The Hummingbird

(Technical Paper)

USAF Risk Management in Counterinsurgency:
Emphasizing Considerations of Civilian Life and Moral Dimensions

(STS Paper)

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Light Attack Aircraft in Counterinsurgency

Light attack aircraft and the specific areas of warfare they excel at have been around since World War I. The United States has employed air power in "more than a dozen conflicts against guerillas, so-called bandits, and other irregulars." (Corum and Johnson, 2003, p.3) After fading in prevalence since their creation, the modern era of counterinsurgency (COIN) missions and the need for close air support have brought back the need and desire for a modern light attack aircraft (LAA). This reemergence is highlighted by the US Air Force (USAF) launching a program in 2016 to replace the A-10 Thunderbolt II, the only active LAA operated by the U.S. The USAF recently used high-end F-22 jets in an operation to destroy a drug laboratory in Afghanistan. This operation was described by then-Air Force Secretary Heather Wilson as "an inefficient use of resources." (Gertler, 2019, p1) Additionally, the strategies and tactics used by the USAF in COIN operations rely on a "weak communication infrastructure," leading to innumerable inaccuracies and mistakes. (Connable, 2012, xxii)

These destabilizing conditions will continue to have a serious negative impact if action is not taken. Regarding the flaws in the strategies surrounding COIN missions, lives will continue to be needlessly lost. Similarly, if the USAF continues to use over-equipped aircraft to carry out these COIN missions, millions of taxpayer dollars will be wasted. This prospectus proposes two separate solutions to improve this situation. First, a novel modern LAA design will be created with emphasis on maximizing efficiency and a wide mission envelope. Secondly, an improved understanding of the sociotechnical system surrounding COIN operations will be offered.

Design of a Modern LAA

To design a viable LAA, the specific desired characteristics should first be evaluated. There are multiple successful LAA currently on the market and by surveying the strengths and weaknesses of each aircraft a new design begins to take shape. LAA have a few main features: an expansive mission envelope, low cost of operation, increased loiter capabilities, and the ability to land on shortened austere fields. (Hempel, 2017) The USAF is interested in LAA for the completion of COIN missions because the "per-hour operating costs for light attack aircraft are typically about 2%-4% those of advanced fighters." (Gertler, 2019, p1) Advanced fighters also cost 6-13x times as much to procure when compared to LAA, further increasing the appeal to deploy them in COIN operations. Additional values for both the unit and operating costs of four selected aircraft are shown below in Table 1.

Table 1: Costs of Selected Aircraft

	Unit Cost	Operating Cost (per hour)
F-35	$90m	$42,000
F-22	$150m	$60,000
A-29	$11m	$1,000
AT-6	$14m	$1,000

The F-35 and F-22 fall into the category of over-powered aircraft being inefficiently used to complete COIN missions. The A-29 and AT-6 are two modern LAA being used by other national air forces around the world. As discussed earlier, the USAF started a program to readopt LAA into their fleet and the A-29 and AT-6 were the two finalists. This prospectus will build on the technical aspects and features incorporated in both the A-29 and AT-6. By evaluating both

aircraft for advantages and drawbacks, a superior design will be crafted by combining and improving the existing individual characteristics. Figure 1 shows a side by side comparison of these two aircraft.

Figure 1: A-29 Super Tucano (left) and AT-6 (right)

Several features of these aircraft that are of importance to consider are: propulsion type, payload capacity, strategies to minimize cost, and strategies to maximize the applicable mission envelope. After examining both aircraft, multiple common features as well as unsuccessful aspects can be condensed into future design considerations. The propulsion employed on both the referenced LAA is a diesel turboprop engine positioned on the nose of the aircraft. This engine has shown to be the most promising due to its high relative fuel efficiency and minimal production cost. The capabilities that multiple hardpoints under the wings lend also presents itself as an important design feature. By having six or more hardpoints it allows for additional configurations and customization of loadouts for any given mission. Additionally, external fuel storage becomes an option for increased endurance times required by certain missions. Analyzing these previous designs and their real-world success in COIN allows for a new LAA to be designed incorporating the best features of each while omitting their respective flaws.

