Florida Institute of Technology

Florida State University

NM State University

New Mexico Tech
Science • Engineering • Research • University

Leland Stanford Junior University

University of Colorado

University of Central Florida

UF University of Florida

utmb Health

www.coe-cst.org

COE CST Center of Excellence for Commercial Space Transportation

Federal Aviation Administration
Center of Excellence for
Commercial Space Transportation

Year 3 Annual Report

Volume 1. Task Financial Reports

December 31, 2013

COE CST YEAR 3 ANNUAL REPORT – VOLUME 1

This report is produced by the FAA Office of Commercial Space Transportation (AST) in fulfillment of FAA Centers of Excellence program requirements.

The full report is broken into an Executive Summary and three volumes:

- The Executive Summary gives an overview of the FAA AST, the FAA COE program and the COE CST. A brief description of the member universities precedes a series of quad charts, one for each task conducted by the COE CST during the second year of operation. The document ends with a listing of the Year 3 students, supporting organizations and technical publications.
- Volume 1 gives a description of the FAA COE CST, its research, structure, member universities, funding and research tasks.
- Volume 2 is a comprehensive set of presentation charts of each research task as presented at the second Annual Technical Meeting in October 2013.
- Volume 3 is a comprehensive set of notes from all FAA COE CST teleconferences and face-to-face meetings.

This is Volume 1 of the full report.

Any questions or comments about the content of this report should be directed to Mr. Ken Davidian, FAA Program Manager for the Center of Excellence for Commercial Space Transportation, or Dr. Patricia Watts, FAA COE Program Director.

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1.0 FAA COE Program Overview

The FAA Center of Excellence (COE) program was established by the Omnibus Budget Reconciliation Act of 1990, Public Law 101-508, Title IX, Aviation Safety and Capacity Expansion Act.

COEs are intended to be a 10-year partnership of academia, industry, and government to create a world-class consortium that will address current and future challenges for commercial space transportation. The three main goals of every COE include research, training, and outreach.

A unique attribute of the COE program is the one-to-one matching requirement for every federal dollar granted to a COE university. The matching requirement can be satisfied through direct or in-kind contributions from any non-federal funding source, including industry, universities, or state and local government organizations.

Eight other COEs have been established by the FAA that pre-date the COE CST, including:

- The Joint Center for Computational Modeling of Aircraft Structures, 1992 to 1996.
- The Center of Excellence for Airport Technology (CEAT), established 1995.
- The National COE for Aviation Operations Research (NEXTOR), operated from 1996 to 2007.
- The Airworthy Assurance COE (AACE) operated from 1997 to 2007.
- The COE for General Aviation Research (CGAR), in operation from 2001 to 2013.
- The Partnership for Aircraft Noise & Aviation Emissions Mitigation Research (PARTNER), in operation from 2003 to 2013.
- The Joint Center for Advanced Materials (JAMS), in operation from 2003 to 2015.
- The Airliner Cabin Environment Research (ACER) Center, also called the COE for Research in the Intermodal Transport Environment (RITE), in operation from 2004 to 2014.

Since the creation of the COE CST in August 2010 and as of December 2013, two new COEs have been created. They are:

- The Center of Excellence for General Aviation Safety Research (named PEGASAS, Partnership to Enhance General Aviation Safety, Accessibility and Sustainability), established in 2012.
- The Center of Excellence for Alternative Jet Fuels and Environment, the Aviation Sustainability Center (ASCENT), announced in 2012

2.0 COE CST Overview

2.1 History

On August 18, 2009, FAA Administrator Randy Babbitt signed a memo to create the COE CST with the goal of helping the Office of Commercial Space Transportation (AST) execute its dual mission through a dedicated university research program. The COE CST is a partnership of academia, industry, and government that is established to create a world-class consortium that will address current and future challenges for commercial space transportation. As is customary of all COEs, this announcement represented a ten-year minimum annual funding commitment of one million dollars.

The FAA released a draft solicitation for the COE CST on December 15, 2009 and held two public meetings in February 2010 before issuing the final solicitation soon afterwards in March.

The FAA COE Program Director and the Office of Commercial Space Transportation hosted the first public meeting in Washington, DC on February 9, 2010, the day before the start of the 13th Annual FAA Commercial Space Transportation Conference. Unfortunately, record-breaking snowfalls blanketed the DC area on February 5-6, the weekend before, and there was a threat (that ultimately did materialize) of a second storm scheduled to hit on February 9-10. Despite attendance nearing one hundred, the inclement weather impeded the turnout of some who had intended to attend so the FAA scheduled a second public meeting later the same month, on February 25, with the hope that the weather conditions would not be so extreme.

In both meetings, presentations about the FAA, AST, COEs, and the COE CST were given. FAA answered questions and accepted comments and suggestions on the draft solicitation from the audience.

As stated in Public Law 101-508, institutions being considered for selection as a COE are required to demonstrate in their proposal the ability to meet the following criteria:

- The extent to which the needs of the State in which the applicant is located are representative of the needs of the region for improved air transportation services and facilities.
- The demonstrated research and extension resources available to the applicant to carry out this section.
- The ability of the applicant to provide leadership in making national and regional contributions to the solution of both long-range and immediate air transportation problems.
- The extent to which the applicant has an established air transportation program.
- The demonstrated ability of the applicant to disseminate results of air transportation research and educational programs through a statewide or region wide continuing education program.
- The projects the applicant proposes to carry out under the grant.

FAA released the final version of the COE CST solicitation on March 15, 2010 and final proposals were due on April 30, six weeks later.

The proposals received were reviewed and evaluated on a competitive basis by a panel of subject matter experts and management officials in accordance with the solicitation. Each proposal was evaluated to determine the extent to which institutions, team members and affiliates were able to provide a quality environment for commercial space transportation research and to determine the extent to which each proposal met the selection criteria established by Congress.

Following the evaluations, a final report was provided to the FAA Administrator on August 5, 2010. On Wednesday, August 18, the FAA announced the establishment of the COE CST and cooperative agreements were signed with the nine member universities in September, 2010. Subsequently, the FAA distributed two million dollars to conduct the initial set of research tasks within the newly created center.

The next two sections of this report give brief descriptions of the COE CST member universities and describe the four research areas they will be pursuing.

2.2 Year 3 Highlights

The following are the major milestones for the FAA COE CST during its third year:

- During the third year of operation, the total FAA funding in the approximate amount of $1,000K was matched through industry and university contributions by a ratio of almost 3:1. Over the entire life of the COE CST, the approximate amount of FAA total funding ($5,300K) has been matched by a ratio of almost 2:1.
- Third Annual Administrative Meeting held near the FAA Technical Center in Somers Point, NJ on June 11-13, 2013.
- Induction of the second set of Affiliate Members, including three universities (Embry Riddle Aeronautical University, University of Nebraska – Lincoln and Baylor College of Medicine) and two industry members (Satwest and NASTAR Center).
- Third Annual Technical Meeting held in Washington, D.C. on October 28-30, 2013.

In the third year of COE CST operation, there were no new tasks, 25 ongoing from the previous year and 3 tasks completed. The complete list of all tasks is given later in this volume.

COE CST STUDENTS, PARTNERS AND PUBLICATIONS

In the third year of operation, the COE CST benefited from the services of 55 students, 20 research partners and 44 industry partners. The combined effort resulted in 28 technical or programmatic papers published in journals or presented at conferences. A complete list of students, partners (both industry and research organization) and publications are given after the research task summary charts in this report.

2.3 Member and Affiliate Universities

The nine COE CST member universities are: Florida Institute of Technology (Florida Tech), Florida State University (FSU), New Mexico Institute of Mining and Technology, (NMT, or New Mexico Tech), New Mexico State University (NMSU), Stanford University (SU), University of Central Florida (UCF), University of Colorado at Boulder (CU), University of Florida (UF) and University of Texas Medical Branch at Galveston (UTMB).

The COE CST member universities provide a comprehensive distribution of geographical coverage representing the entire Commercial Space Transportation industry, including the top four civil space states (California, Colorado, Texas and Florida) and New Mexico, the state leading the suborbital industry as well as having a significant level of military space activity. Combined, the nine universities bring over 60 other government, industry and academic organizations as research partners.

As a single entity, the nine COE CST member universities bring complementary strengths together for the benefit of the overall COE. FAA finds that each team member provides highly respected and accomplished experiences that directly address the research and study needs of the commercial space industry.

In 2013, five organizations joined the COE CST as new Affiliate Members. The remainder of this section provides more detail on each of the nine member universities and six affiliate members of the COE CST.

Florida Institute of Technology (Florida Tech or FIT)

Florida Tech offers broad expertise in aerospace and space-related engineering, science, space traffic management and launch operations, vehicle and payload analysis and design, thermal systems and propulsion.

Florida State University (FSU)

FSU brings a range expertise and unique infrastructure in many areas relevant to the COE CST, including but not limited to: cryogenics, thermal management, vehicle aerodynamics and controls, sensors, actuators and system health monitoring and high performance simulations.

New Mexico Institute of Mining and Technology (NMT)

NMT is a science, math and engineering university with a focus on applied research. Major research facilities include a rocket engine test fixture at the Energetic Materials Research and Testing Center, and a 2.4M fast tracking telescope at the Magdalena Ridge Observatory dedicated to the study of near earth objects.

New Mexico State University (NMSU)

NMSU and its Physical Sciences Laboratory have led space and aerospace research in areas of suborbital investigations from the time of Werner Von Braun to the current era of commercial sub-orbital space transportation with Virgin Galactic. New Mexico Space Grant Consortium, the 21st Century Space and related aerospace research focuses on annual access to space for student and faculty experiments, unmanned aerial vehicles, scientific ballooning and nano-satellite development.

Stanford University (SU)

SU brings a 50 year history of aerospace research excellence and a broad scope of expertise to the COE CST, including the optimization and autonomous operation of complex systems, strategic research planning, organizational integration and distributed administration experience.

University of Central Florida (UCF)

UCF, as partners of Florida Center for Advanced Aero-Propulsion (FCAAP) and the Center for Advanced Turbines & Energy Research (CATER), offers its experience and expertise in thermal protection system, propulsion system components, cryogenic systems and materials, composites, sensors and actuators, and guidance and control.

University of Colorado at Boulder (CU)

CU offers the COE CST their experience in spacecraft life support systems and habitat design, human factors engineering analysis, payload experiment integration, and expertise in space environment and orbital mechanics.

University of Florida (UF)

UF has been performing aeronautical and aerospace research since 1941, with current emphasis in the Department of Mechanical and Aerospace Engineering on research in space systems, MEMS, computational sciences, structural dynamics, controls, gas dynamics, and propulsion.

University of Texas Medical Branch at Galveston (UTMB)

UTMB has a long history of medical support and human spaceflight physiological research with NASA. This is complemented by more recent involvement in the commercial orbital and suborbital spaceflight industry supporting space flight participant visits to the ISS and preparation of passengers and crew for suborbital space flights.

Baylor College of Medicine Center for Space Medicine (CSM)

Baylor College of Medicine Center for Space Medicine (CSM) is a collaborative enterprise involving Baylor College of Medicine, the National Space Biomedical Research Institute, NASA, Rice University, Texas Medical Center institutions, and other academic, industry and government organizations nationally and internationally. The affiliation with UTMB and the COE CST offers UTMB researchers the ability to work side-by-side CSM faculty and students in collaboration with NSBRI, NASA and other colleagues. Most recently, this included UTMB residents working with CSM faculty Dr. Jon Clark, providing medical support and research for the RedBull Stratos project, resulting in many publications and presentations.

COE CST Member and Affiliate University Geographic Distribution

Embry-Riddle Aeronautical University (ERAU)

Embry-Riddle Aeronautical University (ERAU) team focuses upon the demonstration, verification, and validation of the AST funded, and ERAU developed ADS-B prototype (UAT Beacon Radio – ERAU model) for the reusable sub-orbital space vehicles for the first year.

McGill University (MU)

McGill University's Institute of Air and Space Law (IASL) offers the most comprehensive and advanced graduate level space law program in the world covering General Principles of Space Law, Law of Space Applications and Government Regulation of Space Activities.

National Aerospace Training and Research (NASTAR) Center

The National AeroSpace Training and Research (NASTAR) Center is partnering with UTMB and the FAA COE CST to participate as an industrial affiliate in an advisory board capacity and also as a research partner providing cost sharing support. It offers a strong foundations in flight training and research to improve the health and safety of passengers in the extreme aviation and space environments. Most recently, NASTAR donated time and use of its centrifuge for a COE CST sponsored novel study on G-tolerance of subjects with chronic diseases.

Satellite Communications Systems (SatWest)

SatWest is developing low-cost, internet-based data and voice communications services via commercial satellites for payloads and crew located in LEO and suborbital platforms and for ground-based crew interacting with research payloads and space-based crew.

University of Nebraska

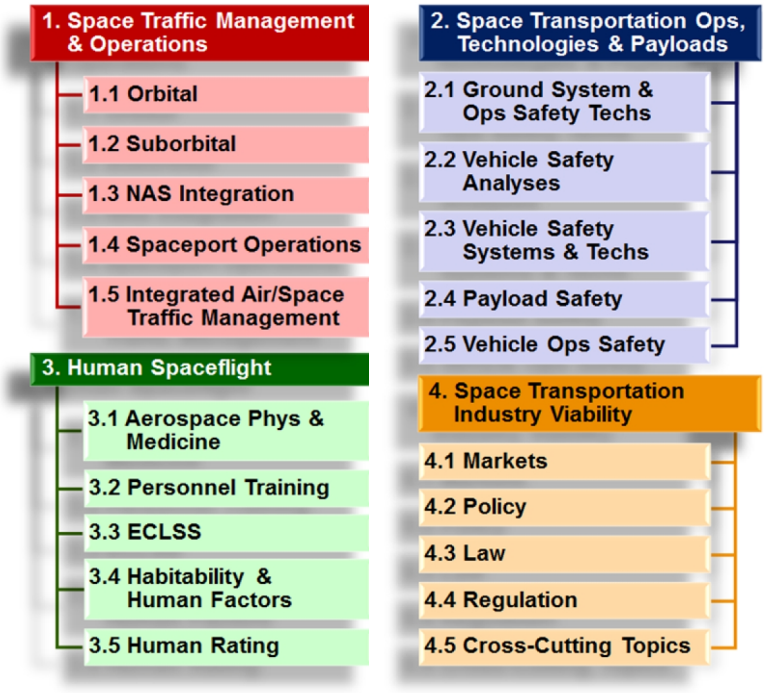
The University of Nebraska, a collaboration of space law and policy, focuses on how the liability regime will achieve the appropriate balance between the risks and benefits of allowing lay persons to travel to space, and what elements of the liability regime are best addressed at both the national and international levels. In addition the research will look at how to avoid over/under-regulating so as to retain profitability and viability, and how regulation should evolve as the industry matures.

2.4 Research Structure

The research conducted within FAA AST is broken into four major research areas:

- Space Traffic Management & Operations
- Space Transportation Operations, Technologies & Payloads
- Human Spaceflight
- Space Transportation Industry Viability

Each of these major research areas are divided into sub-areas (programs) and these, in turn, are further sub-divided into lower level divisions (projects and tasks).



The following pages include a list of the individual COE CST research tasks conducted during the second year of operation followed by summary charts for each task.

Narrative descriptions of each of the research areas shown in the figure above are given below.

Space Traffic Management and Launch Operations

The goal of this research area is "Improved Space Traffic Management", to effectively answer those topics related to the development and optimization of technical and regulatory provisions and processes used to oversee, coordinate, regulate, and promote safe and responsible space all activities between space and Earth (including access to, operations in and return from space to Earth) to avoid physical and/or electromagnetic interference.

It also includes the operational and safety-related design criteria of spaceports, launch and reentry vehicles, and resident space objects, air and space traffic integration, space situational awareness (currently not within AST authority, but listed for the sake of completeness), ground support operations, and other issues which may impact the safe operation of launch, reentry, or on-orbit operations.

Space Transportation Operations, Technologies and Payloads

The goal of this research area is "Improved Vehicle Safety and Risk Management" including knowledge of all safety-critical components and systems of the space vehicles and their operations, so as to better identify potential hazards and to better identify, apply and verify hazard controls.

This research area encompasses all the engineering, operations, management and safety areas of study related to expendable and reusable launch vehicles, their systems and payloads.

Specific discipline areas of research include but are not limited to: ground systems and operations safety technologies, vehicle safety analyses, vehicle safety systems and technologies, payload safety, and vehicle operations safety.

Human Spaceflight

The goal of this research area is "Ensured Human Safety" of those onboard during space vehicle or spaceport operations.

This research area provides opportunities for research in the areas of aerospace physiology & medicine, personnel training, environmental control and life support systems (ECLSS), habitability and human factors, and human rating of commercial spacecraft.

Research in these areas can provide critical information needed to allow the ordinary citizen, i.e., that person without the benefit of the physical, physiological and psychological training and exposure to the space environment that the traditional astronaut has, to travel to space safely, to withstand the extremes of the space environment and to readjust normally after returning to Earth.

Space Transportation Industry Viability

The goal of this research area is "Increased Industry Viability" including economic, legal, legislative, regulatory, and market analysis and modeling.

This research area encompasses all the subcategories of space transportation, including market, policy, international, legal, regulatory and all cross-cutting topics.

Research in these areas will include but not be limited to: a focus on developing innovative and practical commercial uses of space, innovative business and marketing strategies for companies involved in commercial launch operations and related components and services, support of the US commercial space transportation industry's international perspective and competitiveness, and developing innovative financing for commercial launch activities.

Specific COE CST research tasks are defined, evaluated and supported on an ongoing basis throughout the life of the COE CST. Descriptions for current research tasks can be found on the COE CST web site (www.coe-cst.org).

2.5 Research Personnel and Partners

This section provides lists of the COE CST principal investigators, students, research partners and industry partners that were active during year 3 operation. Student demographics are also given. A list of conference papers and journal articles presented or published during COE CST Year 3 is also given.

Year 3 Principal Investigators

The COE CST principal investigators (PIs) and the tasks for which they are responsible are given in the table below.

PI	Organization	Task
Alonso, Juan	Stanford University	185, 193, 258, 259
Alvi, Farrukh	Florida State University	241, 244, 283, 297
An, Linan	University of Central Florida	253
Axelrad, Penina	University of Colorado at Boulder	244
Born, George	University of Colorado at Boulder	193, 257
Castleberry, Tarah	University of Texas, Medical Branch	255, 294
Close, Sigrid	Stanford University	186
Collins, Emmanuel	Florida State University	244
Durrance, Sam	Florida Institute of Technology	247, 282
Fiedler, Tristan	Florida Institute of Technology	296, 300, 301, 302
Fitz-Coy, Norm	University of Florida	244, 288
Forbes, Jeff	Stanford University	186
Fuller-Rowell,	University of Colorado at Boulder	186
Gou, Jihua	University of Central Florida	253
Hanrahan, Pat	Stanford University	259
Hubbard, Scott	Stanford University	193, 244, 258, 259, 286
Hynes, Pat	New Mexico State University	220, 284, 298
Jennings, Richard	University of Texas, Medical Branch	183
Kapat, Jay	University of Central Florida	253, 287
Kirk, Dan	Florida Institute of Technology	247, 282
Klaus, David	University of Colorado at Boulder	184, 281
Miller, Keith	New Mexico Tech	293

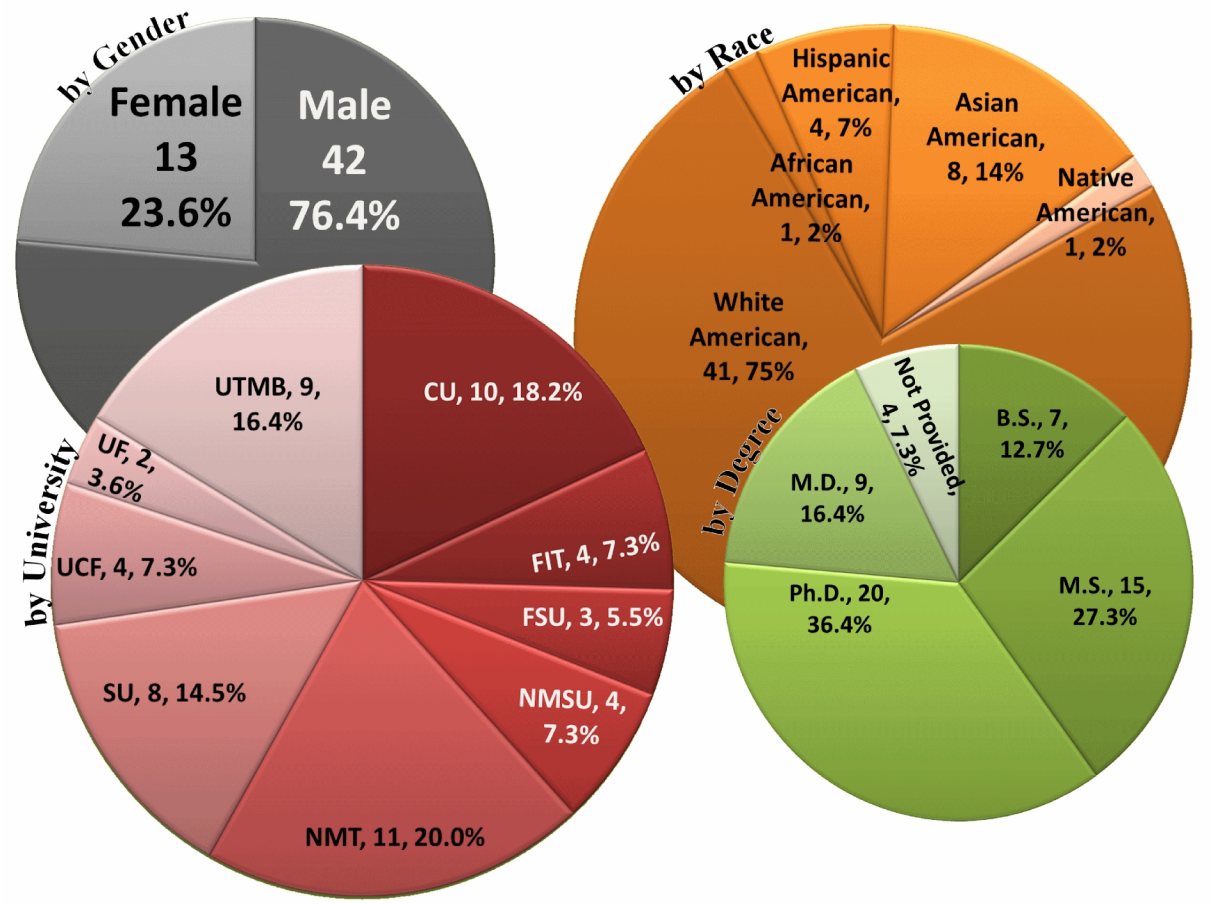
PI	Organization	Task
Oates, William	Florida State University	241
Ostergren, Warren	New Mexico Tech	228, 293, 299, 303
Rock, Steve	Stanford University	244
Scheeres, Daniel	University of Colorado at Boulder	187
Sheplak, Mark	University of Florida	241
Vanderploeg, James	University of Texas, Medical Branch	181, 182, 256, 289, 295
Villaire, Nathaniel	Florida Institute of Technology	247
Zagrai, Andrei	New Mexico Tech	228

Year 3 Students

The following is a list and demographic information of the 55 COE CST students working on research tasks during the third year of operation.

- Bayley, Steven (NMT)
- Blue, Rebecca (UTMB)
- Borowski, Holly (CU)
- Bowers, Marianne (NMSU)
- Capristan, Francisco (SU)
- Carpenter, Cassandra (UCF)
- Cason, Kathryn (UF)
- Charalambides, Gabe (SU)
- Cheetham, Bradley (CU)
- Collins, Justin (FSU)
- Colvin, Thomas (SU)
- Conrad, David (NMT)
- Cooper, Benjamin (NMT)
- Cushman, James (UTMB)
- Deaven, Jacob (NMSU)
- Fanchiang, Christine (CU)
- Feldhacker, Juliana (CU)
- Francis, Griffin (FSU)
- Fujimoto, Kohei (CU)
- Gehly, Steven (CU)
- Gutierrez, Jaclene (NMT)
- Hammond, Marcus (SU)
- Herman, Jon (CU)
- Kasdaglis, Nicholas (FIT)
- Kruse, Walter (NMT)
- Law, Jennifer (UTMB)
- Lawrence, Jeremey (UCF)
- Lewis, Leigh (UTMB)
- Li, Alan (SU)
- LoCrasto, Heather (CU)
- Lui, Donovan (UCF)
- Maillet, Nicole (FIT)
- Masker, William (NMT)
- Mathers, Charles (UTMB)
- McGranaghan, Ryan (CU)
- Meisner, Daniel (NMT)
- Mendoza, Joshua (NMT)
- Menon, Anil (UTMB)
- Michalenko, Joshua (NMSU)
- Mills, David (UF)
- Mulcahy, Robert (UTMB)
- Padial, Jose (SU)
- Pattarini, James (UTMB)
- Phillips, Homer (CU)
- Reiner, Sebastian (FIT)
- Reyes, David (UTMB)
- Runnels, Joel (NMT)
- Sharma, Aneesh (FSU)
- Smith, Andrew (SU)
- Stanley, June (NMT)
- Strevel, Hank (NMSU)
- Trujillo, Blaine (NMT)
- Wilt, Dennis (FIT)
- Yang, Hongjiang (UCF)
- Zimmerman, Jonah (SU)

Year 3 Student Demographics



Year 3 COE CST Research Partners

The following is a list of the 20 COE CST research organization partners that have contributed to the year 3 COE CST research tasks.

- Air Force Research Lab – Kirtland
- Air Force Research Lab - Maui
- Baylor College of Medicine
- FAA Civil Aerospace Medical Institute
- Mayo Clinic - Jacksonville
- Mayo Clinic - Scottsdale
- Metropolitan State College of Denver
- NASA Ames Research Center
- NASA Headquarters
- NASA Jet Propulsion Lab
- NASA Johnson Space Center
- National Science Foundation (Student Fellowships)
- National Space Grant Foundation
- NMSU Space Development Foundation
- Pennsylvania State University, The
- Southwest Research Institute
- Universities Space Research Association
- University of Colorado LASP
- University of Missouri
- US Army

Year 3 COE CST Industry Partners

The following is a list of the 44 COE CST industry partners that have contributed to the year 3 COE CST research tasks.

- Altius Space Machines
- American Institute of Aeronautics and Astronautics (AIAA)
- Analytical Graphics, Inc.
- Arianespace
- ATK
- Bachner Consultants, Inc.
- Ball Aerospace
- Bigelow Aerospace
- Boeing Company, The
- Cimmaron Software Services, Inc.
- Clear Channel Satellite
- CSSI, Inc.
- Digital Solutions
- DigitalGlobe
- Dynetics, Inc.
- Futron
- GeoEye.
- Jacobs Technology, Inc.
- Locked On, Inc,
- Lockheed Martin Space Systems Company
- Marketing Consultant
- NASTAR Center
- New Mexico Spaceport Authority
- Orbital Sciences Corporation
- Orion America Technologies, LLC
- Paris Surgical Association
- Qinetiq
- Scitor Corporation
- Sierra Nevada Corporation
- Space Exploration Technologies (SpaceX)
- Space Florida
- Space News
- Space Systems/Loral
- Space Works Enterprises
- Spaceport America Consultants
- Spaceport Sweden
- Spaceworks
- Special Aerospace Services
- Tauri Group, Inc.
- United Launch Alliance
- Virgin Galactic
- Webster University
- Wyle Integrated Science and Engineering Group
- XCOR Aerospace, Inc.

COE CST would like to thank United Launch Alliance and Craig Technologies for sponsoring the Welcome Reception at the Annual Technical Meeting in Washington, DC.

2.6 Year 3 COE CST Publications

The following is a list of the 28 publications published or presented during COE CST year 3.

Task 182-UTMB Human System Risk Management Approach

- CH Mathers, EL Kerstman. J. Law, JM Vanderploeg, and SRE Fondy. (2013). and "NASA's Human System Risk Management Approach and Its Applicability to Commercial Spaceflight"; Aviation, Space, and Environmental Medicine, Vol. 84, No. 1, January 2013.

Task 184-CU Human Rating of Commercial Spacecraft

- Fong et al., (2013). Winter temperature tides from 30 to 110 km at McMurdo: Lidar observations and comparison with WAM, J. Geophys. Res., submitted, 2013.
- D.M. Klaus and R.P. Ocampo (2013) A Review of Spacecraft Safety: from Vostok to the International Space Station. New Space 1(2): 73-80

Task 185-SU Unified 4-Dimensional Trajectory Analysis

- F. Capristan and J. Alonso. (2014). Range Safety Assessment Tool (RSAT): An analysis environment for safety assessment of launch and reentry vehicles (AIAA 2014-0304), 52nd Aerospace Sciences Meeting, 2014,10.2514/6.2014-0304.

Task 186-SU Space Environment MMOD Modeling and Prediction

- A. Li and S. Close. (2013). Orbital debris parameter estimation from vertical pointing radar, IAC, Conference Proceedings.
- A. Goel, A. Mocker, D. Lauben, D. Strauss, I. Linscott, N. Lee, R. Srama, S. Bugiel, S. Close, and T. Johnson. (2013). Detection of electromagnetic pulses produced by hypervelocity micro particle impact plasmas, Physics of Plasmas, 20, 092102, 1–8, doi:10.1063/1.4819777.
- A. Goel, A. Mocker, D. Lauben, D. Strauss, I. Linscott, N. Lee, R. Srama, S. Bugiel, S. Close, and T. Johnson. (2013). Theory and experiments characterizing hypervelocity impact plasmas on biased spacecraft materials, Physics of Plasmas, 20, 032901, 1–9, doi:10.1063/1.4794331.
- N. Lee, R. Srama, and S. Close. (2013). Composition of plasmas formed from debris impacts on spacecraft surfaces, Sixth European Confer
- ence on Space Debris.
- D. Janches, D. Nesvorny, J. J. Sparks, S. Close, S. Pifko, and T. Nakamura. (2013)., The Meteoroid Input Function and predictions of mid-latitude meteor observations by the MU radar, Icarus, 223, 444–459, doi:10.1016/j.icarus.2012.12.014.

Task 187-CU Space Situational Awareness

- D.J. Scheeres and K. Fujimoto. (2013). "Applications of the Admissible Region to Space-Based Observations," Advances in Space Research 52: 696-704.
- A.J. Rosengren and D.J. Scheeres. (2013). "Long-term Dynamics of High Area-to-mass Ratio Objects in High-Earth Orbit," Advances in Space Research 52: 1545-1560.
- A. Albuja and D.J. Scheeres. (2013). "Evolution of Angular Velocity for Large Space Debris as a Result of YORP," paper presented at the 64th International Astronautical Congress, Beijing, China, October 2013. Paper IAC-13.A6.2.6.
- A.J. Rosengren, D.J .Scheeres and J.W. McMahon. (2013). "The Classical Laplace Plane and its use as a Stable Disposal Orbit for GEO," paper presented at the 2013 AMOS Meeting, Maui, September 2013.
- A. Albuja and D.J .Scheeres. (2013). "Defunct Satellites, Rotation Rates and the YORP Effect," paper presented at the 2013 AMOS Meeting, Maui, September 2013.
- D.J. Scheeres, J. Herzog, K. Fujimoto, and T. Schildknecht. (2013). "Improvements to Optical Track Association with the Direct Bayesian Admissible Region Method," paper presented at the 2013 AMOS Meeting, Maui, September 2013.
- D.J .Scheeres and K. Fujimoto. (2013). "Analytical Non-Linear Conjunction Assessment Via State Transition Tensors In Orbital Element Space," paper presented at the 2013 AAS/AIAA Astrodynamics Specialist Conference, Hilton Head Island, South Carolina, August 2013. Paper AAS 13-913.
- A.J. Rosengren, D.J .Scheeres and J.W. McMahon. (2013). "Long-Term Dynamics And Stability Of Geo Orbits: The Primacy Of The Laplace Plane," paper presented at the 2013 AAS/AIAA Astrodynamics Specialist Conference, Hilton Head Island, South Carolina, August 2013. Paper AAS 13-865.
- D.J. Scheeres, J. Herzog, K. Fujimoto, and T. Schildknecht. (2013). "Applying the Direct Bayesian Admissible Region Approach to The Association of GEO Belt Optical Observations," paper presented at ISTS 2013, The 29th International Symposium on Space Technology and Science, Nagoya-Aichi, Japan, June 2013.

- D.J. Scheeres, J. Herzog, K. Fujimoto, and T. Schildknecht. (2013). "Association Of Short-Arc Optical Tracks Via The Direct Bayesian Admissible Region: Theory And Application," paper presented at the 6th European Conference on Space Debris, ESA/ESOC Darmstadt, Germany, April 2013.
- A.J. Rosengren and D.J. Scheeres. (2013). "Averaged Dynamics Of High Area-To-Mass Ratio Space Debris In Geo," paper presented at the 6th European Conference on Space Debris, ESA/ESOC Darmstadt, Germany, April 2013.
- A. Albuja, D.J. Scheeres, J.W. McMahon. (2013). "Evolution of Angular Velocity for Space Debris as a Result of YORP," paper presented at the 23rd AAS/AIAA Space Flight Mechanics Meeting, Kauai, Hawaii, February 2013. Paper AAS 13-316

Task 193-SU Role of COE CST in EFP

- A. Ow, J. Zimmerman, and S. Hubbard. (2013). "Potential Opportunities for Secondary and Hosted Payloads on NASA Missions", IAC-13-B4.5.7, September, 2013.

