



## The Microservic-ing of Culture

the spheres



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## Executive Summary

To achieve the full tactical potential of the Cloud, it is paramount to create an innovative and agile (pivot speed) corporate environment. This paper challenges us to consider that the Department of the Navy's (DoN) Acquisition (ACQ) Commands can benefit from a cultural transformation in order to adopt a cloud-enabling corporate environment; and that upgrading to agile processes without adopting an agile culture will lead us to the inevitable "I've seen this before" and "I knew this was not going to work".

At an Amazon Web Services (AWS) executive briefing with the DoN, Mr. Charlie Bell (Senior Vice President at AWS) used "Conway's Law<sup>1</sup>" to stress the crucial role that corporate communications skills played in AWS's success. Melvin Conway, a renowned computer scientist, made an observation that "Organizations which design systems are constrained to produce designs which are copies of the communication structures of these organizations".

Applying Conway's Law means that the DoN's use of the Cloud will reflect our current communication structures as dictated by our culture. These communication structures were the basis of the Navy's success during the industrial age, but they have not kept up with the demands of the digital information age.

Recognizing this cultural challenge, the Secretary of Defense established industry exchange programs such as the Cyber Information Technology Exchange Program (CITEP)<sup>2</sup>. CITEP provided me the opportunity to discover the "how" and "why" of cloud implementation success, which fueled the "what" of cloud products and tools.

During my six months (Jan-Jul 19) residency at AWS -a "subsidiary of Amazon that provides on-demand cloud computing platforms to individuals, companies and governments, on a metered pay-as-you-go basis"<sup>3</sup>- I became aware of three basic success tenets of this disrupting company:

1. The "microservicing" of the culture,
2. A stable and supportive infrastructure environment, and
3. State-of-the-art dependable Technology-as-a-Service.

This paper proposes the tenets above as the basis for the DoN's ACQ Commands cloud-enabling cultural transformation. As the Program Offices reach for state-of-the-art cloud technologies, it is imperative that we cultivate a culture of innovation and agility empowered by state-of-the-art communication skills including contracting strategies, funding vehicles, and automated metrics collection and reporting. This paper also proposes using the 14 Amazon Leadership Principles<sup>4</sup> (LP) as the guiding principles for the cultural transformation. These leadership principles are: Customer Obsession, Ownership, Invent and Simplify, Are Right - A Lot, Learn and Be Curious, Hire and Develop the Best, Insist on the Highest Standards, Think Big, Bias for Action, Frugality, Earn Trust, Dive Deep, Have Backbone--Disagree and Commit, and Deliver Results.

## 1. Introduction

One of the goals for my Cyber Information Technology Exchange Program (CITEP) experience was to discover “why” and “how” Amazon succeeds versus just the “what” of their products; so the reader will notice that this paper is descriptive, not prescriptive, with the following challenge: If we were to take this paper and replace the word "Customer" with "Warfighter", could we transform our culture to emulate the success that disruptive companies have accomplished in order to help us achieve the warfighter mission in the digital information age?

As of the time of this writing, Amazon employs over 680,000<sup>5</sup> people from multiple countries with offices spread over 100 countries. It is, in my opinion, a cultural modern marvel, for an enterprise of this size, to be able to onboard employees in less than four hours and allow them to start deploying production-quality code within two weeks. This is what I experienced during my fellowship at Amazon Web Services (AWS). I sum up my amazement in the opening statement of my first Situational Report (SITREP) from February 1 2019: “From "Hello I'm Roland" to "this is your desk" was [an impressively short] 2 hrs and 15 minutes. This included getting my access card, access to the correct building and correct floors, talking in length to the [Human Resources] manager, receiving my fully equipped laptop and backpack, going on a walking tour of the major AWS building and sites...”<sup>6</sup>.

The simplicity of the process is by design and is built upon reliable technology, which is built upon a reliable architecture, which-in turn-is built upon an innovative and agile culture. I describe this innovative and agile culture as well as my findings in the next three sections grouped by culture, environment, and technology; and indexed by the 14 Amazon Leadership Principles (LPs) of [Customer Obsession](#), [Ownership](#), [Invent and Simplify](#), [Are Right – A Lot](#), [Learn and Be Curious](#), [Hire and Develop the Best](#), [Insist on the Highest Standards](#), [Think Big](#), [Bias for Action](#), [Frugality](#), [Earn Trust](#), [Dive Deep](#), [Have Backbone – Disagree and Commit](#), and [Deliver Results](#).

