.marketwatch.com/story/gdp-estimate-cuts-show-divergence-between-economic-activity-and-optimism-2017-03-01>

16 Howard Gold, "Opinion: Geopolitical black swans are the stock market's biggest risk", MarketWatch, February 23, 2017, <http://www.marketwatch.com/story/geopolitical-black-swans-are-the-stock-markets-biggest-risk-2017-02-23>

17 U.S. Government Spending, http://www.usgovernmentpending.com/defense_chart_30.html

18 Aaron Mehta and Joe Gould, "McCain, Thornberry rip White House budget plan on defense", Defense News, February 27, 2017, <http://www.defensenews.com/articles/analysts-new-white-house-plan-to-boost-defense-with-domestic-cuts-wont-happen>

19 Ashton B. Carter, "Defense at a Time of Strategic Transition", The National Interest, February 28, 2017, <http://nationalinterest.org/feature/defense-time-strategic-transition-19623>

20 Tom Batchelor, "US Special Forces deployed at Russian border to defend Baltic states 'scared to death' by Vladimir Putin", Independent, January 4, 2017, <http://www.independent.co.uk/news/world/europe/us-special-forces-russia-border-lithuania-latvia-estonia-putin-scared-to-death-a7509736.html>

21 Ben Rosen, "Why China is strongly objecting to South Korea's THAAD developments", The Christian Science Monitor, March 1, 2017, <http://www.csmonitor.com/World/Asia-Pacific/2017/0301/Why-China-is-strongly-objecting-to-South-Korea-s-THAAD-developments>

carrier group is holding exercises in the South China Sea to counter China's military build-up on the disputed islands.²² The U.S. has imposed new sanctions on Iran, to counter their shenanigans.²³ U.S. airstrikes are targeting ISIS in Syria.²⁴ And U.S. airstrikes are continuing against al Qaeda terrorists.²⁵ So, we have counter-activities ongoing for all five basic threats.

On Iran, if you are interested, you can watch excerpts of a new video-game quality animated movie, released in Tehran in Q1. It depicts them defeating the U.S. Navy fleet with advanced weapons and highly trained soldiers they don't have at their disposal.²⁶

"It depicts them defeating the U.S. Navy fleet with advanced weapons and highly trained soldiers they don't have."

New Projects and Programs in the Services

Meanwhile, we are seeing some significant programs and ideas being initiated for next generation weapons and platform capabilities. In the Army, we have the VICTORY program for ground vehicles. Recently, the Army has adopted an incremental improvement program for the M1 Abrams tank, the M109 Paladin howitzer, and the Armored Multi-Purpose Vehicle (AMPV).²⁷

The Air Force has the FACE Consortia (Future Airborne Capability Environment) doing avionics software standards work. Recently, Northrop Grumman released their new "OpenPod™" concept, for adding, removing, rapidly upgrading, and maintaining certain systems and subsystems on fighter aircraft depending on the mission requirements.²⁸

Lockheed and NASA are testing a new QueSST (quiet supersonic technology) bomber model in wind tunnels. This plane will fly over land without creating the sonic booms experienced by today's supersonic planes, allowing them to sneak behind enemy lines without being detected by the noise.²⁹ This plane will also use new efficient engine technology.



The Air Force is evaluating and testing a smaller, lightweight, inexpensive OA-X fighter jet, that can be used in conflicts against enemies that do not have

22 Ankit Panda, "US Carrier Strike Group Arrives in the South China Sea", The Diplomat, February 21, 2017, <http://thediplomat.com/2017/02/us-carrier-strike-group-arrives-in-the-south-china-sea/>

23 David E. Sanger, "U.S. Imposes New Sanctions on Iran Over Missile Test", The New York Times, February 3, 2017, https://www.nytimes.com/2017/02/03/us/politics/iran-sanctions-trump.html?_r=0

24 Christopher Woody, "Watch a US-led airstrike pound a building in Syria days before ISIS was forced out of the area", Business Insider, February 28, 2017, <http://www.businessinsider.com/us-led-coalition-airstrike-in-syria-al-bab-isis-turkey-2017-2>

