AIAA DESIGN CHALLENGE: DEVELOPMENT OF AN AERIAL FIREFIGHTING AIRCRAFT

THE SOCIAL SHAPING OF AEROSPACE TECHNOLOGY IN THE MID 20TH CENTURY

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SOCIOTECHNICAL SYNTHESIS

Throughout history, societal demands have motivated significant technological innovations, advancing humanity from era to era. This trend continues in contemporary society as humankind strives to transition toward a more environmentally conscious society while battling the effects of climate change, specifically worsening wildfires. The urgent need to protect communities from wildfires inspired the technical research which outlines the design of an aerial firefighting aircraft. A similar relationship between societies and technology influenced the STS research which focuses on the effect of Cold War sociopolitical values on aerospace technology. In times when there is heightened societal demand for change accompanied with strong social and political values seen in both the battle against climate change and the Cold War, the social shaping of technology can be most clearly seen.

As a response to the wildfires that have been increasing in size and frequency since the 1980's, the American Institute of Aeronautics and Astronautics presented a design challenge to design a responsive aerial firefighting aircraft. The challenge outlines a series of requirements and objectives that the aircraft must meet such as a mission distance range, flame retardant capacity, and various speeds. To begin the design process, the team of eight undergraduates researched advantageous aerodynamic structural features for a large load-carrying plane as well as general current issues in aviation. Then, initial CAD designs were developed and analyzed using weight estimation and flight simulation. Finally, the final design was selected and optimized using a series of aircraft design software platforms to most effectively meet the challenge requirements.

The final aircraft is named Material Girl for its reliance on composites in its fuselage. Material Girl is based heavily on the Russian cargo aircraft, the Ilyushin Il-76. It features several design features that set it apart from existing aerial firefighting aircraft. These include anhedral wings that optimize maneuverability, winglets and turboprop engines that improve fuel efficiency, and a flatbed fuselage that allows for easy release of payload. The aircraft is designed for entry into service in 2030 and will be submitted in a technical report to the American Institute of Aeronautics and Astronautics for final review and ranking.

The investigation into Cold War technology centers around the question of how sociopolitical ideologies, specifically the contrasting theories of American capitalism and Soviet socialism, influence distinct technological design. The approach guiding the investigation was that the technologies that emerged from the United States of America and the Soviet Union would greatly reflect the core values that were instrumental to the functioning of each society. In order to support this, research was conducted to determine what those values were. Then, further research was done into the most significant aerospace innovations from one Cold War power that had a counterpart in the opposing Cold War power. Finally, the technologies were analyzed to see how their differences in design reflected the values that saturated their society of origin. This analysis was done using the Social Shaping of Technology framework by Robin Williams, an extension of the Social Construction of Technology by Pinch and Bijker, through an input/output interpretive analysis.

From the Soviet Union, the most influential societal values in this investigation were resourcefulness, militarism, collectivism, and centralized State power. Luxury, corporate power, and business competition were the most significant on the American side. The technologies analyzed were the Soviet N1 rocket and Mikoyan MiG-29 jet as well as the American Saturn V

rocket and the McDonnell Douglas F/A-18 plane. In evaluating Soviet air and spacecraft, it was found that they used more standard, generic parts, simpler technology, had extreme military focus, and problems that stemmed from a rejection of collectivism. The investigation of American air and spacecraft revealed them to be more technologically luxurious, expensive, and collaborative.

When analyzing human history, it is common to separate distinct eras by their most significant technologies. From this strategy, it can be argued that technologies are the most significant shapers of societies. However, the technical research and STS research provide an opposing argument that it is actually societies that first influence technology.

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