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TITLE:

Is the Marine Corps' Transition to the F-35 Joint Strike Fighter the Correct Course of Action for the Future of Marine Aviation?

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OF THE REQUIREMENTS FOR THE DEGREE OF
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Preface

Reaching the conclusion to write about this topic was no easy task. I had tossed around ideas of exploring battles in the past and reviewing what went right and what went wrong, but somehow it was not enough. I decided if I was going to put forth the effort to complete a Masters degree that I was going to research a topic current and relevant to the Marine Corps in a way to help further our warfighting institution. Marine Corps aviation is a very important topic to me personally as a Marine AV-8B aviator, former Squadron Operations Officer, and former Squadron Aircraft Maintenance Officer. From having served at the AV-8B squadron level I understood what my side of the transition was shaping up to be with decreased numbers of qualified aviation maintainers, shortages in the supply system as funding was diverted towards the newer platform, as well as a myriad of other issues while trying to maintain the same level of warfighting capability.

When I initially decided to select the topic of the F-35 Joint Strike Fighter I had no idea where the research would take me or how much I would learn along the way about this program. The more I thought about my thesis statement, the more questions I would have that needed to be answered. Was this transition an entirely new system or has the Marine Corps gone through this before? What will the Aviation Command Element (ACE) look like when the transition is complete? Can the Marine Corps afford this program?

Dedication

The assistance I received while completing this research has been amazing. My respect and gratitude go to Colonel “G-Man” Sofge as well as Majors Ryan “Psycho” Ward, Ryan “Puddy” Hough, Brian “Stamp” Gershutz, and Brent “Nilla” McGregor. I have had the pleasure of serving with these Marines in the past and through their guidance and input this research was able to be completed. Mrs. Rachel Langlois was very helpful in always pointing me in the right direction for research material and is quite possibly the best librarian I have ever met in my life.

While geo-batching here at “The Cross-Roads of the Marine Corps” in Quantico, VA attending Command and Staff College and completing this research, my wife Jami has remained in Cherry Point, NC with our house and family. Jami I know you don’t hear this enough, but thank you ever so much for all that you do. You always seem to be able to put others before yourself and that is one of the things I love and respect about you. Thank you for handling every single issue that happens at home and with our family in order to allow me to complete this program.

DISCLAIMER

THE OPINIONS AND CONCLUSIONS EXPRESSED HEREIN ARE THOSE OF THE INDIVIDUAL STUDENT AUTHOR AND DO NOT NECESSARILY REPRESENT THE VIEWS OF EITHER THE MARINE CORPS COMMAND AND STAFF COLLEGE OR ANY OTHER GOVERNMENTAL AGENCY. REFERENCES TO THIS STUDY SHOULD INCLUDE THE FOREGOING STATEMENT.

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Introduction

In June 2000 U.S. Defense Secretary William Cohen stated in a letter to Congress concerning the F-35 Joint Strike Fighter that “The Joint Strike Fighter (JSF) program is critically important to the modernization of the United States conventional forces and is the cornerstone of tactical aircraft modernization. It will replace 1,763 Air Force, 480 Navy, and 609 Marine Corps aircraft; 2,852 aircraft in total. The JSF’s stealth, advanced avionics, and ability to carry a full array of modern precision munitions will make it much more capable than the legacy aircraft it replaces when operating under challenging circumstances against modern air defenses. It is also critical to the modernization of our ally forces for coalition welfare.”¹ Though some of the numbers of aircraft being replaced may have changed, Cohen’s premise for acquiring the F-35 JSF remains relevant.

The Marine Corps has a robust history of searching for and obtaining new technologies for the use of advancing war fighting capabilities. In the early years of the Marine Corps new concepts consisted of better rifles and artillery. In the present force new concepts consist of ideas such as advanced stealth 5th generation F-35 Joint Strike Fighter (JSF). The F-35 brings a new level of lethality to the Marine Corps’ arsenal. This technology is being designed to allow American forces to operate in areas that were once considered Anti-Access Area-Denial (A2AD). This paper will explain the original AV-8 and F-35 acquisitions and transitions, explore activities in each community and advance the argument that the transition to the JSF, although not entirely popular with all government agencies and the fact that it will be an initial burden to the legacy Harrier fleet, is the correct course of action for the Marine Corps.

The United States must stay technologically ahead of its adversaries and be prepared to fight not just the battles in present day, but it must also be prepared to fight the battles of future

conflict. New operating environments are becoming inoperable for some legacy air platforms currently in the inventory due to the threats owned and employed by our adversaries. This denial of terrain is not just inconvenient, but it could lead to serious implications in regards to national security policies. The United States must be prepared for a changing combat environment and the JSF will enable continued success on the battlefield.

