

Designing a Light Attack Aircraft to Provide Front Line Support to Ground Troops
(Technical Topic)

The Cost Disparity Between Light Attack Aircraft and Current Attack Aircraft
(STS Topic)

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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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Introduction

Light attack aircraft are highly maneuverable aircraft meant to be able to support ground troops with air to ground missiles, bombs, and other armaments and have become the current trend of aircraft that the military is requesting. The combination of efficiency and cost of these aircraft has prompted the Air Force to look towards using the light attack aircraft instead of fighter jets (Gertler, 2019a). Current models in this category include the AT-6 Wolverine, the A-29 Super Tucano, and the A-10 Thunderbolt. The AT-6 and the A-29 are the current baselines for light attack aircraft, as they have a lower operating cost as well as the approximate sizing to be considered a light aircraft. However, these configurations are not widely used as of this time, as aircraft such as the A-10 or fighters such as the F-22 are preferred by military forces such as the Air Force. The A-10 is the light attack craft that has been in deployment since the 1970's and the F-22 is one of the iconic fighters of our time. These aircraft, while efficient at providing necessary support to troops, are very expensive to design, build, and operate. This cost is emphasized in the operating cost or cost per flight hour of these aircraft, with the A-10 at \$11.5 thousand per hour and the F-22 at \$60 thousand per hour. As war is not a widely accepted way of spending taxpayer dollars as show in polls taken by Corman et al. (2015), a less expensive option that still provides the needed military support to the ground troops would be a more acceptable option for those who are against war.

To effectively define a new aircraft with a low operating cost, my group will be designing an entirely new aircraft from scratch while basing our initial design on the AT-6 and the A-29. Based off a design competition hosted by the AIAA, this new aircraft will aim to be efficient and have a low operating cost while still being able to support troops on the front lines. I will be

independently researching the cost disparity in between the old military craft such as the A-10 and the F-22 fighter jet as compared to a new light attack aircraft and how it would be received by taxpayers.

Technical Topic: Designing a Light Attack Aircraft to Provide Front Line Support for Ground Troops

As stated before, light attack aircraft are highly maneuverable aircraft meant to be able to support ground troops in air to ground strikes using missiles, bombs, or other armaments to attack ground forces. Unlike fighter jets and other military aircraft, these airplanes are not equipped to participate in air to air combat (Key Factors, 2012). Current light attack aircraft that are in use include the AT-6 and the A-29. These aircraft are very beneficial to this project by using them as a baseline point to effectively design a new light attack aircraft. This baseline can give multiple insights on what should be used for avionic systems, such as navigation systems, performance capabilities such as maximum range of the aircraft, maximum flying speed, and the maximum payload that can be carried by the aircraft, and overall characteristics such as engine type and output power, total hardpoints, which are areas that can hold weaponry, and overall size of the aircraft (*AT-6 Wolverine*, n.d.; *Super Tucano*, n.d.). These aircraft (shown in Figures 1) have low wing designs to increase the maneuverability of the aircraft and multiple hardpoints along the wing to effectively perform air to ground strikes. This is compared to fighter jets as shown in Figure 2, which has a extremely streamlined body as well as multiple fins to effectively perform air combat maneuvers such as rolls.



Figure 1: AT-6 Wolverine in flight, notice the low wing design and the numerous missile and bombs connected to the hardpoint for ground strikes (*AT-6 Wolverine*, n.d.)



Figure 2: F-22 Raptor in flight, noticed streamlined shape and fins meant for air combat as well as ground strikes. (Ritsick, 2020)

The importance of these aircraft is the necessity for ground support in combat situations. This aircraft design improves the loitering time of current aircraft, which means the aircraft can stay above the battle for more time to continue to support the troops on ground. An example of this improvement is shown by increasing the fuel efficiency of the aircraft or lowering the overall weight of the aircraft to allow it to fly for longer. This allows for the lower operating cost or cost per hour to be compounded in the extra time spent out loitering, making the plane

more affordable over the old A-10 or fighter jets. These aircraft are also designed to be able to land in austere fields, which are packed dirt fields near the front lines of the battlefield. If designed correctly, these aircraft can also be used to complete missions that are only currently feasible with attack helicopters.

