The Next-Generation MAGTF

The state of Marine aviation

by LtGen Steven R. Rudder

As we built the 2018 *Marine Aviation Plan,* we at Headquarters Marine Corps Aviation ran into a fundamental question: what is the next-generation MAGTF, and what capabilities are we pursuing to contribute to it? What do we in aviation bring to the fight? We discuss daily this next generation of capability, but we must define what it means: not only the Joint Strike Fighter but also a larger and systemic change to the way our air-ground team conducts business.

With all the talk about a "next generation" aviation combat element or "next generation" MAGTF, there is no official Service document that defines either of these terms, not to mention how they should be realized. Like many other conceptual concepts, the evolving next-generation concepts are vague and need refinement to provide a vision with tangible, executable initiatives that will deliver true capability to the warfighter. As with any higher-level guidance, lower-level staffs are encouraged (in some cases required) to extract the vision and intent and develop customized and refined products to achieve a desired end state. Here, we start that process.

In aviation parlance, fighter aircraft are grouped into generations, defined by their performance characteristics, aircraft systems, and capabilities. The term next generation began as an HQMC Aviation term of art and expanded to other Marine aviation circles as the Marine Corps began the development and procurement of the F-35 Joint Strike Fighter. With its stealth technology, fusion engine, targeting systems, and expanded weapons capabilities, the F-35 strike fighter squarely fits the definition of a next-generation strike fighter.

The battlefield is a scene of constant chaos.

The winner will be the one who controls that chaos, both his own and the enemy's.

—Napoleon Bonaparte

LtGen Steven R. Rudder. (Official DOD (USMC) photo.)

However, with all the advertisement and excitement about this new capability, some came to believe that the next-generation ACE and the F-35 were synonymous and that the F-35 was the sole initiative in the Marine aviation portfolio, modernizing to keep pace with the challenges of the future operating environment. To achieve a next-generation ACE/MAGTF, Marine aviation's vision is much larger than a single platform; we need to do more than just leverage new commercial technology and procure advanced systems. To evolve the MAGTF, Marine aviation envisions using new and current systems in innovative ways; advancing the idea that every platform is a sensor, shooter, and sharer; and creating a MAGTF that is effective and resilient while not cost prohibitive.

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Definitions of Terms

- Command and control (C2). Next-generation C2 architectures employ agile communications pathways (both voice and digital) to provide resiliency, increase the speed and volume of data flow, and accelerate decision making.
- Intelligence. In a future operating environment, a next-generation intelligence architecture is able to sense and make sense of the entire operational environment. Human decision-making will be supported by "big data" management and advanced analytics.

• Fires. Capitalizing on a range of new weapons and sensors, next-generation fires are networked to leverage the benefits, while mitigating the limitations, of individual systems.
• Maneuver. A next generation MAGTF expertly leverages maneuver across the five domains (air, land, maritime, space, information/cyber/EMS (electromagnetic spectrum)) of the future operating environment.
• Force protection. In the next-generation MAGTF, all elements are aware of their multi-spectral signatures and actively conduct signature management. MAGTF elements will utilize an integrated and layered approach, employing various active and passive, force protective measures/methods.
• Logistics/sustainment. A next-generation MAGTF is capable of providing distributed forces logistics and sustainment support across a dynamic and fully contested battlespace through responsive, agile, and multimodal methods/approaches.


H-1s on the flight deck. ***(Photo provided by Department of Aviation, HQMC.)***

The Next-Generation ACE

• C2 systems are a key element in leveraging and integrating current investments and systems (both fourth and next generation) to connect the network seamlessly between air and ground (fully realizing the potential of the MAGTF tactical grid), ultimately achieving sensor fusion across the MAGTF, similar to the individual aircrew experience in the F-35. Specific command and control systems include:

- Marine Air Command and Control System (MACCS) Family of Systems
  - Common Aviation Command and Control System (CAC2S)
  - Ground/Air Task Oriented Radar (G/ATOR)
  - TPS-59 Long Range Radar
  - Combat Targeting Network (CTN)
    - Cooperative Engagement Capability (CEC)
- MAGTF Agile Network Gateway Link (MANGL)
  - Software Reprogrammable Payload (SRP)
  - Mesh Network Manager (MNM)
- Tactical Datalinks
  - Link-16
  - Multifunction Advanced Datalink (MADL)
  - Tactical Targeting Network (TTNT)
  - Bandwidth Efficient Common Datalink (BE-CDL)
  - Adaptive Networking Wideband Waveform (ANW2)
  - High Performance Waveform (HPW)
- Mobile User Objective System

• Marine aviation intelligence provides additional range, capacity, and automation to MAGTF multispectral collections capabilities, with the associated processing, exploitation, and dissemination capabilities to improve the MAGTF fires, planning, and decision cycles. Key Marine aviation intelligence assets include:

- F-35B and C
- RQ-21 payload development
- Group 5 MAGTF unmanned expeditionary (MUX) aircraft
- Integrated aircraft survivability equipment (IASE)

• As the integrated air arm of the MAGTF, Marine aviation affects the close and deep fight with a variety of lethal and non-lethal fires. Through integrated networks, Marine aviation links sensors and shooters across the naval force, contributing speed and range to the combined arms capability of the MAGTF.

- CTN
  - CEC
- Net-enabled weapons
- Naval integrated fire control-counter air
- Intrepid Tiger II—communications electronic attack future growth

• The premier capability of the ACE is the ability to facilitate maneuver from the sea in support of expeditionary operations ashore, providing aviation assets and aviation ground support that enhance MAGTF speed and range. Enhanced maneuver is provided by the following ACE assets:

- MV-22—speed, range, air and ground refueling
- CH-53K—increased lift capacity/payload
- KC-130J—Outside of SOCOM, this is DOD's only fixed-wing tactical ground and air refuel capability.
- Aviation ground support (expeditionary airfields/FOBs (forward operating bases)/FARPs (forward arming and refueling points))

• Marine aviation enhances force protection efforts by providing a layered air defense capability, combining airborne defensive counter-air with persistent ground-based air defense.

With integrated C2 and networked sensors providing external sensing and cueing, target engagement can be initiated closer to a weapons maximum effective range, effectively increasing the range and depth of protection coverage with the following systems:

- TPS-59 long range radar
- TPS-80 G/ATOR
- Integrated fire control
- Ground-Based Air Defense (GBAD) future weapons system (FWS)

• With the speed and range of its aviation assets, Marine aviation provides additional options and capacity for MAGTF logistics and sustainment. Establishing and operating various FOBs and FARPs, Marine aviation provides additional logistics nodes to support a distributed MAGTF with the following systems:

- CH-53K—increased lift capacity/payload, internal and external cargo distribution
- MUX utility/cargo
- Radio frequency identification
- Distributed Aviation Operations
  - MWSS (Marine wing support squadron) (Expeditionary Airfields/FOBs/FARPs)

Digital Interoperability

If we are to deploy and employ this next-generation MAGTF—and the next-generation ACE—we must link aircraft systems and ground forces. This is digital interoperability.

The Marine Corps executes mission threads primarily as an integrated MAGTF, organized to support the Marine rifleman. The integration of the MAGTF and the successful execution of mission threads rely on the effective exchange of critical information; communication, whether in the form of electronic data or voice, is critical to the exchange of mission-essential information. An effective network infrastructure is required in order to achieve effective end-to-end communication.

