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THE EXCEPTIONAL RELEASE
THE AIR FORCE PROFESSIONAL LOGISTICS JOURNAL
ON THE COVER
F-16C Fighting Falcons with the 13th Fighter Squadron, assigned to Misawa Air Base, Japan, sit on the south ramp at Andersen Air Force Base, Guam, Feb. 28, 2019. Misawa AB’s F-16s were among the nearly 100 aircraft participating in this year’s COPE North exercise in Guam. (U.S. Air Force photo by Senior Airman Jarrod Vickers)

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Repairing Aircraft Faster At Lower Cost

A US Air Force C-5 Galaxy cargo plane equipped with predictive maintenance sensors made history recently when it “told” aircraft technicians that a part was about to fail and maintenance was needed. Understated as it was, the episode marks another significant moment for the Air Force and our effort to develop new tools for maintaining aircraft in a way that increases readiness and lowers cost.

Predictive maintenance involves analyzing aircraft on-board sensor data, telemetry data, and historical maintenance data to develop usage-based algorithms to identify degraded components or systems. By utilizing onboard prognostics and diagnostic sensor data users can provide recommended actions via alerts to the appropriate stakeholders as to the right time and place to change a component. While the current predictive maintenance system is still in its early stages, the goal is for aircraft to tell us, in real time, what parts are about to fail before they fail.

Achieving that will translate directly to improved readiness and reduced cost. The Air Force’s early results show a potential 30 percent reduction in unscheduled maintenance on the subsystems of the aircraft we are testing. We intend to move to conditions-based maintenance approach for all aircraft as rapidly as possible.

Predictive maintenance is only one of the new tools we are testing to build a more lethal and ready Air Force.

One of the most time-consuming steps in maintaining airplanes is removing paint. Working with the Air Force Life Cycle Management Center’s Advanced Technology and Training Center, the Air Force is developing lasers to replace hazardous solvents and elbow grease to strip paint off of airplanes. Where the old technique filled a 55-gallon drum with hazardous waste, using lasers sharply reduces the amount of waste. It also reduces the labor needed to remove paint, which saves both time and money.

We are testing – and in some cases already using – 3D printing to create replacement parts in a process known as additive manufacturing. Expanding this capability will allow the Air Force to print parts on-demand parts across our global operation.

3D printing is, perhaps, the most well-known new technique, but it isn’t the only one being adopted by the Air Force. The Air Force is increasingly using cold spray technology to repair high cost parts that in an earlier era would have been replaced. Cold spray applies metallic powders at high speed that, upon impact, adhere to the surface. This technology is being used to repair hydraulic lines and skin panels for the B-1 bomber.

As with predictive maintenance, additive manufacturing can simplify a supply chain and give us replacement parts faster and at lower cost.

It’s important to recognize too that the flightline of the future is much more than simply changing the way we make replacement parts.

At Sheppard AFB, Airmen are using what’s called the Adaptive Gaming and Training Environment to reduce the time required to train maintainers by 30 percent. If it works, we want to spread the idea across the service.

While the particulars and details vary, the thread connecting all of these efforts is a tireless focus on improving the readiness of the force by driving innovation in the way we maintain aircraft. We have no time to wait.

The Air Force now has more than fifty 3D printers in use at 17 locations... We expect 3D printing of spare parts, particularly for older aircraft, to change the way we do maintenance.

The Air Force now has more than fifty 3D printers in use at 17 locations. We also have 16 printers that produce metal parts. The C-5 is using nine parts produced by additive manufacturing, and this is only the beginning. We expect 3D printing of spare parts, particularly for older aircraft, to change the way we do maintenance.

Among the parts being produced or being tested include armrests and switch knobs for microphones, crew compartment panels and in one case, a dashboard casing for a B1-B Lancer. 3D printers are also used to produce and test more quickly and at much lower cost prototype replacement parts.

ABOUT THE AUTHOR

Heather Wilson is the 24th Secretary of the Air Force and is responsible for the affairs of the Department of the Air Force, including the organizing, training and equipping and providing for the welfare of 685,000 active-duty, Guard, Reserve, and civilian forces as well as their families. She oversees the Air Force’s annual budget of more than $138 billion and directs strategy and policy development, risk management, weapons acquisition, technology investments and human resource management across a global enterprise.
later). Sure enough, the sensor checked bad. The unit recommending the aircraft be restricted to local sorties and generated a work performance was clearly degrading. Rather than flying to fail, AMC sent a message to the underlying aircraft data that we downloaded after flight told us the thrust reverser CBM+ effort. An on-board sensor reported a condition where the thrust reverser was will help you. In December, we experienced our first truly predictive alert from the C-5 Those tools are certainly highlighted in the Secretary's message. But let me take a sustainment, we owe you the tools that will help you succeed—tools that will help unlock the unrealized capacity in our sustainment enterprise. You make it look easy! We know it isn't, maintaining and supporting a 28-year old, 5,000+ aircraft fleet. But the fact that you do is a testament to our Airmen's ingenuity, dedication and enthusiasm in generating lethal, combat-ready equipment in support of our national interests. You are an amazing cadre of talented professionals, and I thank you for what you do every day. I'm honored to be the AF/A4 charged with helping you succeed.

Secretary Wilson clearly lays out several of the initiatives we're pursuing to improve the way we sustain our fleets. In her article lies our charge:  to fundamentally re-think how we sustain our aircraft in order to improve readiness and, ultimately, reduce cost. I would also propose that there is an implied task that can't be lost or understated. We must also make it easier for you to help us recover that readiness faster. Whether you work on the flightline, the backshop, the parts store, the aerial port, or any other facet of logistics and sustainment, we owe you the tools that will help you succeed—tools that will help unlock the unrealized capacity in our sustainment enterprise. Those tools are certainly highlighted in the Secretary's message. But let me take a moment or two to expand on some of these a bit more and tell you exactly how they will help you. In December, we experienced our first truly predictive alert from the C-5 CBM+ effort. An on-board sensor reported a condition where the thrust reverser was on the verge of failing. The sensor didn't trip any on-board indications to the aircrew, but the underlying aircraft data that we downloaded after flight told us the thrust reverser performance was clearly degrading. Rather than flying to fail, AMC sent a message to the unit recommending the aircraft be restricted to local sorties and generated a work order to troubleshoot the condition at the C-5’s next scheduled maintenance (10 days later). Sure enough, the sensor checked bad.

Think of the power of this tool when applied ever more broadly. We’ll change unscheduled maintenance into scheduled maintenance, allowing us to change parts at a time and place of our choosing. We’ll have better parts demand data, helping us eliminate time you’re simply waiting for a part in order to green up an aircraft. We’ll reduce down time, and prevent MRTs which take seasoned maintainers and equipment away from scheduled sorties. In the end, it gives us more predictability...for the aircraft and for you.

We continue to push forward in Additive Manufacturing. Like CBM+, this will alter the equation of how long you’ll have to wait for a part. In fact, coupled with CBM+, this becomes a true game changer. While we have not yet 3-D printed flight/safety critical parts, rest assured we are close. In fact, our AFLCMC experts at Wright-Patterson additively manufactured a small, fully functional turbine engine. Commercial industry leaders like GE have made the leap to safety critical parts, and as you can see, we are not far behind. This is yet another milestone that will materially (pardon the pun) impact our ability to re-think sustainment and improve your ability to deliver readiness.

Laser depaint, another initiative we are actively pursuing, is in use at our depots today. As we mature the technology and the procedures, it will be coming to the field as well. Imagine a far more environmentally friendly process that doesn’t require cumbersome PPE and massively reduces environmental hazards. That’s a process that’s not just easier and quicker for you, but far safer as well.

Quite frankly, we also owe you a 21st century information system. With AMC and AFRC leading the way, we’ve developed and deployed mobile apps that will allow you to document maintenance at the point of need. The first iteration of Virtual Forms for G081 is available across the mobility enterprise, and the IMDS mobile app (called BRICE) is in test with our A-10s at Davis- Monthan. Imagine not having to re-enter your maintenance actions in multiple IT systems. A novel concept, right? It’s here, and we are committed to scale up quickly.

And all of this is just the beginning. We’re exploring how to tap into even more of that unrealized capacity across the sustainment portfolio. We’re bringing Theory of Constraints to sortie generation, mimicking the successes we’ve seen across other industrial processes. We’re looking at ways to implement more of a fleet management approach to our weapon systems, much like commercial airlines. We need to collapse our supply chains and unlock the potential of our entire repair network, removing some artificial barriers between retail and wholesale and between on-equipment and off-equipment. And we need to provide you with training tools like virtual and augmented reality that enhance your learning and help you become more productive, more quickly.