## 2. The “Microservicing” of Culture

“Microservices are a software development technique—a variant of the service-oriented architecture (SOA) architectural style that structures an application as a collection of loosely coupled services. In a microservices architecture, services are fine-grained and the protocols are lightweight. The benefit of decomposing an application into different smaller services is that it improves modularity. Microservice-based architectures enable continuous delivery and deployment.” (Wikipedia, 2019. <https://en.wikipedia.org/wiki/Microservices>)

Amazon may not have invented the idea of software microservices, but they pioneered applying this software concept to their culture by using the LPs as the “loosely coupled services” of a constitution-like social contract. This implementation is what I am labelling the “microservicing of culture”. The LPs are more concrete than a Vision, a Mission, or Core Values. What I'm talking about is simple, versatile, and at times contradictory; it can be used on a day-to-day basis whether in hiring, product selection, decision-making, and meetings; basically you

live them. In the next few paragraphs, I describe how Amazonians go about their daily business guided by their LPs.

First among equals in the Amazon culture is the LP of **Customer Obsession**. In his article “How Amazon Became Agile”, Mr. Steve Denning, a business management teacher, states “In fact, Amazon doesn’t start any activity or develop a capability unless and until the team has figured out how it will measure the customer’s response.”<sup>7</sup> Customer Obsession is exercised through a process called “Working Backwards”<sup>8</sup> and measured through a metric called the Customer Experience. If Customer Obsession is my understanding of my customer’s need, then Customer Experience is my customer’s satisfaction with my response to their need.

Customer Obsession should not be confused with gold plating, for there is tension between it and the LPs of **Frugality** and **Think Big**. A customer obsessed solution cannot be so unique it would serve only one purpose. An Amazonian is challenged to make sure that proposed solution is of the correct value (frugality) and can be provided as-a-service to other customers (think big). In fact, the LPs are often in a state of tension between each other and Amazonians have to weigh one more than the other, depending on the circumstances.

The Working Backwards<sup>8</sup> process is executed by *first* writing a Press Release/Frequently Asked Questions (PR/FAQ) document about the end service/product *before* starting the task of creating said service/product. Through this Amazon-unique experience, we learn how Amazon “works backwards” from a customer request to a product to **Deliver Results** backed by customers’ needs. This is their “requirements decomposition” process; but Amazonians write it as a narrative that answers specific questions. PowerPoint is rarely used and never to introduce a new product. Once they formulate what the end service will look like, the assigned team will work backwards to the actual development. Through this process we also experience the **Learn and Be Curious** LP, because the process of documenting an idea in narrative form is more precise and dives deeper than bullets in a PowerPoint brief.

The process of the PR/FAQ document review is as impressive as the document development process itself. Reviewers, including senior leadership (when appropriate), start the meeting with 10 to 15 minutes of silent reading. No one negotiates, no one argues, no one proves their point before everyone else has had a chance to read all six (enforced limit) pages and get the baseline of what is to be discussed. Then, as an implementation of the **Have Backbone – Disagree and Commit** LP, the critical discussion starts. People are honest, direct, objective, and open to being critiqued. By the time the meeting ends, the team is committed to a way forward; whether it be that the document needs to dive deeper into the details, the idea is ready for implementation, or that the proposed solution is not of the **Highest Standards** and should be discarded.

For the **Dive Deep** LP, we look no further than the metrics that Amazonians chose and the data they collect. Consider this: in order for Amazon to **Earn Trust**, they make it their goal to know *before* their customers if a customer-facing service is going to be negatively affected. They do not wait for the customer to complain to know that they have somehow impacted the

experience of the most important person – their customer. For example, Amazonians not only check if a certain service is up and running from the server side, but also verify that the customer has access to the service from the Internet-facing side. From the customer's perspective a working service means nothing if they cannot get to it.

The Amazon workforce does not excel by accident. They live up to their "**Hire and Develop the Best**" LP through a structured interview process called "The Loop". During this process, potential Amazonians are carefully selected based on their capacity to exhibit LP characteristics that should be inherent to a person, and the potential to adopt those LPs which can be taught. There is a strong desire by Amazon to keep its workforce fungible, as best described by Danny Wei (Principal Engineer at AWS): "We hire smart people expecting that we can throw them at something they've never seen or experienced before and that they can figure it out. This is how we are able to operate our large-scale services with so few people because each person is expected to be able to wear multiple hats and fill in gaps as necessary."