The goal of MAGTF digital interoperability is to provide the required information to the right participants at the right time in order to ensure mission success, i.e., defeating the threat, while improving efficiency and effectiveness. This approach provides the additional advantage of responsible spectrum use, which becomes increasingly important as spectrum demands increase, as technology advances, and as our MAGTFs continually operate in more distributed and disaggregated operations. We continue to pursue integration and data exchange throughout various arenas: situational awareness; aircraft survivability; intelligence, surveillance, and reconnaissance (ISR); fire support; and logistics by conducting continuous and iterative analysis of ever-evolving information exchange requirements (IERs) and the technological tools needed to satisfy those requirements. Network design must be based on IERs so that the right information gets to the right Marine at the right time.

In order to be digitally interoperable, each platform must be enabled from end to end in terms of the equipment required to be digitally capable. At a minimum, a platform must possess and integrate the following four things to be digitally interoperable:

• A *sensor* that takes information from the environment and turns it into digital data; examples include ASE (aircraft survivability equipment), targeting pods, and a Marine's senses.

• A computer *processor* that can take the digital data from the sensor(s) and translate and format it for display or transport; examples include overhead in existing platform mission computers, additional processor cards in both related or unrelated systems, and standalone processors.

• An *interface* that allows the system user to interact with the translated and formatted data from the processor; examples include integrated Multi-Function Display, a handheld electronic tablet, and a laptop computer.

• *Radios and associated antennas* that can transmit and receive the translated and formatted data, such as the Multifunctional Information Distribution System (MIDS-J), ARC-210, Small Tactical Terminal, 117G, SRP, and Vortex systems. Each of these components is required to fulfill the information exchange requirements in a constant integrated loop. The absence of a single aforementioned component breaks the loop and fundamentally prevents interoperability.

Current enhancement and future procurement is the result of continuous end-to-end live and virtual analysis, through multiple efforts, of both USMC mission thread IERs and USMC platform capability over a period of years that has identified capabilities and capability gaps combined with an extensive analysis of alternatives.

The MAGTF as a whole employs four tactical data links that are fielded widely enough across the MAGTF that

F-35B on the flight line. **(Photo provided by Department of Aviation, HQMC.)**

minor enhancements to platforms can greatly improve capability.

- Link-16 is employed by F-35s, F/A-18s, and the MACCS in support of tactical aviation (TACAIR) mission threads.
- HPW and ANW2 are capabilities resident on the single channel radios that are fielded widely across the ground forces.
- TTNT supports ground communications with the Intrepid Tiger II pod in support of electronic warfare mission threads.
- Common Data Link (CDL) receivers are fielded widely among the ground forces and are a capability resident on most unmanned aircraft systems (UAS) as well as targeting pods in support of the dissemination of full motion video.

While our assault support assets (H-1, MV-22, CH-53, and KC-130) possess *sensors* in the form of ASE, they have limited integration with a *processor*, *interface*, and *radios* that can make use of data provided by those sensors. Our TACAIR assets (F/A-18, F-35, and AV-8) possess some integration between *sensors*, *processor*, *interface*, and *radios*, but a lack of common equipment across the entire MAGTF prevents the efficient flow of data.

Filling the capability gap of *processor*, *interface,* and *radio* on MV-22, H-1, CH-53, and KC-130 today is the combination of a PRC-117G or PRC-152A ANW2 capable radio combined with a secure commercial off-the-shelf electronic tablet interface named the Marine Air-Ground Tablet (MAGTAB) and a Commercial Encrypted Wi-Fi Link. These devices are combined in a flight-cleared configuration that enables an airborne tactical network as well as communication with similar systems on the ground. Digital interoperability kits are fielded in support of MEUs from both coasts and Japan as well as the SPMAGTFs. Critically, the MAGTAB as the interface to the tactical network is a secure collaborative briefing, planning, execution, and debriefing tool.

Airborne gateways will serve as a conduit between disparate networks and waveforms on the current battlefield. Gateways possess the ability to receive one waveform/message type and process it into another waveform/message type before off-boarding the data. Due to the inherent difficulties of replacing or adding new systems to some Marine aviation platforms, adding airborne gateways enables information exchanges across a variety of systems and networks. The increased prevalence of airborne gateways will provide data exchange capabilities throughout the MAGTF without each platform having to be equipped with every waveform currently being used on the battlefield, providing network access for the ground combat element with the gear they already carry. Airborne gateways, such as the MNM, utilize a collection of radios and conduct message translation and processing for dissemination, leveraging software that is interoperable with SOCOM, the joint services, and other government organizations.

The 2015 15th MEU assessment solidified the requirement for software-defined radios, airborne gateways, mesh network data exchanges facilitating maneuvering within spectrum, and encrypted wireless tablets in the hands of the operator. Ongoing efforts have and will continue to assist in the seamless integration, decreased kill-chain, and enhanced battlefield situational awareness throughout the MAGTF. This effort, fielding in mid FY18, combines the MNM with off-the-shelf *radios and additional antennas* integrated into MV-22 in a roll-on, roll-off configuration. The *radios* support the five previously identified waveforms, while the MNM addresses the *processor* gap, and the MAGTAB fills the *interface* gap. Modifying the aircraft so that this capability is fully integrated under glass is not feasible in terms of cost and time in the short term. The MNM enables waveform and message translation capability that allows information to be shared across previously disparate systems while ensuring the data sent across the multiple networks is bandwidth efficient.

The SPMAGTF enroute C4 (command, control, communications and computers) UUNS (urgent universal needs statement) is the Initial Capabilities Document for the MANGL. The Capabilities Development Document (CDD) for MANGL is in development, leveraging lessons learned over the last six years by HQMC Aviation and MCCDC. The MANGL CDD will clearly articulate the desired capabilities of the MANGL system that will eventually be installed on MV-22, CH-53, KC-130, and potentially future UAS platforms. MANGL will incorporate tablets, gateways, and SRP to replace the four radios employed by the SPMAGTF enroute C4 UUNS effort. MV-22 is the lead platform, with fielding beginning in FY20.

SRP is a software-defined radio that has the capability of hosting up to seven waveforms simultaneously while offering an advanced, embedded, multi-level security architecture known as the Programmable Embedded Infosec Product. SRP Increment 1 is deployed in support of some U.S. Navy capabilities; however it lacks required existing MAGTF waveforms. To align with the existing architecture of the MAGTF, the following waveforms are being conveyed into SRP Increment 2: Link-16, ANW2, BE-CDL REV-B, and TTNT. MV-22 is the lead platform for SRP Increment 2 integration, immediately followed by the CH-53E/K and KC-130.

Link-16 fulfills the air picture and enables growth for digitally aided close air support potential. ANW2 radios continue to be proliferated throughout the ground combat element; BE-CDL will expand on the existing CDL network facilitating the Type 1 ISR mandate and a far more capable waveform that will enable the furthering of payload control; TTNT continues to enable increased traffic for information exchanges, range extension, and dynamic spectrum maneuvering.

Emerging waveforms, as they become available, can and will be implemented as the MAGTF continues to expand interoperability and capability against the threat.

Command and Control

The strength of Marine aviation is the ability to control airspace anywhere on the world.

