Distributed Aviation Operations

Cutting the tether on outdated aircraft maintenance inspections

by LtCol Drew Bossart

The Marine Corps historically embraces interwar periods with ruthless self-appraisal to prepare for future conflict. These periods of introspection generate insights of military brilliance from innovative leaders, like Maj Earl "Pete" H. Ellis, who developed the concepts for the Pacific island-hopping campaign.[1] Today, the process continues with the intense revision of operating concepts and changes to force structure outlined in *Force Design 2030 (FD2030)*. Equally important but easily overlooked are the organizational processes intrinsic to force employment that are much harder to change. Parallel to developing new operating concepts, the Marine Corps must also scrutinize current organizational processes that unwittingly result in faulty capability assumptions and lead planners astray. The procedures for inspecting and certifying aircraft for flight are examples of long-standing organizational processes that merit analysis and updating to leverage new technology that increases capability fully. The self-diagnostic technology on "new-generation" aircraft, such as the MV-22B, delivers comprehensive system surveillance and testing that reduces, and in some cases obviates, the need for long-standing, routine maintenance inspections that tether aircraft to basting, like the "daily" and "turnaround" (D&T) inspections. Freeing aircraft from their bases for extended periods creates capability that directly supports the concepts under development for distributed operations. The Navy and Marine Corps must renew their outdated aircraft inspection process to leverage this capability fully.

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Updated maintenance and inspection procedures enabled by advanced technology can free aircraft from their bases and support concepts like EABO. ***(Photo by Sgt Alexander Sturdivant.)***

Severing the tie between aircraft and their maintenance departments will unlock long-range, distributed aviation operations, where aircraft gain access to an area and can remain attached to a ground force over extended periods without a trailing maintenance and logistics footprint. The first continuous maneuver of aviation assets with ground forces occurred when the Royal Air Force leapfrogged its maintenance support to establish austere bases while battling Rommel's *Afrika Korps*.[2] Aviation maintenance processes have since developed on an assumption of secure rear areas that tether aircraft to their maintenance departments. The operating environment transformed with the employment of anti-access/area denial weapons (A2/AD) that push secure rear areas far from the area of operations. Fortunately, self-diagnostic aircraft technology provides a solution for aviation to support distributed operations in the new environment. Long-range, distributed operations demand that the Marine Corps harness the technology embodied in new generation aircraft to innovate a flexible approach to aircraft maintenance, like that forced on the Royal Air Force by Rommel. This innovation hypothesizes that long-range distributed warfighting concepts require persistent aviation but preclude the force concentration inherent with basing. The

maintenance processes that generate aviation readiness are prohibitive to this hypothesis. The primary assumption is that new generation aircraft technology, with renewed inspection processes, is adequate to sever ties between aircraft and bases for extended periods. This concept should form around the MV-22B because of its onboard preflight diagnostic capability, extended range, and position as the force's primary troop transport aircraft. If this hypothesis fails because of inadequate technological capability, then the technology gaps must become requirements for the future vertical lift program so that the operating concept remains supported. Affecting this change is a monumental task because it will override a long-held and foundational process in one of the largest organizations in the U.S. military: Naval Aviation.

The Naval Aviation Maintenance Program's (NAMPs) well-entrenched aircraft inspection and certification process directs maintenance action after each flight or within an arbitrary window in the absence of a flight. The NAMP requires that aircraft have current D&T inspections performed before certifying an aircraft as "safe for flight" (SFF). These inspections are "conducted between flights to verify the integrity of the aircraft, proper servicing, and to detect degradation that may have occurred during the previous flight."[3] Turnaround inspections are valid for 24 hours, and after every flight, and dailies, which are slightly more in-depth, are valid for 72 hours or 24 hours after the aircraft launches.[4] D&T inspections limit aircraft to a maximum of 72 hours away from the maintenance department's footprint, extendable to 96 hours by the Group/MAGTF commander. Both inspections existed well before the emergence of self-diagnostic preflight technology on new-generation aircraft. These inspections do not restrict aircraft capability at home-station, and there is no reason to eliminate them for aircraft that recover to the maintenance department. Still, new technology opens the door to policy for aircraft to remain disconnected from the maintenance and logistics footprint for extended periods. Failing to update the process to new technology is analogous to carrying an oil lantern to illuminate dark rooms before flipping on the light switch instead of only using the light switch.

Commercial airlines discarded their oil lanterns long ago and have operated for years on an "ABC check system," where aircraft fly for hundreds of hours between inspections.[5] In the world of light civil aircraft, the minimum maintenance inspection required in the United States is every 100 hours.[6] To be sure, military aviation is wholly different from commercial and civil aviation in ways too numerous to mention. However, one key difference is that commercial and civil aviation adapt processes, technology, and resources to lower operating costs while promoting safety. Military aviation lacks the free market incentives that drive process innovation. Aviation support in distributed operations is Marine aviation's incentive to overhaul the long-standing aircraft inspection process. The answer is not removing the D&T inspections alone but leveraging new technology to fulfill the intent of the D&T while dislocated from the maintenance department.