One may be forgiven if one thought this next LP sounds boastful, "**Are Right, A Lot**" is anything but, as being "right" must be backed by data. Through a conversation with Mr. Wei, I came to understand that being "data driven" is core to Amazon and drives much of their interactions with each other. It is a good way to handle conflicts and disagreements; helping them stay away from politics and infighting. As their assumptions are challenged, including by junior employees, Amazon will adjust course as long as the data and the interpretation of the data is correct.

Being right a lot (with the right data) is in tension with the "**Bias for Action**" LP. The concept of this tension between LPs was best summarized by Mr. Wei: "Sometimes we may not have data. Instead of getting into analysis paralysis and spend huge amounts of effort guessing or building predictive models, we may go ahead and ship something we're unsure of to collect that missing data, which we can then use to go back and refine or alter. The saying we like is that you can't improve what you aren't measuring. This is where we talk a lot about one way doors. As long as we aren't going through a one way door, then it's fine to make that decision even if it's a mistake because you can always go back and correct it."

We will address the "Ownership" LP in the next section, so we end this section with the "**Invent and Simplify**" LP by looking at how the enterprise-level program review process has been reinvented and simplified, backed with automated metrics. On Wednesdays, AWS senior leadership (including the CEO) spends two hours randomly picking programs to review, 20 minutes at a time. If picked, AWS programs are ready to provide an update at a moment's notice. Because the metrics and data is live and automatically ingested into standardized dashboards, there is no need for endless briefs updates and no need for lead-time before programmatic reviews. The reviewers can, as needed, dive deep into the details thus making the review more meaningful.

### **3. A Stable and Supportive Infrastructure Environment**

In this section, I describe Amazon’s physical, logical, and process-based environment that allows state-of-the-art products, described in Section 4, to exist.

At the physical core-services level, and as has been noted in the end-of-tour reports from multiple Department of Defense (DoD) CITEP fellows<sup>10,11,12</sup>, including my SITREPs (February 1<sup>6</sup> and February 26<sup>9</sup>), we did not experience any breaks in AWS physical and logical infrastructure. The Virtual Private Network, the gates, the heating, our laptops, and the software worked efficiently and reliably ... I emphasize these facts for the purpose of bringing to attention how much time is saved from having a stable and reliable infrastructure. This “saved time” is used for solving customer-centric problems which is what the workforce is there to do in the first place.

At the logical level, a look at the AWS implementation of the technical microservices architecture shows very specific and well-defined **Ownership** and boundaries for said microservices. Mr. Charlie Bell (SVP UCS AWS) explained that the key ingredient for success was to break down every “capability or feature or product” to its smallest primitive “end product” state. This process allows for the entity to exist by itself clearly defined and to communicate with other entities through its Application Programming Interface (API).

The ownership and autonomy that happens at the coding level also takes place at the team level as summed up by Denning: “The [Product] team is autonomous. Interaction with other teams is limited, and when it does occur, it is well documented, and interfaces are clearly defined. It owns and is responsible for every aspect of its systems. [...] Teams that are more independent move faster”<sup>7</sup>. AWS terms this efficient team structure the “Two Pizza Team”, meaning that the team is as big as the number of people that can be fed with two pizzas.

With the ownership established, the interfaces defined, and the physical and logical necessities taken care of, the Amazonian’s responsibilities are clear: make my product better every day. So it then makes sense that when Amazon uses the expression “we prefer a 70% solution to a 100% idea”, they mean “for now”, not as a permanent state. And since the 70% solution is usually 100% reliable, Amazonians can count on needed services to deliver as expected, so they spend their time iterating by delivering small and very frequent increments to their base solution.

#### **4. State-of-the-Art Dependable Technology-as-a-Service**

In order to better appreciate the solutions mentioned below, we have to consider Amazon’s unusual problem-solving techniques that seek to eliminate (rather than add) process steps by using advanced technologies. Looking at the cashier-less Amazon Go Store as an example, Amazon did not streamline the checking out process, they eliminated it. We can see the same problem-solving technique in the AWS Snowball Edge shipping process (more on this device below). Once they discovered challenges in the shipping process, the Snowball Edge team did not issue a more stringent instruction on how to label these boxes, they completely got rid of

the need to manually label them; making the Snowball Edge its own secure and ruggedized shipping container.