As part as the AIAA 2021 Undergrad Aircraft Design RFP, my 7-member capstone design team will be designing a new affordable light attack aircraft with short austere field capability to provide support to ground forces (AIAA,2020). As outlined in the design challenge document, the aircraft must fulfill a list of requirements and objectives that allow for the light attack aircraft to effectively perform in a battle situation to both arrive at the battlefield in a timely manner as well as being equipped for the battle. The list of requirements and objectives are as follows:

1. Austere Field Performance: Takeoff and landing over a 50 ft obstacle in $\leq 4,000$ ft when operating from austere fields at density altitude up to 6,000 ft with semi-prepared runways such as grass or dirt surfaces with California Bearing Ratio of 5
2. Payload: 3000 lbs of armament
3. Integrated gun for ground targets
4. Service life: 15,000 hours over 25 years
5. Service ceiling: $\geq 30,000$ ft
6. Crew: Two, both with zero-zero ejection seats
7. Capable of completing both a design mission and a ferry mission
8. Provisions for carrying/deploying a variety of weapons, including rail-launched missiles, rockets, and 500 lb (maximum) bombs

- Survivability: Consideration for survivability, such as armor for the cockpit and engine, reduced infrared and visual signatures, and countermeasures (chaff, flares, etc.).

The design and ferry missions given by this proposal outline specific parameters that our aircraft must be able to achieve such as the minimum flight speed, the range, and loiter time. Our initial design configuration is shown in Figure 3 with a tilt wing concept to allow for increased vertical mobility. Our team is divided into seven specialty positions for the different state of the art sections of an aircraft which are aerodynamics, structures and weight, propulsion, survivability, austere field design, certifiability design, and affordability. For my team, I am the survivability specialist for the team which is in charge of payload, stealth technology, armaments, and general survivability.

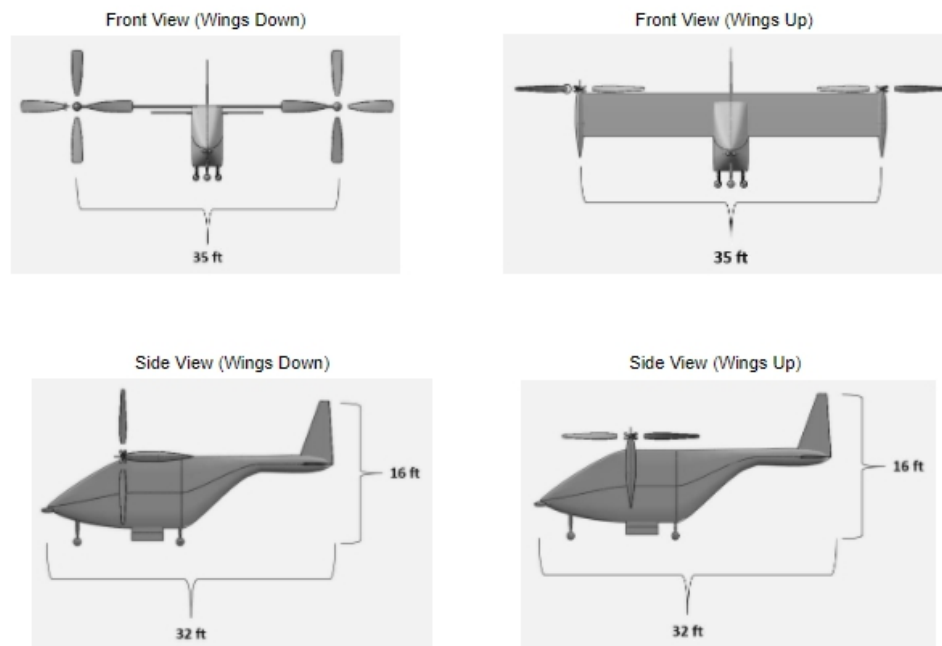


Figure 3: Initial design configuration for our team, notice the tilt-wing configuration to allow for a short or vertical takeoff. (Created by Author)