25 Lizzie Dearden, "US air strikes kill more than 100 'al-Qaeda militants' at training camp in Syria", Independent, January 21, 2017, <http://www.independent.co.uk/news/world/middle-east/us-air-strikes-syria-isis-al-qaeda-jabhat-fateh-al-sham-nusra-aleppo-idlib-training-camp-100-killed-a7539571.html>

26 Hope Hodge Seck, "New Animated Film Depicts Iran Defeating US Navy", Defensetech, February 22, 2017, <https://www.defensetech.org/2017/02/22/iran-defeats-us-navy-animated-film/>

27 Brian Wang, "US Army continuing de-modernization and sticking with incremental upgrades to Abrams and other vehicles", Next Big Future, February 28, 2017, <http://www.nextbigfuture.com/2017/02/us-army-continuing-de-modernization-and.html>

28 "OpenPod™ Briefing at the National Press Club", Northrop Grumman, [http://www.northropgrumman.com/MediaResources/MediaKits/OpenPod\(TM\)/Pages/default.aspx](http://www.northropgrumman.com/MediaResources/MediaKits/OpenPod(TM)/Pages/default.aspx)

29 Sebastien Roblin, "The TOW Missile: The One Weapon That Could Make Russia's Suoer Armata Tank Obsolete?", The National Interest, March 30, 2017, <http://nationalinterest.org/blog/the-buzz/get-ready-russia-china-the-first-step-towards-new-us-19640>

sophisticated air defense systems, like Taliban and ISIS.³⁰ This fighter would be better than the F-35 for such missions, according to reports.

Also, the Air Force is retiring their fleet of MQ-1 Predator UAVs, and replacing them with the MQ-9 Reaper.³¹ The Reaper is faster, has more range, and carries more ordnance. Last flights of the Predator are planned for mid-2018.

The Reaper is the center of a new “open systems mission architecture” in the Air Force, similar to what the Navy is doing with plug-and-play weapons modules, and OpenPod does for plug-and-play fighter aircraft modules. The primary element in this architecture is a new “universal weapons interface.”³²

The Air Force also has a new project called “Disaggregation and Diversity” intended for protecting our critical military satellite systems from Chinese and Russian anti-satellite missiles and “kamikaze” killer satellites.³³ While much of this plan is secret, it’s basically taking functions from the big satellites (disaggregation) and putting them on numerous smaller satellites (diversity). We’re talking about hundreds of networked modular cubesats doing what one of the bigger satellites was doing. The thought being that it would be much more difficult to bring down such a network of diverse and separated satellites.

And finally, the Air Force is considering a stealthy air refueling tanker design. It can fly in contested areas undetected and refuel fighters and bombers without being shot down by anti-aircraft missiles or enemy fighters. Meanwhile, upgrades are planned for the older KC-135 and the newer KC-46 tankers. The KC-46 was nearly obsolete before it entered the fleet.³⁴

The Navy is shifting to a “Domain Architecture” model, where the platforms and weapons needed are modular and connected.³⁵ Different weapons, RADAR, communications, and other subsystems can be plugged-in and booted-up on the ships as needed. They can also be ungraded incrementally, instead of pulling the boat out of service for months, for extensive overhauls. Also, there’s a program to allow the Army to fire anti-ship missiles in this new Domain Architecture concept.³⁶

The Navy has just finished an upgrade to the nuclear submarine SONAR systems: A-RCI (Acoustic-Rapid Commercial-off-the-shelf Insertion). This is yet another example of modularity efforts in critical systems.³⁷

This modularity idea offers the same benefits to ships that VICTORY gives to ground vehicles, and OpenPod brings to aircraft. Modularity and incremental upgrades are the new mantra of the services. This is exactly what VME (and now VPX) has been doing for military platforms since the 1980’s, but this new concept is network-based, not backplane-based. All of these efforts require a standardized network connection in the platform.