The AWS console (<https://aws.amazon.com/>) is your one-stop shop for all things “as-a-service”, whether you are streaming video to millions of customers, using serverless functions that take advantage of horizontal scaling, or ingesting Internet-of-Things-based data.

As the leader in the infrastructure-as-code industry, AWS has developed the building blocks of the Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS) cloud stack. As of July 2019, AWS offered over 168 services that are not only offered to customers but used by Amazon itself, just like Lego® pieces, to build customer solutions. These services are grouped by: Compute, Storage, Databases, Migration and Transfer, Networking and Content Delivery, Developer Tools, Robotics, Blockchain, Satellite, Management and Governance, Media Services, Machine Learning, Analytics, Security Identity and Compliance, AWS Cost Management, Mobile, AR & VR, Application Integration, Customer Engagement, Business Applications, End-User Computing, Internet of Things, and Game Development.

I was assigned to the Migration and Transfer and Edge Compute service team of which the Snowball Edge is the star product. As part of the team, I established my first environment on the AWS Cloud, provisioned and ordered, and received and experimented with my first Snowball Edge device. The process was simple. This is by design. The services I studied are physical extensions of the cloud. All provisioning, coding, design, and implementation takes place on the AWS cloud and then is moved into these edge devices described below:

- a. Snowball Edge: the “AWS Snowball Edge device contains storage and an embedded computing platform that helps you perform simple processing tasks. They can be rack shelved and may also be clustered together, making it simpler to collect and store data in [...] remote locations. Customers use these devices in environments with intermittent connectivity [...]; or in [...] remote locations (such as military or maritime operations) before shipping them back to AWS data centers.”<sup>13</sup>
- b. SnowMobile: “The AWS Snowmobile moves up to 100PB of data (equivalent to 1,250 AWS Snowball devices) in a 45-foot long ruggedized shipping container and is ideal for multi-petabyte or exabyte-scale digital media migrations and datacenter shutdowns.”<sup>13</sup>
- c. OutPost: “AWS Outposts bring native AWS services, infrastructure, and operating models to virtually any data center, co-location space, or on-premises facility. You can use the same APIs, the same tools, the same hardware, and the same functionality across on-premises and cloud to deliver a truly consistent hybrid experience. Outposts can be used to support workloads [with] low latency or local data processing needs.”<sup>14</sup>
- d. Small form factor Snowball Edge. Information upon request and with permission from AWS.

## 5. Recommendations

In a March 2019 *Fortune* (magazine) article titled “The New Blueprint”, President and CEO of the global design firm IDEO, Tim Brown, makes a statement about product and process design that seems applicable to the current situation in the DoD. He states “[...] like any other artifact of our civilization, they [items or processes] may be designed well or poorly, or may simply have been designed to meet challenges that are no longer relevant.”<sup>15</sup>

It is in that spirit that I pose the hypothesis that our immediate challenge is that our current PORs were powered and built on a cultural construct that includes contractual and funding principles and processes successful in the industrial age. Trying to force agile processes, agile products, agile thoughts, and agile organizations through the current contractual and funding structure is making the task of modernization exponentially more complex, if not impossible. That does not mean that the actions taken by our ACQ Commands are wrong, nor am I saying that how the government conducts business should be replaced by the commercial version. My observation is that our current processes, which are a manifestation of current cultural communication mechanisms, are not sufficiently agile or efficient to meet the demands of current and future challenges. We are not moving at the speed of digital information. In the instances where the warfighter’s time-sensitive need is in contrast with the Acquisition Program Baseline (APB), it’s the APB that wins. And the APB does not get updated at the speed of digital information.

I believe this hypothesis is in line with a recent statement by Secretary Geurts at a talk titled “Risk-Taking in Leading”<sup>16</sup>, where he mentions that we have to have velocity not just speed, which is to say it is not enough to be going fast, we have to be headed in the right direction as well. So to satisfy Secretary Geurts’ desire for pivot speed, we have to respond quickly to the fleet’s capability needs, which means we have to update our systems quickly, which requires us to be efficient communicators employing agile contracts, agile funding mediums, and agile technology.

