REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
04092018	Research	

4. TITLE AND SUBTITLE
A lighter ACE: Marine Corps Aviation in Future Warfare

5a. CONTRACT NUMBER
N/A

5b. GRANT NUMBER
N/A

5c. PROGRAM ELEMENT NUMBER
N/A

6. AUTHOR(S)
Jose L. Castillo, Major, USMC

5d. PROJECT NUMBER
N/A

5e. TASK NUMBER
N/A

5f. WORK UNIT NUMBER
N/A

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

8. PERFORMING ORGANIZATION REPORT NUMBER
N/A

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
USMC School of Advanced Warfighting
Breckinridge Hall
2076 South St.
Quantico, VA 22134

10. SPONSOR/MONITOR'S ACRONYM(S)
N/A

11. SPONSOR/MONITOR'S REPORT NUMBER(S)
N/A

12. DISTRIBUTION/AVAILABILITY STATEMENT
Unlimited

13. SUPPLEMENTARY NOTES
N/A

14. ABSTRACT

The current state of weapons development and procurement have pushed the costs of outfitting the service to budget busting limits. Efficiencies in cost and capabilities must be considered not only in individual services but across the entire Joint Force. Many capabilities of Marine Corps aviation are unnecessarily duplicated functions found in both the U.S. Navy and Air Force. In concert with the Joint Force, the Marine Corps' Aviation Combat Element must jettison redundant aviation function capabilities and embrace anew its role as a tactical air force within a service, making Assault Support and Close Air Support the most important functions in order to increase the lethality and decrease the cost of support it provides to the Marine Air Ground Task Force.

15. SUBJECT TERMS
Aviation Combat Element (ACE), Close Air Support (CAS), F-35, Functions of Marine Aviation, A-29 Super Tucano, AT-6 Wolverine

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Marine Corps University/ School of Advanced Warf
Unclassified	Unclassified	Unclassified	UU	14	19b. TELEPHONE NUMBER *(Include area code)* (703) 432-5318 (Admin Office)

School of Advanced Warfighting

United State Marine Corps
School of Advanced Warfighting
Marine Corps University
Marine Corps Combat Development Command
Quantico VA 22134

FUTURE WAR PAPER

A Lighter ACE:

Marine Corps Aviation in Future Warfare.

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF OPERATIONAL STUDIES

Major Jose Castillo

AY 2017-18

Mentor: Dr. Wray Johnson

Approved: _____

Date: 09 Apr 18

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School of Advanced Warfighting

"The only excuse for aviation in any service, is its usefulness in assisting the troops on the ground." - A. A. Cunningham[1]

Problem Statement

Since the dissolution of the Soviet Union in 1991 and the intervening years since the 9/11 attack the focus of the U.S. military has been on conducting operations other than war, counter terrorism operations, and re-learning how to conduct counter insurgency operations. For well over two decades a monolithic military power against whom to train, equip, and plan did not exist. To fill this void of direction the separate services of the Joint Force marched on in accordance to their respective service paradigms and service domains: the Navy bought more aircraft carriers and submarines, the Air Force bought revolutionary 5th generation fighter planes, the Army concentrated on distributed lethality and land systems, and Special Forces took the lead on the Global War on Terror. The Marine Corps, without a domain of its own to operate independent of other services, strove to maintain similar capabilities as its sister services without a full appreciation of long term effects on how this will change the way the Marine Corps fights. In its effort to compete with Navy and Air Force capabilities the Aviation Combat Element (ACE) of the Marine Air Ground Task Force (MAGTF) has become capable of sharing in the Air Force's strategic role, and thus detailing it away from its intrinsic mission of servicing Marine Corps ground forces. Cognizant of the capability redundancies within the Joint Force, the ACE must embrace anew its role as a tactical air force within a service and make Assault Support (AS) and Close Air Support (CAS) the most important functions in support of the MAGTF.

Future State

The Marine Corps Operating Concept (MOC), published in 2016, describes how the Marine Corps will fight in 2025 and further into the 21st century. The threat environment as the MOC and the supporting concept of Expeditionary Advanced Bases Operations (EAB)[2] portray is a highly capable and well trained adversary with the ability to project combat power on par with or greater than the U.S. Joint Force capabilities. In an effort to defend against the U.S. and Marine Corps expeditionary reach, adversaries have assembled an elaborate, detailed, and deadly defense in depth on the littorals by integrating across the space, cyber, land, air, and sea domains to establish an Anti-Access/Area Denial (A2/AD) systems and networks to challenge U.S. warfighting doctrine.