Expeditionary Force 21 (EF21) states that its overarching goal is to improve the support for the requirements of the Geographic Combatant Commander (GCC). Furthermore it explains that the development and proliferation of A2/AD capabilities threaten freedom of action and maneuver at sea and pose a threat to bases overseas. Under the 'Fires' section of EF21 the F-35B is identified as a platform that provides a signification level of situational awareness in addition to being a platform for responsive, scalable firepower.²

Webster's Dictionary defines transition as "a movement, development, or evolution from one form, stage, or style to another."³ The act of transitioning from one item to another can be a difficult and confusing time. In the case of the JSF, what is the best way to employ this aircraft? How many aircraft are needed for a certain mission and what formation is best to fly for each mission? What are the major aircraft maintenance issues that this new aircraft will present? Can the F-35 truly operate in A2/AD? The answer to all these questions is we do not know. It is too new of a platform to tell with any certainty the answer to any of these questions.

While remaining within the bounds of an unclassified document, this paper will begin with an explanation of the initial acquisition for the Harrier. This acquisition is different from the F-35 program, but it will show what the parties concerned try to compare the current acquisition to. It will then explain the transition that was involved to move from the older A-4 Skyhawk and F-4 Phantom to the AV-8A Harrier. There will be a brief explanation of current

operations and maintenance within the Harrier fleet to show the tempo of what the F-35 will be replacing. This paper will then transition to the F-35 acquisition followed by current operation and maintenance events happening in the units that have already transitioned. Due to the classification of this document there will not be in depth discussions of capabilities or tactics involving the F-35.



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A-4 Skyhawk

F-4 Phantom

AV-8B Harrier

AV-8 Harrier Acquisition

In the late 1960's the Marine Corps was looking for a new aircraft to replace the current legacy platforms of the F-4 and A-4 aircraft. This new aircraft would need to be able to perform in an environment where conventional runways might not be available and it would also need to have the capability to operate aboard amphibious ships to support Marines as part of a Marine Expeditionary Unit (MEU). There were many people who supported the search for a new aircraft as they knew in order for the Marine Corps to remain relevant in conducting warfare it would need a new tactic in the aviation area. There were also many skeptics who believed that since the Marine Corps was performing well at that particular time, there was no need to fix what was not broken. The skeptics also believed that spending money on such an extensive project was not warranted.

The drive for finding a new aircraft platform was based on the need to speed up the response time of air power during Close Air Support (CAS). The new requirement for this rapid

air support and alternate basing called for a new aircraft that could be close to or co-located with Marine ground forces.⁵ The Marine Corps found that the aircraft that was correct for this vacancy was currently being pursued by the United Kingdom in the first generation Harrier, the Harrier GR Mk. 1.



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Harrier GR Mk. 1

The Royal Air Force (RAF) purchased and began receiving more than 150 of these GR Mk. 1 aircraft in 1965.⁷ In 1969 the U.S. Congress approved \$57.6 million to purchase 12 Harriers with the additional training and support expenses included for the FY1970 budget.⁸ In total, the planned first stage of these purchases included 110 Harriers plus 8 two seat TAV-8A trainers for a sum of \$474.4 million.⁹

Since the United States was purchasing this aircraft “off the shelf”¹⁰ the money needed for research and development would be lower than if it needed to invent a brand new platform. The aircraft purchased from the RAF would need changes and upgrades to meet the requirements for the Marine Corps, but the overall build of the aircraft was consistent with what the United States was looking for. In fact, in 2011 when the United Kingdom discontinued their Harrier program the United States purchased the remaining 70 aircraft to sustain the Marine Corps’ current Harrier fleet. These purchased aircraft now remain at MCAS Cherry Point, North Carolina and are used for the parts that are hard to acquire or are no longer built.

AV-8 Transition

The challenge with transitioning from the A-4 and F-4 platforms to the AV-8A aircraft impacted across the Marine Corps. The change to utilize this aircraft impacted the planning and employment efforts for future combat. With this new capability, new tactics, techniques, and procedures (TTP's) needed to be created. With the short takeoff and vertical landing (STOVL) capabilities, there would no longer be an absolute need to secure forward conventional runways for this aircraft. STOVL would also permit an on call Close Air Support (CAS) platform to be positioned a few minutes from the battle instead of transiting from foreign airfields or ships and only having the ability to remain on station overhead for a very limited period of time before having to return to base for refueling or rearming.