Task 193-CU Role of COE CST in EFP

- B. Cheetham, B. Henwood, J. Crowell, J. Feldhacker, J. Stark, K. Davidian, K. Raimalwala, L. Kennick, M. Cannella, N. Wong, and S. Bandla,. "The 'Game' of Training Humans for Commercial Suborbital Spaceflight," 64th International Astronautical Congress, Beijing China, IAC-13-E6.2.3

Task 228-NMT Magneto-Elastic Sensing for Structural Health Monitoring

- A. Zagrai, B. Cooper, B. Trujillo, C. White, J. Gutierrez, J. MacGillivray, J. Schlavin, K. Tena, L. Magnuson, L. Puckett, N. Demidovich, S Chesebrough, S. Kessler, T. Gonzales. (2013). "Structural Condition Assessment during High Altitude Stratospheric Balloon Flight," Presentation at Next-Generation Suborbital Researchers Conference 2013, June 3-5, 2013, Broomfield, Colorado.
- A. Zagrai, B. Cooper, B. Trujillo, C. White, J. Gutierrez, J. MacGillivray, J. Schlavin, K. Tena, L. Magnuson, L. Puckett, N. Demidovich, S Chesebrough, S. Kessler, T. Gonzales. (2013). "Structural Health Monitoring using COTS Equipment during High Altitude Stratospheric Balloon Flight," Presentation at Commercial and Government Responsive Access to Space Technology Exchange, Bellevue, Washington, June 26, 2013.
- A. Zagrai, B. Cooper, C. White, J. Schlavin, and S. Kessler. (2013). "Structural Health Monitoring in Near-Space Environment, a High Altitude Balloon Test," Proceedings of International Workshop on Structural Health Monitoring, Stanford University, September 10, 2013.
- A. Zagrai, B. Cooper, and S. Kessler. (2013). "Effects of Altitude on Active Structural Health Monitoring," Proceedings of SMASIS-13, ASME Conference on Smart Materials, Adaptive Structures and Intelligent Systems, September 16 – 18, 2013, Snowbird, Utah, paper: SMASIS2013-3269.

Task 244-FSU Autonomous Rendezvous and Docking

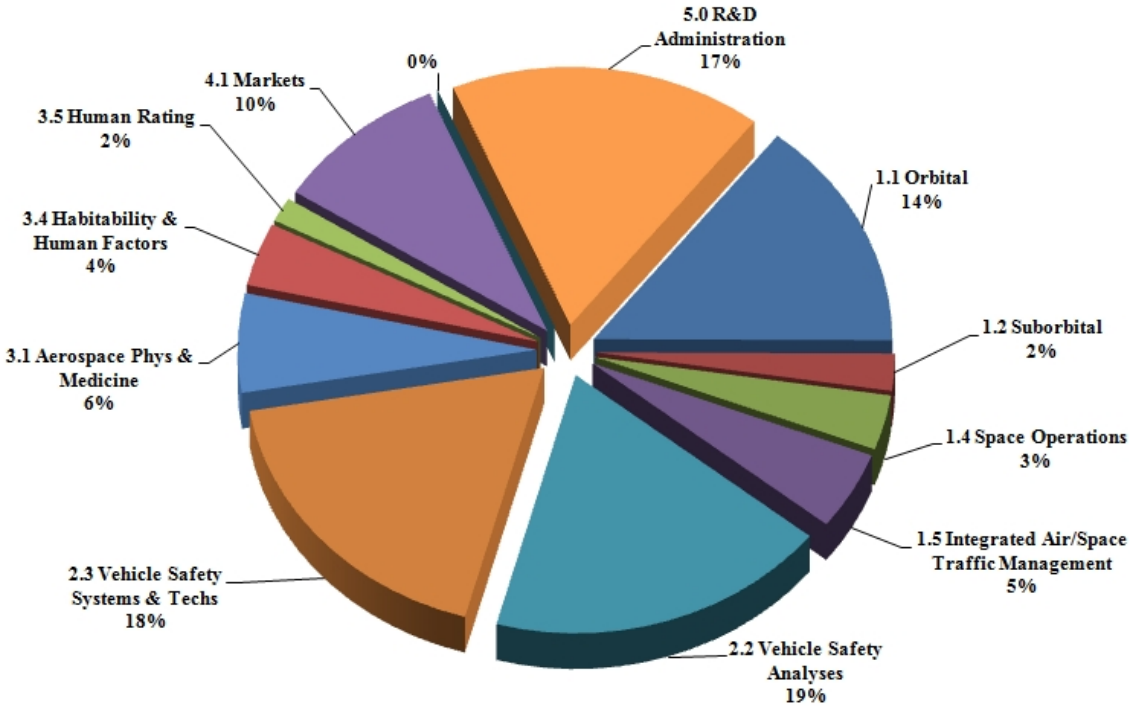
- A. Sharma, E. Collins, G. Francis, and O. Chuy. (2013). "Sampling-Based Trajectory Generation for Autonomous Spacecraft Rendezvous and Docking," AIAA Guidance, Navigation, and Control Conference, Boston, MA, August 2013.

3.0 COE CST Funding Overview

3.1 Funding By Program

FAA funding in FY11 and FY12 combined was $1.94M. The total funding to date (FY10-13) is $5,544,002.00. The division of funds among the research programs and administrative costs is shown in the figure below.

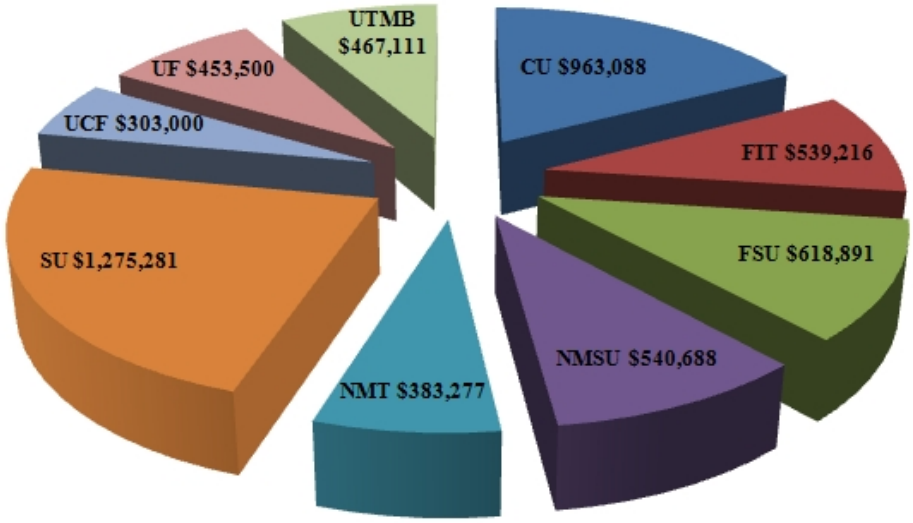
FAA COE CST Cumulative (FY10-13) Distribution of Funds among Research Programs



3.2 Funding By University

The FAA funding by organization over the first three years of operation is shown below:

FAA COE CST Cumulative (FY10-13) Distribution of Funds among Member Universities



3.3 Funding by Task

The total funding for each COE CST over the three-year life of the center is shown below. The table below shows total funding for all tasks that were active at the end of calendar year 2013.

Total COE CST Funding (FY10-13) for All Active tasks

Task-Org	Title	Amount
184-CU	Human Rating of Commercially Operated Spacecraft	$219,892.00
185-SU	Unified 4D Trajectory Approach for Integrated Management	$260,996.00
186-CU	Space Environment Modeling/Prediction	$98,000.00
186-SU	Space Environment Modeling/Prediction	$185,314.00
187-CU	Space Situational Awareness Improvements	$259,975.00
193-CU	Role of the COE-CST in Encourage, Facilitate and Promote	$100,360.00
193-SU	Role of the COE-CST in Encourage, Facilitate and Promote	$428,445.00
220-NMSU	Space Operational Framework for Commercial Space Launch Standards	$190,167.00
228-NMT	Magneto-Elastic Sensing for Structural Health Monitoring	$144,500.00
241-FSU	High Temperature, Optical Sapphire Pressure Sensors for Hypersonic Vehicles	$254,163.00
241-UF	High Temperature, Optical Sapphire Pressure Sensors for Hypersonic Vehicles	$272,000.00
244-CU	Autonomous Rendezvous and Docking for Space Debris Mitigation	$121,467.00
244-FSU	Autonomous Rendezvous and Docking for Space Debris Mitigation	$225,868.00
244-SU	Autonomous Rendezvous and Docking for Space Debris Mitigation	$131,128.00
244-UF	Autonomous Rendezvous and Docking for Space Debris Mitigation	$161,500.00
247-FIT	Air and Space Traffic Control Considerations for Commercial Space	$271,578.00
253-UCF	Ultra High Temperature Composites For Thermal Protection Systems	$282,090.00
255-UTMB	Wearable Biomedical Monitoring Equipment for Spaceflight Participants	$185,437.18
256-UTMB	Testing and Training in High-G Profiles	$84,861.21
257-CU	Masters Level Commercial Space Operations Instruction	$128,510.00
258-SU	Multi-Disciplinary Analysis of Launch Vehicle Safety Metrics	$164,288.00
293-NMT	Reduced-Order Non-Linear Dynamic System Models	$75,500.00
294-UTMB	Development of Minor Injury Severity Scale for Orbital Human Space Flight	$25,422.00
295-UTMB	Effects of EMI and Ionizing Radiation on Implantable Devices	$18,689.00
296-FIT	Outreach - Commercial Space Transportation	$28,650.00
297-FSU	Technical Oversight and OMIS Integration	$105,000.00
298-NMSU	Integration & Evaluation of ADS-B Payloads	$79,191.00
299-NMT	Nitrous Oxide Composite Tank Testing	$113,227.00
300-FIT	COE CST Collaboration Coordination	$219,000.00
301-FIT/MU	Spaceport Regulation in a Post Modern World	$0.00
302-FIT/MU	International Commercial Space Regulations	$0.00
303-NMT	OMIS Integration	$50,000.00
	TOTAL	**$4,885,218.39**

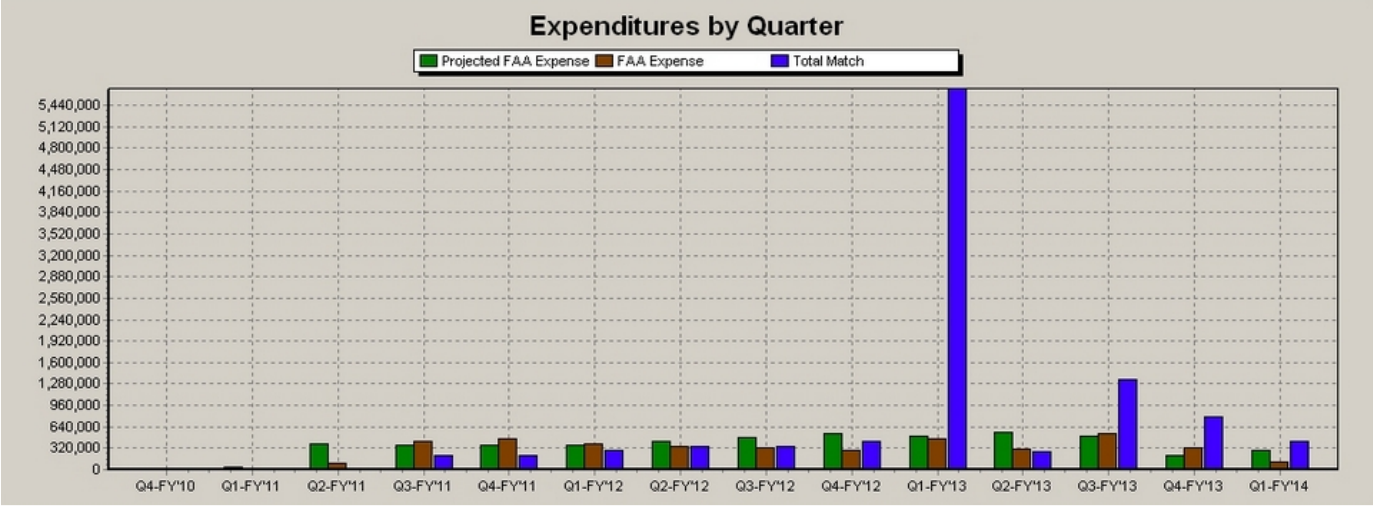
The following table shows total funding for tasks that were completed at the end of calendar year 2013

Total COE CST Funding (FY10-13) for All Completed tasks

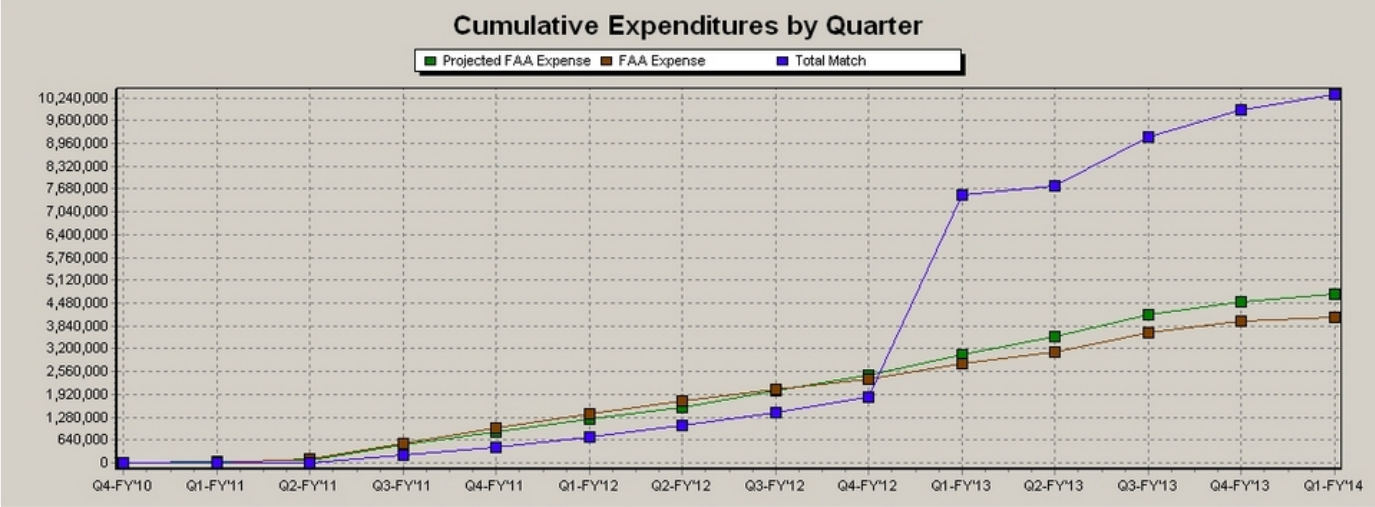
Task-Org	Title	Amount
181-UTMB	Medical and Physiological Database System	$40,657.58
182-UTMB	Human System Risk Management Approach to CST	$25,190.00
183-UTMB	Spaceflight Crew Medical Standards & Participant Acceptance Criteria	$49,006.03
259-SU	Flight Software Validation and Verification for Safety	$5,110.00
281-CU	Technical Oversight - CU	$34,884.00
282-FIT	Technical Oversight -FIT	$19,988.00
283-FSU	Technical Oversight - FSU	$33,860.00
284-NMSU	COE CST Admin Lead Activities	$271,330.00
286-SU	Technical Oversight - SU	$100,000.00
287-UCF	Technical Oversight - UCF	$20,910.00
288-UF	Technical Oversight - UF	$20,000.00
289-UTMB	Technical Oversight - UTMB	$37,848.00
	TOTAL	**$658,783.61**

3.4 Funding by Quarter

The following chart displays the expenditures by fiscal year quarter. The green bar displays the projected FAA expense. The Orion Management Information Systems (OMIS) was created to manage and track multiple centers of excellence projects. It was developed for managing FAA Air Transportation Centers of Excellence. OMIS calculates the projected expense by taking the amounts funded and divides the sum over the four quarters. In the first year, some anomalies occur as project dates are varied during the project period. As indicated below, the bar chart begins to even out as the projects begin to progress. The large amount of matching funds in Q1 of FY13 reflects that most universities began accounting for matching funds received to date.



The Cumulative Expenditures by Quarter chart is similar to the bar chart above and is displayed in a line format below.



The table below shows the projected and the actual FAA expense by quarter.

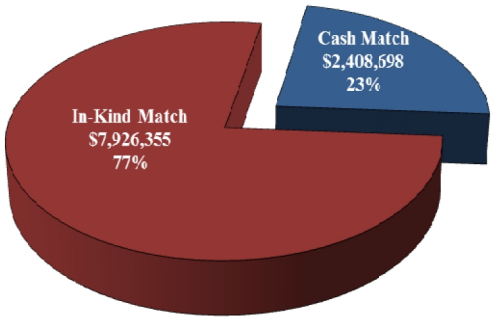
FAA Cash by Quarter

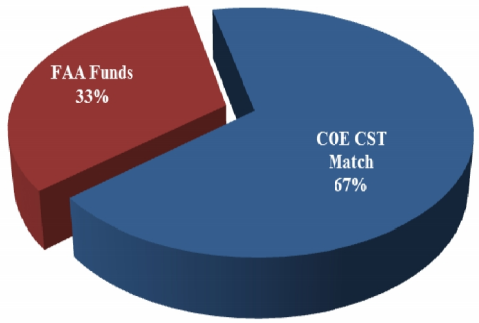
Date	Projected	Cumulative Projected	Actual	Cumulative Actual
FY2010 Q4 (Oct-Dec)	$23,258	$23,258	$0	$0
FY2011 Q1 (Oct-Dec)	$39,630	$62,888	$1,745	$1,745
FY2011 Q2 (Jan-Mar)	$379,131	$442,019	$98,544	$100,289
FY2011 Q3 (Apr-Jun)	$359,840	$801,858	$424,638	$524,926
FY2011 Q4 (Jul-Sep)	$358,083	$1,159,941	$457,286	$982,213
FY2012 Q1 (Oct-Dec)	$359,868	$1,519,809	$389,074	$1,371,287
FY2012 Q2 (Jan-Mar)	$420,624	$1,940,433	$353,997	$1,725,284
FY2012 Q3 (Apr-Jun)	$472,382	$2,412,815	$322,131	$2,047,415
FY2012 Q4 (Jul-Sep)	$533,451	$2,946,266	$283,645	$2,331,060
FY2013 Q1 (Oct-Dec)	$504,816	$3,451,082	$461,278	$2,792,338
FY2013 Q2 (Jan-Mar)	$550,337	$4,001,419	$305,933	$3,098,71
FY2013 Q3 (Apr-Jun)	$493,600	$4,495,018	$545,467	$3,643,739
FY2013 Q4 (Jul-Sep)	$220,252	$4,715,270	$335,887	$3,979,626
FY2014 Q1 (Oct-Dec)	$285,819	$5,001,089	$109,657	$4,089,283
TOTALS	**$5,001,091**		**$4,089,282**	

3.5 Matching Funds

The Match Profile pie chart below displays the fraction of cash match (23%) and the fraction of in-kind match (77%).

The COE Match vs. FAA Expenditures pie chart displays the percentage of combined matching funds (cash and in-kind) over the FAA expense. tasks funded under the FAA Grant require a 100% match and the COE CST has achieved a 2.6:1 matching ratio. The match requirement is spread out over the first five years of the COE. Each university partner can combine the total FAA funding with their matching funds to comply with the FAA matching requirements.





The table below shows the actual cash and in-kind match.

COE CST Matching by Quarter

Date	Cash Match	Cumulative Cash Match	In-Kind Match	Cumulative In-Kind Match	Total Match	Cumulative Total Match
FY2010 Q4 (Oct-Dec)	$0	$0	$0	$0	$0	$0
FY2011 Q1 (Oct-Dec)	$0	$0	$0	$0	$0	$0
FY2011 Q2 (Jan-Mar)	$0	$0	$0	$0	$0	$0
FY2011 Q3 (Apr-Jun)	$152,182	$152,182	$51,509	$51,509	$203,691	$203,691
FY2011 Q4 (Jul-Sep)	$177,622	$329,803	$39,656	$91,165	$217,278	$420,969
FY2012 Q1 (Oct-Dec)	$166,097	$495,900	$120,483	$211,648	$286,580	$707,549
FY2012 Q2 (Jan-Mar)	$281,241	$777,141	$68,857	$280,506	$350,098	$1,057,647
FY2012 Q3 (Apr-Jun)	$288,952	$1,066,093	$56,142	$336,648	$345,094	$1,402,741
FY2012 Q4 (Jul-Sep)	$259,518	$1,325,611	$164,741	$501,389	$424,259	$1,827,001

Date	Cash Match	Cumulative Cash Match	In-Kind Match	Cumulative In-Kind Match	Total Match	Cumulative Total Match
FY2013 Q1 (Oct-Dec)	$358,869	$1,684,480	$5,334,858	$5,836,247	$5,693,726	$7,520,727
FY2013 Q2 (Jan-Mar)	$151,254	$1,835,734	$111,888	$5,948,135	$263,142	$7,783,869
FY2013 Q3 (Apr-Jun)	$251,933	$2,087,677	$1,092,136	$7,040,271	$1,344,068	$9,127,937
FY2013 Q4 (Jul-Sep)	$166,110	$2,253,777	$612,931	$7,653,202	$779,041	$9,906,979
FY2014 Q1 (Oct-Dec)	$154,922	$2,408,698	$273,153	$7,926,355	$428,074	$10,335,053
TOTALS	**$2,408,700**		**$7,926,354**		**$10,335,051**	

Expenditure and match data for each task is provided with the individual project data later in this report.

4.0 COE CST Management Plan

The document below was modified in August of the 2012 calendar year and reflects the changes in the COE CST committee and subcommittee structure as discussed and agreed upon at the second Annual Administrative Meeting on the campus of Florida State University in Tallahassee.

4.1 Introduction

4.1.1 Background

In August 2009, the FAA Administrator signed a memo agreeing to the creation of a Center of Excellence (COE) for Commercial Space Transportation (CST) that would be supported at a minimum level of one million dollars per year for 10 years.

Following two public meetings conducted in February 2010, a competitive process was conducted over the following four months to solicit and then evaluate proposals for the COE CST.

In September 2010, Cooperative Agreements (CAs) were executed between the FAA Office of Commercial Space Transportation (AST) and nine universities to create the COE CST. The member universities are (in alphabetical order):

- Florida Institute of Technology (FIT, or Florida Tech)
- Florida State University (FSU)
- New Mexico Institute of Mining and Technology, (NMT, or New Mexico Tech)
- New Mexico State University (NMSU)
- Stanford University (SU)
- University of Central Florida (UCF)
- University of Colorado at Boulder (CU)
- University of Florida (UF)
- University of Texas Medical Branch at Galveston (UTMB)

Subsequently, the FAA distributed two million dollars to these universities to conduct the first set of research tasks. Through this Management Plan, the FAA encourages the COE CST member universities to cooperate and collaborate with the purpose of conducting world-class research in support of the Commercial Space Transportation industry.

Together, the nine member universities bring complementary strengths together for the benefit of the overall COE CST. FAA finds that each team member provides highly respected and accomplished experiences that directly address the research and study needs of the commercial space industry.

- Florida Tech (FIT) offers broad expertise in aerospace and space-related engineering, science, space traffic management and launch operations, vehicle and payload analysis and design, thermal systems and propulsion.
- FSU brings a range expertise and unique infrastructure in many areas relevant to the COE CST, including but not limited to: cryogenics, thermal management, vehicle aerodynamics and controls, sensors, actuators and system health monitoring and high performance simulations.

- NMT is a science, math and engineering university with a focus on applied research. Major research facilities include a rocket engine test fixture at the Energetic Materials Research and Testing Center, and a 2.4M fast tracking telescope at the Magdalena Ridge Observatory dedicated to the study of near earth objects.
- NMSU and its Physical Sciences Laboratory have led space and aerospace research in areas of suborbital investigations from the time of Werner Von Braun to the current era of commercial sub-orbital space transportation with Virgin Galactic. The 21st Century Space and Aerospace research focus encompasses annual access to space for student and faculty experiments, unmanned aerial vehicles, scientific ballooning and nano-satellite development.
- SU brings a 50 year history of aerospace research excellence and a broad scope of expertise to the COE CST, including the optimization and autonomous operation of complex systems, strategic research planning, organizational integration and distributed administration experience.
- UCF, as partners of Florida Center for Advanced Aero-Propulsion (FCAAP) and the Center for Advanced Turbines & Energy Research (CATER), offers its experience and expertise in thermal protection system, propulsion system components, cryogenic systems and materials, composites, sensors and actuators, and guidance and control.
- CU offers the COE CST their experience in spacecraft life support systems and habitat design, human factors engineering analysis, payload experiment integration, and expertise in space environment and orbital mechanics.
- UF has been performing aeronautical and aerospace research since 1941, with current emphasis in the Department of Mechanical and Aerospace Engineering on research in space systems, MEMS, computational sciences, structural dynamics, controls, gas dynamics, and propulsion.
- UTMB has a long history of medical support and human spaceflight physiological research with NASA. This is complemented by more recent involvement in the commercial orbital and suborbital spaceflight industry supporting space flight participant visits to the ISS and preparation of passengers and crew for suborbital space flights.

Additionally, the team members provided a comprehensive distribution of geographical coverage representing the entire Commercial Space Transportation industry. Combined, the nine universities bring over 50 other government, industry and academic organizations as research partners.

4.1.2 Overview

Key FAA Personnel

In this document, the following position titles are used. As of the distribution date of this document, the individuals named below hold each of these positions:

- Dr. Patricia Watts, FAA Center of Excellence (COE) Program Director
- Mr. Ken Davidian, Director of Research and COE CST Program Manager, FAA AST

Purpose

The purpose of the AST COE Management Plan is to define the relationships, roles, goals and membership of the COE CST organizational entities and AST.

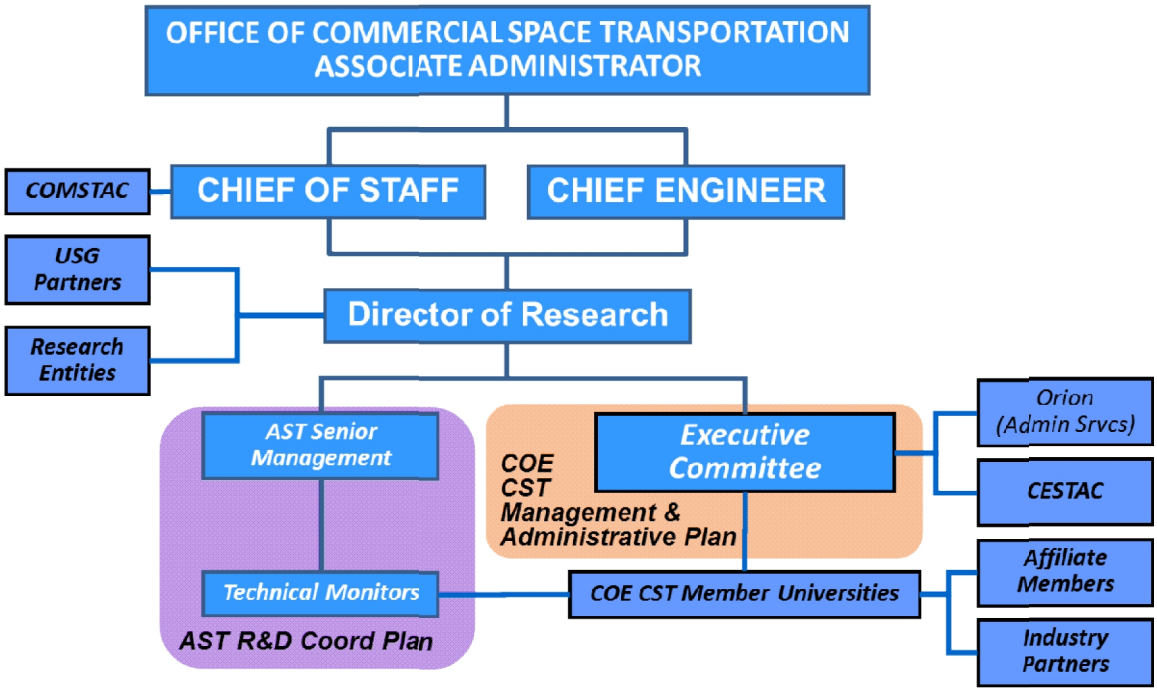
Organizational Context

As shown in the figure below, the R&D Coordination and COE are programs within the following organizational hierarchy:

- Dr. George Nield, Associate Administrator, FAA AST
- Mr. Greg Rasnake, Chief of Staff, FAA AST
- Mr. Mike Kelly, Chief Engineer, FAA AST

Also shown in the figure below, COE CST member universities interface with both AST's R&D Coordination processes and the COE CST. Specifically, the research task proposal and selection process, including all competition sensitive information submitted by member universities, is coordinated by the FAA AST through the R&D Coordination activity (in coordination with AST entities such as the AST Senior Steering Committee and the Technical Monitors as shown in the figure below). All other activities of the COE CST member universities fall within the COE CST program.

Figure 1. Organizational Context of AST R&D Management and Administration Plan



4.1.3 Scope

The Center of Excellence (COE) is comprised of the AST COE Management Council (ACMC) and the Executive Committee (EC). The relationship of these entities with respect to the rest of the FAA AST R&D organization is shown below.

Administrative activities of the COE CST member universities are defined in COE CST Cooperative Agreements. For activities not specified in the COE CST Cooperative Agreements, member universities are at liberty to conduct business as agreed upon among them and by the Executive Committee through a consensus-driven decision-making process.

COE CST appraisal review and audits will be performed by the FAA COE Program Office in accordance with terms of the COE Policy Guide.

Other COE CST-related organizations, including the COE CST Advisory Council (CESTAC) and other non-member universities, interact with the COE CST through the Executive Committee and Member Universities, respectively.

4.1.4 Abbreviations and Acronyms

Below are the abbreviations and acronyms used in this document.

ACMC	AST COE Management Council	NMSU	New Mexico State University
AOB	Any Other Business	NMT	New Mexico Tech
AST	Office of Commercial Space Transportation	OMIS	Orion Management Information System
CA	Cooperative Agreement	PI	Principal Investigator
CESTAC	COE CST Industry Advisory Council	PM	Program Manager
COE	Center of Excellence	R&D	Research and Development
CST	Commercial Space Transportation	SU	Stanford University
CU	University of Colorado at Boulder	UCF	University of Central Florida
EC	Executive Committee	UF	University of Florida
FAA	Federal Aviation Administration	UTMB	University of Texas Medical Branch at Galveston
FIT	Florida Institute of Technology		
FSU	Florida State University		

4.2 Executive Committee

4.2.1 Functions and Goals

The Executive Committee (EC) is responsible for the following COE CST functions:

- DEVELOP A SET OF SELF-GOVERNANCE DOCUMENTS. Beginning with an EC Terms of Reference document, working through the second step of an EC Management Plan of its own, and culminating with an EC Constitution that will be iteratively refined over multiple years, these will evolve toward the foundational document for the COE CST entering its self-sustaining phase after 10 years of guaranteed FAA funding.
- FOSTER COOPERATIVE EFFORTS AMONG THE COE CST MEMBER UNIVERSITIES. To respond not only to FAA funding solicitations but also to external funding solicitations, cooperative efforts will require some modified posturing. The intent is to demonstrate through signaling and subsequent action that being a member of the COE CST and partnering with other member universities actually enhances the chances of winning funding for related research tasks.
- BEGIN CONDUCTING STRATEGIC PLANNING ANALYSES. Strategic planning analyses is very valuable to the COE CST and can provide the basis for sustained, meaningful activities among the participating members. The long-term goal is self-sustenance after 10 years and the results of many structured analyses will be essential to painting a more complete picture of how it can best be achieved.

4.2.2 Membership

Members of the EC include:

- EXECUTIVE COMMITTEE CHAIR. Mr. Ken Davidian, AST Director of Research and COE CST Program Manager, is the EC Chair.
- COE CST MEMBER UNIVERSITY REPRESENTATIVES. Each university can be represented by COE CST Principal Investigators (PIs) and other university personnel (including staff and student observers) on an "as interested" basis. However, each university will designate a primary and secondary PI to attend the EC as a voting member.
- CESTAC. The COE CST Industry Advisory Council will be represented at the EC meetings by the CESTAC Chair, Vice-Chair and/or the COE CST CESTAC Point of Contact. Although they are contributing member in discussions leading to consensus, CESTAC participants are not voting members of the EC.

4.2.3 Meetings and Schedule

Attendance at the EC meetings will be generally inclusive (allowing multiple PIs, student observers and staff as needed to attend from any given university).

