**Thesis Project Portfolio**

**Design of Autonomous Unmanned Aircraft System**

(Technical Report)

**Comparing Current Drone Regulations with Public Concerns**

(STS Research Paper)

An Undergraduate Thesis

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

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## Sociotechnical Synthesis

Rapid technological developments in autonomous unmanned aerial vehicles (UAV) and an evolving legislation may soon open the way for their large-scale implementation in the future. My technical research topic is set up so that it explores the technical developments and limitations of UAVs through the design of a drone and its ground systems. The STS research topic dwells more on the legislation side concerning drones. We found relatively early into our technical research that drones have a rich and long relationship with society. Starting with drones originating from a military context, drone regulators have been working to progress so that drones can be used in a more commercialized setting. The STS thesis explores this context more by comparing public concerns of drones with current drone regulations. This research embraces the ideas presented in STS classes as this research acknowledges the fact that the public (society) have a huge impact on drones (technology), and vice versa. By knowing public concern, the drone regulators can better design regulations and limitations regarding drones and in turn, drone companies can design to better fit public interest.

The technical portion of my thesis produced a design of a safe, reliable, profitable, low-noise autonomous unmanned aircraft system (UAS), including the ground systems, to deliver small packages via air transport to designated landing platforms. The main performance requirements the aircraft had to accomplish were: fly in winds up to 23 mph, carry 6x6x6 inch package weighing up to five pounds, land and takeoff from a 50x25 feet platform, and fly a minimum of 40 miles without human intervention in less than 40 minutes. To accomplish this task my capstone team devised a fully electric tiltwing tandem drone. Sized similar to a sedan, this drone has two main wings, 8 propellers, an advanced detect and avoid system, and lithium-metal batteries to power the whole craft. The wings can rotate 90 degrees allowing it to

transform from vertical flight to horizontal flight. The optimization for both horizontal and vertical flight was necessary because the craft needed to be able to take off and land in extremely short areas but also needed to be able to maintain high speeds in harsh weather conditions. The drone features a fully autonomous flight as it will perform flight controls as well as package drop off and pick up by itself. The final iteration of our drone was calculated to be able fulfill deliveries within 30 minutes of placing an order at a nearby distribution center and also fulfill all of NASA's requirements.

In my STS research, I compared the regulations governing drones in the United States with the concerns held by the public they are meant to protect. In general, the public were most supportive of those regulations that could be categorized as limiting one's exposure to an unwanted drone. The most popular policies were those that protected personal privacy, while the least popular were those that hampered drones used for public safety. The largest discrepancy was found to be the publics' preference for laws protecting personal privacy compared with the lack of regulatory constraints currently in place. Federal regulators have only begun to introduce regulations on how drones can be used in our national airspace, with additional regulations for other types and sizes of drones likely to be introduced in the future. The results of this research may be utilized by regulators and lawmakers to create a regulatory structure that effectively mitigates risk and supports the public interest.

Working on drones through a technical aspect and researching its legal side has foregrounded the fact that the drone is part of a sociotechnical system. Without carefully considering the implications of technical implementations on society, the drone will not be an effective technological advancement in society. Fully autonomous drones require extensive detect and avoid software and hardware. Having too much detect and avoid often constitutes as

being intrusive on people's personal privacy, however having too little detect and avoid endangers the drone and its surroundings. Drone regulators and manufactures must tread delicately to take both scenarios into consideration.