For the individual squadrons the change affected both the enlisted and officer ranks. For the enlisted Marines the changes involved learning to perform maintenance and support for a new aircraft. For those Marines that were currently working on the A-4 and F-4 it would mean follow-on education to learn how to work on the new systems of the new aircraft. Some of the troubleshooting and maintenance TTPs would transfer from the old platform to the new one, such as hydraulic and electronic theory, but some did not. They would need to understand the new systems and how they interacted with each other. The new maintenance Marines entering the service would attend their respective newly formed technical school following recruit training.

Pilots for the new Harrier aircraft would also experience change. Given the new platform and the experience level needed to fly the Harrier, initially no newly winged aviators fresh from flight school were allowed to fly it.¹¹ Originally the news of transitioning to the Harrier was not met with enthusiasm by some pilots as many Marine pilots loved to fly the A-4 Skyhawk.¹² The

seasoned aviators allowed to transition to this aircraft would have to go through additional flight training. This flight training would teach the pilots the basics of taking off and landing in the vertical environment. It would also teach them the performance envelope of the new aircraft. Once the aircrew selection process was complete for this new program, the next challenge the Marine Corps faced was the operational environment and tempo in which this new aircraft would be utilized.

Current AV-8B Operations

As of March 2014 the current inventory of AV-8B's within the Harrier community consisted of 134 aircraft. These aircraft consist of Night Attack, Radar, 2 seat TAV-8B trainers, and one Day Attack conversion. These aircraft are divided amongst 6 operational squadrons and one fleet replacement squadron. Originally the AV-8B aircraft had a 6,000 flight hour service life, but with the incorporation of PMA-257 aircraft are now enabled to advance past 6,000 flight hours as PMA-257 provides more accurate measures of actual stress history for the airframe.¹³

The AV-8B currently fulfills a vital role within the Marine Air Ground Task Force (MAGTF). Whether deployed shipboard or from sites on land, the Harrier is always available to provide support to the war fighter on the ground. The two main home bases for AV-8B operations within the United States are located within Marine Air Group (MAG) 14 at MCAS Cherry Point, North Carolina and MAG 13 at MCAS Yuma, Arizona. Both of these MAGs conduct operations independently from each other, but also work together on important items such as pilot training, aircraft maintenance, and aviation supply.

Current AV-8B operations in the Marine Corps are being conducted at a rapid pace. With the number of legacy Harrier squadrons standing down in order to transition and F-35

squadrons not ready for deployment, current AV-8B squadrons will have to fill the deployment rotation for tactical aircraft with less operational squadrons. Figure 1¹⁴ shows the current TACAIR legacy to JSF transition plan. Legacy Harrier squadrons are depicted with unit names beginning with “VMA-.”¹⁵ VMFA-121 is already in transition, but the chart does not show VMA-513 which has already shutdown Harrier operations and is awaiting transition. Of note, VMA-513 was the first USMC squadron to transition to the AV-8A.

What this means to the individual Marine that remains in the legacy platform fleet is that there will be more deployments with shorter dwell times between rotations. With the current Marine Corps drawdown of coupled with fewer squadrons, more deployments will be on the horizon for the Harrier fleet in the foreseeable future while the transition takes effect.