30 Kyle Mizokami, “The Air Force Wants a Lightweight Fighter to Do What the F-35 Can’t”, Popular Mechanics, February 27, 2017, <http://www.popularmechanics.com/military/aviation/news/a25400/air-force-lightweight-fighter-qa-x/>

31 Christian Clausen, “Air Force to Retire MQ-1 Predator Drone, Transition to MQ-9 Reaper”, U.S. Department of Defense, February 27, 2017, <https://www.defense.gov/News/Article/Article/1095612/air-force-to-retain-mq-1-predator-drone-transition-to-mq-9-reaper>

32 Kris Osborn, “The Air Force has plans to make one of its drones even more deadly”, Business Insider, October 24, 2016, <http://www.businessinsider.com/air-force-weapons-upgrade-reaper-drone-2016-10>

33 Kris Osborn, “U.S. Air Force Has a Plan to Counter China’s Super Lethal ‘Satellite-Killer’ Weapons”, The National Interest, October 31, 2016, <http://nationalinterest.org/blog/the-buzz/us-air-force-has-plan-counter-chinas-super-lethal-satellite-18247>

34 Valerie Insinna, “Air Mobility Command head calls for more survivable tanker fleet”, Defense News, March 6, 2017, <http://www.defensenews.com/articles/air-mobility-command-head-calls-for-more-survivable-tanker-fleet>

35 Bryan McGrath, “OPED: Navy Shifts SeaPower Strategy”, Scout.com, February 20, 2017, <http://www.scout.com/military/warrior/story/1756022-exclusive-oped-navy-shifts-seapower-strategy>

36 Jeremy Hsu, “The Army gets back in the ship-killing business”, Wired, March 1, 2017, <https://www.wired.com/2017/03/army-converting-missiles-ship-killers-china/?hl=1&noRedirect=1>

37 Ryan Maass, “U.S. Navy buys new submarine sonar systems”, UPI, March 6, 2017, <http://www.upi.com/Defense-News/2017/03/06/US-Navy-buys-new-submarine-sonar-systems/4701488806769/>

DARPA is working with the Navy on an underwater acoustic GPS system, for our submarines and UUVs (unmanned underwater vehicles).³⁸ A number of acoustic buoys would be deployed in the oceans like GPS satellites that are now deployed in orbit.

DARPA held the Cyber Grand Challenge at the 2016 DEFCON hacking convention in Las Vegas. Seven teams turned their find-and-fix algorithms loose, that could detect, analyze, and fix software and OS vulnerabilities on the fly. The DoD is integrating the results into their Cyber Strategy and National Cyber Incident Response Plan.³⁹

BAE is working with DARPA on an “Adaptive RADAR Countermeasures” program. Intelligence groups capture the signals of their enemy’s RADAR (frequencies, pulse rates, wave forms, etc.), and create EW countermeasures for them. The enemy signal, and the derived countermeasure, go into a digital threat library and are downloaded to appropriate military platforms as “mission data files”. But, if an F-35 runs into an enemy adaptive RADAR, those signals and responses are not in the library. By using AI (Artificial Intelligence) algorithms, the F-35 can analyze the new enemy signal and create a countermeasure on the fly.⁴⁰ The DoD was supposed to release their latest Electronic Warfare Strategy report sometime in February, but I could not find it. I assume that the old Secretary of Defense approved it, but the new Secretary of Defense wants to look it over.⁴¹

What’s Going on with NATO?

This brings us to a discussion of NATO. The U.S. pays about 72% of the total cost of the defense of Europe, and our new president and Secretary of Defense want that to change.⁴² The 28-country alliance requires that each NATO member spend at least 2% of their GDP on defense. Only five members meet that requirement: USA, Greece, Poland, UK, and Estonia in order of contribution. The remaining 23 countries are way below the threshold.⁴³ With Russia’s recent actions in Crimea and Ukraine, more military resources need to be deployed, especially in the Balkan countries (Lithuania, Latvia, and Estonia), the previous satellite buffer states of the old Soviet Union before it collapsed in 1991. Russia has deployed nuclear-capable missiles to their tiny exclave in Kaliningrad, and are building-up their air defenses and troop numbers there.⁴⁴

As we have discussed in previous reports, few EU countries have the financial ability, technology, manufacturing assets, leadership, or the motivation to build-up their militaries. They have lived under the blanket of protection and freedom provided by U.S. soldiers for many decades, and they will have trouble shifting their government spending away from social benefit programs to weapons development and indigenous soldiers. President Trump has hinted that if Russia invades one of the NATO countries that have not been meeting their 2% military spending goal, the U.S. may not be so eager to come to their rescue. The passive Europeans are ignoring their plight and the visible threats. NATO has to change, to adapt to the 21st century. It’s not completely obsolete, but it does need substantial changes to make it practical. We’ll have to wait and see how tough our new president and Secretary of Defense get with the members who refuse to shoulder their part of the burden.