In 2015, the Defense Department listed Russia, Iran, China, and North Korea as the greatest threats to national interests.[3] All have advanced air defense systems capable of intercepting fourth and fifth generation aircraft, modern air forces capable of competing for (at least) local air superiority, the ability to project a missile defense screen 120 to 3000 kilometers to sea, and are all nuclear powers.[4] The potential loss of life and material from contested littoral operations with any of these nations would be beyond anything seen since World War II and the Korean War. As such, contested littoral operations could not be a preemptive option, but rather a retaliatory response to a perceived threat to the survival of the state or a threat to the American way of life. The size and scope of this operation would put it well beyond the capabilities of just the U.S. Navy and the Marine Corps alone. This would most assuredly demand the resources of

the entire joint force and a consolidation of air power from all services, even at the cost of breaking up the reverent MAGTF.

One of the critical tasks listed in the MOC is the integration of Naval Force to fight at and from the sea to better project combat power and increase sea control. [5] Sea control is necessary in order to conduct amphibious and forcible entry operations in the littorals and to support EAB. As described above, any such operation in a contested environment cannot be done by the Navy and Marine Corps alone and must be conducted by the entire joint force. The Marine Corps will aggregate into a MAGTF as it naturally does, but in this scenario, the separate divisions within the Marine Corps aggregate into a single corps level Ground Combat Elements (GCE). The separate wings of the Marine Corps come together to form a combined Aviation Combat Element (ACE), and the Logistics Combat Element (LCE) will aggregate and restructure itself to best meet the needs of the combined assembled force. The assigned MEF commander will, in turn, preside over the entire assembled force.

At first glance, except for the size, this looks very much like business as usual for the MAGTF. However, within the joint context, the structure of the MAGTF is challenged by the needs of the joint force. The GCE of the Marine Corps will represent only a portion of the total ground forces available and required for this operation and will operate as one of many corps controlled by the Joint Task Force (JTF) commander or the Joint Force Land Component Commander (JFLCC). The ACE, while doctrinally in direct support of the MEF commander will be called upon to execute the Joint Force Aviation Component Commander (JFACC) air plan.[6] The procurement of the F-35 affords the ACE capabilities to conduct sorties in support of

operational and strategic objectives - in line with the Air Force's strategic force nature. As a multi-role platform it is stealthy, can conduct electronic attack, air-to-air, and strike missions. While flying these sorties for the JFACC, the ACE will lose the very platforms and Close Air Support (CAS) sorties the MAGTF relies upon to augment its inherent lack of organic artillery during the initial stages of an amphibious landing - a problem made even worse with current state of limited and inept naval surface fires platforms. In a littoral fight with a near-peer competitor with an advanced A2AD capability, it must be assumed that a significant number of these aircrafts will be lost in combat, greatly exacerbating the problem of competing demands for aircraft.

Current State

The proposition of a contest in the littorals against a near-peer threat comes with the gravest of warfare's realities and therefore an operation rarely conducted. In fact, it has been argued that the need to fight from the sea is antiquated and too costly an endeavor to merit any serious consideration. However, as a maritime nation, the U.S. must retain the ability to conduct such operations as part of a national sea control strategy.[7]

That being said, there is a significant degree of overlap in capabilities across the three services. The Air Force counts among its core competencies the ability to achieve air superiority, conduct precision strike, and electronic attack while the Navy assumes the task of protecting the fleet and supporting the amphibious force. Marine Corps aviation duplicates all of these capabilities with the F-18, F-35 and EA-6B. In its attempt to be proficient at each of its functions Marine Corps aviation procured an aircraft that sacrificed an internal gun that could be

used to support troops on the ground for a vertical take-off capability and now has more strategic value to the Joint Force than it has tactical value to the MAGTF.

