

**CESTAC Assessment
of the
2012 FAA COE CST Research Portfolio**

A handwritten signature in black ink, reading "Joseph H. Rothenberg". The signature is written in a cursive style with a long horizontal flourish at the end.

**Joseph H. Rothenberg
CESTAC Chairman
February 14, 2013**

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Report

1 2012 Assessment Summary

It is commonly forecasted by the Commercial Space Industry that over the next 5 years along with the continued increase in Commercial space scientific and remote sensing satellites, we can expect to see the emergence of an active Commercial Human Spaceflight suborbital and orbital market. Based on the information presented by the Research Teams at the October 31 – November 1, 2012 COE CST Annual Research Program Review Meeting, the CESTAC assessed the strategic relevance of the Tasks currently in the COE CST Research Portfolio to both the growing Commercial Space Industry needs and FAA Dual Mission Goals. The CESTAC assessment found that almost all of the current COE CST Research Tasks have the potential to help enable the growth of the Commercial Space Industry and to meet the FAA Regulatory and AST Goals for the Program. However the CESATC also found a notable variance in the level of potential near-term impact of the Tasks on both the Industry and FAA needs. The CESTAC concluded that given the funding constraints of COE CST, both Industry and the FAA needs may be better served by deferring some of the current Research activities, where the potential payoff is in the far-term, in order to accelerate those areas that have higher potential of nearer-term payoff.

2 COE CST GOALS AND CESTAC ASSESSMENT CRITERIA

2.1 COE CST Goals

The COE CST Research Portfolio is structured to the FAA’s AST Dual Mission Goals:

- Regulate the commercial space transportation industry, only to the extent necessary, to ensure compliance with international obligations of the United States and to protect the public health and safety, safety of property, and national security and foreign policy interest of the United States
- Encourage, facilitate, and promote commercial space launches and re-entries by the private sector

In support of these Goals, the FAA COE CST developed a Technology Roadmap that identified 4 major Research Themes with subareas of interest within each of the areas as shown in the Table below.

COE CST Research Themes	
1. Space Traffic Management & Operations	1.1 Orbital
	1.2 Suborbital
	1.3 NAS Integration
	1.4 Spaceport Operations
	1.5 Integrated Air/ Space Traffic Management
2. Space Transportation Operations, Technologies & Payloads	2.1 Ground System & Ops Safety Technologies
	2.2 Vehicle Safety Analyses
	2.3 Vehicle Safety Systems/Technologies
	2.4 Payload Safety
	2.5 Vehicle Operations Safety
3. Human Spaceflight	3.1 Aerospace Physiological & Medicine
	3.2 Personnel Training
	3.3 ECLSS
	3.4 Habitability and Human Factors
	3.5 Human Rating
4. Space Transportation Industry Viability	4.1 Markets
	4.2 Policy
	4.3 Law
	4.4 Regulation
	4.5 Cross-Cutting Topics

2.2 CESTAC 2012 Assessment Criteria

The CESTAC focused its' assessment of the COE CST Research Program Tasks on the relevance of the potential output to both the FAA Regulatory Goals and the Commercial Space Transportation Industry's products and or services.

In particular the goal of the assessment was to provide the FAA feedback on:

- The relevance of current Research Areas and Tasks to the FAA goals and/or Industry needs
- Consistency between funding levels and relative importance
- Timeliness of potential Research results versus FAA and Industry needs

Based on the data presented by the Teams and the 2012 Research Review Meeting the CESTAC members provided written inputs from which the 2012 assessment findings were generated.

The CESTAC assessment was also intended to look at the Research Areas funding levels and balance versus potential value to the FAA and Industry needs, but the data provided Teams was of insufficient consistency to develop an opinion. CESTAC will work with the COE CST Leadership to try to improve the cost and schedule information provided at the 2013 Review.

3 CESTAC Members and Participation in the 2012 Assessment

CESTAC currently has a membership of 15 Industry representatives of which 10 attended the 2012 Annual Meeting and provided inputs to this assessment. In addition, 1 CESTAC member participated by phone and 1 provided comments after reviewing the presentations.

The current CESTAC members and their participation in the 2012 COE CST Research Assessment are listed below.

CESTAC	Affiliation	Participated in 2012 Assessment
Carissa Christensen	The Tauri Group	Yes
M. Brian Bennett	Satwest	Yes
Frank Dibello	Space Florida	No
Carl Ehrlich	Independent Consultant	Yes
Tristan Fiedler*	Florida Institute of Technology	Yes
David Headley	Boeing	Yes
Brienna Henwood	NASTAR Center	Yes
Mark Leifeste	Jacobs Engineering	Yes
James R(Russ) McMurry	Boeing	Yes
Scott Norris	Lockheed Martin	Yes
Kevin Miller	Ball Aerospace	No
Larry Richardson	United Launch Alliance	Via Phone
Joe Rothenberg	Independent Consultant	Yes
Alex Saltzman	Commercial Space Federation	Yes
Christine Smith	Wyle Laboratories	Submitted Comments
Gerrit van Ommering	Loral	No

* Dr. Tristan Fielder is the COE CST Academic Liaison to CESTAC

Clearly there are holes in Industry representation on the CESTAC. Most notably the emerging Commercial suborbital and orbital Human spaceflight community is not as well represented as it should be. CESTAC needs to and is actively working on increasing the number of Commercial Human spaceflight product and service providers on the Committee in 2013.