38 “Deep ocean GPS would revolutionize submarine and naval warfare”, Next Big Future, February 25, 2017, <http://www.nextbigfuture.com/2017/02/deep-ocean-gps-would-revolutionize.html>

39 Christopher Meissner, “The Most Militarily Decisive Use of Autonomy You Won’t See”, Defense One, November 7, 2016, <http://www.defenseone.com/ideas/2016/11/most-militarily-decisive-use-autonomy-you-wont-see-cyberspace-ops/132964/?oref=d-river>

40 Colin Clark, “DARPA Ups Funding For Autonomous Electronic Warfare Work”, Breaking Defense, November 3, 2016, <http://breakingdefense.com/2016/11/darpa-ops-funding-for-autonomous-electronic-warfare-work/>

41 Kris Osborn, “Pentagon to unveil new electronic warfare strategy”, Defense Systems, December 7, 2016, <https://defensesystems.com/articles/2016/12/07/ew.aspx>

42 Doug Bandow, “The U.S. NATO Alliance Has Been a One-Way Street for Too Long”, The National Interest, February 21, 2017, <http://nationalinterest.org/blog/the-skeptics/the-us-nato-alliance-has-been-one-way-street-too-long-19527>

43 Kedar Pavgi, “NATO Members’ Defense Spending, in Two Charts”, Defense One, June 22, 2015, <http://www.defenseone.com/politics/2015/06/nato-members-defense-spending-two-charts/116008/>

44 “Russia transfers nuclear-capable missiles to Kaliningrad”, The Guardian, October 8, 2016, <https://www.theguardian.com/world/2016/oct/08/russia-confirms-deployment-of-nuclear-capable-missiles-to-kaliningrad>

Technology

Lots of activity in the GPU (Graphical Processing Unit) segment. Data is leaking out about NVidia's new Volta architecture, while AMD is releasing their new Vega chips in 2017.⁴⁵ There's going to be a constant barrage of new GPUs coming to market this year, that will drive HPC (high performance computing) board designers crazy.

- AMD is also releasing their new Ryzen CPU in March. It beats the Intel i7 chip by a mile in performance and costs 40-50% less.⁴⁶ But AMD has never shown any serious interest in the embedded industry. This is a server chip, to go after the motherboard and server blade business in data centers.
- Additionally, new memory architectures are coming to market. Memory is a big bottleneck for servers and HPEC (high performance embedded computers), but these new memories can reduce some of the latencies.⁴⁷ Where and how these new memories will be used in embedded computers is yet to be seen.
- Six companies (Boeing, Space-X, OneWeb, O3b Networks, Samsung, and Theia Holdings) have submitted plans to launch a total of 20,000 V-band communications satellites.⁴⁸ In February, India launched 104 communications nano-satellites on one rocket. You can watch the video of them being released into orbit, like a vending machine spitting-out candy bars at 17,000 MPH.⁴⁹ It's going to get crowded up there in space very soon.
- Tremendous advances in silicon photonics have been occurring lately. Intel, HP, Cisco, and Juniper have made substantial investments in SP devices for the data centers. Mentor, Synopsis, and Cadence have been enhancing their tools for design. Global Foundries has been ramping-up their manufacturing processes to make the silicon.⁵⁰ One optical fiber can handle more data than a double handful of the fastest copper cables.
- Over 140 companies doing work on artificial intelligence (AI) have been bought up since 2011. The primary buyer was Google, followed by IBM, Yahoo, Apple, Intel, Salesforce, GE, and Samsung.⁵¹ Microsoft bought Maluuba, another AI company, in January 2017 too.⁵² Artificial Intelligence is going to play a big role in future military weapons platforms.⁵³
- Microsoft is working on a quantum computer that uses non-Abelian anyons to encode Qubits and protect them from degradation and electromagnetic interference in a new topological structure.⁵⁴ As you are well aware, Abelian anyons are quasi-particles that occur in three or more dimensions, and have properties much less restrictive than Fermions, which must obey the Fermi-Dirac statistical model, and Bosons, which must obey the Bose-Einstein statistical model. However, non-Abelian anyons are a major factor in fractal quantum Hall effects. Observing that behavior, it becomes obvious that non-Abelian anyonic statistics are monoidal, such that the integrity of

