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Capt David Loska

THE EXCEPTIONAL RELEASE
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ON THE COVER

48th Fighter Wing conducts in-flight refueling: F-15E Strike Eagles assigned to the 48th Fighter Wing conduct in-flight refueling over the English Channel with KC-135 Stratotanker assigned to the 100th Air Refueling Wing in support of the 75th anniversary of D-Day, June 9, 2019. An epic multinational operation, D-Day forged partnerships and reinforced trans-Atlantic bonds that remain to this day. (U.S. Air Force photo by Tech. Sgt. Matthew Plew)

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Team LOA,

Today, as I get ready to sign off as your LOA President, let me first thank every one of you for what you do every day in support of our logistics enterprise, our military services, and our Nation. You each bring talents, innovation, and insight into our future that seems to be everchanging with challenges or better yet…opportunities.

Your Executive Board has been busy planning, preparing, and pouring their hearts into another engaging symposium. This year in Oklahoma City, OK, we will be focused on “Increasing Lethality Today, Readiness for Tomorrow’s Fight.” Get ready, because this is going to be one to remember.

Since the 2017 LOA Symposium in National Harbor, MD, I have had the privilege of leading our professional organization. These past two years, your interconnected team of national and local volunteers has dedicated themselves to growing minds and membership to continue our objective of providing world-class professional development, networking, and mentorship. We’ve made considerable strides in engagement and also honored the core culture and heritage of LOA to ensure our association remains relevant and useful.

Over the last few months, you’ve provided feedback, and we listened. We are excited to announce the following changes that have recently gone into effect and those that we are still developing.

Revitalizing the Chapter – We’re taking a lesson from our Air Force Chief of Staff. Our mission gets done in the squadrons and enhanced by our chapters. That is why we are dedicating more money and resources to our chapters, so they can continue to provide world-class professional development throughout the year, and our Airmen will be better prepared to achieve our Air Force mission. It is our job to ensure we do everything we can to help our chapters thrive – both small and large. This year, all active chapters will receive a monetary percentage of their total active membership. In other words, you will now see a direct investment in your membership to aid your chapter in accomplishing its goals.

Modernized Media and Communication – We want LOA to be your primary professional development resource. Our atloa.org website, LOA Symposium, and the Exceptional Release (ER) are our primary national drivers to achieve this. We have transformed these platforms into a resource for you and your chapters to use to help improve yourselves and your organizations. The ER now publishes articles individually online so you can share your stories, experiences, thoughts, and successes with our entire community as it becomes available. But don’t worry, we will still have our quarterly publication available to read in your squadron’s common areas like before, except now you can access it from your mobile device!

Awards and Scholarships – We have made it easier to recognize and reward our most deserving members and chapters by reducing the bullets by 25% for individual awards and cut in half the bullets for chapter awards. Now you can focus on the mission you’re passionate about and the challenging problems you face each day while still recognizing the people that deserve it. These changes affect scholarships, chapter, and individual awards.

Your contributions, both locally and nationally are appreciated, and I look forward to visiting with you at the 2019 LOA Symposium, 8-11 October 2019 in Oklahoma City, OK.

#nomissionwithoutthelogistician
#freakinmiracleworkers

Carol A. Howitz
President
Logistics Officer Association

We’ve made considerable strides in engagement and also honored the core culture and heritage of LOA to ensure our association remains relevant and useful.
Gerard J. Carisio
Lt Col, USAF
Editor in Chief

This column appears infrequently in the journal; its most recent appearance was in the first issue for which I served as Editor in Chief in 2016. With gratitude and optimism, I am including it again to mark the final issue wherein I will have editorial responsibility.

I must express my thanks to the members of the LOA Executive Board for entrusting me with this responsibility during a period of transition. Their patience and confidence empowered the journal staff to redesign the publication format, streamlining it for a fully web-based reading experience. We have arrived at a juncture where each issue offers the reader consistently superior content through a digital humanities delivery methodology. The individuals who dedicated themselves to that evolution are extraordinary.

Without them, this publication would not enjoy such a storied history. The heroic efforts of the managing editors, our field team, ensure that each article receives a rigorous review even as new authors discover this journal as a space for professional conversation. The editors are true volunteers, lending their expertise entirely pro bono. Each deserves praise, but two stars of that team shine brightest.

Their involvement with the journal predates my own and will, fortunately, continue. Mary Parker has served as Assistant Editor for many years and is certainly the heart of this publication. We simply could not get an issue to press without her wrangling all of our articles through the editorial process and making it look easy. Dave Lostka, our Director of Publication and Online Production, takes the baton from the editors and bolts across the finish line each quarter. He literally builds the journal, assembling the various media into a professional product.

How fitting, then, that I may now pass the editorial baton to Dave as the new Editor in Chief. Having received confirmation from the LOA Board, he begins a tenure which will add to the impressive legacy of this publication. I look forward to enjoying future issues with excitement for what our staff will build and what our authors will write.

-Gerard J. Carisio

Driving Innovation throughout Sustainment: Thinking Differently and Leveraging our Digital Airmen

By: Brig Gen Linda Hurry

It is indeed a tremendous honor to join the incredible HAF team especially at a time when we’ve been given the opportunity of a lifetime by our Secretary and Chief to drive change throughout our logistics enterprise. If there has ever been a time to be able to make a huge difference, it’s right now...as our most senior DoD and AF leaders are focused on sustainment and logistics. Driving the kind of change we need to meet the challenges set forth in our National Defense Strategy will require us to have the courage to think differently to innovate, challenge the status quo, and listen to our digital Airmen. Most importantly, it will take all of us working together…after all I see Logistics as a Team Sport!

As I step into this new role, I want to share my focus areas as we push our logistics enterprise forward. First and foremost, my top priority is to lead and care for our 180,000 person team and their families. In my view, there is nothing more important than leading, mentoring, developing and taking care of our TEAM of logistics professionals. Whether this is through inspiring excellence, creating additional training and educational opportunities, helping them achieve their goals or simply doing a better job at getting to know their stories and helping them get through what I like to call life’s little curveballs, I believe our people are our greatest asset and we need to treat them as such.
Driving the kind of change we need to meet the challenges set forth in our National Defense Strategy will require us to have the courage to think differently to innovate, challenge the status quo, and listen to our digital Airmen.

My second overarching priority to truly connect and synchronize our federation of logistics entities and create an environment that allows our team to think differently, encourages innovation, capitalizes on technology and empowers the team to drive change for the right reasons. From an operational perspective, our focus will be as follows:

**Strategic Sustainment Framework.** We’ve already been engaged in building the implementation plan that turns this aspirational document into action. It identifies predictive maintenance, theory of constraints, optimized maintenance schedules, a resilient supply chain and a more robust repair/manufacturing network as vital attributes of our future logistics system. We need to execute this plan with a burning sense of urgency as this work will be foundational to how we provide better support to a fight postulated by the NDS.

**F-35 Sustainment.** The F-35 is an operational marvel, but we need to improve its supportability and sustainment costs. While the AF has many players in this realm today, we the logistics team need to be a persistent and vocal force in the sustainment decisions on this platform. We need our experts to help inform the broader discussions designed to drive health into our systems and processes.

**Health of the Sustainment Enterprise.** We often focus on tactical readiness of our units (i.e. AMXS, LRS), but we need to develop a methodology to assess the broader, strategic health of the sustainment enterprise. Our COCOMs and C-MAJCOMs expect the sustainment system to deliver, and we owe them the confidence level that it can meet their demand signal.

**Readiness Recovery.** Our Secretary and Chief have handed us an ambitious goal: 80% of all pacing units “ready” by FY20, and 80% of all combat-coded units “ready” by FY22. We need to ensure that we have postured the combat support and combat service support units that contribute to our operational readiness correctly.

**Future Log Concepts.** We need to remain the thought leaders when it comes to advanced logistics concepts envisioned in the NDS, Agile Combat Employment, Multi-Domain Command and Control, and Contested Logistics/Logistics Under Attack are but a few examples where we need our experts to help inform the broader discussions in future force design.

**Logistics Capability and Capacity.** While the Sustainment Framework implementation has begun to unlock the power of the total force sustainment enterprise, there is much to be done at the tactical level. Applying the Theory of Constraints methodology will large and partnering with our MAJCOMs will be crucial to unlock logistics capability and capacity at the wings. New tech training methodologies capitalizing on virtual/ augmented reality, creating multi-skilled Airmen where it makes sense, kitting and investing in NMC campaigns are all essential to driving the needed increase in readiness.

To help facilitate our transformation, we’ve partnered with the Rapid Sustainment Office technology and BESPIN coding experts and are standing up Tesseract, a team of Airmen to serve as a unifying innovation entity for our logistics enterprise. These “Tesseract” Airmen will operate as our partners for learning how to leverage and then scale Theory of Constraints methods to identify bottlenecks in our processes, lead process reengineering efforts and ultimately assist in constraint resolution. They will work with you to build LRS & Mx Next, the Flight Line of the Future with wireless internet access, mobile devices and software, and to learn about how to employ predictive algorithms in the weapon systems we launch or manage each day.

Most importantly, Tesseract Airmen will be recruited from volunteers across the enterprise and be given streamlined access to the A4, A6, AFMC and other senior leaders to directly impact policy, process and resourcing decisions. The goal is to streamline operations in the squadrons, on the flight line, backshops, warehouses, and offices by trusting these digital Airmen to transform the enterprise based on a North Star goal designed to drive health into our systems and processes.

We all know our job isn’t to win the last war, but rather to adapt so we can win the next one. Doing so will require us to create an institutional culture that can rapidly respond to the changing nature of warfare and allow us to out think and out maneuver our enemy. So get excited, start thinking and go out there and help us build the logistics team and system we want...for the Air Force we need! While you do, please don’t ever forget to take care of one another. Lt Gen Berry and I have your back!
Think Differently

*Here’s to the crazy ones. The misfits. The rebels. The troublemakers. The round pegs in the square holes. The ones who see things differently. They’re not fond of rules. And they have no respect for the status quo. You can quote them, disagree with them, glorify or vilify them. About the only thing you can’t do is ignore them. Because they change things. They push the human race forward. And while some may see them as the crazy ones, we see genius. Because the people who are crazy enough to think they can change the world, are the ones who do.* — Apple

Operationalizing DLA Support to the Air Force

*By: LTG Darrell K. Williams*

The Defense Logistics Agency has undergone an exciting transformation in recent years. While changes are mostly behind the scenes, they’ve already contributed to something Air Force sustainers care deeply about: improved military readiness. DLA has accomplished this through a number of initiatives that operationalize our support to the warfighter.

What does “operationalize” mean? Our customers have traditionally viewed DLA as a predominantly wholesale, static supply chain organization. What we’re doing better is translating what DLA does into immediate, actionable information more relevant to our military services. DLA must view success through the same lens as the warfighter. In the Air Force’s case, success is defined as fully mission capable weapon systems and maximum readiness.

**Service Readiness Dashboard**

In spring 2018, DLA rolled out the Service Readiness Dashboard, a comprehensive tracking tool that has become a centerpiece of our efforts to operationalize support to the services. We’ve always been good at addressing consumable and Depot Level Repairable requirements at the aggregate level, however we were not able to relate our support particularly well to the readiness of specific weapon systems.

The Service Readiness Dashboard provides a common operating picture by combining data from the services’ automated systems with DLA's wholesale data. Through that combination, we’re able to see DLA's operational impact on service weapon systems and requirements.
This tool improves our capabilities in other ways as well. While we used to monthly review our agency performance metrics, recent advances in data management and data science have made it possible for us to address the readiness of key weapon systems in near real-time. We can respond more quickly and accurately to critical materiel and supply availability issues and we're more predictive in our support to service readiness.

As Director, I access the Service Readiness Dashboard virtually every day, as do the commanders of our six Major Subordinate Commands (MSCs) and other key leaders across the agency. But more importantly, our DLA professionals now have a powerful decision-making tool to help them prioritize their work. As a result, we’ve seen significant improvements in our material support to Air Force readiness.

The bottom line is that of the Air Force’s weapon system platforms with supply chains primarily managed through DLA—A-10, F-15, F-16, T-38, CV-22, E-3, KC-135, C-130 and C-5—all nine saw improvements in DLA Material Availability from October 2018 through August 2019. During this same time frame, DLA-managed open document orders across the Air Force’s nearly five thousand aircraft have dropped 19%, and aircraft down for DLA supply is trending positively downward at 4.3%.

Granted, DLA’s Material Availability at the wholesale level is different than Air Force Supply Availability. Nonetheless, by any objective measure, DLA’s overall material support to the Air Force has enhanced the readiness of Air Force weapon systems and it has been the Service Readiness Dashboard that has allowed us to focus on what’s important to keep these platforms fully mission capable.

The future for the Service Readiness Dashboard points to greater levels of definition. For example, the dashboard tells us the systems that are Non-Mission Capable for Supply. That supply may be service supply or DLA supply. But there’s another level of definition required, because in the services’ Non-Mission Capable for Supply category, there are some DLA impacts not currently taken into account. So we’re working toward greater definition to break out the DLA impact on this category.

We have recently deployed metrics for industrial support in Air Force depots as well. Now, the dashboard can focus on support to operational units as well as view our impact on the industrial support, which will give us a much more comprehensive picture. We’re very excited about the additional capability the dashboard brings to DLA’s ability to operationalize our support to the services, and to date the Air Force has been a strong partner.

Operationalizing the DLA Regional Commands

DLA’s organizational structure includes three centrally-selected commanders for our regional commands: DLA Indo-Pacific, DLA CENTCOM & SOCOM and DLA Europe & Africa. These commanders oversee the critical capabilities all closely linked to the J-4 sections of the combatant commands they support.

DLA’s transformation over the last three years has made all our elements in those regions centrally led and commanded by our regional commanders, giving warfighters access to all DLA capabilities through a single point of contact.