4 Assessment

Key findings from the CESTAC's assessment of the current COE CST Research Portfolio are:

- 1. Almost all of the current COE CST Research Tasks have the potential to produce results that are relevant to Industry, the FAA Goals or both, but some are more appropriate for Research funding than others at this stage of commercial development and FAA regulation**
- 2. There is a mix of alignment with FAA AST's public protection and promotion of commercial space launches goals**
- 3. Task expected outputs varied in near versus far-term usefulness to Industry**

From a crosscutting view of the Research Portfolio, the CESTAC found the relevance of the the COE CST Research portfolio tasks fell into three categories:

1. Highly relevant and timely research
 - Medical research (medical conditions, database of physiological effects, EMI effects on devices)
 - Spaceport operations
 - Policy and Legal
 - Space traffic control and 4D modeling
 - Orbital debris characterization
2. Important and timely research if the Research objectives specifically addressed areas with high ROI potential for FAA and/or Industry where:
 - Flight System Technology Research included an objective to simplify design certification or to eliminate the need for Certification
 - Market Research emphasized areas that are not typically funded or easily performed by Industry but will be of direct benefit to industry such as identifying
 - Candidates for new Policy that enable the Commercial Space Market
 - Recommended changes to current Policies that constrain Industry

3. Research areas which given limited funding may not be the best investment of COE research dollars at the current time:
 - a. Studies on student leadership and training. (The CESTAC, however strongly believes that student involvement in all of the other Research Areas is absolutely critical!)
 - b. Although significant Research by the COE CST is being supported for Debris mitigation CESTAC believes this is an International problem and does not appear to be an FAA technology development responsibility.

The following provides the assessment that support the above findings and a discussion of the CESTAC consensus view as to the “relative relevance” of Tasks, and recommendations are shown in bold for each of the 4 major Research Themes.

4.1 Space Traffic Management and Operations

The CESTAC concluded that in general the Research Tasks in this Theme that addressed Traffic Management, Characterizing Orbital Debris, Atmospheric Modeling, and work on the Integrated Framework for Spaceports were relevant and important. The products from these Tasks have the potential to provide significant inputs to Industry and the FAA. These Tasks will guide the establishment of the core infrastructure and processes needed safely and efficiently conduct Commercial space and spaceport operations. The CESTAC is however concerned that the expected outputs of these research Tasks may be not be timely enough to meet the Industry and FAA operations management and safety challenges expected to be presented by the increase of Commercial orbital and suborbital spaceflight activities over the next 5 years.

One area that was not clearly addressed and appears not to be currently funded as part of the Integrated Framework for Spaceports is off-nominal operations. CESTAC believes given the expected sub-orbital commercial industry flights that could begin as early as late 2013, funding the study of off-nominal operations is important and may already be behind the need. Off nominal launches/landings and aborts are some examples where presumably Spaceports will have infrastructure and processes in place but what responsibilities (required/optional) will individual operators have and the FAA? What guidelines exist for operators?

In addition, for the Situational Awareness Task, although the question being addressed is relevant, the output product was defined in terms of Research Papers given at conferences, the target application or product was not made clear to the Reviewers. Thus the CESTAC questions the relative importance of this investment versus those with specific applications potential.

Finally, the CESTAC questions the near-term ROI and relevance of funding for development of University Students to train for Commercial spaceflight operations, however the CESTAC strongly supports Student involvement in all areas of the COE CST Research.

The CESTAC recommends that the Space Traffic Management and Operations Research Theme Task priorities and products versus funding allocations be reassessed and, if warranted be realigned to meet Industry and FAA challenges of the increase in Commercial suborbital and orbital spaceflight expected in the next 5 years.

4.2 Space Transportation Operations, Technologies and Payloads

CESTAC concluded that the Research Tasks in this Theme with one exception were important and relevant to both Industry and the FAA. They all had the potential to enable Industry to develop safer space flight vehicles and software, while at the same time simplifying the any FAA Certification process. Furthermore several of them such as the Magneto-Elastic Sensing for Structural Health Monitoring would help assess the structural integrity during and post flight and play an important role in verifying on-going health during repeated re-flight of the same vehicle.

With respect to the Space Debris Mitigation Tasks CESTAC believes that the fast trajectory generation research has potential value in the relatively near term for incorporation into space situational awareness capabilities. The CESTAC however does question both the role of the FAA in Space Debris Mitigation and any relevance to the FAA or Industry in the next 10 years of the Research the Autonomous Rendezvous & Docking for Space Debris and Mitigation. The Research being performed in this area is both cutting edge and at some time in the future the potential capability being evaluated may be needed for safe space operations, however debris mitigations is an international problem and will require significant resources to operationalize. In CESTAC's opinion this is not the best investment of the limited FAA Research funds.