The MACCS comprises the ground nodes that enable digital interoperability across the MAGTF. Using CAC2S, the MACCS is able to receive, translate, and forward data from multiple sources and sensors. The Multi-Source Correlating Tracker as part of CAC2S provides a fused, realtime, and near realtime common operational picture to all elements of the MAGTF and the Joint Force. The MACCS also provides the airspace surveillance sensors, TPS-59/80, which provide situational awareness of both friendly and enemy aircraft. The MACCS is truly the longstanding digital interoperability node that ties the MAGTF together and links it to the joint force. The combination of CAC2S, G/ATOR, and CTN ensure that the MAGTF commander can control the three-dimensional battlespace and seamlessly push and pull information throughout the area of responsibility.

CAC2S consists of two systems: a currently fielded communication system (CS) and an air command and control system (AC2S) that started production in FY17. The CS provides VHF/UHF/HF/SATCOM radios and intercom systems based on a lightweight shelter mounted on a High Mobility Multi-Purpose Wheeled Vehicle (HMMWV). The AC2S will provide a fused, near, and non-realtime common operational picture that will enable enhanced air control, improved situational awareness, sensor integration, full tactical data link integration, and improved planning and command functionality as well as sensor-netting integration. The combination of the CS and AC2S will provide a common platform and common operational picture for air command control across the MACCS agencies, TACC, DASC, and TAOC.

CTN is a joint sensor netting capability that integrates ground, surface, and airborne sensors through the CEC network to provide accurate, composite, realtime airborne tracks to C2 nodes. CTN is key to providing an accurate representation of the airspace, reducing ground-to-air and air-to-air fratricide, enabling air and surface integrated fire control, and extending the air defensive capability of forces in the littorals. With this capability, Marines ashore at the CTN node will take inputs from existing sensors including TPS-80 and utilize CAC2S as the interface to then hand off tracks and targets to supporting Navy surface ships; similarly, naval surface forces can send information over the CEC for display and action in CAC2S.

TPS-80 G/ATOR is designed to detect low-radar cross-section air threats, rockets, artillery, and mortars. This expeditionary radar supports Sea Shield and Sea Strike as a compatible data provider to the CTN for naval engagements. TPS-80 ensures the MAGTF has the ability to control its future airspace and provides: a highly accurate multi-role radar designed to detect low observable aircraft, rockets, artillery, mortars, UAS, and cruise missiles; and a primary data provider supporting both Navy's and the Marine Corps' prosecution of enemy ground and air threats.

GBAD FWS. After many years of cuts, GBAD is going through a major revitalization given today's air and missile threats. First, we are growing capacity and modernizing the LAAD battalions by fielding a maneuverable short-range air defense with turreted JLTV incorporating the Stinger for fixed- and rotary-wing, as well as kinetic and non-kinetic counter-UAS, enabled by a small radar, passive RF detection, and EO (electo-optical)/IR sensors. With the GBAD FWS, the USMC will have an air defense and counter-UAS capability.

Currently, the LAAD C2 vehicle contains a Joint Range Extension (JRE) gateway to communicate with higher headquarters in either JRE Application Protocal A, B, or C format and distributes the air picture and targeting data to fire units at-the-halt. The C2 picture is not integrated with the dismounted Stinger gunner. The GBAD FWS incorporates C2 on-the-move and provides integrated cueing of the kinetic/non-kinetic weapons system to enable movement and maneuver by destroying, neutralizing, or deterring low altitude air threats to defend critical fixed and semi-fixed assets and maneuvering forces. The GBAD FWS will be developed utilizing an open system architecture in order to accommodate system improvements and allow for the inclusion/addition of future passive, kinetic, and non-kinetic material/technology solutions.

Unmanned Aircraft Systems

The future of aviation is manned-unmanned teaming. We as the ACE must be ready in any clime, in any place—and that means UAS on the battlefield. The MACCS will enable and maximize this manned-unmanned team: CAC2S, G/ATOR, and CTN and the tools we will use to provide linked, fused information across the battlefield.

This year, the Marine Corps will employ its first long-endurance, high-altitude surveillance Group 5 system UAS in the form of the MQ-9A Block 5 Reaper. Beginning with a contractor-owned and -operated system under the leadership of Marine air mission commanders, these unmanned aircraft will bring organic, persistent observation of the battlefield to Marines, sailors, and partners of Task Force Southwest in Afghanistan. This direct support will significantly augment the battlefield awareness of commanders and Marines in the field. Enhanced payloads will improve information gathering in the electromagnetic spectrum. Operations with MQ-9 will give the Marine Corps valuable insight to best practices which support USMC concepts of operations, to include BLOS (beyond line of sight) operations and the processing, exploitation, and dissemination of data from remote locations. We will develop Group 5 operators and build a Group 5 organizational structure.

The family of unmanned aircraft systems (FOUAS) exists to support MAGTF battlespace awareness, offensive air support, target acquisition, and force protection. The FOUAS plays a key role in Marine Corps missions across the range of military operations, to include forward presence, security cooperation, counterterrorism, crisis response, forcible entry, and prolonged operations. The FOUAS currently consists of the Small Unit Remote Scouting System (SURSS)/small UAS, RQ-7B Shadow, and RQ-21A Blackjack.

Delivering organic airborne battlespace awareness to regiments, battalions, and smaller units is the role of SURSS members of the FOUAS. These platforms use a common ground control station to control the RQ-11B Raven, RQ-12A Wasp, and RQ-20A Puma. VTOL and nano-VTOL SURSS will complement capabilities of the current FOUAS in confined operations and where vertical obstructions create difficulties for other SURSS. Advancements in small UAS occur at a rapid rate, often outpacing typical procurement and fielding practices. HQMC Aviation, along with Combat Development & Integration, Marine Corps Installations, and Naval Air Systems Command, will continue to work together to streamline policy and training to meet fleet requirements. Currently available tools, such as small quadcopters, will be fielded and refreshed with newer, more advanced systems as they become available to ensure Marines at all layers of the MAGTF have maximum awareness of the battlespace.

The Marines of the Marine Unmanned Aerial Vehicle Squadrons (VMUs) are transitioning their organic weapons system from the RQ-7B Shadow to the RQ-21A Blackjack. The Night Owls of VMU-2 have supported combat operations ashore and afloat with the RQ-21A and gained valuable lessons learned for the medium-sized UAS community. Those lessons are being incorporated by the VMU-1 Watchdogs as they complete their transition to the RQ-21A and begin support to MARFORPAC MEUs. Simultaneously, the VMU-3 Phantoms continue to support contingency operations with the RQ-7B and will transition to the RQ-21A within the next year. The Reserve Marines of VMU-4 will also transition from the RQ-7B to the RQ-21A over this year, fulfilling a complete transition of the VMU squadrons to the shipboard capability and modular payload architecture the RQ-21A brings to the fight.

That modular payload capability is one of the significant improvements of the RQ-21A over the RQ-7B. Multiple payloads are being researched, developed, and fielded to leverage this capability to configure mission packages which best support the MAGTF. These payloads will enhance battlefield awareness of the MAGTF with technologies such as synthetic aperture radar (SAR) and ground moving target indicator (GMTI) sensors, which can detect objects through clouds and vegetation. Research is also ongoing in the study of hyperspectral payloads to detect explosives, as well as payloads in development to monitor and operate in a wide range of the electromagnetic spectrum. The standard capabilities of the RQ-21A are also being enhanced with improved EO and IR sensors and a laser designator. Furthermore, industry research continues to progress toward a BLOS capability for the RQ-21A, which could allow the MAGTF to extend these sensing capabilities to far greater ranges.