Within the Air Force, the regional commands are also linked with the Theater A-4s in those regions. We consider this a critical element and a significant multiplier that extends DLA’s capability and support to the services in their areas of responsibility.
DLA’s transformation over the last three years has made all our elements in those regions centrally led and commanded by our regional commanders, giving warfighters access to all DLA capabilities through a single point of contact.

They provide one-stop shopping for all DLA capabilities in a combatant command area of responsibility. This has greatly strengthened our relationship with the combatant command and improved the support we provide to the Air Force and the Joint Force as a whole.

Joint Logistics Operations Center Transformation to the Agency Synchronization Operations Center

The linchpin for synchronizing these new operational concepts is our progression from a Joint Logistics Operations Center to an Agency Synchronization Operations Center, or ASOC. The ASOC will provide a better, more comprehensive common operating view of DLA’s mission support and business processes.

DLA is organized into six Major Subordinate Commands (MSCs), three regional commands and several critical functional directorates, such as our Procurement and Acquisition Directorate, or P&A. The ASOC will provide a better, more comprehensive common operating view of DLA’s mission support and business processes.

As DLA has been and always will be a Warfighter First, our strategic plan contains five lines of effort, but the one that is central to everything we do and that will never be compromised is “Warfighter First.”

Although many of these operationalizing efforts are internal to DLA, for the Air Force majors and lieutenant colonels commanding Logistics Readiness Squadrons (LRS), the Wing Commanders supported by those LRSs, and the MAJCOM A-4s — our goal is for you to see an improvement in supply availability that leads directly to improved readiness.

Parting thoughts

Before I close, I’d like to leave you with a couple of thoughts. Make sure you know who your local DLA forward representative is; there’s one on every major Air Force installation. That person or element can be of enormous benefit to you and is a direct link to DLA Headquarters and each one of our MSCs. Use this capability to its fullest. Through them and the other enterprise organizations that support the Air Force, you’ll see an improvement in your readiness.

I also want to promote DLA as a great place for Air Force sustainment professionals to serve. In my estimation, DLA is an agency not as well known to our junior leaders, field-grade officers, and NCOs, but it’s a rewarding joint assignment you should seek. Currently, of the eight general officers serving at DLA, three are Air Force. Historically, of the 19 DLA directors since 1961, five have been Air Force.

Moreover, the alignment and interdependencies between DLA, the Air Force A-4 and Air Force Materiel Command will grow even stronger in the decades to come. I like to say, “To describe the Air Force as our customer just doesn’t cut it — we are partners. Neither of us can support the warfighter without the other.”
Lieutenant General Darrell K. Williams is the 19th Director of the Defense Logistics Agency, headquartered at Fort Belvoir, Virginia. He is a native of West Palm Beach, Florida, and a Distinguished Military Graduate of the Hampton Institute ROTC Program in 1983. He leads the Defense Department’s $38 billion combat support agency for worldwide logistics. He directs nine supply chains supporting the U.S. Military Services and Global Commands, as well as federal, state, local and international partners. DLA provides food, medical material, uniforms, construction equipment, fuel and spare parts for military weapons systems. He oversees the National Defense Stockpile, the Department’s process for disposal and reutilization, an international network of 34 distribution centers, and a global workforce of over 26,000 people.

“In September 2018, Secretary of Defense James Mattis issued a directive for all services to increase mission capable rates for specified platforms to 80% within one year. A harsh reality underlies this bold requirement. Air Force weapons systems, critical to the Joint fight, are not meeting standards that Combatant Commanders forecast they will require for potential Large-Scale Combat Operations (LSCO). The reasons for this multi-year shortfall are complex and spread across the entire operations, logistics and sustainment enterprises. While a full analysis of this problem could generate hundreds of pages of analysis, discussion, and possible enterprise-level solutions, field-level leaders should instead focus on Air Force maintenance culture and procedures that we can, and must, reform in order to meet the demands of future warfare. The Air Force maintenance community must revitalize itself while becoming more responsive and creative with its management of aircraft, personnel and equipment. We should do this by forging a new mindset that critically examines stale regulations, outdated analytics, legacy organizational structures, inefficient manpower utilization, and top-down decision-making structures. This new mindset must also plant the seeds of a new cultural approach that is dynamic, flexible, exercises disciplined initiative, and empowers our tactical-level leaders.

Revitalizing our culture should start with a recognition of the dynamic, complex operating environment in which we find ourselves, and the corresponding criticality of readiness. When imagining a model of effective combat readiness, one could picture it as a bar stool resting on three legs representing aircrew proficiency, maintainer proficiency, and weapons system health. Without all three legs in balance, readiness fails. Maintenance culture is a supporting enabler for the first leg of the stool and the primary enabler for the latter two. As such, we should not take our responsibility to adapt and innovate lightly. Maintenance leaders should not be surprised that the threats we face, as outlined in the 2017 National Defense Strategy, are larger and more severe that those we have faced in the counter-insurgency fight since 2001. Near-peer and peer adversaries seek to contest Air Force lethality, and as a result, sortie production demands have grown rapidly in the past few years. For example, since 2015 the fleetwide annual Ready Aircrew Program (RAP) requirement for F-22 pilots has increased by nearly 25%. More sorties with the same (or fewer) aircraft at a time would be necessary...”
The Air Force maintenance community must revitalize itself.

when sustainment resources are scarce and MXGs are grappling with workforce proficiency issues presents a looming cliff of challenges to the maintenance community. So, what can we do?

Most maintenance leaders are no stranger to the "figure it out" marching orders frequently given when faced with a seemingly impossible task. However, in order to solve this particular challenge, we will have to collectively shed ourselves of many of the cultural and procedural dogmas that have been a part of Air Force aircraft maintenance for the last 20-30 years. While many have attempted to reform and revise AFI 21-101 "Aircraft Maintenance Management," it has changed (substantively) very little in the last two decades. Despite some attempts at streamlining, with every revision its page-count of flying, and the disconnect between reality and the picture painted by the metrics serves to highlight their ineffectiveness.

The Wing accomplished this turnaround through several approaches, two of which are most relevant to this discussion. The first approach was to examine what institutional and organizational barriers were preventing the MXG workforce from achieving maximum effectiveness. Many maintenance leaders are familiar with the "least or famine" problem that exists within many units. Some specialist shops may go days without receiving enough work to fully employ their available capacity, and then suddenly become task-saturated for long periods of time. At those times, leadership discussion usually focuses on increasing that shop's capacity so that it does not become a production bottleneck. This approach is a short-term solution; it ignores a large potential source of productivity that exists during the "famine" periods. MXG leaders should challenge their organizations to find ways to employ personnel within some specialist shops on the flightline (or wherever chokepoints may exist), though it is also important to minimize the impact to those technicians' training and skillset retention. While those who saw or felt the impacts of the "Rivet Workforce" career field consolidation throughout the 90s may argue this practice demanded an inherently decentralized activity, spread amongst thousands of airmen and dozens of facilities on any given base. However, by imposing a top-down, functionally stovepiped command structure (such as that mandated in AFI 21-101), creativity and innovation are stifled. Commanders at all levels should be empowered to task-organize their squadrons and flights to the degree that most suits the demands of their operational environment.

The maintenance concepts we use today, especially on 5th-gen platforms, open up opportunities that did not exist 25 years ago...

From October-November, the 93rd Fighter Wing concept, has now been in place since 2002. Prior to this, the longest period of time the Air Force had adhered to one ops/maintenance organizational structure was 14 years. This is because Air Force leaders of the past recognized that changing operational conditions necessitated changes in organization, doctrine, training and procedures. Why, then, after two decades of the most operationally demanding period of conflict since Vietnam has the maintenance community not recognized a need to adapt again?

A recent vignette can serve to highlight examples of how overcoming legacy organizational structures, manpower practices, analytical data, and cultural mindsets can produce benefits for maintenance organizations. In November of 2016, the 325th Fighter Wing at Tyndall AFB with its 55 F-22 Raptors, was at a crossroads. The wing was still recovering from a particularly brutal summer of flying, with 158 Maintenance Non-Deliveries (MNDs) occurring in a three-month span. The fleet's Low Observable (LO) average signature assessment rating was exploding out of control. The fleet's Maintenance Performance Indicator (MPI) set reflected this dire condition, with neither Aircraft Maintenance Unit (AMU) meeting more than two of eight primary metrics for four months in a row. As November drew to a close, this negative trend seemed to continue: in that month, the 43 AMU met only one of its metric standards. Judging from the data alone, November 2016 should have been a dismal month of flying. An outside observer looking at the data might have concluded that the Wing was descending into a dreaded maintenance "death spiral." However, reality could not have been more different.

The second key approach that allowed the 325 MXG to execute a turnaround in 2017 was by inculcating a climate of trust and empowerment. Aircraft maintenance is an inherently decentralized activity, spread amongst thousands of airmen and dozens of facilities on any given base. However, by imposing a top-down, functionally stovepiped command structure (such as that mandated in AFI 21-101), creativity and innovation are stifled. While we rightly train our Airmen (and each other) that procedural compliance with technical orders is paramount, we then apply the same rigid discipline
to programmatic and administrative compliance. Discipline is critical to the effectiveness of any MXG, but it is too often also used as an excuse for failing to innovate or protecting the status quo. With squadron-level empowerment and innovation among the top concerns of General David L. Goldfein, CSAF, it seems the maintenance community has lagged in embracing a more decentralized mindset. The vast majority of programmatic requirements levied on MXGs are dictated from the MAJCOM level or higher, despite depopulation of the A4 staffs in recent years and a reduced capacity to administer these requirements. Of more than 2600 specific regulations in the current version of AFI 21-101, only 81 are waivable at the Wing commander level or below. This leaves little room for leaders to lead and solve problems creatively at their level, despite Gen Goldfein’s intent.

To this end, aircraft maintenance culture should align with the most essential of Air Force doctrinal concepts—namely, Centralized Control and Decentralized Execution. That is, production priorities should be set from the top, where limited resources can be most easily allocated and organizational barriers to efficiency can be overcome, but authority for execution rests firmly where it belongs: with the AMU, Flight, and Squadron leaders who most closely understand the local constraints and tactical conditions. This concept within CAF aircraft maintenance is not new. General Wilbur L. Creech, Commander of Tactical Air Command (TAC), enshrined decentralization and point-of-execution empowerment in the initial publication of TACR 66-5 in 1978, enacting the Combat Oriented Maintenance Organization (COMO) for TAC, and subsequently adopted with some modifications by Strategic Air Command (SAC). More broadly, Air Force Doctrine Document 1 underscores the need for commanders to “resist the temptation to make tactical-level decisions that are best left to subordinate commanders and forward decision-makers.” The closely-related joint concept of Mission Command is built on “subordinate leaders at all echelons who exercise disciplined initiative and act aggressively and independently to accomplish the mission.” Just as our service and joint senior leaders trust is sometimes abused. However, as with public demonstration of trust in subordinates inspires confidence, loyalty and pride. Empowerment drives creativity, resilience and peak performance. This principle naturally carries some amount of risk for a commander…trust is sometimes abused. However, as with

Commanders at all levels should be empowered to task-organize their squadrons and flights

In order to become more responsive and capable, our community must adopt a new mindset.

Dynamic Action and Reaction. No matter how much we plan and prepare, there is an aspect of aircraft maintenance that will always be inherently reactive. The aircraft get a vote. While disciplined planning and scheduling is vital to minimizing the risk of unexpected events, the ability to dynamically react to those events is equally as critical. The Flying Scheduling Effectiveness metric has been treated as a barometer for organizational health for decades, and flying schedule Adds and Cancels have long been the “third rail” of flightline maintenance. However, as operational demands increase in both scope and unpredictability, it is time to critically examine the long-cherished tenet of “plan what you fly, fly what you plan.” The flying schedule should be the starting point, not the endpoint. Leaders must be able to react deliberately, intelligently and dynamically to changing conditions throughout the execution of a flying schedule. They must also leverage a healthy, collaborative relationship between maintenance and operations to balance short-term and long-term mission requirements. Dynamic reaction is not a license to be reckless, merely an impetus to use all the scheduling tools at a leader’s disposal… and good judgement… without fear of immediately descending into a “death spiral.”

Disciplined Initiative. Related to Flexibility, and stemming from doctrinal concepts in Joint Publication 3-0, Disciplined Initiative is a charge to our tactical-level leaders. The DISI metric has been treated as a barometer for organizational resilience. It is often required for long-term success. Neither does empowerment relieve a commander of the responsibility to guide his or her organization, or be accountable for its mistakes. It is merely a recognition that Airmen perform at their highest potential when they feel unencumbered by bureaucracy and micromanagement.
Introduction

Aircraft maintenance is a fast-paced career which demands long, fluctuating hours involving strenuous, complex tasks. Maintainers are sometimes required to work greater than 12 hours in heavily fatigued states. The military aircraft maintainer is often exposed to the dangers of working in sleep-deprived states due to frequent changes to duty schedules. Fatigue can cause an array of health problems ranging from heart rate fluctuations to reductions in cognitive ability.

The military aircraft maintainer has not been the subject of studies involving fatigue; however, other research has been performed that can be applied to the military maintainer. In a 2011 article, for example, Boeing published a Federal Aviation Administration (FAA) study in which maintainers’ sleep habits were tracked. The findings concluded that the average maintainer received approximately five hours of sleep per night, three hours less than the eight hours recommended for the average person. These and other findings provide excellent evidence of the role that fatigue plays in the daily lives of aircraft maintainers and proves that further studies and control techniques are warranted within the Air Force community.

Frequent Schedule Changes and Fatigue

The most consistent element of military aviation may be its ability to consistently change. Aircraft receive frequent modifications in order to keep up with the requirements of new missions. Mission changes also lead to flying schedules that are altered numerous times. Movement of flying hours often results in changes to duty hours for maintainers. Military service on the flightline is, therefore, a dynamic environment that demands an extreme level of flexibility and often places personnel on duty while fatigued.