The core missions of the Air Force and the warfighting functions of Navy and Marine aviation are listed as follows:

Marine Corps	Navy	Air Force
Air Reconnaissance	Fleet Air Defense	Nuclear Deterrence Operation
Anti-Air Warfare	Anti-Submarine Warfare	Air Superiority
Electronic Warfare	Anti-Surface Warfare	Space Superiority
Offensive Air Support	Support Amphibious Operations	Cyberspace Superiority
Assault Support	Maritime Patrol	Command and Control
Control of Aircraft and Missiles		Global Integrated ISR
		Global Precision Attack
		Special Operations
		Rapid Global Mobility
		Personnel Recovery
		Agile Combat Support
		Building Partnerships

The F-35 has a $1.53 trillion total program cost.[8] Individual unit cost for the F-35A (the Air Force model) is $111.3 million; the F-35B (the Marine Corps model) is $123.4 million, and the F-35C (the Navy model) is $112.4 million each (Appendix A). The cost per flight hour for these aircraft ranges from $29,685 to $42,169 per hour[9]. In comparison, the F-18 cost the tapayers $70.5 million per copy with an overall program cost of $48 billion. These numbers are mind-boggling but somewhat justifiable when the expectation of these aircraft is to penetrate an

enemy A2/AD network and strike strategic and operationally relevant targets. When asked to conduct the close air support mission and drop a $3,100 Mark 84 or a $2,082 Mark 82 bomb the cost becomes difficult to rationalize.

In short, the significant overlap in aviation platforms, capabilities, and missions within the Joint Force is the product of individual Service failures to view aviation holistically as a joint capability. The Air Force views itself as inherently offensive, independent and strategic while the Navy sees its aviation as defensive and tactically employed. Marine Corps aviation vacillates between the two. Its amphibious roots lend it to follow the Navy's lead and its ground forces require it to be a tactical ACE in support of Marines on the front line. However, it has evolved into an aviation component with strategic capabilities that align with the Air Force. This all leads to gross inefficiencies and capability gaps across the Joint Forces. Marine Corps aviation must do its part to break the Service parochialism by reprioritizing the roles and missions of the ACE.

New ACE Model

To better meet the needs of future war, the ACE must evolve into a leaner and more focused organization. Its evolution must stem from a reprioritization of the six aviation functions and embracing the fact that its role within the Marine Corps it that of a tactical ACE. Upon doing so, the ACE must jettison the redundant capabilities and make AS and CAS the cornerstone functions of the future ACE to ensure that it is capable and available to support the MAGTF as it is envisioned in the MOC. In turn, Electronic Warfare (EW) and Offensive Anti-Air Warfare (OAAW) must now become the least important of the six functions.

Having deemphasized the EW and OAAW functions they should be dropped as a core competency. The Navy, via the EA-18G "Growler" and the Air Force via the F-35A, will conduct the EW function while the ground force will do its part by conducting localized EW in support of the Joint Force strategic and operational objectives. Using the F-22, F-16, and F-15, the Air Force, along with the Navy's use of the F-35C and the F-18 Super Hornet, will protect the fleet as it closes on the Amphibious Objective Area (AOA) and competes for air superiority. Thus, the OAAW should be dropped from the redundant list of ACE warfighting functions.

Along with the OAAW and EW functions goes the need for the F-35. The 400 total force buy of F-35B aircraft should be transferred to both the Navy and Air Force. Aircraft already in the Marine Corps inventory should be transferred to the Navy to fill its squadrons and, the as yet to be delivered but programed F-35Bs should be reprogramed in favor of A models for the Air Force and C models for the Navy. Once their respective squadrons are full, the remaining non-delivered aircraft can either be scheduled for later delivery or cut from the program. Cutting these aircraft from the overall program could result in a fiscal savings of $49 billion over the life of the program.

Having freed itself from an aircraft that doesn't meet the reprioritized needs of the MAGTF, the ACE can now procure a platform that is purpose-built and more economical. The Marine Corps must invest in a single role CAS platform that is economical to procure, maintain, and simple to fly. The Air Force is currently evaluating three platforms to replace the aging A-10 to be their CAS platform of the future: AT-6 "Wolverine", A-29 "Super Tucano", and the "Scorpion".