As such, it is not sufficient that we move (speed) towards the adoption of edge compute products like the AWS Snowball Edge device; it is imperative that we first address our current limited knowledge of the actual workings of the cloud (direction). We should be adopting the concepts of the cloud stack (IaaS, PaaS, SaaS...), and designing on the cloud, as the first step towards adopting edge compute devices.

Given the opportunity to transform our organization into the next big technological success, I propose our workforce commit to reshaping our enterprise services as follows:

- a. Workforce communications-skills training: recalling Conway’s Law introduced in the Executive Summary, it is of the utmost importance that we reconsider the current communication skills and tools used to conduct our daily business. Based on lessons from large-size organizations like Amazon, I propose that a cultural transformation is a necessary precondition in the areas of conflict resolution techniques, efficient time management, and



metric-based programmatic updates. These training investments must be core to the workforce skills training process, not an elective.

- b. Workforce-wide technical training: The task of developing a capability on the cloud, creating a machine image, and transferring it onto a portable cloud-based unit does not need to be proven. It works. It must be learned and used to design warfighter-centric solutions. We have proven that we can effectively train our workforce for such challenges, as we have demonstrated with the recent Model-Based Systems Engineering (MBSE) enterprise-wide training. In order to proceed we need:
  - i. Cloud trained (at the appropriate level) leaders, managers, coders, architects, and network engineers,
  - ii. A better understanding of the different cloud offerings capabilities and limitations and what they mean from an operational perspective,
  - iii. To transition from "I need to investigate if the cloud does the following" to "How do I implement the following on the cloud?", and
  - iv. An enterprise-wide understanding of cloud access possibilities (contracts, cloud access presence...)
- c. Tooling: Common tools are essential for efficient communications. Although Amazon does allow the use of the appropriate tool for the appropriate task, if the tool is not common, it can only be adopted after data has proven that it is the correct one to transition to.
- d. Metrics: Metrics count when they reflect the experience of the customer. Imagine if we could tell how well our C4I systems, for example, were operating on a ship before the sailors knew? Or in disconnected operations, if sailors had dashboards to alert them immediately of any mission degradations? As an example, Amazon develops software functions designed to mimic normal customer behavior by continuously checking on endpoints and portals. "Canaries" are placed at these endpoints so that metrics are collected from both sides of the transaction. The functions consistently check that the API and the portal are working as designed and the canaries proactively raise a flag if certain expected values are exceeded. All this data is collected on the cloud and machine learning serverless functions automatically raise alarms or trigger remediating functions as designed.
- e. Funding: This may be a big hurdle to overcome as we redefine a trust-based relationship with our resource sponsors and work within our laws and regulations that are very different from commercial industry's rule. We are currently funded in program-centric silos doomed to re-create common services again and again within each silo. Our current funding culture also encourages independence versus a trust-based interdependent-ownership with stakeholders and service providers. We need to consider:
  - i. Organizing ourselves in a services-centric structure that allows for the funding of services-based capabilities that serve the enterprise (with backing from sponsors)

- ii. Funding enterprise products such as one IdAM solution for all programs, one video streaming ingest solution for all programs, one Cross Domain Solution abstraction layer for all programs ... provided as-a-service.
  
- f. Contracts: Even with new contracting vehicles like Other Transaction Authority (OTA), we are still executing contracts at the individual Program of Record (POR) not at the Enterprise level. I propose we learn to implement contract vehicles that are in support of enterprise-level services as well as specific PORs. We know this is already feasible, as we have learned through the report of the Air Force's Project Kessel Run<sup>17</sup>.
  
- g. Unified warfighter-centric presence: Guided by the AWS implementation of their portal, I propose a centralized user-facing interface-based portal to the ACQ Commands, such as one place for all warfighters to interact with mission support products. This portal would include what we have in SAILORWEB and would include capabilities for users to get their applications, order services, open tickets, learn or validate their ships C4I architecture with Functional Interface Drawing, Interactive C4I Architecture Guide, training videos, and eventually download applications, receive updates, and possibly build solutions and solution updates themselves. Some of the ACQ Commands has already begun working some of these initiatives, so we need to bring them into a consolidated approach.