Fatigue and Worker Health

Fatigue is an issue for any workforce and can cause an array of health problems, including psychological and physiological ailments. Bambra, Whitehead, Sowden, Akers, and Petticrew initiated research into the problems caused by fatigue by reviewing 40 studies on the topic. The researchers compounded existing information and discovered ample evidence that shift work caused social life problems with difficulties maintaining a balance between personal and work lives.

References

The research showed that night shift workers had more difficulty with task switching and exhibited a reduction in task efficiency as compared to day shift workers.

**Fatigue and Job Performance**

The final literature review for this research is on law enforcement. In 2000, the United States Department of Justice published findings from a study on police officers and fatigue. A total of 379 officers from 4 different departments across the United States took part in the study, which analyzed approximately 60,000 workdays.

The research included the FITTM fatigue eye measurement system and interviews. The test results concluded that fatigue played a role in all personnel’s performance regardless of shift assignments. One of the most significant findings was related to personnel’s safety immediately after completing night shift duties. Several accidents occurred when officers were required to attend mandatory daytime appointments after their shifts ended. The conclusion drawn from this research is that altering the sleep schedule of shift workers has an impact on job safety and increases accident rates.

**Summary of Literature Review & Statement of Problem**

While carrying out aviation maintenance, airmen must perform complex actions while monitoring numerous systems and ground equipment. Considering these tasks, it is evident that fatigue in aviation can lead to catastrophic results.

Aircraft maintenance is a physically and mentally demanding career field, involving high risks activities that often result in injuries, including loss of fingers in landing gear, eyes punctured by safety wire, severe burns from hot engine components, and even death. When either the mission changes or a shortage of qualified personnel occurs, moving maintainers to cover day shift or night shift becomes necessary. While advanced warning is preferred, the military maintainer often has little or no warning due to the unpredictability of the aircraft maintenance environment. These no-notice changes and long duty hours put maintainers at high risk of working in states of reduced situational awareness caused by fatigue.

These rates indicate a relatively high percentage of fails associated with changes in sleep patterns of personnel regardless of shift assignment.

**Study/Analysis**

This study relied on two years of archived quality assurance (QA) inspection data compared to shift schedules from the same period. Therefore, this research is limited to drawing conclusions from these documents and the patterns that arise. Due to military medical standards, all maintainers are assumed free from sleep disorders that may interfere with duty performance.

In order to complete the study two fiscal years’ worth, 2017 and 2018, of USAF flightline maintenance quality assurance inspections were gathered for analysis from the quality assurance 2000 (QA2000) database. The purpose of rejecting or accepting the following null hypothesis: no statistical difference exists in the number of quality assurance fails between day and night shift maintainers. Once the initial analysis was accomplished, each QA inspection was investigated for the type of fail and compared to possible shift fluctuations up to two weeks prior to the event.

**Results**

Per the QA2000 database, the military unit chosen for this research experienced 1,935 quality assurance inspections during a two year period starting at the beginning of FY17 and ending at the close of FY18 (Tables 1 & 2). FY17 accounted for 833 inspections and FY18 totaled 1,102 (Tables 1 & 2). An analysis of the results proved the null hypothesis; there is no statistical difference in the number of QA fails between day and night shift maintainers (Table 3). This analysis alone does not end the discussion of fatigue-induced fails in maintenance shift operations.

The USAF has many mottoes, one of which is, “the mission comes first.” This saying is frequently put into action when personnel are required to make short or no-notice shift changes resulting in the immediate alteration of
their sleep schedules. While investigating each fail for the two year period, it was discovered that detailed shift data was only available for 75 of the 95 total fails (Table 4). The 75 fails included all inspection types from both day and night shifts (Table 4). Of the 75 fails, 20 occurred within one week of a shift change while two fails occurred two weeks after a shift change (Table 4). These data points contributed to 29.3% of the fails occurring within two weeks of a shift change (Table 4). Analysis of the 29.3% revealed the majority of fails occurring within one week of a shift change (Table 4). The 75 fails included all inspection types from both day and night shifts (Table 4). Of the 75 fails, 20 occurred within one week of a shift change while two fails occurred two weeks after a shift change (Table 4). These data points contributed to 29.3% of the fails occurring within two weeks of a shift change (Table 4). Analysis of the 29.3% revealed the majority of fails occurring within one week of a shift change (Table 4). The 75 fails included all inspection types from both day and night shifts (Table 4).

### Discussion, Conclusion, Recommendations

This list of 22 failures represents only a portion of the total fails from the two-year period under review. There is a discernible pattern of fails associated with interruptions in personnel’s normal and sleep routines that may be affecting their ability to perform complex tasks. It seems unlikely that these maintainers altered their schedules to accommodate work requirements rather than their personal lives. Upon returning to work after schedule interruptions, maintainers missed maintenance steps, committed safety violations, and failed to use tech data (Table 5). These personnel may have been experiencing a reduction in cognitive ability brought on by fatigue induced by a change in their sleep schedules.

In conclusion, military aircraft flightline maintenance is a complex environment where attention to detail is essential for ensuring safety. The research question aimed to discover what effect fatigue had on military aircraft maintainers. To answer this question, this military unit’s 1,935 QA inspections from FY17 and FY18 were analyzed, and it was determined that night shift did not produce a statistically significant higher fail rate than day-shift. Further investigation of the data uncovered that altering a person’s shift hours did affect job safety and productivity. This study warrants further research into the effects of fatigue in a military aircraft maintenance environment.

### Recommendations

Workers benefit from a stable routine; however, in the military, it cannot be expected that this routine will not be interrupted. While safety is the responsibility of every unit member, augmenting current regulations would be required to promote and enforce a culture of safety. Regulations could include granting night shift workers with daytime appointments a minimum of 10 hours off duty prior to their next day’s appointments. An amended regulation would ensure personnel changing shifts are allowed 48 hours of off-duty time to acclimate to the new shift hours. In conjunction with time off and acclimation periods, personnel should be assigned to administrative duties, such as aircraft forms reviews, for one shift immediately following a change in their schedules. This will remove maintainers from safety-critical areas while providing additional time for schedule acclimation.

Finally, when alterations in schedule hours occur due to shift changes or holidays, safety briefings can be utilized to bring awareness to fatigue and its association with quality assurance fails and unsafe conditions in the workplace. Utilizing these recommendations could have reduced the analyzed military unit’s QA fails by 29.3%. When used together, updated regulations and awareness can play a large role in the reduction of failures and increase safety and productivity. This study warrants further research into the effects of fatigue in a military aircraft maintenance environment.

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### Table 3: Contingency Table Results

<table>
<thead>
<tr>
<th>Cell Format</th>
<th>Count (Percent of Total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>Fail</td>
</tr>
<tr>
<td>Days</td>
<td>1127 (58.24%)</td>
</tr>
<tr>
<td>Nights</td>
<td>713 (36.85%)</td>
</tr>
<tr>
<td>Total</td>
<td>1840 (95.09%)</td>
</tr>
</tbody>
</table>

**Chi-Square test:**

- **Statistics:**
  - DF: Value
  - P-Value: 0.7468

**Note:** Contingency table was calculated using stataunch.

---

### Table 4: Analysis of QA Fails FY2017-FY2018

<table>
<thead>
<tr>
<th># of Fails</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fails Analyzed</td>
<td>75</td>
</tr>
<tr>
<td>Week 1</td>
<td>20</td>
</tr>
<tr>
<td>Week 2</td>
<td>22</td>
</tr>
<tr>
<td>Total # of Fail within 2 weeks of shift change</td>
<td>22</td>
</tr>
<tr>
<td>No significant shift change</td>
<td>53</td>
</tr>
</tbody>
</table>

**Note:** QA Fails organized by shift changes. Weeks 1 and 2 list QA Fails that occurred within the first or second week of a shift change.

---

### Table 5: Schedule Change QA Fails

<table>
<thead>
<tr>
<th>Shift</th>
<th>Week 1 Fail</th>
<th>Week 2 Fail</th>
<th>Type of Fail</th>
<th>Shift Change Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Night</td>
<td>x</td>
<td>UCR</td>
<td>Planned on 12-hour shift</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>DT</td>
<td>Planned on 12-hour shift</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Day shift appointment followed by day off</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Day shift appointment</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Day shift appointment</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Day shift appointment</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Day shift appointment</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Day shift appointment</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Holiday</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>UCR</td>
<td>Holiday</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>UCR</td>
<td>Holiday</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>UCR</td>
<td>Holiday</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>UCR</td>
<td>Holiday</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Holiday followed by rotating day hours</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>UCR</td>
<td>Shift Change</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
<td></td>
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<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
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<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
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<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
<td></td>
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<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
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<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
<td></td>
</tr>
<tr>
<td>Night</td>
<td>x</td>
<td>OT</td>
<td>Shift Change</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Week 1 and 2 columns list QA Fails occurring within the first or second week of a schedule change.

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### Figure 1. Schedule Change QA Fails

This figure illustrates the effect of shift changes on the number of QA fails. The chart shows the percentage of QA fails associated with different types of shift changes, highlighting the impact on safety and productivity.
References

Williamson, A. M. (2000). Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. Occupational and Environmental Medicine, 57(10), 649-655. doi:10.1136/oem.57.10.649


Cheng, et al. 2017


Predicting and Measuring Competitive Advantage in Future State Logistics

By: Lt Col Dan McGuire

Introduction
The Department of Defense (DoD) and United States Air Force (USAF) should think big, start small, and learn fast about the Internet of Things (IoT) and the associated logistical capability towards future state-contested environments. Enhancing prior waves of information technology competition, IoT enables disruptive innovation by adapting the logistics enterprise to exceed the competitive advantage of adversaries. Centered upon future-state logistics with global implications, the research first asks what if? What if USAF logistics could identify the next disruptive innovation within future state logistics and the critical period of integration? What if USAF logistics could forecast alternative futures of a nation or region’s capability to exploit the innovation and gain competitive advantage? Correspondingly, this is in connection with the National Defense Strategy’s (NDS) foresight where “new commercial technology will change society and, ultimately, the character of war.”

2018 National Defense Strategy and the Importance of Technology in A2AD

The NDS asks us to “evolve innovative operational concepts” by anticipating how competitors and adversaries will employ innovative technologies to deter and defeat the US. In future environments, where time is a decisive parameter, logistics enterprise must make decisions and process data faster than the enemy. Regarding Anti-Access, Anti-Denial (A2AD), the technological capability a nation holds within its borders will have greater influence on deciding the outcomes of future conflicts. Because both state and non-state competitors will have access to these technologies, there is a risk of degraded conventional advantage. To mitigate this risk, we must consider IoT capability within future state logistics.

Thirty-year Cycles of IT Evolution in Logistics

Through an industrial lens, we may consider the vast leaps forged within logistical infrastructure through the integrated network within information and communications technology (ICT), energy, and transportation. Between 1900 and 1929, the United States constructed comprehensive infrastructure interconnections of electrical grids, telecommunications, roads, pipelines, water, and sewage. As a result, advanced production across every industry from manufacturing to real estate, propelling economic advantage and increased industrial competition. In time, these industrial advances framed 30-year waves of information technology (IT) evolution. Namely, electronic information via computers in the 1960s followed by an integrated network of information via the internet in the 1990s. The third wave of IT evolution is postured for 2020 in the form of IoT (Figure 1).

The Critical Decade to Measure: 2020-2030

Demographics
When engaging the future of IoT integration, the world’s population is of great consideration. Reductionist demographic projections will radically alter the workforce, military end strength, and arising political conflicts. It is projected within 2020-2030, the United States and its military will gradually become short of workers and require them at the same time the rest of the industrial world develops a similar demand.
The Influence of Culture
At the heart of America today is the blended culture of traditional values and disruptive innovations; consider the military as a reflection of this culture. Arguably, the binary logic held within USAF computations is merely an extension of military pragmatism and the desire to evaluate ideas within easy to understand practical consequences. However, the DoD has learned current warfare no longer reflects this methodology. Therefore, if we are to use technology to enhance the logistics posture towards future conflicts beyond 2020, the technology must be congruent with the warfare itself: analogously wicked, interconnected, complex, and adaptive.

50-Year Economic Crises and Further Influence of Infrastructure
Every fifty years, the United States has been confronted with a defining economic crisis reemphasizing the importance of infrastructure. A historical, cyclical perspective reveals the transition from founders to pioneers (1776–1828), pioneers to small-town America (1826–1876), small-town America to industrial cities (1876–1932), and industrial cities to service suburbs (1932–1980). In our current cycle, President Reagan’s supply-side economics set the foundation for late 20th-century economic gains and will be continually going forward.

Selecting the Right Systems Model: International Futures
The International Futures (IFs) model, by way of the Pardee Center at the University of Denver, contains the required parameters and equations to forecast the implications of new technologies and the associated strategic advantage. IFs has evolved over the past 25 years as a global database drawing heavily upon demographic, econometric, and systems dynamics traditions. Under the parameter category of technology, IFs contains a subset titled, artificial intelligence subject to tasks, which includes measurements of IoT. Under the parameter category of infrastructure, IFs reflect measurements within ICT, energy, and transportation. As a force multiplier, IFs offers cybersecurity measurements as an index through the International Telecommunication Union database. Through integrated computer simulation, IFs further offered a comparison of alternative levers inside a consistent framework. Strategically, if this research can compile a baseline means of evaluating IoT capability, then a discussion can begin regarding how to best adapt and monitor the data and metrics IoT offers going forward.

