

**Conceptual Design Report of A Firefighting Very-Large-Air Tanker “Material Girl”
(Technical Report)**

**2002 Crash of the Lockheed C-130 Hercules in Walker, California
(STS Research Paper)**

An Undergraduate Thesis Portfolio

Presented to the Faculty of the
School of Engineering and Applied Science
University of Virginia, Charlottesville, Virginia

In Partial Fulfillment of the Requirements for the Degree
Bachelor of Science in Aerospace Engineering

By

Logan Patrick Honts

May 11, 2022

Sociotechnical Synthesis: The Role of Maintenance Procedures in the Safety of Aerial Firefighting Networks

Both my technical and STS research focus on the field of aerial firefighting. Aerial firefighting is the use of aircraft to respond to wildfires and stop their spread by dropping water or fire retardant in strategic locations to aid ground firefighting crews. My technical work consisted of a conceptual design of a new air tanker class aircraft designed specifically for aerial firefighting. My STS research focused on the cultural and social aspects that can destabilize an aerial firefighting network through eroding of safety precautions and maintenance standards.

My technical work produced through my capstone design course delivers a conceptual design of a new, uniquely purposed firefighting aircraft. The current fleet in the United States and worldwide are dominated by modified cargo or transport aircraft with firefighting capabilities added retroactively to the base design. Thus, there is a large opportunity for an aircraft designed for the sole purpose of aerial firefighting to prevail in the current market. The American Institute for Aeronautics and Aviation (AIAA) gave my capstone team and I (as well as other universities nationwide) a design challenge through a Request For Proposal (RFP) to meet this goal. This aircraft we design must meet the requirements set out in the AIAA's RFP, perform at a level as good or better than current options, and also innovate for lower cost and sustainability. My team and I designed an air tanker class aircraft capable of meeting the requirements in the RFP while also being more efficient, cost-effective, and sustainable than the current options for aerial firefighting.

My STS research, while related to the field of aerial firefighting, focused on the cultural aspects leading to an unstable aerial firefighting network and the resultant crash of the C-130 Hercules near Walker, California in 2002. I utilized Actor-Network Theory developed by

Michael Callon to determine which parties were ethically responsible for the crash. I argue that a passive, reactionary culture which blames inadequate funding and only values safety after a crash occurs contributed significantly to the C-130's crash. This as well as the maintenance network, carried over from the United States Air Force when the C-130 was acquired by Hawkins and Power Aviation, were insufficient to properly support the C-130's operation. My paper discusses the shortcomings of prevailing attitudes in the field of aerial firefighting and what a proper maintenance network should do to maintain an aircraft in service and prevent future crashes.

I found great value in working on my technical capstone project and STS research in tandem rather than individually. Information I gathered to better inform design decisions in the technical project exposed me to the social aspects behind the successful operation of aerial firefighting networks. Through my analysis of a crash in the field of aerial firefighting, I was better able to understand the necessary components an aircraft must have to ensure a record of safety throughout its life in my group's technical design. The improper maintenance that I argue caused the crash of the C-130 Hercules in 2002 made me realize how important designing for ease of maintenance in a new firefighting aircraft is. In summary, working on my technical project and STS research together, both designed to address the increasing amount and intensity of wildfires worldwide, has highlighted key aspects of the issue and each complimented my understanding of the other.

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