## 6. Conclusion

As we find ourselves at the crux of a disruptive technologically-fueled cultural change, we need to, using Amazon terms, have backbone, work through our disagreements, and commit to a way forward as a demonstration of our bias for action. It is our communication culture (including contracting strategies, funding vehicles, and automated metrics collection and reporting) that will benefit the most from a transformation, because otherwise, the cloud migration process itself does not have an easy button. Cloud adopters follow the same process of cloud migration by assessing their infrastructure holistically, and dividing their services according to the "6 Rs" of Retire, Retain, Re-Host, Re-Platform, Repurchase, and Re-Factor<sup>18</sup>.

Our reinvented culture (including the tools we chose) cannot be simply copied from Amazon or any other company. Our culture is to be transformed by us, for us, using the lessons learned from our industry partners as guidelines. We know that the cultural change needed as well as the adoption of a new technology are not impossible tasks, as we have already accomplished similar scale efforts as the Data Center Consolidation, as well as the implementation of the Navy and Marine Corps Intranet and the Consolidated Afloat Network and Enterprise System. The idea here is to perform the next big move in a more efficient manner.

The changes this paper proposes cannot be implemented on an individual program basis. The momentum needed for such an enterprise-level change dictates that it be done with stakeholders (resource sponsors and capabilities users) seated at our decision-making table.

I close with the following two tasks as my call to action: First, use the lines of effort mentioned in Section 5 above to guide the enterprise-wide cultural transformation. And second, use the CITEP program to the maximum extent possible with the purpose of diversifying our knowledge of culture and tools at all levels of our organization, especially for the civilian acquisition workforce not just at the engineering level; for it is critical for managers to understand what they are managing.



## Appendix A: References

1. Wikipedia. *Conway's Law*. Retrieved from [https://en.wikipedia.org/wiki/Conway%27s\\_law](https://en.wikipedia.org/wiki/Conway%27s_law)
2. Chief Information Officer (CIO) website. Cyber Information Technology Exchange Program (CITEP). Retrieved from <https://dodcio.defense.gov/In-the-News/Information-Technology-Exchange-Program/>
3. Wikipedia. *Amazon Web services*. Retrieved from [https://en.wikipedia.org/wiki/Amazon\\_Web\\_Services](https://en.wikipedia.org/wiki/Amazon_Web_Services)
4. Amazon Jobs (nd). *Leadership Principles*. Retrieved from <https://www.amazon.jobs/en/principles>
5. Aboutamazon.com (2019). *Investing in the U.S.* Retrieved from <https://www.aboutamazon.com/investing-in-the-u-s>
6. Feghali, R. (2019, February 1) *PMW 750 TD at AWS (JAN-JUL 19) - Cyber IT Exchange Program (CITEP) -- Update Week 1 of 26 -- Stories of Amazonia*. Situational Report (SITREP) sent via email.
7. Denning, S. (2019, June 2). *How Amazon became agile*. Retrieved from <https://www.forbes.com/sites/stevedenning/2019/06/02/how-amazon-became-agile/#7fffa3ba31aa>
8. Amazon. Working Backwards. Retrieved from <https://www.product-frameworks.com/Amazon-Product-Management.html>
9. Feghali, R. (2019, February 26) *PMW 750 TD at AWS (JAN-JUL 19) - Cyber IT Exchange Program (CITEP) -- Update Week 4 of 26 -- Stories of Amazonia*. Situational Report (SITREP) sent via email.
10. Simpkins, B. (2018, September 9). *DON ITEP Program out Brief*. SPAWAR Atlantic/PMS 444 (NMMES-TR). Report presented by Brandon Simpkins subsequent to his Cyber Information Technology Experience Program (CITEP) fellowship. Received by email.
11. Dorsky, W. (nd). *CIDP Fellowship @ AWS*. Brief presented by Weina Dorsky subsequent to her Cyber Information Technology Experience Program (CITEP) fellowship. Received by email.
12. August, M. (2018, August 22). *DoN Cyber IT Exchange Program @ Amazon Web Services*. Brief presented by Michael August subsequent to his Cyber Information Technology Experience Program (CITEP) fellowship. Received by email.
13. Amazon. AWS Snow family members. Retrieved from <https://aws.amazon.com/snow/?c=23&pt=8>
14. Amazon. AWS Outposts. Retrieved from [https://aws.amazon.com/outposts/?nc2=type\\_a](https://aws.amazon.com/outposts/?nc2=type_a)
15. Brown, T. (2019, March 1 issue of Fortune magazine p94). *The New Blueprint*.
16. Hon. James "Hondo" Geurts (2019, April 9) *Risk Taking in Leading Rapid Capability Development Initiatives*. Retrieved from <https://media.dau.mil/media/Risk+Taking+in+Leading+Rapid+Capability+Development+Initiatives/1rmkw0csq/62970351>
17. Sanders, J Lt Col USAF. *KesselRun. The Agile Imperative*. Brief received through email.
18. Amazon Web Services (2015, December) *A Practical Guide to Cloud Migration. Migrating Services to AWS*. Retrieved from <https://d0.awsstatic.com/whitepapers/the-path-to-the-cloud-dec2015.pdf>
19. OUSD(A&S) Human Capital Initiatives (2018, September). *Department Of Defense Public-Private Acquisition Talent Exchange (PPTe) Pilot Program Operating Guide*. Received by email on June 28 2019.

