Integrating Space Operations in Aviation Safety Reporting

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ABSTRACT

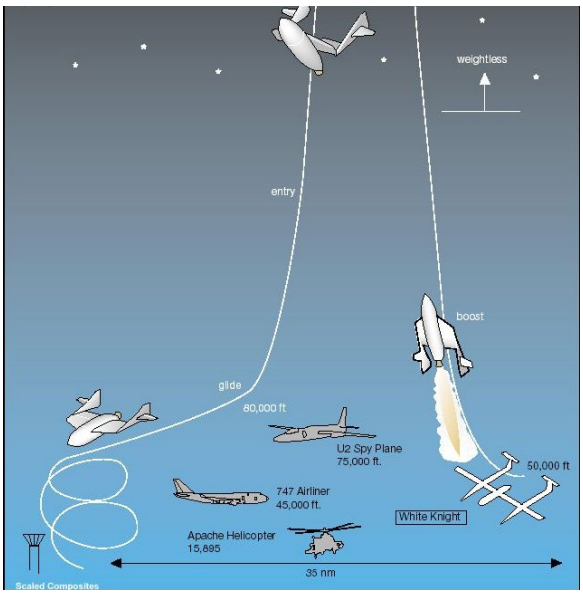
Space launch and reentry operations have a direct effect on the airspace and safety events in space operations can have safety consequences for aviation operations. For example, the Columbia shuttle disaster is often cited as posing a significant debris collision risk for civil aviation. While fatal accidents in space operations are investigated by NTSB, policy developments in each industry, aviation and space, have remained independent. The Virgin Galactic accident of 2014 resulted in a recommendation to increase the development of the commercial space safety database [1]. While this will eventually mirror the aviation safety databases, without integration, the opportunity for comprehensive understanding of safety issues across domains is lost. Increasing pressure on airspace managers to reduce the amount of airspace protected for space launch will expand the overlapping interests of aviation and space operators. At the same time, policy changes to increase the requirements on space operators to deorbit space objects will lead to increased re-entry activity directly impacting aviation. As the commercial space sector grows, so too does the interaction between aviation and space. For safety reporting, continuing to segregate safety data could create a gap in understanding that may be critical in preventing a future collision in civil airspace. This paper examines the evolving interactions between aviation space operations in civil airspace and the need for integrated safety reporting.

Keywords: Safety reporting, space launch and reentry, accident investigation

Introduction

The Federal Aviation Administration licensed the United States' first spaceline on June 25, 2021[2]. The National Transportation Safety Board has had express jurisdiction to investigate commercial space launch accidents for more than 20 years[3]. However, this overlap between aviation and space operations has not extended to safety reporting. As we have seen with the recent integration of UAS into aviation safety reporting systems [4], this is a critical step in the development of comprehensive safety management systems, but one that is often delayed.

The Blurred Line between Aviation and Space



Scholars and practitioners have debated the line between aviation and space since the beginning of the Space Age. Throughout the discussions, debates, proposals, and quests to find that defining line, the community is no closer to consensus than the day it began. Some have argued for a physical line, others have argued for a functional one, but neither has found the clear distinction. As we have progressed from Sputnik to space tourism, the lines between aviation and space have become more intertwined, not less.

The increasing pace of space launch and reentry has an increasing impact on shared airspace, the development of launch vehicles from aircraft has coupled air and space operators, and the space plane bridges both domains.

While there is clear functional overlap, the differences in air law and space law frameworks, both internationally and within the US, provide clear illustration of some of the effects resulting from the segregation of aviation and space activities, from a policy perspective.

There are a number of points of divergence -- for instance, air law is founded upon a State's sovereignty over its airspace, [5] while a lack of sovereignty in outer space is a fundamental principle enshrined in the Outer Space Treaty [6].

However, several chief differences help demonstrate the effects of stove-piping. One is that space law allows no private right of recovery while aviation law has an entire body of private international air law governing such claims. Another is how we categorize people traveling on aircraft for hire as opposed to those non-crew members on a space flight. These can be government astronauts or spaceflight participants. Spaceflight participants in the U.S. are required to sign an informed consent, after a very detailed procedure

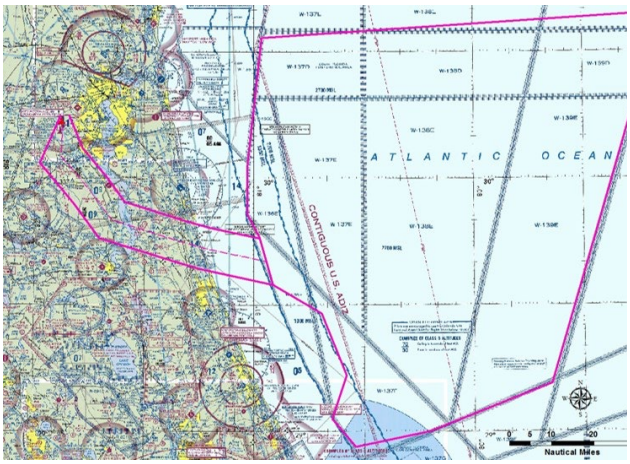
Figure 1: Space Ship One Trajectory (source: Scaled Composites)

ensuring their understanding of risks and indemnifying the U.S. government should anything go wrong, and in some states even indemnifying launch operators. Air passengers might have some limits to liability as per the Montreal Convention, but they are not precluded from bringing a claim per se. Yet another is that collisions involving spacecraft in airspace can mean absolute liability for the country that authorized its launch or agreed to launch it from its spaceport or territory, even if the accident could be deemed the fault of an aircraft operator. And, the aircraft carrier's liability, absent gross negligence or intention, could be very limited by contract.