EC meetings will normally be conducted by teleconference on a monthly basis with face-to-face meetings twice a year (at the annual administrative and technical meetings).

The teleconferences will be normally very short unless there were special briefings (for example, updates from the "Terms of Reference" team) or other topics to discuss.

The EC is intended to be a consensus-driven decision-making body, but in the event that decisions were not able to be made by consensus in an open session, a closed-session vote may be necessary. Each member university would have a single vote given to their primary PI, regardless of the number of PIs representing any given university on the EC.

In the event the primary PI from a given university is not able to participate in a close-session vote, the designated secondary PI from that same university will be able to act as a substitute.

The agenda of these meetings will be determined by the EC Chair in consensus with the EC membership and distributed in advance of each meeting by the EC Chair or designee.

4.3 Administrative Processes

4.3.1 How to Submit a COE CST Research Grant Proposal

- ❑ Enter www.grants.gov/
- ❑ Click on Apply for Grants
- ❑ FAA assigns each proposal a number and acknowledges receipt of each proposal
  - Proposal number must be referred to in all future correspondence concerning the proposal.
  - Provide Required Fields
- ❑ Enter CFDA 20.109
- ❑ Download Package
- ❑ Select CST New Funding Package and Download
- ❑ Complete Download Instructions and Application
- ❑ Submit

4.3.2 How to Request a No Cost Extension

- ❑ Go to www.grants.gov
- ❑ Click on Apply for Grants
- ❑ Provide Required Fields

- ❑ Enter CFDA 20.109
- ❑ Download Package
- ❑ Select CST No Cost Extension Package
- ❑ Complete Download Instructions and Application
- ❑ Submit

Mandatory Requirement: Form SF424

4.3.3 How to Document Cost Share Contributions

- Refer to OMB Circular A-110 Section .23 Cost Sharing or Matching
- Complete FAA COE Matching Contribution Form
- Submit prior to award when value of in-kind activities are calculated (vs cost of contribution)

Based on activities not solely used for supporting a funded COE project
In the instance where the in-kind cost sharing activity is not solely for the benefit of the proposed project, the activities conducted and provided by a third-party source will be clearly defined in the proposal submission to justify the value of the anticipated contribution to the specific project(s).

- Each investigator proposing credit for such contributions will review the anticipated cost sharing plan with his/her Fiscal Officer.
- Prior to submission of the proposal to the FAA, the university COE member's Fiscal Officer will discuss the plan with the COE lead institution's Fiscal Officer for consideration in accordance with the lead institution's policies and procedures on cost-sharing. The university Fiscal Officer will notify the FAA COE Program Director/Grants Officer that such a proposal is under consideration and in the process of being submitted.
- In applying the value of a contribution versus the direct cost of contribution, the interpretation of the Fiscal Officer representing the COE Lead institution regarding the amount found to be "prudent and reasonable" will hold for all those participating on the project. The COE Lead institution is expected to conduct discussions and make a determination within 5 business days.
- The COE Lead institution will forward a concurrence notice to the COE Program Office with a justification for the value of the cost-share proposed.
- The FAA COE Program Director will consider each request on a case-by-case basis. The expectation is that all COE members and Leads will be prudent in developing value statements and formulas.
- In keeping with Legislative intent and the spirit of COE enabling legislation, Public Law 101-508, the FAA will not allow the in-kind nonspecific contributions that might be a result of one project to satisfy the matching obligations for an entire agreement Phase or for a significant number of other funded projects.

Although the COE Fiscal Officers and ultimately the FAA may accept the value of the documented contribution as reasonable, allowable and allocable, each university is subject to final acceptance by its own auditor(s). Any penalty imposed by a cognizant auditing agency is the sole responsibility of the recipient providing the contribution and the associated documentation (Prime or Sub recipient).

4.3.4 How to Do Quarterly Reporting

Quarterly reports cover three month calendar increments

- Q1: October 1 – December 31, due January 31.
- Q2: January 1 – March 31, due April 30.
- Q3: April 1 – June 30, due July 31.
- Q4: July 1 – September 30, due October 31.

Deadline for entering quarterly information is 30 days after the quarter ends

- Research accomplishments (measured against the proposed goals and objectives):
- Citation for written publications:
- Journal articles published or in press:
- Journal articles submitted:
- Conference papers submitted and accepted:
- Patents:
- Follow-on research proposals submitted:
- Transition of research results:
- Plans for next quarter:

4.3.5 How to Close-Out a Research task

Project Closeout Requirements

The PI is responsible for completing all required documentation. Orion America will prepare for the PI detailed reports based on information provided by the PI and entered into OMIS data fields. By forwarding a completed form 9550.5 to Orion, the PI is authorizing Orion to gather the required data.

- Due Date: 90 days after expiration of award
- Send to: FAA Technical Monitor designated on FAA award letter,
- The closeout requires the FAA Form 9550.5 be sent to Technical Director (Ken Davidian)
- TD forwards to Tech Monitors for concurrence
- TMs return approved form to TD
- TD signs off and forwards to COE Program Director (Pat Watts)
- COE Program Director approves and sends to OAT
- OAT pulls any necessary reports from the OMIS
- OAT sends complete electronic file to TD, PI, COE Program Director
- Completed project information resides in two places: COE Program Director and the OMIS where it awaits audit, etc.
- 5 printed copies to COE Program Director (Dr. Patricia Watts)
- Electronic file to Technical Director (Ken Davidian), OAT Contract Support (Carol Gregorek),
- Completed FAA Form 9550-5 “Final Project Report” (on the web at www.faa.gov.documentLibrary/media/form/faa9550-5.pdf) with attachments below:

Required Documents attached to the completed 9550.5 form (compiled by Orion America (OAT) for the PI, retrieved from OMIS):

- Abstracts of Theses
- Publication Citations (published and planned) (5 printed copies) (including Title, Journal or other reference, Date, Author)

- Scientific Collaborators (including Co-Investigators, Research Assistants, Associate Professors, Graduate Students, Associate Members and short statement of their participation, and others as appropriate)
- Inventions or Propriety Data (Patents and status)
- Technical Summary
- Additional Material required under the award instrument
- OMIS Report showing no outstanding reports due
- Budget sheet reflecting +/- balance
- Cost share with sources
- Short narrative discussing value of project and results
- Nationality report (including Name and Country of Origin)
- Completed SF 425 Financial Close out prepared by University Fiscal office

Final Unobligated Balance

FAA has a reversionary interest in the unobligated balance of a grant upon expiration or completion of the grant. Based on final disbursements reported on the SF-272, the final unobligated balance is to be computed by FAA and reported to the grantee. If the grantee's funding has been fully advanced and the unobligated balance deduction results in a negative balance, the grantee must refund by check, payable to FAA, the amount of the negative balance.

Compliance with Reporting Requirements

The FAA Technical Center accounting section monitors report submissions to ensure that the requirements for final disbursement information are fulfilled. The technical monitor is responsible for assuring that the final project reports on prior, expired awards have been submitted by principal investigators before new awards are made to those individuals.

Grant Closeout

Grant closeout is the process by which FAA determines that all applicable administrative actions and all required work of the grant are complete. Grants are closed upon receipt of final disbursement information in the final project report, and after determination that any other administrative requirements in the grant instrument have been met. In the event a final audit has not been performed prior to the closeout of the grant, FAA reserves the right to recover appropriate amounts after fully considering the recommendations on disallowed costs resulting from the final audit.

4.3.6 How to Initiate an Affiliate Membership

When a new task is proposed with an Affiliate Member, the Host University shall

- Submit their proposal through the standard FAA proposal process using grants.gov
- Submit the appropriate budget (even if the budget is $0)
- Submit Cash/In-Kind Match form (FAA COE In-Kind Cost Sharing) with supporting documentation from the Affiliate Member
- Upon acceptance, the task will be tracked in OMIS and the Affiliate Member will be setup as a “Primary Partner” permitting the OMIS to track the matching contributions
- Establish a method of receiving financial reports from the Affiliate Member that will satisfy the Host University auditor(s) and their State regulations

- Be responsible for entering the matching contributions in OMIS

For more information

- FAA COE In-Kind Cost Sharing Guidance
- OMB Circular A-110 Section .23 Cost Sharing or Matching
- FAA Centers of Excellence Matching Contribution Form

5.0 Funding Details for Active Tasks

The technical effort requires monitoring and tracking progress both technically and financially.

The quarterly project reports consist of a technical report and an expenditure report. The progress report covers schedule, cost, and technical status: progress since the last report. If problems exist in schedule, cost, or technical areas, they are reported. Any problem noted requires an explanation of the solution being pursued to solve that problem. A summary display of tasks provides a color coded indication of status: green, yellow, or red – for schedule, cost, and technical -- to reflect whether there are problems (yellow) and whether they are serious (red) in one or more of these three categories. There are no pre-established criteria for establishing these color codes. They are set based upon the subjective evaluation of project status by the assigned FAA Technical Managers in conjunction with the FAA's CST Program Manager.

The reporting function is supported by the Orion Management Information System (OMIS). Access to the system through the Internet is password protected and the data is transferred via SSL. The PI enters data through a forms page. The FAA and the PMO management team can monitor the data through Internet access as well.

Each project has a bar chart showing the FAA expenditures for the quarter, as well as the cash and in-kind match. Projected expenditures versus actual expenditures are plotted. The estimated expenditure rates and cumulative projections are based on straight-line projections. The quarterly expenditure estimate is calculated by dividing the total project budget by the quarters of performance.

There are two pie charts for every project. One indicates the relative proportion (percentage) of cash matching versus in-kind funds. The second compares the total FAA expenditure with the total match (cash + in-kind). Total project funding, FAA supported versus the matched support is exhibited. These two plots are based upon the cumulative expenditures, cumulative cost, and in-kind matching.

Following are the task fiscal summaries.

Task 184-UTMB: Human Rating of Commercially Operated Spacecraft

Project Description

PURPOSE: Human Rating is a broad-reaching topic that brings together the process of integrating a human into a spacecraft system for safe and reliable operations. This process first requires ensuring that fundamental human physiological needs are satisfied, makes use of human capabilities as an integral element of design and operation of the vehicle, and controls hazards and manages safety risks intended to protect the public, the flight crew and passengers, and ground personnel to the maximum extent possible during all phases of the mission.

OBJECTIVES: The objective of this work is to define the criteria for human rating of a commercial spacecraft habitat and launch vehicle, either individually or as an integrated spacecraft system, as appropriate. NASA's current governing document (NPR 8705.2B) describes this process as it applies to the development and operation of crewed space systems developed by NASA and used to conduct NASA human spaceflight missions. The process of ensuring compliance and verification for commercially-designed space vehicles flying on independently operated (i.e., non-NASA) space missions has not yet been defined.

GOALS: Review, extension and/or modification of the requirements defined in NPR 8705.2B and in other relevant NASA and FAA documents as determined applicable for commercial spaceflight; definition of compliance and verification processes for commercial spacecraft developers and operators; definition of the human physiological parameters within which a commercial spacecraft must function; and determination of acceptance criteria to achieve human rating designation. Moving from mission with crew and space flight participants into the passenger carrying era will also be given consideration.

Partners

Federal Aviation Administration AST *
University of Colorado at Boulder *

*- indicates primary partner

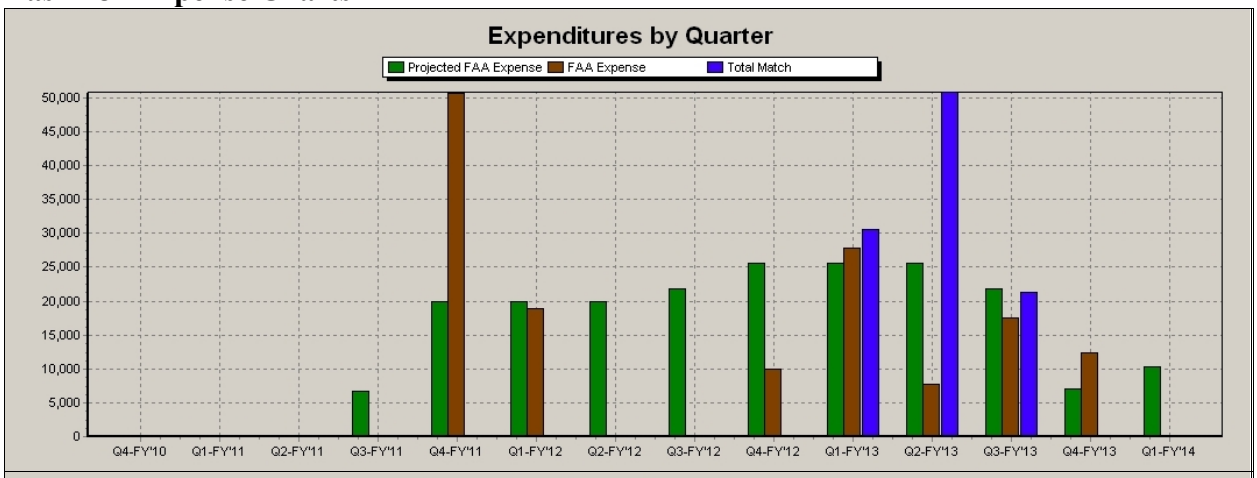
Funding History

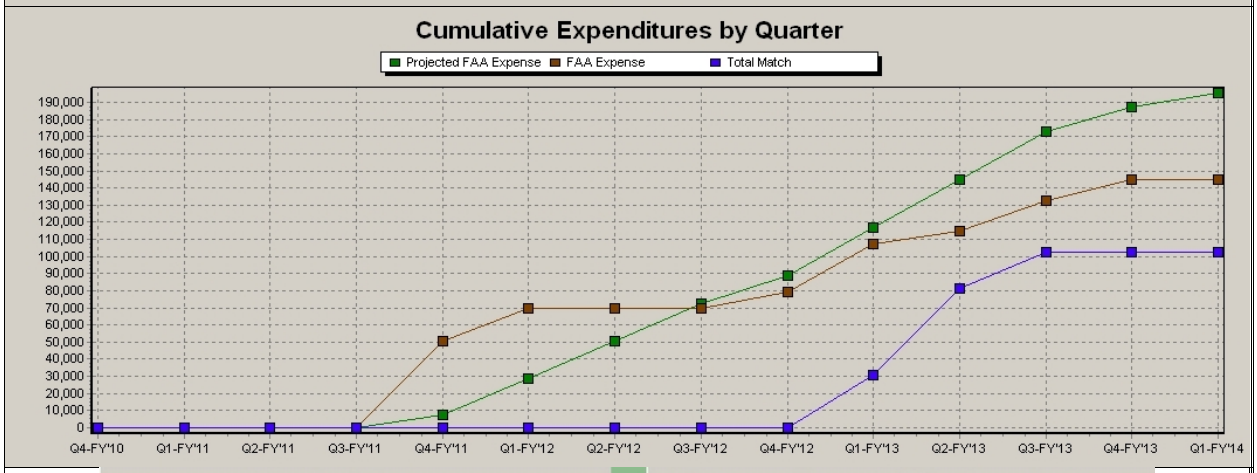
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2011	5/31/2012	2010	10-C-CST-UC-007	$79,542	$79,542
6/1/2012	5/31/2013	2012	10-C-CST-UC-017	$52,350	$52,350
6/1/2012	5/31/2013	2012	10-C-CST-UC-023	$50,000	$50,000
5/31/2013	12/31/2013	2013	10-C-CST-UC-025	$19,000	$19,000
12/31/2013	5/31/2014	2013	10-C-CST-UC-029	$19,000	$19,000
					Total: $219,892

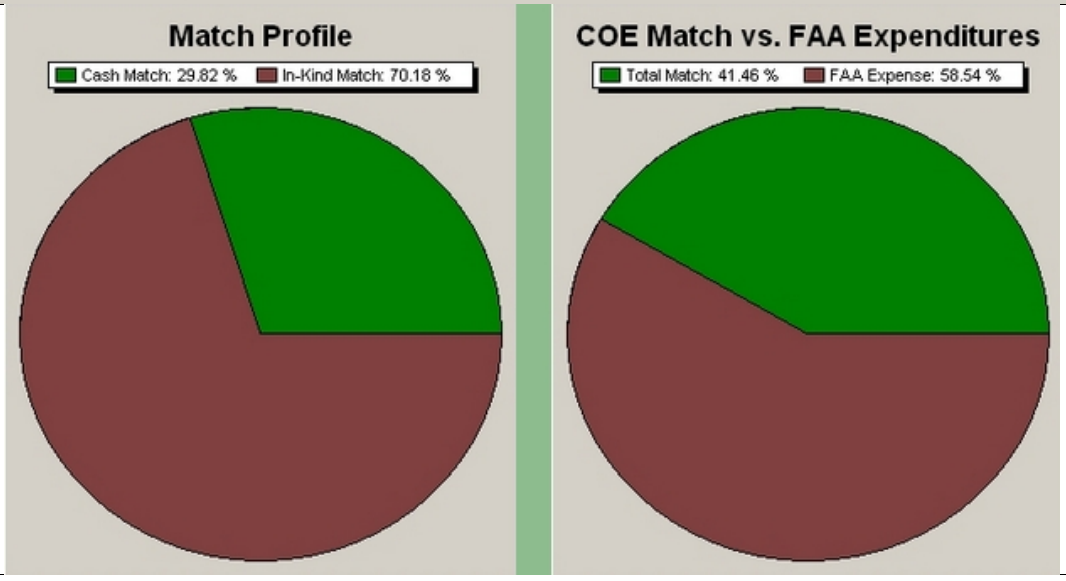
Students

Name	Organization	Department	Discipline	Degree	Graduation
Fanchiang, Christine	University of Colorado	Aerospace Engineering Sciences	-	Ph.D.	-

Task 184 Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$6,629	$6,629	$0	$0
Q4(Jul-Sep) FY2011	$19,886	$26,514	$50,739	$50,739
Q1(Oct-Dec) FY2012	$19,886	$46,400	$18,902	$69,640
Q2(Jan-Mar) FY2012	$19,886	$66,285	$0	$69,640
Q3(Apr-Jun) FY2012	$21,786	$88,071	$0	$69,640
Q4(Jul-Sep) FY2012	$25,588	$113,659	$9,902	$79,542
Q1(Oct-Dec) FY2013	$25,588	$139,246	$27,857	$107,399
Q2(Jan-Mar) FY2013	$25,588	$164,834	$7,660	$115,059
Q3(Apr-Jun) FY2013	$21,808	$186,642	$17,593	$132,651
Q4(Jul-Sep) FY2013	$7,125	$193,767	$12,381	$145,033
Q1(Oct-Dec) FY2014	$10,292	$204,059	$0	$145,033
Totals	$204,059		$145,033	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$30,631	$30,631	$0	$0	$30,631	$30,631
Q2(Jan-Mar) FY2013	$0	$30,631	$50,832	$50,832	$50,832	$81,463
Q3(Apr-Jun) FY2013	$0	$30,631	$21,255	$72,087	$21,255	$102,718
Q4(Jul-Sep) FY2013	$0	$30,631	$0	$72,087	$0	$102,718
Q1(Oct-Dec) FY2014	$0	$30,631	$0	$72,087	$0	$102,718
Totals	$30,631		$72,087		$102,718	

Task 185-SU: Unified 4D Trajectory Approach For Integrated Traffic Management

Project Description

PURPOSE: The projected growth in demand for the use of the traditional airspace by commercial space transportation entities will make it increasingly hard to accommodate launches on a Special Use Airspace (SUA) basis.

OBJECTIVES: The three main objectives for this project are:

(i) to develop plausible architectures for an Integrated Airspace Management System,

(ii) to research and develop the foundation of such a system so that, from the outset, time-space probabilistic trajectories and safety assessments can be incorporated, and

(iii) to create a prototype implementation for a proof-of-concept of the system that may be further developed in a follow-on project.

GOALS: Development of requirements, architecture and prototype implementations of simultaneous air/space traffic management procedures for commercial space transportation. Leverage projected improvements derived from NextGen.

Partners:

Federal Aviation Administration AST *
Stanford University *
NASA Ames Research Center

* - indicates primary partner

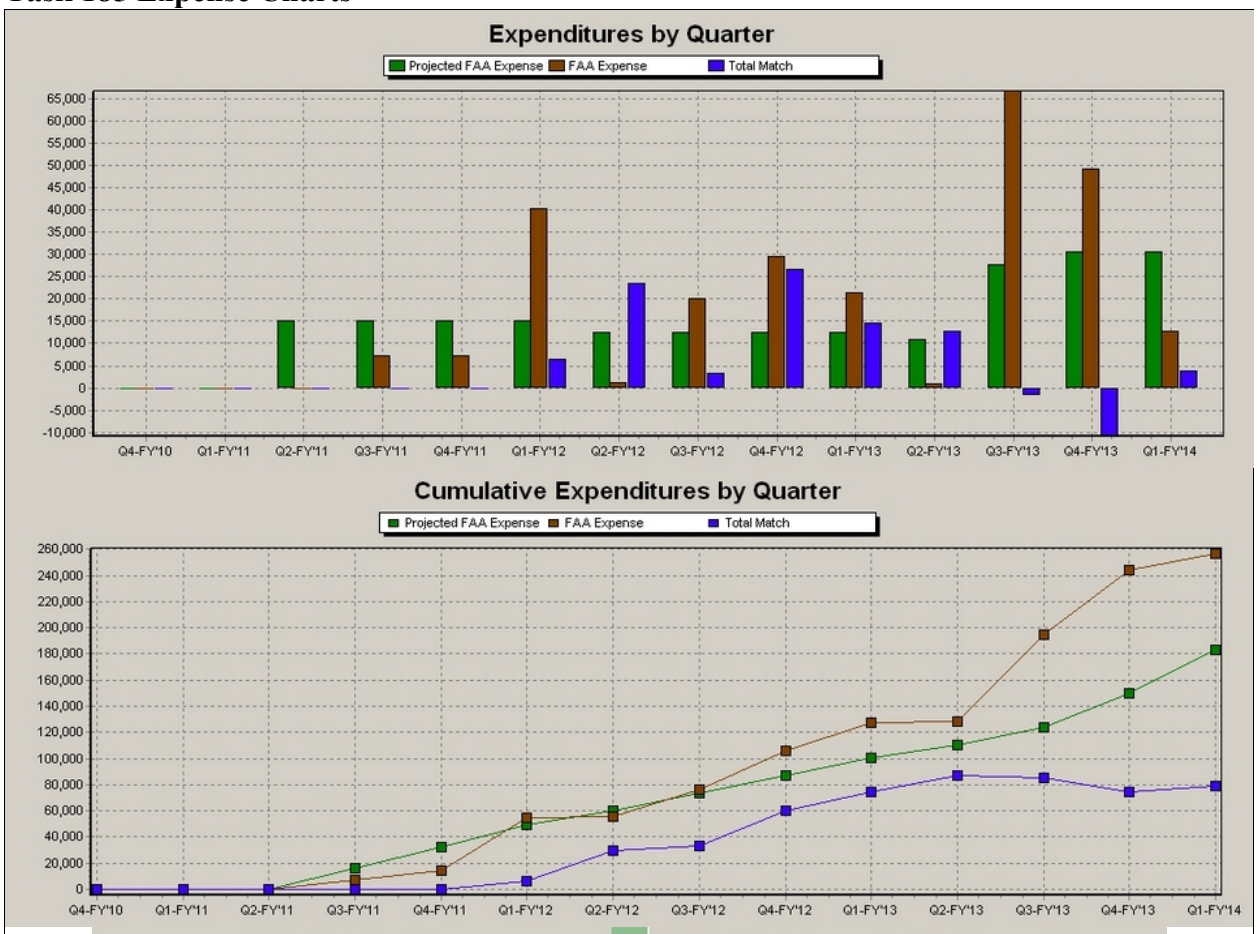
Funding History

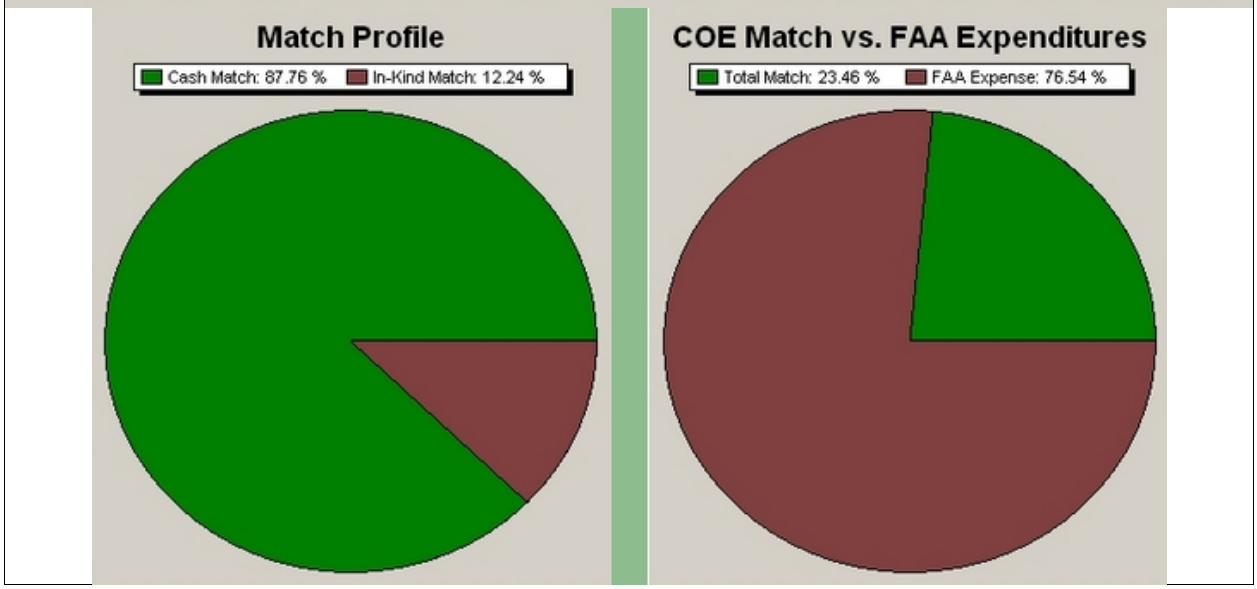
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-SU-005	$60,000	$60,000
1/1/2012	12/31/2012	2011	10-C-CST-SU-012	$50,000	$50,000
1/1/2013	5/31/2013	2012	10-C-CST-SU-019	$17,416	$17,416
1/1/2013	5/31/2013	2012	10-C-CST-SU-021	$580	$580
5/31/2013	5/31/2014	2013	10-C-CST-SU-025	$130,000	$130,000
5/31/2013	5/31/2014	2013	10-C-CST-SU-032	$3,000	$3,000
					Total: $260,996

Students

Name	Organization	Department	Discipline	Degree	Graduation
Colvin, Thomas J	Stanford University	Aeronautics & Astronautics	Aerospace Engineering	Ph.D.	6/1/2015

Task 185 Expense Charts





FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$15,000	$15,000	$0	$0
Q3(Apr-Jun) FY2011	$15,000	$30,000	$7,365	$7,365
Q4(Jul-Sep) FY2011	$15,000	$45,000	$7,237	$14,602
Q1(Oct-Dec) FY2012	$15,000	$60,000	$40,149	$54,751
Q2(Jan-Mar) FY2012	$12,500	$72,500	$1,111	$55,862
Q3(Apr-Jun) FY2012	$12,500	$85,000	$20,182	$76,044
Q4(Jul-Sep) FY2012	$12,500	$97,500	$29,620	$105,664
Q1(Oct-Dec) FY2013	$12,500	$110,000	$21,355	$127,019
Q2(Jan-Mar) FY2013	$10,798	$120,798	$977	$127,996
Q3(Apr-Jun) FY2013	$27,660	$148,458	$66,740	$194,736
Q4(Jul-Sep) FY2013	$30,692	$179,150	$49,158	$243,893
Q1(Oct-Dec) FY2014	$30,692	$209,842	$12,736	$256,629
Totals	$209,842		$256,629	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$6,468	$6,468	$0	$0	$6,468	$6,468
Q2(Jan-Mar) FY2012	$18,292	$24,760	$5,124	$5,124	$23,416	$29,884
Q3(Apr-Jun) FY2012	$3,234	$27,994	$0	$5,124	$3,234	$33,118
Q4(Jul-Sep) FY2012	$21,535	$49,529	$5,129	$10,252	$26,664	$59,782
Q1(Oct-Dec) FY2013	$11,695	$61,224	$2,848	$13,100	$14,542	$74,324
Q2(Jan-Mar) FY2013	$9,369	$70,593	$3,417	$16,517	$12,786	$87,110
Q3(Apr-Jun) FY2013	$203	$70,796	($1,771)	$14,746	($1,568)	$85,542
Q4(Jul-Sep) FY2013	($5,720)	$65,076	($5,124)	$9,622	($10,844)	$74,698
Q1(Oct-Dec) FY2014	$3,940	$69,016	$0	$9,622	$3,940	$78,638
Totals	$69,016		$9,622		$78,638	

Task 186-CU: Space Environment Modeling/Prediction

Project Description

PURPOSE: An integrated air and space traffic management system requires seamless and real-time access to density predictions for on-orbit collision avoidance and atmospheric reentry; future knowledge of deleterious particles including energetics, meteoroids, and debris; and near-surface weather prediction.

OBJECTIVES: We will develop (i) a weather prediction model extending from Earth's surface to the edge of space and (ii) a micrometeoroid detection and risk assessment system that, together, predict the environmental conditions needed for safe orbital, entry, descent and landing operations.

GOALS:

1. Define the process to develop a weather prediction model extending from Earth's surface to the edge of space (~600 km altitude).

2. Define the Process to develop a micrometeoroid detection and risk assessment system that, together, predict the environmental conditions needed for safe orbital, entry, descent and landing operations.