Advanced sensors and aircraft are a significant benefit to the MAGTF, but the ability to process and share the data generated by these sensors is critical to realizing the full capabilities of these systems. The Tactical ISR Processing, Exploitation, and Dissemination System (TIPS) Block 3 is the key enabler in the RQ-21A system which allows the MAGTF to leverage this data. TIPS Block 3 allows the fusion of data collected by the RQ-21A with data from off-board sensors. This digitally interoperable system enables the data collected by RQ-21A to be integrated into networks of higher classification, while also integrating with Link-16, full motion video, Simplified Electronic Warfare System Interface, and other software applications. TIPS Block 3 will act as a hub for the collection, cataloguing, and storage of full motion video, multi-intelligence sensor data, and target information. This system determines optimal means to disseminate intelligence products. Future iterations of TIPS will use advanced algorithms to analyze data as it is collected and autonomously cue operators to pre-defined areas of interest.

As the RQ-21A Blackjack continues to pass program milestones in the next year and advance toward maturity, a process of continuous reliability improvements through lessons learned, training, and engineering is improving the availability of these capabilities to the MAGTF. Marines are the key component of any weapons system, and the initial operational capability (IOC) of the RQ-21A Fleet Replacement Detachment aboard MCAS Cherry Point will ensure that the maintenance and operations personnel of the VMUs are trained to employ their weapons system for maximum advantage to the MAGTF.

Future UAS platforms include the MQ-9A Block 5 Reaper, the Unmanned

Coming in to pick up a team of Marines. *(Photo by LCpl Manuel Serrano.)*

Logistics System-Air (ULS-A), and the MUX. The contractor-owned and -operated MQ-9A Block 5 Reaper will support Marines currently engaged in the fight in Afghanistan as a near-term response to an urgent need for additional battlespace awareness. The ULS-A is the airborne component to future distributed logistics concepts in development by HQMC Installations and Logistics. The MUX program will develop a state-of-the-art unmanned system to complement the reach of the MAGTF with a digitally interoperable network node, capable of fires and tactical logistics.

The Group 5 MUX will provide the MAGTF commander with robust, organic, all-weather, sea-based capabilities, to include an expeditionary multi-mission UAS capability with persistence at extensive operational radius (>350 nautical miles), as well as an aerial tactical distribution capability for the logistics combat element with improved C4 and situational awareness. MUX's range and persistence shall complement the long-range capabilities of the F-35B/C, CH-53K, MV-22, and future vertical lift (FVL). MUX shall provide persistent battlespace awareness, electronic warfare, C4, logistics, and fires to all elements of the MAGTF.

The Marine Corps is researching and developing ULS-A. This medium-sized UAS will provide organic, responsive tactical logistics delivery tools to the logistics combat and ground combat elements. This capability will transform tactical logistics, enabling more assured logistics support with greater tempo in distributed operations. These emerging ULS-A capabilities will be highly automated and leverage autonomy developed as part of the Office of Naval Research's Autonomous Aerial Cargo Utility (AACUS) project. The AACUS project enables an aerial platform to receive minimal guidance and navigate to a destination, then choose the optimal landing path to the requested landing site. The emerging concept of unmanned logistics calls for a range of systems sized to support both squad-level and platoon-sized elements. The air delivery specialist community is envisioned to provide oversight, training, and management of these emerging tools. Early prototype systems will be utilized for experimentation during ITX 3-18 in order to more fully refine the concept.

The temporary employment of MQ-9A Block 5 will inform decision making for the MUX program. MUX will be a key aviation component to ensure persistent, responsive, lethal, and adaptive full-spectrum operations by the MAGTF. This program will develop a network-enabled, digitally interoperable platform to complement the capabilities of MV-22B, F-35B/C, and the FVL platform. As a multi-sensor, shipboard capable, expeditionary platform, MUX will fill capability gaps in early warning, ISR, electronic warfare, communications relay, offensive air support, and possibly others such as self-escort and cargo. Initial program development has begun with the release of a request for information to industry. With the approval of FY18 budget funding, the program will progress rapidly and methodically toward an early operational capability in the mid-2020s.

Fixed-Wing Aircraft

F-35 Joint Strike Fighter

Those unmanned systems are one bridge to the future. The Joint Strike Fighter is another.

We are in the midst of a TACAIR transition: the roles of Hornet, Harrier, and Prowler will be subsumed into F-35B and C models. The Marine Corps currently has five squadrons operating the F-35B: Marine Fighter Attack Squadron 121 (VMFA-121) out of MCAS Iwakuni; VMFA-211 and VMFA-122 operating out of MCAS Yuma; VMFAT-501, the fleet replacement squadrons (FRS), operating out of MCAS Beaufort; and Marine Operational Test Squadron 1 (VMX-1) operating out of MCAS Yuma and several detached testing locations, primarily at Edwards AFB. VMFA-121 was the first U.S. F-35 fleet operational squadron for any Service to declare IOC, in July 2015.

The F-35B detachment now aboard the USS *Wasp* with 31st MEU will be followed by one afloat with USS *Essex* and 13th MEU. These MEUs mark a new leap in combat capability, available on-call to the regional combatant commanders. Additionally, the Marine Corps has taken delivery of seven F-35C, the tail-hook variant aircraft, and will transition VMFA-314 to be the Marine Corps' first carrier variant squadron onboard MCAS Miramar in 2020, ready to deploy worldwide shortly thereafter.

> ***This is a historic deployment.***
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> ***The F-35B is the most capable aircraft ever to support a Marine rifleman on the ground. It brings a range of new capabilities to the MEU that make us a more lethal and effective Marine air-ground task force.***
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> **—Col Tye R. Wallace, 31st MEU Commanding Officer, commenting on F-35B detachment deploying aboard USS Wasp, March 2018**

The F-35 FRS, aboard MCAS Beaufort, trains both American and British pilots. The 617 Squadron of Her Majesty's Royal Air Force began sending personnel to Beaufort as part of their transition plan after their government decided to purchase the F-35B. That squadron currently has eleven British F-35Bs and approximately 150 personnel, and it will stand up in December this year. The UK is regenerating its aircraft carrier capability with the construction of their new *Queen Elizabeth* Class carriers: HMS *Queen Elizabeth* and HMS *Prince of Wales*. When *Queen Elizabeth* embarks on her inaugural operational deployment in three years, six U.S. Marine Corps F-35Bs will be aboard.

The Marine Corps has a program of record of 420 F-35 aircraft, and beginning in 2018, the Marine Corps procurement rate will exceed twenty aircraft per year; this will mark the start of the full rate of transition operations. The Low Rate Initial Production (LRIP) of two to nine aircraft currently in our inventory will give way to the more familiar "lot" categories, which will have more seamless capability integration and will operate more reliably as the program continues to mature.