Our charge is clear, and we have our work cut out for us. But all of this is within reach, and we have a unique opportunity to scale these initiatives rapidly to impact our readiness and, just as importantly, impact your ability to work smarter and not harder. You are instrumental in how we re-think sustainment, but we won’t recover readiness on the backs of our Airmen. These initiatives are key to all of us moving forward together...faster...as our National Defense Strategy demands. Thanks again for all you do! It’s an exciting time to be in our business!
Designing Flexibility into Government Modernization Projects

By: Mr. Steven Lane

My case study looked at the Eastern Distribution Center (EDC) for the Defense Logistics Agency (DLA). A report conducted by the Government Accountability Office (GAO) conducted in 2017 stated that, “The Department of Defense (DOD) manages about 4.9 million secondary inventory items, such as spare parts, with a reported value of $91.7 billion as of September 2015 (GAO, 2017a, 1). A GAO Study stated that DLA generated $23 billion in revenues from supply chain services in 2015. The study applauded efficiency improvements taken by DLA. However, inefficiencies across DLA’s US distribution centers remain and must be analyzed by the existing authorities. The GAO postulated the underutilization of the DLA distribution capability limits effectiveness in the enterprise supply chain. In response to this DLA leadership are pushing for modernization to better utilize their assets (GAO, 2017b).

The current Defense Logistics Agency’s Eastern Distribution Center in Susquehanna, PA boasts $13 billion of inventory over 770,000 stock numbers. The EDC was designed and built in the 1990s, which is the last time any study was completed for efficient operations. The EDC recently underwent a $62 million roof project, which prolonged the EDC’s life by 30 years. The estimated cost to modernize the warehouse is $107 million. DLA hired St. Onge, an engineering consulting firm, to conduct a study developing an estimate and possible options to modernize the warehouse(s).

The proposed modernization is a multi-year, multi-million-dollar project to completely overhaul the current warehouse operations. Such projects rarely behave in a manner predicted from the onset. They are subjected to uncertainty at myriad points throughout, which cannot be ignored (de Neufville & Schots, 2011). The case study conducted sought to understand the feasibility of large DoD warehouse technological modernization efforts and implement a flexible approach towards future warehouse modernizations projects. The study developed a construct to aid DoD leaders in implementing flexible design for warehouse modernization projects. The key comparison in my study is flexibility. The adaptability to an ever-changing market and rapidly growing technology allow advantageous decision making. How then can the DoD rapidly flex its options when bureaucratically and financially constrained?

Case Study

The following section outlines the case study conducted to answer this question. Case studies focus on answering the why and how; specific to an instance, scenario, or in this case a government entity attempting to modernize a warehouse. The case study centers on five key tenants of design outlined by Robert Yin’s Case Study Research: questions, propositions, units, logic, between data and propositions, and the criteria to interpret (Yin, 2014). The case study relied upon three elements of data: interviews, observations, and historical or archival data surrounding the project.

The questions being addressed come from a gap of knowledge in the literature as it pertains to DoD agencies. The case study itself focuses on propositions to be gained throughout the process to apply to future projects. Linking these propositions to data will provide a framework for decision makers to engineer flexibility into their designs. The interpretation will decipher the analysis into usable constructs. For these reasons a case study provides the best approach of research. Within the case study research design, semi-structured interviews were used to collect qualitative data.

The raw data was collected through interviews, observations, and historical documentation. It was organized and structured in preparation for analysis by systematically typing and storing the transcripts of interviews. The observations were broken into sections based upon location. The historical documentation likewise received preparatory scrubbing and sorting. The data was then read to frame the researcher’s mind. After reading, the coding effort began and was conducted in Excel. The themes and codes came from the reading of the data. The codes were then assigned and interpreted.

Evaluation style interviews were the primary structure utilized in the research. In these interviews, “the researcher learns in depth and in detail how those involved view the successes and failures of a program or project” (Rubin & Rubin, 1995, 122). The knowledge sought was highly experiential and particular to the interviewee’s personal experiences on projects.

Questions were developed to hear detailed descriptions, those that go beyond surface knowledge of observation and are derived from the experience (Rubin & Rubin, 1995). This experience sharing allowed the researcher to deduce meaning and repeatable lessons from another’s experience.

The data collection of the research came from semi-structured interviews. These interviews included engineers designing the DLA EDC warehouse modernization, DLA management, industry-comparable personnel, and observations from site visits. The experts interviewed all worked modernization efforts for their perspective organizations. They ranged from project managers to industrial engineers and operational managers. Each person was interviewed in person or over the phone. Transcripts of the interviews are held by the researcher. Each one is anonymous and only differentiated by government or commercial respondent. Table 1 provides the stakeholder group breakdown as well as the individual’s organization. The site visits included the DLA EDC, an Amazon Fulfillment Center, and a P&G Mixing Center.

<table>
<thead>
<tr>
<th>Commercial</th>
<th>Government</th>
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<tr>
<td>9</td>
<td>8</td>
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<tr>
<td>P&amp;G</td>
<td>DLA</td>
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<tr>
<td>Kohl’s</td>
<td>NASA</td>
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<tr>
<td>Huskey Refinery</td>
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<td>Northrop Grumman</td>
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Respondents were professionals involved in large-scale modernization projects; specifically, those seeking to include innovative technologies into their designs. Respondents were contacted through mutual connections, site visits, and from the sponsoring organization. The respondents were either directly working on a distribution center or a multi-million/billion-dollar project that took place over several years. Considering the timeline and large-scale budget was imperative to drawing conclusions from sources outside the distribution and warehousing field. For example, the respondent from Northrop Grumman Newport News Shipyard worked modernization projects and procurement for aircraft carriers for 30 years. The object is different, but the considerations of obsolescence and investment were similar. Each project took a decade to complete and had to consider flexible options developed throughout the life of the project.

From the 17 interviews conducted there were common themes developed and within those theme’s nomenclatures of categories. The following table shows these themes which guided the creation of the flexible framework.
### THEMES

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<th>Theme 2</th>
<th>Theme 3</th>
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<td>Environment of Organization</td>
<td>Executability</td>
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<tr>
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<td>The organization’s views and goals; their operating mentality when approaching new modernization projects</td>
<td>Considerations that functionally describe whether the project will be successful based off criteria and how that criteria is developed.</td>
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<td>Detailed Design’s Elements</td>
<td>Purchasing Power</td>
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<td>Agile Support System</td>
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<td>Competitive Advantage</td>
<td>Work Force</td>
<td>Option Comparisons</td>
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<tr>
<td>Payment Method</td>
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</tbody>
</table>

**Design Elements**

The first theme uncovered similarities and differences between the commercial and government sectors pertaining to physical design factors. The main focal points were physically designing flexibility, phasing the projects appropriately, benchmarking from industry, and the balance of automation integration. The commercial respondents relied upon knowledgeable expert contractors and teams to develop a design envisioning growth. The commercial respondents built their contracts and phases to be broken into portions that could be stopped upon a certain level of utility gained. That utility determination came from executive decision makers responsible for project execution and the firm’s future state. The commercial sector relied upon a benchmarking and prototype method of modernization. Upon determining a successful design, it was repeated and adjusted dependent upon location-specific requirements. Commercial respondents considered the integration of automation to meet their needs. Finding the balance of automation to labor was a critical consideration, which was determined largely by the investment required versus the gain from the technology. The government respondents discussed their frustrations with lengthy, unclear and poorly designed projects. They felt the contracting office and decentralized nature of procurement led to poorly articulated bids and designs. There was a consensus of proper team formulation as a requirement for success. The government viewed phased approaches completely differently than their commercial counterparts. The government did not consider stopping a project from full completion. They fully committed to a project from the beginning and counted the different phases of construction or implementation as a phased approach. The government respondents also relied upon benchmarked practices from industry but did not consider the prototype methodology of modernization. Each project developed individually. The design elements or technological benchmark considerations were sourced from the industry for consideration in their design. A similarity between the government and commercial sectors was the integration of automation. Neither agency wants to overcommit to an automation process and overly invest in a technology. Both agree that the automation to labor was a critical consideration, which was determined largely by the investment required versus the gain from the technology.