Forecasting Alternative Futures in IFs
The research forecasted two alternative futures to evaluate specially selected dependent variables as compared with time in highly contested regions. One alternative future contains the label [0] to indicate baseline, and the other alternative future is labeled [1] to indicate working. The baseline case is a future remaining consistent with current social and economic trends resulting from policy frameworks. In comparison, the working model contains additional parameters of technological and military focus. The working case incorporates strategic interventions such as ten percent increases in investment in research and development, protectionism in trade, increased electronic networking, technological advancement, and expenditures in the nuclear enterprise. This manipulation was framed by the research’s strategic themes and implemented through self-learning by the researcher on the means to forecast variables within IFs. A summary of forecasted trends is found in Table 1 below.

Table 1: Summary of Forecasted Trends towards IoT Capability

<table>
<thead>
<tr>
<th>Infrastructure Category</th>
<th>Competitive Advantage</th>
<th>Critical Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
<td>regulation, connectivity</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td>availability, consumption</td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>land area, road networks</td>
<td></td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>technical measurements, resources</td>
<td></td>
</tr>
</tbody>
</table>

Formulation of an IoT Capability Index Score
Analogous to the indexes represented within IFs, this research is introducing an index concerning the interconnections within IoT. This research is titling the formulation as the IoT Capability Index Score and desires to demonstrate the relationship of these parameters in a simplistic, organic, and comparable value. A visualization of this index is seen in Figure 2, and the theoretical equations are displayed in Equation 1. This research does not claim this index to be a solution to the complex issues surrounding 2+1+1 but one method to help understand how the evolution of technology can impact the future battlespace.

In this weighted equation, a measurement of a nation-state or region (r) at a given year (t) occurs through the combination of the weighted score of their n ICT parameters, Energy parameters, and Transportation parameters multiplied by their Cybersecurity Index Score. N represents the total number of ICT, energy, and transportation parameters considered in the equation, and n represents the individual parameter. The utilization
of N and n within a theoretical formula is intentional as this research hopes the formula will be adapted, modified, and enhanced in the future.

**Charting the IoT Capability Index through 2030**

As the theoretical index is computed, the US is forecasted to maintain a competitive advantage within the measure of the interconnection between ICT, energy, and transportation through the year 2030. However, the growth rates are not as rapid as peer competition and begin to plateau. North Korea lags behind but experiences steady growth towards 2030. While Iran lags as well, they begin to experience an accelerated growth towards 2025-2030, and by 2030, they almost reach the state the US currently holds. While Russia closely models the growth of the US, China advances aggressively to surpass Russia by 2030 ultimately. The figure indicates both China and Iran if they continue to experience these rates of growth, would ultimately surpass the US in the future.

**Base Case versus Working Case: IoT Capability Index Score.**

Analysis of the baseline case versus the working case reveals the strategic interventions of the working case equate to higher values than the baseline case. This means nation-states who apply strategic interventions within ICT, energy, and transportation can maintain a competitive advantage in future environments where new interconnected technology holds exponential influence.

**Significance of Research: A Futurist’s Look Towards 2030**

The strategic implications of the IoT Capability Index reach far into the future. In truth, a weapons culture of interacting, synchronized sensors will be congruent with the projected demographic reduction of 2020-2030. Ultimately, this paves the necessity and requirement of IoT to supplement and enhance the logistics workforce. This enhanced logistics capability will be proven first on land-based platforms such as base, fleet, and inventory management before fully transitioning to aerospace and hypersonic platforms. Eventually, successes learned during initial exploration and incorporation will create enhanced technological capability in space. This is a similar pattern to the first use and then the modernization of precision-guided munitions as well as aircraft. When this occurs, the military conceptualization of societal mobilization within a global battlefield will begin to fade. In fact, as the evolution of technology further increases speed, accuracy, and range the size of the required military force decreases alongside massive stockpiles of land-based resources and associated petroleum requirements.

**Figure 3: IoT Index Score charted through 2030**

As IoT continues to become the third wave of disruptive IT innovation within logistics, a fourth wave becomes postured. The most logical conclusion in the next thirty-year cycle becomes the exponential growth of artificial intelligence. As USAF logistics evolves towards smart, connected systems, the logistics enterprise will one day facilitate what this research currently titles the Internet of Military Things (IoMT). Research predicated towards the IoMT will then shape what future-state logisticians may know as the Internet of Logistics (IoL) where physical and digital logistics are fully integrated within smart operations.

**A Call for Logisticians to Embrace IoT and a New Leadership Culture**

Under IoT integration, logistics leaders are postured for success within a national strategy advocating modernization and innovation towards current resources. Leaders with the ability to effectively communicate sustainment on behalf of the DoD will be fully complementary to military success in the future. The evolutionary initiatives found within IoT integration pave the way for logistic leaders to innovate how the USAF postures for war. Ultimately, the current culture of move-by-move control within most military operations has proven ineffective in a networked world of complexity and speed. As logistics and IT are further integrated, the days of a senior leader who acts as a controller and surveyor of all will shift towards a crafter of information and culture. A key leadership trait will become promoting integration and collaboration within a similar pattern in the technologically advanced environment. Only those with the ability to lead in adaptation will find success.

**ABOUT THE AUTHOR**

Lt Col Dan McGuire is a 15-year Air Force logistician currently serving as Commander of the 377th Logistics Readiness Squadron at Kirtland AFB. Lt Col McGuire holds a PhD in Strategic Foresight from Regent University and is a recent graduate of the Advanced Study of Air Mobility.
In the Beginning...

Upon arriving at the 332nd Air Expeditionary Wing (AEW), the Wing Commander issued a challenge to his subordinates, asking them to become “owners” not “renters.” He said, “When you own something, you invest blood, sweat, and tears into it, and truly take it to be your own. When you are a renter, you roll through the motions, leaving it to the owner to improve things.” The challenge he proposed bled down through his command teams, inspiring the most junior Airmen and instilled a culture that still endures to this very day. The Gatekeeper Compound, co-owned by the 332nd Expeditionary Logistics Readiness Squadron (ELRS) and the 332nd Expeditionary Force Support Squadron (EFSS), is a prime example of how motivated Airmen in the 332 AEW were to be “owners” rather than “renters.” Over the course of two deployment rotations, the Aerial Port and PERSCO teams joined forces, making a one-stop-shop for all in-processing and out-processing. Their efforts, the no-kidding, blood, sweat, and tears they put into the development of the Gatekeeper Compound is now felt by every team that rotates in or through the 332 AEW. In the course of just one year, the team went from only being able to process four passengers at a time, in a tiny trailer, to be able to process upwards of three hundred passengers in one dedicated area, and slashing the processing time by 75%! Without full support from all levels of leadership, and the continued push for #OwningNotRenting, the Gatekeeper Compound would not be what it is today.

The initial development of the Gatekeeper Compound began in April 2018. At the time, the installation was knee-deep in transitioning towards an enduring status, and the base population was bursting at the seams. Traffic Management was tightly squeezed into a single temp-controlled Conex, and the passenger terminal was operating out of a tiny trailer where they could only process four to five passengers at a time. The limited servicing capacity was not conducive to the upick of aircraft transitioning through the region supporting OPERATION INHERENT RESOLVE. There was simply no way to sustain the requirement to service anywhere from four to forty Space-R passengers on a daily basis, not to mention the large aviation packages and Army swap-outs (i.e. 500 plus personnel processing in/out at a time). The team recognized their limited capabilities and jumped at the chance to relocate into a larger facility. In July 2018, they underwent a full transition into their new facility, where they merged all Aerial Port functions for both passengers and cargo. Although it was not ideal.
for larger movements, the new location provided them with the ability to accomplish day-to-day operations while maintaining the security of their passengers. For processing the larger in- and outbound movements, the team paired up with PERSCO to use the “MWR K-Span” (Reds) and base movie tents. Though space was adequate, it forced all morale events to shut down for the duration of the processing periods in an attempt to provide passengers with an uninterrupted experience. For out-processing, all passengers had to show up at Reds to complete 100% bag dumps with US Customs and fill out the paperwork with multiple agencies, which often took all day. For inbound movements, the Life Support Area was closed off to traffic for bag drop-off (prohibiting emergency vehicles access to the area), while members fought to cut in line and rush their personnel through processing!

In the meantime, the team continued to search for a more appropriate venue to conduct large scale passenger movements. After weeks of tenacious brainstorming, the team believed they had a solution! They worked with Al Udeid to obtain a 4K dome out of the War Reserve Materiel inventory and solicited help from Civil Engineering to build up an area behind their current facility for the dome to be placed. Then, they procured an x-ray machine and began the process of purchasing the x-ray capability for US Customs processing. Their ingenuity was making a difference, and their enthusiasm became contagious!

The team was prepared to stand up their new passenger terminal/reception control center; however, they had overlooked one important aspect... SAFETY. Due to the base’s transition into “enduring status,” DoD guidance dictated that new construction for passenger terminals was not authorized to be built within a specific proximity to the blast arc radius around fighter aprons. What did this mean for the team? Back to the drawing board!

After weeks of research and discussion with Wing Safety, the 332 ELRS worked to develop a different solution and found a new home outside of the blast arc radius. By September of 2018, the team had relocated the 4K dome to the main Life Support Area and gained approval to take over one of the hardened facilities, intending to eventually create a fully operational passenger terminal and reception control center.

October 2018 brought new momentum to the project as well as new challenges. As units began to swap out and space was limited, the 332 ELRS moved into their new facilities to begin working even more fervently in order to make the most out of their newly acquired resources. Seemingly overnight, they teamed with the 332 Expeditionary Communications Squadron to install Wi-Fi just-in-time for the first massive passenger movement of the season. In the following weeks, the team was also able to support not just one, but six more large scale movements, processing over seven hundred passengers!

Rather than run through the motions of mindlessly processing passengers, the team took these six movements as an opportunity to streamline their process even more. During the October and November movements, they captured real-time data from start to finish, identifying where they could reduce unnecessary wait times for passengers while maintaining mission standards and requirements. With every movement, lessons learned from the previous were implemented into the next movement.

For instance, they were able to identify that in one hour, the US Customs team could process twenty-five personnel with 100% bag dumps complete. Due to the lengthy time it could take for processing checked bags, the team determined that by splitting the schedule into two days, they could have all necessary items pre-staged before departure day thus reducing passenger wait time altogether.

Processing on the day prior to movement is traditionally done in waves of twenty-five personnel. This new schedule allowed the passenger terminal representatives to finalize the Excel manifest (XMAN) with the members’ weight (including their carry-ons) and submit it into GATES 24 hours prior to mission departure. Previously, the team would have to wait until departure day to submit the XMAN because they were finalizing the document as passengers arrived for their flight. Due to minimal manning and the new passenger terminal being geographically separated from where the team worked day-to-day, they had to go back to their primary work location to submit the XMAN. This excursion could take upwards of 3.5 hours, depending on the size of the group being processed. By completing this portion on the day prior to movement, the team was no longer racing against the clock to submit the XMAN and could focus their attention on the passengers during departure day.

Additionally, by processing checked bags prior to departure day, the containers could be sealed by US Customs and staged in the cargo yard ready to go for the aircraft, reducing the processing time by four to six additional hours and eliminating potential aircraft delay due to incomplete processing. This gave the team the flexibility they needed to build a schedule that could accommodate all parties involved.
Departure day processing became even more simplified. On departure day, passengers must arrive at their designated showtime, which can range anywhere from forty-five minutes to two hours prior to the aircraft’s arrival time. In order to streamline the process, even more, the troop commander (highest ranking passenger) will identify the baggage upload team, and they will be processed first. By processing the baggage team first, a passenger terminal representative can escort them on to the flight line at the thirty-minute outcall for the aircraft’s arrival. Meanwhile, the Aerial Port and US Customs can simultaneously escort the baggage containers, and baggage upload can seamlessly begin. In the intervening time, the remaining passengers will continue processing through the line with their carry-ons. As seen in the 332 ECES, Red Horse, and 332 ESFS movement schedules, the team was able to identify crucial bottlenecked areas and adjust their process to cut any unnecessary time.

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January came to an end, and the team had two months to complete the next development phase before the March Army rotation and aviation swap. During this time, a new team rotated in to replace PERSCO and the Aerial Port, and they didn’t skip a beat in the transition. All the equipment that was previously ordered had now arrived. The team worked together and installed over three hundred new chairs and twelve tables across the facilities, and they set up stations to direct passengers where to go. The Red Horse team came out and installed the second row of gravel, AM2 matting, and light carts across the required areas for night-time processing.

Between March and April, the team processed over two thousand personnel through the Gatekeeper Compound. During one of the rotations, the team processed 289 passengers in one go; when just a year ago, the Passenger Terminal could only process five passengers at a time out of a tiny trailer in the cargo yard. Because of their hard work and ingenuity, they’re now able to exceed their previous capacity by 285 passengers.

Despite the team’s already impressive success, they continued to work in order to evolve their process at the Gatekeeper Compound further! In March of 2019, the Aerial Port earned enough positions to double their manpower. This meant that in May of 2019, after the majority of the large movements were complete, and before they transitioned into the next large movement season, the new team will be able to man the Gatekeeper Compound full-time. Until that time, the team is continuing to work eagerly in an effort to fulfill all remaining equipment and construction requirements for the Compound.

In June 2019, PERSCO, Logistics Plans, and Traffic Management-Passenger Travel will transition into the Gatekeeper Compound. Additionally, the 332 ELRS and Lodging offices intend to move into the final building of the quad within the next year. Once all of the organizations have finished transitioning in, the Gatekeeper Compound will become a “one-stop-shop” for all personnel processing in or out of the 332nd Air Expeditionary Wing!
Introduction

Since their inception in 1972, the 635th Materiel Maintenance Group (MMG) has been maintaining rapidly deployable basing solutions in support of operations, contingencies, and disasters responses world-wide. Despite their name, owning command and equipment catalogue changing multiple times, their mission has remained—to maintain, deploy and employ War Reserve Material (WRM) capable of transforming any site with a runway and water source into an operational Airbase.