Partners:

Federal Aviation Administration AST *
University of Colorado at Boulder *

* - indicates primary partner

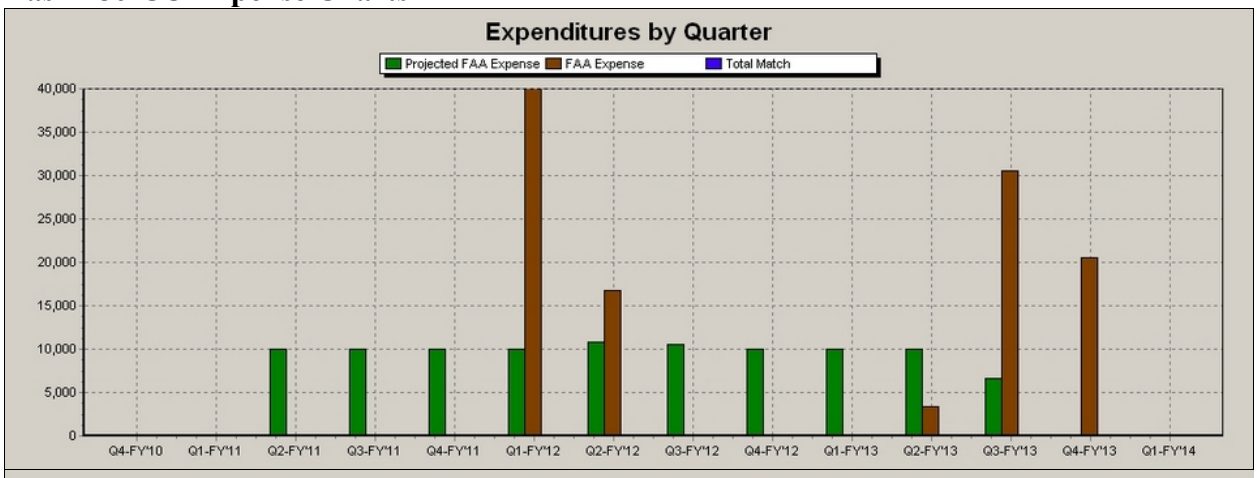
Funding History

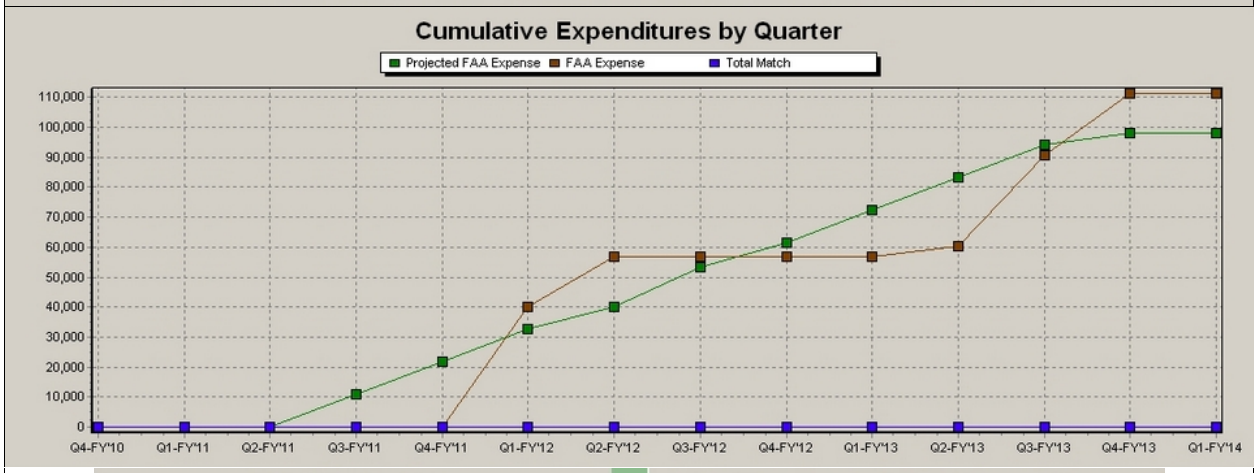
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UC-006	$40,000	$40,000
1/1/2012	5/31/2012	2012	10-C-CST-UC-013	$18,000	$18,000
6/1/2012	5/31/2013	2012	10-C-CST-UC-019	$40,000	$40,000
5/31/2013	5/31/2014	2012	10-C-CST-UC-032	$0	$0
					Total: $98,000

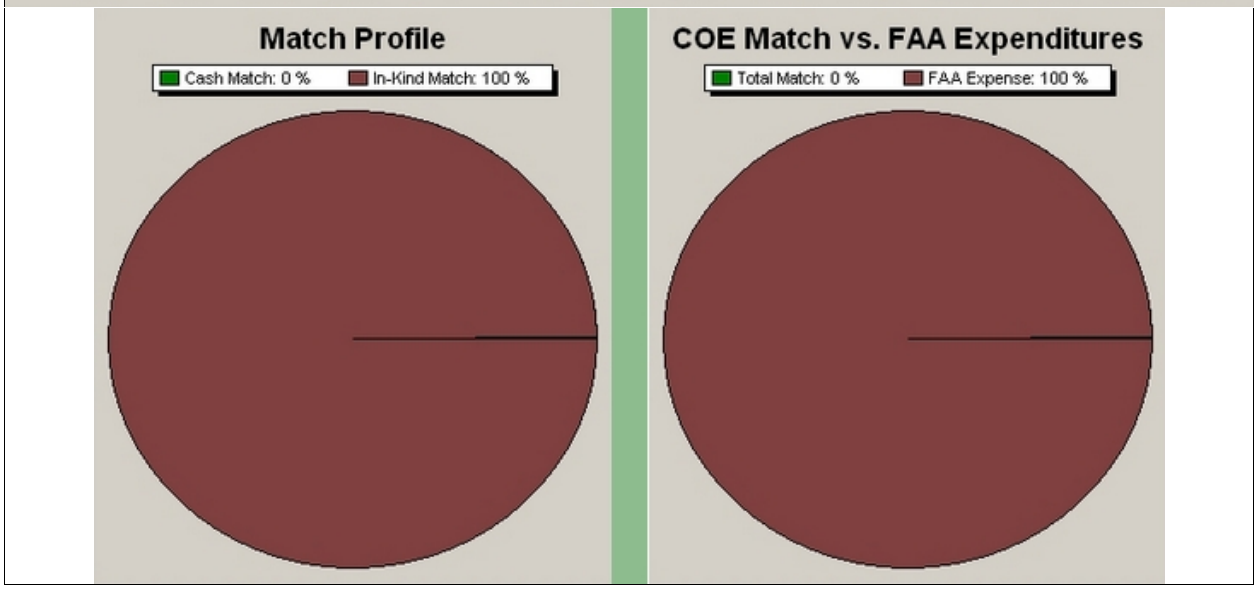
Students

None

Task 186-CU Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$10,000	$10,000	$0	$0
Q3(Apr-Jun) FY2011	$10,000	$20,000	$0	$0
Q4(Jul-Sep) FY2011	$10,000	$30,000	$0	$0
Q1(Oct-Dec) FY2012	$10,000	$40,000	$40,013	$40,013
Q2(Jan-Mar) FY2012	$10,800	$50,800	$16,778	$56,790
Q3(Apr-Jun) FY2012	$10,533	$61,333	$66	$56,856
Q4(Jul-Sep) FY2012	$10,000	$71,333	$0	$56,856
Q1(Oct-Dec) FY2013	$10,000	$81,333	$0	$56,856
Q2(Jan-Mar) FY2013	$10,000	$91,333	$3,373	$60,229
Q3(Apr-Jun) FY2013	$6,667	$98,000	$30,610	$90,839
Q4(Jul-Sep) FY2013	$0	$98,000	$20,491	$111,330
Q1(Oct-Dec) FY2014	$0	$98,000	$0	$111,330
Totals	$98,000		$111,330	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$0	$0	$0	$0	$0	$0
Totals	$0		$0		$0	

Task 186-SU: Space Environment Modeling/Prediction

Project Description

PURPOSE: An integrated air and space traffic management system requires seamless and real-time access to density predictions for on-orbit collision avoidance and atmospheric reentry; future knowledge of deleterious particles including energetics, meteoroids, and debris; and near-surface weather prediction.

OBJECTIVES: We will develop

(i) a weather prediction model extending from Earth's surface to the edge of space and,

(ii) a micrometeoroid detection and risk assessment system that, together, predict the environmental conditions needed for safe orbital, entry, descent and landing operations.

GOALS:

1. Define the process to develop a weather prediction model extending from Earth's surface to the edge of space (~600 km altitude).

2. Define the Process to develop a micrometeoroid detection and risk assessment system that, together, predict the environmental conditions needed for safe orbital, entry, descent and landing operations.

Partners:

Federal Aviation Administration AST *
Stanford University *

* - indicates primary partner

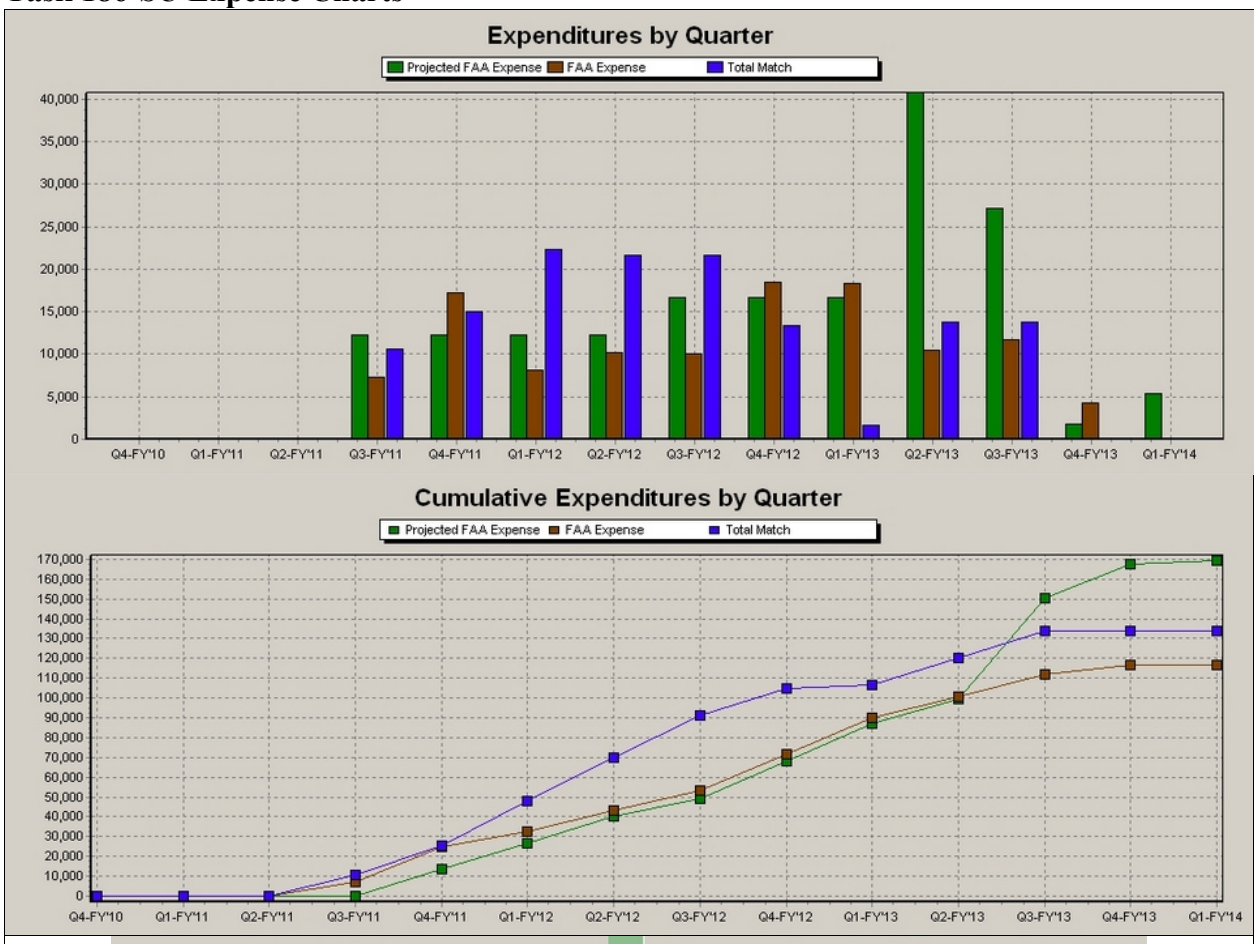
Funding History

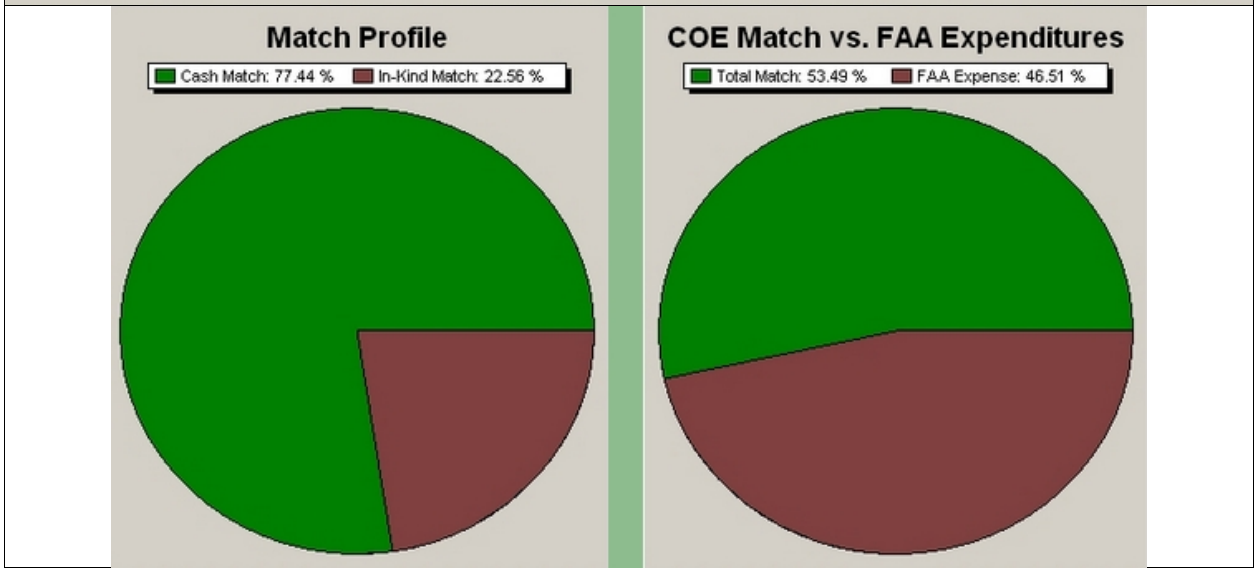
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
4/4/2011	3/31/2012	2010	10-C-CST-SU-003	$49,272	$49,272
4/1/2012	12/31/2012	2011	10-C-CST-SU-013	$50,000	$50,000
1/1/2013	5/31/2013	2012	10-C-CST-SU-022	$50,000	$50,000
1/1/2013	5/31/2013	2012	10-C-CST-SU-023	$18,042	$18,042
6/1/2013	9/30/2013	2012	10-C-CST-SU-026	$0	$0
9/30/2013	6/30/2014	2013	10-C-CST-SU-031	$10,000	$10,000
9/30/2013	6/30/2014	2013	10-C-CST-SU-033	$8,000	$8,000
					Total: $185,314

Students

Name	Organization	Department	Discipline	Degree	Graduation
Li, Alan	Stanford University	Aeronautics and Astronautics	-	Ph.D.	6/1/2015

Task 186-SU Expense Charts





FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$12,318	$12,318	$7,370	$7,370
Q4(Jul-Sep) FY2011	$12,318	$24,636	$17,270	$24,639
Q1(Oct-Dec) FY2012	$12,318	$36,954	$8,163	$32,803
Q2(Jan-Mar) FY2012	$12,318	$49,272	$10,235	$43,038
Q3(Apr-Jun) FY2012	$16,667	$65,939	$10,091	$53,129
Q4(Jul-Sep) FY2012	$16,667	$82,605	$18,439	$71,568
Q1(Oct-Dec) FY2013	$16,667	$99,272	$18,392	$89,960
Q2(Jan-Mar) FY2013	$40,825	$140,097	$10,454	$100,414
Q3(Apr-Jun) FY2013	$27,217	$167,314	$11,728	$112,143
Q4(Jul-Sep) FY2013	$1,800	$169,114	$4,305	$116,448
Q1(Oct-Dec) FY2014	$5,400	$174,514	$0	$116,448
Totals	$174,514		$116,448	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$8,529	$8,529	$2,098	$2,098	$10,627	$10,627
Q4(Jul-Sep) FY2011	$11,763	$20,291	$3,246	$5,344	$15,009	$25,635
Q1(Oct-Dec) FY2012	$16,555	$36,846	$5,840	$11,184	$22,394	$48,030
Q2(Jan-Mar) FY2012	$16,080	$52,926	$5,571	$16,755	$21,651	$69,680
Q3(Apr-Jun) FY2012	$16,091	$69,017	$5,578	$22,332	$21,669	$91,349
Q4(Jul-Sep) FY2012	$10,768	$79,785	$2,564	$24,896	$13,332	$104,681
Q1(Oct-Dec) FY2013	$1,666	$81,451	$0	$24,896	$1,666	$106,347
Q2(Jan-Mar) FY2013	$11,126	$92,576	$2,660	$27,557	$13,786	$120,133
Q3(Apr-Jun) FY2013	$11,126	$103,702	$2,660	$30,217	$13,786	$133,919
Q4(Jul-Sep) FY2013	$0	$103,702	$0	$30,217	$0	$133,919
Q1(Oct-Dec) FY2014	$0	$103,702	$0	$30,217	$0	$133,919
Totals	$103,702		$30,217		$133,919	

Task 187-CU: Space Situational Awareness Improvements

Project Description

PURPOSE: Effective space situational awareness faces the challenges of bringing together observations from disparate sensors and sources, developing computationally efficient dynamic propagation schemes, and formulating accurate estimation methods for the purpose of quantifying and qualifying space-based activities.

OBJECTIVES: The desired outcome is to:

(i) maximize the information extracted from all sources of collected data (minimize ambiguity),

(ii) gather data in a way that maximizes its information content (maximize efficiency),

(iii) recover and predict the space domain with more realistic and accurate knowledge, and

(iv) infer the space-based environment in a timely fashion so as to increase safety and enable effective decision making.

GOALS: The goal of this effort is to improve our knowledge of current and future behavior of space objects by reducing the associated uncertainties. This project will improve, develop, and test software, hardware, and information fusion plans to produce accurate, autonomous, and near real-time understanding of objects in the operational space environment to promote orbital safety and evaluate debris threat mitigation schemes. This will require coordination with various organizations in civil, commercial, and military space sectors.

Partners

Federal Aviation Administration AST *
University of Colorado at Boulder *

* - indicates primary partner

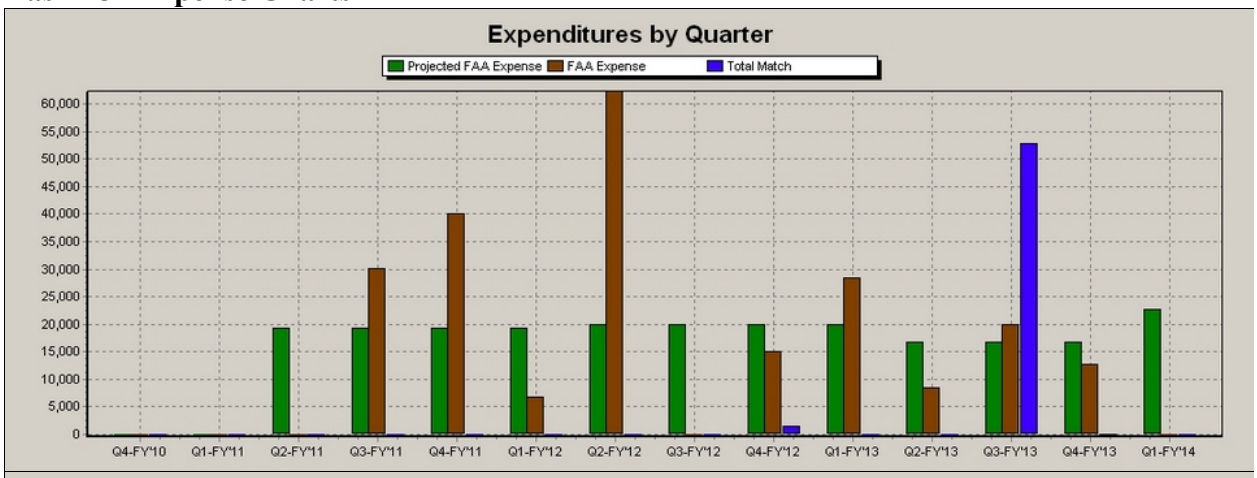
Funding History

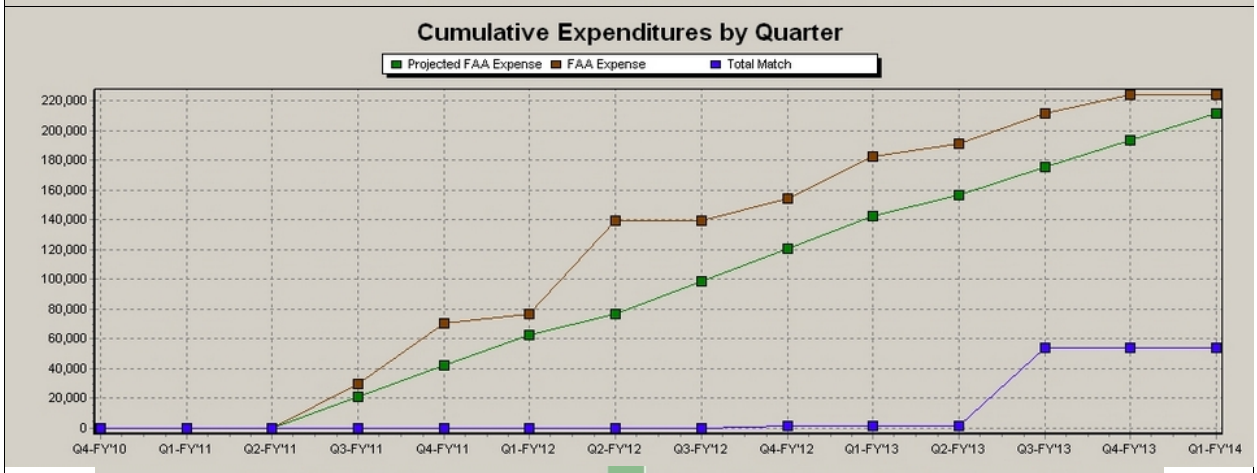
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UC-004	$76,906	$76,906
1/1/2012	12/31/2012	2011	10-C-CST-UC-010	$80,000	$80,000
1/1/2013	12/31/2013	2012	10-C-CST-UC-016	$67,069	$67,069
12/31/2013	5/31/2014	2013	10-C-CST-UC-031	$28,000	$28,000
12/31/2013	5/31/2014	2013	10-C-CST-UC-034	$8,000	$8,000
					Total: $259,975

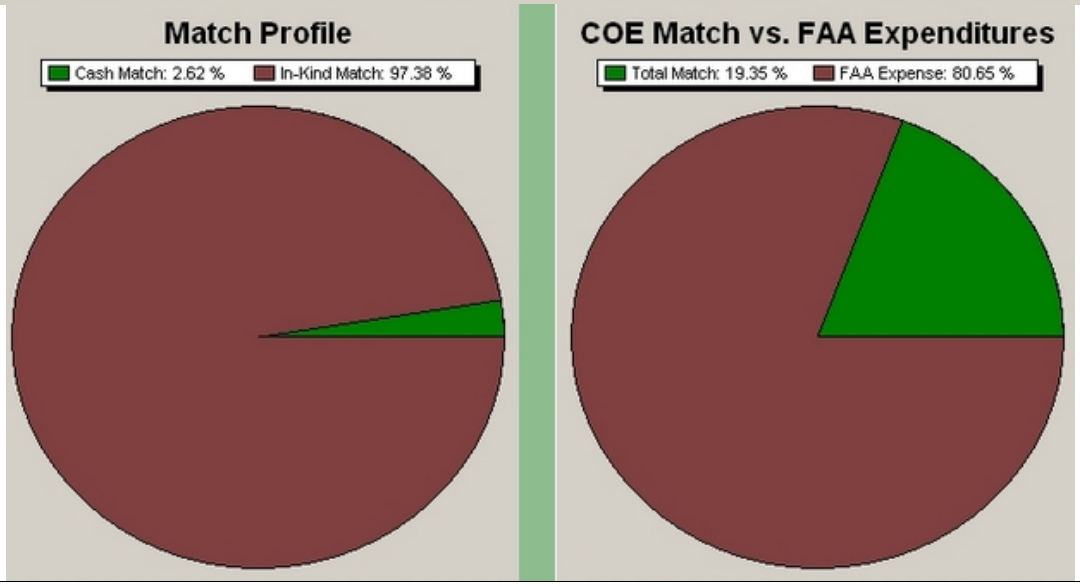
Students

Name	Organization	Department	Discipline	Degree	Graduation
Fujimoto, Kohei	University of Colorado	Aerospace Engineering Sciences	Astrodynamics	Ph.D.	5/13/2012

Task 187 Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$19,227	$19,227	$0	$0
Q3(Apr-Jun) FY2011	$19,227	$38,453	$30,147	$30,147
Q4(Jul-Sep) FY2011	$19,227	$57,680	$40,064	$70,211
Q1(Oct-Dec) FY2012	$19,227	$76,906	$6,695	$76,906
Q2(Jan-Mar) FY2012	$20,000	$96,906	$62,360	$139,266
Q3(Apr-Jun) FY2012	$20,000	$116,906	$0	$139,266
Q4(Jul-Sep) FY2012	$20,000	$136,906	$15,031	$154,297
Q1(Oct-Dec) FY2013	$20,000	$156,906	$28,367	$182,664
Q2(Jan-Mar) FY2013	$16,767	$173,673	$8,444	$191,108
Q3(Apr-Jun) FY2013	$16,767	$190,441	$20,040	$211,148
Q4(Jul-Sep) FY2013	$16,767	$207,208	$12,826	$223,975
Q1(Oct-Dec) FY2014	$22,767	$229,975	$0	$223,975
Totals	$229,975		$223,975	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$1,408	$1,408	$0	$0	$1,408	$1,408
Q1(Oct-Dec) FY2013	$0	$1,408	$0	$0	$0	$1,408
Q2(Jan-Mar) FY2013	$0	$1,408	$0	$0	$0	$1,408
Q3(Apr-Jun) FY2013	$0	$1,408	$52,743	$52,743	$52,743	$54,151
Q4(Jul-Sep) FY2013	$0	$1,408	($419)	$52,324	($419)	$53,732
Q1(Oct-Dec) FY2014	$0	$1,408	$0	$52,324	$0	$53,732
Totals	$1,408		$52,324		$53,732	

Task 193-CU: Role of the COE-CST in Encourage, Facilitate and Promote

Project Description

PURPOSE: The current environment favors such initiatives conceptually, but the business case for them is difficult to close. Unless they have a specific interest in the hosted technology, commercial launch users are reluctant to give up even a few kilograms of launch mass at prices supportable by research institutions and small commercial startups.

OBJECTIVES: The objectives of this project are to provide training in and to construct, analyze and optimize a business model that fosters a favorable environment for flying many research and operational payloads either as rideshares deployed from commercial launches or as hosted payloads aboard commercial spacecraft.

GOALS: Near-Term: Develop a COE CST commercial space transportation research road-map by conducting workshops. Far-Term: Implement the strategy for commercial space transportation EFP using analysis tools and techniques at the intersection of engineering and business.

Partners:

- Federal Aviation Administration AST *
- University of Colorado at Boulder *

* - indicates primary partner

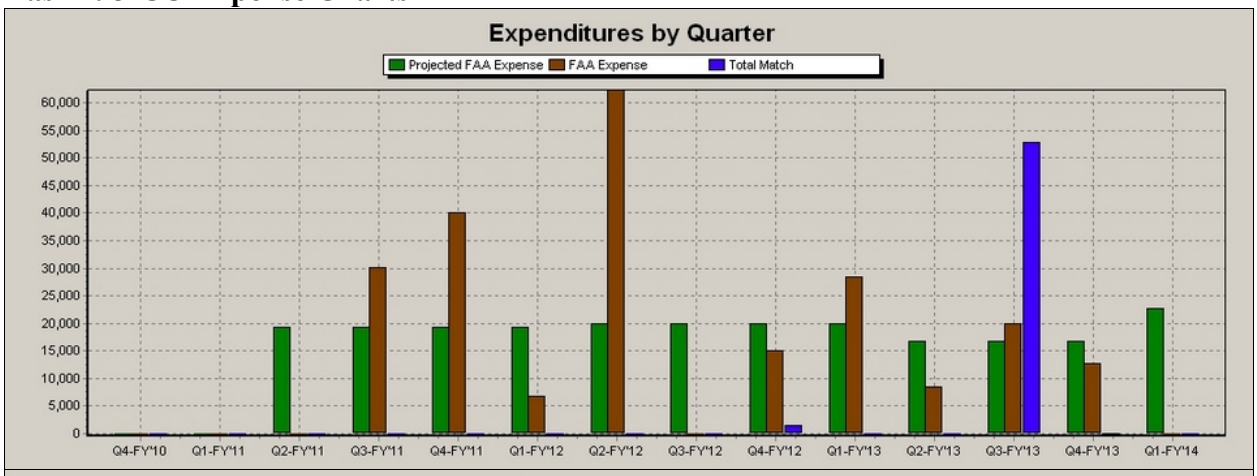
Funding History

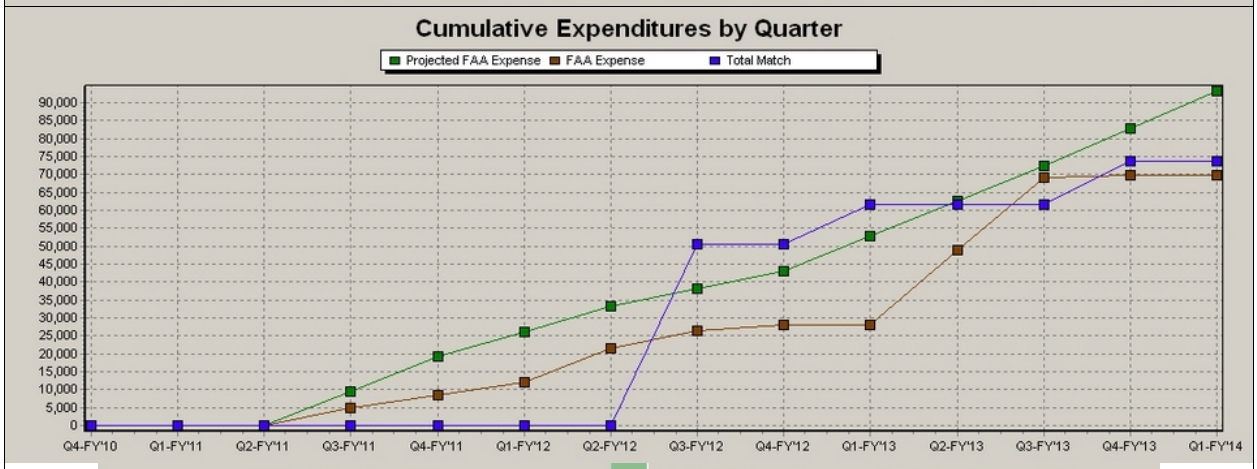
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UC-002	$11,552	$11,552
1/3/2011	8/31/2011	2010	10-C-CST-UC-008	$15,092	$15,092
9/1/2011	5/31/2012	2012	10-C-CST-UC-012	$13,000	$13,000
6/1/2012	12/31/2012	2012	10-C-CST-UC-018	$0	$0
6/1/2012	5/31/2013	2012	10-C-CST-UC-020	$36,000	$36,000
5/31/2013	12/31/2013	2012	10-C-CST-UC-026	$24,716	$24,716
					Total: $100,360

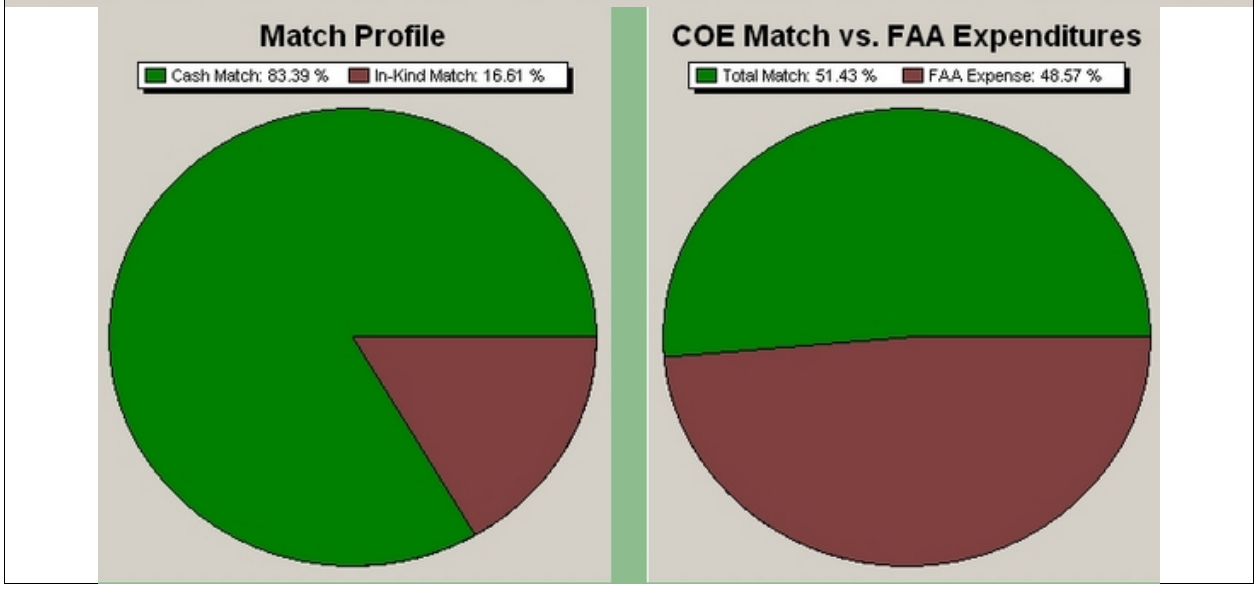
Students

Name	Organization	Department	Discipline	Degree	Graduation
Cheetham, Bradley W	University of Colorado at Boulder	Aerospace Engineering Sciences	Aerospace Engineering	Ph.D.	-
Feldhacker, Juliana	University of Colorado at Boulder	Aerospace Engineering Sciences	-	Ph.D.	-

Task 193-CU Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$8,548	$8,548	$0	$0
Q3(Apr-Jun) FY2011	$8,548	$17,095	$5,050	$5,050
Q4(Jul-Sep) FY2011	$8,105	$25,200	$3,291	$8,340
Q1(Oct-Dec) FY2012	$7,221	$32,422	$3,837	$12,177
Q2(Jan-Mar) FY2012	$4,333	$36,755	$9,451	$21,628
Q3(Apr-Jun) FY2012	$5,889	$42,644	$4,853	$26,481
Q4(Jul-Sep) FY2012	$9,000	$51,644	$1,442	$27,923
Q1(Oct-Dec) FY2013	$9,000	$60,644	$0	$27,923
Q2(Jan-Mar) FY2013	$9,000	$69,644	$21,130	$49,053
Q3(Apr-Jun) FY2013	$12,179	$81,823	$19,999	$69,051
Q4(Jul-Sep) FY2013	$9,269	$91,092	$671	$69,722
Q1(Oct-Dec) FY2014	$9,269	$100,360	$0	$69,722
Totals	$100,360		$69,722	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$50,598	$50,598	$0	$0	$50,598	$50,598
Q4(Jul-Sep) FY2012	$0	$50,598	$0	$0	$0	$50,598
Q1(Oct-Dec) FY2013	$10,966	$61,564	$0	$0	$10,966	$61,564
Q2(Jan-Mar) FY2013	$0	$61,564	$0	$0	$0	$61,564
Q3(Apr-Jun) FY2013	$0	$61,564	$0	$0	$0	$61,564
Q4(Jul-Sep) FY2013	$0	$61,564	$12,258	$12,258	$12,258	$73,823
Q1(Oct-Dec) FY2014	$0	$61,564	$0	$12,258	$0	$73,823
Totals	$61,564		$12,258		$73,823	

Task 193-SU: Role of the COE-CST in Encourage, Facilitate and Promote

Project Description

PURPOSE: The current environment favors such initiatives conceptually, but the business case for them is difficult to close. Unless they have a specific interest in the hosted technology, commercial launch users are reluctant to give up even a few kilograms of launch mass at prices supportable by research institutions and small commercial startups.