**Environment of Organization**

Across the discussion of the organization’s environment several key characteristics stood out. The strategic goal alignment of that organization drives the purchasing power and agility. Rapid changes are required for flexible decision making. The environment that is aligned strategically to consider these changes and make determinations throughout the project will remain the most flexible. An aspect of that organization is the relationship throughout the supply chain. Organizations that support long-term, strong relationships with suppliers and contractors are able to adjust more rapidly on projects than those continually using new sources. Throughout the project each phase and decision should relate to an overarching goal of the agency. Goals then drive and justify continuing or ceasing project phases.

**Executability of the Project**

Every option was tied to a certain ROI. The ROI was developed by the engineers designing the plan, but the executives also considered the value-added and new capabilities the said modernization would offer. This is one of the option comparison criteria required by successful decision makers prior to bid. Without an end scorecard to hold up against other designs it will prove fruitless to try and assess one against another. A commercial respondent stated, “There was a lot of scrutiny of the vendors and the team developed a scorecard.” Aligning end goals with criteria of value helps quantify the decision. When comparing designs commercial experts relied upon a scorecard developed internally. One organization gave the researcher a copy of their scorecard and the top priorities were: confidence in design, references/comparable projects’ successes, IT capability, schedule, confidence in approach, and total cost. These highlight their top concerns, but the total scorecard was made up of 39 considerations. This criteria for analysis helps their executives quantify differences between somewhat subjective areas.

**The EDC was designed and built in the 1980s, which is the last time any study was completed for efficient operations.**

The major themes and their subcomponents led to developing a framework of flexible decision making. The idea of developing a flexibility scorecard arose several times in the literature and interviews. A simple additive model of key components can provide a quantitative value; however, the ranking of those attributes proves vastly more difficult when considering the different options. The model assesses flexible attributes for the decision maker to consider. The model relies heavily upon the input from decision makers. They will need to develop an internal condition of each element. This model merely represents key themes and attributes based upon the interviews conducted with commercial and government personnel familiar with large-scale modernization projects.

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**The scorecard method relates ROI and timeline to one another and is a direct result of developing option comparison criteria. The scoring of projects in this method is an attempt to judge their executability and directly pulls from several attributes within the topic of executability. The timeline and ROI commonly rank at the top of an option comparison list and judge whether the organization can truly execute the proposed project.**
The model framework builds off the three themes. Each question can be answered yes or no and provide guidance for areas to consider improving flexibility. There are not specific values assigned to rank projects because doing so is subjective to the decision makers. Rather this model provides a framework of considerations for decision makers to assess if flexibility can be designed into warehouse modernization efforts across the Air Force and DoD. There are feedback loops, but it is shown as a straight line process for simplicity. The physical design and organization structure questions can and will most likely occur correspondingly. Neither one is prioritized over the other and dependent upon the organization utilizing the framework. Finally, the third column helps decision makers determine their ability to carry out the proposed project.

Prototype

The idea of prototyping modernization efforts allows for decision makers to start with a past success. Starting at this point then allows them to adjust based on the specific criteria for that specific project. Responders overwhelmingly rely upon industry leaders to develop and smooth technologies and processes. Judging whether a project has been completed within the industry will reveal its ability to provide the required benefits with a lower risk. The more proven out a technology or improvement is, the more flexible responders judged it. Many respondents in the commercial sector attested to their own company’s ability to benchmark and prototype methods for modernizing within its own organization. Examining Real Options Exercise Decisions in Information Technology Investments. Journal of the Association of Information Systems, 18(S), 372–402. The prototype or benchmark gave decision makers a platform to begin with and adjust depending upon specific location requirements. Having a model to work from provides shorter design requirements and more agile decision-making abilities. A commercial responder stated of his company, “We put together a prototype because we didn’t know exactly what we would need but we had an idea so that each one would be somewhat interchangeable at least. Going forward that became the prototype for the whole company.” If the modernization project is well benchmarked or prototyped, then its overall assessment of flexibility would be more favorable.

Figure 1: Flexibility Framework

<table>
<thead>
<tr>
<th>Physical Design:</th>
<th>Executability:</th>
<th>Organization’s Environment:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you have flexible physical designs?</td>
<td>Can your project meet the required timeline?</td>
<td>Is your organization set up to support flexible projects?</td>
</tr>
<tr>
<td>Are there benchmarked designs or prototypes?</td>
<td>Is the return investment sufficient?</td>
<td>Can your organization make purchasing decisions at the local level?</td>
</tr>
<tr>
<td>Do you have a truly phased approach?</td>
<td>Does your organization have strong relationship with vendors?</td>
<td>Does your organization aligning its projects with its end goals?</td>
</tr>
</tbody>
</table>

Phased Approach

A common theme amongst the commercial sector and literature from de Neufville (2011) was a phased approach. The government responders believed in a phased approach but only in so much as there were several phases of the overall project execution. The commercial sector relied upon the ability to continue or cease the overall project at the completion of each phase for flexibility. With this knowledge a prudent decision maker can gain benefits from considering these top attributes to provide flexibility: timeline, phases, design, net present value or discounted cash flow, and benchmarked success.

Local Purchasing Power

Throughout the research many responders commented on the level of purchasing power within an organization. The lower the level of purchasing power, the more rapidly an organization could respond to developing technologies, benefits, or avoidance of overages. The larger the chain of command between purchasing power and execution, the larger the timeline for decisions and often larger cost for mistakes or missed opportunities. Delegating portions of purchasing ability to the lower levels allows for more flexibly designed execution of projects. In turn this affords the lower-level expert team the power to maximize the return on investment.

Vender Relationships

Maintaining a small pool of vendors or suppliers consistently allows for relationships between the buyer and supplier. The chain becomes a symbiotic relationship where each is working to benefit the other because it will eventually benefit them. Strong, repeated relationships pass information quickly. They adapt to arising situations with the other organization’s benefit as a core driving factor. If the organization has strong relationships with its supply chain, then it will flexibly alter its course more efficiently and successfully.

End Goal Alignment

The modernization project for each organization must directly improve or strengthen the end goal of that organization. Aligning decisions to goals can maximize value and allows decision makers to directly evaluate investments. As decision makers evaluate options, they can consider different phases and options for their project. Each option should improve their end goal metrics as defined by the organization. Furthermore, the end goal alignment will provide criteria for option comparison not only from the onset of the project but throughout its development and execution.

Timeline

The timeline can be viewed as a strength. An elongated timeline allows for further design development and goal alignment while letting the technology develop within the industry. The assessment would be whether or not the agency can reap benefits during the timeline of the project. If the timeline is short, then the flexibility will most likely be lower and thus a lower score should be given. A longer timeline, if cost-free adjustments can be made during it, should give a higher score allowing more decisions and changes prior to execution. The phased approach relies on the ability to break decisively between stages of the overarching project. The modernization of an entire distribution center could be segmented in order to invest smaller individual amounts and potentially reach the 80% benefit sufficient to stop the project.

Return on Investment

An evaluation of investment consistently touts the largest consideration by decision makers. It must be included to weight the score. A short and long-term view of investment should be considered. The money invested or set aside early on for one project but not “costed” until later in the project could potentially earn benefits elsewhere. Understanding the value of money long-term will help when considering a truly phased approach. If the project is broken into smaller projects, albeit costlier individually, then the investments can be spread across more platforms or a longer timeline. The division of investment allows decision makers a more diverse and flexible option for project continuance or scission.

Criteria for Evaluation

The organization and decision makers specifically, need to have an upfront understanding of their evaluation criteria. The quantitative comparison categories that will be judging the project’s phases must be laid out to properly assess the outcome. Without an understanding of critical components and values there will be no determining factors to flexibly plan a course of action. Using valued components from the overall goal and strategy should provide a starting point for decisions to be evaluated.
CLOSING REMARKS
The EDC requires modernization to maintain the Warfighter support that DLA demands. The facility and project can be used as a beginning template for the DoD to model further modernization prototypes. The decision makers can plan for flexible options within this project that allow them to capture the most value for the least cost. It will require investments, expertise, and time. Through proper evaluation of design, organizational factors, and executability, DLA can flexibly adapt to some uncertainties. DLA and the DoD can further improve upon their initial modernization as they move forward. Keeping their end goal in sight at all times, they can support the Warfighter while flexibly designing modernization efforts across the enterprise.

REFERENCES
While this pattern fits with the needs of past NDS iterations, we cannot let ourselves think that these exercises are how an “inter-state strategic fight” would unfold. We must prepare ourselves to fully empower our Airmen and ready our installation’s capabilities to absorb the operational shock of a more dynamic scenario.