45 Harsh Chauhan, "NVIDIA vs. AMD: Who Will Win the GPU War in 2017?", The Motley Fool, March 4, 2017, <https://www.fool.com/investing/2017/03/04/nvidia-vs-amd-who-will-win-the-gpu-war-in-2017.aspx>

46 Mark Hachman, "AMD's Ryzen launches March 2, outperforming Intel's Core i7 at a fraction of the price", PCWorld, February 22, 2017, <http://www.pcworld.com/article/3171161/components-processors/amds-ryzen-launches-march-2-outperforming-intels-core-i7-at-a-fraction-of-the-price.html>

47 Brian Bailey, "New Memories And Architectures Ahead", Semiconductor Engineering, February 13, 2017, <http://semiengineering.com/new-memories-and-architectures-ahead/>

48 "Total global satellite plans could have around 20,000 satellites in low and mid earth orbits in the 2020s", Next Big Future, March 4, 2017, <http://www.nextbigfuture.com/2017/03/total-global-satellite-plans-could-have.html>

49 Charlie Osborne, "Watch over 100 satellites deploy at the same time for India's space mission", ZDNet, February 16, 2017, <http://www.zdnet.com/article/watch-over-100-satellites-deploy-at-the-same-time-for-indias-space-mission/>

50 Ed Sperling, "Silicon Photonics Comes Into Focus", Semiconductor Engineering, October 31, 2016, <http://semiengineering.com/silicon-photonics-comes-into-focus/>

51 "The Race For AI: Google, Twitter, Intel, Apple In A Rush To Grab Artificial Intelligence Startups", CB Insights, December 6, 2017, <https://www.cbinsights.com/blog/top-acquirers-ai-startups-ma-timeline/>

52 Barb Darrow, "Microsoft Buys Canadian Artificial Intelligence Startup for More Brainpower", Fortune, January 13, 2017, <http://fortune.com/2017/01/13/microsoft-montreal-ai-company/>

53 Dave Gershgorin, "The US government seriously wants to weaponize artificial intelligence", Quartz, August 26, 2016, <https://qz.com/767648/weaponized-artificial-intelligence-us-military/>

54 Elizabeth Gibney, "Inside Microsoft's Quest for a Topological Quantum Computer", Scientific American, October 23, 2016, <https://www.scientificamerican.com/article/inside-microsoft-s-quest-for-a-topological-quantum-computer/>

a quantum computing system is stabilized and protected against degeneracy. D-wave, Intel, Google, IBM, HP, Lockheed and now Microsoft have started quantum computer divisions. If you want to see a fight between Abelian and non-Abelian anyons first hand, come to a VSO meeting.

- *If one quantum computer isn't enough, then how about connecting a bunch of them in a cluster, like a cluster of Linux servers. For that, you'll need a "quantum nanophotonic bridge". That's what the good people at Sandia and Harvard just created, by embedding electrons in a diamond matrix.⁵⁵ I pray that the bridge does NOT use the horrible high-latency PCIe protocol layer.*
- *Faster than quantum computers are DNA computers. They use much less power and are naturally less susceptible to degradation and electromagnetic interference without relying upon those pesky monoidal non-Abelian anyons.⁵⁶ I pray that they did NOT use DNA from telecom engineers as a starting point.*
- *But, neuromorphic computers are much better at running AI (artificial intelligence) algorithms than quantum computers.⁵⁷ IBM makes a neuromorphic chip that contains five times more transistors than an Intel CPU, and uses only milliwatts of power. I pray that they did NOT use an Intel board designer's brain as the model for the neural network.*

There's a lot more stuff going on in our technology sphere. More acquisitions of semiconductor companies and AI software companies in the works. But the long-term trend, at the high-end of the processing market, is away from the problematic latency-encrusted I/O-bound antiquated von Neumann architectures. Could we see Q-VPX (quantum-VPX), D-VPX (DNA-VPX) and N-VPX (Neuromorphic-VPX) standards committees crank-up soon? I would be happy just to see O-VPX (optical-VPX) get some traction

Mergers and Acquisitions

Since the last report, there have been eight reported acquisitions in our industry. This matches the eight acquisitions reported in 2015 and is above the 3-year moving average of 7. With three deals already closed in 2017, you can expect the pace to continue.

