AIAA 2021-2022 UNDERGRADUATE RESPONSIVE AERIAL FIREFIGHTING AIRCRAFT FINAL DESIGN REPORT

UNDERSTANDING THE DEARTH IN FIREFIGHTING AIRCRAFT FUNDING THROUGH THE LENS OF ACTOR-NETWORK THEORY

An Undergraduate Thesis Portfolio
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SOCIOTECHNICAL SYNTHESIS

Wildfires pose a serious threat to our ecosystems, infrastructure, and communities, and as climate change exacerbates the virulence with which these fires spread, the technology with which we combat them must also improve. Through the development of a next-generation firefighting airtanker, specifically calibrated for the purpose of suppressing the magnitude of a wildfire, modern tools can be leveraged to improve humans' capability to defend itself from the natural disaster. Such a technology would provide a much-needed improvement to an industry landscape hindered by budgetary restriction, and thus populated with older aircraft renovated to suit the firefighting job. Why the budget for firefighting technology has not increased despite the contemporaneous increase in wildfire potency is explored in the science, technology, and society (STS) research paper. In adopting a network for the federal budget allocation process using an Actor-Network Theory (ANT) framework, the social and political motivations of the actors involved are analyzed to support conclusions on how this dearth in funding comes about. The two projects are tightly coupled, with the technical project concerned with the actual development of technology within the firefighting industry, while the sociotechnical explores the budgetary limitations present in this industry, and the reasoning for their existence.

The technical report proposes the clean-sheet design of a firefighting airtanker to the American Institute of Aeronautics and Astronautics (AIAA). In contrast to current firefighting aircraft which are repurposed and purchased cheaply from military or civilian application, the design outlined in the report is intentionally crafted with the firefighting retardant drop mission in mind. By leveraging state of the art aerodynamic high-lift systems, propulsive technologies, and structural ingenuity, the proposed aircraft can reach a disaster site more quickly, and with greater accuracy release a larger amount of retardant on a wildfire.

The final aircraft, dubbed SB-22 “Woodzy Owl”, is a large airtanker class aircraft, carrying four 2,000 gallon tanks of retardant in the fuselage, and powered by 4 turboprop engines. Using software to calibrate each of the individual aerodynamic, geometric, and propulsive factors, the data was the integrated into the Flight Optimization System (FLOPS) software to test the viability of the design for completing a two-drop firefighting mission. The aircraft successfully completed the mission at a takeoff gross weight of 224,089 pounds and a block fuel burn of 11,231.3 pounds. Our complete technical and mission analysis has been submitted in the proposal to the AIAA.

The research question investigated in the sociotechnical report is why this dearth in funding exists at the federal budgetary allocation level. Law and Callon’s Actor-Network Theory (ANT) framework was adopted to organize and define the relationships between the various actors involved in the budget process. The report divides the larger global network into two smaller local networks with some level of autonomy with respect to the other, and analyzes the motivations of the actors in each, as well as the internal and external relationships present between them which hinder the realization of technology as a valid solution to the wildfire problem. These conclusions are supported by newspaper articles, political databases and reports, poll and economic statistics, as well as ethical readings on the application of ANT to other sociotechnical scenarios.

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