The NDS is clear: the primary focus of the Department of Defense is to be READY for whatever may challenge our lethality – whether it is an inter-state strategic competitor, disaster response, or some other challenge to base security and defense. We must evaluate how units prepare for this. It may be difficult to conceptualize the thought of going from steady state operations to a high-intensity strategic conflict overnight. However, it is important to keep in mind that the concept of Phase III is not preparing for a major war; it is about the entire concept of absorbing operational shock. A Phase III exercise can be built around any operational military or disaster response scenario. The key is to develop ready, resilient Airmen who are capable of facing the operational shock of the initial series of events without breaking the base.

The Installation as a Weapons System

Airmen assigned to JBER will tell you that a massive natural disaster challenging our readiness is not inconceivable. JBER experienced a 7.0 earthquake on 30 November 2018, and since then we have experienced more than 4,500 aftershocks that threaten our mission resiliency. Any Airmen stationed along the Southeastern coast knows the importance of the installation when executing hurricane evacuation plans. These sudden and operationally shocking events occur with little or no warning. As logisticians, we must treat our installations, and the agile combat support capabilities they provide as weapons systems. This will enable us to deliberately plan how we make our Airmen, processes and infrastructure agile enough to absorb numerous levels of operational shock.

This process starts with developing our Airmen’s leadership abilities. In these large scale scenarios, we need effective mission leaders who can quickly respond to the ever-changing situation and adjust focus accordingly. The 673d Logistics Readiness Group Superintendent, CM Sgt John Smith believes that, “You can bet Murphy will have a say in what you are doing. NCOs must understand that mission priorities will change daily, sometimes instantly, and they have to be ready to adjust fire rapidly when necessary to address new, unexpected challenges.” Phase III exercises focus on this mindset, and enable leaders to develop Airmen who are ready and empowered to act in a variety of situations.

Treating our installations as weapons systems will help drive the way we think, and shape how we exercise our capabilities to better perform our operational resiliency and readiness. Going beyond the traditional Phase I and Phase II exercises will present an opportunity to focus on the specific and implied mission tasks that may arise during a sudden operational shock. Whether an installation faces a contingency response, natural disaster or base defense scenario, it is important to train with a Phase III mindset because each installation will still have an agile combat support mission to execute after we deploy our tasked forces. The installation weapons systems must be ready for whatever that scenario will be. Exercising in this capacity will push decision making, risk management, critical thinking, and mission command skills down to the lower levels of your unit.

Going further, it is important that we prevent Phase I, II, and III labels from nulling our Airmen into a chronological event mindset. The concept of Phase III allows us to consolidate instances where multiple scenarios collide in an unpredictable chain of events. Think back to the DCC scenario, the team had started to deploy forces across the theater (Phase I), but the situation dictated a mindset shift from initial deployment to the operational shock of full-scale conflict in a rapidly changing and dynamic environment (Phase III). In Col Csánk’s words, “we may deploy and accomplish the mission in contested areas downrange, but the home station mission will persist and likely morph.” When these scenarios happen in the real world, your wing may have significant portions of the team at RED FLAG, or a similar TDY off station. Or, you may have just sent 20% of your Airmen on an AEF rotation. Despite these obstacles, what matters is how the Airmen on the ground, at that moment, can respond and adapt to the challenges ahead.

How to Build a Phase III Exercise

The traditional way of thinking about an exercise is rooted in looking at the unit’s most stringent O-Plan tasking, and testing whether the installation could meet that requirement. The Phase III concept goes a step further, by asking, “what’s next?”

After the Airmen and equipment have deployed in support of the conflict at hand, we must focus on the resiliency and readiness on the installation so that we do not break the base. Installation requirements will continue, and the Phase III concept looks at this and identifies the gaps and blind spots in the planning process. This forces installation leaders to examine where we may break, and how we can mitigate those risks to the mission. Deploving to a contingency is one thing, but staying ready is another. One of the answers we have started to pursue at JBER is the concept of cross-functional Airmen; members able to perform tasks outside their core AFSC. This concept will enhance the effectiveness of our Airmen on the base, and be ready to fight. Another area we addressed was local contract support. We looked at vendors in and around Anchorage to fill potential gaps in food services, shelter and other joint logistics requirements that may arise during a contingency. Finally, we are revamping the Wing’s Base Support Plans. According to Maj John Harding, 773d Logistics Readiness Squadron Commander, it is important we organize how we capture our capabilities, “As a mission partner on JBER, it's essential we have a common understanding of the installation's joint requirements. The 673 ABW is a weapons system that offers the Joint Warfighter a wide range of agile combat support options. As we deliberately exercise them, it is important that we also consolidate the installation's capabilities into a compressive Joint Base Support Plan.”

The concept of Phase III will look different for every base, and for every unit. However, the principle theme will remain the same: as logisticians, we must be ready to execute our deployment mindset in your installation as the base as an effective weapon system. For Col Csáňk and JBER, this centers on “making our Airmen resilient, mission ready, and deliberately training our people to be exceptional leaders.”

When looking at these scenarios, the response is paced off the ability for logistics and base support to handle the operational shock. As logisticians, it is essential we advocate for an installation level O-Plan review that examines what happens when you pace every action off the ability for the installation to support it. If you deploy all of your Airmen tasked to that O-Plan, could you still support your remaining and follow-on mission sets with logistics, maintenance, engineering, security, services, medical, etc.?

We need to organize, train, and equip ourselves to initiate a rapid and effective response. This is not just for the Port Dawgs pushing pallets, or the Knuckle-Busters generating sorties, this is true for every installation. If we are to execute the 2018 NDS, we must be more agile and ready to respond to a large scale conflict. This begins with the truth that the USAF must redefine the installation as the weapon system...the pacing unit that enables all other missions. When lives depend on a rapid and agile logistics response, will your installation be ready?

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Troop Support Event Poses Question: How and Where Can Blockchain Help?

By: John Dwyer III

During the 2017 hurricane season, the Defense Logistics Agency Troop Support provided approximately 41,000 power poles, 88.1 million meals and 1.264 generators in partnership with the Federal Emergency Management Agency. Responding to three major hurricanes was a record undertaking for DLA, and the mission was a success. But could the use of blockchain technology improve DLA’s support even more? That was the question posed during a two-day presentation hosted by Troop Support’s Continuous Process Improvement (CPI) office from Dec. 3-4 in Philadelphia. CPI leaders, by direction of the Commander, Army Brigadier General Mark Simerly, reviewed Troop Support’s processes during their response to Hurricane Maria and recovery operations in Puerto Rico. After review, the CPI office presented how blockchain capabilities could have improved efforts. “We think there’s a lot of potential in blockchain,” CPI management analyst Elijahondo said. “Where do we want to be as an organization in shaping and influencing where the [Department of Defense] goes with blockchain?”

CPI process director Daniel Keenaghan described blockchain as a digital, decentralized “distributed ledger” where identical copies of data are stored across multiple servers. Changes to the data, or “blocks”, such as updates to the ordering and delivery tracking information key to DLA’s logistics processes, are linked in a “chain” that builds trust through peer-user validation within the chain. Changes are immediately viewable by all peers with access to the block of data, improving transparency and auditability of agency transactions. Currently, processes are tracked through systems and databases that are centrally managed by one agency or another. Visibility can be challenging at times, and stakeholders have to synchronize data to make sure they are all tracking accurate, up-to-date information.

To help answer whether blockchain could have helped, Construction and Equipment (C&E) deputy director Marko Graham used a process map of C&E’s actions linking FEMA, the Army Corps of Engineers, Troop Support, and industry partners—key stakeholders who would be peer users in a blockchain scenario—to review where this technology might improve associated logistics processes. Graham shared some challenging points in the process and how C&E worked through them, such as the efforts that went into the maintenance of an internal spreadsheet tracking requirements sourced through multiple vendors as items are purchased and delivered. He then discussed these points using blockchain capabilities like transaction processing and in-transit visibility of shipments to evaluate the process improvements. “This is where I can see where blockchain would have been a big help,” Graham said. “Flowing [materiel specifications and tracking data] from the manufacturer buying the raw materials to…getting the transportation and getting it on the barges.”

According to Londo, the potential of blockchain technology exists. “The potential is absolutely enormous,” Londo said. “Talk about blockchain, and you’ll hear experts comparing it to transforming trust or transactions in the same way the internet changed communication. Other agencies and countries are also looking into this technology.”

