

4th Quarter Report

As a follow-up to our first research roadmapping workshop in April, a second workshop was held in Washington DC at the Lockheed Martin Global Vision Center on August 15-17. Our goal was to further work of obtaining research priorities for the COE. Similar to our first workshop, approximately 60 representatives of industry, academia, and government (FAA, NASA, DoD) gathered to discuss the issues involved and work towards a consensus on COE research priorities. Additional information about both workshops is available on our website, coe-cst.stanford.edu.

What Happened

On the first day of the workshop, several representatives from FAA-AST gave presentations on what their role is in the commercial space transportation industry. Ken Davidian began with a general overview of AST's structure and personnel and discussed the main players in the industry. Phil Brinkman discussed ELV and RLV licensing, and Sherman Council briefed the group on permits and safety applications.

On the second day, the workshop began with additional presentations. Scott Hubbard talked generally about the research roadmapping work and its importance, and Jim Van Laak gave a brief welcome from FAA-AST. Faith Chandler was present to discuss NASA OCT's own research roadmapping efforts and the process that they used. Major General Jay Santee then discussed what the DoD's perspective on the CST industry is and what their main concerns are. Jeff Foust discussed some market studies that the Futron Corporation had completed in order to frame discussions of what makes up the CST market.

Lastly before the breakout sessions began, our four session chairs gave overviews of their research themes: Mike McElligott (FAA-AST) on theme 1, Nick Demidovich (FAA-AST) on theme 2, Mark Weyland (NASA-KSC) on theme 3, and Rene Rey (FAA-AST) on theme 4.

For the breakout sessions the group divided into these four themes and were each tasked with:

- Reviewing the results of the first workshop and correcting as needed
- Detailing the organizational structure of the theme
- Identifying important cross-cutting areas
- Prioritizing research topics

These groups spent six hours over two days working on these issues and then convened on the afternoon of the 17th to present their results and discuss them in plenary session.

Results of Breakout Sessions

The primary result of the four groups is their research priorities. The presentations that each chair gave to the plenary group discussing these results are available on our website.

Theme 1: Space Traffic Management and Operations

Research priorities:

- Airspace
 - De-confliction between air and space traffic
 - What kind of airspace do we need for the vehicle?
 - Do we need to reserve portions of NAS for rocket traffic?
 - Do we need transition corridors from air to space?
 - Do we need a new class of airspace?
 - How does space transportation interface with NextGen?
- Spaceport Requirements
 - What are the vehicle specific requirements (fueling, servicing, passengers, etc)?
 - Talk with existing launch sites to determine best practices?
- Air Traffic Issues
 - What are the navigational requirements?
 - What are the flight planning requirements?
 - How are anomalies resolved?
 - Who do we tell that we're aborting?
- Weather and Space Weather
 - Triggered lightning
- Command and Control
 - What should be command and control element at spaceports?
 - What are the vehicle specific command and control requirements?
 - What is the integrated concept of operations?
 - Who offers these services?

Theme 2: Space Transportation Operations, Technologies, and Payloads

Research priorities:

- Research and recommend safe, expeditious, and cost efficient processing of reusable manned or unmanned vehicles that are payloads on ELV's
 - Landing, inspection, modification if needed, transportation, and integration
- Explore expeditious procedures for licensing and permitting
 - When minor changes to a licensed spacecraft, consider between having to re-license entire spacecraft or license the specific change
- Explore expeditious processes to migrate technologies and payloads to be tested in flight

- Research the physics and impacts of re-entry debris
- Study how to facilitate small companies to have access to NASA and FAA test facilities (e.g. test chambers)
- Investigate what NASA and FAA do for handling CG locations for aircraft before flight in order to develop a reliable procedure that can be used to process payloads
- Analyze which safety equipment and systems can be leveraged from aviation, and identify the type of analysis required
- Study literature on redundancy for safety critical systems to develop guidelines for redundancy levels
- How much information does a developer/operator need to tell the FAA in order to safely fly a payload (leverage work from NASA FOP program)?
- Case study of a generic deployment of a payload on an RLV, and how to do a safety analysis on this
- Develop minimum requirements and guidelines for a return to flight after off nominal operation
- Study interoperability of commercial space safety management system with other FAA and TBD agencies and develop guidelines for vehicles, spaceports, and operators
- Hazmat template of what toxic materials information need to be provided to fire departments to assess resulting fire due to a vehicle crash

Theme 3: Human Spaceflight

In this theme, much work was done in finalizing the organizational structure and identifying import research areas. Despite substantial progress, there was insufficient time available to prioritize these different research areas. The full breakdown structure that the group developed is available on our website and showcases the considerable work that was accomplished at the workshop.

Theme 4: Space Transportation Industry Promotion

Research priorities:

1. Markets

1.1. CST demand market research

1.2. Retrospective analysis of:

1.2.1. Transition from government to private customers

1.2.2. Commercial failures

1.3. Workshop of industrial organization economists looking at CST industry

2. Policy
 - 2.1. Options of a single international space regulatory regime
3. Law
 - 3.1. Liability limitation: history, issues, and options
4. Regulation
 - 4.1. Barrier analysis of existing regulations

Next Steps

Now that we have the results of our two workshops, representing almost 800 man-hours of work during the breakout sessions by key personnel from throughout the industry, our main task is reporting. This will primarily involve drafting a report that presents our results in a concise yet detailed manner.

Once our report is complete it will be circulated first amongst the COE, and then taking comments and suggestions from our research partners it will be circulated to a wider audience. We believe that this resultant research roadmap has its basis in consensus views of the CST industry and therefore can be used by any group or agency wishing to understand or facilitate CST in the US.