Currently, the Marine Corps is operating Block 2B/3i aircraft. These are fully combat capable aircraft with an ordnance loadout of two x AIM-120 and two x GBU-12 (500-pound laser-guided bomb) or two x GBU-32 (1,000-pound GPS-guided joint direct attack munition) carried internally. Their sensor suite is a significant upgrade over preceding aircraft: high resolution SAR mapping; all-weather targeting; laser designator combined with electro-optical tracker system; built-in targeting pod; radar electronic attack; GMTI; MADL; Link-16; and variable message format datalink. All of these sensors are fused to allow the operator a clearer picture of what is occurring on the battlefield, both in the air and on the ground.

In the near future, the F-35 will expand to the Block 3F capability, which will add external weapons up to four x 500-pound class weapons on wing stations, a gun pod, AIM-9X IR missiles, and the ability to carry 2,000-pound weapons on the F-35C. Sensor upgrades through both software and hardware improvements will expand ranges of datalink networks, send and receive still images of targeting pod data, provide automatic target recognition, implement a ground moving target tracker, and field an interim full motion video, providing realtime targeting data to the ground.

Further out into Block 4, the F-35 will look to continually modernize and adapt to an ever-changing threat with initiatives to deliver an expansion of weapons that include moving target capable weapons, Small Diameter Bomb (SDB-II), Net Enabled Weapon, JSOW C-1, and AIM-9X Block 2. Sensor improvements included in the potential Block 4 upgrade consist of maritime radar modes, expansion of combat identification capabilities, expansion of digital and analog interoperability capabilities, passive targeting/employment capabilities, offensive electronic attack and electronic protection capabilities, resolution upgrades, and built-in full motion video.

External lift of an AV-8B engine. ***(Photo provided by Department of Aviation, HQMC.)***

Hornet and Harrier. As we transition TACAIR to the F-35B and C, we owe it to the ground forces to provide continuous forward support to the MAGTF, the joint force, and the ground commander. We are carefully managing our Hornet and Harrier fleet to do just that.

F/A-18s will continue to execute UDP and SPMAGTF deployments through the sundown of the aircraft. AIM-120D and AIM-9X Block II are currently fielded and operating around the globe in support of combat operations. Advanced Precision Kill Weapon System (APKWS) will be successfully fielded on F/A-18s forward deployed in support of SPMAGTF CR (crisis response)-CC (Central Command), adding an additional lethality to the aircraft's already-lethal air-to-surface arsenal. APKWS will be introduced with the M151 warhead followed by the M282 warhead, which provides an armor-piercing capability. The M282 will be cleared for employment in the near future. Future weapons such as SDB-II and APKWS will give the MAGTF commander increased capability throughout the spectrum of operations.

Current survivability and interoperability upgrades include Link-16 modifications to increase sustainability and communication across joint assets. Headquarters Marine Corps is looking to equip all variations of Marine Hornets with a new Link-16 upgrade that will increase joint communications. This new capability will increase reliability in contested environments to help joint communications and sharing of information between fourth and next-generation platforms. Multiple different upgrades are being evaluated for incorporation into the F/A-18. Some of the systems include a new self-protect jammer and radar warning receiver gear. The integration of these two systems will drastically improve the survivability of the F/A-18 against current and future adversaries.

Additional upgrades focus on required mandates and interoperability for the DOD and MAGTF. Multiple navigation upgrades, such as Required

Navigation Performance/Required Area Navigation (RNP/RNAV), Mode 5/ Mode S and ADS-B, will continue to upgrade the communications and navigation equipment already organic in the airframe. The LITENING Advanced Tactical Data Link (ATDL), which is scheduled for early FY21 in AV-8B and F/A-18, is an improvement to our inventory of LITENING Gen 4 pods.

Harrier is on step and ready, as it has been for decades, flying off the big-deck amphibs. Current interoperability upgrades include Link-16 modifications to the AV-8B radar aircraft fleet. Beginning in calendar year 2018, the program began upgrading all 75 radar aircraft with Link-16; these installations are scheduled to be complete by the end of 2018, and the first units will deploy with this capability in the fall of 2018. AV-8Bs will transmit and receive Precise Participant Location and Identification as well as surveillance tracks in this initial release. Future upgrades to Link-16 software, which are scheduled for release in early FY21, provide increased combat capability and situational awareness, to include transmitting and receiving fighter-to-fighter messages.

Harrier weapons upgrades are focused on addressing the obsolescence and sustainability of air-to-air weapons, improving recently integrated air-to-surface weapons, and expanding the ordnance loads that the aircraft can carry. AIM-9X Block II integration is in work and scheduled to replace the aging AIM-9M in FY21. AIM-120C5 and C7 testing is almost complete, and clearance for the fleet is anticipated in the summer of 2018. APKWS was successfully fielded on AV-8B and has been employed on MEUs and SPMAGTF CR-CC. M282 warheads, which provide an armor-piercing capability, are now cleared for employment.

Additional AV-8B upgrades focus on required mandates and interoperability for the DOD and MAGTF. RNP/ RNAV will be released in the summer of 2018 and bring improved navigation and non-precision approaches. Mode 5/ Mode S and ADS-B Out will be released in early FY21 and address required mandates. The LITENING ATDL, which is scheduled for early FY21 in AV-8B and F/A-18, is an improvement to our inventory of LITENING Gen 4 pods. ATDL provides two-way full motion video and stills through Band Efficient Common Data Link and incorporates TTNT to extend the MAGTF TTNT network. Additionally, ATDL will provide wireless high-definition video to an in-cockpit tablet; this capability will greatly increase detection and identification of targets.

KC-130 J. As fixed-wing TACAIR assets transition, the Hornet and Harrier fleet continues to shoulder the load. Their lifeline, the KC-130J, continues to improve to provide the Marine Corps' unique assault support and aerial refueling capability to take us anywhere in the world when we get the call.

> ***Product and aircraft modernization will also continue with targeted improvements . . .***

The active component Hercules fleet completed divestment of legacy KC-130s in 2009, while the Reserve Component began the KC-130J transition in 2014. To date, that transition is 65 percent complete, with a scheduled completion date of 2024. Delivering the remaining 26 airframes is imperative to resourcing the reserves and ensuring adequate overall inventory. The Marine Corps has funded 79 KC-130J aircraft in the FY19 President's Budget; we will have delivered 54 of those 79 airframes in spring 2018.

Product and aircraft modernization will also continue with targeted improvements that include aircraft survivability, an advanced electronic countermeasure system, and obsolescence upgrades to the Harvest HAWK MIR/Weapons Mission Kit. The future of aircraft survivability in the KC-130J is the replacement of the aging ALQ-157 IRCM system with the upgraded Large Aircraft Infrared Counter Measure System (DON LAIRCM). This advanced threat warning system provides direct IR survivability and increases combat effectiveness in expanded threat environments. The KC-130J is also addressing critical safety issues and the expansion of aircraft capabilities to meet CNS/ATM mandates with the retrofit of Block Upgrade 7.0/8.1. The Block Upgrade 7.0/8.1 satisfies all CNS/ATM Phase II requirements that include ADS-B and RNP/RNAV, improving digital interoperability with the addition of Link-16, and adding Mode 5 IFF, while avoiding increased sustainability and maintainability costs.

Another improvement that is well suited to the needs of the forward deployed MAGTF includes the obsolescence upgrades to the Harvest HAWK MIR/Weapons Mission Kit. All six upgraded mission kits have been fielded and are undergoing development and operational testing and will be ready for tasking in FY19. Additional funding in the FY19 budget request will be used to maintain operational relevance of this mission system through compatibility with additional Hellfire variants, improved system integration with the new mission operator's pallet, improved sensor reliability with the MX-20 sensor, and an improved full motion video data link.