Keenaghan referenced US and foreign agencies already experimenting with blockchain. Craig Fischer, for example, is program manager with the Department of the Treasury’s Financial Innovation and Transformation Office. Fischer provided Keenaghan lessons learned from a blockchain pilot he conducted for equipment accountability, an application useful to any government agency. Keenaghan also shared that the United Arab Emirates has set a goal to have 50 percent of government transactions processed via blockchain technology by 2021. However, it’s still a while until the technology can be put to use at DLA. “We’re researching the technology,” Londo said. “[We’re] getting as smart as we can about what it is, what industry is saying about it, what the future might look like, how it applies to supply chains, and how other industries are using it. We’re doing our due diligence.” Simerly’s plan is to take the research as it applies to the hurricane response, a “use case”, and provide information for DLA to justify and apply research and development efforts with blockchain. A restoration of power to Puerto Rico is a mission success, but advances in technology offer potential improvements to what Keenaghan says is “already amazing work.”

That’s what the CPI office is after through their evaluation and coordination with government and industry partners, such as the U.S. Transportation Command and container shipping giant Maersk, who are already experimenting with blockchain technology. “There’s really no shortage of players out there,” Londo said. “At the very least, it’s a collaboration and knowledge share. And at its best, it’s actual partnerships and pilot opportunities.”
Resilient Sustainment
By: Dr. Daniel W. Steeneck & Maj Timothy Breitbach

Supply Chain Disruptions
Seasoned supply chain managers know that supply chain disruptions are going to happen. The devastation at Tyndall Air Force Base due to Hurricane Michael is the most recent example of how catastrophic events can wreak havoc on operations, but as a large organization with activities across the globe, recent history in the DoD is littered with disruptions—and not just those of a natural type. A September 2012 attack on Camp Bastion destroyed or damaged nine U.S. Marine Corps AV-8B Harriers (1). On the technical side, Air Force generation of combat sorties has been disrupted due to fleet groundings from safety concerns and common parts failures. Recent examples include F-15s grounded at Kingsley Field for structural issues and hypoxia challenges across three different airframes—the F-22, F-35, and T-6.

The challenge of dealing with supply chain disruptions are not unique to the military. For example, a 10-minute fire in an Albuquerque, NM semiconductor plant “shifted the balance of power between two of Europe’s biggest electronics companies” and has become a classic supply chain case study (2). Though the negative effects of supply chain disruptions are known, many organizations find themselves woefully unprepared when these disruptions occur.

One challenge is that forecasts based on historical information may not predict the full range of possible future disruption types, timings and severities (4). While there may be uncertainty surrounding the exact nature and timing of the disruptions, we can model the consequences of disruptions across a wide range of possibilities, and we can test how different supply chain designs perform against those consequences. Responding to this challenge of preparing for low-probability, high impact events, we are exploring the concept of resiliency (4). Along with a team of students and other researchers at the Air Force Institute of Technology (AFIT), we are addressing the critical issue of sustainable sustainment by asking the following questions:

1. How can supply chain resiliency be quantified?
2. What operational strategies can be employed to improve resiliency?
3. How should sustainment networks be designed for resiliency?
4. How much does resiliency cost?

To answer these questions, we draw from academic, commercial and government sources to develop useful insights for Air Force decision makers. First, we explore what resilience means and how different strategies affect resilience. Then, we discuss supply chain strategy and the logic behind building resilient, but affordable networks. Finally, we show model results that use representative data from the Pacific Air Forces (PACAF) Theater to demonstrate how the supply chain responds to disruptions.

Quantifying Resilience
While definitions abound for the term resilience, we find that the USAF definition is sufficient: “the capacity of a force to withstand attack, adapt, and generate sufficient combat power to achieve campaign objectives...despite disruption whether natural or man-made, inadvertent, or deliberate.” Another way to put it is that a resilient military system both (1) resists any change in performance due to a disruption and (2) recovers quickly from a disruption. These key concepts are illustrated in Figure 1, in which resistance is determined by severity of the initial dip in the performance graph and ability to recover is indicated by how performance graph increases after its minimum.

Visibility of disruptions is the ability to quickly know that a disruption has taken place. One goal of the Air Force Repair Network is to provide “enterprise visibility of like repair capabilities” so that throughput can be improved (11). One of General David L. Goldfein’s key initiatives is to have a common operational picture for the decision maker, so that we can make decisions at a speed our adversaries cannot match (12).

Adaptability deals with the ability of a supply chain to modify or change operations in response to some type of disruption. This could include shifting combat sortie generation to another base or even another service while the disrupted base recovers. Reduction of lead times has been identified as one way to add adaptability to the supply chain.

Anticipation involves the ability to forecast or discern future threats or disruptions. Big Data and Artificial Intelligence (AI) promise to help improve risk anticipation. In fact, former Deputy Defense Secretary Bob Work invested heavily in this effort with the stand-up of the Algorithmic Warfare Cross-Functional Team. The team was stood-up in April 2017 to leverage AI to maintain situational awareness on the battlefield (13).

Recovery is the ability to return to normal state. Some ways to expedite recovery are based on the ability of the service to manage a crisis, communication, and the ability to mitigate a disruption before damage becomes wide-spread (10). For example, Repair Network Integration supports AF repair network recovery through routine communication between node and product repair group managers. This enables high visibility, and therefore quick resolution of repair network issues.

Dispersion involves the distribution of aircraft and repair capability. Here, the adage “don’t have all your eggs in one basket” applies. For example, the attack on Marine Corps’ Harriers shows what happens when aircraft are not dispersed. Granted, this is difficult to do in some locations (1). Also, it is interesting to consider that the trend toward centralization for efficiency’s sake is at odds with dispersion. This tradeoff is one that we seek to model to provide decision makers more accurate information as to the cost and value of efficiency versus effectiveness.

Visibility
d oth supply chains: in-theater capacity reduces lead times, but also creates the excess capacity presents a unique trade-off for military systems, as Lieutenant General Lee K. Levy II mentions in a recent ER article, (8). Additionally, deciding where to locate repair capacity. Here, the adage “don’t have all your eggs in one basket” applies. For example, the attack on Marine Corps’ Harriers shows what happens when aircraft are not dispersed. Granted, this is difficult to do in some locations (1). Also, it is interesting to consider that the trend toward centralization for efficiency’s sake is at odds with dispersion. This tradeoff is one that we seek to model to provide decision makers more accurate information as to the cost and value of efficiency versus effectiveness.

Adaptability 

Anticipation

Recovery

Dispersion

Visibility
Network Design and Resilience

In an idealized setting, a network would never be subject to a disruption. In this case, from an efficiency standpoint, the network would have a few nodes of extremely high degree (called hubs), and many nodes of very low degree (see Figure 2a). This is called a scale-free network structure (Barabási, 2016). Additionally, in many applications hubs enjoy economies of scale and therefore are overall more efficient at performing work than other, more distributed alternatives.

The disadvantage of scale-free networks is that they are susceptible to targeted disruptions (Barabási, 2016), i.e., attacks made by an intelligent adversary who has knowledge of the network’s structure. Specifically, an adversary would target the hubs. However, scale-free networks are extremely resistant to random disruptions, i.e., disruptions that are equally likely to affect any node of the network.

On the other hand, network structures with fewer hubs, such as random networks (see Figure 2b) are more resilient to targeted attacks since very few, if any, nodes contain a disproportionate number of connections in the network. However, these network structures are less efficient than scale-free networks since they do not have the same economies of scale without hubs.

The Resiliency Dilemma

Many supply-chain scholars have concluded that a more cost-effective approach is to build a resilient supply chain rather than prepare for specific events or disruptions that have a small probability of happening. Lt Gen Levy highlighted this conundrum in a recent ER issue when discussing the criticality of the sustainment function (6). He added that the Air Force no longer has the capacity it once had to surge to “a diminishing defense industrial base, scarcity of natural resources, and the gap in Science, Technology, Engineering, and Mathematics (STEM)-based human capital” (8) which is both increasing risk and exposing vulnerabilities in “the logistics kill chain” (8).

Furthermore, current operations are “burning up weapons and ammunition at a ferocious rate, far beyond what the highly consolidated and fragile US defense industry can produce” (9). Complicating this problem even more is that congress is reluctant to pay for weapons that may be never used. Lt Gen Levy ends his article with a challenge for the Air Force to “think about and make improvements to our supply chains, maintenance processes, and our ability to project requirements” (8).

With respect to resiliency, AFIT is looking into the following set of questions:

- Are we resilient enough?
- How resilient should we be?
- How can the Air Force properly measure resiliency?
- If one or more Air Force bases was incapacitated or destroyed, what would be the impact on our ability to conduct operations in the theater?
- How can we design resiliency into the supply chain to better plan for disruptions that are difficult to forecast?
- What are the tools Air Force leaders have available to build more resilient supply chains?