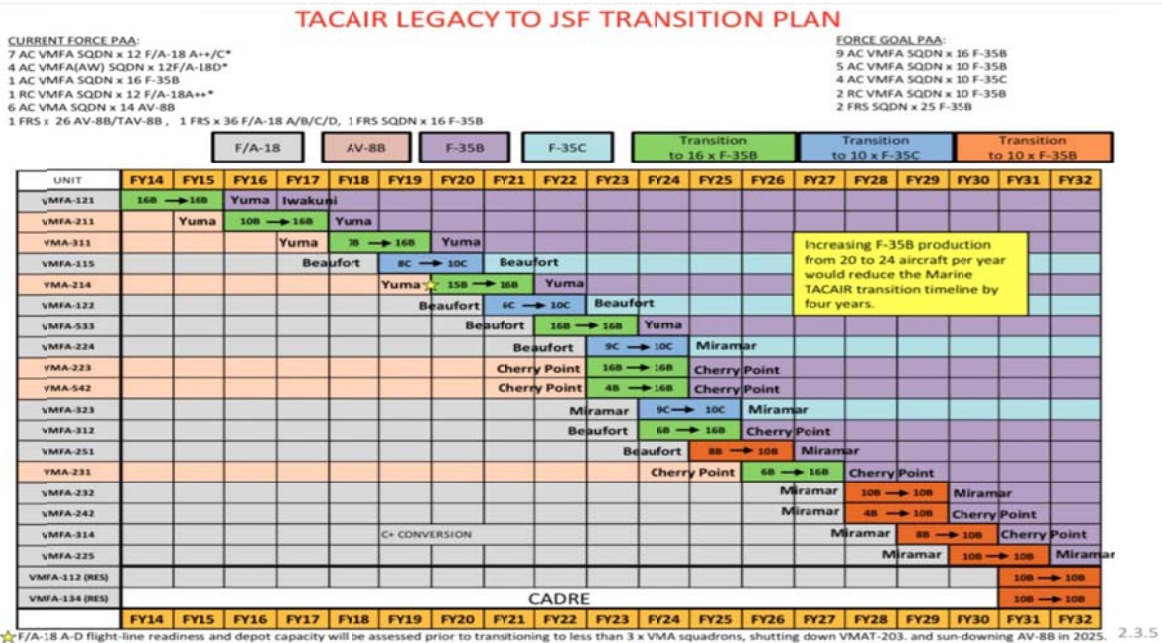


Figure 1

Aside from the rapidly building deployment cycle, the AV-8B squadrons have a plethora of obligations to support while they are not on a scheduled deployment. These squadrons support Weapons and Training Instructor (WTI) training which consists of 2 separate 6 week exercises at MCAS Yuma in order to conduct training and advanced certification for pilots. In addition to WTI the Harrier fleet supports the Integrated Training Exercise (ITX) conducted at Twentynine Palms, California in order to provide pre-deployment training for both ground and aviation units. The squadrons also currently support training for external units to include Close Air Support (CAS), Armed Reconnaissance (AR), Strike Coordination Armed Reconnaissance (SCAR), Multi-sensor Imagery Reconnaissance (MIR), Aerial Interdiction (AI), Air to Air (AA) missions, and Carrier Qualifications (CQ).¹⁶ In addition to this external support the squadron also has to continue to focus on advancement of individual training for pilots within the squadron in order to contribute towards advanced qualifications for each individual aircrew.

Very few platforms in the United States' military can perform CAS exceptionally well. Two platforms that excel in CAS are the Air Force A-10 Warthog and the United States Marine Corps AV-8B Harrier. With the Air Force's relationship with the A-10 and with budget cuts threatening to shut down the A-10 program all together, the Harrier will remain in high demand for CAS until the F-35 is ready to assume this role. One issue affecting the F-35 from being able to take on this role is the delays in software development specifically related to its gun system. The forecasted date for the F-35 to be able to use the gun in CAS is 2019. Once this software is available the F-35 will be able to perform CAS in support of the Ground Combat Element. Once the gun system is available for use in the F-35 additional training will be needed for the pilots to gain proficiency in its use.

Current AV-8B Maintenance

Current maintenance operations in the legacy Harrier fleet have a very fast tempo and as a result have led to busier than normal maintenance evolutions. As the fleet accumulates more flight hours on every airframe through normal operations and surge operations, such as those flown during Operation Iraqi Freedom and Operation Enduring Freedom, new maintenance issues are emerging. In addition to regular scheduled and planned maintenance to the aircraft, new unscheduled maintenance actions are being required to replace parts of the airframe that are now starting to reach service limits and need to be replaced. Despite these additional maintenance issues, Harrier maintainers have performed well and continuously provide aircraft for flight at a rate of 65 percent mission capable and 50 percent full mission capable.¹⁷ Currently AV-8B readiness rates are well ahead of F-18 rates.

Parts and systems for the AV-8B that have never shown a pattern of malfunction are now showing a trend of failure. Examples of these parts and systems degradation were evidenced in the December 2014 Type Model Series Action Officer brief given between MAG-13 and MAG-14. These teleconference meetings usually occur on a monthly schedule and are chaired by the MAG Commanding Officers at MAG-13 and MAG-14. In attendance of these meetings are also individual squadron Maintenance Officers, Depot maintenance representatives, Boeing representatives, and Rolls Royce representatives.

During the December 2014 teleconference meeting some of the top degraders for the Harrier community were noted as Gas Turbine Starters, Warfare Management Computers, Speedbrakes, and Digital Electronic Control Units (DECUs). Currently there are 94 DECUs on backorder and the fleet is awaiting delivery of these much needed parts.¹⁸ The unfortunate part for this issue is that many major components of the aircraft are not in production anymore and

many of them are unavailable from decommissioned aircraft. To help alleviate this, Intermediate levels of maintenance aboard MCAS Cherry Point and MCAS Yuma are able to rebuild and repair some of these components and parts. The Marine Corps has a Depot level maintenance facility aboard MCAS Cherry Point for major rework components and for major maintenance efforts on the aircraft. Usually when an aircraft enters rework at the Depot level it will be unusable for the fleet for an extended period of time dependant on the repair or rework that is needed on the airframe.