Platform	Engine	Unit Cost	Cost per flight hour
A-29 Super Tucano	Turbo Prop	$9-14 million	$430-500
AT-6 Wolverine	Turbo Prop	$4.2 million (est)	$400-800 (est)
Scorpian	Jet Engine	$20 million	$3,000

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For the Marine Corps, the AT-6 or the A-29 should be adopted as the platform of choice to fill the squadrons that were once filled with F-35Bs. Both aircraft are more affordable and easier to fly. They are survivable, possess large control surface for great low speed/low altitude maneuverability, have five hours of sortie time or greater, and can land on a dirt road or grass field. The A-29 has already proven its close air support capabilities in combat in Afghanistan, and around the globe. Twenty six aircraft have been procured by the Afghan Air Force (AAF) and have proven themselves in constant support of Afghan National Army counterinsurgency operations.[11] The AT-6 "Wolverine" is a platform familiar to most aviators as it is an advanced model of the T-6 "Texan" that pilot student learn to flight in flight school. Pilot familiarity with this platform will simplify a transition to this aircraft.

Given that flight school graduates are already proficient in these aircraft, pilots can report immediately to the Replacement Air Group (RAG) to complete qualifications needed to join a combat squadron. There is no longer a requirement to send pilots to an advanced school, which greatly reduces the time and cost to qualify a pilot.

The ACE's ability to seamlessly add and drop wings, squadrons, and detachment to it's structure to task organize for an operation has long been a hallmark of Marine Corps aviation. In an environment that is less than full spectrum combat, the ACE must look to include units from

sister services for increased capability and flexibility. With the loss of the F-35, the attachment of Air Force fighter and attack squadrons will give the MAGTF the ability to conduct strike and air-to-air missions without sacrificing the ability to conduct CAS.

Implications

The implications for changing the missions and platforms of the ACE are numerous and far-reaching. It will fundamentally change how the Marine Corps operates as a part of the joint force. It will make for an altogether leaner organization better equipped to conduct the Corps central role of winning battles.

The Marine Corps is no stranger to fiscal austerity. In fact, much of its successes and innovations stem from the need to operate with less. Today, the railing against sequestration is prevalent in all services. Instead of designing service capabilities in the hopes of fiscal windfalls the present economic conditions must be seen as the new normal. Thus, it would be fiscally irresponsible to continue to pursue an aircraft at such exorbitant cost.

With a single copy price tag of 4.2 million dollars the cost to replace the 440 aircraft in the 27 VMFAT, VMFA (AW), VMFA, VMAT, and VMA squadrons with the AT-6 is roughly $1.85 billion. This is still only 60% of what it costs to equip a single squadron with 20 F-35Bs. The cost per flight hour being less than 2% of an F35B's $42,169 per hour cost permits pilots to log more flight and training hours, resulting in a more skilled and experienced pilot.

The procurement of a platform like the A-29 or the AT-6 reduces the probability that the ACE will be called upon to fly sorties for the JFACC that are not in direct support of front line-

troops. The sorties that were, in the past, used to fly EW, OAAW, and Anti-Air Warfare (AAW) have now become available to conduct CAS and Aerial Reconnaissance (AR). More CAS and AR equates to greater firepower at the point of attack, increasing the lethality and tempo of the MAGTF attack.

A smaller and lighter turboprop aircraft will reduce the logistic footprint of the supporting organizations and reduce the number of maintainers needed in the squadron. Able to land on unimproved surfaces, the A-29 and the AT-6 require less runway maintenance and preparation from the Marine Wing Support Squadron (MWSS). In a contested fight for the littorals, the speed at which these aircraft could transition from carrier-based aircraft to ground-based aircraft is now predicated on how fast the landing force can make fuel and ammunition available to these planes and not on when an airfield can be seized or built.

The challenges to a change of this magnitude in the ACE are two-fold. First, the Marine Corps becomes more reliant on the Joint Force to conduct operations that it once could conduct within the MAGTF proper. With the loss of the F-35B's ability to provide Combat Air Patrol (CAP), the MAGTF must now request Air Force or the Navy support from a JFC when conducting operations that include a viable threat to aviation.[12] This changes the operation from what once was done through service components to one conducted by functional components.[13]

While this is a nonsensical proposal to the current generation of service members it is a concept that has historical precedent and was employed with success. As early as WWII there evolved a clear delineation between strategic and tactical air forces. This delineation dictated command and control, design and procurement of aircraft, and employment within respective

theaters. Bomber Commands flew missions in support of the greater strategic objective while tactical air forces flew interdiction, reconnaissance, and CAS missions. During the Korean War, the 1st Marine Air Wing (1st MAW) with a mix of World War II era piston driven aircraft and early jet fighter aircraft, along with Navy aircraft again conducted tactical air missions while the U.S. Air Force conducted strategic missions up to and along the Chinese boarder[14]. In Vietnam, with the country divided into route packages, Navy, Marine Corps and the Air Force were not only separated by tactical and strategic assignments but also separated by geography.