This body of work is being completed by a team of seven undergraduate aerospace engineers under the mentorship of Dr. Jesse Quinlan, a NASA aircraft design engineer. One of the main challenges being faced in the completion of this work is finding novel solutions. This is

important because producing a design that is nearly identical to a preexisting aircraft would lend no added value to the current situation. Additionally, the sheer complexity of designing an aircraft will force the team of undergraduate students to both learn design methods and implement them with little experiential background. The anticipated deliverable from this prospectus will be a complete modern LAA design with full descriptions of performance capabilities and operational limits. This deliverable will include both text, graphical representations of flight envelopes, and a complete 3-D rendering of the aircraft.

Understanding COIN Operations

The COIN sociotechnical system consists of constantly changing actors and interactions. Accordingly, this environment is described as both "complex and chaotic" by researchers devoting their professional career to the subject. (Connable, 2012, p 33) However, by looking at the system from an overarching view, a few systematic flaws can immediately be found. Former Secretary of Defense Robert Gates has openly criticized the USAF for "focusing excessively on the kind of high-end, near-peer conflicts" that more expensive and capable aircraft are designed to complete. (Gertler, 2019, p1) This issue presents a huge initial weakness in the tactics used by the USAF when carrying out COIN operations. The USAF has begun attempting to solve this weakness by investigating LAA in the OA-X program; however, this renewed interest is only the first step in reintroducing LAA into the USAF fleet. Even in the best-case scenario, it will still be multiple years before they are mission ready and the pilots have been trained.

Another flaw specific to COIN missions is the act of targeting civilians to suppress insurgencies. It has been shown through previous research that "campaigns that target civilians indiscriminately increase support for insurgency among civilians." (Pechenkina, 2017, p. 1) By gaining an increased understanding of how the COIN sociotechnical system functions, specific

consequences can be avoided or minimized. These avoidable costs are generally summarized as loss of civilian life. Researchers from Johns Hopkins University estimated that in a span of 40 months between 2003 and 2006 over 650,000 civilians were killed in Iraq alone. (Hall and Stahl, 2006, p. 3) This staggering number speaks volumes to the impact COIN operations and insurgency regimes have on a region. Bringing the civilian death count to zero is not the goal, seeing as it is virtually unachievable. However, decreasing this number for all future COIN related missions will not only save lives but also increase the effectiveness of COIN campaigns.

The research question of the STS portion of this prospectus relates to how the tactics currently used in COIN missions can be improved and optimized to reduce loss of life. Specifically, the factors that influence decision makers in the USAF will be explored extensively. This work will build on similar research done in the area by Hall and Stahl, as well as Pechenkina, by using a sociotechnical system analysis approach similar to the cartography of controversies (CoC). The CoC is a tool defined by Venturini to improve the observation and analysis of a sociotechnical system. (Venturini, 2010) In describing this tool, Venturini outlines a list of five observation frames to be used when analyzing any given controversy or system. The use of these observation frames in the context of this prospectus will ensure that a comprehensive view of the sociotechnical system is generated. The main challenges for this work will be developing a firm grasp on the constantly fluid actor network and finding accurate statistics to support the claims made. The deliverable for this STS work will be an improved understanding of the COIN sociotechnical system in order to minimize civilian casualties.

Conclusion

Counterinsurgency operations will continue to be prevalent in the frame of global warfare for the foreseeable future. This continuous increase in the number of COIN operations requires both

the use of an aircraft designed specifically for these types of missions and a better understanding of the COIN sociotechnical system. The anticipated deliverable of this technical work will be a unique modern LAA design including design with full descriptions of performance capabilities and operational limits. This deliverable will include both text, graphical representations of flight envelopes, and a complete 3-D rendering of the aircraft. The STS research will yield an improved understanding of the COIN sociotechnical system and the tactics used in these missions. These deliverables could potentially contribute to saving both the lives of civilians involved in COIN conflicts and millions of taxpayer dollars spent on overkill. However, it is important to note that the "USAF counterinsurgency capabilities will neither deepen nor expand without the strong support of the senior leaders." (Vick et al., 2006, p. 13) Therefore, individuals with decision-making power must be held accountable for the implementation of the results presented.

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