The individual maintenance Marines who work on the Harrier are becoming more proficient at troubleshooting procedures as they progressively are encountering maintenance issues that are not covered in their respective maintenance manuals. By increasing the speed and skill of the Marines troubleshooting techniques they each ultimately become a better mechanic. One problem that is currently occurring is that the Harrier fleet is losing a vast wealth of Harrier maintenance knowledge as former AV-8B mechanics transition to the JSF program. It takes time to build a good mechanic with a working knowledge of an aircraft's systems and the rate of turnover with Marines to the JSF program is making maintenance efforts increasingly difficult.

One unit of measure for the health of a maintenance department is the Maintenance Man Hour. The term Maintenance Man Hour (MMH) is defined as one Maintenance Marine performing one hour's worth of maintenance on an aircraft. MMH can be used to determine health of a unit or platform as a whole when compared to how many MMHs are needed per flight hour. One legacy squadron, VMA-542, had an average of 16.92 MMHs per flight hour during the period from April 2013 to March 2014. The highest ratio of MMH per flight hour during this period was 37.9 while the lowest ratio showed 8.2.¹⁹ When comparing these numbers with the

rest of the AV-8B fleet squadrons it shows that this squadron represents a normal amount of maintenance per flight hour.

Cannibalization maintenance actions are a maintenance practice sometimes used if an aircraft is awaiting a certain part that is not currently available in the supply system or if it is predicted that it will take a long time for the part to arrive to the squadron. This practice involves taking a component from one aircraft, usually a non-mission capable aircraft unable to fly for a different reason, and using it on a different aircraft that might be waiting for that single component that prevents it from flight operations. Although this practice is mostly frowned upon as it causes extra MMHs in order to remove the needed components, sometimes it is absolutely necessary to meet flight operations. VMA-542 had a monthly average of 26 MMHs dedicated to cannibalization activities during the period from March 2014 to October 2014. On average during this period there were 9 cannibalization events that needed to occur for every 100 flight hours flown.²⁰

An aging AV-8B fleet will be increasingly difficult to maintain. Increased maintenance evolutions with decreased maintenance personnel will reduce capabilities of the Harrier community. The F-35 is a much needed platform to continue the abilities of Marine aviation.



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F-35 Joint Strike Fighter

F-35 Acquisition

Even though a new aircraft is needed for replacement of legacy platforms, the DoD acquisition system makes this endeavor difficult to achieve. Unfortunately the Department of Defense does not have a good track record when it comes to research, development, and acquisition. Many times there are delays in production or cost increases that delay the new technology from reaching the warfighter. One example of this could be the F-22 Raptor program. The F-22 started with a unit price of \$110 million per model for an initial plan to purchase 750 aircraft to replace the Air Force's aging F-15 fleet and ended up costing \$189 million per model with a reduced order to 187 aircraft.²² Another example of failed acquisition is the planned VH-71 acquisition to replace the aging "Marine One" presidential helicopters at cost of \$400 million per aircraft for a total of 23 helicopters.²³ For the price of each VH-71 you could purchase three F-35 aircraft.

The Joint Strike Fighter program consists of a joint effort between the U.S. Navy, U.S. Air Force, and the U.S. Marine Corps. Other countries involved in this program include: United Kingdom, Netherlands, Norway, Denmark, Canada, Italy, Singapore, Turkey, and Israel.²⁴ Each one of these foreign countries contributes to the program at different levels. These countries will be buying the JSF "off the shelf" from the United States. At the beginning of this project the JSF is one of the largest acquisitions in history and was estimated to be worth \$300 billion (then-year dollars) over the next quarter century.²⁵

Much of the controversy surrounding the F-35 can be directly linked to the acquisition process that was used to acquire this aircraft. Cost overruns and delays initially plagued this program. In 2010, escalating cost overruns caused a critical Nunn-McCurdy Breach (mandatory report due to Congress for certain percentage cost overruns) was reported to Congress with

program restructuring based on the Joint Estimation Team II estimation of cost and production rates estimated by the Independent Manufacturing Review Team.²⁶ The cost of this program has grown to \$239.6 billion for future funding required. This is an increase of \$107 billion from the original first full estimate.²⁷ It is estimated that due to challenges in mission system software has already delayed the program by 13 months.²⁸

Increased procurement costs coupled with delays in testing and evaluation has caused concern for some of the parties involved. In the beginning of this program the acquisition process itself was not as strong as it needed to be. Since the early days of this program there have been two Joint Estimating Team review, an Independent Manufacturing Review Team review, and a Joint Assessment Team review all driven to finding the problems within this program and to correct and report any deficiencies that are occurring.²⁹ As a result of the ongoing problems during this phase, in 2011 Defense Secretary Robert Gates dismissed Marine Corps Major General David R. Heinz as the F-35 Joint Strike Fighter program manager stating “If I have set one tone here at the Department of Defense- when things go wrong, people will be held accountable.”³⁰

