Sociotechnical Synthesis

The general problem this portfolio looked at was the deployment of payloads in launch vehicles. The launch vehicle industry is growing rapidly, with Deloitte expecting an annual growth rate of 15.7% as of 2021. Additionally, companies like SpaceX are planning to launch almost 150 times in 2024, and the overall number of launches at DoD spaceports are expected to grow by 100%-200% over the next two years. This growth in the market has created an abundance of space debris in lower earth orbit (LEO) which can be detrimental to the existence of current satellites in orbit, as well as spacecraft passing through. Furthermore, it has placed lots of strain on launch infrastructure, with commercial activity making up 90% of launches at DoD spaceports, there simply isn't enough infrastructure to meet expected demand. Factoring in the high levels of waste and overhead to develop and launch these vehicles, it becomes apparent that the current launch infrastructure wasn't designed to be sustainable. The technical aspect of this portfolio details using a smaller launch vehicle with a deployable payload, in the form of a passively stable glider, to gain telemetry and imaging data over a prescribed area. The STS research problem attempted to determine whether the technical solution could be implemented, and not stay a 'science project', with the research question being: "To what extent can a decentralized system of small-scale LV's equipped for imaging and data collection replace our current satellite imaging infrastructure".

The technical project involved designing both the payload and its deployment system in tandem with the rocket separation and parachute deployment circuitry. The designing stage looked at current deployment methods for rockets of the same class and retrofitting them to our rocket with adjustments made based on differences in our rocket's design. For the payload, aerodynamic analyses were made using both real-time data from prototype flights as well as computational simulations to find the optimal structure of the glider. During the development of the technical solution, the problem of waste in the launch industry was seen first-hand, with difficulties in creating testing schedules, manufacturing being time consuming and costly, shortages of specialized materials, and lots of environmental, health and safety considerations did completely halt the design cycle entirely at certain moments. Furthermore, once our final design was developed, there were some physical design limitations with using a passively stable glider, meaning that it did limit the potential use-cases for the technical solution.

The STS research portion used Geel's MLP to understand how new innovations can be introduced to established wide-spanning technological systems, and looked at how decentralized systems are easier to integrate and can lead to greater equity and sustainability within the technological system. Through a literature review and reviewing case studies, the STS research paper proved that the use of UAV's in lieu of relying on satellite imaging systems is plausible but cannot replace every single use-case.

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