Design of a Light Attack Aircraft

(Technical Paper)

Light Attack Aircraft: A Modern Example of Military Technological Development Through SCOT

(STS Paper)

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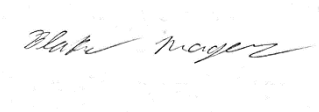
On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Signature  Date 05/07/2021

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Prospectus

Introduction

The light attack aircraft is a new and emerging class of military aircraft that is gaining recognition in the United States for its usability and cost effectiveness. My capstone technical research project is to design a new light attack aircraft, in a team with six other members, to submit to the American Institute of Aeronautics and Astronautics (AIAA) undergraduate aircraft design competition. For our design to be competitive, it must carry an extensive payload of modern weapons like smart bombs and other guided air to ground ordinance. The design must also be capable of operating out of unpaved airstrips, such that it can be deployed without much existing infrastructure. And just as importantly, the aircraft design must be cost effective, to incentivize the U.S. and other nations to purchase an aircraft whose capabilities mostly exist in existing military airplanes and helicopters.

Typical thought would suggest that the research and development of a new type of military weapon would be a side effect of military expansion and growing foreign involvement around the world. The light attack aircraft my team is designing however, is a product of new and more reserved military strategy. The need for the light attack aircraft does not come from a significant lack in military capability, rather it stems from a growing interest to support foreign nations to fight their own international and domestic conflicts. This interesting deviation of historical connection between military technology and increased American military presence around the world is the basis of my research. For my sts capstone research project, I am analyzing how the increase in popularity of a potential new light attack aircraft is a reflection of a broader shift in U.S. foreign policy away from a world policeman role, towards a supporting

role that is minimally engaged in combat for conflicts that do not directly involve the United States.

Technical Topic

Currently, the United States relies on its existing fighter and attack aircraft to execute the mission requirements of our national defense in all theaters of the world. While the U.S. Air Force's highly capable aircraft can stand up against our most advanced adversaries, they are not frequently called upon for those types of missions. According to the U.S. Air Force, since 2001 there has been a significant amount of missions carried out by the service's fighter jets for armed overwatch and close air support missions (Weisgerber 2010). As Weisgerber (2010) explains, the air force has stated that the "brutally high operations tempo since 2001 has taken a toll on high-performance aircraft, particularly F-15E and F-16 types." Essentially, we are overusing our fighter jets to execute missions that they are vastly over capable of doing, and it is at the expense of our aircraft and the taxpayer. Modern fighter jets like the F-22 cost as much as a whopping $70,000 per flight hour and are operating missions that are well beneath their abilities (Nease, 2019 p. 39). Additionally, these aircraft are too expensive and too advanced to share with most of our allied forces. To solve this problem, my technical capstone research team is designing a new light attack aircraft that has significant payload capabilities, can operate from unpaved airstrips, and is much less expensive than current fighter aircraft.

To accomplish this goal, my capstone class has been divided into three teams, each of which will design a light attack aircraft. Each team has seven members who are each assigned an individual responsibility. The member from each team that specialize in the same field are working together to break down each individual's role even more. My role within my team is to be the expert on weights and structures for the aircraft design. Within that field, I am

specifically assigned to the research and implementation of low noise airframe technologies in our aircraft design. So far, the seven specialized groups that each have three members, one from each team, have come up with a state-of-the-art report (SOA). This report provides an overview of the current modern technology within each group's specialized topic and provides a framework for making a design that best suits a light attack aircraft.

My research for my group's SOA report is a technical overview on what causes airframe noise, what technology is currently available to help reduce it, and how it can be implemented into my team's aircraft design. To help silence these aero acoustic noises, I have identified three practical techniques that are effective at reducing airframe noise. The first are called slat and flow cove fillers. Slats and flaps create a geometry that can lead to isolated airflow separation, and cause noise (Li, Wang, Zhang, 2013). These slat and flap cove fillers can significantly help reduce the noise that these high lift devices create. Vortex generators are another technology that I have identified as beneficial for noise reduction. These little devices can be placed upstream of external airframe features to swirl the airflow which helps keep the flow attached, reducing noise caused by irregularities in airframe geometry such as fuel overpressure ports (Zhao, Okolo, Neri, Chen, Kennedy, & Bennett, 2020). The last practical silencing technology I have researched for my capstone project is flow blowing. Flow blowing uses high pressure air to deflect the incoming flow of air around a complex body, slowing down the flow over the body that would typically cause noise (Zhao et al., 2020).

Thus far in our capstone project, each team member has researched their own specific field, and we have started to come together to create an initial design. Currently, my team is in the process of estimating the weight of our preliminary design. Moving forward, we will have to go through each team member's SOA to meet all the requirements set forward by the AIAA for

the final design. The focus of the spring will be refining our final design to meet or exceed all of the design requirements through each team member's individual expertise.