One challenge with the acquisition for the F-35 was that the needed technology needed to be created and could not be “bought off the shelf” as in the case of the Harrier. This is different from the Harrier acquisition as this acquisition is not buying a product that is already complete and being bought off the shelf. At the onset of this program the Department of Defense was initially buying an idea of a 5th generation aircraft and it was up to the engineers and designers to produce this aircraft with all the agreed upon capabilities. Due to the Joint Strike Fighters advanced capabilities and as the program has developed it is estimated that the Operating and Support cost per year for the F-35 will total approximately \$19.9 billion. This is an increase of

the legacy platforms consisting of F-15C/D, F-16C/D, AV-8B, and F-18A-D by \$8.8 billion.³¹

With the addition of the F-35 aircraft into the United States inventory it is estimated that the current sustainment cost for all U.S. aircraft, based on an estimated 30 year service life, will exceed \$1 trillion.³²

Another challenge that this program has had to contend with is social media. Problems with acquisitions of legacy platforms simply did not get distributed to the population as fast or as much as with the F-35 program. Any issues that arise in this program are almost instantly transmitted through media outlets and social media as they occur. In addition to real time media events individual media outlets tend to put their respective “political spin” on such topics, be that good or bad, and rely on so called “experts” for analysis of such problems. If the public really wants to know what is happening with an individual topic they should strive to acquire primary research sources rather than relying on offhand reports.

F-35 Transition

With any aircraft the four basic forces that apply are lift, thrust, weight, and drag. Pilots who are transitioning from legacy platforms to the F-35 understand these forces well. The challenge with pilots transitioning to a new aircraft platform is how these forces apply towards the aircraft they are going to vice the aircraft they were coming from. The seasoned pilots will have to partially relearn how to fly an aircraft and understand the new operating procedures associated with their new platform. Just like the Naval Aviators before them that transitioned to the AV-8A, these aviators will have to learn the unique characteristics of the aircraft. They must learn and memorize all of the new emergency procedures accompanying the JSF. They will also

have to learn the operating envelope of the aircraft and know what exceeds the aircrafts capabilities in addition to the use of new weapons employment systems.

VMFA-121 was the first F-35 squadron to be created within the Marine Corps. The squadron currently has 19 F-35 pilots who consist of almost an equal number of former AV-8B pilots and former F-18 pilots. Major Brian “Stamp” Gershutz (AV-8B transition pilot to the F-35 and currently holds the position of Aircraft Maintenance Officer for VMFA-121) stated that in the beginning of the transition program pilots would attend the F-35 Fleet Replacement Squadron (FRS) and receive training that lasted 2 months and consisted of simulator training and approximately 10 flight hours in the F-35 before detaching to their permanent squadron. The F-35 community is more reliant on training in the simulators than previous legacy communities as the use of the simulators will offset operational costs. Qualifications such as Section Leader and Division Leader would follow transitioning pilots from legacy platforms to the F-35 community and were “grandfathered” in to this new platform. Advanced instructor qualifications such as Night System Instructor (NSI) and Weapons Tactics Instructor (WTI) are still being reviewed as the syllabus for these qualifications in the F-35 platform are still being constructed.³³

Enlisted Marines who work with the JSF will undergo a transition to this new platform. New Marines fresh from recruit training will complete requisite initial training at respective ‘A’ and ‘C’ schools then transfer to the fleet for duty. Older Marines who are transitioning from legacy platforms will also have to attend portions of school in order to learn new systems incorporated in the F-35.

Current F-35 Operations

As of June, 2014, 78 F-35 aircraft have been fielded and have flown 18,250 flight hours.³⁴ Currently VMFA-121 is the only operational F-35 Marine Squadron conducting training. The squadron consists of 17 assigned F-35 Joint Strike Fighters of which 7 aircraft are used for flight operations with 10 aircraft at Depot level maintenance facilities having upgrade maintenance performed. There are many different software blocks being delivered to F-35 units that contain software needed for aircraft operations and weapons delivery. Each software block contains data to allow more advanced operations of the aircraft. The current software block being used is 2A with 2B expected to be available for use in summer of 2015. Under the 2A software block the aircraft cannot yet carry live ordnance. Simulated ordnance is used during training. When the release of 2B is available it will allow the carriage of GBU-12 laser guided 500 pound bombs, GBU-32 1000 pound JDAM, and the AMRAAM 120 Air to Air missile.

