Creation of an Original Design for a Light Attack Aircraft

(Technical Paper)

The Impact of a Low Cost Aircraft on Military Strategy and Sociopolitical Environments

(STS Paper)

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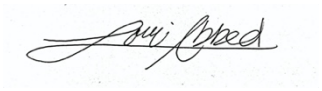
On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments



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Prospectus

The United States is in an era in which its foreign policy strategies' reliance upon overwhelming military capability and technological advantage are being called into question. For decades, the United States has been at the forefront of technological advances in military research and development. Throughout its history, the United States' military strategy evolved in tandem with the progression of its weapons development. The conception of increasingly advanced weaponry such as machine guns, tanks, and militarized aircraft created new approaches to the execution of warfare. This report will study the category of militarized aircraft that operate within an increasingly important layer of today's modern battlefield; a class called light attack aircraft. Modern light attack aircraft typically weigh less than 15,000 pounds and are designed for slow, low-level flights to support ground troops and perform low-level reconnaissance missions.

Unlike the large-scale wars of the past, modern warfare includes low intensity conflicts encompassing smaller regional conflicts, guerilla warfare, and terrorist insurgencies. These conflicts have triggered the development of more efficient aircraft that excel in these low and slow flight envelopes. Unfortunately, the United States Government's enthusiasm to deploy troops to the domestic conflicts of other nations produces concern in the people of the United States by continuously putting troops at risk. With pressure from American citizens, there is a strong social desire to reduce the amount of money from the U.S. budget that is dedicated to fighting wars overseas that could be better utilized to fund domestic problems at home like inadequate housing, failing infrastructure, and poverty. In addition to the socioeconomic pressures, there is political pressure to avoid sending troops overseas to fight "endless" wars. It is from these perspectives that I researched the manner in which light attack aircraft have emerged

to satisfy the operational and strategic requirements of irregular warfare while also considering the impact of sociopolitical demands.

Technical Topic:

The increase in low intensity conflicts around the globe has created a window of opportunity for the technical advancement of a class of aircraft that is more efficient at lower altitudes and slower speeds. Aerospace companies have developed a solution that meets this niche profile by creating the light attack aircraft to support combat troops on the ground. Light attack aircraft were designed to fly efficiently in a slow and low flight envelope, while being inexpensive to acquire, operate, and maintain (Smith, 2013).

As a fourth year aerospace engineering student at the University of Virginia, you are enrolled in a yearlong technical Capstone for Aircraft Design. Mr. Jesse Quinlan is our lecturer for the year and chose an American Institute of Aeronautics and Astronautics competition to guide our final project. The competition requires a schematic for an original light attack aircraft designed by a team of less than ten students. To ensure each team creates a detailed final design for submission, our Aircraft Design course includes checkpoint assignments throughout the year.

Mr. Quinlan divided the class of twenty-one students into three design teams of seven students each. A single semester is by no means extensive enough to become experts on all state-of-the-art components of an advanced aircraft; therefore, each team selected an individual to become an expert on one of seven state-of-the-art topics provided by Mr. Quinlan. The topics included: configuration aerodynamics, structures and weights, propulsion, survivability/stealth/payload, design for austere fields, design for certifiability, and cost/affordability. My designated state-of-the-art topic was cost/affordability. All of the state-of-the-art topics had three subset categories to guide and channel an individual's development of

expertise. The three subcategories for cost/affordability were cost data collection for existing light attack aircraft (acquisition and operations), lifecycle costs modeling (development, acquisition, and operations costs), and service life and maintenance considerations. My expertise focused on cost data collection for existing light attack aircraft.

Four different aircraft model types researched as part of a detailed cost analysis were the Textron AT-6 Wolverine, the Sierra Nevada A-29 Super Tucano, the Textron AirLand Scorpion, and the Pilatus PC-21. I incorporated the following information into the acquisition cost data: cost of the aircraft, cost for training, and the cost for engineering design modifications. Regarding the cost of operations, the cost data included both the fixed and variable costs associated with the operations and maintenance of each aircraft type for their initial operating capability and the first year of operations (Boito, 2015). The variable costs are defined as the expenses that an operator incurs when an aircraft is being used and is based on either the amount of hours flown or the number of cycles flown by the aircraft. The other costs are categorized as the fixed costs, which are usually defined by calendar-based requirements. This cost breakdown is the typical strategy used in the military and commercial markets for acquisition programs of this type to determine budget requirements ("Executive Order. No. OMB A-11", 2015).

The cost data obtained was from publicly available sources previously released by the military or manufacturing companies through various means such as press releases or required government reporting; all other information was considered proprietary ("Iraq - AT-6C Texan II Aircraft", 2014). The publicly available sources used were similar for the acquisition of commercial aircraft with their associated operations and were used as a benchmark for determining the cost of military light attack aircraft. Due to extensive proprietary information, certain assumptions were made to further research. The cost assumptions made were that aircraft

classes of similar weights and engine types would essentially have similar operating costs. A summary of my research is presented in Figure 1, which breaks down the acquisition and operating costs of the four researched light attack aircraft.