OBJECTIVES: The objectives of this project are to provide training in and to construct, analyze and optimize a business model that fosters a favorable environment for flying many research and operational payloads either as rideshares deployed from commercial launches or as hosted payloads aboard commercial spacecraft.

GOALS: Near-Term: Develop a COE CST commercial space transportation research road-map by conducting workshops. Far-Term: Implement the strategy for commercial space transportation EFP using analysis tools and techniques at the intersection of engineering and business.

Partners:

Federal Aviation Administration AST *

- Stanford University *
- Futron*
- Lockheed Martin Space Systems Company*
- Orbital Sciences Corporation*
- Scitor Corporation Launch and Space Sector*
- Space Systems / Loral*
- The Boeing Company Boeing Space Exploration*
- The Pennsylvania State University College of Engineering*
- United Launch Alliance*
- Wyle Integrated Science and Engineering Group*

* - indicates primary partner

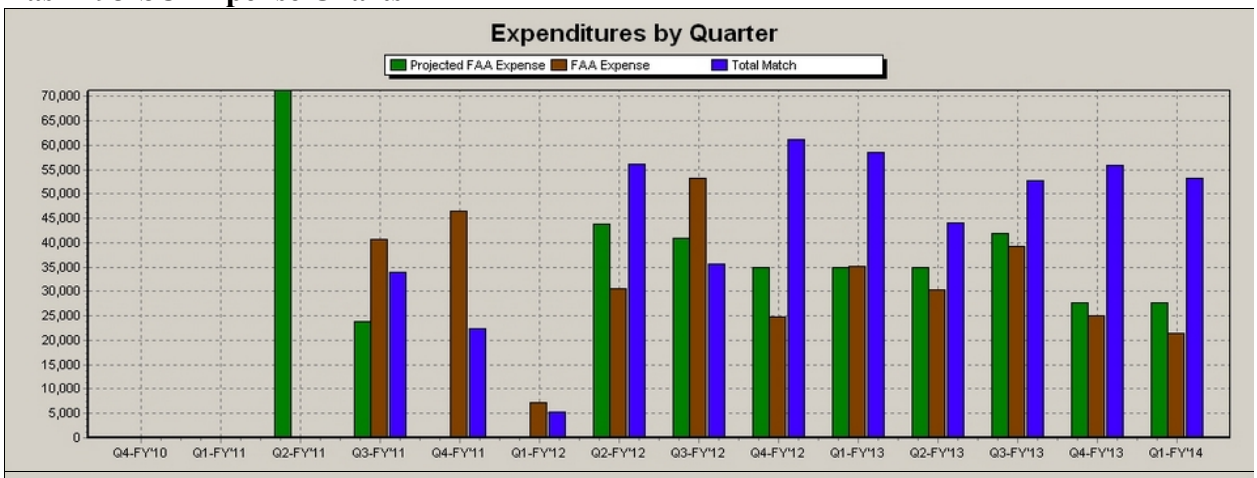
Funding History

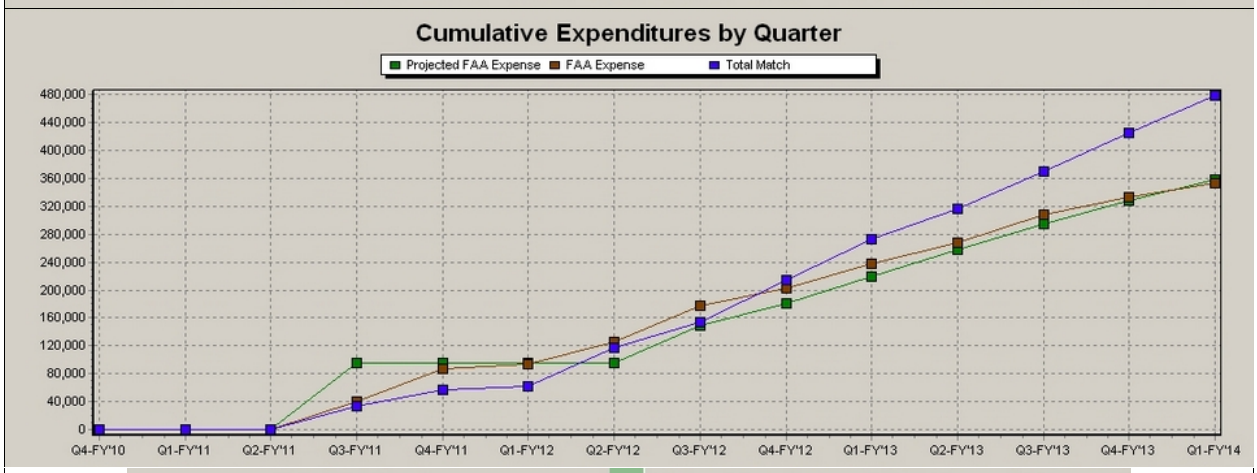
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	4/30/2011	2010	10-C-CST-SU-002	$95,038	$95,038
5/1/2011	12/31/2011	2010	10-C-CST-SU-009	$0	$0
8/18/2010	12/31/2011	2010	10-C-CST-SU-011	$0	$0
1/1/2012	5/31/2012	2012	10-C-CST-SU-015	$73,000	$73,000
6/1/2012	5/31/2013	2012	10-C-CST-SU-018	$140,123	$140,123
5/31/2013	5/31/2014	2013	10-C-CST-SU-027	$71,284	$71,284
5/31/2013	5/31/2014	2013	10-C-CST-SU-035	$45,000	$45,000
5/31/2013	5/31/2014	2013	10-C-CST-SU-039	$4,000	$4,000
5/31/2013	5/31/2014	2013	10-C-CST-SU-040	$0	$0
				Total:	$428,445

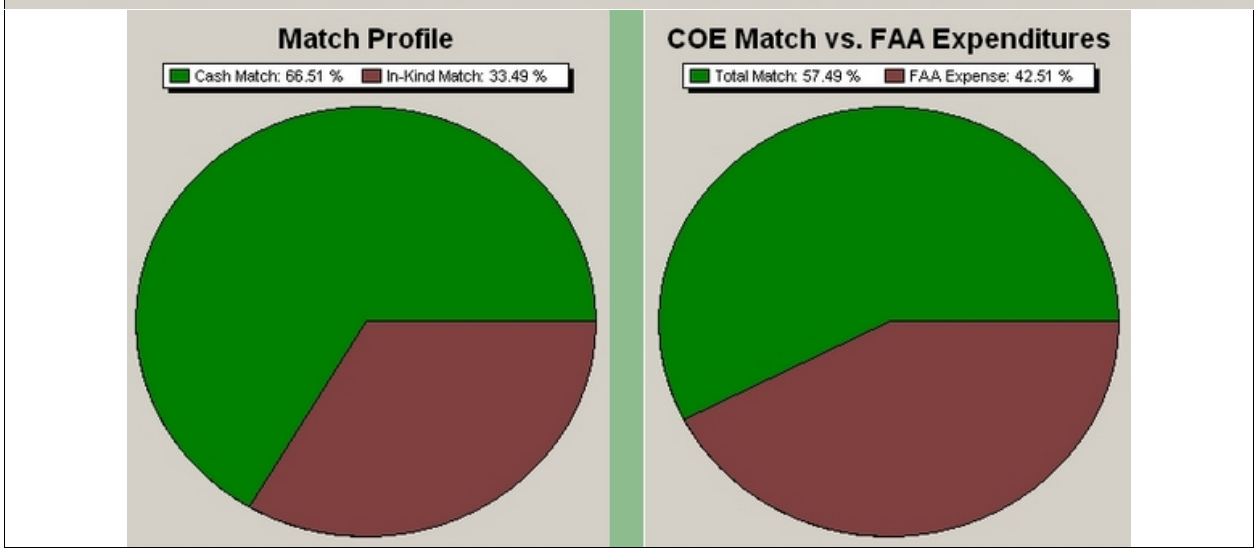
Students

Name	Organization	Department	Discipline	Degree	Graduation
Zimmerman, Jonah	Stanford University	Aeronautics and Astronautics	-	Ph.D.	6/1/2015

Task 193-SU Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$71,279	$71,279	$0	$0
Q3(Apr-Jun) FY2011	$23,760	$95,038	$40,582	$40,582
Q4(Jul-Sep) FY2011	$0	$95,038	$46,415	$86,997
Q1(Oct-Dec) FY2012	$0	$95,038	$7,159	$94,156
Q2(Jan-Mar) FY2012	$43,800	$138,838	$30,650	$124,806
Q3(Apr-Jun) FY2012	$40,877	$179,715	$53,285	$178,091
Q4(Jul-Sep) FY2012	$35,031	$214,746	$24,880	$202,971
Q1(Oct-Dec) FY2013	$35,031	$249,776	$35,114	$238,085
Q2(Jan-Mar) FY2013	$35,031	$284,807	$30,272	$268,357
Q3(Apr-Jun) FY2013	$41,859	$326,666	$39,367	$307,724
Q4(Jul-Sep) FY2013	$27,758	$354,424	$24,982	$332,706
Q1(Oct-Dec) FY2014	$27,758	$382,182	$21,360	$354,066
Totals	$382,182		$354,066	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$11,843	$11,843	$22,147	$22,147	$33,990	$33,990
Q4(Jul-Sep) FY2011	$3,425	$15,268	$18,991	$41,138	$22,416	$56,406
Q1(Oct-Dec) FY2012	$3,378	$18,646	$1,912	$43,050	$5,290	$61,696
Q2(Jan-Mar) FY2012	$35,777	$54,424	$20,250	$63,300	$56,028	$117,723
Q3(Apr-Jun) FY2012	$32,662	$87,085	$3,047	$66,347	$35,709	$153,432
Q4(Jul-Sep) FY2012	$36,856	$123,941	$24,310	$90,657	$61,166	$214,598
Q1(Oct-Dec) FY2013	$47,574	$171,515	$10,997	$101,654	$58,571	$273,169
Q2(Jan-Mar) FY2013	$12,421	$183,936	$31,635	$133,289	$44,056	$317,225
Q3(Apr-Jun) FY2013	$43,732	$227,668	$9,002	$142,291	$52,734	$369,959
Q4(Jul-Sep) FY2013	$43,351	$271,020	$12,421	$154,712	$55,772	$425,732
Q1(Oct-Dec) FY2014	$47,484	$318,504	$5,686	$160,398	$53,170	$478,902
Totals	$318,504		$160,398		$478,902	

Task 220-NMSU: Space Operational Framework

Project Description

Develop an accepted framework to capture a body of knowledge for commercial spaceport practices through 2012. Once the framework and processes are established, and proven to be useful, further individual practices may be developed by the spaceport community, the launch provider community, the FAA, NASA, and other users of commercial launch services on a priority basis as needed as the industry evolves.

Partners:

AIAA *
American Institute of Aeronautics and Astronautics *
ATK *
Bachner Consultants, Inc. *
Ball Aerospace Civil and Operational Space *
Cimmaron Software Services Inc. *
Digital Solutions *
Federal Aviation Administration AST *
Marketing Consultant *
National Space Grant Foundation *
New Mexico State University *
NMSU Space Development Foundation *
Space News *
Spaceport Sweden Swedish Institute of Space Physics *
The Boeing Company *
CSSI Inc.
Dynetics, Inc. Test & Operations
Jacobs Technology Inc. NASA/White Sands Test Facility
Lockheed Martin Space Systems Company
Penn State University Aerospace Engineering
Qinetiq
Space Works Enterprises
Spaceport America Consultants
Spaceworks Washington DC Operations
The Tauri Group
Webster University Space Programs
XCOR Aerospace, Inc.
* - indicates primary partner

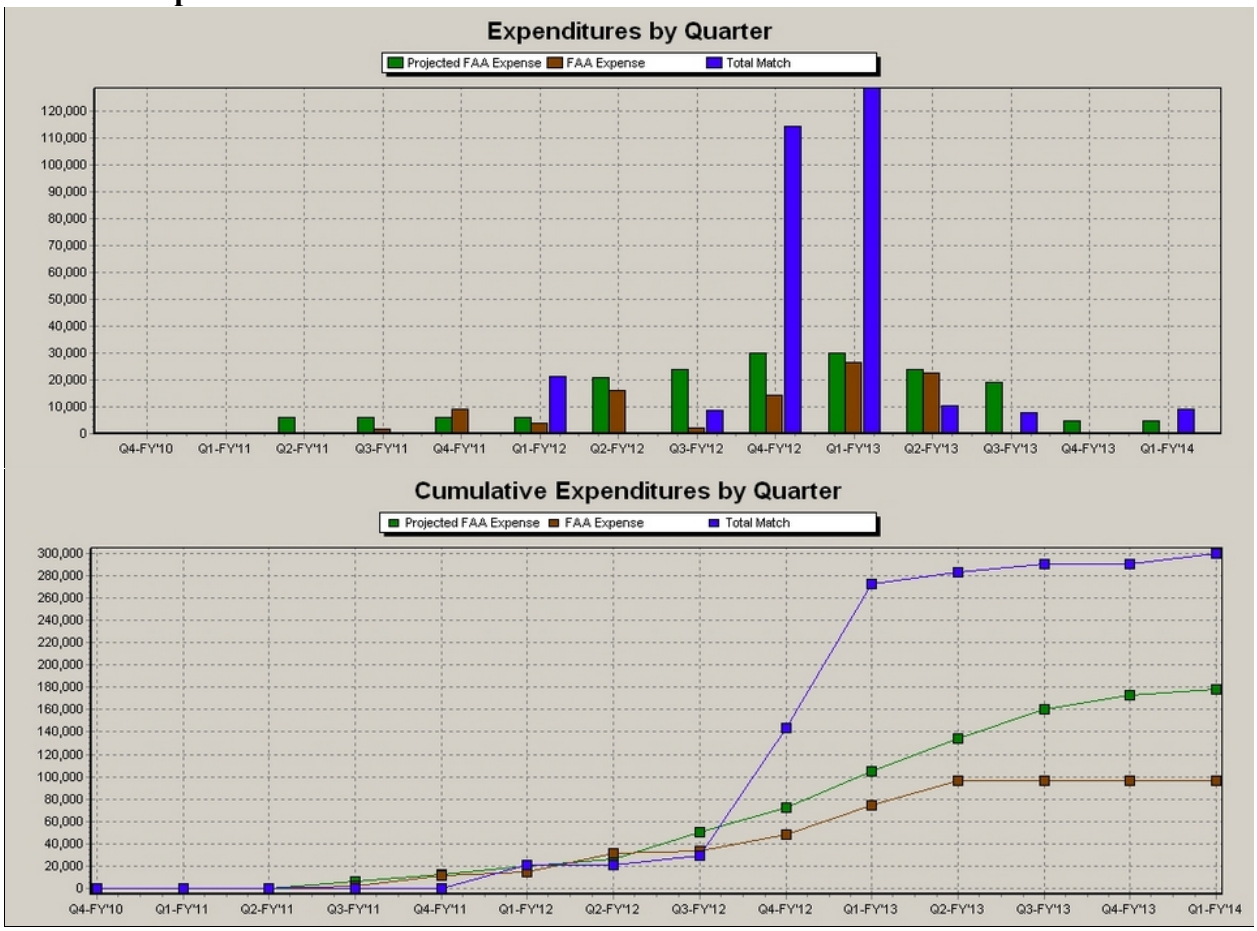
Funding History

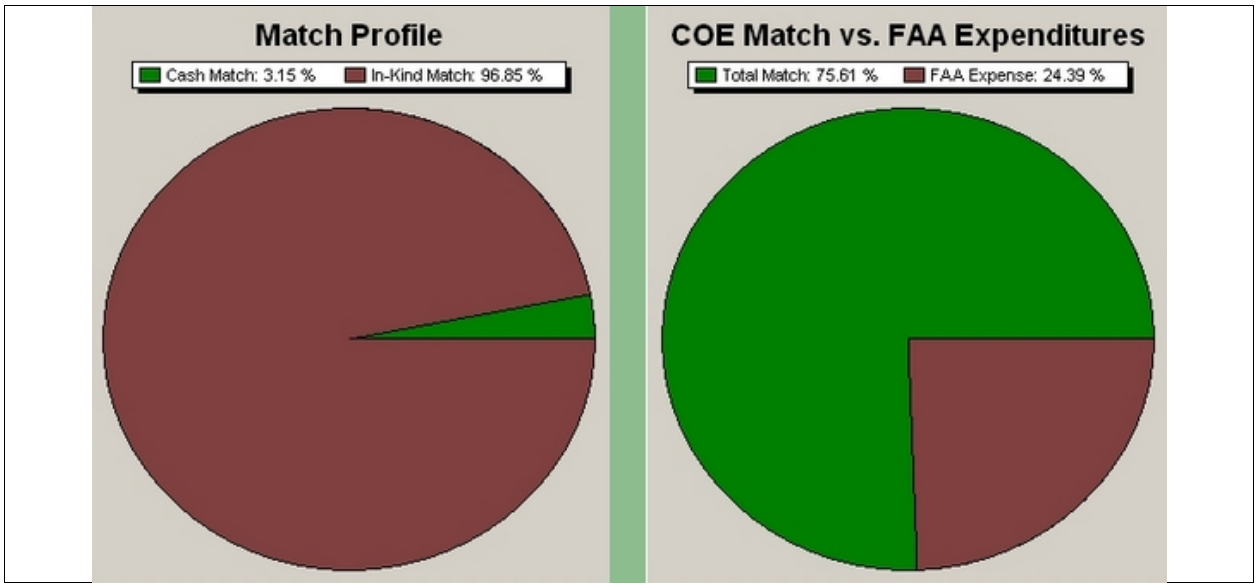
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2012	2010	10-C-CST-NMSU-002	$50,126	$50,126
1/1/2012	5/31/2012	2010	10-C-CST-NMSU-004	$24,000	$24,000
6/1/2012	5/31/2013	2010	10-C-CST-NMSU-006	$26,310	$26,310
6/1/2012	5/31/2013	2012	10-C-CST-NMSU-008	$35,497	$35,497
6/1/2012	5/31/2013	2012	10-C-CST-NMSU-010	$5,000	$5,000
6/1/2012	5/31/2013	2010	10-C-CST-NMSU-007	$28,234	$28,234
5/31/2013	5/31/2014	2012	10-C-CST-NMSU-011	$0	$0
5/31/2013	5/31/2014	2013	10-C-CST-NMSU-015	$18,000	$18,000
5/31/2013	5/31/2014	2013	10-C-CST-NMSU-017	$3,000	$3,000
					Total: $190,167

Students

Name	Organization	Department	Discipline	Degree	Graduation
Deaven, Jacob W	New Mexico Space Grant	Government	Government	Masters	12/15/2013
Strevel, Hank	NMSU	Government	-	Masters	12/1/2012
Bowers, Marianne	NMSU	Government	Government	Masters	-

Task 220 Expense Charts





FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$6,266	$6,266	$0	$0
Q3(Apr-Jun) FY2011	$6,266	$12,532	$1,743	$1,743
Q4(Jul-Sep) FY2011	$6,266	$18,797	$9,265	$11,008
Q1(Oct-Dec) FY2012	$6,266	$25,063	$4,113	$15,121
Q2(Jan-Mar) FY2012	$20,666	$45,729	$16,207	$31,328
Q3(Apr-Jun) FY2012	$23,786	$69,515	$2,266	$33,594
Q4(Jul-Sep) FY2012	$30,026	$99,541	$14,237	$47,831
Q1(Oct-Dec) FY2013	$30,026	$129,567	$26,352	$74,183
Q2(Jan-Mar) FY2013	$23,760	$153,327	$22,539	$96,723
Q3(Apr-Jun) FY2013	$19,071	$172,398	$0	$96,723
Q4(Jul-Sep) FY2013	$4,846	$177,244	$0	$96,723
Q1(Oct-Dec) FY2014	$4,846	$182,090	$0	$96,723
Totals	$182,090		$96,723	

COE Matching by Quarter						
Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$21,081	$21,081	$21,081	$21,081
Q2(Jan-Mar) FY2012	$0	$0	$0	$21,081	$0	$21,081
Q3(Apr-Jun) FY2012	$0	$0	$8,610	$29,691	$8,610	$29,691
Q4(Jul-Sep) FY2012	$0	$0	$114,380	$144,071	$114,380	$144,071
Q1(Oct-Dec) FY2013	$9,440	$9,440	$119,148	$263,219	$128,588	$272,659
Q2(Jan-Mar) FY2013	$10	$9,450	$10,309	$273,528	$10,319	$282,978
Q3(Apr-Jun) FY2013	$0	$9,450	$7,820	$281,348	$7,820	$290,798
Q4(Jul-Sep) FY2013	$0	$9,450	$0	$281,348	$0	$290,798
Q1(Oct-Dec) FY2014	$0	$9,450	$9,020	$290,368	$9,020	$299,818
Totals	$9,450		$290,368		$299,818	

Task 228-NMT: Magneto-Elastic Sensing For Structural Health Monitoring

Project Description

PURPOSE: Our prior work and experience in SHM of space structures indicates that a robust, reliable and low maintenance approach is needed to monitor integrity of space vehicles.

OBJECTIVES:

1. Develop adequate analytical and numerical models which describe magneto-elastic damage detection.
2. Investigate potential of the magneto-elastic SHM for characterization of interfaces in space structures and assessment of incipient fatigue damage before crack development.
3. Explore damage manifestation in the magneto-mechanical sensor signature and suggest respective feature extraction algorithms.
4. Consider methodologies for features classification / damage characterization that enable integration of the above mentioned components into a comprehensive SHM system.

GOALS: Near-Term: explore if embedding sensors that can be pulsed with magnetic fields can yield reduction of space vehicle qualification time (and cost) via real time monitoring of structural interfaces during and after assembly, on-orbit diagnosis and system characterization - would enable rapid turnaround/flight rates of RLVs Far-Term: deploy to industry if successful.

Partners:

- Federal Aviation Administration AST *
- New Mexico Institute of Mining and Technology *

* - indicates primary partner

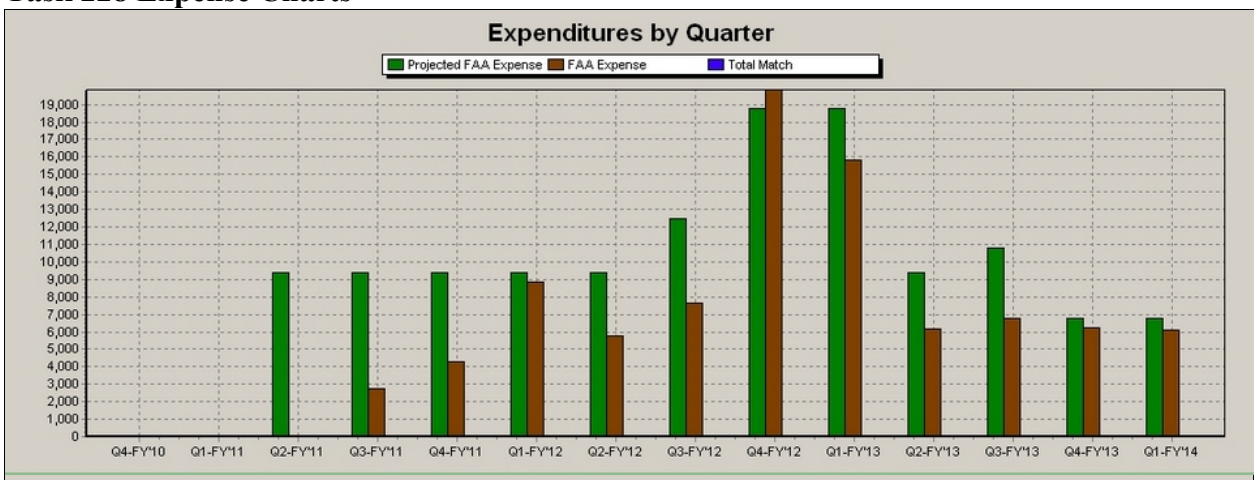
Funding History

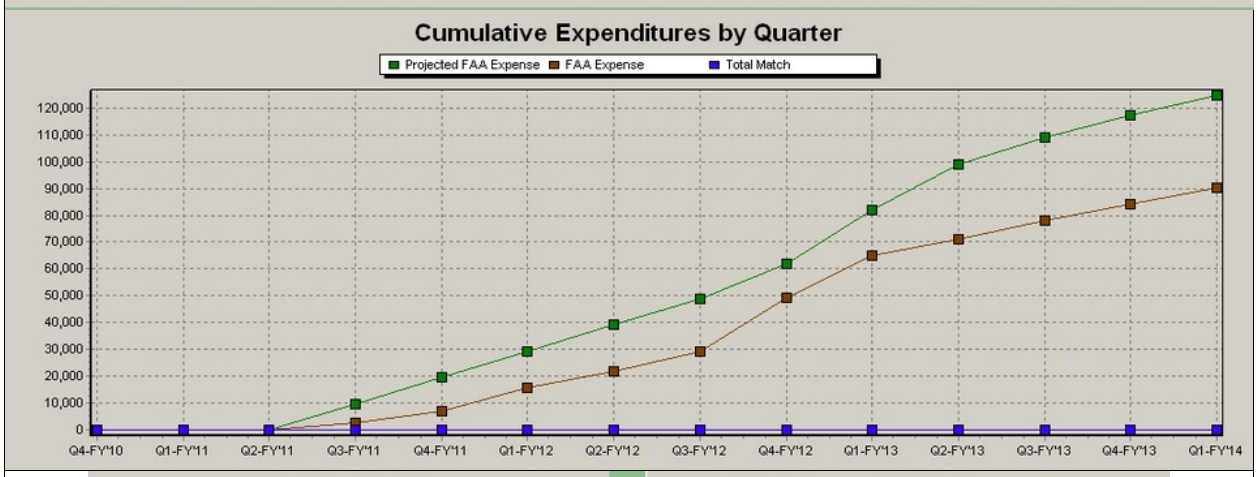
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2012	2010	10-C-CST-NMT-002	$75,000	$75,000
6/1/2012	5/31/2013	2010	10-C-CST-NMT-005	$37,500	$37,500
5/31/2013	7/31/2014	2010	10-C-CST-NMT-009	$0	$0
5/31/2013	7/31/2014	2012	10-C-CST-NMT-011	$19,000	$19,000
5/31/2013	5/31/2014	2013	10-C-CST-NMT-014	$6,000	$6,000
5/31/2013	5/31/2014	2013	10-C-CST-NMT-017	$7,000	$7,000
5/31/2013	7/31/2014	2013	10-C-CST-NMT-020	$0	$0
					Total: $144,500

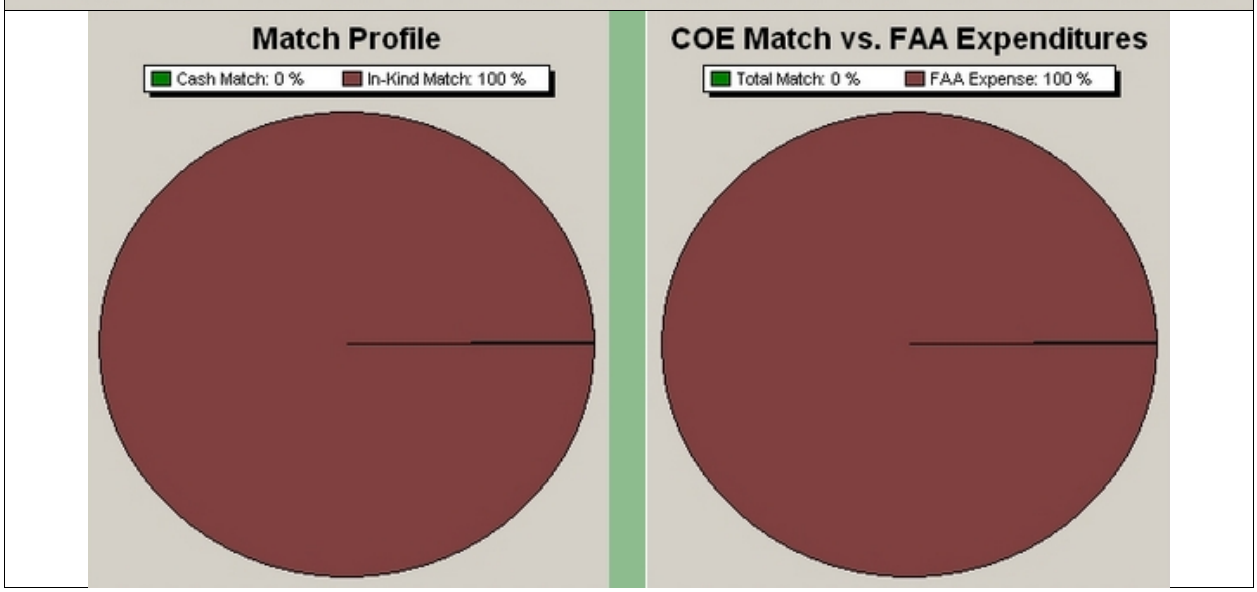
Students

Name	Organization	Department	Discipline	Degree	Graduation
Meisner, Daniel	New Mexico Institute of Mining and Technology	Mechanical Engineering	Mechatronics Systems Engineering	Masters	-
Conrad, David	New Mexico Institute of Mining and Technology	Mechanical Engineering	Mechatronics Systems Engineering	Masters	-
Kruse, Walter	New Mexico Institute of Mining and Technology	Mechanical Engineering	Mechatronics Systems Engineering	Masters	5/1/2011
Gutierrez, Jaclene	New Mexico Institute of Mining and Technology	Mechanical Engineering	-	Bachelors	-
Trujillo, Blaine	New Mexico Institute of Mining and Technology	Mechanical Engineering	Mechatronics Systems Engineering	Masters	-
Masker, William	New Mexico Institute of Mining and Technology	Electrical Engineering	Electrical Engineering	Bachelors	-
Runnels, Joel	New Mexico Institute of Mining and Technology	Mechanical Engineering	Mechanical Engineering	Bachelors	-
Cooper, Benjamin	New Mexico Institute of Mining and Technology	Mechanical Engineering	Mechatronics and Systems Engineering	Masters	-

Task 228 Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$9,375	$9,375	$0	$0
Q3(Apr-Jun) FY2011	$9,375	$18,750	$2,758	$2,758
Q4(Jul-Sep) FY2011	$9,375	$28,125	$4,291	$7,049
Q1(Oct-Dec) FY2012	$9,375	$37,500	$8,820	$15,869
Q2(Jan-Mar) FY2012	$9,375	$46,875	$5,799	$21,668
Q3(Apr-Jun) FY2012	$12,500	$59,375	$7,651	$29,318
Q4(Jul-Sep) FY2012	$18,750	$78,125	$19,845	$49,164
Q1(Oct-Dec) FY2013	$18,750	$96,875	$15,829	$64,992
Q2(Jan-Mar) FY2013	$9,375	$106,250	$6,150	$71,142
Q3(Apr-Jun) FY2013	$10,783	$117,033	$6,751	$77,893
Q4(Jul-Sep) FY2013	$6,800	$123,833	$6,261	$84,154
Q1(Oct-Dec) FY2014	$6,800	$130,633	$6,112	$90,266
Totals	$130,633		$90,266	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$0	$0	$0	$0	$0	$0
Totals	$0		$0		$0	

Task 241-FSU: High Temperature, Optical Sapphire Pressure Sensors For Hypersonic Vehicles

Project Description

PURPOSE: The study of hypersonic boundary layers is critical to the efficient design of hypersonic vehicles for rapid global and space access. The harsh environment makes conventional instrumentation unsuitable for time accurate, continuous, direct measurements. The development of a high temperature sensor for direct measurement of pressure is vital to the understanding of shock-wave/boundary layer interactions which directly influence critical vehicle characteristics such as lift, drag, and propulsion efficiency.

OBJECTIVES:

- Design a sapphire optical lever microphone via multiphysics analytical modeling - Develop thermocompression fabrication methods for the formation of devices with moving parts out of sapphire and platinum
- Development of techniques for ultrafast laser micromachining of sapphire for sensor and packaging fabrication
- Fabrication and packaging of pressure sensors optimized for low-noise and highsensitivity while possessing minimal drift associated with changes in relative humidity, temperature, etc.
- Characterization of sensors in a simulated, high temperature, pressurized laboratory environment - Implementation in a hypersonic flow facility (such as Arnold Engineering Development Center, etc.) and/or a gas turbine (such as the Capstone C60 microturbine at the University of Florida, etc.)

GOALS: Design a fiber optic lever pressure sensor with a remote photo-diode optical readout. The microphone is composed of a compliant, platinum coated, sapphire diaphragm bonded over a cavity containing a single optical fiber. The diaphragm deflection is detected via intensity modulation due to the motion of the reflective platinum coated sapphire diaphragm. The optical signal is routed via the high temperature sapphire fiber to a remote photo-diode allowing for insulation of the electronics from the harsh environment.