Helicopter and Tiltrotor

MV-22B Osprey. Our fixed-wing fleet is tested and strong, and getting stronger. Osprey is fully engaged, day in and day out around the world, and we are now focused on modernizing this revolutionary capability. As we begin to close on completing the procurement on all 360 MV-22 Program of Record aircraft, we will increase efforts to upgrade operational requirements and attack reliability issues.

The Marine Corps teamed with its industry partners to develop the Common Configuration-Reliability and Modernization plan (CC-RAM). CC-RAM consists of improvements that enhance operational effectiveness, reliability, and maintainability. These improvements are implemented by modifying older MV-22s and giving them readiness enhancements found on newer aircraft. CC-RAM also keeps operating costs down by reducing the number of different components that suppliers must produce and keep stocked. In addition to CC-RAM, planned nacelle improvements will reduce required maintenance and aid maintainers by incorporating design changes that focus on reliability. The Maintenance Training and Qualification Integration Program will also aid our maintenance personnel by providing them with better education and training.

Similar to the CH-53K, the MV-22B is developing a multi-tiered solution for addressing the challenges associated within DVE. The MV-22 will leverage state-of-the-art pilot cueing technology, combined with flight control computer (FCC) upgrades and image sensing technology to enhance the aircraft's ability to operate effectively in all ambient conditions. Additionally, the MV-22 program is developing an open system architecture that allows future DVE initiatives to be seamlessly integrated with existing devices. Specific efforts for the MV-22 program include Helmet Mounted Display and Tracking Systems, infrared cameras, synthetic graphics, and improved FCC software algorithms currently used by commercial aircraft.

CH-53K King Stallion. Where Osprey goes, the CH-53 will go as well. We remain committed to our future in heavy lift, both in getting into our new heavy-lift aircraft, the CH-53K, and resetting and keeping relevant our CH-53E workhorse. The CH-53K is a fully marinized, heavy-lift rotorcraft that will support current and future warfighting concepts by lifting 100 percent of the equipment in the MAGTF. The King Stallion is designed to take off from sea level with an ambient temperature of 103 degrees Fahrenheit; carry a 27,000 pound external load 110 nautical miles, delivering it to a landing zone at a pressure altitude of 3,000 feet with an ambient temperature of 91.5 degrees Fahrenheit; and return to the original pick-up zone with thirty minutes of fuel in addition to the prescribed minimum fuel requirements. Under those same conditions, the CH-53E can carry a 9,700 pound maximum external load; the 53K will triple that capability.

The CH-53K program achieved Milestone C in March 2017, approving procurement of up to 26 LRIP aircraft. The CH-53K's program of record is 200 aircraft and is scheduled to declare IOC in FY20. We will deploy these aircraft in 2023 and declare Full Operational Capability in 2029.

UH-1Y Venom and the AH-1Z Viper. The CH-53 transition has an analogue in our utility and attack helicopters: tough, capable airframes aging out, with new aircraft dawning. In the same way that we are fully engaged in our King Stallion, the Marine Corps has doubled down on our investment in the H-1 series aircraft, and we are well on our way to a complete replacement of the venerable UH-1N and AH-1W to state-of-the-art systems.

The H-1 upgrade consists of two independent conversions: UH-1N to UH-1Y and AH-1W to AH-1Z. The UH-1Y transition is complete, and USMC will take delivery of the last UH-1Y production aircraft in spring 2018. The AH-1Z conversion is being completed in-stride, with squadrons undergoing conversion while still performing the mission of the HMLA. The active component is scheduled to complete transition to the Viper in late 2020, with the Reserve Component completing in 2021.

The UH-1Y Venom is one of the world's most capable utility helicopters, teaming a new drivetrain and engines with state-of-the-art mission systems. All Venoms are outfitted with the third-generation BRITE Star Block II FLIR and color television camera to provide robust navigation and long-range targeting capabilities. The sensor is outfitted with a laser designator/rangefinder and integrated infrared pointer to take full advantage of its unguided and laser-guided 2.75-inch rockets or a selection of 7.62mm and .50 caliber machine guns. Combat-tested in the world's harshest climates, the Venom performs a wide array of missions. The ability of this platform to conduct combat assault support missions and immediately be re-tasked to provide precision fires to troops in contact makes the Venom a force multiplier for the MAGTF.

The AH-1Z Viper is a fully integrated attack helicopter capable of carrying a wide variety of munitions, including Hellfire and Sidewinder missiles, laser and unguided 2.75-inch rockets, and a 20mm three-barrel Gatling type cannon. The Viper incorporates the same upgraded engine and drive system as the Venom, enabling the Viper to carry ordnance on six weapons stations. The Viper is outfitted with a third-generation Targeting Sight System that shortens targeting time while improving threat standoff. The future integration of the AIM-9X and Joint Air to Ground

Preparing for take off. ***(Photo provided by Department of Aviation, HQMC.)***

The KC-130 continues to be an unsung workhorse. ***(Photo provided by Department of Aviation, HQMC.)***

Missile will expand the Viper's ability to engage targets rapidly, at extended range, and with increased lethality.

Making it All Work: Enablers, Supply, Logistics

MWSS. Nothing I have discussed will work without those who make the ACE run: logisticians, maintainers, supply experts, air traffic controllers, those who build our runways and maintain our systems and get the parts we need to keep flying. The MWSS is key to everything we do. It enables the ACE to perform their missions in steady state as well as austere conditions. The MWSS will be central to distributed lethality.

The MAGTF future operating environment includes expeditionary advance base operations which may be airfields. The MWSS enables this distributed lethal force: in logistics sustainment, expeditionary airfield operations, or even temporary forward air refueling operations. Our MAGTF survivability may well depend on the ability to be distributed.

The MWSG (Marine Wing Support Group) is coming back. The reactivation of MWSG-27, 2d MAW, Cherry Point, NC, and MWSG-37, 3d MAW, will occur by the end of first quarter FY19. The reactivated MWSG headquarters will serve in a C2 role over subordinate MWSSs. The MWSG will provide advocacy for the aviation ground support community and ensure a focus of effort to man, train, and equip the MWSS units in preparation for future expeditionary operations and concepts. The leadership and staff functions of the MWSG enable the commanding officer of the MAG to focus on the operations and maintenance requirements of the MAG while in garrison as he prepares them for combat. In an expeditionary environment, the MWSS shall provide aviation ground support directly to the MAG it is tasked to support; however for large scale operations, the MWSG will assume C2 and be responsible for the maneuver and integration of multiple MWSS locations.

Heat Resistant Lightweight Matting Solution. The current expeditionary airfield of choice, AM2 matting, has proved itself durable since its development in the 1960s. However, with advances in military aircraft technology, there is an emerging need for newer matting that can withstand the intense heat that modern aircraft generate. The Marine Corps is working with the University of Alabama and Pennsylvania State University on a science and technology process to develop a lightweight expeditionary mat.

