American Institute of Aeronautics and Astronautics: Aerial Firefighting Design Competition
(Technical Paper)

The Effects of Past and Current U.S. Wildfire Policy
(STS Paper)

A Thesis Prospectus
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Bachelor of Science, School of Engineering

By
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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

The technical portion of this thesis will consist of the conceptual design of a firefighting aircraft, created for submission in the AIAA 2022 Design Competition. The STS portion of this thesis will investigate the impacts of the practices and policies surrounding U.S. wildfires, answering the research question, "What are the impacts of past and current U.S. wildfire policy?" As wildfires become an increasingly prominent issue in the U.S., it is imperative to ensure the effectiveness of current policies and solutions regarding wildfires.

Technical Project

As wildfire frequency and intensity increases, so do the threats they pose to people and wildlife. In response to the increasing need for effective firefighting responses to these wildfires, the AIAA's 2022 Design Competition released an undergraduate team aircraft design request for proposal (RFP) focusing on a responsive firefighting aircraft (AIAA, 2021).

Current firefighting aircraft mainly consist of commercial or military aircraft which were modified for firefighting purposes. These aircraft have various inefficiencies and drawbacks because of the incompatibilities between their original design missions and those of firefighting aircraft. Firefighting aircraft face unique challenges. Fire retardant's high density requires the aircraft to bear high structural loads. The RFP required payload of 4,000 gallons of retardant with a density of 9 lbs / gal gives a payload weight of 36,000 lbs. The extreme maneuvers executed by the aircraft during firefighting missions cause additional strain to the airframe. A purpose built firefighting aircraft could reduce the inefficiencies experienced by current firefighting aircraft by considering these increased loads, potentially implementing lighter, easily repairable and replaceable structures instead of the heavy, robust designs seen in current aircraft.

The UVA aircraft design capstone project teams will conceptually design firefighting aircraft to fulfill the requirements and objectives listed in the AIAA's RFP, devising unique solutions to create competitive yet feasible firefighting aircraft.

STS Project

What happens when one forms a solution without sufficiently understanding the problem? What happens when one solves the wrong problem? What should one do when they realize their solution has become part of the problem, or worse, created larger problems?

The STS portion of this thesis will focus on the impacts of the U.S.'s practices and policies surrounding wildfires. U.S. wildfires have grown tremendously in recent years. The Dixie wildfire burning in California covers 963,276 acres as of 10/02/21 8:00 AM and is the second largest wildfire recorded in California by acreage (Cal Fire, 2021a; Cal Fire, 2021b). Part of the problem stems from climate change, which won't be the main focus of this thesis. Another part of the problem stems from the U.S.'s past and current policies surrounding wildfire prone areas and wildfire solutions. Previous policies of aggressive wildfire suppression allowed for increased biomass levels which then provided fuel for larger and more damaging fires (Gorte, 2013). What are other ramifications of the past and current U.S. wildfire policy? Who has been impacted by these policies? Initial research shows that these "no fire" policies not only helped cause the large wildfires in recent years, but also further separated the Yurok, Karuk, and Hoopa Tribes from their tradition of controlled burns (Buono, 2020). These controlled burns were necessary for these tribes to cultivate traditional resources. Without them, "we lose our salmon, we lose our acorns, we lose all those things, and we don't have a culture. We just slowly disappear" (Buono, 2020).

This thesis' STS project relates to its technical project because new firefighting aircraft are used to enforce current firefighting policy. If the current policy is insufficient or damaging, these aircraft could fail to achieve their objective of reducing the negative impacts of wildfires. Additional potential ramifications from these aircraft include environment damage from fire retardant chemicals and expending money for the development and manufacture of these aircraft (Little & Calfee, 2002).

STS Methodology

This thesis will employ the STS methods of history, public policy, and ethnography. The STS methods of history will consist of gathering and studying previous literature regarding wildfires, wildfire policy, and wildfire practices (see the following section, Literature Review). This literature will allow for greater understanding of the history of U.S. wildfire policy and its impacts. Using the STS method of public policy will mainly consist of gathering and unpacking the various stories told about wildfires, whether they be pieces published by various media outlets or U.S. public policies. Networks of relationships will be drawn from these pieces and policies. Finally, ethnography will consist of either gathering previously made interviews from fire stewards such as the Yurok, Karuk, and Hoopa Tribes, or seeking interviews with these stewards to seek their perspective.

Literature Review

Five primary sources selected for initial research cover the following topics: contributing factors of wildfires, wildfire policy, past wildfire practices, and current wildfire practices. Literature to consider for this section:

- Exploring the onset of high-impact mega-fires through a forest land management prism (Williams, 2013)

    - Author: Jerry Williams
    - Topic: This paper explores not only the policies which have been implicated in wildfire problems, but also land management policies which further added fuel to the fire.
    - Why selected: Gain understanding of problematic past (and potentially current) policies which affect wildfires.
- Large airtanker use and outcomes in suppressing wildland fires in the United States (Calkin, Stonesifer, et at., 2014)
    - Authors: David E. Calkin, Crystal S. Stonesifer, et al
    - Topic: Large firefighting airtankers – cost effectiveness, practices, strategies, etc.
    - Why selected: Increase understanding of current U.S. wildfire fighting practices.
- Airtankers and wildfire management in the US Forest Service: examining data availability and exploring usage and cost trends (Thompson, Calkin, et al., 2013)
    - Authors: Matthew P. Thompson, David E. Calkin, et al
        - ** note repeat author Calkin
    - Topic: Another resource analyzing aerial firefighting (this resource focuses on a wider range of firefighting aircraft, not just large airtankers).
    - Why selected: Increase understanding of current U.S. wildfire fighting practices.
- Prehistoric fire area and emissions from California's forests, woodlands, shrublands, and grasslands (Stephens, Martin, et al., 2007)
    - Authors: Scott L. Stephens, Robert E. Martin, Nicholas E. Clintron
    - Topic: Historic Native American burning practices.

    - Why selected: Gather information on past fire practices which vary greatly from previous U.S. policies.
- Climate and very large wildland fires in the contiguous western USA (Stabros, Abatzolglou, et al., 2014)
    - Authors: Natasha E. Stavros, John Abatzoglou, et al
    - Topic: Climate factors affecting wildfires and wildfire effects on climate.
    - Why selected: Despite climate factors on wildfires not being a main focus of this thesis, it's still important to understand these effects.

Timeline

March 15th: First Draft

April 15th: Polished Draft

April 15th through May: Review

Conclusion

As the size and intensity of wildfires increase, so do the problems they pose for society and wildlife. It is imperative to study the effects of past and current wildfire policy and apply key findings to the development of new wildfire policy and technology. In addition to the analysis of key literature works and news pieces, the history of peoples whose cultures are closely tied to wildfires must be studied. The voices of fire stewards such as the Yurok, Karuk, and Hoopa Tribes must be heeded. The first objective of studying the effects of wildfire policy and practice will be realized in the STS portion of this thesis. The second objective of developing future wildfire fighting technology will be met through the development of a wildfire fighting aircraft in the technical portion of this thesis.

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