1. *VadaTech bought Radio Frequency Simulation Systems, Inc. (RFSS)*
2. *One Stop Systems bought Mission Technology Group (dba Magma)*
3. *Mercury Systems bought Creative Electronic Systems (CES)*
4. *Abaco Systems bought the Technobox Micro Mezzanine Systems line*
5. *Abaco Systems bought 4DSP LLC*
6. *Curtiss-Wright bought Teletronics Technology Corporation*
7. *Bittware bought nCk Research*
8. *Wireless Telecom Group bought CommAgility*
9. *Mercury Systems bought Delta Microwave*

Two acquisitions in the past year stand out: Mercury Systems bought the RF and Microwave division (among other things) of Microsemi last March. Curtiss-Wright bought Teletronics, a maker of military testing and data acquisition products in December. On the surface, the Mercury Systems acquisition looks like vertical integration, buying a supplier of components used in Mercury Systems high performance boards and systems, but with some horizontal harmonics. This should give Mercury Systems an advantage against competitors in the RF segment in the future since

⁵⁵ "Sandia, Harvard team create first quantum computer bridge which can enable clusters of quantum computers", Next Big Future, October 22, 2016, <http://www.nextbigfuture.com/2016/10/sandia-harvard-team-create-first.html>

⁵⁶ "Computing exponentially faster using DNA", Next Big Future, March 1, 2017, <http://www.nextbigfuture.com/2017/03/computing-exponentially-faster-using-dna.html>

⁵⁷ Aaron Frank, "The future of AI is neuromorphic. Meet the scientists building digital 'brains' for your phone", Wired, March 6, 2017, <http://www.wired.co.uk/article/ai-neuromorphic-chips-brains>

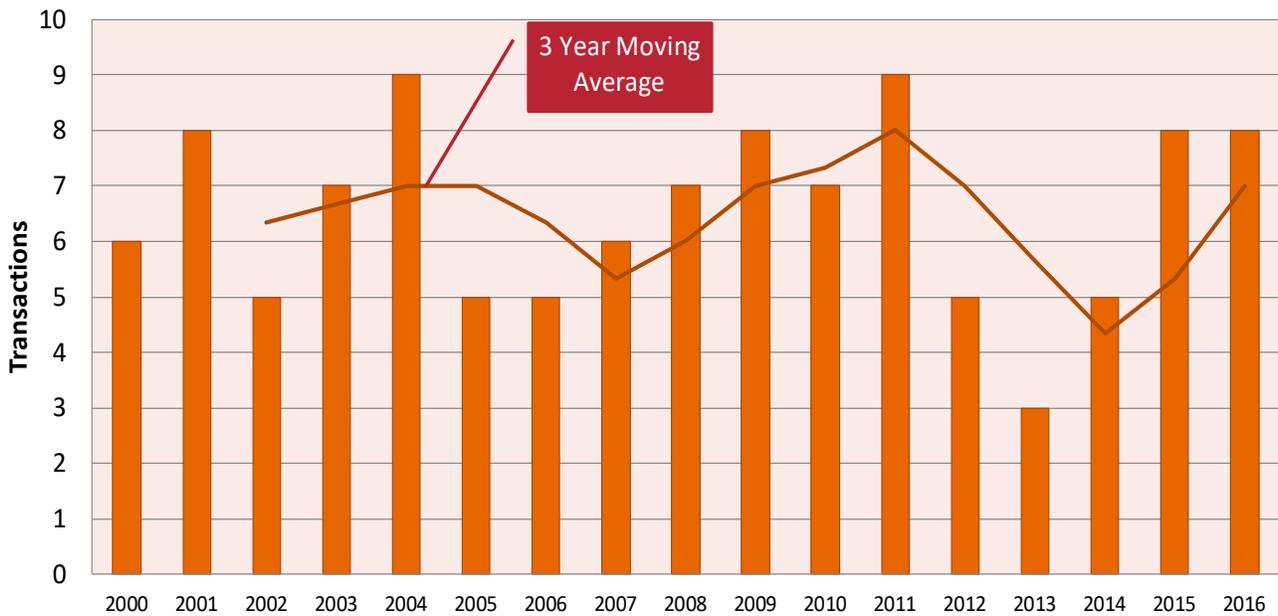
they can now take a systems-level approach and influence the IC design they need to push performance, instead of buying generic ICs from common suppliers. And, they can sell chips to other industries too.