History

After World War II, the US Air Force (USAF) recognized the key advantages gained by being able to mobilize and erect bases for air operations quickly. Honing this ability allowed the USAF to become a more agile force and lower their rapid response times. It also avoided the costs associated with heavy construction and precluded any appearance of US forces being permanent or intended to occupy the host country.1

The original mobile base design, titled Gray Eagle, supported up to 1,100 personnel and was utilized during the Vietnam War at Cam Ranh Bay and Phan Rang Air Bases.2 In the 1970’s the USAF upgraded to the first Harvest Bare, Harvest Eagle and Harvest Falcon, and had them prepositioned near tactical positions. These packages included a variety of sized tents for billeting, dining halls, morale centers and workspaces (in green and tan depending on the terrain), as well as equipment to provide electricity, showers, laundry services, and water purification. The USAF relied heavily on these packages at Howard AFB, Panama, and in OPERATION DESERT STORM. In the early 2000’s, the mobile base concept evolved into the Basic Expeditionary Airfield Resources (BEAR) program, as part of the USAF’s push towards the Air Expeditionary Forces (AEF) construct.3

The MMG was originally named the 4449th Mobility Support Squadron in the 1970’s and changed in 1991 to the 49th Bare Base Systems Group, and again in 1994 to the 49th MMG. The 635 MMG got its name when it was transferred to Air Force Material Command in 2016 and aligned under the 635th Supply Chain Operations Wing (SCOW). This reorganization aligned the 635 MMG (BEAR base) with the WRM global managers, enabling the 635 MMG to better execute the global nature of its mission.

The composition of BEAR packages has adapted over time. The concept focused on a 1,100 person camp from Gray Eagle through Harvest Falcon and became a 550 person package under the BEAR base concept. In 2008, the Bear base concept transitioned into BEAR Order of Battle (BOB), which broke the equipment packages, or Unit Type Codes (UTC’s), into separate capabilities. This allowed the USAF to task certain aspects of the mobile base like billeting or kitchens individually, rather than deploying the entire package. BOB packages could be built for camps from 250 to 3,500 personnel and if the location didn’t need a certain capability in the BOB package, it could be removed and made available for another tasking—this saved the USAF money and allowed the removed capability to be employed elsewhere. Once
a site survey had been completed, the WRM team could build custom support packages specific to that location. The BOB concept has since evolved and is organized by Force Generation Modules, however, the UTC-based approach remains the primary method of employment.

**Present Time**

Today, BEAR WRM assets are primarily dispersed throughout Europe, the Pacific, and the Middle East. Most of these sites are managed by contractors, but the 635 MMG remains the only organic BEAR unit in the USAF. Aside from maintaining over 3,000 UTCs valued at $415M, the 635 MMG fills an important role as the Pilot Unit for all BEAR and Fuel Support Equipment (FSE) assets; owning the personnel UTCs that deploy experts for employing and maintaining BEAR equipment.

As the Pilot Unit, the 635 MMG works with the 635 SCOW-WRM Global Managers, the Air Force Civil Engineering Center, storing organizations, and planners to ensure UTCs are standardized and concerns are addressed so that the UTC meets mission requirements. This is especially vital to BEAR packages since a minor change of assets can impact the packing plan of that UTC. A deviation in model or brand of a clothes washer, knife sharpener, or cables can create a situation in which the assets no longer fit in their assigned shipping container, impacting operations planning by changing the transportation requirements. This requires careful coordination not only during modernization planning, but also during the replenishment of assets as they are consumed, wear out, or reach their shelf life. In addition to packing and maintenance, members of the 635 MMG are also experts on deployment and employment, and they are the only unit posture for BEAR personnel UTCs (XFAJ1, Technical Supervision Team, and XFAJ2, Large Structures Team).

XFAJ1, Technical Supervision Team, known as J1, is a 30-person team that deploys to oversee and train other civil engineers in the setup of BEAR. This UTC consists of electricians, plumbers, and structures Airmen who are available to deploy worldwide with limited notice to build camps and provide places for Airmen to sleep, eat, and work. The more specialized, 8-person XFAJ2, Large Structures Team, known as J2, provides similar oversight on the erection, maintenance, and redeployment of Large Area Maintenance Shelters (LAMS), dome shelters, and sunshades—assets that can directly enable sortie generation. Additionally, the 635 MMG maintains Fuels Operational Readiness Capability Equipment (FORCE) to provide FSE and ensure the availability of fuel for flying and ground operations.

The 635 MMG has supported combat capabilities and humanitarian response through planning efforts and deploying personnel and equipment around the globe. One major current planning effort the 635 MMG is involved with is the European Deterrence Initiative (EDI), which aims to increase readiness in Europe and counter Russian aggression. To support this task, the 635 MMG is responsible for consolidating individual parts ordered by National Stock Number (NSN) into equipment packages and UTCs ready for deployment. This task is time-consuming and decentralized management makes the execution of the plan challenging; since personnel in Europe have to be synchronized with WRM managers at the 635 SCOW, purchasing agents in the Air Force Life Cycle Management Center (AFLCMC) at Robins AFB, and the Airmen at the 635 MMG.

Deliberate coordination efforts have ensured efforts are mostly proactive rather than reactive, but requirements for the Pacific are likely to add to this workload, and all parties involved must continue to meet mission requirements as they arise.

Natural disasters add a significant workload to the 635 MMG and SCOW. The process of requesting support is fairly simple as the 635 SCOW acts as gatekeeper for any taskings, whereas the 635 MMG acts as subject matter experts for determining what equipment best meets requirements, identifies what is available, and then works to pack and ship assets forward. This task has proven crucial to humanitarian and sortie generation efforts across the USAF in recent decades. In 2005, the 635 MMG sent Airmen and equipment to Louisiana in support of Joint Task Force-Katrina, building a 2,000-person camp for relief workers. The need to build tent cities spiked in late 2018, culminating the largest equipment deployments in BEAR Base history. The first tasking was after Hurricane Michael devastated Tyndall
4449th Mobility Support Squadron: In 1989, the 4449th Mobility Support Squadron builds Harvest Bare expandable personnel shelters at Howard AFB in Panama to help with overcrowding at that installation. ([https://nara.getarchive.net/media/](https://nara.getarchive.net/media/))

AFB, which resulted in the 635 MMG building aircraft maintenance shelters to aid the recovery of 17 F-22s and a 1,200-person camp for Airmen working base recovery. Before completing the mission in Florida, an additional task came to build a 2,000-person camp at Davis-Monthan AFB to house Joint personnel supporting President-directed border security efforts. Erecting tent cities is only a portion of what the 635 MMG bring to the fight, they demonstrated this by providing water purification capabilities to Minot AFB in 2011 and deploying FSE to restore flying operations at Offutt AFB in 2019.

Future

Looking forward, the importance of BEAR is unlikely to change. However, the acquisition model and force packaging options should. The AFLCMC owns their procurement, and currently, all UTCs (except a single pallet kitchen) are bought by their national stock number item. This means that for a billeting UTC, cots are purchased separately from tents, cables, and other assets. Then the items are taken out of manufacturer’s packages, and 635 MMG Airmen repack as many as 8,500 items into shipping containers. This is sometimes simple, but it takes hours to prepare, pack, and inventory—tasks not in the Airmen’s AFSC and that are not wartime skills. The 635 MMG leadership is currently trying to change the procurement model so that full UTCs are purchased and arrive ready for deployment. The benefits would be huge because BEAR would be free to focus on employment training, function checks, and perhaps even manpower requirements within the 635 MMG at Holloman AFB could shrink, making assigned engineers and logistics available for other Air Force needs. This shift in focus could also create the capacity to support logistics senior leaders’ transition toward the Adaptive Basing concept—a transition that could drastically change the overall mission of the 635 MMG.

Hurricane Michael Deployment: 635 MMG Airmen prepare cargo and deploy to Tyndall AFB to support the recovery of 17 F-22s and build a 1,200-person tent city. ([US Air Force photo by Staff Sgt. Timothy Young](https://www.holloman.af.mil/News/Display/Article/1655058/flood-of-support/))
Adaptive Basing involves deploying forces across multiple bases rather than a single larger base in order to complicate “the enemies’ ability to target and deliver mass while providing a means for US forces to survive, persist and operate in the A2/AD environment.” Centrally stored traditional BEAR UTCs and the J1 and J2 skill teams located solely at Holloman AFB currently cannot effectively support this concept. To modernize the BEAR program, the aforementioned transition to buying UTCs and returning MMG Airmen, along with J1 and J2 capabilities, is vital. Additionally, WRM storage plans need to be balanced to ensure large basing solutions are retained in accordance with operations plans while new requirements are filled. Like the changes in 2008 that broke up the massive Harvest Falcon, Harvest Eagle, and BEAR-550 kits into capability-based UTCs, this is an achievable task.

Summary

USAF’s BEAR packages have come a long way since they were first conceived in the 1950s. However, despite all its adaptations, the need for rapidly deployable basing solutions remains. Since its inception, the team of professionals, now known as the 635 MMG, stand ready to support any natural disaster or contingency with scalable capabilities. Give us a runway and water source, whether it’s a large base or a small camp, and we will enable sortie generation through Adaptive Basing. Call DSN 572-BEAR—the 635 MMG will live up to their motto and be “Ready When Called.”

References


ABOUT THE AUTHOR

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Eighth Air Force Depot Maintenance & Logistics Leadership in World War II

By: Capt David Loska

Contemporary histories of the Army Air Forces (AAF) in World War II acknowledge that the deployment of depot maintenance and logistics operations enabled the rapid assembly, development, and reconstitution of bomber and fighter aircraft in the ETO. The resultant tactical agility proved vital to achieving air dominance over the Luftwaffe and defeating the Third Reich. Seldom do these histories capture how the AAF accomplished this feat, however. Rarer still are examinations of the individual contributors to this success. The stories of these maintenance and logistics forerunners beckon resurrection amidst the high-octane output of a hundred thousand cranking engines infused in the icy fog of obscurity.

Origins

In September 1941, following the combined Anglo-American strategy of the Argentia conference, General Henry H. Arnold directed Maj General George H. Brett, a seasoned materiel officer and commander of the Air Corps, to conduct a study of the maintenance of American planes, supply lines, equipment and training supporting Lend-Lease requirements in England and Northern Ireland. This was to be followed by a survey of logistical efforts in Northern Africa. Brett bid farewell to his wife and young son “Rock,” who would many years later grow to become Commander of Allied Air Forces Southern Europe. As Brett boarded his LB–30 Liberator aircraft, he told his son “I want to introduce you to a very special individual…. Captain LeMay.” Curtis LeMay’s mission, though concurrent to Brett’s, was singularly significant to theater logistics as it would establish the ferrying and supply route into North Africa. He would fly a southerly route, first to Brazil and then across the Atlantic and through western Africa to Cairo and return. Brett traveled onward from Cairo to England but would eventually return to North Africa for further surveying; leading to the establishment of a depot at Gura in Eritrea. Brett’s mission was critical; survey and report a detailed account of theater maintenance and logistics.

Time was unimaginably of the essence.

Facility Construction Langford Lodge, Lockheed Overseas Corporation Annual Report 1942-1943. 1943, National Archives

The U.S.’s early investigatory mission in the U.K., the Special Observers Group, known simply as “SPOBS” led by General James Chaney, were directed to test and observe American equipment in the campaign, study British operational methods and manage the exchange of personnel and the standard and experimental equipment between the British and U.S. military.

Chaney, who was
would cause some consternation in the War Department transfer of maintenance responsibilities from the RAF. Brett’s forethought recommendation for the overall AAF, and for the supply of spare parts. "

"Make a thorough study of bombing operations being conducted by the RAF Bomber Command and submit to this headquarters’ recommendations covering the training, equipment, tactical doctrines and methods of employment of units required to conduct an effective air offensive... and...a plan covering the reception and assignment to stations of bombardment and auxiliary service units and the administration and supply of such units."

The lack of preparedness and planning for critical logistical factors was immediately apparent to Eaker. In his view, this complex problem had two options with only one objectionable choice. He could fully construct facilities and develop an independent logistics organization before initiating combat operations, or he could have his forces rely on the British to undertake bombing missions soonest. Ideally, Eaker would have built the required depots, and equip them for the overhaul of engines, aircraft, instruments, and ordnance. He could complete and prepare them entirely. Optimistically, he could have this done before the year was out. Eaker and his staff estimated that the Warton site, not far from Blackpool, could be developed within nine months. Realistically, construction and preparations for any depot facilities had not even begun. Nor had any effort been made to prepare any basing for the reception of troops. Eaker would “compromise” his ideal vision and have the 8th borrow from their hosts. This was difficult to stomach for a man who’d entered military service at the twilight of World War I and witnessed the air arm going hat-in-hand to the French. However, closing on the enemy earlier would add nourishment to the cheapened sustenance of a hand-to-mouth existence. The immature supply lines would have to be accepted; waiting was just too dangerous. The AAF would develop the operational bases that had been made available to them by the British government. Though the stations would still require a lot of work, they could be available almost immediately and, by Eaker’s estimate, could have three bomber groups begin familiarization training for missions by the early summer.