A PACAF Case Study

While this case study is a work in progress, AFIT faculty are developing a simulation that measures resiliency and begins to answer the questions listed above. We focus on the Pacific Theater because of its geographic size and limited number of bases. Building resilience into such a supply chain is particularly challenging.

The Air Force repair network is a multi-echelon supply chain. At the top-level, it consists of several Air Force Logistics Complexes (ALCs) which perform specialized and equipment intensive types of repairs/rebuilds of engines, avionics, landing gears, and other repairable aircraft components. Some ALCs, e.g., Ogden ALC at Hill AFB, have satellite repair centers in forward operating locations such as the Supply Center Pacific (SCP) at Kadena AB, Japan. The SCP was set up to provide faster support to bases in the geographic region for which PACAF is responsible. Furthermore, for engine repair, there is a CF, which acts a hub in the network. In addition, the repair network consists of back shops that perform intermediate-level repairs.

A healthy repair network is critical to sustaining operations. However, this network is vulnerable to offensive actions by an adversary (targeted) or other disruptions such as manmade or natural disasters (random). For example, loss of, or diminished capability at the SCP would require affected workloads to be shifted to other facilities at great cost in both time and money. Additionally, lead times, shipping costs, and inventory costs for replacement parts would increase to maintain the required throughput of repair parts.

Furthermore, we must acknowledge that the likelihood of random and/or targeted disruptions depend on if the Pacific theater is at peace or war. During peacetime, an efficient repair network is desirable. However, during wartime a more robust and resilient, albeit less efficient, repair network is needed.

Figure 3: Example Repair Network Simulation in Simio®

How do we Study and Measure Resiliency?

Simulation is a tool well suited to gain insight into how network design decisions impact resiliency. We start by setting up a supply chain in Simio® with four bases, two centralized repair facilities, a depot, and appropriate links between them. The simulation produces broken engines via a statistically representative process intended to capture the historical engine break rate we would expect during combat operations. The maintenance teams install a spare engine or wait for the broken one to be repaired per the established rules for intermediate versus depot level maintenance.

When the engine is repaired, it is installed on the aircraft to make it mission capable again. The simulation can measure the mission capable rate over time as well as the average flow time (break to installed) for an engine. A picture of the model repair network is shown in Figure 3.

The notional results show some promise in that it’s feasible, and perhaps useful with the right data and operational insight, to measure effectiveness of different supply chain designs. The competing designs have an incremental investment value attached to them, thus a return on investment in terms of mission effectiveness metrics, could be at least be proposed given accurate cost data and mission requirements.
Initial Notional Results

The chart in Figure 4 shows a typical performance pattern in any system that becomes tight on capacity following a disruption. Prior to the disruption, we see that there are peaks and valleys of operational capability due to normal system variation. This is to be expected, and the fluctuations are indicative of a highly complex supply chain with high variability. With very little buffer capacity the system cannot respond to the normal variation in engine breaks and repair times. Then, following a period of normal activity, a disruption was simulated at Day 300. The disruption took a repair facility offline, thus reducing sustainment capability.

As Figure 4 shows, the up cycle was cut short and the down cycle was exacerbated. In this case the system pulled out of the nose dive but the new average is well below the normal capacity average. The number of mission capable aircraft in the system has been reduced. Figure 5 shows why: engine throughput drops off after the disruption.

The results above are simply estimates. Though realistic and useful for generating insights into how Air Force repair networks function, they are not interpretable without the context of parameters like break rate, repair times, repair capacity, transit times, and other policy decisions. With that context and proper data input, analyses could be performed to make actual decisions as to where we should add maintenance flexibility, excess capacity, adaptability, and dispersion assets. These decisions could lead to a network design that yields the greatest resiliency. With a cost model behind each potential network design, the investments can be compared against performance.

Conclusions

As Lt Gen Levy stated, building a more resilient supply chain network depends on the critical thinking skills of future Air Force leaders. With our adversaries nipping at our heels, and the sky rocketing cost of high tech weapon systems, now is the time to think critically about improving our military supply chains. We at AFIT are looking for sponsors, data, and people passionate about logistics to help build this case study so that senior leaders can answer important strategic questions regarding building resiliency in the Pacific and across the Air Force.

ABOUT THE AUTHORS

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On January 19, 2018, then Secretary of Defense James Mattis delivered a press conference introducing the National Defense Strategy (NDS). A departure from previous editions, the 2018 NDS warns that “We are emerging from a period of strategic atrophy,” and “inter-state strategic competition, not terrorism, is now the primary concern in U.S. national security” (Office of the Secretary of Defense, 2018, p. 1). The strategic document calls for “accelerating our modernization programs and devoting additional resources in a sustained effort to solidify our competitive advantage”—naming “Resilient and agile logistics” as a priority (Office of the Secretary of Defense, 2018, pp. 6-7). Unless Air Force supply chain professionals—including logistics readiness, maintenance, acquisitions, and contracting personnel—have a fundamental understanding of how base-level, wholesale, and acquisitions processes work together, the resiliency and agility called for within the NDS will not be possible. This article advocates for establishing a 2-week in-person training that connects these functions to improve the resiliency and effectiveness of the supply chain enterprise.

While logistics has always relied on information technology, the need for this advocated training is borne of the increasing threats posed by near-peer competitors, particularly in the cyber domain. Reliant on more than 43 individual software systems, the Air Force supply chain functions because of data transfer through a complex network that few understand from end-to-end. The many threats posed by offensive cyber effects create operational vulnerabilities, such as those within the Global Air Transportation Execution System (GATES) described by Major Anthony Mollison in his 2015 paper “Fighting Through a Logistics Cyber Attack.” The potential disruption or degradation of these systems will result in delayed parts deliveries and impact weapons system readiness.

While centralization creates a more cost effective supply chain, it also increases vulnerability for degradation. To succeed in a cyber-contested environment, logistics must understand how the many organizations within the supply chain work together to reach back in support of warfighters.

In the face of such threats, the Air Force needs to train supply chain personnel to have a clear understanding of how the enterprise is integrated. This training would enable the supply chain to adapt when faced with systems degradation and to effectively prioritize as units come back online. This would ensure rapid return from degraded system functionality, minimizing lost transactions. Sister services also recognize the need for precautions in cyber-contested environments. The Army recently set a goal to “double the standalone sufficiency” of its brigade combat teams—acknowledging that cyber attacks may increase the time before forward deployed units are resupplied (South, 2018). Such steps are necessary to ensure operational effectiveness moving forward and to deliver the resiliency and agility called for in the NDS.
In addition to operational necessity, the design of the Air Force supply chain and recent organizational changes highlight the need for this training. In his Strategic Policy Fellows paper titled “The Enterprise: Integrated Life Cycle Management,” Major Samuel Payne, Jr. describes how the Air Force balances acquisitions and logistics functions between two distinct offices, which are usually combined under industry definition as a “supply chain” (Council of Supply Chain Management Professionals, 2018). While the Secretary of the Air Force staff manages “acquisition and contracting professionals,” policy for product support, and the supply chain, Headquarters Air Force personnel are responsible for “logistics readiness, maintenance, and aerial port personnel”—including organizing, training, and equipping as well as developing and implementing logistics policy (Payne, 2012, p. 18). Additionally, in 2001 the Air Force consolidated some base level logistics functions such as material management, transportation, and distribution into Logistics Readiness Squadrions (LRS) (Johnson, 2002). In 2008 and 2010, further consolidation occurred when functions traditionally managed at the base level were centralized in the 448th Supply Chain Management Wing (448 SCMW) and the 635th Supply Chain Operations Wing (635 SCOW) (Haulman, 2016; Robertson, 2014). These reorganizations resulted in manpower savings but restricted base level capabilities. For example, the management of stock control, which is an organization’s authorized-on-hand quantities of specific parts, was transferred from the base level to these supply chain agencies. While centralization creates a more cost effective supply chain, it also increases vulnerability for degradation. To succeed in a cyber- contested environment, logisticians must understand how the many organizations within the supply chain work together to reach back in support of warfighters. These organizational changes required maintenance and logistics readiness personnel to have an enterprise-level understanding to communicate mission impact and identify problems, as logisticians closest to the mission require a common, base-line understanding of organizational roles and responsibilities as well as the enterprise-level processes crucial for ensuring mission accomplishment.