Base Recovery After Attack (BRAAT) and the Nibbler Class I Unmanned Aircraft System. MWSS-372, MAG-39, 3d MAW, recently deployed for six months in the Middle East in support of SPMAGTF-Crisis Response 17.2. A highlight of the deployment was their use of an open source, 3D printed, Class I UAS platform as a damage assessment tool aboard Al-Taqaddum Air Base, Iraq, as a proof of concept. During a BRAAT scenario, the CO, MWSS, sends out a seven-person damage assessment team (DAT) to assess damages to the airfield in preparation for recovery, repair, and resumption of flight operations. Typically, airfield damage is identified and reported by a DAT that physically transits the airfield in a vehicle or on foot, a lengthy and potentially dangerous undertaking. MWSS-372's experimentation with the use of a UAS for damage assessment is revolutionary and is a fine example of the resourcefulness and adaptability of the MWSS in solving real-world problems with creative solutions.

BRAAT includes multiple actions taken immediately after an attack on an airfield that include identifying the type and location of airfield damage, selecting a minimum operating strip, and dispatching teams to repair damage and resume flight sorties in support of the operational mission. During their experimentation with this concept, MWSS-372 Marines successfully modified parameters and tuning settings in the open source Mission Planner software to utilize autopilot to extend the UAS range beyond the line of sight. They also developed a reference marking system for surveyed damage utilizing the uniform lengths of the runway markings as the reference. Additionally, they created a custom scale to estimate damage size and location from center line. This innovation is a welcomed new method to handling BRAAT scenarios that may lead to rewriting the aviation ground support doctrine.

Sustainment Lighting System (SLS) is a long-term lighting system for expeditionary airfields. SLS is an LED-based system that will replace the legacy hard-wired 1960s era incandescent technology expeditionary airfield lighting system and the minimum operating strip lighting system (MOSLS). The key feature of SLS is that it will work with air traffic control precision approach radar to allow for Category I instrument flight rule approaches. SLS will also support night vision goggles aviation operations, which will provide visual assistance for aircraft operations.

For the future ACE operating environment, there will be limited secure operating bases where ballistic missile attacks will be the norm. Airfield damage repair will be essential for continuous operations. The Airfield Damage Repair (ADR) kit is an assemblage of commercial off-the-shelf items that enable Marines to utilize current technology and updated engineering methods to repair airfields. The Marine Corps began fielding the current ADR kits in FY05. The equipment and material in the current kit are insufficient to meet operational requirements and reestablish airfield operations within six to eight hours. Modernization of the kit will contribute to the faster repair of seized enemy airfields and enhance BRAAT missions. Key upgrades to the current ADR kit will include a lightweight and scalable foreign object debris cover system, upgraded tracked skid steered loader with concrete cutting saw, and a self-contained volumetric mixer.

Manpower and Personnel

Aviators. "Once a Marine, always a Marine" is our motto. However, we are losing pilots. The military pilot shortage has received plenty of media coverage, and the Marine Corps is not exempt from this phenomenon. To combat the exit rate of Marine pilots, *MARADMIN 614/17* was released last November, announcing the Aviation Bonus (AVB). AVB and Aviation Incentive Pay (AvIP) are a necessary, yet short-term, measure to address the pilot shortage. In order to increase pilot inventory, we need a two-pronged approach.

Inventory can be defined as a complete list of available assets. Inventory is dependent on the outcome of *input* and *output* variables. In mathematical terminology, it can be depicted as such:

Input - Output = Inventory

Pilot *inventory* is the total number of primary MOS-trained and qualified pilots who are able to fill fleet operational, training, and staff billets.

- These billets are by design allocated to specific ranks or grades and are limited in quantity by congressional end strength restrictions.

The *input* variable is defined by initial accession production through flight school and the FRS.

- Flight school and FRS production is directly related to aircraft readiness and instructor-pilot availability: planes and people to fly them. Currently, each is a barrier to pilot production across all stages of pilot training.

Output is defined by separations.

- Output is the inverse of pilot retention.

Pilot retention is influenced by individual job satisfaction and external factors. Job satisfaction consists of numerous factors which can often be linked to aircraft readiness: no planes to fly means unhappy aviators. External factors are those economic and quality of life opportunities outside of the Marine Corps.

Therefore:

Input + Retention = Inventory

Recent annual pilot separation data show an increase in separation rates in comparison to the long-term yearly average. Additionally, the input of fleet pilots from undergraduate aviator training and FRS training is stagnant or decreasing in some circumstances. The result of less pilot production and lower retention is lower pilot inventory.

All FRS and flight school inputs to pilot inventory are strained by lagging aircraft readiness. Improving retention rates is a necessary but insufficient long-term solution to seek alone. The AVB and AvIP are intended to increase pilot retention. When combined with reduced pilot input, the AVB creates an inverted grade shape: fewer company-grade pilots and an excess of field-grade pilots.

AVB is a critical inventory management tool, but it does not decrease company grade pilot inventory shortfalls caused by strained input. We need a holistic approach to the pilot shortage problem. Attacking both retention and input variables, which include aircraft readiness, is required to create a healthy pilot inventory.

Under the conditions of the pilot inventory shortage, the variables affecting pilot inventory create positive feedback loops. For instance, the reduction in total pilot inventory affects our ability to staff instructor pilots in an FRS. The lack of instructor pilots reduces the FRS's pilot production, which in turn further reduces total pilot inventory, which then amplifies the negative effects of the retention variable.

For example, pilots often are moved among squadrons—"cross-decked"—so that units are sufficiently staffed to deploy. The result is that pilots face multiple deployments in short periods of time. Reduced deploy-to-dwell times affect pilots' decisions to leave the Marine Corps. The amplifying effect of this feedback loop of reducing both input and retention variables decreases total inventory. Clearly, a feedback loop of this nature is unsustainable.

The pilot training requirement seeks to balance requirements against capacity. Increasing the number of pilots that start training in order to fill the current vacancy in inventory is delayed by an increased time-to-train for flight training. Adding more students than the system can handle creates pools of officers awaiting training. Putting insufficient amounts of students into training expands the current pilot shortage. The pilot training requirement seeks to match readiness improvements with a corresponding manpower requirement in a similar manner as the just-in-time production methodology used in the commercial manufacturing industry.

An analogy is illustrative. Introduced in the 1970s, just-in-time production was a radical new approach to the manufacturing process. This process cuts waste by supplying parts only as and when the process requires them. Just-in-time eliminates the need for each stage in a production process to hold buffer stocks or pools, which results in huge savings.

A similar process works in pilot production: the number of students who start pilot training is metered based on current and expected aircraft readiness. The goal is to reduce the pools of student pilots in a training status in order to reduce the chocking effect on production. Restricting the starts to match the system's capacity reduces time to train by focusing training resources on fewer students in training. As readiness improvement trends increase, the number of students who start pilot training can increase, with a subsequent increase to the fleet pilot inventory.

Purposely slowing the inputs to match readiness comes with some risk because it puts a greater reliance on retention programs. The bonus tries to improve pilot retention *in conjunction with* improving aircraft readiness.

For our aviation manpower assets, we have created specific necessary MOSs (NMOSs) to identify, track, and manage aircrew and aircraft maintainer advanced qualifications similar to what was done to identify, track, and manage Weapons and Tactics Instructor (WTI) graduates.