For this to work, the 8th would also need to share and borrow depot facilities to overhaul aircraft until their own could be constructed. Eaker initiated a search for existing facilities that could be put to immediate use. That April, Eaker and Colonel A.J. Lyon, who had been immersed in logistics planning with SPOBS, inspected and selected the Burtonwood Repair Depot. Eaker forwarded his decision with Chaney’s strong endorsement, and upon receipt, Arnold immediately put into motion the necessary plan to base in the UK:

The planned number of bomber groups would fluctuate varyingly through the early months of the war before being stabilized by the Joint Chiefs of Staff in October 1943, reaching their maximum strength in the summer of 1944 at forty-one heavy bomber, eight medium bomber, three light bomber, thirty-three fighter and fourteen troop carrier groups.7

Deployment
On January 19, 1942, the War Department activated the 8th Air Force at Savannah, Georgia. Also activated was the VIII Air Force Service Command (redesignated from 8th AF Base Command), the logistics arm of the 8th. General Ira C. Eaker arrived in England the following month. After reporting to the U.S. Air Forces in the British Isles (previously SPOBS), Eaker was directed to:

On January 26, Arnold notified General Chaney of the plan to base in the UK:

"20 Groups of B-17s or B-24s, 12 Groups of B-29s; 22 Groups of B-29s or other heavy bombardment planes, 10 Groups of pursuit planes, 10 night fighter squadrons, 10 photo recon squadrons"
The expeditious training of technicians was the norm for the Airmen that would come to make up the depot personnel. Maj General Hugh J. Knerr, who would come to exercise theater-wide authority of AAF ETO logistics by assuming the “dual-hatted” position of both deputy commanding general for administration as well as commander of the VIII AFSC, under Gen Carl Spaatz, would later say that it was providing and sustaining trained mechanics that was the most considerable logistics challenge of the war. Knerr would recall, “Early in 1943 there were not enough crews trained or untrained, and those sent over after having been trained in this country fell down.” Knerr would later recall that it was during a flight with General Arnold to Prestwick, that Arnold decided to address the need for trained mechanics by furnishing more personnel to be trained on the in-theater production lines under control of an experienced technician rather than by increasing the quality of training before deployment. “That process trained men in small jobs, larger and larger so that eventually we had all the trained men we needed.” Although August 17, 1942 saw the 8th fly their first mission, in the early parts of 1943, it would be made manifest that the combat units had outpaced their logistical tail.

The composition of personnel at each depot was a criss-crossed patchwork of British and American civilians and military. Nowhere was this more uniquely pronounced than at Langford Lodge. Initially conceived as a depot repair facility, Langford Lodge Air Depot quickly grew into the most extensive design, assembly, test and engineering mission in the theater. Intending for the depot’s eventual management under the military, the War Department contracted the Lockheed Corporation to run the site initially. This leveraged the relationships that Lockheed had built during its tenure operating an assembly plant for the British near Liverpool. Civilian and military men and women from Great Britain, Ireland, America, and a small group of workers from Poland, were employed on the two-runway air base off the east shore of Loch Neagh. The local men and women arrived to work via train disembarking at Gortnagallon marshaling yard, while the American civilian and military personnel lived and worked on-station out of “Butler Shed” hangers, pole-barn style rectangular buildings roofed and sided in corrugated metal. Base Manager Henry H. Ogden, who was uniquely qualified to manage complex international aviation materiel and logistics operations, having inaugurated the field himself primarily, led the operation.

In 1924, at age twenty-three, Staff Sergeant Ogden served as assistant supply officer and co-pilot as one of two non-commissioned officers on the eight-man team of U.S. Army Air Service pilots: the first ever to circumnavigate the globe in an aircraft. The feat required the prepositioning of fuel, replacement engines, and spare parts around the world. The planes could only carry 300 pounds of supplies each so Ogden, responsible for the materiel management of the team, made tough decisions about what to bring along, excluding even precious parachutes and life-preservers. After 175 days, seventy-four stops, one crash and the forced landing of Ogden’s initial aircraft in the Atlantic, flying a total of 27,550 miles of serpentine routes through Indochinese jungle, the deserts of Iraq and Jordan, and dodging icebergs as low visibility drove their cruising altitude terrifyingly close to Atlantic wavetops, the team arrived back in Seattle. Ogden, for his resourcefulness, was awarded the Distinguished Service Medal and later Staff Sergeants Ogden and Alva Harvey were commissioned as Second Lieutenants. Shortly after, Ogden left the service and ventured into entrepreneurial roles in aviation, leading to his employment with Lockheed Overseas Corporation Annual Report 1942-1943.

The World Flight crews at Sand Point, Washington, before the start of their round-the-world journey, Staff Sgt. Henry Ogden (second from left) Source: National Air and Space Museum, Smithsonian Institution (SI 81-8960).

Mary Ann Site, Burtonwood, Photo: Lawrence Sutton, Source: Aldon Ferguson

US and British personnel check the instruments on a P-51 Mustang at Burtonwood, 1942, © IWM (FR 14819)

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Lockheed. Nearly twenty years after his round-the-world expedition, Ogden led the BADD team that would rapidly grow to 1,200 diversely qualified support professionals before the end of his first year, and 7,600 at the war’s peak.18 Again performing the role of pathfinder, this time on an industrial scale.

Sharing a similar culture, and both a common enemy and language, relationships between Americans and British at the depots were overall friendly and cooperative. Nevertheless, there were occasional frictions. During the early period that Burtonwood was still under the control of the British, and was carrying the majority of the workload while the other depots came on line, the hastening expansion of American capabilities stirred conflict with the British shop technicians. Upon his arrival in August of 1943, USAAF Captain K. McGee had trouble making heads-or-tails of the production difficulties in his Metal Manufacturing Department. A surprising 50% of all his parts were discarded after failing inspection. The equipment in his shop was the most apparent problem; sixty of the seventy-five machining tools being used were clearly obsolete. McGee quickly put in requisitions for new machine tools, lathes, milling machines, and grinders. Here too he ran into a conflict, a tangle of bureaucratic red-tape, as his orders were rejected from the U.S. citing that the machines were “too heavy” and therefore ill-equipped for work in the ETO. Now, insisted upon remedying the root cause of the failure of his production line, McGee found in one of the corners of his shops three brand new screw machines covered in dust. He learned that they were delivered earlier that Spring, but had not been used or even wired for service be-cause the British Labour unions had complained that the machines were too fast and would put men out of a job. McGee could not understand this objection and, despite the controversy, he ordered them put to use. By the end of September, the three screw machines were operational and be-fore the years end 200 total production machines were up and running. With that, the shop that was initially envisioned to address minor battle damage repair was now mass-producing orders of parts over 1,000 items.

Maintenance

The average bomber spent 204 days in the ETO: 19 days engaged in operational missions, 96 days on operational status but not engaged in operations, 21 days in non-operational training, and of those 204 days in the ETO, 68 were committed to repair maintenance and modification.14

The depots were assigned the modification, battle damage repair, supply, reception, and dispatch of all aircraft. The specialization of each location was either deliberately planned or developed out of necessity. Bomber aircraft, for instance, were flown directly to their combat units after being flown to the depots from the states for modification. Fighter aircraft, however, required shipment. These aircraft were shipped to ports in Liverpool or Glasgow and were transported and assembled at Speke and Renfrew aerodromes, then transported to the depots for modifications before being dispatched to their operational squadrons.15 The processing of radial engines was primarily performed at Burtonwood, while the processing of in-line engines was performed at Warton. Battle damage repair and heavy maintenance were for the most part conducted at Warton and Burtonwood. Langford Lodge was inaccessible to most units, and so only flyable aircraft could be taken there for repair. Langford Lodge, therefore, became specialized in engineering and test and took on a large share of the modification and design program early on in the war.

Knerr in a memo to the War Dept. describes operations as follows.

“...Langford Lodge is essentially a civilian operated aircraft factory functioning under military management. Warton is an engine overhaul and airframe repair activity, and Burtonwood is essentially a supply depot and engine repairshop. In addition, each is capable of doing some of the work of the others”18

Moreover, the depots specialized in maintenance by subsystem. Langford Lodge was responsible for the fabrication of modification kits and certain modifications as well as the overhaul of some propulsion components. Warton was responsible for v-type in-line engines and aircraft, instruments, hydraulic and electrical accessories, and armament equipment such as gun turrets and computing gun sights. Burtonwood was responsible for radial type engines and aircraft, propulsion systems and components, radios, and rubber components such as fuel cells, deicer boots, and self-sealing oil tanks.19

The Base Air Depot Area (BADA) was instated near Burtonwood to establish oversight of the depots. BADA acted as a small headquarters that was sometimes called upon to shift backlogs of workload between the three depot locations. The Bradley-Knerr Commission recommended the establishment of BADA for “centralized control and decentralized operation” of the independent operations of the three depots. This was to ensure that the “...independent operations should be tied together by one management, which by continuous contact with daily problems involved could take immediate action therein without time consuming reference to a headquarters several hundred miles away, and, in the case of Langford Lodge, across the Irish Sea.”20


B–17G Undergoing Maintenance, Source: Aldon Ferguson
BADA and its repair and supply network would grow to an end strength of nearly fifty-thousand personnel as set forth by the Bradley-Knerr commission. At the depots, this included roughly fifteen-thousand at Burtonwood, ten-thousand at Warton and over six-thousand civilians with more than a thousand military personnel at Langford Lodge.\(^2\) Command of BADA was entrusted to Brigadier General Isaac “Ike” Ott, who had previously commanded BAD1.

Ott’s tough-as-nails leadership is the stuff of legend. Ott was so demanding that he was outright hated by many depot personnel, especially at Warton where he was particularly overbearing toward the BAD2 base commander.\(^2\) During his first visit to Warton since the beginning of his generalship, Ott demanded the expedited relocation of the Internal Supply Section to the partially constructed facilities intended for the unit’s future use. Section personnel immediately set to work preparing the building during a week of weather that produced gale force winds and over the next twelve hours relocated all of the stock into the partially constructed facilities intended for the unit’s future use. Section personnel immediately set to work preparing the building for future use.\(^2\)

Contrasted in their approach to the demands of leadership was Ike to his trusted cousin Lt Col Walter “Dewey” Ott. Assigned to BAD1 as Chief of Flight Test, “Dewey” Ott was responsible for the test of newly assembled and overhauled aircraft before their delivery to operational bases. Dewey Ott was protective over the pilots in his care. He would often fly the most doubtful of the unproven aircraft himself, earning him the dedication of his crew. Dewey’s warm and outgoing nature also made him a favorite amongst celebrities traveling into theater, and he was chosen to shuttle VIPs such as Cagney, Crosby, Rooney, and Hope. Dewey Ott became Bob Hope’s preferred pilot during his many visits to the theater, and he was chosen to shuttle VIPs such as Cagney, Crosby, Rooney, and Hope.

The weaving repair network and its evolving terminology developed to such a complex state that by July of 1942 General Spaatz wrote in a letter to Arnold “This constant changing of terms leads to too much confusion.”\(^2\)

One innovation that by the end of 1943 General Eaker would recall as “One of the principal technical achievements of the Eighth Air Force during the year...”\(^2\) was the development of the Mobile Repair Unit. In fall of 1942, weighing the need for mission-ready aircraft and the man-hours required to produce them, coupled with the sheer difficulty in disassembling large aircraft for transport to repair bases, the 8th decided to devise a means to deliver repair capabilities to the aircraft. This would restore the aircraft to a safe-for-flight condition for travel to a depot for further reconstitution. The Lockheed Overseas Corporation designed and fabricated the first of the units, and with a successful design, was awarded a contract for the construction of 50 units in February of 1943. The units consisted of two semi-trailers outfitted with tooling and repair facilities and one or two trucks or jeeps to ferry personnel and supplies. Initially, one of the trailers was designed to house its 16-19 specialist personnel, but it became clear that the personnel would be better off finding lodging in local amenities and the trailer was adapted to hold more repair equipment and parts.

In another clever attempt to overcome the challenge of access to repair capabilities, engineers and mechanics at Langford Lodge experimented with the conversion of a WACO Gilder into a mobile aircraft repair shop, known as the “Mechanikite.”

The weaving repair network and its evolving terminology of air depot, sub-depot, advanced depot, mobile depot and service centre developed to such a complex state that by July of 1942 General Spaatz wrote in a letter to Arnold “This constant changing of terms leads to too much confusion.”\(^2\)

Personnel of the 322nd Bomb Group inspect a battle-damaged B-26 Marauder. © IWM (FRE 4527)

Material support falling behind operational need was heightened as 25%-50% of aircraft coming back from missions into Nazi-held Germany were returning with battle damage. General Eaker complained, “This places a burden on repair establishments which had certainly not been recognized in peacetime planning and for which there was no adequate organization.”\(^2\) The cannibalization of parts from non-operational “hangar-queen” aircraft became invaluable to the reconstitution of mission-ready aircraft. However, due to the inadequate provisioning of spares at the onset of war, the practice began to get out of hand. New assemblies such as landing gear, turrets and starters, arriving from the U.S. were stripped of their sub-components and their carcasses sent to the depots with a repairable tag. This led General Miller, Commanding General VIII AFSC, to intervene into the cannibalization problem borne out of necessity. “...the practice violates existing regulations and must be curbed.” To address the battle damage problem, the spring of ’43 Bradley-Knerr commission recommended the establishment of a network of sub-depots to extend repair capabilities and supply closer to the operational bases. These sub-depots were activated and would later become further decentralized into advanced depots.\(^2\)

As some bomber formations were singled out during missions, the need for battle damage repair fluctuated greatly between the bases and depots. The network of sub-depots and advanced depots absorbed the 3rd and 4th echelon overhaul repair through roving work parties between stations.