The above chart reinforces this need for greater supply chain expertise in the field, as it shows the overwhelming majority of Materiel Management and Deployment, Distribution, Transportation personnel had under 5 years’ experience as of 2017. Efforts are underway to increase this experience, but they will not solve the problem. For example, recent efforts to robust the Advanced Logistics Readiness Officers Course (ALROC) will not be effective due to its limited annual number of available seats and requirement to cover a wide variety of core competencies. Major Payne highlights how “The lack of a centralized [Integrated Life Cycle Management] curriculum means each career field expects its professionals to understand the entire enterprise; however, [current courses] fail to provide the necessary education and training to assist in this understanding” (2012, pp. 21-22). While the structure of the Air Force supply chain is capable of “resilient and agile logistics,” the design requires supply chain personnel to have a common, base-line understanding of organizational roles and responsibilities as well as the enterprise-level processes crucial for ensuring mission accomplishment.

To provide this enterprise-level understanding across the supply chain, the Air Force should establish a supply chain enterprise course (SCEC) targeted specifically for experienced logistics readiness (21B), maintenance (21A and 21M), and acquisitions (63A) CGOs as well as their civilian and SNCO counterparts. The Air Force Institute of Technology’s Enterprise Logistics Course (Log 420) covers many topics that need to be addressed in the proposed SCEC—such as financial mechanisms in logistics, demand forecasting and planning, sustainability, maintenance, logistics systems, and more (Air Force Institute of Technology, n.d.), but it’s currently offered to only Lieutenant Colonels and civilians in the GS-14/15 grades. Additionally, given the thousands of mid-level managers who work within the supply chain, the SCEC should provide hundreds of seats on an annual basis.

While the number of students proposed may seem audacious, other Air Force courses have demonstrated similar models work. For example, the Contingency Wartime Planning Course (CWPC)—offered by the LeMay Center—trains nearly 700 students on an annual basis (LeMay Center for Doctrine Development, n.d.). Incorporating both large lecture and classroom seminar formats, this course provides key context on deployment system mechanisms to war planners on command staffs, installation deployment officers, unit deployment managers, and others involved in planning and deployment execution. These large classes draw together a diverse set of personnel who work together in support of future contingencies. Like CWPC, the Installation Deployment Officers Course, and the Transportation Fleet Managers Course, the SCEC would provide an important networking opportunity for supply chain professionals as well as an enterprise perspective on how the supply chain works. In addition, the SCEC would promote cohesion across the career field specialties and between the base- and wholesale-levels of the supply chain.

There are several second and third order effects of creating the SCEC as described. Providing this training would unify supply chain personnel to deliver necessary resources to the warfighter in accordance with supply chain best practices. Additionally, this training would equip personnel across the supply chain with the required knowledge to ensure strategic priorities (such as demand data accuracy) are realized at the tactical level within the supply chain. With the enterprise perspective in mind, logistics and acquisitions professionals would be capable of enterprise-wide networking and collaboration. Long-term, this knowledgebase would enable personnel to innovate within the supply chain—an area described by the Government Accountability Office as “high-risk” and in need of improvement (U.S. Government Accountability Office, 2017). These effects—cohesion, unity of effort, and innovation within the supply chain—are required to achieve the logistics described in the NDS.

**With the enterprise perspective in mind, logistics and acquisitions professionals would be capable of enterprise-wide networking and collaboration.**

While a necessity, establishing the SCEC on the scale described comes at a cost. Using CWPC as a model and assuming 700 students each year, SCEC operating costs would amount to approximately $1.96 million annually (Benton, 2018). While this course would recoup some costs in the form of gained efficiencies within the supply chain, the substantial price tag associated with offering training on this scale comes with risk. To mitigate this, the Air Force could implement two supplemental alternatives immediately and at low cost while senior leaders can program resources in support of creating a SCEC. First, the Air Force Institute of Technology should organize existing distance learning programs in a sequenced, end-to-end sustainment suite. Once consolidated, senior Air Force logisticians need to prioritize accomplishment of this suite among mid-level managers within the supply chain.
In conclusion, expanding enterprise logistics training to personnel across the supply chain is worth the investment to achieve the resiliency and agility called for in the 2018 NDS. As the document recognizes, failure to act will critically impact “our military advantage” (Office of the Secretary of Defense, 2018, p. 1), particularly in the face of unprecedented cyber threats. Many giants of military thought have described the crucial role of logistics in war. In future conflicts, the speed of the supply chain will require a well-trained team of professionals with strategic awareness. Logisticians with an effective understanding of the supply chain will make it more resilient during anticipated cyber degradation in a conflict with a near-peer adversary. We need this course to make that a reality. Valuable at any point, this training would have more effect if supply chain professionals have the appropriate management experience.

The views expressed are those of the author and do not necessarily reflect the official policy or position of the Department of the Air Force or the U.S. Government.

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About THE SYMPOSIUM
The Logistics Officer Association (LOA) Symposium is this year’s premier event dedicated to enabling interactive exchanges among logistics, acquisition and technology professionals from across the Department of Defense, defense industry and academia. While there is continued focus on Leadership, Innovation, Velocity, Excellence (L.I.V.E.), the 2019 LOA Symposium will focus on “Increasing Lethality Today, Readiness for Tomorrow’s Fight” which will offer a forum where logisticians at all levels of leadership can collaborate to discuss challenges of operating in a dynamic global defense environment and brainstorm solutions to overcome them.

For a moment, imagine yourself as the pilot of a C-130 Hercules which you are preparing to land with a full load of cargo. On approach, you extend your landing gear and touch down with the rear wheels first, keeping the front up and the nose landing gear off the ground. As you ease the nose of your aircraft down and the front gear makes contact with the ground, the axle and wheel assembly break away and the underbelly of your $150M aircraft impacts the runway at over 100 knots. You finally skid to a stop and exit the aircraft to the noise of sirens as crash and recovery personnel respond to the ground emergency. After a thorough investigation, it is determined that a counterfeit front axle, which was made using inexpensive steel, had entered the Air Force supply chain and had recently been installed on your aircraft. How could this have happened? The axle looked like the real thing. It was installed correctly and was a perfect fit. Additionally, its record showed that the raw materials used came from approved sources, and it was built by a reputable manufacturer. Shouldn’t there have been a system in place to prevent a counterfeit part from traveling through the supply chain?

Counterfeits…A Real Problem
Counterfeit parts have found their way into every branch of the DoD and pose a huge threat to our national security. A 2012 report released by the US Senate Armed Services Committee, a congressional investigation found that in the Air Force alone, bootleg parts have been identified in aircraft produced by Boeing, Lockheed Martin, and Sikorsky—in other words, they impact the major Air Force Original Equipment Manufacturers (OEMs). In total, 1,800 cases of counterfeit electronic parts were uncovered in items ranging from night vision equipment to Global Positioning System (GPS) navigation modules. In response to these findings, the Committee adopted an amendment to the FY12 National Defense Authorization Act (NDAA) to “address weaknesses in the defense supply chain and to promote the adoption of aggressive counterfeit avoidance practices by DoD and the defense industry.”

As a follow-up, a 2016 Government Accountability Office (GAO) report found that while the number of counterfeit parts in the DoD supply chain decreased significantly between 2011 and 2015, there were still nearly 50 parts per year that were identified as being counterfeit. As a percentage of total parts, this was a mere .006% of the DoD supply chain. However, as the opening scenario illustrated, a single counterfeit part can have a disastrous impact on the Warfighter, and identifying counterfeit parts is extremely difficult when they are deliberately manufactured to pass as the “real deal”. Moreover, the threat of counterfeit parts being introduced by US adversaries is thought to be increasing, and these subversive agents are good at figuring out ways to make their counterfeits blend in with other components.

This article outlines the problem associated with counterfeit parts in the DoD and will explore using blockchain technology platforms to address it. Blockchain platforms are one of a number of potential solutions being investigated by researchers at the Air Force Institute of Technology (AFIT) to address the supply chain security problem. Blockchain technology can improve the likelihood that transactional records associated with critical parts are valid and increase the traceability of parts across the supply chains. This article will explain blockchain technologies in their current form as well.
Blockchain Technology

Blockchain is a relatively new technology, most commonly associated as the underlying framework for Bitcoin and other cryptocurrencies. It was conceived to prevent modification of historical transactions and allow for an unbroken chain of custody from conception to termination. The way in which this is accomplished is by creating "blocks", or individual records, each time an asset changes custody much in the same way that a ledger records transactional history. The difference with blockchain however is that these ledger entries, or blocks, cannot be modified and once created are added to the end of the chain. Using this process depicted in Figure 1 allows for anyone (depending on adopted business rules) to view the historical transactions along the chain which have each been validated and secured upon their creation.