The social and political pressures involved in the meta policy choices at the international level during the negotiations of the Chicago Convention in 1944 and the Outer Space Treaty in the 1960s are beyond the scope of this paper. However, within these two frameworks, a myriad of smaller operational policy choices are available to assist in managing the problems that can arise when these two transportation modes literally share the same operating domain.

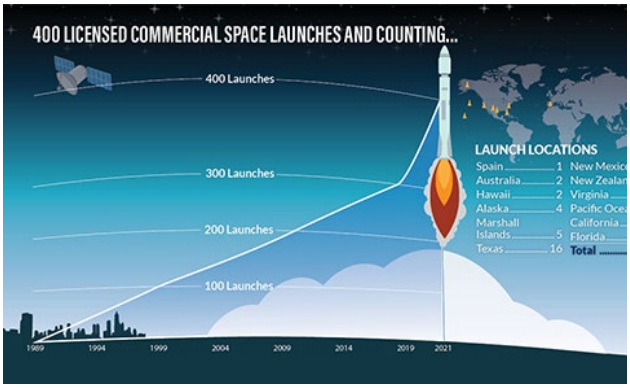
Airspace Integration

Historically, space activity occurs in segregated airspace, with a hazard area created to ensure that non-participating aircraft are excluded from the protected airspace. The airspace management model has been static from the beginning of the space age and does not consider the innovation in launch models and pace of launch activity.



This model places a significant economic burden on the aviation community, disrupting hundreds of flights and delaying thousands of passengers for each launch [7]. As a result, new models for airspace management that seek to reduce the size and duration of airspace management are emerging. The view that space actors, particularly commercial space operators, are airspace users to be integrated rather than an airspace hazard to be mitigated brings aviation and space even closer.

Launches are no longer an occasional event, they occur weekly and getting more frequent.



The recreational launches with human participants this summer will capture the public imagination, but it is the consistence cadence of launch to populate and refresh mega-constellations that will generate the greater impact on shared airspace. Shared airspace creates shared risk and our most effective tool for mitigating risk is information.

Safety Reporting

As the operations begin to interact with one another, the ability to report and share information on potential safety events becomes critical. The benefit of an effective safety reporting system is accident prevention. This is common across all aviation safety reporting regimes, Skybrary consolidates the concept with this clear objective:

> *Safety occurrence reporting aims to improve safety of aircraft operations by timely detection of operational hazards and system deficiencies. It plays an essential role in accident prevention enabling the identification of appropriate remedial actions by prompt analysis of safety data and by the exchange of safety information.*

The European Union Aviation Safety Agency, EASA, puts it this way:

> *Experience has shown that accidents are often preceded by safety-related incidents and deficiencies thereby revealing the existence of safety hazards. Therefore, safety data is an important resource for the detection of potential safety hazards. In addition, whilst the*

ability to learn from an accident is crucial, purely reactive systems have been found to be of limited use in continuing to bring forward improvements. Reactive systems should be complemented by proactive systems, which use other types of safety data, to make effective improvements in aviation safety.

The aviation industry has recognized the value of proactive safety information, but has yet to realize the value of proactive steps in creating the organizational frameworks necessary to collect that data from new entrants and those with emerging technologies. For example, the provisions for accident reporting for aircraft over 55 pounds applied to drone operators, but the NASA Aviation Safety Reporting System did not add a report category for unmanned aircraft systems until this year and does not have a category for commercial space operations. The certification of a "spaceline" to carry commercial spaceflight participants takes us one step closer to an integrated policy construct. Safety reporting systems provide an important link in that integration.

Sharing safety information is precisely one of the granular policy choices available that can constructively help manage the differences in legal systems governing these two modes of transport. Appropriate outreach to ensure that safety reporters and officers in both aviation and the space sector are speaking the same language is necessary. Currently, the space community is working on developing a standard for the classification of safety-related events. ASTM International Work Item No. 65152, Guide for Classifying Safety-Related Events, recently went to ballot to provide guidance on how to classify events and to define terms like severity and impact deemed necessary for effective classification. Sharing this standard with aviation safety personnel, and reciprocal communication from the aviation safety community, can potentially facilitate more comprehensive and usable reporting systems.

Conclusion

Space launch operations, including re-entry are licensed by the FAA. Commercial space operator accidents are investigated by the NTSB. Space launch operations occur in shared airspace, albeit temporarily segregated for the purpose of the launch. The overlap between aviation and space safety is recognized, but falls short of integration. The integration of safety reporting mechanisms can provide benefits for both domains. The value of safety reporting is well established and a critical tool for accident prevention, however it is too often an afterthought when integrating new entrants and new technologies. The opportunity to integrate commercial space operations into established safety reporting mechanisms should not be overlooked.

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[5] Article I, Convention on International Civil Aviation (hereinafter "Chicago Convention"), signed in Chicago 7 December 1944.

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