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under the 8th Air Force’s Combat Support Wing, these transport units navigated England’s harrowing carriageways packed with bombs, ammunition, and supplies. Ashamedly failed by the myopic policies of leaders who were dealt complex problems resulting from old prejudices, the AAF as an occupying force instituted segregation in a land where beforehand it could not be found. This led to infamous firesstorms of conflict such as that at Bamber Bridge near Warton. It also led to a formalized lack of human decency. After round the clock, arduous distribution missions between bases, often through rain and fog, many of the truck transport servicemen were not afforded a bed or a warm meal at the stations they serviced; instead, they found rest only on the cold bench seat of their utility truck.\textsuperscript{31} In the same selfless and proud legacy of the military units serving the U.S. during WWII, the truck transport units of the 8th Air Force’s Combat Support Wing dilated the logistical veins of the 8th as the lifeblood of ETO lethality.\textsuperscript{32}

One of the most unique stories to actualize from the battle damage crisis was that of Lt. Lieutenant Edward Hall. As an engineer and Officer in Charge over the repair of battle-damaged aircraft at BAD2, Hall invented a method and the special tooling required for substituting press-fitted hollow steel tubes in place of drive bolts, enabling faster repair of aircraft and requiring less personnel. The timeliness and magnitude of this development, earned Hall the Legion of Merit. This was one of only a few such medals base historical records document were pinned, one other presented to General Ike Ott in early 1944, near the close of the war.\textsuperscript{33} Hall’s depot successes, background in mechanical and chemical engineering, and a knack for the technical, led to his introduction into missile technology near the end of the war. Hall was assigned to acquire intelligence on the propulsion work of the Nazi’s through the V-2 rocket parts that had either exploded or were retrieved through networks of spies.\textsuperscript{34} At the war’s end, he also led efforts to research underground Nazi missile production facilities for the Air Force. It was during this time that Hall developed a fascination for rocket and missile technology that defined the rest of his military career. In 1957, Colonel Hall, recognizing the limitations of liquid fuel rocket propulsion, developed and promoted a solid-fuel rocket technology that led to the development of the intercontinental ballistic missile (ICBM) under Chief of Staff Gen Curtis LeMay. In 1960, for his work on solid-fuel, Colonel Hall was awarded his second Legion of Merit and would subsequently become known as the Father of the Minuteman ICBM program.\textsuperscript{35}

Leadership and coordination of the daily operations and production planning within the functional departments of the depots were primarily conducted by the Maintenance Division, under the direction of the Maintenance Division Chief. To coordinate depot operations, Production Control sections within each maintenance department collected and reported production data to the centralized Statistical Control office, who further collected the status and production data to generate reports.\textsuperscript{36} These offices were located in rooms surrounded by blackboards covered in statistical data. At Warton for example, 2 officers and 16 enlisted men staffed Statistical Control. Data compiling aircraft arrivals, backlogs, man-hours both available and used, modification programs, parts manufacturing, and assembly and overhaul statistics was organized and reported. This data culminated in the depot’s report to HQ BADA of their statistics covering final delivery and output. Lt Col Billy Arnold, Chief of the Maintenance Division, was uniquely experienced at leading both of the mainland depot operations having transferred from Warton to Burtonwood February 15, 1944.\textsuperscript{37} Arnold’s Maintenance Division Weekly Activity Reports to HQ BADA never missed an opportunity to highlight record-breaking production metrics and output. Arnold’s unique origin and technical background made him unusually adept to the rigors and undaunting pace of depot operations. Before joining the Army a week after the attacks at Pearl Harbor, Arnold was employed by the Chrysler Corporation.\textsuperscript{38} Years earlier, Arnold studied for a baccalaureate in mechanical engineering at the University of Illinois before taking up car racing. Between the years 1930 and 1932, Arnold led almost every lap he raced at the Indianapolis 500. In 1930 at age 24, Arnold became the first to win the Indy 500 in under 5 hours and the first to finish at a greater than 100 mph average speed without relief help. He also led all but the first two laps of the race, 198 out of 200 or 99% of the total laps, a record and metric that has yet to be surpassed even to the day of this writing.\textsuperscript{39}

**Modification**

The U.S. learned the importance of keeping an agile modification program in order to seize and retain the air offensive early in the war, even prior to the Battle of Britain. In a SPOBS report dated 13 June 1941, Lyon wrote:

“The lessons of the past year have demonstrated that aircraft must be constantly modified and changed during its life to meet the requirements of modified tactics and specialized operations. The RAF has recognized the necessity of modifications and changes in their planning and maintenance organizations. It is recommended that plans for Base Repair Units and Maintenance include provision for a technical staff and manufacturing facilities adequate to undertake modification of aircraft and its components operated by American Forces in the United Kingdom.”\textsuperscript{40}
During the Battle of Britain, modifications were the mechanized lethality of the RAF combat squadron. RAf mechanic B. Edwards of St Albans, having arrived at Burtonwood the previous spring, would later recall, “Most of the work I was employed on at this time was in fact embodiment of various mods.” During the fall of 1940, the highest priority modification was to equip the Merlin engines of the Spitfire with Constant Speed Units and Propellers. The parts were manufactured by Rootol (a joint venture of Rolls-Royce and Bristol), 125 miles to the south in Gloucester. This system increased the Spitfire’s maneuverability at all altitudes, maintaining the advantage over Luftwaffe bombers. Modifications during the early days of the war included installing armor plating and nose and fuselage guns on Hampden, Buffalo and Oxford aircraft. Though the distance of Burtonwood from England’s south coast or the RAF’s East Anglian operational bases was far enough to limit air attacks, it did not eliminate them entirely. On September 6, 1940, during the early period that Burtonwood was still managed by the RAf, two Ju88’s flew far enough inland to perform a low-level incendiary bombing mission over the airfield. However, after dropping several bombs, no damage to aircraft or airfield resulted. The newly invented Identification Friend or Foe (IFF) system was installed on nearly all model aircraft during this time, and was fixed with an explosive device in the rear fuselage in case the aircraft was to come down in enemy territory.

“The aircraft went out to squadrons practically as quickly as the mods were embodied,” Edwards remembered.

Of the 68 days in maintenance the average bomber aircraft spent in the ETO, an average 12 days were consumed by modification.42 Early AAF policy categorized modifications between those that were necessitated by military or combat requirements, those needed to correct original design errors, and those required to divert aircraft to tactical use other than initially intended.43

As operations were strained to adapt to emerging tactical needs, much of the engineering and design modification workload fell to the Lockheed Overseas Corporation based at Langford Lodge.44 When originally conceived, the Engineering Department at Langford Lodge was only staffed to handle “Shop Contact Engineer” workload, defined as that which would “…develop repair design, approve material substitution, justify a necessary departure from aircraft specifications, and to prepare unsatisfactory reports and very minor modifications.”

The fall of 1942 saw the introduction of the design, engineering and modification workload at Langford Lodge, transferring the primary responsibility of this work from the British engineers at Burtonwood. Lockheed relied on whatever design capabilities their small staff could muster, and recruited whatever engineering help they could find locally. This amounted to only two Polish, one British and one Irish engineer.45 Lockheed filed emergency requisitions to its Burbank office for engineering personnel to meet the growing requirements as the mission of the base transitioned from that of a repair depot to the center for the manufacture and design of modifications.

The difficulties in adopting a standard policy for modification programs was a result of the shifting nature of the program. This was, in effect, responsive to the shifting nature of tactical demand and of enemy attack. Communicating technical plans, specifications, and prototypes between depots based in America and England created a tug-of-war on resources and communication. In July of 1943, Maj General Henry Lodge, transferring the primary responsibility of this work to General Eaker:

“With the shortage of trained personnel in this theater and... the requirements for the sustained air effort, the Materiel Command must realize its responsibilities insofar as it pertains to modification of aircraft...As you know, we have been struggling with the P–47 which has taken 4-months to get into combat ...Recommend the modification centers in the United States must be stepped up to ensure the arrival of aircraft ready for combat. Modifications in this theater are being accomplished at the expense of maintenance and supply, and we cannot hope to continue to rob Peter to pay Paul indefinitely.”

The balance was ultimately between the comparative value of man-hours at home and abroad; civilian versus military labor between that of the Air Service Command Maintenance Division in the U.S. and VIII AFSC in England. It was General Clements McMullen, Chief of the Maintenance Division of the Air Service Command who ultimately suggested to Arnold on July 19, 1943, that a heavy bomber in the completely modified form be sent back monthly from the UK to guide the modification program at home.46 This practice was adopted by VIII AFSC and reduced the discontinuity between modification programs at home and abroad.

Modifications ranged from the complex to the simple, from those directed by headquarters to those originating from the technicians that employed them; from the mods that failed to those that succeeded.

In June of 1944, 2d Lt Bill Clearwater departed Warton on a routine test flight of a P–51D. Observers from the airfield watched as the Mustang’s wing detached and the aircraft began to dive vertically toward the earth from 3,000 feet. Test pilots could not determine the cause of the failure and concluded it was a one-off occurrence.47 In the same month, 2d Lt Burtie Orth crashed in another P–51D accident after witnesses on the ground reported having seen his right wing detach during straight and level flight shortly after climb out. The wreckage of Orth’s P–51D was taken back to Warton. The P–51 experts of Hangar 5 found that on both crashed Mustangs, the brake lines had bent around the undercarriage shock absorbers leading them to believe that the landing gear, having been wholly twisted around, had dropped from its stowed position during flight. The Hangar 5 technicians devised a test by placing a P–51D on jacks and exhausting the pilot’s checklist, but to no avail. Leaving the aircraft in a condition of cruise flight with the gear up and undercarriage lever in neutral, they went...
effort and begged for the opportunity to prove that it enlisted technicians had already committed a great effort to modify a CG–4A Waco Glider by installing two engines to determine if it was possible to produce kits to convert them into self-propelled aircraft. Although the project was discarded midstream, the department's depot technicians, desiring merely to prove they could. Other modifications originated from the creativity of newly manufactured Mustangs.

There were exceptional safety incidents, however. The testing of aircraft was inherently hazardous and occasionally resulted in the accidental death of aircrew. Deaths to the ground crew were rare, but did occur infrequently. Langford Lodge reported only one death during its first year due to a loss at sea from a man falling overboard during transit. Because of the threat of German U-Boats, the ship's crew could not attempt a rescue and, "threw him a raft with a flare on it, and kept going," Lockheed later counted the loss as "non-industrial." Warton boasted a generally flawless safety record up to the second half of 1943, despite an accidental wing clipping of a P–51 by an alert crew vehicle. Nevertheless, the first months of 1944 would not be so kind. The month of April was particularly bad in terms of safety for Warton. On the evening of the 16th, a night-shift electrician accidentally blasted all eight guns of a P–47 Thunderbolt, disintegrating part of the hangar roof. The following day technicians accidentally fired the top turret guns of a B–24, spraying the entire area with 50-caliber bullets and shells. Fortunately, in these two incidents no one was hurt, but that same day a civilian contractor named Frederick Cooke was killed while riding in the back of a lorry after being struck by the propeller of a taxiing P–51. Later that year Private Edward Farow died of his injuries while on night shift after walking into the spinning propeller of a P–38. Considering the austerity of the depot conditions, the lack of training and experience, and the sheer number of personnel, casualties to the ground crew were quite rare and allowed for largely uninterrupted progress of industrial depot practices.

And yet, despite the relative safety of these industrial sites, it was at the depots that on the 23rd of August 1944, the Allies would suffer the single most significant loss of the war.

Early that morning in Freckleton, teachers prepared their lessons as students at Holy Trinity School listened attentively. Patrons of the adjacent Sad Sack Cafe, a popular restaurant for locals and for Airmen looking for a better alternative to the mess hall, enjoyed an early meal. 1st Lt. John Bloemendal of BAD2 took off in the B–24 named Classy Chassis II for a post-maintenance check ride. Lieutenant Peter Manassero, commanded a second B–24. While airborne, the two pilots discussed a rapidly developing storm formation that Manassero later called “a very impressive sight and looked like a thunderhead.”

To calm the children after the sudden dark and stormy shift in weather, school teachers at Holy Trinity had the young children place their heads on their desks and read them fables. General Ott at BADA headquarters, aware of the developing storm, telephoned BAD2 ordering the immediate grounding of aircraft and the suspension of flight operations. At 500 feet in altitude, Bloemendal and Manassero approached for landing.
With zero visibility, both decided to abort. Manassero was successful, but the turbulence and downdrafts of the thunderstorm grabbed hold of Classy Chassis II and sent it cartwheeling down narrow Lytham Road. The wreckage demolished homes and the Sad Sack Cafe, and the impact immediately killed its patrons and Bloemendal. The momentum of the crash carried the wreckage farther still, slamming the B–24’s nose turret into the infant’s wing of the school, creating a 2,793-gallon tidal wave of flames. The flames rolled down the narrow street as the small schoolhouse of Holy Trinity Church became enveloped in violent flashing tongues of yellow and red. One of the few survivors later recalled watching his teacher Ms. Louisa Hulme engulfed in flames as the air was sucked from his lungs. Hulme and teacher Ms. Hall were lowered into one of the arms of the cross, and Ms. Hulme later laid along its vertical frame. The small caskets of the children were each laid within the grave’s outstretched arms as if to embrace and comfort the heavily burdened mourners and to beckon the stranger come, see the proof in the scars of the hands and feet and to know better the cost. General Arnold in Washington, so saddened by the news of the tragedy, requested that General Ott represent him at the funeral. The gravity of the war so saddened by the news of the tragedy, requested that General Ott represent him at the funeral. The gravity

Funeral procession for the children who died in the Freckleton Air Disaster, Source: BAE Systems

Resolve

During the spring and summer of 1944, plans and personnel were ever more committed to the successful completion of the war.

In a subtle but remarkable gesture expressing their commitment, depot personnel of BAD2 organized a unique war bond drive intending to raise enough money to purchase two P–51 Mustangs for employment against the Axis powers, at the cost of $114,000. One aircraft would be named “Too Bad” commemorating the depot, and the other would be designated by an enlisted man chosen through a raffle. The chance of naming the P–51 increased through each purchase of a $25 bond. To the astonishment of depot leadership, the personnel raised enough money to purchase three P–51 Mustangs. The men who named them, Pfc Stanley Ruggles and Pvt Stanley Silverman, in a Memorial Day ceremony overseen by Maj Gen Knerr, Brig Gen Ott, and Col Moore, unveiled the aircraft and their names, “Mazie R” and “Pride of the Yanks.”