After developing our expertise all members returned to their original design teams to represent their state-of-the-art component. Back in our design teams, we have begun preliminary work and designs for our original light attack aircraft with the input of experts of seven different state-of-the-art components of aircraft design.

	Model	AT-6	A-29	PC-21	Scorpion
	Class	Turboprop	Turboprop	Turboprop	Jet
Acquisition	Aircraft	$ 4,272,000	$ 18,000,000	$ 9,000,000	$ 20,000,000
	Training	$ 4,940,000	$ 4,940,000	$ 4,940,000	$ 11,720,000
	Design Modifications	$ 3,000,000	$ 3,000,000	$ 3,000,000	$ 3,000,000
	Subtotal	**$ 12,212,000**	**$ 25,940,000**	**$ 16,940,000**	**$ 34,720,000**
Operations	**Class**	**Turboprop**	**Turboprop**	**Turboprop**	**Jet**
Variable	Engine Maintenance	$ 180	$ 180	$ 180	$ 307
	Aircraft Parts	$ 450	$ 450	$ 450	$ 450
	Fuel	$ 85	$ 85	$ 85	$ 230
	Overhead	$ 285	$ 285	$ 285	$ 583
Fixed	Pilot Labor	$ 140,000	$ 140,000	$ 140,000	$ 140,000
	Mechanic Labor	$ 550,000	$ 550,000	$ 550,000	$ 550,000
	Training	$ 12,000	$ 12,000	$ 12,000	$ 35,000
	Subtotal	**$ 703,000**	**$ 703,000**	**$ 703,000**	**$ 726,570**
	Total	**$ 12,915,000**	**$ 26,643,000**	**$ 17,643,000**	**$ 35,446,570**

Figure 1 - Cost Data Collection for Light Attack Aircraft (Acquisition and Operations)

STS Topic:

All countries deserve the ability to defend themselves against myriad enemies from hostile nations, civil wars, to terrorists and insurgents. Due to the economic impact of wars, countries also need to manage their budgets properly in order to be able to pay for other domestic needs. Highlighting the cost of light attack aircraft provided a unique insight into how affordability can create opportunities for countries to manage their budgets to engage in conflicts that might otherwise have been too expensive. As irregular warfare becomes the new default for conflict types, new maneuvers arise for military aircraft to consistently perform. After extensive research of the cost of current light attack aircraft, it was shown that these cheaper alternatives have offered countries empowerment and self-sufficiency (Mosser, 2010). However, the introduction

of inexpensive and technologically advanced aircraft have potentially opened the door for more conflicts due to the proliferation of light attack aircraft around the world.

In this case, I will be focusing on engaging stakeholders' opinions on the degree of implementation and development of light attack aircraft. I will be using Multi-Level Perspective to track the way in which this innovation goes from a relatively underutilizes technology to potentially upgrading it to a major component in the regime of low intensity conflicts. The light attack aircraft companies are getting support from members within both governments and troops demonstrating the connections between niche and regime. Specifically in the United State, these groups push Congress to find new alternatives to police the globe by balancing efficiency and diminished risk to American troops. As with other parts of the sociopolitical landscape level, antiwar lobbyist and constituents with similar beliefs push Congress to limit American troops and government involvement in foreign conflicts. This allows for the niche level innovation of the light attack aircraft to have a window of opportunity to fill a new role in today's battlespace. This sociopolitical environment has a spider web of connections, which effect each other in different ways all cultivating with their influence on the progression of light attack aircraft. The landscape level also includes the impact of insurgencies and other adversaries around the globe involved in low intensity conflicts driving the need for light attack aircraft. This evolving landscape level requires countries to developed military capabilities to combat these threats. The niche level that the light attack aircraft fills is the low cost solution to effectively operate in this unique battlespace. It is the regime levels duty to listen to opinions and formulate legal regulations that reflect these views. As a low cost solution, there is a wide desire from many countries to acquire this capability. The United States along with other countries have developed these aircraft for both domestic and international sales to meet foreign military needs. In turn,

these weapons although given to allies to support battling a common threat, may in the future be used against nations that were previously allies.