The D&T inspections serve crucial roles for verifying the integrity of components that lack self-diagnostic monitoring and screening data from monitored systems. Both D&T tasks require specially qualified maintainers. In addition to D&T inspections, numerous "special inspections" focus on particular components of the aircraft. The most restrictive special-inspection on the MV-22B occurs after 35 flight hours. A 35-hour special inspection window means that an MV-22B can fly for 35 hours without scheduled maintenance, except for the D&T SFF requirements. Special inspections reflect an engineering and data-driven approach to maintaining aircraft health, while D&T inspections are safety backstops used before flight and for screening post-flight system diagnostics. While on-board system monitoring technology is not new to military aircraft, new generation aircraft have additional functionality to test the aircraft systems before flight. The introduction of preflight built-in-test (PFBIT) technology allows a realtime verification of aircraft systems, and these tests are part of the aircrew checklists before flying. The arrival of PFBIT technology should have spurred the Naval Aviation Maintenance Enterprise to renew the aircraft inspection and certification process to gain efficiencies that increase capability. Like most large organizations, though, it resisted change and incorporated the new technology into the existing process. The result is an excessively redundant and resource-intensive process for certifying aircraft to fly. The nature of the daily and turnaround inspections, combined with the wealth of data provided by on-board self-diagnostic and PFBIT technology, must be streamlined into a process that the flight crew can complete independently while supporting distributed operations. Assimilating these processes and endowing the flight crew with the ability to perform them will be resisted by the Naval Aviation Maintenance Enterprise's organizational memory.

The Naval Aviation Maintenance Enterprise will consider new procedures that eliminate the current D&T inspections to be high risk, as it runs counter to how every aircraft has been certified SFF for decades. Large organizations, like the maintenance community in Naval Aviation, "place a premium on predictability, stability, and certainty" and are, therefore, "inimical to innovation."[7] Countering Naval Aviation's organizational resistance to change necessitates the need for rigorous testing combined with a requirement to show demand for the new capability. The MV-22B offers a great example of the capability gained by replacing the D&T inspection with a streamlined certification process. The 35-hour special inspection window on the MV-22B enables it to fly 1,000 miles and have approximately 25 flight hours left "on-station" over an extended period before needing to return for scheduled maintenance. A crew that can satisfy the intent of the current D&T inspections through a revitalized inspection process for distributed operations could theoretically remain at an expeditionary advanced base until the special inspection flight hour window elapses. Capability gains,

The Corps is currently experimenting with new maintenance and inspection processes to allow aircraft to be co-located with dispersed maneuver forces for extended periods. ***(Photo by Cpl Francisco Diaz.)***

such as these, must be included in the experimentation and simulation process outlined in *FD2030* to create demand for organizational change and support the testing of new aircraft maintenance certification processes.

Developing the new aircraft certification process involves experimentation and testing that should occur along two lines of effort. First, the Marine Corps is conducting iterative wargaming as part of phase III for *FD2030*.[8] Phase III analysis should include detaching new generation aircraft, like the MV-22B, from the maintenance footprint for weeks. It is necessary to ascertain the value of changing the inspection processes to allow aircraft to co-locate with dispersed maneuver forces over long distances. Second, establish a dedicated team that comprises individuals from the MV-22B program office, Naval Aviation maintenance professionals, and operational test Marines from VMX-1 to develop and test new inspection procedures that allow crews to operate MV-22Bs autonomously for extended periods while supporting distributed operations. Part of renewing the process is bridging the safety backstops of the D&T inspections with the flight crew's inspections and updated data-screening software that allows the crew to screen the maintenance download for impending component failure easily. Suppose PFBIT technology on the MV-22B is deemed insufficient to replace the D&T inspections. In that case, the test results must be used to generate improvements on the MV-22B and create additional requirements for the future vertical lift program that make a flight crew aircraft certification concept viable. Renewing the inspection and certification process is long overdue and requires both lines of effort to show new generation aircraft technology's reliability and organizational demand for the new capability.

In summary, aggressive self-reflection is a paramount quality for winning in a future conflict. New operating concepts and force structure changes are exciting and attractive, but they are also relatively easy to implement—compared to changing cross-department, well-entrenched organizational and bureaucratic processes. Changing aircraft inspection procedures to be congruent with current technology requires changing how aircraft are certified SFF across both the Navy and Marine Corps. Enacting this change is a monumental but necessary task. The Marine Corps must break free from outdated processes that stifle capability because of the perceived risk associated with change. Marine aviation operates some of the most advanced aircraft in the world, and it must employ those aircraft to their full capability. It is time to cut the tether of outdated maintenance procedures that tie aircraft to bases.

Notes

1. Stephen Rosen, *Winning the Next War,* (Ithaca, NY: Cornell University Press, 1991).

2. Robert Ehlers, *The Mediterranean Air War: Airpower and Allied Victory in World War II,* (Lawrence, KS: University of Kansas Press, 2015).

3. Department of the Navy, *4790.2C, Naval Aviation Maintenance Program*, (Washington, DC: January 2021).

4. Ibid.

5. Staff, "The A, C and D of Aircraft Maintenance," Qantas Airlines, (July 2016), available at https://www.qantasnewsroom.com.

6. Federal Aviation Administration, *Federal Aviation Regulations, Part 91, General Operating and Flight Rules, Subpart E- Maintenance, Preventative Maintenance, and Alterations*, (Washington, DC: U.S. Dept. of Transportation, Federal Aviation Administration, August 2004).

7. Barry Posen, *The Sources of Military Doctrine*, (Ithaca, NY: Cornell University Press, 1984).

8. Gen David H. Berger, *Force Design 2030*, (Washington, DC: March 2020).