Advanced echelons of 9th Air Force personnel, composed of a considerable number of men previously assigned to the 8th, forward deployed to the European continent during the cross-channel landings at D–Day. Most of their supplies transferred through the 9th’s BAD4 at Bavestock, near a railway at Dinton, Wiltshire. By June 10, more than 6,000 men and 1,000 vehicles from the 9th AF had landed in France, virtually all of them on Omaha Beach. Among the units ashore by that time were engineer battalions, airdrome squadrons, truck companies, signal units, and other service organizations that would prepare the way for the later arrival of the combat groups. By June 20, more than 18,000 men and 4,000 vehicles had left England for the continent. Plans were to establish a depot in France as early as July 1944. In December of that year, Brig Gen Ike Ott was transferred to establish and command the Continental Air Depot Area (CADA) in Compiegne, France, which was two months later re-designated as the Central Air Depot Area. Further advancing the depot maintenance and logistics capabilities from England to the continent, empowered the AAF to lower the strategic mountains, raise the valleys, and close with tactical agility against the Axis enemy, ultimately leading to victory.

Maj Gen Hugh J Knerr shakes hands with a member of BAD 2 during a war bond drive where three North American P–51’s were dedicated. Note the nickname “Mazie R” England, June 3 1944. National Archives

Legacy

The stories of these depot-maintenance and logistics leaders recall the earliest warriors of democracy, where the ancient Athenian navy operated complex shipyards enabling rapid deployment and reconstitution of trireme warships. These drydock ship-sheds were the depots of their day, equipping the Athenians to defy the odds when outnumbered, achieving victory at the Battle of Salamis, the first great naval battle in recorded history. Together, all social classes fought onboard the technologically advanced warships, creating the social bonds that historians say were the turning point in establishing the world’s first democracy. Inextricably linked to these forerunners of freedom, the depot leaders of the 8th Air Force and the Allies fought together to preserve the ancient democratic liberties of the world, strengthening a foundation for independence, and contributing a legacy of leadership for generations to follow.

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Work-Life Balance, What Is It, and How Do I Get Some?

By: Lt Col Michael Boswell and CMSgt Daniel Guzman

If you have been in the Air Force for any amount of time, you have likely heard the phrase “Work-life Balance.” A person can glean the meaning to be a proper balance between one’s job and their personal life. While this concept may seem intuitive, truly understanding and applying this balance is a bit of a challenge. To complicate matters, we are taught as Air Force members the golden rule of Service Before Self. On the surface, it may seem like these concepts are horrifically contradictory in nature, however they are not.

How can you put Service Before Self and still have a positive work-life balance? This is the question that will be explored in this article. Arguably, the operations tempo over the past decade and a half has not decreased, and the global threat seems to increase regularly. As such, it is becoming increasingly important that service members deliberately create and maintain the right work-life balance or resiliency road map.

Having the correct work-life balance starts with knowing how to appropriately apply the self-care concept to your daily life. This article will present a conceptual blueprint as well as the seven areas of self-care that enable a solid work-life-balance in today’s military.

The Air Force has focused on resiliency for many years in various shapes and forms. Typically the concept of being resilient is manifested in a quarterly event that concludes with a barbecue or some sort of team-building event. While those events are important, the first step in the journey to becoming more resilient is understanding what makes you resilient as an individual. In short, true resiliency is your ability to take life’s hits and bounce back. Think of resiliency as a gas tank on a car. The more fuel you have in the tank, the longer you can drive. In this analogy, the car is you, work-life balance or more importantly, self-care is the fuel, and your journey is life. So, that brings us to our first big question, how do we define work-life balance?

The online Business Dictionary defines this concept as “a comfortable state of equilibrium achieved between an employee’s primary priorities of their employment position and their private lifestyle” (N.A., 2019). The website further suggests that “most psychologists would agree that the demands of an employee’s career should not overwhelm the individual’s ability to enjoy a satisfying personal life outside of the business environment” (N.A., 2019). In short, this means that you should rarely if ever, feel off-balance due to your job. While this seems like an alien concept, it is not unattainable.

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It all begins with you. If you do not take care of yourself, you will not be strong enough to take care of anything in life.

— Leon Brown

The proper implementation of work-life balance is often seen as a binary concept. Work is on one end of the spectrum and what you value most on the other. The truth is that balance is more multi-faceted and multidimensional. This balance does not mean an equal distribution of time across all spectrums. Additionally, author Raphalia Michael suggests, that taking care of oneself is not selfish. She further argues that, “it is not only about considering our needs; it is rather about knowing what we need to do in order to take care of ourselves, being subsequently, able to take care of others as well. That is, if I don’t take enough care of myself, I won’t be in the place to give to my loved ones either” (Michael, 2018).

Often it seems disingenuous that leaders speak about this balance, but they themselves either personally do not demonstrate proper balance or show a lack of respect for subordinates’ personal boundaries. Additionally, work-life balance is a nebulous concept and not universally applied. Part of the reason why it is difficult to capture a concrete and succinct understanding of this concept is because “life” means many things to different people. For example, the life in work-life balance may mean spending time with family. Proper balance for others may be fitness and still others spending time with pets or spending time with family. Proper balance for others may be spending time with a mother or father, the life in work-life balance may mean being a good person who is worthy of love, without needing to prove yourself or outshine others” (Breines, N.D.).

The truth is that balance is more multi-faceted and not universally seen as a binary concept. Work is on one end of the spectrum and what you value most on the other. The proper balance for others may be fitness and still others spending time with pets or spending time with family. Proper balance for others may be spending time with a mother or father, the life in work-life balance may mean being a good person who is worthy of love, without needing to prove yourself or outshine others” (Breines, N.D.).

As noted on the article, The 5 Levels of Maslow’s Hierarchy of Needs and How They Affect Your Life, notes that, the starting place for this category are basic needs like food, water, sleep and shelter (Gversion.com, 2017). Once these needs are met, then the follow-on discussion should be physical exercise, nourishment in food as well as those aspects of physical self-care that dissect emotional. Things like taking walks, playing with an animal or learning how to salsa. What are your physical needs and are you truly getting what you require to be stable for yourself and others?

Now that we have defined self-care, how do we apply it to my life? As mentioned previously, there are seven categories of self-care. They are environmental, emotional, financial, mental, physiological, social and spiritual. While on the surface, a few of the categories are similar to the Air Force’s four pillars, however the practical application is different. Let us dive into the categories:

1. **Environmental**: This self-care category is looking towards the physical environment to allow you to feel more comfortable and whole. While this may seem a little reminiscent of “Feng Shui”, having a work environment that is organized and clutter-free is important to feeling peaceful for many. Start by asking yourself, what do you need environmentally? Should work have family pictures? Do you need clutter-free desk? Should you be near a window?

2. **Emotional**: It is often said that no one can truly love and respect anyone else without showing some love and respect for themselves. In essence, one has to take the time to practice self-acceptance in order to do the same for others. Doctor Juliana Breines defines self-acceptance as “Viewing yourself as a good person who is worthy of love, without needing to prove yourself or outshine others” (Breines, 2016). Negative self-talk and an overall toxic self-view make it impossible to view others through a positive lens and can eventually lead to terrible consequences i.e., emotional, verbal and in extreme cases physical abuse of loved ones, peers, etc. As I often heard in church and witnessed in my personal and professional life, hurt people go out and hurt other people. If something is having a negative impact on our emotions, it’s only a matter of time before our personal and professional relationships are impacted. Hence the reason why it is crucial to seek professional help and to appropriately mend internal discord when emotional distress strikes, you owe it to yourself and to those around you!

3. **Financial**: Jennifer Navarro-Marroquin, a licensed financial professional and founder of Claiming Prosperity, a financial education and counseling organization suggests that, financial self-care is a practice empowering oneself to create balance by building a financial plan that will help you achieve the life that you want (Rapacon, 2018). In short, the focus of money in today’s society is predicated on spending for what you want today and tomorrow will come tomorrow. A lack of financial self-care has the potential to create significant stress as one’s life happens and bills accrue. The question going forward is do you have a five- or ten-year financial plan? What are you saving today? Have you looked at your credit score lately? When you retire, how much will you need to live on before you transition to your next career? These are just a few questions. Know that there are tons of resources for military members to gain assistance in this area.

4. **Physiological or physical**: Famed social theorist Abraham Maslow argues in his Hierarchy of Needs that physiological security is hard wired into who we are all the way to the subconscious level and is the first level of his model. As noted on the article, The 5 Levels of Maslow’s Hierarchy of Needs and How They Affect Your Life, notes that, the starting place for this category are basic needs like food, water, sleep and shelter (Gversion.com, 2017). Once these needs are met, then the follow-on discussion should be physical exercise, nourishment in food as well as those aspects of physical self-care that dissect emotional. Things like taking walks, playing with an animal or learning how to salsa. What are your physical needs and are you truly getting what you require to be stable for yourself and others?

This is where the concept of self-care comes into play. Self-care is defined as “any activity that we do deliberately in order to take care of our mental, emotional, and physical health” (Michael, 2018). Believe it or not, work-life balance starts with taking care of yourself first. To note, self-care is not a blank check to abdicate your personal responsibilities or not fulfill one’s duties to the mission. It simply means that you take the time to focus on how to best care for yourself first before others. This seems very selfish, alien and counterintuitive. Arguably, you cannot be the best husband, mother, uncle, pet owner, supervisor or leader if you don’t know how to take care of yourself.

Major League Baseball Player Leon Brown once said, “It all begins with you. If you do not take care of yourself, you will not be strong enough to take care of anything in life” (Brown, N.D.). The most important aspect of the aforementioned quote is being “strong enough to take care of anything in life.” The goal of this practice is to create an environment where you have enough in your reserve to take care of others. Another good analogy is putting on your breathing mask while traveling on an airplane. For consideration, right before an aircraft takes off everyone has heard the standard safety briefing that includes knowing where the exit is, as well as the flight attendant buckling and unbuckling the obligatory seat belt at the front of the airplane.

One of the most important parts of the presentation is the breathing mask demonstration. Along with being taught how to pull the straps to tighten on your face, you are also directed to put your oxygen mask on first before you do so for kids or others. This concept dictates that, if you don’t put your mask on first then you risk passing out or endangering yourself before you are able to take care of someone else. Needless to say, the person who puts their mask on first has a better chance of saving others as well as themselves. The same can be said about self-care.
5. **Spiritual:** Contrary to popular belief, spiritual self-care is not exclusively related to observing a set of religious customs or attending religious services on a regular basis. For some of us it might include a morning prayer, meditation and some time to clear our minds and to reflect on our daily, weekly and long term goals. For others it might include physical activity, going for a run, bike ride, strength training or even something as simple as taking 15-20 minutes of quiet time to take inventory of what is truly important in our lives and to connect with our inner self. The documented benefits of spiritual self-care range from reduced anxiety to improved mood and faster recovery from health ailments (mentalhealthamerica.net, 2019). Bottom line, there is no right or wrong answer to practicing spiritual self-care, the key thing is to devote time daily to get after it!

6. **Social:** The 5 Levels of Maslow’s Hierarchy of Needs and How they Affect Your Life, notes that, “Different people in different societies meet this need in different ways” (Gversion.com, 2017). While the need for emotional intimacy may vary from person to person, it is still a very important aspect of being a human being. That said, you must make a qualified professional are some of the many steps one can take. To quote Albert Einstein “we cannot solve our problems with the same thinking we used when we created them” (Einstein, A.). In essence looking for fresh ways to deal with psychologically challenging situations is crucial in order to prevent self-doubt, negative thinking and mental burnout.

7. **Psychological:** Much like our muscles, our minds also need to be cared for and conditioned in order to preserve or improve our fitness level and to prevent our health from deteriorating. Similarly when engaging in a new muscle or cardiovascular training routine we often enlist the help of a qualified professional or look to fitness focused publications, books, videos, etc. in order to learn new techniques and to help us build on what we already know. A very similar approach can be utilized with regards to psychological self-care in order to discover innovative ways to deal with our mentally training challenges. Self-care books, articles, confiding in a friend, family member, mentor or seeking the help of a qualified professional are some of the many steps one can take. To quote Albert Einstein “we cannot solve our problems with the same thinking we used, when we created them” (Einstein, A.). In essence looking for fresh ways to deal with psychologically challenging situations is crucial in order to prevent self-doubt, negative thinking and mental burnout.

After reviewing the above descriptions, it is important to rack and stack your needs from most important to least. The number one self-care need is where you should start focusing your attention and is likely the place that you will spend the most time in the work-life balancing equation. It is easy to assume that the emotional may be the most important, as it will zero in on yourself, immediate family and those needs. A quick google search will reveal a significant amount of research as well as opinion articles on proper care. Again, work-life balance starts with what you deem to be important aspects of who you are as an individual and making that a priority. The aforementioned categories are starting points that will certainly get you underway towards the road to success.

In closing, during a January 2018 Airmen’s Call at Maxwell AFB, Chief Master Sergeant of the Air Force Kaleth O. Wright noted that our current military environment is tough and “it gets tougher.” With what’s happening in the world with the level of global insecurity and instability, our jobs will only get more difficult. I don’t look out a year or two or three from now and see less mission. I see more deployments to Europe. I see more deployments to Africa. I see continued deployments to the Middle East, and I also see, at some point, some deployments to the Pacific” (Brown, 2018). In the ability to take care of yourself first is an ultimate measure of personal and organizational resilience. Whether running, spending time with your family, make sure you take time to go to church or simply taking a nice bath is what creates balance -- knowing is half the battle. We hope this article will be useful in your efforts to find the appropriate level of work-life balance for both you and your teammates around you.

"It is often said that no one can truly love and respect anyone else without showing some love and respect for themselves. In essence, one has to take the time to practice self-acceptance in order to do the same for others."

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References

Einstein, A. (Ph.D.). Albert Einstein quote: We cannot solve our problems with the same thinking we used when we created them. Retrieved April 8, 2019, from Brainy Quote website: https://www.brainyquote.com/quotes/albert_einstein_121992


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