On the other hand, the Curtiss-Wright acquisition looks like horizontal integration, moving into test equipment and data acquisition systems in military and aerospace applications. They too should find competitive advantages against basic competitors. But, they'll be competing against larger companies like Agilent and others in the test equipment space. The avionics test equipment market alone is over \$7 billion, about 6 times the size of the embedded board and systems market in the military.

Curtiss-Wright's defense segment, and Mercury Systems, are both over \$300 million in sales, and they are both restrained by the law of large numbers in our niche industry. If they want to grow at 10%, they each have to find an unidentified \$30 million market in the board niches. Or, they have to buy-up another board company, as they have both done in the past. Mercury Systems, moving into the RF components and systems, and Curtiss-Wright, moving into test and DAQ, gives them both growth opportunities in larger markets.

What does this mean for the smaller board companies? Not much, really. Mercury Systems and Curtiss-Wright will maintain their presence in mission computers, EW (Electronic Warfare), RADAR, SONAR, and SIGINT (Signal Intelligence). While both acquisitions are one step removed from our basic industry, they are synergistic with the products and focus of each company, expanding their footprints in the MIL/AERO markets. And both new product lines could bring in new customers and opportunities for their present board and systems products.

A better explanation of these moves is revealed in a Harvard Business School book, "The Keystone Advantage" by Marco Iansiti and Roy Levin. No company in our industry ever had more than 35% market share in its entire history, and it takes 41.7% market share to be the market leader (according to the New Lanchester Strategy). And even with both companies buying-up a significant number of smaller board companies, neither have reached market leader status. Buying-up smaller board companies just won't get them the growth and market share they want because our market is very fragmented and nichey. Both companies are market players (requiring 26.1% market share under the New Lanchester Strategy). And, neither is likely to become a keystone in our industry (according to "The Keystone Strategy"). So, they have to move vertically or horizontally to increase their opportunities. Now we'll have to wait and see what Veritas Capital, who bought the GE Embedded Systems group back in 2015, does in the future.



Summary

For those of you who follow the F-35 vs F/A-18 Hornet fighter plane arguments, I have written an article on the generations of fighter jets (there are 5 different lists, all with different definitions).⁵⁸ If you care to dig into the topic deeper, there's an excellent article about why the F/A-18 is the better choice.⁵⁹ Also, there's another article that talks about abandoning both the F-35 and the F/A-18, and designing a new F-45 Mustang fighter jet.⁶⁰ There seems to be a schism in the military about what the next generation fighters should be capable of doing: fight Russia, China, Iran, and North Korea, or terrorism. Another consideration is quantum RADAR, and the Chinese have announced that they have it working. Quantum RADAR eliminates the advantages of stealth aircraft altogether.⁶¹ The small RADAR cross section (RCS) of stealthy fighter jets and bombers will no longer be a guarantee of survivability.

What we are seeing are major programs in the Air Force, Navy, and Army for increased modularity in electronic systems. For the Air Force, it's "OpenPod"; for the Navy, let's call it "OpenBay"; and for the Army, we'll call it "OpenRack". How far each of these programs will go is questionable. These modularity schemes could knock-over a lot of big proprietary rice bowls. But, with defense spending under pressure to be more cost-effective, they could each enjoy some level of popularity. So, it's worth watching as these efforts progress. Modularity makes configurability, maintenance, and upgrades much faster, easier, and cheaper.

Could all the services work together, under a collective "OpenArchitecture" program, to share commonly needed modules like CPUs or communications interfaces or sensors across different platforms? Maybe that's what could happen with HOST (Hardware Open Systems Technology) and SOSA (Sensor Open Systems Architecture) activities, but I doubt it. The Army (AR670-1), Air Force (AFI 36-2903) and Navy (NR3501.54) all have different specifications for the same basic black dress uniform shoe. So how can you possibly expect them to agree on a common electronic module specification when they can't agree on the specs for a simple ugly black shoe?