Figure 1: Blockchain Design

The inability to modify any part of the blockchain comes from the decentralized way in which each transaction is verified, and the sum of the records are stored. By requiring multiple decentralized nodes to verify the validity of the transaction before it can be added to the chain, the ability to falsify a transaction is negated. Additionally, by storing the chain on distributed nodes within a decentralized network, no single node or computer has the ability to control the blockchain by itself but instead must cooperate with the entire network.

Blockchain for Air Force Supply Chains

Applying blockchain to the DoD and Air Force supply chains would allow for the decentralization and security of transactional records associated with critical parts. Blockchain can provide the capability to view the complete history of a given part from the time it was created until that current moment. This is a major step towards preventing the falsification or modification of documents for the purpose of passing off a counterfeit part as the "real thing". This would mean that all parts in the DoD supply chain would have a provenance showing when and where they were created, by whom, the time and mode of transportation, and also where they were stored.

Using blockchain to record the history of an individual part introduces additional issues which are not present in cryptocurrency; the parts that makeup a part. Nearly every end item worth tracking will itself be made from numerous subcomponents. For example, a simple hydraulic actuator could be made up from dozens of parts ranging from hydraulic cylinders and tubing to electrical circuitry, nuts, bolts and washers. The possibility exists for a counterfeit subcomponent to be incorporated into a legitimate assembly thereby making that assembly unfit for entry into the DoD supply system. To counteract such a scenario, a new kind of blockchain would need to be used—a Nested Blockchain. Nested Blockchains require that each subcomponent be tracked using blockchain from the time that an individual bolt or electrical wire is manufactured, until such time that they are mated into a final assembly. At that time, each of the subcomponents’ blockchain would be nested into the first block of the final assembly as depicted in Figure 2. With such a robust transaction history associated to each part, algorithms could then be applied to the network to identify and flag suspected counterfeit parts.

Figure 2: Nested Blockchain Diagram

Additionally, any counterfeit part that is identified can quickly be cross referenced to other parts that were manufactured, stored, or shipped from the same location or during the same time. While this may seem like a futuristic use of the technology, it is not a new application of blockchain. Commercial companies have integrated this capability as a tool to provide transparency across their supply chains and traceability as to where products came from. One such example is Walmart, which has adopted blockchain to track from individual suppliers in China across its global supply chain. For example, they use the blockchain to record where each piece of meat came from, its process and storage location, and its sell-by-date. The blockchain records where the animal was raised, where and when it was slaughtered, where and for how long it was refrigerated, the mode and duration of transportation, and any other important information needed for Walmart to ensure it sells a quality product.

Cost and Risk

As the saying goes, “there is no free lunch” and there are both costs and risks of adopting blockchain technology. There will be a direct cost of developing and integrating blockchain platforms into the Air Force supply chain. Depending on the number of equipment items and
parts included in the system, the cost will be substantial. Additionally, if the technology is adopted, the number and validity of transactional records will increase dramatically. With the increased number of records, the need for more computing power and storage capacity will increase as well. The increased computing and storage capacity will require a significant financial investment but will potentially require an investment in personnel to manage and build the new network.

Adopting a technology such as blockchain may seem too risky for a government organization. This is because the very principle that makes blockchain work, decentralized records, is a vast departure from traditional records keeping practices. The mitigation plans for this risk revolve around piloting programs before making large investments, developing sound business rules, and prioritizing the systems on which to apply the solutions by identifying and categorizing risks. Educating decision makers and drawing from industry lessons is the best way to overcome the hurdle of the new process. Then, testing the technology on a small scale or in a limited environment to identify other issues which could be corrected before full-scale roll out will be a key factor to avoiding large-scale failures that have derailed previously supply chain IT systems.

Way Forward
Blockchain is a new technology, and it is not a panacea solution for the Air Force supply chain. It does, however, have great potential at helping us to identify and prevent counterfeit parts. New technology adoption and integration is a difficult endeavor, but the DoD—although we all can provide examples of failures, has been a historical leader in developing and using new technologies. Examples within the private industry have demonstrated that blockchain technologies can be used with great success, as companies like Walmart, IBM and Maersk are already realizing the benefits. Introducing this technology can help prevent the inflow of counterfeit parts into the supply chain, a matter of national security, and may also unlock other unintended benefits both inside and outside the logistics community.

References


Edwards AFB Muroc Chapter Visits Air Force Research Laboratory (AFRL)

By: Capt. Clinton Bialcak

On March 12th, the Muroc Chapter at Edwards AFB had the rare opportunity to get up close and personal with AFRL. The tour featured Areas 1-42, Altitude Facility, Steam Plant, Test Stand 2A, Test Stand 1C, Test Stand 1A (pictured), Motor Case Winding Facility, and their Spacecraft Propulsion Lab.

The tour was an incredible opportunity to witness past, present and future research efforts that have helped shape military technology and United States history. For example, the “Saturn V F-1 Engine” was test fired on Test Stand 1A in the late 1950s, early 1960s. “The F-1 engine, with 1.5 million pounds of thrust, was the powerplant for the first stage of the 363-foot long Saturn V launch vehicle that took the first astronauts to the Moon for six successful landing missions between 1969 and 1972 in the Project Apollo program.” (Rocket Engine, Liquid Fuel, F-1)

References

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Capt Leighton is a Course Director at the Air Force Institute of Technology’s School of Systems and Logistics Wright-Patterson Air Force Base, Ohio.

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The tour was an incredible opportunity to witness past, present and future research efforts that have helped shape military technology and United States history.

Leaders from the Defense Logistics Agency Troop Support hosted members of the Logistics Officer Association’s (LOA) Pudgy Chapter from Joint Base McGuire-Dix-Lakehurst to educate members on its mission and Warfighter impact during a visit on January 24 in Philadelphia. LOA members were provided an overview of DLA and DLA Troop Support, as well as detailed presentations from each of Troop Support’s five supply chains: Subsistence, Clothing and Textiles (C&T), Construction and Equipment, Medical, and Industrial Hardware (IH). Each presentation touched on the importance of the Troop Support mission and finding supply chain solutions for the Warfighter.

“The main wording [in our mission] that always sticks out to me is ‘solutions,’” Janeen Hayes, Troop Support Corporate Communications Chief, said, “That’s our main goal…to make sure we’re there to provide solutions to our customers, and primarily that is you – the Warfighter.”

The LOA is an organization comprised of current and former military and civilian logistics professionals whose goals include logistics innovation and collaboration – a parallel to one of Troop Support’s objectives: “Collaborate with customers, industry…to identify innovative supply chain solutions.”

As a member of the LOA, Air Force Maj Justin Hickey, 305th Maintenance Squadron Commander, appreciated the visit. “These types of immersions are invaluable for developing our logistics professionals, both junior and senior,” Hickey said, “It’s a chance to see how our piece fits into the larger strategic puzzle and to be exposed to a broader perspective of how supplies and materiel get into the hands of the Warfighter. The LOA visit filled in many of our knowledge gaps about the DoD logistics enterprise and was truly fascinating.”

During his presentation, C&T Director, Air Force Col Melvin Maxwell keyed in on the shared interest in joint solutions. He described the end-to-end logistics processes within C&T, and explained the supply chain’s coordination with military services, industry, and other DLA offices to provide the best service possible. “Big picture, it’s about integrated logistics solutions. It’s not just about acquisition,” Maxwell said.

The director of IH brought the point closer to home for the group when he detailed DLA’s coordination with the Air Force’s 635th Supply Chain Operations Wing (SCOW), whose mission is to develop logistics solutions and deliver capabilities to the Warfighter. “[The SCOW] will reach out to DLA Aviation or DLA Land and Maritime,” Air Force Col Adrian Crowley said, “And if it’s a supplier issue, they reach out to us and we work with [the SCOW] to prioritize and find a solution.”

The tour ended with a visit to Troop Support’s flag room, where presidential and vice-presidential flags are hand-embroidered by seamstresses.

ABOUT THE AUTHOR

John Dwyer III is a public affairs specialist with the DLA Troop Support Public Affairs Office.
These types of immersions are invaluable for developing our logistics professionals, both junior and senior. It’s a chance to see how our piece fits into the larger strategic puzzle and to be exposed to a broader perspective of how supplies and material get into the hands of the Warfighter. The LOA visit to DLA Troop support filled in many of our knowledge gaps about the DoD logistics enterprise and was truly fascinating. We’re very grateful for the opportunity and look forward to continuing the partnership.

– MAJ JUSTIN HICKEY