The second challenge is overcoming centuries of institutional hubris and breaking service paradigms. At the individual level, from a Marine recruit's first day at the recruit depot, he is inculcated with the treasured history and legendary figures of the Corps. This perpetuates within the Corps a perception that what the Corps has always done has always worked, leaving little or no reason to seek change. At the Service level, these views persist. It will take rare individuals with foresight to see that the logical evolution of the Joint Force is the "One" force, and leadership to announce that the Corps history is just that - history, and not a roadmap of the future. It will also take charismatic, confident leadership to convince the Corps that the pain of change is for the Service's own good. Without this kind of leadership, the Marine Corps will be forced by civilian leadership into a program of change that values economic efficiencies over force capabilities.

Conclusion

The only certainty of war is that it is unpredictable. Despite its unpredictability it can be safely assumed that the wars of tomorrow will not look like the wars fought yesterday. The trend

towards increased lethality should force the increased distribution of formations and an emptying of the battle space. In ways that are not fully understood, in domains that are not fully explored, war will be faster both physically and cognitively. Above all else, future war will be a much more costly endeavor to prosecute. Changes to the conduct of war can occur incrementally or in great leaps, or both. Change can be passively accepted, denied, or it can be embraced - even preempted. Marine Corps aviation must preempt the inevitable changes of future warfare to remain a relevant and available option for the MAGTF commander. It must now strive to become lighter and more lethal all while doing it with less money and personnel. Embracing the limitations associated with being only a tactically focused aviation component and reducing the number of warfighting functions the ACE is expected to perform in support of the MAGTF will set conditions for paradigm shift in the Marine Corps. Adopting a platform that is less expensive to purchase, less expensive to operate, easier to fly, and better suited to supporting the Marine Corps' tactical role of winning its nation's battles makes for a service that can remain competitive for decades to come.

[1]Alfred A. Cunningham "*Value of Aviation to the Marine Corps*," Marine Corps Gazette , (September 1920).

[2]Headquarters US Marine Corps, *How an Expeditionary Force Operates in the 21st Century,* Marine Corps Operating Concept, (Washington, DC: US Marine Corps, September, 2016), 13.

[3]U.S Joint Chiefs of Staff, *The National Military Strategy of the United States of America 2015*, (Washington DC: U.S Joint Chiefs of Staff, March 25, 2013), 2.

[4]Center for Strategic and International Studies. "*Missiles of the World*". https://missilethreat.csis.org/country/russia/

[5]Headquarters US Marine Corps, *How an Expeditionary Force Operates in the 21st Century,* Marine Corps Operating Concept, (Washington, DC: US Marine Corps, September, 2016),5.

[6]Headquarters US Marine Corps, A*viation Operations,* MCWP 3-2 (Washington, DC: US Marine Corps, 9 May, 2000), 4-2.

[7]U.S Joint Chiefs of Staff, *The National Military Strategy of the United States of America 2015*, (Washington DC: U.S Joint Chiefs of Staff, March 25, 2013).

[8]http://www.jsf.mil/news/docs/20160324_Fact-Sheet.pdf

[9] Office of the Under Secretary of Defense, *Fiscal Year (FY) 2016 Department of Defense (DoD) Fixed Wing and Helicopter Reimbursement Rates,* FY 2016 Reimbursable Rates (Washington DC:Office of the Under Secretary of Defense, 2 October 2015), 2.