Aircrew NMOSs include:

- Section Lead
- Division Lead
- Flight Leader
- Weapons Training Officer
- Marine Division Tactics Course Qualification
- EA-6B Defensive Tactics Instructor
- AV-8B Air Combat Tactics Instructor
- Strike Fighter Tactics Instructor
- Forward Air Controller (Airborne) Instructor
- Night Systems Instructor
- Strategic Refueling Air Commander

Maintainers

- Aircraft Maintainer NMOSs include:

- Collateral Duty Inspector
- Collateral Duty Quality Assurance Representative
- Quality Assurance Representative
- Multi-systems Quality Assurance Representative
- Quality Assurance Safety Officer
- Maintenance Control Safe-For-Flight

Properly trained maintainers and maintenance managers are the bedrock of a healthy and effective maintenance base. The training continuum starts with leaders, including 75XX squadron commanding officers and aircraft maintenance officers, and flows through SNCOs and junior officers to entry-level technicians and young crew supervisors. Marine Aviation champions a "training is continuous" philosophy whereby maintainers and managers receive performance-based and criterion-referenced instruction that promotes student transfer of learning from the instructional setting to on-the-job training. Multiple technical and managerial training initiatives focused on post-accession maintenance personnel have been implemented, with future training actions dedicated to formal schools and graduate-level curriculum development that is tracked by additional MOS designations and training and readiness progression reported through the Advanced Skills Management (ASM) system.

Current training initiatives recently implemented within Marine aviation span the aviation logistics commodity areas of aviation supply, maintenance, avionics, and ordnance. The most critical element and cornerstone of maintenance training is the Advanced Aviation Maintenance Officer Course (AAMOC). AAMOC is designed to instill and codify critical management skills within department-level leaders in order to achieve a common and predictable managing style across flying squadrons which will enable institutional improvements in resource management. This course is delivered biannually by MAWTS-1 maintenance leaders concurrently with WTI courses and encompasses 120 hours over seven weeks, including 83 classes and sixteen practical applications. The target student populations are chief warrant officers, lieutenants, and captains who are currently filling the billet of maintenance material control officer in our flying squadrons. In addition to AAMOC, MAWTS-1 will deliver the inaugural MAWTS Maintenance Management Course in March 2018. This period of instruction is independent of WTI courses and targets Expeditionary Warfare School ACE Occupational Field Expansion Course students, fleet 75XX aircraft maintenance officers, assistant aircraft maintenance officers, quality assurance officers, maintenance chiefs, and maintenance controllers.

Avionics' current and future training initiatives include Advanced Wire Repair training and the Avionics Officer (AVO) and Avionics Chief (AVC) Course. Advanced Wire Repair addresses the current inadequacies of journeyman-level training and material conditions across Type/Model/Series. ASL, in conjunction with Training and Education Command, the Center for Naval Aviation Technical Training, and the Naval Air Systems Command Wiring Branch, have established just-in-time training through FY19, with formalized implementation of a multi-site wire repair course beginning in FY20. The AVO and AVC Courses are in the process of developing a curriculum and formal course for newly promoted AVOs and AVCs. The courses will address proficiency levels required by commands from those subject matter experts, to include aircraft survivability equipment, electronic countermeasures equipment, electronic keying material, laser system safety, digital interoperability, and 5th generation avionics systems.

The aviation ordnance community recently established the MAWTS Expeditionary Ordnance Course (MEOC) that provides seasoned fleet Marines training focused on the expeditionary aspects of ordnance support operations. The MEOC courses are taught in conjunction with WTI courses and continue to evolve in parallel with USMC aircraft modernization and distributed aviation operation concepts. This year will bring to conclusion a long effort to modernize the three levels of the Aviation Ordnance Career Progression courses. Level I is scheduled to finish its pilot in the second quarter of FY18 and will be marked by a course name change to "Aviation Ordnance Manager's Career Progression." The name change is intended to better support and align with the educational and professional career path designations for naval aviation and naval surface ordnance officers, as well as senior enlisted personnel and civilians serving in ordnance management roles.

Building and sustaining the requisite experience levels in our squadrons is challenging. The AMTRP provides standardized training requirements that are documented in the ASM training management system. Training and readiness (T&R) manuals contain individual training syllabi for applicable MOSs within a maintenance community. Individual maintainer proficiency is based on specific requirements and performance standards to ensure aviation assets are maintained through required system and subsystem skill proficiency. ASM provides data to maintenance managers in order to measure, analyze, and report individual and departmental T&R completion rates and required qualifications, certifications, and licenses. ASM data, coupled with maintenance and material management metrics, provides squadron maintenance managers and leadership with facts regarding the health and effectiveness of the maintenance department. This knowledge assists managers in identifying areas of concern including skill or training deficiencies and the efficient or inefficient use of available manpower.

Aircraft "touch-time" is central to both building experience within the workforce and ensuring the efficient application of available manpower. Currently, no individual standard exists for aircraft touch-time. Much like pilots track and report flight hours per aircrew per month, ASL is currently developing an individual and work center touch-time metric that will assist leaders in analyzing workforce efficiency and proficiency levels. Tracking and analyzing touch-time statistics will facilitate the identification of constraints and institute process improvements to increase maintenance efficiencies.

Marines moving toward awaiting helicopters. ***(Photo provided by Department of Aviation, HQMC.)***

The Next Fight

All of this—new aircraft, better supply management, far better communications and linkages with the ground force, and, most of all, better-trained people—comes together in war.

A combined arms element such as today's MEU afloat is completely revolutionized by F-35B aircraft aboard. The F-35B can fill the basic role of providing fixed-wing strike and ISR support to the MAGTF commander and, in the moment, turn and penetrate a high-threat integrated air defense system—a concept completely impossible prior to the advent of the F-35B aboard a MEU. The F-35s deployed aboard a MEU can perform all of our current missions to support the Battalion Landing Team, while simultaneously providing a high-end deterrent to any potential near-peer threat that may emerge.

In the next few years, the Marines will be partnered with the Navy aboard the CVN with a squadron of USMC F-35Cs and the Navy's mix of F-35C, F/A-18 E/F Super Hornets, and EA-18 Growlers, enhancing the current high-end deterrent with an additional and exponential factor. This capability will be invaluable in terms of the impact it could have on nations, nation-states, and world actors and their willingness to challenge American interests. Our TACAIR fleet—a mix of legacy and brand-new aircraft—works hand in glove with our helicopter and tiltrotor assets to bring the fight wherever the Nation calls.

What does all of this mean to the Marine on the ground? Our tactical skills to find, fix, target, track, engage, and assess against any potential adversary is exponentially improved over our current ability. Manned-unmanned teaming means we can provide 24-hour coverage anywhere in the world and preserve assets. New systems facilitate the Marine Corps' tactical entry into a contested environment and allow for us to better support the MAGTF and Marines on the ground once we have established air superiority—or, more likely, air supremacy—in a given theater of operations. We will be able to shoot missiles and drop bombs from farther away, but more importantly, we will be able to provide increased situational awareness to aviation and ground commanders on a chaotic battlefield in order to help lessen the effects of the fog of war and ultimately provide a common operating picture across the joint and allied forces.

As we look ahead, the Marine Corps imagines what the future battlespace will look like—and we design and build weapons systems that will enable Marines to be prepared for the continuum of conflict. The lines between low-intensity engagements requiring realtime precision strike capabilities and complex engagements requiring counters to high-threat, strategic, near-peer adversary systems can blur quickly.

The next-generation MAGTF will be ready.

USMC