As mentioned earlier, the F-35 does not yet have an operational gun system. Eventually the F-35 will utilize a GAU-22/A 25MM Gatling gun.³⁵ This gun is the same caliber weapon currently used on the AV-8B. It is predicted that the gun system will not be operational until 2019 at the earliest. This is troublesome in the fact that when conducting Close Air Support the gun system is used for "Danger Close" missions when friendly forces are in close proximity to the enemy due to the risk of friendly casualties. Until the F-35 has an effective gun system it will have limited abilities to perform CAS and will require legacy aircraft to fill this role.

Another technology unavailable to the F-35 will be ROVER capability. The ROVER system is a tool utilized when conducting CAS that allows the air controller on the ground to see the image that the pilot is currently looking at via onboard aircraft sensors. ROVER was not developed by the time engineers were designing the F-35. ROVER has become a common tool

used during CAS and provides situational awareness between the pilot and the ground controller which allows for a more rapid employment of weapons during combat. The final software 3F block for the F-35 will still lack ROVER capability.³⁶

Finally, the last piece of important technology omitted from the F-35 is an Infrared (IR) marker. The IR marker is a tool utilized in numerous missions and provides a marker that is originated from the aircraft which is not able to be seen via the naked eye, but is visible when utilizing night vision devices. The IR marker can be used during CAS in order for the aircraft to mark the target for visual confirmation between the pilot and the ground controller. The IR marker can also be used during convoy and helicopter escort missions for jobs such as marking important terrain features, targets, or landing zones.

According to Major Gershutz, the F-35 community will not deploy for some time until the platform is ready for operations. The Marine Corps aviation operations department predict that the F-35 squadrons will conduct their first deployments fulfilling a role in the Unit Deployment Program (UDP). This deployment program deploys units to Iwakuni, Japan for operations in the Asia-Pacific region. Normal UDP rotations are 6 months in duration, but VMFA-121 is expected to conduct a lengthened deployment of 2 to 3 years until they are replaced by another F-35 unit. It is still too early to know for certain when Joint Strike Fighter units will take over for legacy platforms in fulfilling fixed wing roles within Marine Expeditionary Unit deployments.

Current F-35 Maintenance

Current legacy aviation communities consist of 3 different levels of maintenance. The first level is called the Operational level or 'O' level. O level operations occur at the squadron

level and consist of day to day scheduled and unscheduled maintenance of the aircraft. The next level of maintenance is the Intermediate level or 'I' level. This level of maintenance occurs at a location away from the squadron and consists of advanced maintenance operations as well as testing and repair. The final level of maintenance is known as the Depot level or 'D' level. D level maintenance may or may not be collocated with the operating squadron's base and consists of major maintenance evolutions to include rework.

According to Gershutz the F-35 maintenance makeup is a little different than its legacy components and is striving to embrace a hybrid of legacy Marine maintenance and some Air Force concepts. At the O level there are still individual shops with specific responsibilities such as Airframes, Powerline, and Avionics. The difference at the O level of the F-35 community is that now they are trying to create Plane Captains who are subject matter experts and cross trained into many different fields. This idea will create incredibly knowledgeable individuals who will have a certain ownership of the aircraft they are in charge of.

The level of maintenance known as the I level in the legacy platforms is now referred to as the O+ level. This level has changed from the original I level, but retains some of the former tasks such as tire and wheel operations, Non-destructive inspections, and certain Individual material readiness list tasking.

The F-35 D level of maintenance has changed very little from legacy platforms with respect to what maintenance operations are performed. For legacy platforms much of the D level work was performed at MCAS Cherry Point. F-35 D level maintenance is now performed at MCAS Cherry Point, MCAS Yuma, and Ogden Utah.

The F-35 was designed to create an environment in which maintenance of the aircraft would be easier than legacy platforms. The Automatic Logistics Information System (ALIS)

was designed to be the primary sustainment tool for the F-35 and was intended to predict maintenance and supply issues as they occur.³⁷ The idea behind this system was to track the health of the aircraft and report maintenance codes for parts needing service or replacement as the event occurred. Currently VMFA-121 is using this system in conjunction with the assistance of the Lockheed Martin representatives.

With the F-35 still under warranty much of the components are able to be sent back to the factory for rework and new parts were available for replacement. Many of the system and components are closed systems. This means that as a part of the component fails, the entire component can be pulled as a complete unit and replaced. One issue that must be considered with this system of maintenance is if the warranty ever runs out and maintenance Marines need to go back to troubleshooting and fixing the aircraft would they be able to? Troubleshooting systems and components is a skill that can atrophy over time.