STS Topic

For years, there has been much debate and questions surrounding what U.S. foreign policy in the middle east should look like. Much of this debate has been over the post 9/11 war on terror, and the efficacy of the Iraq war. On March 19, 2003, the U.S. officially went to war in Iraq with the intention of removing Saddam Hussein (Dobransky, 2014). The war was justified by a claim that the U.S. had evidence that Saddam Hussein possessed weapons of mass destruction. While that claim turned out to be false, it was enough to push the U.S. into an era of foreign policy in the middle east that involved significant direct military intervention with the intention of promoting democracy in the region (Simón, 2016). Since the beginning of the Iraq war, the U.S. has shifted its foreign policy away from erroneous wars in the Middle East. Currently, the U.S. is reducing its physical presence in the Middle East and is looking to support the states in the region that are democratic without direct military intervention. The light attack aircraft is a weapon that has gained popularity while this shift in foreign policy has been going on. The light attack aircraft is a technological artifact that symbolizes the aforementioned shift in geopolitics. This research investigates how advocates of the light attack aircraft take advantage of this context.

Support for direct military intervention in the Middle Eastern region has declined among politicians over the last decade. The narrowing number of U.S. troops in the middle east is probably the best indicator of this trend. In 1991 the U.S. sent 500,000 troops to the Gulf, and in 2003 the U.S. sent 285,000 troops to the region (Karlin, Lustic, Satloff, & Wittes, 2019). In 2019, the number of U.S. troops in the Middle East dropped to just 35,000 (Karlin et al., 2019).

This significant reduction of presence in the region is a clear indication of a reluctance to continue the foreign policy of the past, that's effectiveness was questionable. This shift in direct military involvement in the region is not to suggest that the U.S. has lost interest in the Middle East. The 2018 U.S. national defense summary (2018) indicates that "Despite the defeat of ISIS's physical caliphate, threats to stability remain as terrorist groups with long reach continue to murder the innocent and threaten peace more broadly" (p. 1). Non state actors like ISIS and other terrorist groups still exist in the Middle East, and now the U.S. would like to maintain enough influence in the region to keep terrorist organizations at bay, while still avoiding an increase in troop presence in the region. This provides the light attack class of aircraft an opportunity to fill a hole in the U.S. military, by adding an effective air to ground attack weapon that is highly interoperable with foreign militaries in the Middle East.

In framing my argument that interest in light attack aircraft reflects shifting foreign policy in the U.S., Ybarra (2011) gives evidence of how light attack aircraft are being seen as extremely important in Afghanistan. Ybarra (2011) explains that the then commander of the NATO Air Training Command stated that the U.S. funded "Light Air Support (LAS) effort is 'a key enabling platform' for the Afghan air force" (p. 11). This is the integral component of my sts argument, light attack aircraft allow the U.S. to support the physical states in the Middle East in their pursuit to fight counterinsurgency and ensure the safety of their own country (Ybarra, 2011). This argument connects the reduction in U.S. direct military action in the region to the increase in interest around light attack aircraft since it expresses senior military support for the light attack aircraft program, with Obama simultaneously stating that Afghanistan would have "full responsibility for the country's security by 2014" (p. 11). Ybarra's (2011) article, while not

a structured argument on the correlation between light attack aircraft and shifting foreign policy, still lays out the framework for my research on my sts topic very well.

Observing the coincidental uptick in interest in light attack aircraft with a simultaneous decrease in U.S. physical military activity in the Middle East does raise questions about the relation between light attack aircraft and U.S. foreign policy, but it does not firmly define the connection between them. This is where additional analysis is required of both the U.S. national defense strategy and the capabilities of light attack aircraft. My initial research is promising, as the summary of the U.S. national defense strategy (2018) indicates requirements that light attack aircraft are well suited to fulfill. One example is that the 2018 summary of national defense strategy (2018) expresses the U.S. intent to "deepen interoperability" (p. 9). This means increasing the ability for the U.S. military to integrate with our allies. Light attack aircraft achieve this mission very well, particularly in a country like Afghanistan, because of their affordability to nations with a limited defense budget, as well as their ability to operate in temporary unpaved airstrips. More in depth analysis on what new military capabilities are required to effectively execute an indirect support style of foreign policy in the Middle East, I believe, will show that a modern light attack aircraft is well equipped to meet the military's new capability requirements.

Next Steps

As my initial research indicates, light attack aircraft are a solution to a lack in capability produced by a shift in foreign policy opinion within the United States. As I continue my technical aircraft design for my capstone, I will look at how the capabilities of the aircraft coincide with the needs of the U.S. military to help carry out a reserved supporting role in the Middle East. By conducting more research on the capability requirements of the U.S. military

before and after the geopolitical shift, I will analyze how the new capability requirements highlight the need for a new light attack aircraft. To conduct this further research in the future, I will move outside of just peer reviewed scholarly articles and expand my research to have a large focus on the specific needs of the military through official public sources from the U.S. Department of Defense. I anticipate finding that the needs of the U.S. military are in line with the capabilities of the aircraft design in my technical project.

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