Partners:

- Federal Aviation Administration AST *
- Florida State University *
- Space Florida *

* - indicates primary partner

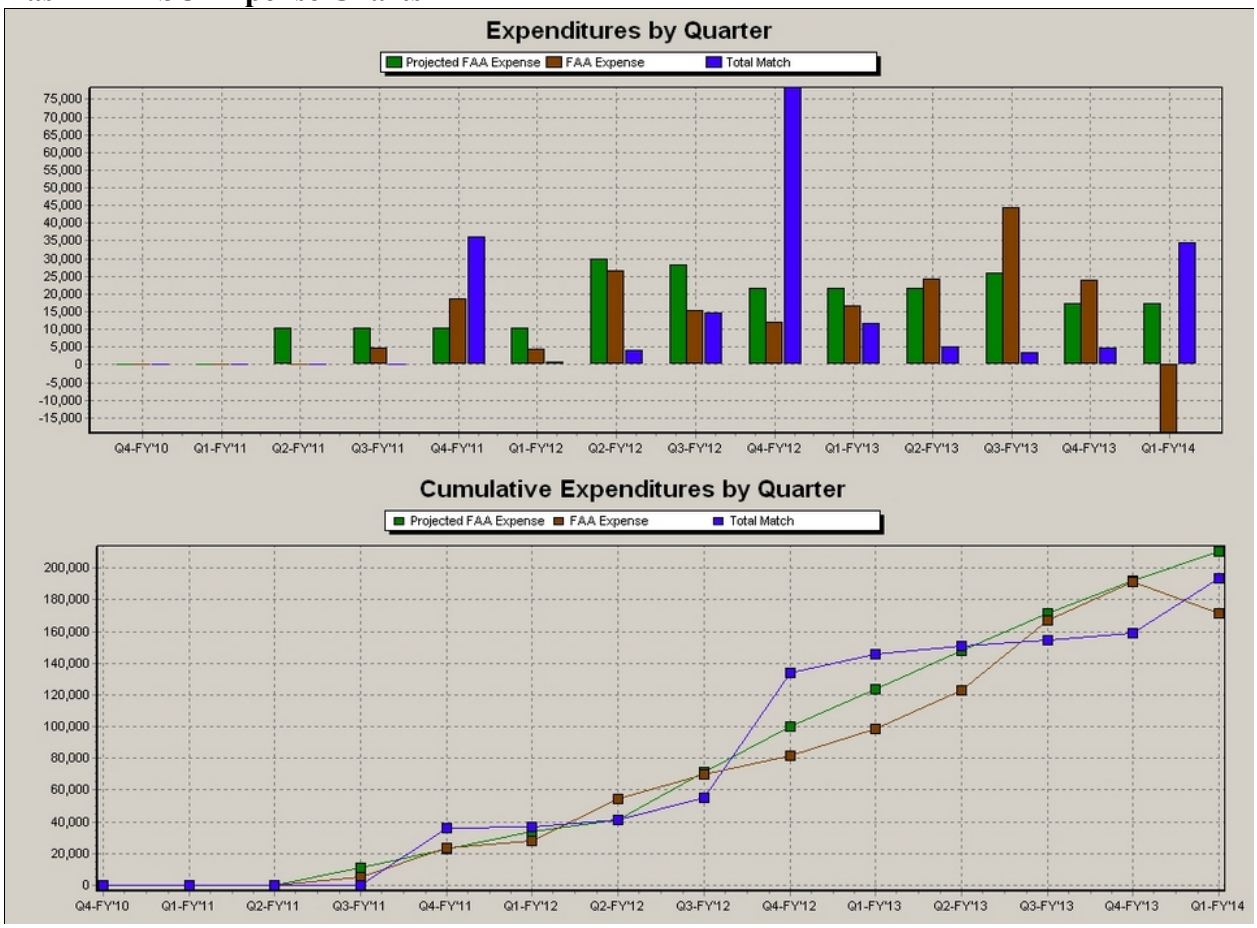
Funding History

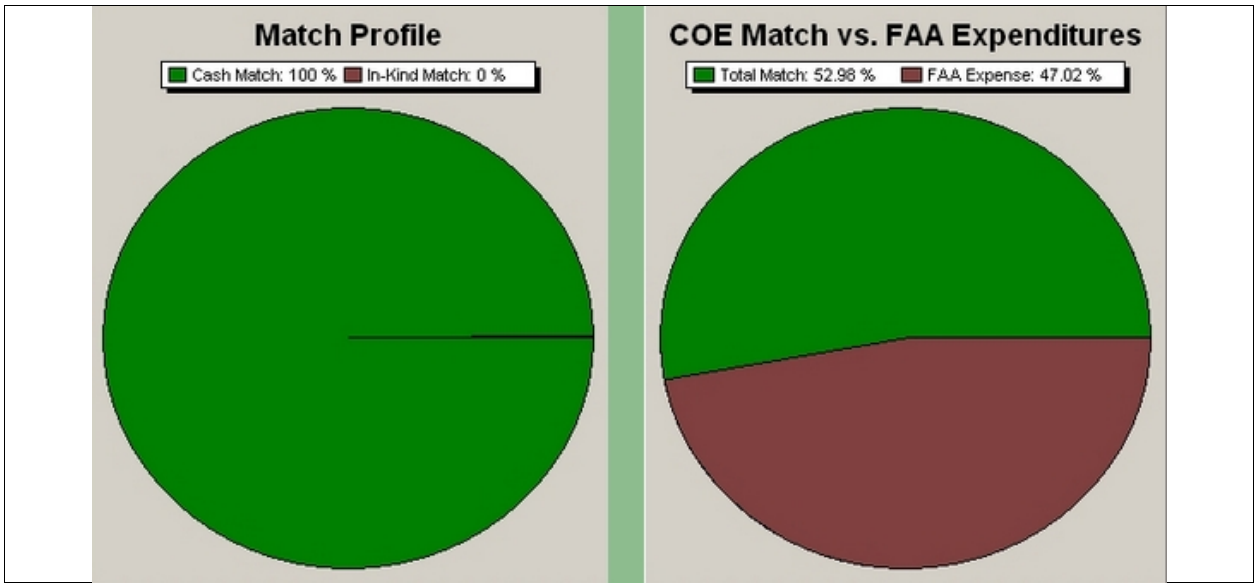
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-FSU-004	$41,310	$41,310
1/1/2012	3/31/2012	2011	10-C-CST-FSU-006	$30,000	$30,000
4/1/2012	5/31/2012	2012	10-C-CST-FSU-009	$21,000	$21,000
6/1/2012	5/31/2013	2012	10-C-CST-FSU-011	$86,853	$86,853
5/31/2013	5/31/2014	2012	10-C-CST-FSU-015	$0	$0
5/31/2013	5/31/2014	2013	10-C-CST-FSU-021	$60,000	$60,000
5/31/2013	5/31/2014	2013	10-C-CST-FSU-022	$15,000	$15,000
					Total: $254,163

Students

Name	Organization	Department	Discipline	Degree	Graduation
Collins, Justin	Florida State University	Mechanical Engineering	Materials Science and Mechanics	Ph.D.	7/6/1905

Task 241-FSU Expense Charts





FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$10,328	$10,328	$0	$0
Q3(Apr-Jun) FY2011	$10,328	$20,655	$4,786	$4,786
Q4(Jul-Sep) FY2011	$10,328	$30,983	$18,748	$23,533
Q1(Oct-Dec) FY2012	$10,328	$41,310	$4,297	$27,830
Q2(Jan-Mar) FY2012	$30,000	$71,310	$26,722	$54,552
Q3(Apr-Jun) FY2012	$28,238	$99,548	$15,313	$69,864
Q4(Jul-Sep) FY2012	$21,713	$121,261	$11,915	$81,780
Q1(Oct-Dec) FY2013	$21,713	$142,974	$16,631	$98,411
Q2(Jan-Mar) FY2013	$21,713	$164,688	$24,239	$122,650
Q3(Apr-Jun) FY2013	$26,014	$190,701	$44,377	$167,027
Q4(Jul-Sep) FY2013	$17,308	$208,009	$23,944	$190,971
Q1(Oct-Dec) FY2014	$17,308	$225,317	($19,346)	$171,625
Totals	$225,317		$171,625	

COE Matching by Quarter						
Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$36,046	$36,046	$0	$0	$36,046	$36,046
Q1(Oct-Dec) FY2012	$791	$36,837	$0	$0	$791	$36,837
Q2(Jan-Mar) FY2012	$4,004	$40,841	$0	$0	$4,004	$40,841
Q3(Apr-Jun) FY2012	$14,565	$55,406	$0	$0	$14,565	$55,406
Q4(Jul-Sep) FY2012	$78,425	$133,831	$0	$0	$78,425	$133,831
Q1(Oct-Dec) FY2013	$11,624	$145,455	$0	$0	$11,624	$145,455
Q2(Jan-Mar) FY2013	$5,197	$150,652	$0	$0	$5,197	$150,652
Q3(Apr-Jun) FY2013	$3,550	$154,202	$0	$0	$3,550	$154,202
Q4(Jul-Sep) FY2013	$4,737	$158,938	$0	$0	$4,737	$158,938
Q1(Oct-Dec) FY2014	$34,454	$193,393	$0	$0	$34,454	$193,393
Totals	$193,393		$0		$193,393	

Task 241-UF: High Temperature, Optical Sapphire Pressure Sensors for Hypersonic Vehicles

Project Description

PURPOSE: The study of hypersonic boundary layers is critical to the efficient design of hypersonic vehicles for rapid global and space access. The harsh environment makes conventional instrumentation unsuitable for time accurate, continuous, direct measurements. The development of a high temperature sensor for direct measurement of pressure is vital to the understanding of shock-wave/boundary layer interactions which directly influence critical vehicle characteristics such as lift, drag, and propulsion efficiency.

OBJECTIVES:

- Design a sapphire optical lever microphone via multiphysics analytical modeling
- Develop thermocompression fabrication methods for the formation of devices with moving parts out of sapphire and platinum
- Development of techniques for ultrafast laser micromachining of sapphire for sensor and packaging fabrication
- Fabrication and packaging of pressure sensors optimized for low-noise and highsensitivity while possessing minimal drift associated with changes in relative humidity, temperature, etc.
- Characterization of sensors in a simulated, high temperature, pressurized laboratory environment
- Implementation in a hypersonic flow facility (such as Arnold Engineering Development Center, etc.) and/or a gas turbine (such as the Capstone C60 microturbine at the University of Florida, etc.)

GOALS: Design a fiber optic lever pressure sensor with a remote photo-diode optical readout. The microphone is composed of a compliant, platinum coated, sapphire diaphragm bonded over a cavity containing a single optical fiber. The diaphragm deflection is detected via intensity modulation due to the motion of the reflective platinum coated sapphire diaphragm. The optical signal is routed via the high temperature sapphire fiber to a remote photo-diode allowing for insulation of the electronics from the harsh environment.

Partners:

- Federal Aviation Administration AST *
- Space Florida *
- University of Florida *

* - indicates primary partner

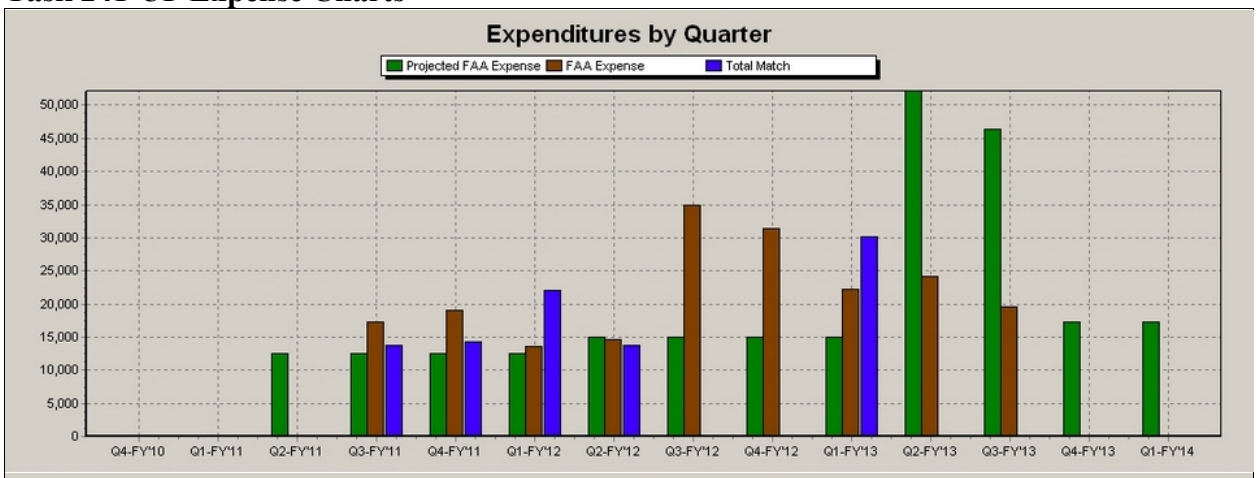
Funding History

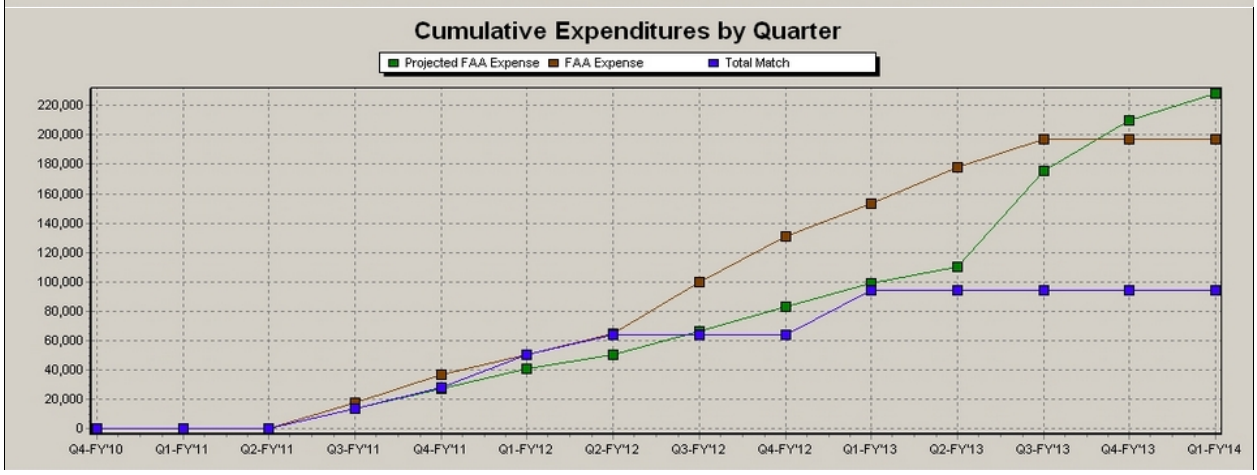
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UF-003	$50,000	$50,000
1/1/2012	12/31/2012	2011	10-C-CST-UF-005	$60,000	$60,000
1/1/2013	5/31/2013	2012	10-C-CST-UF-008	$87,000	$87,000
5/31/2013	5/31/2014	2012	10-C-CST-UF-014	$0	$0
5/31/2013	5/31/2014	2013	10-C-CST-UF-015	$60,000	$60,000
5/31/2013	5/31/2014	2013	10-C-CST-UF-016	$15,000	$15,000
					Total: $272,000

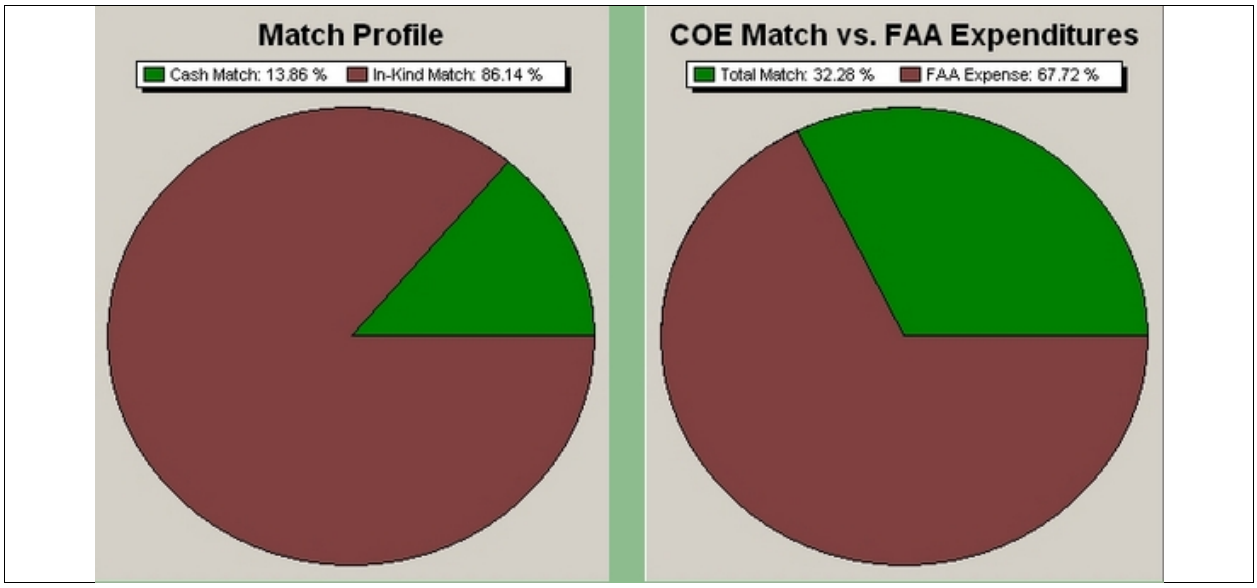
Students

Name	Organization	Department	Discipline	Degree	Graduation
Mills, David	University of Florida	Mech and Aero Eng.	Mechanical Engineering	Ph.D.	5/1/2014

Task 241-UF Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$12,500	$12,500	$0	$0
Q3(Apr-Jun) FY2011	$12,500	$25,000	$17,355	$17,355
Q4(Jul-Sep) FY2011	$12,500	$37,500	$19,060	$36,415
Q1(Oct-Dec) FY2012	$12,500	$50,000	$13,634	$50,049
Q2(Jan-Mar) FY2012	$15,000	$65,000	$14,658	$64,707
Q3(Apr-Jun) FY2012	$15,000	$80,000	$34,934	$99,641
Q4(Jul-Sep) FY2012	$15,000	$95,000	$31,413	$131,054
Q1(Oct-Dec) FY2013	$15,000	$110,000	$22,301	$153,355
Q2(Jan-Mar) FY2013	$52,200	$162,200	$24,230	$177,585
Q3(Apr-Jun) FY2013	$46,338	$208,538	$19,514	$197,099
Q4(Jul-Sep) FY2013	$17,308	$225,846	$0	$197,099
Q1(Oct-Dec) FY2014	$17,308	$243,154	$0	$197,099
Totals	$243,154		$197,099	

COE Matching by Quarter						
Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$13,674	$13,674	$13,674	$13,674
Q4(Jul-Sep) FY2011	$0	$0	$14,278	$27,952	$14,278	$27,952
Q1(Oct-Dec) FY2012	$0	$0	$22,097	$50,049	$22,097	$50,049
Q2(Jan-Mar) FY2012	$0	$0	$13,674	$63,723	$13,674	$63,723
Q3(Apr-Jun) FY2012	$0	$0	$0	$63,723	$0	$63,723
Q4(Jul-Sep) FY2012	$0	$0	$0	$63,723	$0	$63,723
Q1(Oct-Dec) FY2013	$13,023	$13,023	$17,185	$80,909	$30,209	$93,932
Q2(Jan-Mar) FY2013	$0	$13,023	$0	$80,909	$0	$93,932
Q3(Apr-Jun) FY2013	$0	$13,023	$0	$80,909	$0	$93,932
Q4(Jul-Sep) FY2013	$0	$13,023	$0	$80,909	$0	$93,932
Q1(Oct-Dec) FY2014	$0	$13,023	$0	$80,909	$0	$93,932
Totals	$13,023		$80,909		$93,932	

Task 244-CU: Autonomous Rendezvous and Docking For Space Debris Mitigation

Project Description

PURPOSE: Launch vehicles are nonlinear dynamic systems that require skill to maneuver in tight spaces as required for docking and berthing maneuvers (DBMs). This problem is akin to the difficult task of parallel parking for ground vehicles. However, whereas the latter task can be based on a simple kinematic model, DBMs for space vehicles require the use of more complex dynamic models due to the need to model the less precise actuators (e.g., thrusters) and to explicitly consider the inertia of the vehicle due to the lack of friction or environmental resistance.

OBJECTIVES: The motion planning will be based on Sampling Based Model Predictive Control (SBMPC), which is a synergy between the Model Predictive Control (MPC) paradigm used by control researchers and engineers and the sampling based planning methodologies popularized by robotics and artificial intelligence researchers. SBMPC, like MPC, uses dynamic models in planning and treats the inputs to the system as the optimization parameters. However, unlike MPC, it optimizes uses sampling and A*-type optimization, which enables it to avoid local minimum and be used for real-time planning and control.

GOALS: This project will develop the technology needed to automate DBM.

Partners:

- Federal Aviation Administration AST *
- University of Colorado at Boulder *

* - indicates primary partner

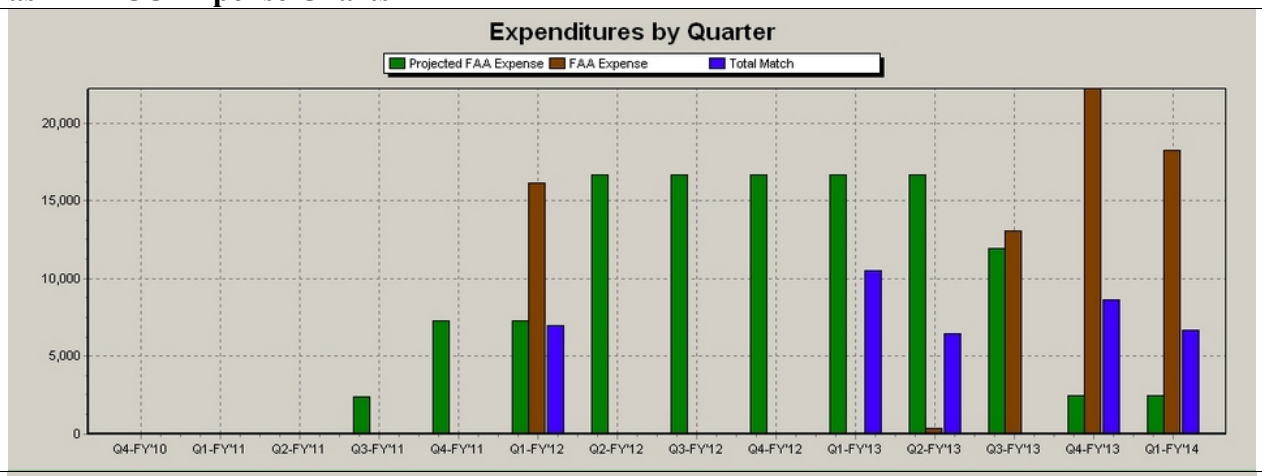
Funding History

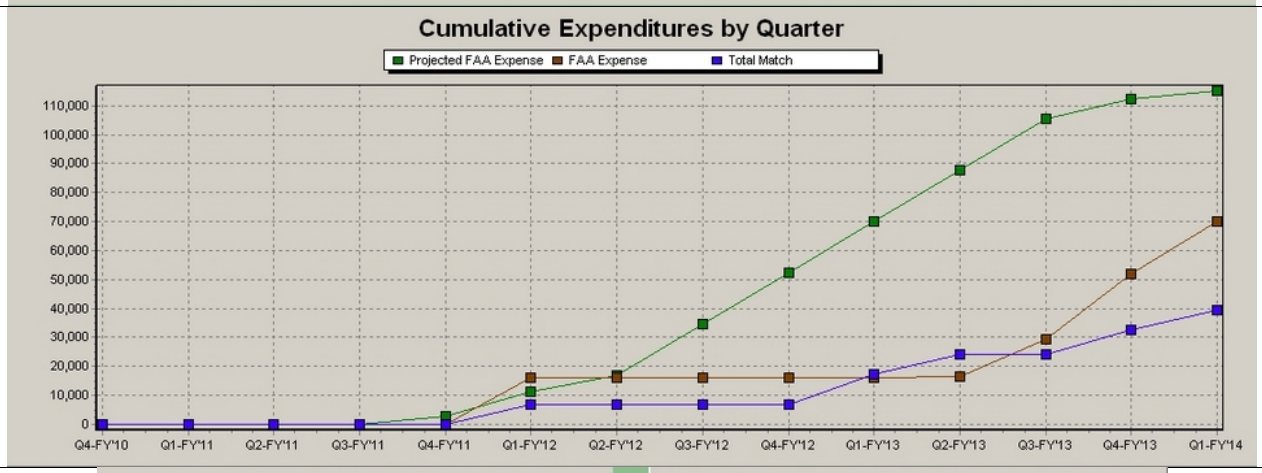
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2011	12/31/2011	2010	10-C-CST-UC-009	$17,000	$17,000
1/1/2012	5/31/2013	2012	10-C-CST-UC-021	$94,467	$94,467
6/1/2013	5/31/2014	2012	10-C-CST-UC-024	$0	$0
6/1/2013	5/31/2014	2013	10-C-CST-UC-028	$5,000	$5,000
6/1/2013	5/31/2014	2013	10-C-CST-UC-033	$5,000	$5,000
					Total: $121,467

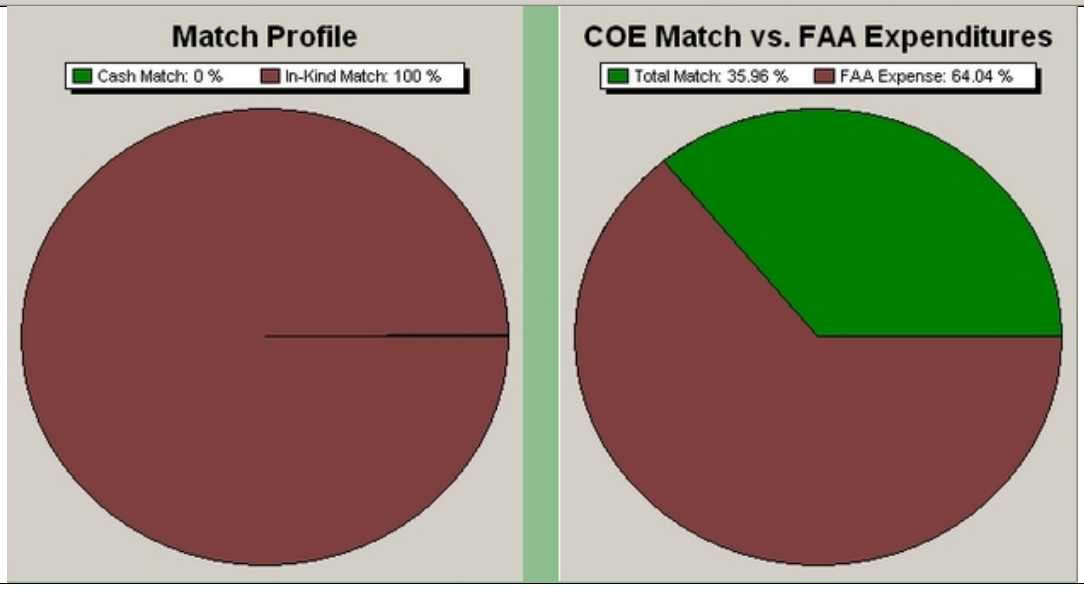
Students

Name	Organization	Department	Discipline	Degree	Graduation
Phillips, Homer S	University of Colorado - CCAR	Aerospace Engineering Sciences	Aerospace	Terminated	-
Borowski, Holly	University of Colorado	Aerospace Engineering Sciences	Aerospace Engineering Sciences	Ph.D.	-
Gehly, Steven R	University of Colorado Boulder	Aerospace Engineering Sciences	Estimation	Ph.D.	-
LoCrasto, Heather	University of Colorado Boulder	Aerospace Engineering Sciences	Systems Engineering	Masters	-

Task 244-CU Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$2,429	$2,429	$0	$0
Q4(Jul-Sep) FY2011	$7,286	$9,714	$0	$0
Q1(Oct-Dec) FY2012	$7,286	$17,000	$16,159	$16,159
Q2(Jan-Mar) FY2012	$16,671	$33,671	$0	$16,159
Q3(Apr-Jun) FY2012	$16,671	$50,341	$0	$16,159
Q4(Jul-Sep) FY2012	$16,671	$67,012	$0	$16,159
Q1(Oct-Dec) FY2013	$16,671	$83,683	$0	$16,159
Q2(Jan-Mar) FY2013	$16,671	$100,353	$343	$16,502
Q3(Apr-Jun) FY2013	$11,947	$112,300	$13,033	$29,535
Q4(Jul-Sep) FY2013	$2,500	$114,800	$22,223	$51,758
Q1(Oct-Dec) FY2014	$2,500	$117,300	$18,246	$70,004
Totals	$117,300		$70,004	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$7,000	$7,000	$7,000	$7,000
Q2(Jan-Mar) FY2012	$0	$0	$0	$7,000	$0	$7,000
Q3(Apr-Jun) FY2012	$0	$0	$0	$7,000	$0	$7,000
Q4(Jul-Sep) FY2012	$0	$0	$0	$7,000	$0	$7,000
Q1(Oct-Dec) FY2013	$0	$0	$10,477	$17,477	$10,477	$17,477
Q2(Jan-Mar) FY2013	$0	$0	$6,491	$23,968	$6,491	$23,968
Q3(Apr-Jun) FY2013	$0	$0	$0	$23,968	$0	$23,968
Q4(Jul-Sep) FY2013	$0	$0	$8,626	$32,594	$8,626	$32,594
Q1(Oct-Dec) FY2014	$0	$0	$6,712	$39,305	$6,712	$39,305
Totals	$0		$39,305		$39,305	

Task 244-FSU: Autonomous Rendezvous and Docking For Space Debris Mitigation

Project Description

PURPOSE: Launch vehicles are nonlinear dynamic systems that require skill to maneuver in tight spaces as required for docking and berthing maneuvers (DBMs). This problem is akin to the difficult task of parallel parking for ground vehicles. However, whereas the latter task can be based on a simple kinematic model, DBMs for space vehicles require the use of more complex dynamic models due to the need to model the less precise actuators (e.g., thrusters) and to explicitly consider the inertia of the vehicle due to the lack of friction or environmental resistance.

OBJECTIVES: The motion planning will be based on Sampling Based Model Predictive Control (SBMPC), which is a synergy between the Model Predictive Control (MPC) paradigm used by control researchers and engineers and the sampling based planning methodologies popularized by robotics and artificial intelligence researchers. SBMPC, like MPC, uses dynamic models in planning and treats the inputs to the system as the optimization parameters. However, unlike MPC, it optimizes uses sampling and A*-type optimization, which enables it to avoid local minimum and be used for real-time planning and control.

GOALS: This project will develop the technology needed to automate DBM.