[10]http://economia.terra.com.brnoticiasnoticia.aspidNoticia=201106211424_RTR_1308666185nN1E75K09U

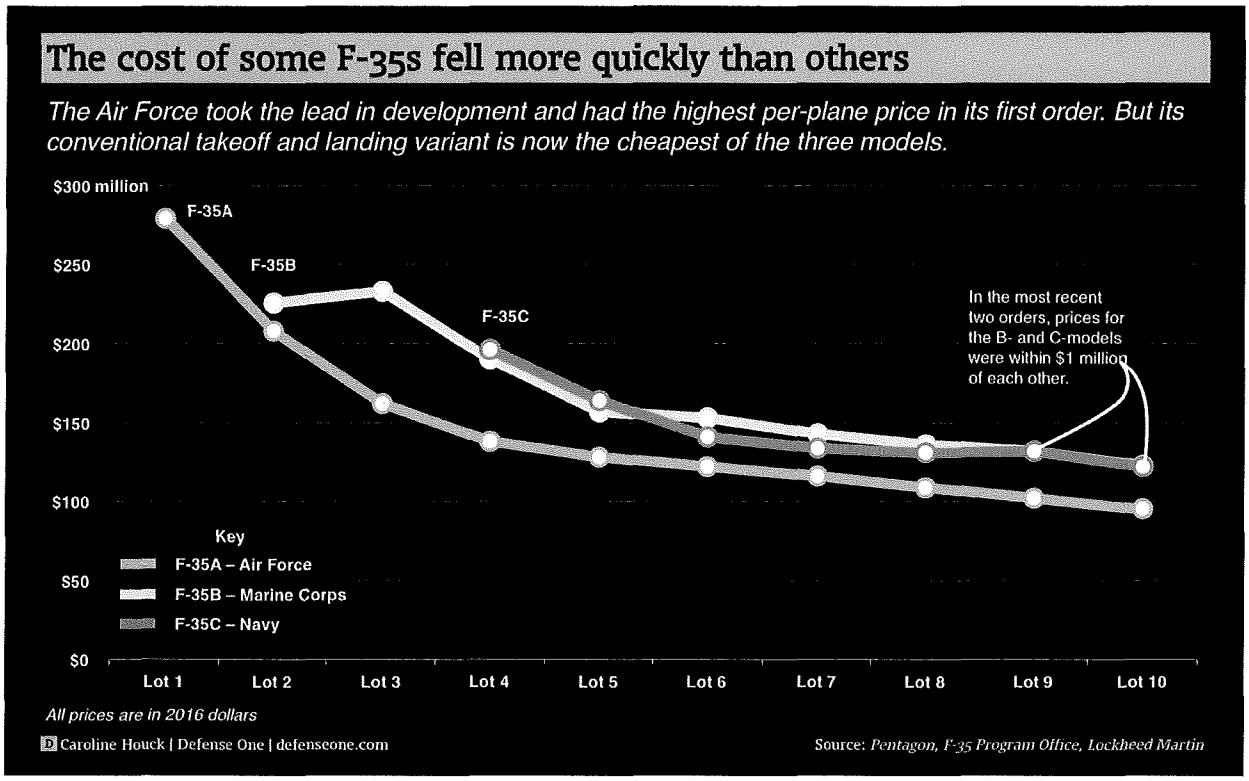
[11]Reed Business Information Limited. *"Super Tucano beats out AT-6 for Afghan Light Air Support tender".* 24 March 2015.

[12]Headquarters US Marine Corps, A*viation Operations,* MCWP 3-2 (Washington, DC: US Marine Corps, September, 2016), 4-1.

[13] Headquarters US Marine Corps, MCWP 3-2, 4-2.

[14] John P. Condon, *Corsairs to Panthers: U.S. Marine Aviation in Korea* (Philadelphia: Diane Publishing Company, 2003), 13-15.

Appendix A


The cost of some F-35s fell more quickly than others
The Air Force took the lead in development and had the highest per-plane price in its first order. But its conventional takeoff and landing variant is now the cheapest of the three models.
$300 million
$250
$200
$150
$100
$50
$0
F-35A
F-35B
F-35C
In the most recent two orders, prices for the B- and C-models were within $1 million of each other.
Key
F-35A – Air Force
F-35B – Marine Corps
F-35C – Navy
Lot 1
Lot 2
Lot 3
Lot 4
Lot 5
Lot 6
Lot 7
Lot 8
Lot 9
Lot 10
All prices are in 2016 dollars
Caroline Houck | Defense One | defenseone.com
Source: Pentagon, F-35 Program Office, Lockheed Martin