4.3 Human Spaceflight

The CESTAC found the Human Spaceflight Research Tasks are both important and relevant to Industry particularly with the anticipated emergence of Commercial Human spaceflight over the next 5 years. Physiological Data Base development, risk management, in-flight, medical standards, medical condition characterization are important to Crew Certification and passenger safety. In addition the test and training of crew under high-G stress is also an important tool for Crew Certification. There appears to be good progress and an application focus for this Task Set. **It was less clear if or how the FAA is planning to use Human Spaceflight Medical**

Research data and what the FAA will regulate in these areas which is of high interest to the Commercial Human Spaceflight Industry stakeholders.

One area that did concern the CESTAC was that the Research Task for Human Rating of Commercial Operated Spacecraft is lagging behind a real need, given both suborbital and orbital human space flight vehicles are currently in development and some ready to fly in 2013. **The CESTAC believes that Research Task for the Human Rating of Commercial Operated Spacecraft is an important Research Task that can address near-term needs and recommends the FAA reexamine the schedule and expected output of this Task for consistency with FAA and Industry needs.**

4.4 Space Transportation Industry Viability

In general, the CESTAC believes that industry viability is an important topic and the Role that Policy, Law and Regulation play in either constraining or enabling is important to understand and highly relative to the FAA and Commercial Industry needs. Clearly CESTAC applauds the FAA goal to regulate only to the extent necessary to protect the public safety, security and international obligations.

The Research activities to understand International Policies that were presented appeared to be very relevant and the CESTAC recommends that these areas be pursued vigorously. The CESTAC was surprised that there are not similar tasks within the COE CST portfolio focused on research toward the development of US Policies and Regulations. Given the potential for a fairly rapid increase in all Commercial Space activities in the next 5 years, the CESTAC would advise the FAA to invest ASAP in any additional research required to identify and they intend to regulate. The urgency of understanding the Policies and Regulations are important for two reasons.

1. The ability to continue to grow private investment in the Commercial Space Transportation Industry requires investor understanding of any National or International Regulatory Policies that may either impede or enable commercial operations.
2. The next 5 years are in all likelihood going to see the long predicted Commercial Human Space Flight suborbital and orbital market emerge. It would appear that as these markets emerge, the Policies and Regulations may be put in-place on an ad-hoc basis based on individual license applications. A set of more systematic top-down developed Policies and set of Regulations, that are understandable and give Industry the opportunity to be creative and cost effective in meeting them, would be a big benefit to the Commercial Space Transportation Industry

The CESTAC believes the Policy, Legal and Regulatory areas for Commercial space are still immature and the Research in these areas is important and

would also benefit by engaging the broader Industry community and University work going on outside the current COE CST member Universities.

The Market Research Project Area raised some questions regarding the focus of the planned activities. The CESTAC believes that the work done to date to identify programmatic issues as the biggest challenge to the hosted and shared payload market development is on target. The resolution of programmatic challenges are in practice business “risk versus rewards” based for both payloads and service providers for shared launches and hosted payloads. The CESTAC therefore believes that the next phase of this effort as presented “to understand what it takes to mitigate programmatic barriers” may be more appropriately funded by Industry, and the FAA research funds for example to pursue identifying FAA regulations that either constrain or would enhance the Commercial market.

Some examples of candidate areas where research to better understand current US government regulations and potentially recommend changes to better facilitate the commercial shared launch and hosted payload market follow:

- **Licensing**

Launch licenses and communications frequency licenses for commercial ground stations to support launch and early orbit satellite checkout are typically needed. In many cases these licenses require renewing if the launch slips outside the licensed window. For a shared launch with multiple spacecraft that need multiple licenses for multiple ground stations support initial as well as updating multiple licenses becomes a bigger chore. It is not unusual for a commercial shared launch to have 10 or more payloads and maybe there is some Regulatory relief that can be identified and proposed as a result of a COE CST Research Task.

- **Student Launches**

In terms of student launch opportunities, maybe a worthwhile COE CST research effort would be to explore options for tax incentives for commercial launch providers who allow student payloads to be launched using excess capacity.

- **ITAR:**

Looking at ways of dealing with ITAR to enable providers to both ensure US Technology is protected while at the same time making it easier for the Commercial Space Industry to serve non-US markets would be valuable.

It should be noted that the recent US Air Force decision to solicit and use Hosted Payload opportunities, as well as the extensive use by the European and Russian launch industry providing shared rides for multiple large, mid-sized and microsats have demonstrated the viability of the market for this capability. There are lessons

to be learned by industry on how to deal with the programmatic issues from these endeavors.

The CESTAC believes COE CST Research in the Marketing area may be more appropriately focused on activities not typically funded by Industry, such as identifying Policies and Regulations that currently constrain efficient Commercial operations or new Policies that could help attract new services and investment in the Commercial Space Transportation Market.