Partners:

- Federal Aviation Administration AST *
- Florida State University *
- Space Florida *

* - indicates primary partner

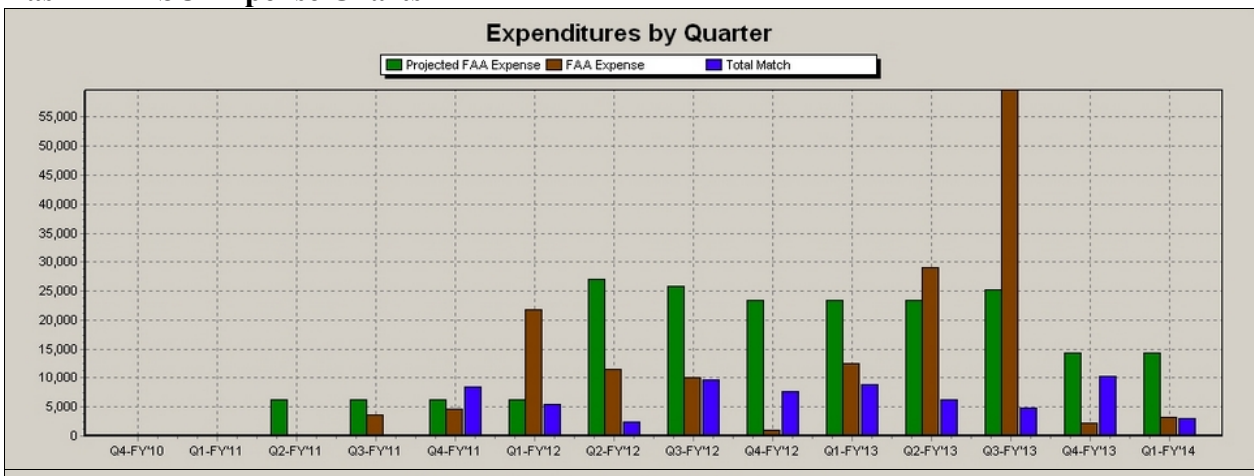
Funding History

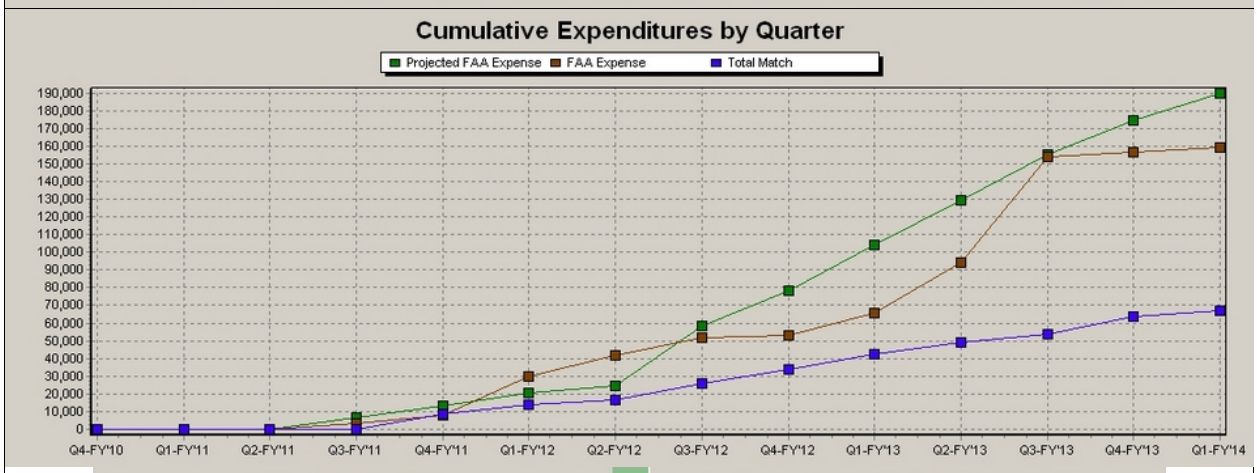
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-FSU-003	$24,830	$24,830
1/1/2012	5/31/2012	2011	10-C-CST-FSU-007	$45,000	$45,000
6/1/2012	5/31/2013	2012	10-C-CST-FSU-013	$94,038	$94,038
5/31/2013	5/31/2014	2012	10-C-CST-FSU-016	$0	$0
5/31/2013	5/31/2014	2013	10-C-CST-FSU-018	$10,000	$10,000
5/31/2013	5/31/2014	2013	10-C-CST-FSU-020	$15,000	$15,000
5/31/2013	5/31/2014	2013	10-C-CST-FSU-023	$37,000	$37,000
					Total: $225,868

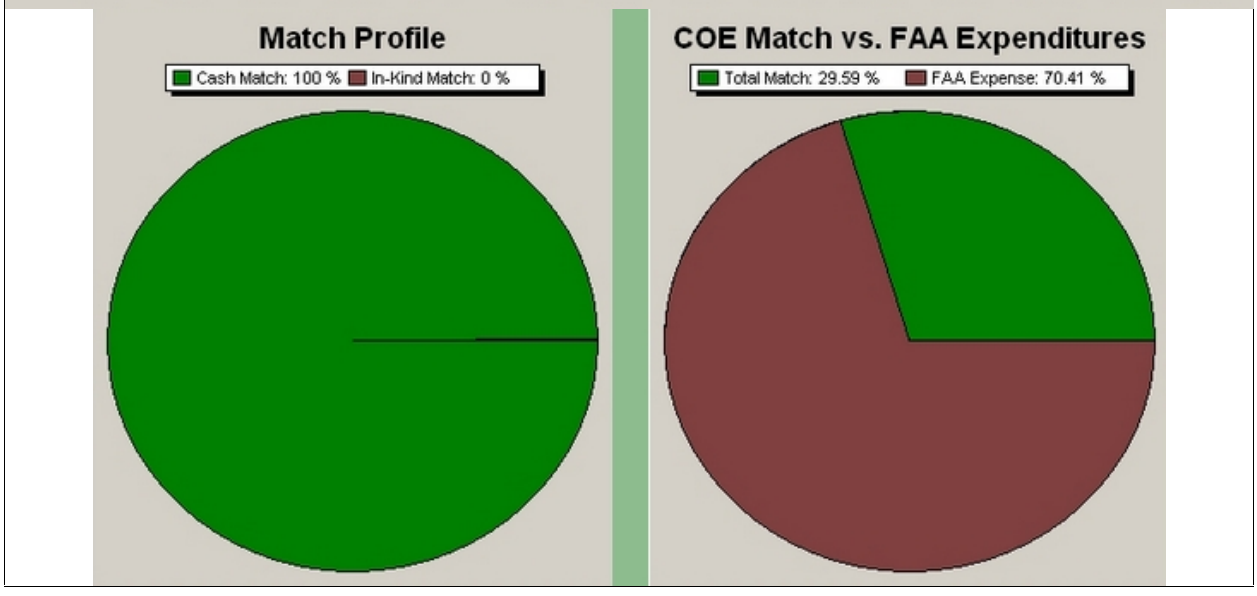
Students

Name	Organization	Department	Discipline	Degree	Graduation
Francis, Griffin	Florida State University	Mechanical Engineering	Dynamics , Control and Robotics	Ph.D.	-
Sharma, Aneesh	Florida State University	Computer Science	Robotics	Bachelors	-

Task 244-FSU Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$6,208	$6,208	$0	$0
Q3(Apr-Jun) FY2011	$6,208	$12,415	$3,546	$3,546
Q4(Jul-Sep) FY2011	$6,208	$18,623	$4,697	$8,243
Q1(Oct-Dec) FY2012	$6,208	$24,830	$21,851	$30,094
Q2(Jan-Mar) FY2012	$27,000	$51,830	$11,590	$41,684
Q3(Apr-Jun) FY2012	$25,837	$77,667	$10,102	$51,787
Q4(Jul-Sep) FY2012	$23,510	$101,176	$1,059	$52,846
Q1(Oct-Dec) FY2013	$23,510	$124,686	$12,551	$65,397
Q2(Jan-Mar) FY2013	$23,510	$148,195	$29,038	$94,435
Q3(Apr-Jun) FY2013	$25,211	$173,406	$59,742	$154,177
Q4(Jul-Sep) FY2013	$14,308	$187,714	$2,130	$156,307
Q1(Oct-Dec) FY2014	$14,308	$202,022	$3,137	$159,444
Totals	$202,022		$159,444	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$8,537	$8,537	$0	$0	$8,537	$8,537
Q1(Oct-Dec) FY2012	$5,538	$14,075	$0	$0	$5,538	$14,075
Q2(Jan-Mar) FY2012	$2,351	$16,426	$0	$0	$2,351	$16,426
Q3(Apr-Jun) FY2012	$9,710	$26,136	$0	$0	$9,710	$26,136
Q4(Jul-Sep) FY2012	$7,756	$33,893	$0	$0	$7,756	$33,893
Q1(Oct-Dec) FY2013	$8,856	$42,749	$0	$0	$8,856	$42,749
Q2(Jan-Mar) FY2013	$6,225	$48,974	$0	$0	$6,225	$48,974
Q3(Apr-Jun) FY2013	$4,780	$53,753	$0	$0	$4,780	$53,753
Q4(Jul-Sep) FY2013	$10,203	$63,956	$0	$0	$10,203	$63,956
Q1(Oct-Dec) FY2014	$3,064	$67,020	$0	$0	$3,064	$67,020
Totals	$67,020		$0		$67,020	

Task 244-SU: Autonomous Rendezvous and Docking For Space Debris Mitigation

Project Description

PURPOSE: Launch vehicles are nonlinear dynamic systems that require skill to maneuver in tight spaces as required for docking and berthing maneuvers (DBMs). This problem is akin to the difficult task of parallel parking for ground vehicles. However, whereas the latter task can be based on a simple kinematic model, DBMs for space vehicles require the use of more complex dynamic models due to the need to model the less precise actuators (e.g., thrusters) and to explicitly consider the inertia of the vehicle due to the lack of friction or environmental resistance.

OBJECTIVES: The motion planning will be based on Sampling Based Model Predictive Control (SBMPC), which is a synergy between the Model Predictive Control (MPC) paradigm used by control researchers and engineers and the sampling based planning methodologies popularized by robotics and artificial intelligence researchers. SBMPC, like MPC, uses dynamic models in planning and treats the inputs to the system as the optimization parameters. However, unlike MPC, it optimizes uses sampling and A*-type optimization, which enables it to avoid local minimum and be used for real-time planning and control.

GOALS: This project will develop the technology needed to automate DBM.

Partners:

- Federal Aviation Administration AST *
- Stanford University *

*- indicates primary partner

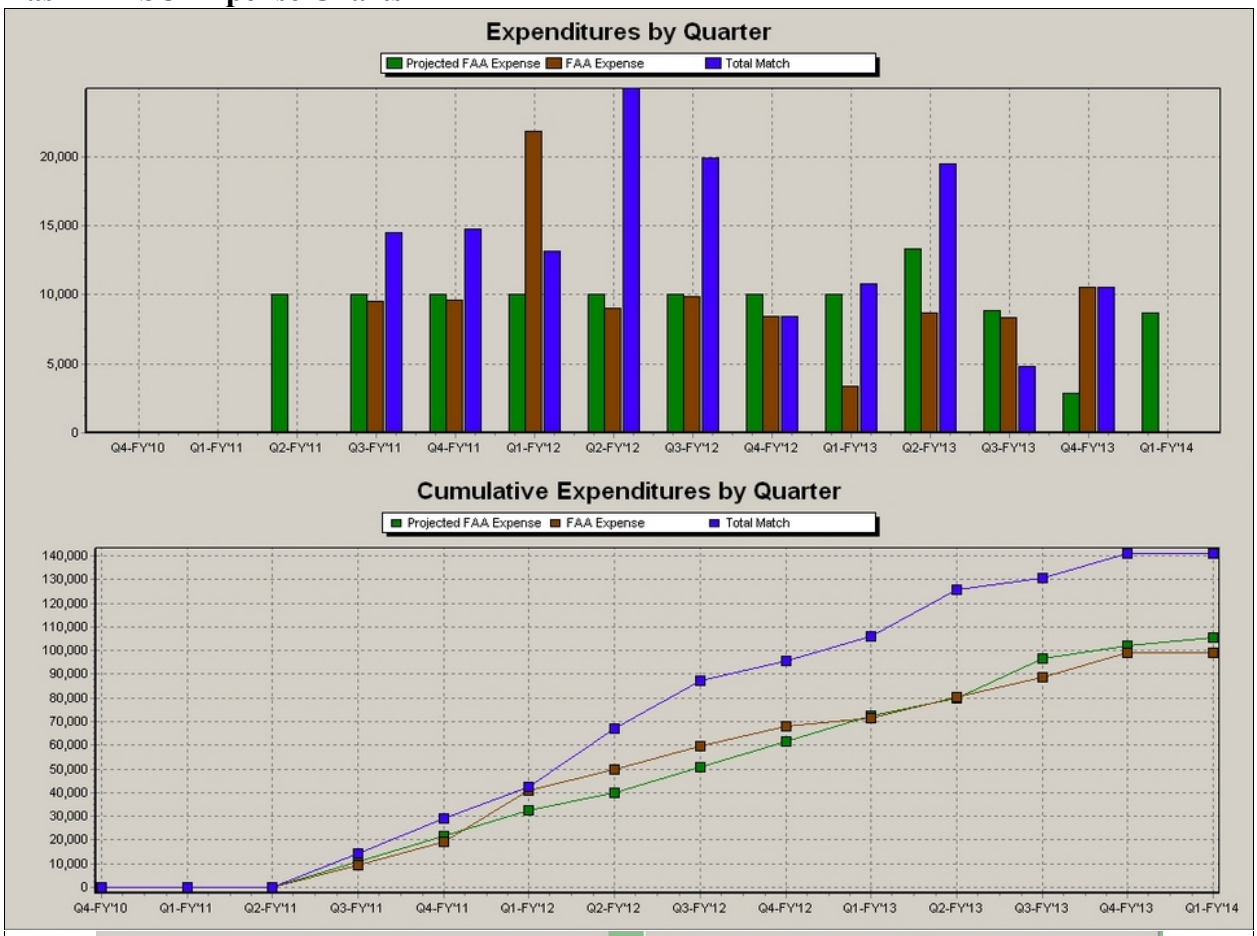
Funding History

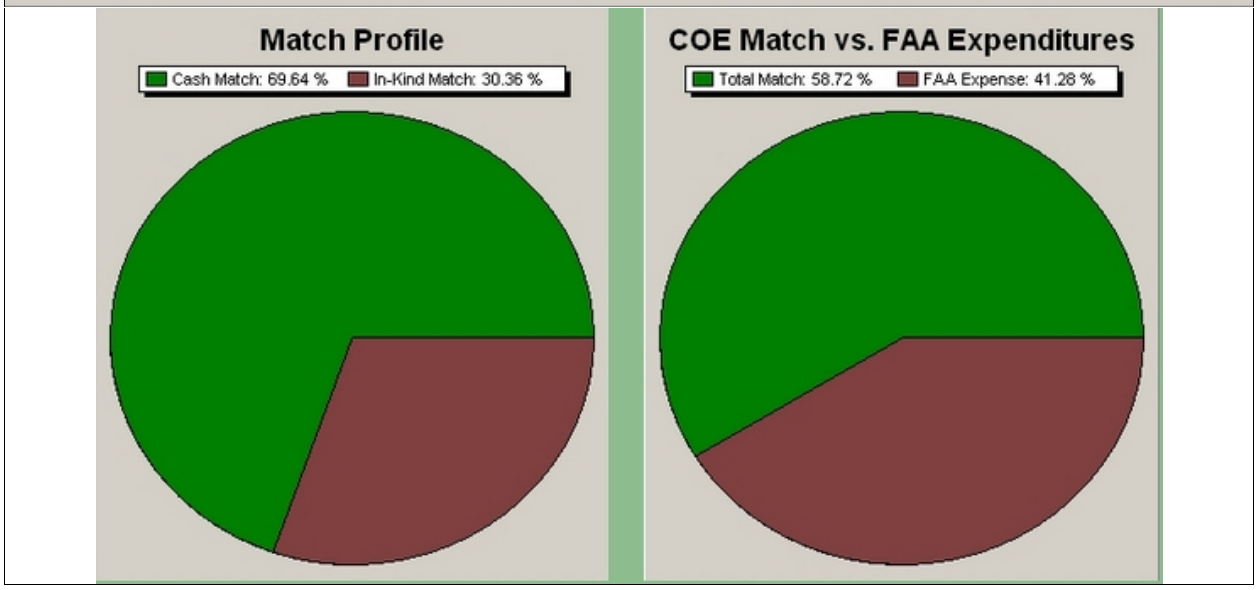
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-SU-004	$40,000	$40,000
1/1/2012	12/31/2012	2011	10-C-CST-SU-014	$40,000	$40,000
1/1/2013	5/31/2013	2012	10-C-CST-SU-024	$22,128	$22,128
5/31/2013	9/30/2013	2013	10-C-CST-SU-028	$0	$0
9/30/2013	6/30/2014	2013	10-C-CST-SU-034	$18,000	$18,000
9/30/2013	6/30/2014	2013	10-C-CST-SU-037	$11,000	$11,000
					Total: $131,128

Students

Name	Organization	Department	Discipline	Degree	Graduation
Hammond, Marcus	Stanford University	Aeronautics and Astronautics	Estimation and Control	Terminated	-
Smith, Andrew C	Stanford University	Aeronautics and Astronautics	Estimation and Control	Ph.D.	-
Padial, Jose	Stanford University	Aeronautics and Astronautics	Estimation and Control	Ph.D.	-
Charalambides, Gabe	Stanford University	Aero and Astro	Dynamics and Control	Ph.D.	-

Task 244-SU Expense Charts





FAA Cash by Quarter				
Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$10,000	$10,000	$0	$0
Q3(Apr-Jun) FY2011	$10,000	$20,000	$9,508	$9,508
Q4(Jul-Sep) FY2011	$10,000	$30,000	$9,637	$19,145
Q1(Oct-Dec) FY2012	$10,000	$40,000	$21,807	$40,952
Q2(Jan-Mar) FY2012	$10,000	$50,000	$9,024	$49,976
Q3(Apr-Jun) FY2012	$10,000	$60,000	$9,834	$59,810
Q4(Jul-Sep) FY2012	$10,000	$70,000	$8,397	$68,207
Q1(Oct-Dec) FY2013	$10,000	$80,000	$3,344	$71,550
Q2(Jan-Mar) FY2013	$13,277	$93,277	$8,701	$80,251
Q3(Apr-Jun) FY2013	$8,851	$102,128	$8,343	$88,594
Q4(Jul-Sep) FY2013	$2,900	$105,028	$10,554	$99,148
Q1(Oct-Dec) FY2014	$8,700	$113,728	$0	$99,148
Totals	$113,728		$99,148	

COE Matching by Quarter						
Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$11,421	$11,421	$3,053	$3,053	$14,474	$14,474
Q4(Jul-Sep) FY2011	$11,578	$22,999	$3,141	$6,194	$14,719	$29,193
Q1(Oct-Dec) FY2012	$9,549	$32,548	$3,574	$9,768	$13,123	$42,316
Q2(Jan-Mar) FY2012	$16,859	$49,407	$8,068	$17,836	$24,927	$67,243
Q3(Apr-Jun) FY2012	$13,156	$62,563	$6,709	$24,546	$19,865	$87,109
Q4(Jul-Sep) FY2012	$5,833	$68,395	$2,564	$27,110	$8,397	$95,505
Q1(Oct-Dec) FY2013	$6,863	$75,258	$3,884	$30,994	$10,747	$106,252
Q2(Jan-Mar) FY2013	$12,903	$88,161	$6,544	$37,538	$19,448	$125,700
Q3(Apr-Jun) FY2013	$3,049	$91,210	$1,726	$39,264	$4,775	$130,475
Q4(Jul-Sep) FY2013	$7,008	$98,219	$3,545	$42,809	$10,554	$141,028
Q1(Oct-Dec) FY2014	$0	$98,219	$0	$42,809	$0	$141,028
Totals	$98,219		$42,809		$141,028	

Task 244-UF: Autonomous Rendezvous and Docking For Space Debris Mitigation

Project Description

PURPOSE: Launch vehicles are nonlinear dynamic systems that require skill to maneuver in tight spaces as required for docking and berthing maneuvers (DBMs). This problem is akin to the difficult task of parallel parking for ground vehicles. However, whereas the latter task can be based on a simple kinematic model, DBMs for space vehicles require the use of more complex dynamic models due to the need to model the less precise actuators (e.g., thrusters) and to explicitly consider the inertia of the vehicle due to the lack of friction or environmental resistance.

OBJECTIVES: The motion planning will be based on Sampling Based Model Predictive Control (SBMPC), which is a synergy between the Model Predictive Control (MPC) paradigm used by control researchers and engineers and the sampling based planning methodologies popularized by robotics and artificial intelligence researchers. SBMPC, like MPC, uses dynamic models in planning and treats the inputs to the system as the optimization parameters. However, unlike MPC, it optimizes uses sampling and A*-type optimization, which enables it to avoid local minimum and be used for real-time planning and control.

GOALS: This project will develop the technology needed to automate DBM.

Partners:

- Federal Aviation Administration AST *
- Space Florida *
- University of Florida *

*- indicates primary partner

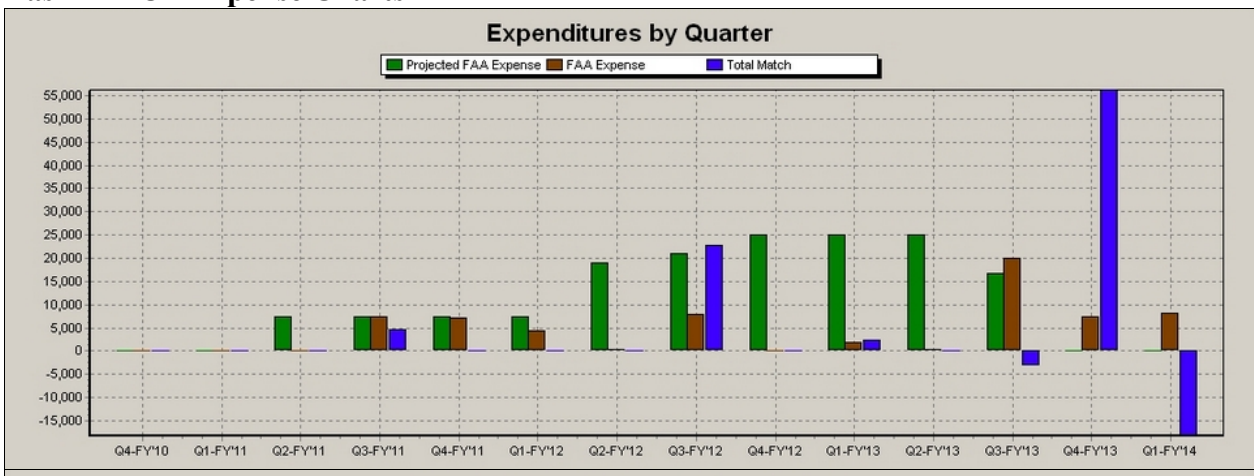
Funding History

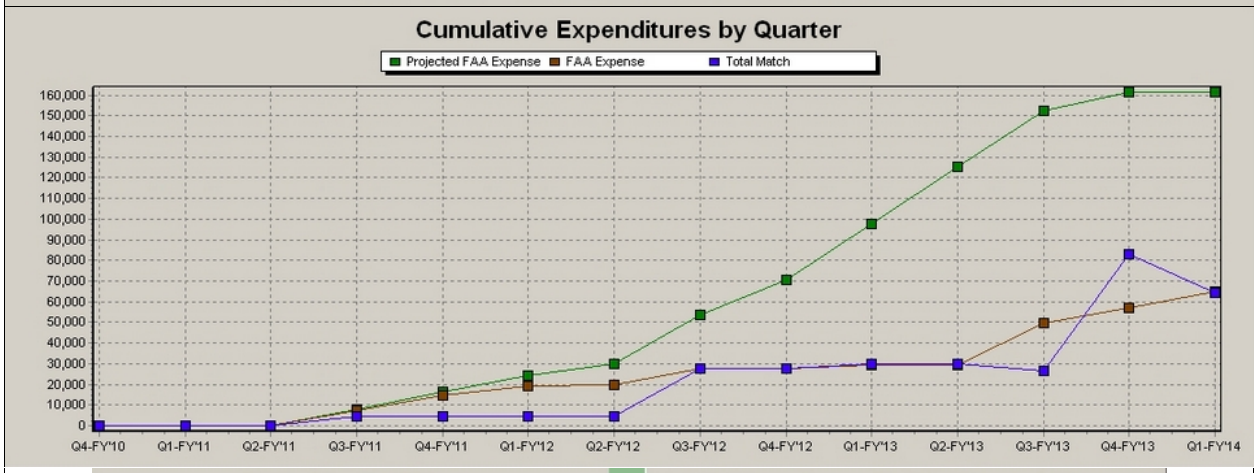
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UF-002	$30,000	$30,000
1/1/2012	5/31/2012	2012	10-C-CST-UF-006	$31,500	$31,500
6/1/2012	12/31/2012	2012	10-C-CST-UF-009	$0	$0
6/1/2012	5/31/2013	2012	10-C-CST-UF-011	$100,000	$100,000
6/1/2013	4/30/2014	2012	10-C-CST-UF-013	$0	$0
					Total: $161,500

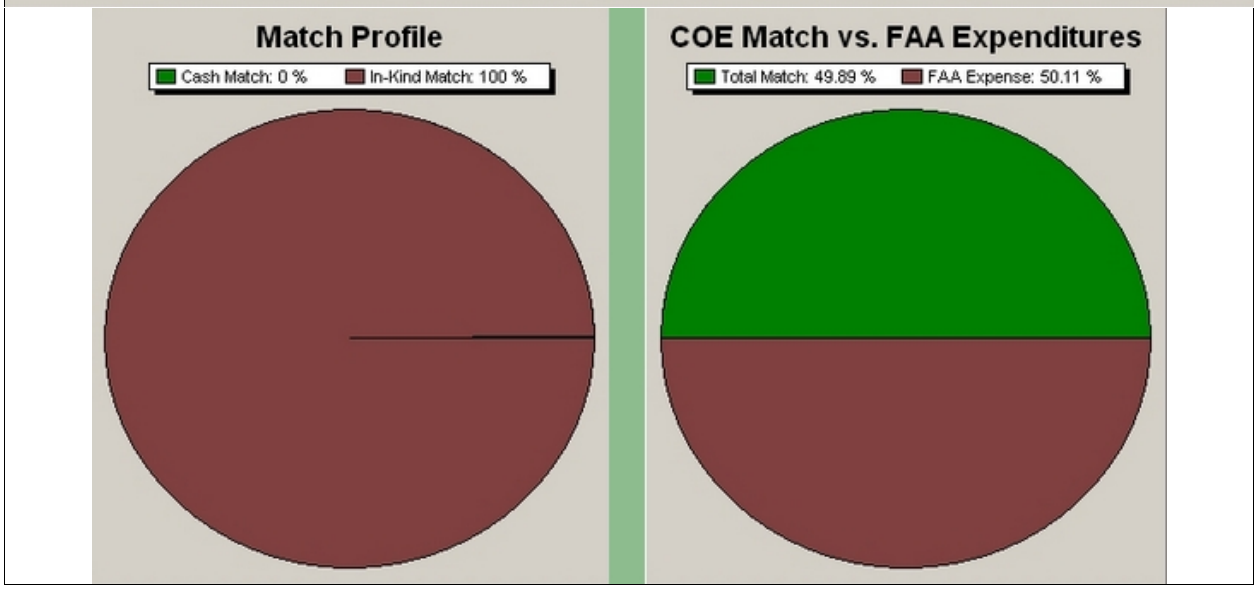
Students

Name	Organization	Department	Discipline	Degree	Graduation
Cason, Kathryn	University of Florida	Mechanical & Aeospace	Aerospace Engineering	Ph.D.	-

Task 244-UF Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$7,500	$7,500	$0	$0
Q3(Apr-Jun) FY2011	$7,500	$15,000	$7,420	$7,420
Q4(Jul-Sep) FY2011	$7,500	$22,500	$7,225	$14,645
Q1(Oct-Dec) FY2012	$7,500	$30,000	$4,469	$19,114
Q2(Jan-Mar) FY2012	$18,900	$48,900	$447	$19,561
Q3(Apr-Jun) FY2012	$20,933	$69,833	$7,907	$27,468
Q4(Jul-Sep) FY2012	$25,000	$94,833	$0	$27,468
Q1(Oct-Dec) FY2013	$25,000	$119,833	$1,804	$29,272
Q2(Jan-Mar) FY2013	$25,000	$144,833	$250	$29,522
Q3(Apr-Jun) FY2013	$16,667	$161,500	$19,966	$49,488
Q4(Jul-Sep) FY2013	$0	$161,500	$7,299	$56,787
Q1(Oct-Dec) FY2014	$0	$161,500	$8,115	$64,902
Totals	$161,500		$64,902	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$4,667	$4,667	$4,667	$4,667
Q4(Jul-Sep) FY2011	$0	$0	$0	$4,667	$0	$4,667
Q1(Oct-Dec) FY2012	$0	$0	$0	$4,667	$0	$4,667
Q2(Jan-Mar) FY2012	$0	$0	$0	$4,667	$0	$4,667
Q3(Apr-Jun) FY2012	$0	$0	$22,801	$27,468	$22,801	$27,468
Q4(Jul-Sep) FY2012	$0	$0	$0	$27,468	$0	$27,468
Q1(Oct-Dec) FY2013	$0	$0	$2,407	$29,875	$2,407	$29,875
Q2(Jan-Mar) FY2013	$0	$0	$0	$29,875	$0	$29,875
Q3(Apr-Jun) FY2013	$0	$0	($3,264)	$26,611	($3,264)	$26,611
Q4(Jul-Sep) FY2013	$0	$0	$56,264	$82,874	$56,264	$82,874
Q1(Oct-Dec) FY2014	$0	$0	($18,265)	$64,609	($18,265)	$64,609
Totals	$0		$64,609		$64,609	

Task 247-FIT: Air and Space Traffic Control Considerations For Commercial Space Transportation

Project Description

PURPOSE: The current ATC system employs both terminal control (ATCT) and En Route control (ARTCC) systems to manage air traffic up to 60,000 ft (FL 600). In order to integrate atmospheric traffic with transitional aircraft (atmospheric to space, and space to atmospheric), concepts and procedures for integration need to be developed.

GOALS: (1) Determine if FAA's current NAS architecture can accommodate hypersonic vehicles transitioning all Class A Airspace. (2)Explore TCAS modification, NAVAID usability and all systems anticipated for NextGen.

