Thesis Project Portfolio

The Hummingbird

(Technical Report)

USAF Risk Management in Counterinsurgency:

Emphasizing Considerations of Civilian Life and Moral Dimensions

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

(Executive Summary)

Optimizing Counterinsurgency Operations

Light attack aircraft and the specific areas of warfare they excel at have been around since before World War I. After fading in prevalence since their creation, the modern era of counterinsurgency (COIN) missions and the need for close air support has brought back the need and desire for a modern light attack aircraft (LAA). My thesis is focused on how to optimize COIN operations, both from a technical aircraft design perspective and a sociotechnical morality perspective. During the process of completing this thesis portfolio, I encountered countless challenges that seemed insurmountable. However, the engineering method is never an individual effort and embracing that concept was one of the most valuable lessons I garnered throughout this year.

The technical portion of my thesis produced a novel LAA design to be entered in the annual AIAA undergraduate aircraft design competition. The creation and full analysis of a new aircraft design is a task I would have thought impossible only a year ago. However, the delegation and collaboration of my team allowed us to thrive and opened my eyes to the hive mentality of engineering in the real world. The final design boasts an expansive mission envelope, low cost of operation, increased survivability capabilities, and the ability to take off from and land on shortened austere fields. These characteristics were initially derived from the AIAA request for proposal, as well as general desired features for a LAA in modern day warfare. A rendering of the completed aircraft can be seen below in Figure 1.

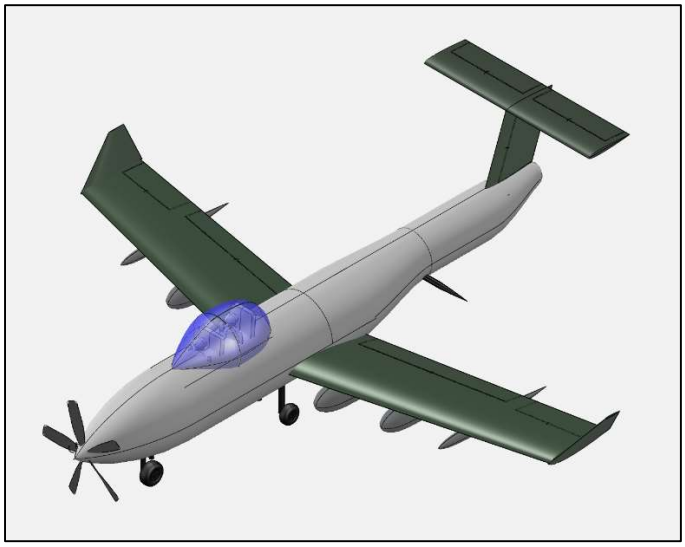

Figure 1: Complete 3D Model of the Produced Aircraft

In my STS research, I investigated the sociotechnical systems surrounding USAF risk management by applying a model of risk management analysis to yield a better understanding of why civilian casualties are so prevalent in COIN operations. I used concepts from Rachel Hollander's model for risk management analysis to assess the current United States Air Force (USAF) risk management system. Applying Hollander's model for risk management analysis to two primary sources, which detail conduct and risk management strategies, from the USAF revealed that there is a systemic underrepresentation of collective moral responsibility. Collective moral responsibility is a concept that describes how moral responsibilities lie not only with an individual but are shared and divided across an organization. This lack of collective moral responsibility stems from the hierarchical nature of the military, as well as quantifying and undervaluing civilian life.

My technical and STS projects both work towards optimizing COIN operations but approach the problem differently by focusing on separate aspects. In designing the aircraft, the goals for optimization were established from the viewpoints of military decision makers and

pilots, whereas my STS research investigated the problem of optimization from an overarching moral responsibility perspective. However, my STS work was inspired by my interest in LAA and the types of combat for which they are used. Understanding the environments and situations that my aircraft could be used in contributed significant insight into how LAA are utilized and what characteristics are optimal. The culmination of my thesis results in a greater understanding of the broad sociotechnical system surrounding COIN operations. Additionally, it highlights the distinct moral complexities of COIN operations and their importance in the professional responsibility of an engineer. This thesis project as a whole has given me much more than technical abilities or argumentative skills. The concept of the final product being more valuable than the sum of its parts rings resoundingly true in my situation. Breaking down an initially seeming insurmountable amount of work and collaborating across months with my team gave me an invaluable lesson to take into my professional career.

I would like to acknowledge and thank my technical advisor Dr. Jesse Quinlan for his constant and invaluable guidance given throughout my aerospace capstone project. Additionally, I thank my capstone team members: Lori Abbed, Sander Abraham, Justice Allen, Marcus Dozier, Landry Myers, and D'Michael Thompson, for their diligent work towards completing our capstone project.