The maintenance Marines that transitioned from the Harrier community with the ability and knowledge of how to troubleshoot systems in theory will have limited troubleshooting needed for anything on the F-35. Currently there are Lockheed Martin civilian technicians assisting maintenance Marines with day to day maintenance evolutions. These civilians are available for use while the aircraft is still in test and evaluation phases and while it undergoes software block upgrades. One issue to consider is what will happen when the F-35 community is ready for operational deployments and these civilians will no longer be located with the aircraft and Marines once deployed? With little troubleshooting needed little to no training in troubleshooting will be passed down from the current generation that knows how to do it. If and when the time comes when troubleshooting is needed the Marine Corps will have close to no organic maintainers that know how to do it.

CounterPoint

Some would argue that the Marine Corps does not need the Joint Strike Fighter and that it is overpriced for what is being created. Delays and increasing costs are causing concern for both pro-JSF individuals as well as individuals against the program. One argument against this aircraft is that not all of the adversaries that the United States will face in the future require this technology. The counter argument to this logic would be that some of the more important countries that we might face do in fact have, or will soon acquire, the ability to deny our current legacy aircraft inventory the ability to conduct warfare and support the ground units. These are the countries that the F-35 was designed to be effective against.

Although the transition to the AV-8A can on some levels be compared to the transition to the JSF, one cannot exactly compare the acquisition of the Harrier with the acquisition of the Joint Strike Fighter. The Harrier acquisition was not without its share of controversy. In May of 1969 there was a House Appropriations Committee concerning the procurement of the Harrier from the British. Some members were shocked that the Marine Corps wanted to purchase an aircraft from a company that was not inside the United States.³⁸ During the infancy of the AV-8A program there were many safety concerns related to the stability of the aircraft, especially in the landing environment, and this raised a lot of skepticism. In the infancy of the MV-22 program safety concerns were also present, but were later compounded when an MV-22 crashed that was carrying infantry Marines which resulted in a large number of fatalities.

When the AV-8A was purchased the price per aircraft was approximately \$4.3 million. The 2014 current dollar value per Harrier 4 computes to be approximately \$20.4 million. The 2014 estimates per aircraft for the F-35 are \$112 million. Is this new aircraft really worth almost

5 times that of an AV-8A? Given the need for research and development of this particular technology it is worth the increased cost. Each time a new technology has been adapted into the Marine Corps there has usually been a price increase over the legacy equipment being replaced. The acquisition of the F-35 happens to be on a much larger scale. As adversaries and technologies advance, I predict in the future there will be many more programs that cost more than the F-35 program. This program just happens to be the most recent one. One example of increased price for replacement technology can be shown when the Marine Corps purchased the MV-22 at a cost 5 times greater per aircraft than the CH-46 that it replaced.³⁹

Some would argue that the F-35 is an empty shell as it cannot yet carry ordnance and will not deploy until it is fully operational. Currently the F-35 cannot carry ordnance, but one needs to remember that it is still in design and testing. Even though the aircraft cannot carry or employ ordnance does not mean that the pilots are not training and honing skills in preparation for the day in which they can carry ordnance. Thus far VMFA-121 has conducted numerous operations for both internal squadron training and external support of units on the ground in places such as the Twentynine Palms training facility. Instantaneous media allows developers to broadcast new achievements for the aircraft as they occur, however the down side to this is that it appears to the public that this program is taking a long time to come on line.

Conclusion

Unarguably the acquisition system currently in place for the Department of Defense is broken. With the unpredictability of research needed for new technologies, software issues, cost overruns, unexpected budget changes, etc. . . there are obviously many moving parts to this to system. The purpose of this paper was not to try to fix the acquisition system, but rather point

out some portions of the system that could be improved upon and show that the Marine Corps' future depends on the success of the F-35 Program. Hopefully the research and development of this aircraft can be completed in a timely manner and replace the aging legacy Harrier fleet as seamlessly as possible.

This paper has shown the differences and similarities between the Harrier and Joint Strike Fighter acquisition and transition. It has explained the challenges currently facing each community as the Joint Strike Fighter transition occurs. One important point that this paper addressed is that despite the challenges that are occurring with this current transition both officer and enlisted Marines are enabling the Marine Corps to progress. Marines in both the Harrier and Joint Strike Fighter community are doing their individual part. With the continued effort from both communities this transition will be successful.

The F-35 Joint Strike Fighter is a much needed platform and the correct course of action for the Marine Corps. As more legacy Harrier squadrons shut down to transition and more Marines transfer to the JSF program, life in the existing Harrier fleet will become more chaotic. Experience in the maintenance department will struggle to maintain flyable aircraft and the length between deployments will decrease until the JSF community is ready to join the deployment rotation. Transition is not a new concept for the Marine Corps, but each one is unique. The current legacy aircraft have performed well beyond what they were designed for, but it is time to go in a different direction and evolve to stay ahead of the new threats that the United States will face in the future.

Endnotes

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