There are many stakeholders with different perspectives on the use and proliferation of modern advanced weapons in warfare to include the light attack aircraft. These perspectives span across public and private sectors expressing a variety of sociopolitical and socioeconomical issues. From a sociopolitical perspective, during the past few decades Americans have become extremely concerned with protecting our troops during times of combat. With over two thousand U.S. troops killed during the War in Afghanistan, the American people want their troops to come home ("Casualty Status", 2020). To bring our troops home while preventing terrorist from falling back into power the United States is supporting the Afghanistan Air Force (Ybarra, 2011). As Defense Secretary Robert Gates stated it is "Arguably the most important military component in the War on Terror is not the fighting we do ourselves, but how well we enable and empower our partners to defend and govern themselves" (Smith, 2013, p.27). This sociopolitical perspective is supported by the technical capability of light attack aircraft. Ground troops are in need of a capable aircraft that has the following attributes: persistence, sustainability, responsiveness, spectrum target lethality, survivability, interoperability, and low cost per flight hour (Smith, 2013). Light attack aircraft were deliberately created to specifically fulfill these design characteristics and allow the United States to support its allies.

In addition, Democratic Representatives Alexandria Ocasio-Cortez and Ilhan Omar, were calling for the Administration to remove U.S. troops from Syria and to increase the focus on diplomatic efforts. Ultimately, they want a change in foreign policy which they feel has failed to make people safer and stop fighting endless wars against other countries (Bailey, 2019). Also, from a socioeconomic perspective politicians like Senator Bernie Sanders and former Vice

President Joe Biden have advocated for American troop withdrawal from wars like Afghanistan. Senator Sanders believes that the money spent on warfighting could be diverted and used to deliver desperately needed humanitarian aid. Former Vice President Biden believes that the troops should come home to allow Afghanistan and its neighboring countries to engage and negotiate a lasting peace ("The Presidential Candidates on the War in Afghanistan", 2019). The light attacked aircraft reflects these sociopolitical, economical, and technological problems. It is a smaller aircraft that can be operated and maintained by both large and small countries allowing them to protect their troops and people.

Many stakeholders are effected by the creation of light attack aircraft, from global players to local towns, some of these players push for a increase in light attack aircraft implementation. At different levels from taxpayers to government officials, these stakeholders desire different outcomes varying from political capital to economic capital. From an economic standpoint, while low intensity conflicts are small, they have been very expensive. The War in Afghanistan has cost the United States almost $1 trillion over the past 20 years (Amadeo, 2020). With modern fighter aircraft costing hundreds of millions of dollars to purchase, finding a less expensive means to support ground troops is needed. Therefore, government defense budgets appreciate the light attack aircraft's affordability. These light attack aircraft are dramatically cheaper to buy and operate than modern high-performance jet fighters. Many of these light attack aircraft cost less than ten million dollars. From a soldier's viewpoint, this would help the United States take a step back from the frontlines of many international conflicts that do not directly involve us and give countries the means and opportunity to defend themselves.

Although these light attack aircraft are helping many countries defend themselves, antiwar stakeholders like the VoteVets and Concerned Veterans for America complain about

endless wars created by these aircraft. Some believe that these aircraft, carelessly provided to countries, give them the ability to use these aircraft to create an escalation and proliferation of weapons increasing the amount of conflicts and casualties (Harpootlian, 2019). Critics claim that creating a new market for weapons diverts technology companies from researching advancements in other businesses like housing or renewable energy production.

Defense contractors are another stakeholder that support these weapons because it gives them a new product to sell during periods of defense budget cuts. For example, Textron Aviation/Beechcraft, the manufacture of the AT-6 Wolverine, has had numerous large contracts to sell light attack aircraft to foreign countries. Recently the Iraqi Air Force has requested to purchase 24 AT-6 aircraft with the associated training and logistic support for approximately $790 million ("Iraq - AT-6C Texan II Aircraft", 2014). Along with the contractors are the towns in which these companies are based out of like Wichita, Kansas that will benefit from the three-quarters of a billion dollar AT-6 program. This program would be a huge boost to the local economy by providing jobs for the residents and more tax revenue for the local government. The other manufactures involved in this program are Lockheed Martin Mission Systems and Training out of Oswego, New York and Pratt & Whitney Corporation the builder of the engines out of Bridgeport, West Virginia. These stakeholders in addition to those previously mentioned all hold different perspectives that affect the implementation of light attack aircraft.

Next Steps

Plan moving forward:

End of this semester:

- Multi-level Perspective framework for final thesis

- Multilevel perspective seems work very well with presenting the multiple sides of opinions for light attack aircraft
- Study the documents like "*The Promise and the Peril: The Social Construction of American Military Technology*" that will help map out a framework that I utilized

Beginning of next semester

- Technical project will have progressed so an actually initial configuration will begin to form
  - Use the STS topic from the social aspect to possibly make decisions on the physical attributes of our aircraft
  - Specifically analyzing the cost of materials and cost to purchase while analyzing how light attack aircraft affects the countries whom are interested in purchasing
- Collecting more evidence of stakeholders from different perspective levels
  - Ties the technical project to the STS topic to see how they affect each other

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