STS Topic: The Cost Disparity Between Light Attack Aircraft and Current Attack Aircraft

War has been a constant in the human world since long before our time. As mentioned by Carafano (2013), "The use of force must be for a military purpose – in other words not indiscriminate – and the risk to harming innocents cannot be out of proportion to the direct military end that is anticipated." In simpler terms, the force used cannot exceed what is needed. As war continues to evolve, the addition of aircraft and bombing increase the possibility and scale of harm to innocent parties. Further complications arise from the fact that money is being used to purchase and implement these aircraft. As shown by Corman et al (2013), when asked "There is much discussion as to the amount of money the government in Washington should spend for national defense and military purposes. How do you feel about this?", 35% of the general population thought the government spent too much in 2013. This shows distaste from a portion of citizens as to how their money is being spent. While this concern on the part of citizens cannot be avoided completely, it can be lessened by lowering the overall spending on attack aircraft. This concern with public acceptance also shows itself in the fact that while light attack aircraft will save a significant amount of money in the overall operations, the Air Force will be required to do initial spending into the designing and implication of the new airplanes. To further expand this, while these light attack aircraft are significantly cheaper to implement in comparison to normal attack aircraft, there will be an expensive cost to create a full fleet of light aircraft to replace the current fleet of attack aircraft that the Air Force and other branches of the military currently have in service. This significant cost up front could undermine citizen support by emphasizing the initial price and obscuring the savings in operation costs over the course of the aircraft's life.

Current attack craft are both expensive to implement and expensive to fly during the life of the craft. To show this, the A-10 Thunderbolt and the F-22 Raptor will be studied for the initial unit cost which includes the design, production, training, and implementation costs as well as the operating cost per hour which include the fuel, and maintenance costs during the life of the aircraft. First, the A-10 as stated before is the primary light aircraft currently in use. This aircraft is analyzed due to the frequency in which it is utilized in the field while being the most comparable craft to the current light attack aircraft (United States, 2007). Next, the F-22 Raptor is a fighter jet that is commonly in use by the Air Force. This fighter is used due to the amount both spent in development and how often it is used (Ritsick, 2020). While this fighter is not the most recent fighter in use, with the F-35 Lightning being developed in 2006 and still currently being in use, the F-22 is an iconic aircraft that opened up many possible directions for new development as well as flew many missions. Moving to the current light attack aircraft in production, the A-29 Super Tucano and the AT-6 Wolverine will be used to show the initial and operating costs of the crafts. As stated before, these aircraft are chosen due to their prevalence in the field of light attack aircraft. Designed by Embraer and Textron Aviation respectively, these craft are found to be suitable for ground troop support while lowering the cost point significantly (*AT-6 Wolverine*, n.d.; *Super Tucano*, n.d.).

This research will affect the average taxpayer by allowing them to know the taxes they pay will go towards a more cost-effective option in war. As stated by Gertler (2019b), If these craft are used in replacement of the fighters and craft such as the A-10, billions of dollars could be saved in the total operation life of the aircraft. While the development of these aircraft will cost a large initial cost in development and production costs, these craft are meant to continue

to fly long into the foreseeable future. This initial cost will be offset by the amount saved years down the road due to the large difference in operation costs between the attack aircraft and the light attack aircraft. Given this information, taxpayers can receive a sense of relief that less of the money they are spending will be going towards funding wars that they may not agree with in the long run.

Conclusion

My capstone group will be designing a new light attack aircraft that is more efficient than current light attack aircraft and more cost-effective than current attack aircraft. This new aircraft will be based on the designs of the A-29 and the AT-6 to increase the efficiency of the current light attack aircraft designs. Additionally, my STS research will allow a comparison of the cost of current aircraft to light attack aircraft to show the population that have ethical problems with war and attack aircraft that less of the money they spend in taxes will be put towards military aircraft spending. If both these tasks are completed, troops will be able to be supported by a more efficient light attack aircraft while saving money on what aircraft is used to complete the mission.

Word Count: 2043

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