We have seen two of the top companies in the board and systems business make acquisitions recently, that take them into larger markets (Mercury Systems bought the RF division of Microsemi, and Curtiss-Wright bought Teletronics in military testing). What Veritas Capital, who bought the GE Embedded Computing business back in 2015 will do along these lines, is yet to be seen. I have written another article that applies the Boston Consulting Group Matrix, the "Margin Call" (the movie) model, and the "New Lanchester Strategy" model to our industry.⁶² All of these models show that our board and systems business is just a collection of many small but growing niches. For larger companies to grow substantially, they must move into larger niche markets than those prevalent in our industry today. I am working on a new report about our industry using "The Keystone Advantage" model, that explains these recent moves.

It's hard to say what the economy is going to do in the coming months: there are good things and bad things occurring. As for military spending, it's not going to jump up until Congress does something, and then there's a lag-time after budgets get increased. That brings me to another irritating point: predictions vs forecasts. Predictions say something is going to happen, and they propose their reasons. But, they do NOT give you any probabilities of that event happening. I can predict that the earth is going to be hit by a meteor, and it will at some point, but if I give no probabilities over time frames, it's worthless information. Read any market research report concerning this or other industries, and you'll see tons of numbers. But, you will never see any probabilities associated with their future predictions. On the other hand, forecasts will always

"It's hard to say what the economy is going to do in the coming months: there are good things and bad things occurring."

58 Ray Alderman, "Generations of fighter aircraft and the F-35 vs F/A-18 arguments", Military Embedded Systems, February 28, 2017, <http://mil-embedded.com/guest-blogs/generations-of-fighter-aircraft-and-the-f-35-vs-fa-18-arguments/>

59 Jon Harper, "Clear the Decks: Super Hornet to Challenge F-35", National Defense, March 2017, <http://www.nationaldefensemagazine.org/archive/2017/March/Pages/CleartheDecksSuperHornettoChallengeF35.aspx>

60 Mike Fredenburg, "'Simplicate and Add Lightness!' — Designing the F-45 Mustang II", National Review, March 13, 2017, <http://www.nationalreview.com/article/445708/f-35-replacement-f-45-mustang-ii-fighter-simple-lightweight>

61 David Majumdar, "Don't Buy Into China's Stealth-Defeating 'Quantum Radar' Hype", War is Boring, March 1, 2017, <https://warisboring.com/dont-buy-into-china-s-stealth-defeating-quantum-radar-hype-7b96c5f54ffb#.n546r2py7>

62 Ray Alderman, "How This Bus and Board Industry Works - Part 1", <http://www.vita.com/resources/Documents/Whitepapers%20by%20Ray/Business%20Strategies%20-%20Part%201.pdf>

give you a range of possible future outcomes, and the probabilities for each one. Even the weather forecasters give you the probabilities for a rainy or sunny day (if there's a 20% chance of rain, there is an 80% chance of sun or clouds). Stop what you are doing right now, and order Nate Silver's book, "The Signal and the Noise". You will never again read another article or market report with the same old perspective. You will immediately see that some reports are purely predictive bunk, written by industry pundit fortune tellers. But, you will also find that a few are written by disciplined researchers using sound Bayesian forecasting probability methods. Remember the \$10 billion market predictions about AdvancedTCA sales to telecom?

Ever since the invention of the Internet and World Wide Web, we have been inundated with information. At least 95% of that information is noise: there is not a huge new amount of absolute truth in the world today, than there was before all this data was collected. And all that worthless information is being put into data bases, for "Big Data" analysis. What big data analytics is actually doing is analyzing the noise, not the signal. Just because there is a positive correlation between certain variables does NOT mean there is identifiable causation. Let's take an example of big data analytics: "People who drink milk are smarter." How did they come to that conclusion? The majority of Nobel Prize winners come from countries with the highest milk consumption. Is there any medical evidence that drinking milk increases brainpower? Nope, no causation mechanism anywhere in sight. So, read the book, to protect yourself from the nutty market reports and whacko prediction articles, and adopt my mantra for 2017: "If it ain't Bayesian, it's Crazian!" I am having bumper stickers made now.

*"If it ain't
Bayesian, it's
Crazian!"*

So, based on the reasons this report has presented, I predict that sales in the MIL market this year will increase 10%, as it moves to 15% growth in late 2017 and into 2018. And I forecast that there's a 95% chance that I'm going to get stuck with a lot of unsold bumper stickers!

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