## Appendix B: Recommended reading

1. Rosario, P. (2018). *DoD Cyber Information Technology Program (CITEP) – Microsoft-Navy Exchange Program*. Brief presented by Perla Rosario subsequent to her CITEP fellowship. Received by email.
2. Downs, T. (2018, June). *The DeltaTech Ops Approach to Reliability and Predictive Maintenance*. Air Force Education with Industry (EWI) Delta Air Lines, Delta TechOps, MRO Services, Atlanta GA June 2018. Received by email.
3. Hernandez, G. (2018, December 3). *Education with Industry (EWI) Student Report*. Received by email.
4. Hernandez, G. (2019, March 1). *Education with Industry (EWI) Student Report*. Received by email.
5. Simpkins, B. (2018, August 24). *Continuous Deployment on Shipboard Environments*. Brief presented by Brandon Simpkins subsequent to his Cyber Information Technology Experience Program (CITEP) fellowship. Received by email.
6. Feghali, R. (2019, May 1) *PMW 750 TD at AWS (JAN-JUL 19) - Cyber IT Exchange Program (CITEP) -- Update Week 8 of 26 -- Stories of Amazonia*. Situational Report (SITREP) sent via email.
7. Feghali, R. (2019, February 1) *PMW 750 TD at AWS (JAN-JUL 19) - Cyber IT Exchange Program (CITEP) -- Update Week 12 of 26 -- Stories of Amazonia*. Situational Report (SITREP) sent via email.
8. Feghali, R. (2019, April 22) *PMW 750 TD at AWS (JAN-JUL 19) - Cyber IT Exchange Program (CITEP) -- Update Week 16 of 26 -- Stories of Amazonia*. Situational Report (SITREP) sent via email.
9. Feghali, R. (2019, June 26) *PMW 750 TD at AWS (JAN-JUL 19) - Cyber IT Exchange Program (CITEP) -- Update Week 20 of 26 -- Stories of Amazonia*. Situational Report (SITREP) sent via email.
10. Sanders, J. Lt Col USAF. (nd). *The Agile Imperative*. Brief presented by Lt Col Jeremiah Sanders Deputy Commander, AFLCMC Det12. Received by email from Michael August on 2019, May 16.
11. Denning, S. (2019, June 2). *How Amazon Tames the Budget*. Retrieved from <https://www.forbes.com/sites/stevedenning/2019/06/02/how-amazon-tames-the-budget/#74cf9ce46c04>
12. Amazon Web Services (2017, September) *Web Application Hosting in the AWS Cloud*. Retrieved from <https://d1.awsstatic.com/whitepapers/aws-web-hosting-best-practices.pdf>

## Appendix C: Acronyms

API: Application Programming Interface  
AWS: Amazon Web Services  
CITEP: Cyber Information Technology Exchange Program  
DoD: Department of Defense  
DoN: Department of the Navy  
IaaS: Infrastructure as a Service  
LP: Leadership Principle  
OTA: Other Transaction Authority  
PaaS: Platform as a Service  
PEO C4I: Program Executive Office for Command, Control, Communications, Computers and Intelligence  
PR/FAQ: Press Release/Frequently Asked Questions  
SaaS: Software as a Service  
SITREP: Situational Report  
SOA: service-oriented architecture