Partners:

- Federal Aviation Administration AST *
- Florida Institute of Technology *
- Space Florida *

*- indicates primary partner

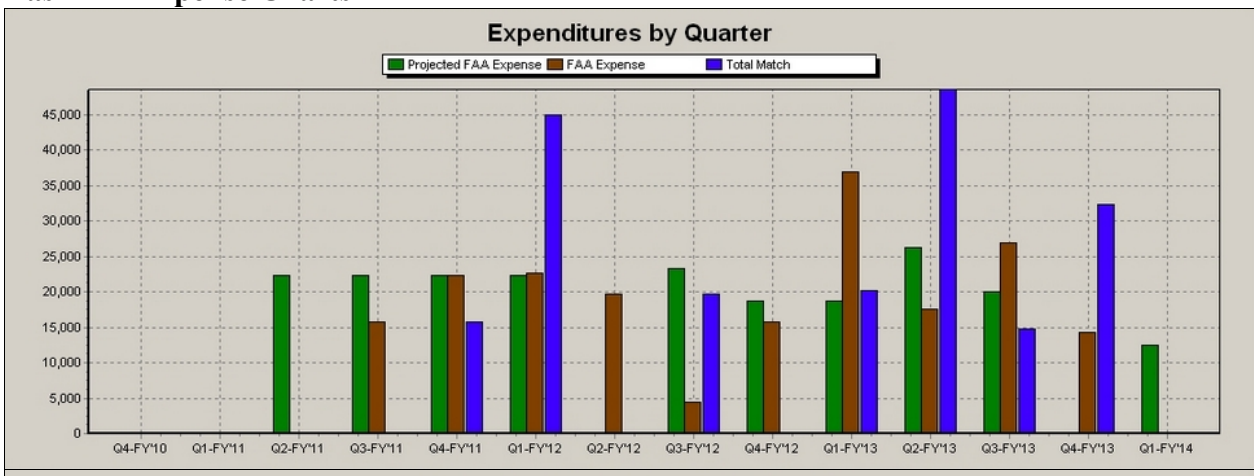
Funding History

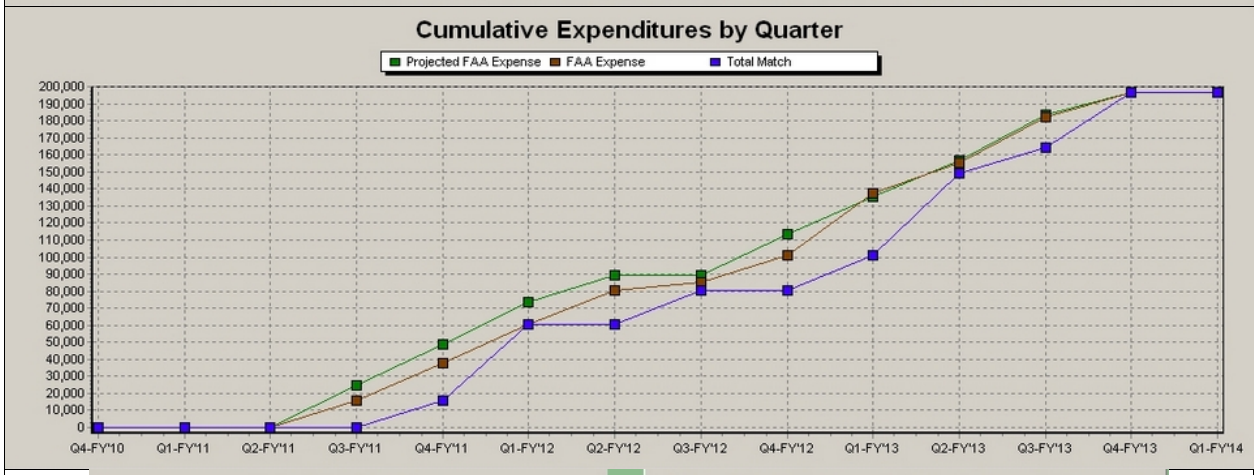
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-FIT-002	$89,486	$89,486
1/1/2012	3/31/2012	2010	10-C-CST-FIT-004	$0	$0
4/1/2012	5/31/2012	2010	10-C-CST-FIT-005	$17,000	$17,000
6/1/2012	1/31/2013	2010	10-C-CST-FIT-007	$23,526	$23,526
6/1/2012	1/31/2013	2012	10-C-CST-FIT-008	$26,566	$26,566
2/1/2013	5/31/2013	2012	10-C-CST-FIT-010	$40,000	$40,000
5/31/2013	8/31/2013	2012	10-C-CST-FIT-016	$0	$0
8/31/2013	12/31/2013	2012	10-C-CST-FIT-021	$0	$0
12/31/2013	5/31/2014	2013	10-C-CST-FIT-022	$45,000	$45,000
12/31/2013	5/31/2014	2013	10-C-CST-FIT-023	$30,000	$30,000
					Total: $271,578

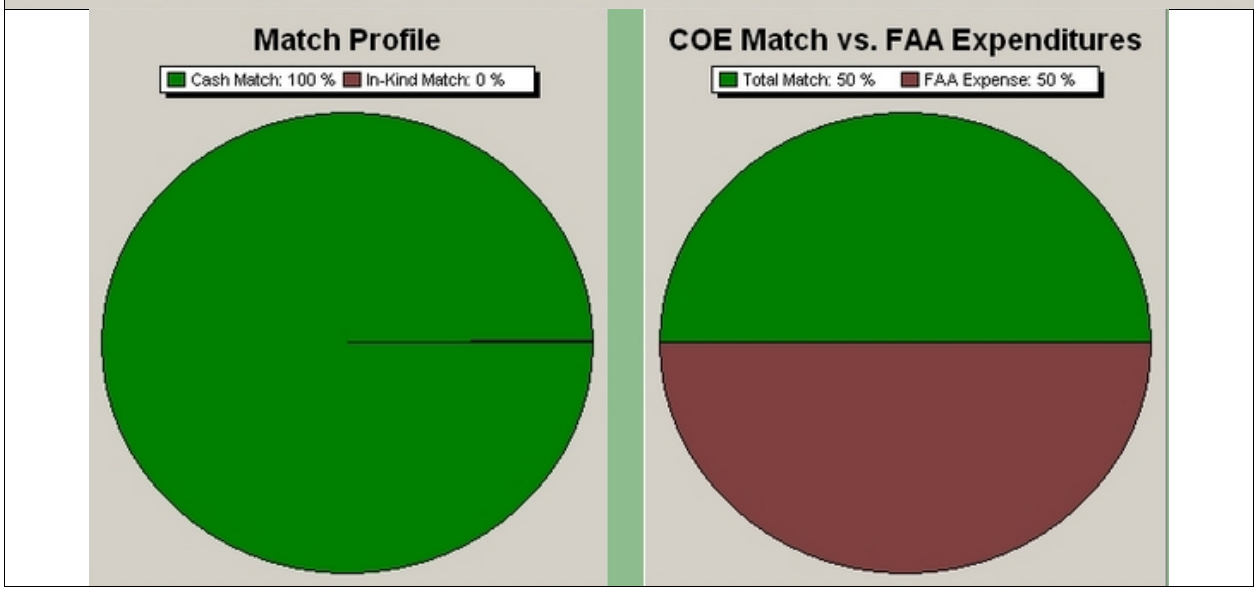
Students

Name	Organization	Department	Discipline	Degree	Graduation
Wilt, Dennis	FIT	Aeronautics	Aviation Safety	Masters	-
Reiner, Sebastian	FIT	Computer Engineering	Computer Science	Bachelors	-
Maillet, Nicole M	Florida Institute of Technology	Aeronautics	-	Masters	5/1/2012
Kasdaglis, Nicholas	Florida Institute of Technology	Aeronautics	-	Terminated	5/1/2012

Task 247 Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$22,372	$22,372	$0	$0
Q3(Apr-Jun) FY2011	$22,372	$44,743	$15,780	$15,780
Q4(Jul-Sep) FY2011	$22,372	$67,115	$22,316	$38,096
Q1(Oct-Dec) FY2012	$22,372	$89,486	$22,723	$60,819
Q2(Jan-Mar) FY2012	$0	$89,486	$19,785	$80,604
Q3(Apr-Jun) FY2012	$23,262	$112,748	$4,398	$85,002
Q4(Jul-Sep) FY2012	$18,785	$131,532	$15,741	$100,743
Q1(Oct-Dec) FY2013	$18,785	$150,317	$37,003	$137,746
Q2(Jan-Mar) FY2013	$26,262	$176,578	$17,595	$155,342
Q3(Apr-Jun) FY2013	$20,000	$196,578	$26,915	$182,257
Q4(Jul-Sep) FY2013	$0	$196,578	$14,321	$196,578
Q1(Oct-Dec) FY2014	$12,500	$209,078	$0	$196,578
Totals	$209,078		$196,578	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$15,800	$15,800	$0	$0	$15,800	$15,800
Q1(Oct-Dec) FY2012	$45,019	$60,819	$0	$0	$45,019	$60,819
Q2(Jan-Mar) FY2012	$0	$60,819	$0	$0	$0	$60,819
Q3(Apr-Jun) FY2012	$19,785	$80,604	$0	$0	$19,785	$80,604
Q4(Jul-Sep) FY2012	$0	$80,604	$0	$0	$0	$80,604
Q1(Oct-Dec) FY2013	$20,139	$100,743	$0	$0	$20,139	$100,743
Q2(Jan-Mar) FY2013	$48,606	$149,349	$0	$0	$48,606	$149,349
Q3(Apr-Jun) FY2013	$14,809	$164,158	$0	$0	$14,809	$164,158
Q4(Jul-Sep) FY2013	$32,420	$196,578	$0	$0	$32,420	$196,578
Q1(Oct-Dec) FY2014	$0	$196,578	$0	$0	$0	$196,578
Totals	$196,578		$0		$196,578	

Task 253-UCF: Ultra High Temperature Composites For Thermal Protection Systems

Project Description

PURPOSE: One of the critical issues of high-speed flight vehicles is the aerodynamic thermal loading, encountered at the sharp leading edges. From aerodynamic considerations, hypersonic vehicles require sharp leading edges and recent estimates suggested that such edges should have a radius of curvature on the order of 3mm. As a result of such sharp geometry, temperatures in excess of 2600oC are generated, at the tip of a leading edge, and the resulting stagnation temperature exceeds the realistic upper use temperature of most materials. It was observed that even the most advanced materials such as Ti, Inconel X, carbon-carbon, silicon carbide-based composites cannot withstand the excessive heat generated, especially during reentry, resulting in blunting of the sharp leading edges. Thus, sharp leading edges and nose cones require thermal protection system (TPS) to prevent spacecraft from high aerodynamic heating loads, during reentry into atmosphere. The sharp leading edges experience extreme aerodynamic heating loads resulting in temperature gradient as high as 1000oC within 2mm beneath the surface. Only a few materials can withstand such high heating loads. It has been identified that the ultra-high temperature ceramics (UHTCs), such as refractory metal diborides (ZrB2 and HfB2) based ceramics, with high melting temperatures and large thermal conductivities are ideally suited for the protection of sharp edges and yet capable of maintaining their sleek shapes without significant deformation or melting.

OBJECTIVES: The objective of this proposal is to develop multifunctional ultra-high temperature ceramic composites with sensing capabilities for applications in hypersonic space vehicle, where aggressive environments including high temperatures and corrosive species prohibits the usages of the currently available technologies.

G*OALS:* The proposed work will provide a rigorous scientific methodology for development of multifunctional, nanostructured, light-weight, thermal protection systems (TPS) for high-speed air-breathing vehicles which have encountered many daunting challenges in various areas spanning thermal management, hypersonic aerodynamics, aerothermodynamics and aero-propulsion integration.

Partners:

- Federal Aviation Administration AST *
- Space Florida *
- University of Central Florida *

*- indicates primary partner

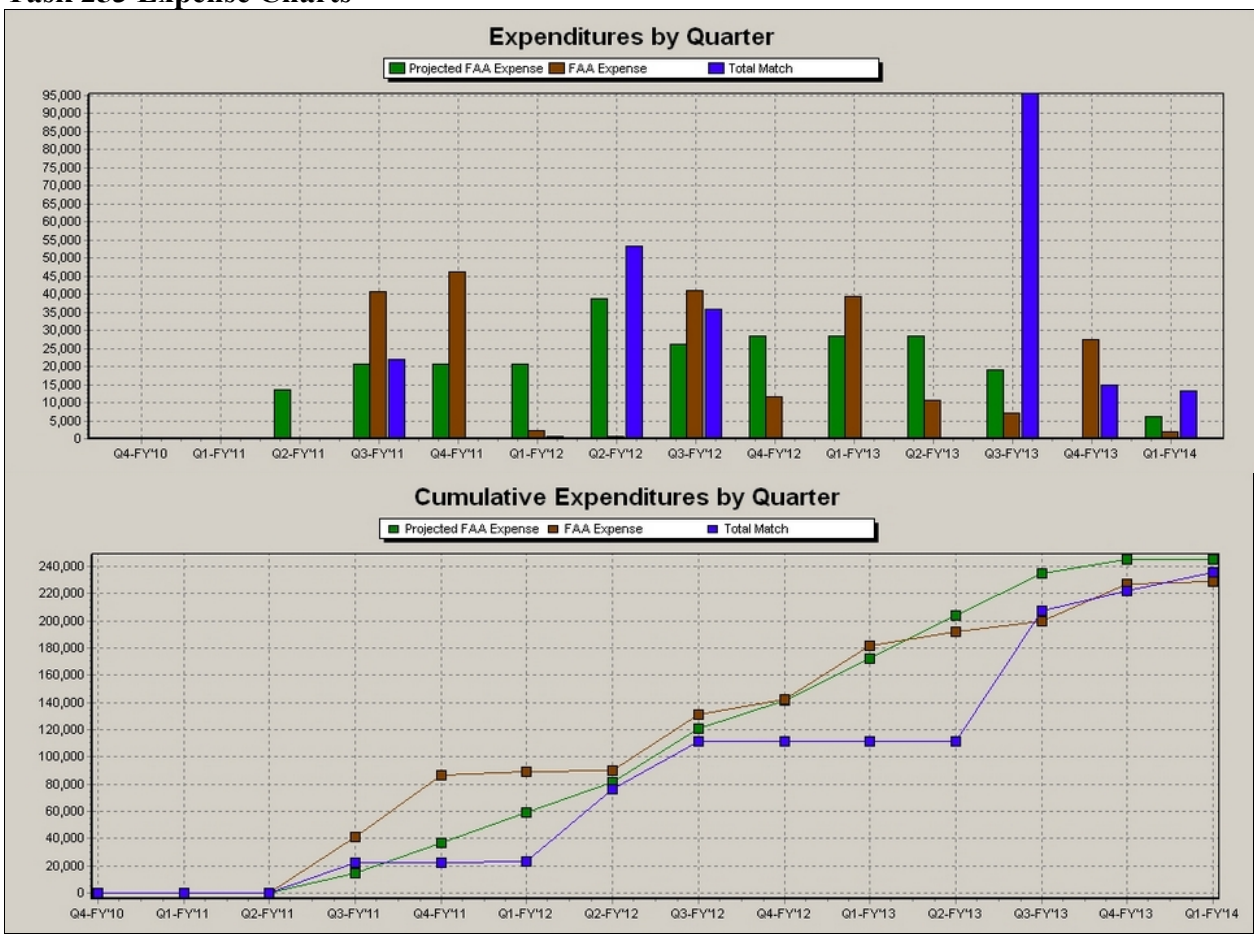
Funding History

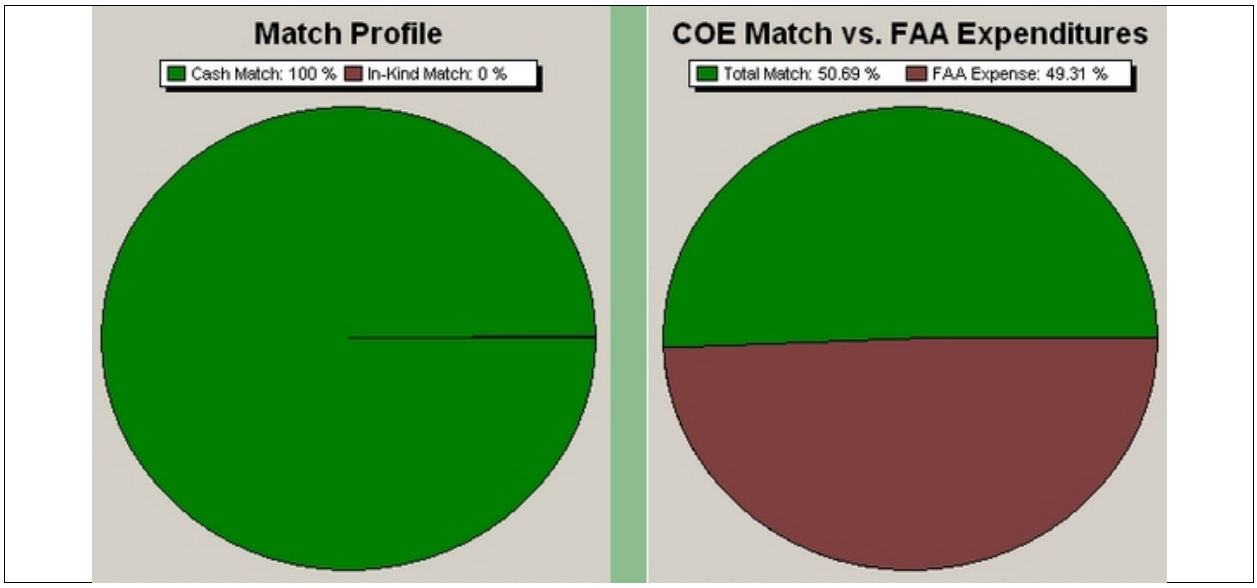
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
2/15/2011	2/14/2012	2010	10-C-CST-UCF-002	$89,090	$89,090
2/15/2011	2/14/2013	2010	10-C-CST-UCF-005	$0	$0
1/1/2012	5/31/2012	2012	10-C-CST-UCF-006	$42,000	$42,000
6/1/2012	5/31/2013	2012	10-C-CST-UCF-008	$114,000	$114,000
5/31/2013	12/31/2013	2012	10-C-CST-UCF-010	$0	$0
12/31/2013	5/31/2014	2013	10-C-CST-UCF-011	$10,000	$10,000
12/31/2013	5/31/2014	2013	10-C-CST-UCF-012	$27,000	$27,000
					Total: $282,090

Students

Name	Organization	Department	Discipline	Degree	Graduation
Lui, Donovan	University of Central Florida	Mechanical and Aerospace Engineering	Mechanical Engineering	Masters	5/10/2014
Lawrence, Jeremey	University of Central Florida	Industrial Engineering	Manufacturing Engineering	Bachelors	5/1/2013
Carpenter, Cassandra A	University of Central Florida	Mechanical and Aerospace Engineering	Mechanical Engineering	Masters	5/10/2014
Yang, Hongjiang	University of Central Florida	Mechanical and Aerospace Engineering	Mechanical Engineering	Ph.D.	5/5/2016

Task 253 Expense Charts





FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$13,706	$13,706	$0	$0
Q3(Apr-Jun) FY2011	$20,559	$34,265	$40,761	$40,761
Q4(Jul-Sep) FY2011	$20,559	$54,825	$46,123	$86,884
Q1(Oct-Dec) FY2012	$20,559	$75,384	$2,206	$89,090
Q2(Jan-Mar) FY2012	$38,906	$114,290	$490	$89,580
Q3(Apr-Jun) FY2012	$26,300	$140,590	$41,152	$130,732
Q4(Jul-Sep) FY2012	$28,500	$169,090	$11,481	$142,213
Q1(Oct-Dec) FY2013	$28,500	$197,590	$39,326	$181,539
Q2(Jan-Mar) FY2013	$28,500	$226,090	$10,765	$192,304
Q3(Apr-Jun) FY2013	$19,000	$245,090	$7,237	$199,541
Q4(Jul-Sep) FY2013	$0	$245,090	$27,528	$227,069
Q1(Oct-Dec) FY2014	$6,167	$251,257	$1,958	$229,027
Totals	$251,257		$229,027	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$21,937	$21,937	$0	$0	$21,937	$21,937
Q4(Jul-Sep) FY2011	$0	$21,937	$0	$0	$0	$21,937
Q1(Oct-Dec) FY2012	$789	$22,726	$0	$0	$789	$22,726
Q2(Jan-Mar) FY2012	$53,363	$76,089	$0	$0	$53,363	$76,089
Q3(Apr-Jun) FY2012	$35,727	$111,816	$0	$0	$35,727	$111,816
Q4(Jul-Sep) FY2012	$0	$111,816	$0	$0	$0	$111,816
Q1(Oct-Dec) FY2013	$0	$111,816	$0	$0	$0	$111,816
Q2(Jan-Mar) FY2013	$0	$111,816	$0	$0	$0	$111,816
Q3(Apr-Jun) FY2013	$95,604	$207,420	$0	$0	$95,604	$207,420
Q4(Jul-Sep) FY2013	$14,847	$222,267	$0	$0	$14,847	$222,267
Q1(Oct-Dec) FY2014	$13,156	$235,423	$0	$0	$13,156	$235,423
Totals	$235,423		$0		$235,423	

Task 255-UTMB: Wearable Biomedical Monitoring Equipment For Spaceflight Participants

Project Description

OBJECTIVES: The overall objective of this project is to identify, set design requirements, and procure prototype biomedical monitoring equipment that can be incorporated into a wearable vest or harness to support the operational monitoring needs of space flight surgeons as well as the research interests of aerospace physiologists.

GOALS:

- identify biomedical monitoring equipment that can be worn by passengers in a convenient and unobtrusive way so as not to interfere with flight experience.
- review existing Off-the-shelf equipment.
- survey flight surgeons, researchers, and space vehicle operators To determine desired features and capabilities.
- compared desired features and capabilities with existing equipment to identify gaps.
- identify new technologies needed and explore what existing technologies can be repackaged and incorporated into a wearable system.

Partners:

- Federal Aviation Administration AST *
- NASTAR Center *
- University of Texas Medical Branch at Galveston *
- Wyle *
- NASA-Johnson Space Center

*- indicates primary partner

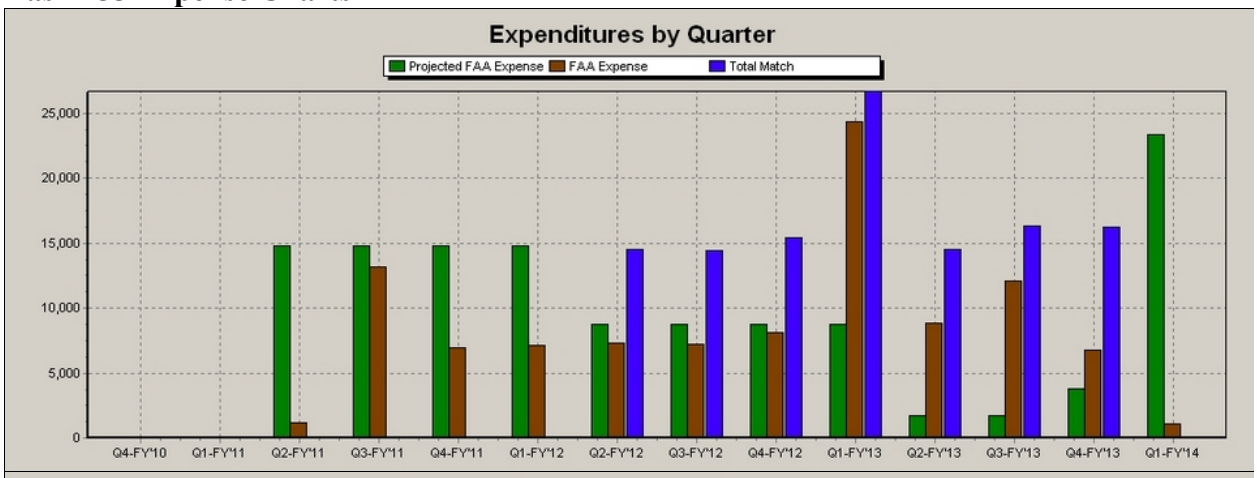
Funding History

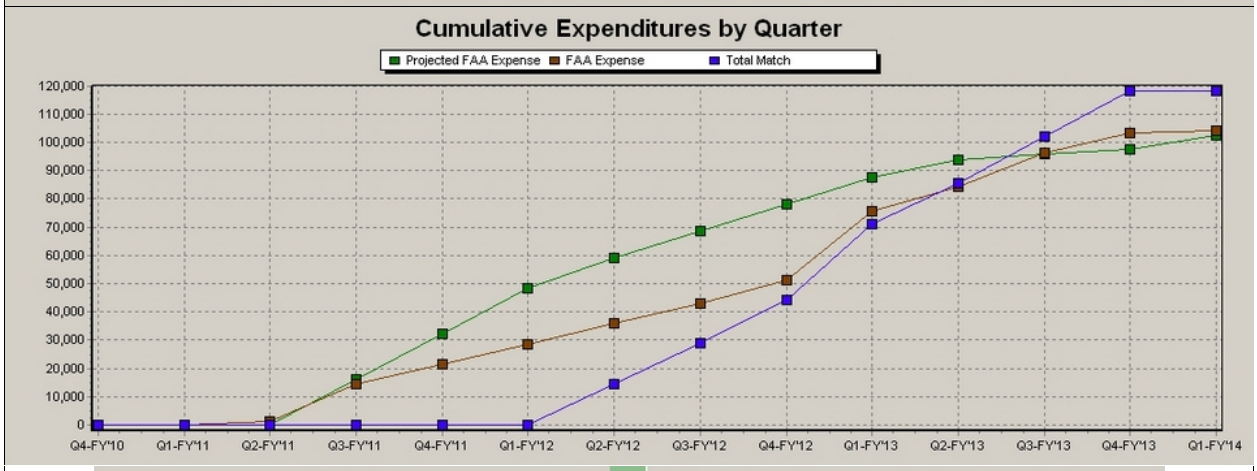
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UTMB-005	$59,025	$59,025
1/1/2012	12/31/2012	2010	10-C-CST-UTMB-009	$34,896	$34,896
1/1/2013	6/30/2013	2010	10-C-CST-UTMB-017	$0	$0
1/1/2013	6/30/2013	2011	10-C-CST-UTMB-018	$3,516	$3,516
6/30/2013	9/30/2013	2011	10-C-CST-UTMB-022	$0	$0
9/30/2013	12/31/2013	2013	10-C-CST-UTMB-024	$15,000	$15,000
12/31/2013	5/31/2014	2013	10-C-CST-UTMB-025	$30,000	$30,000
12/31/2013	5/31/2014	2013	10-C-CST-UTMB-026	$43,000	$43,000
5/31/2014	8/31/2014	2013	10-C-CST-UTMB-027	$0	$0
					Total: $185,437

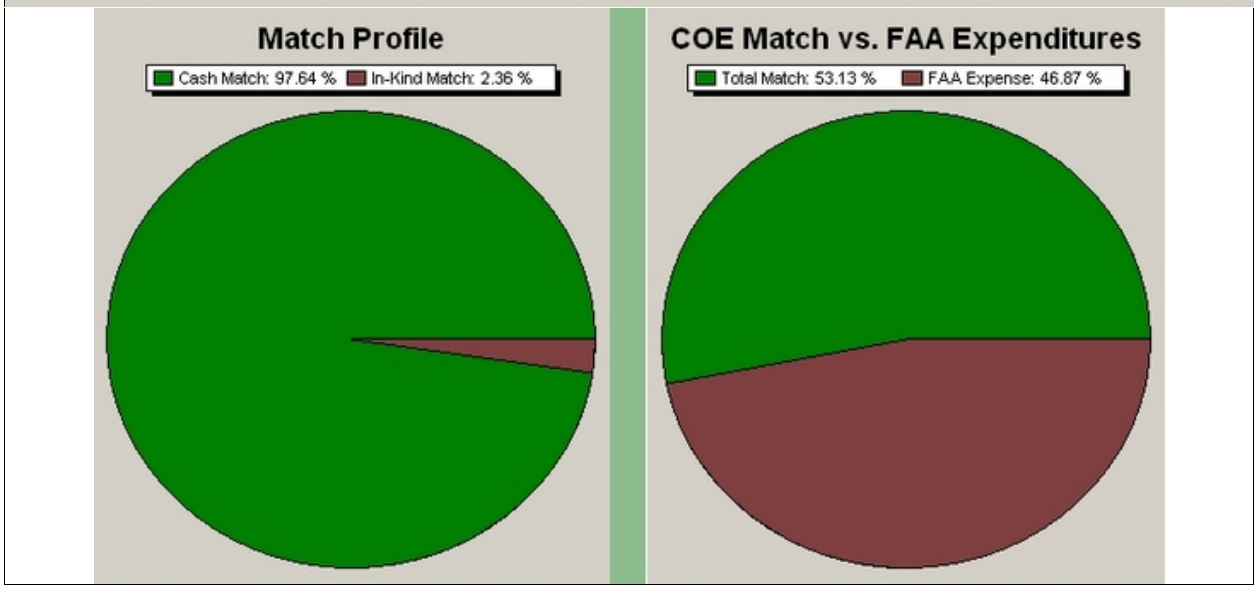
Students

Name	Organization	Department	Discipline	Degree	Graduation
Menon, Anil	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2012
Law, Jennifer	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2012
Blue, Rebecca S	UTMB	PMCH	Aerospace Medicine	M.D.	6/30/2013
Reyes, David P	UTMB	PMCH	Aerospace Medicine	M.D.	8/19/2014
Pattarini, James M	UTMB	PMCH	Aerospace Medicine	M.D.	6/30/2015
Mulcahy, Robert A	UTMB	PMCH	Aerospace Medicine	M.D.	6/30/2016

Task 255 Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$14,756	$14,756	$1,208	$1,208
Q3(Apr-Jun) FY2011	$14,756	$29,513	$13,214	$14,422
Q4(Jul-Sep) FY2011	$14,756	$44,269	$6,985	$21,406
Q1(Oct-Dec) FY2012	$14,756	$59,025	$7,124	$28,531
Q2(Jan-Mar) FY2012	$8,724	$67,749	$7,347	$35,878
Q3(Apr-Jun) FY2012	$8,724	$76,473	$7,198	$43,075
Q4(Jul-Sep) FY2012	$8,724	$85,197	$8,112	$51,187
Q1(Oct-Dec) FY2013	$8,724	$93,921	$24,333	$75,520
Q2(Jan-Mar) FY2013	$1,758	$95,679	$8,802	$84,322
Q3(Apr-Jun) FY2013	$1,758	$97,437	$12,109	$96,431
Q4(Jul-Sep) FY2013	$3,750	$101,187	$6,756	$103,187
Q1(Oct-Dec) FY2014	$23,417	$124,604	$1,103	$104,291
Totals	$124,604		$104,291	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$14,511	$14,511	$0	$0	$14,511	$14,511
Q3(Apr-Jun) FY2012	$14,432	$28,943	$0	$0	$14,432	$28,943
Q4(Jul-Sep) FY2012	$15,426	$44,369	$0	$0	$15,426	$44,369
Q1(Oct-Dec) FY2013	$23,925	$68,294	$2,786	$2,786	$26,711	$71,080
Q2(Jan-Mar) FY2013	$14,566	$82,860	$0	$2,786	$14,566	$85,646
Q3(Apr-Jun) FY2013	$16,318	$99,178	$0	$2,786	$16,318	$101,964
Q4(Jul-Sep) FY2013	$16,255	$115,433	$0	$2,786	$16,255	$118,219
Q1(Oct-Dec) FY2014	$0	$115,433	$0	$2,786	$0	$118,219
Totals	$115,433		$2,786		$118,219	

Task 256-UTMB: Testing and Training In High-G Profiles

Project Description

PURPOSE: There is a need to test, train, and evaluate groups of individuals with the most common diseases of mid and older ages. Characteristic responses of disease states will be identified and any particular risks that need to be mitigated identified.

GOALS: This task will enroll, train, and monitor groups with specific conditions as they experience G-profiles of commercial space flights.

Partners

- Federal Aviation Administration AST *
- University of Texas Medical Branch at Galveston *
- NASTAR Center *

*- indicates primary partner

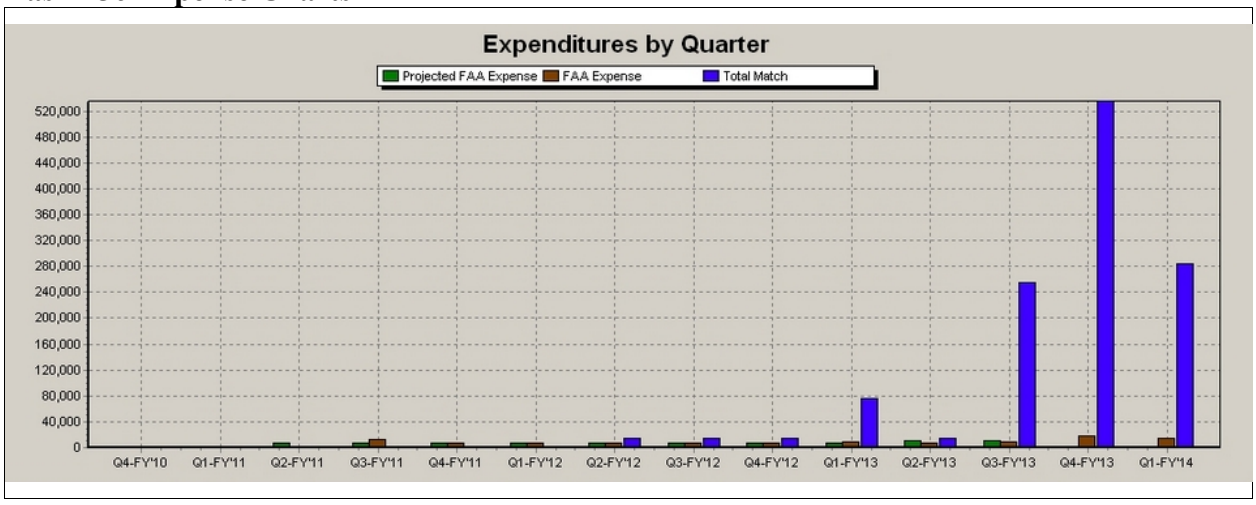
Funding History

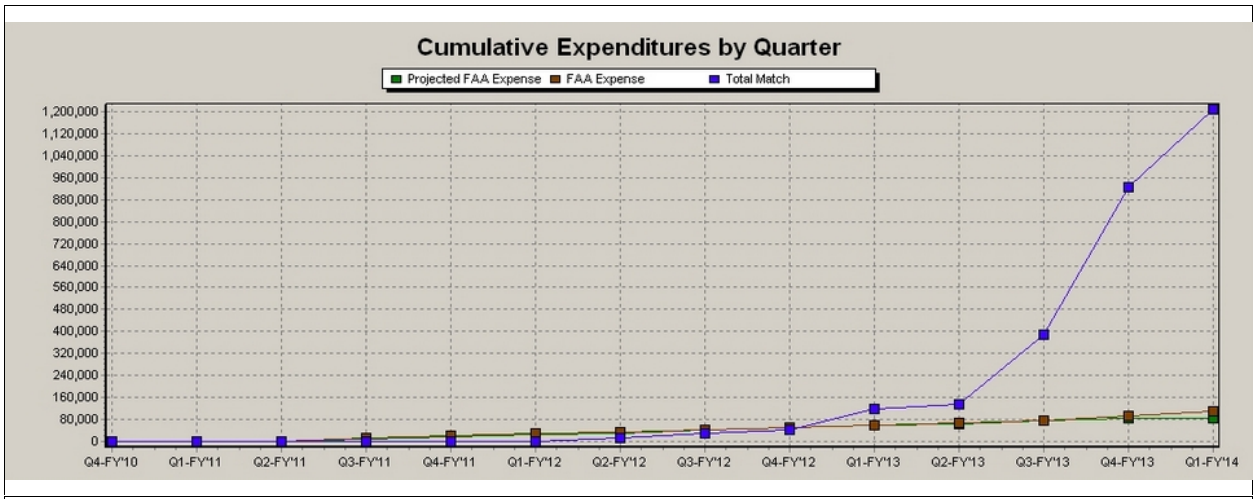
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UTMB-006	$31,525	$31,525
1/1/2012	12/31/2012	2010	10-C-CST-UTMB-010	$32,396	$32,396
1/1/2013	6/30/2013	2010	10-C-CST-UTMB-016	$0	$0
1/1/2013	6/30/2013	2011	10-C-CST-UTMB-019	$15,762	$15,762
1/1/2013	6/30/2013	2010	10-C-CST-UTMB-019	$5,178	$5,178
6/30/2013	9/30/2013	2010	10-C-CST-UTMB-023	$0	$0
					Total: $84,861

Students

Name	Organization	Department	Discipline	Degree	Graduation
Reyes, David	UTMB	PMCH	Aerospace Medicine	M.D.	8/15/2014
Blue, Rebecca S	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2013
Pattarini, James	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2014
Mulcahy, Robert	UTMB	Preventive Medicine	Aerospace Medicine	M.D.	6/1/2016

Task 256 Expense Charts




Cumulative Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
1,200,000
1,120,000
1,040,000
960,000
880,000
800,000
720,000
640,000
560,000
480,000
400,000
320,000
240,000
160,000
80,000
0
Q4-FY'10
Q1-FY'11
Q2-FY'11
Q3-FY'11
Q4-FY'11
Q1-FY'12
Q2-FY'12
Q3-FY'12
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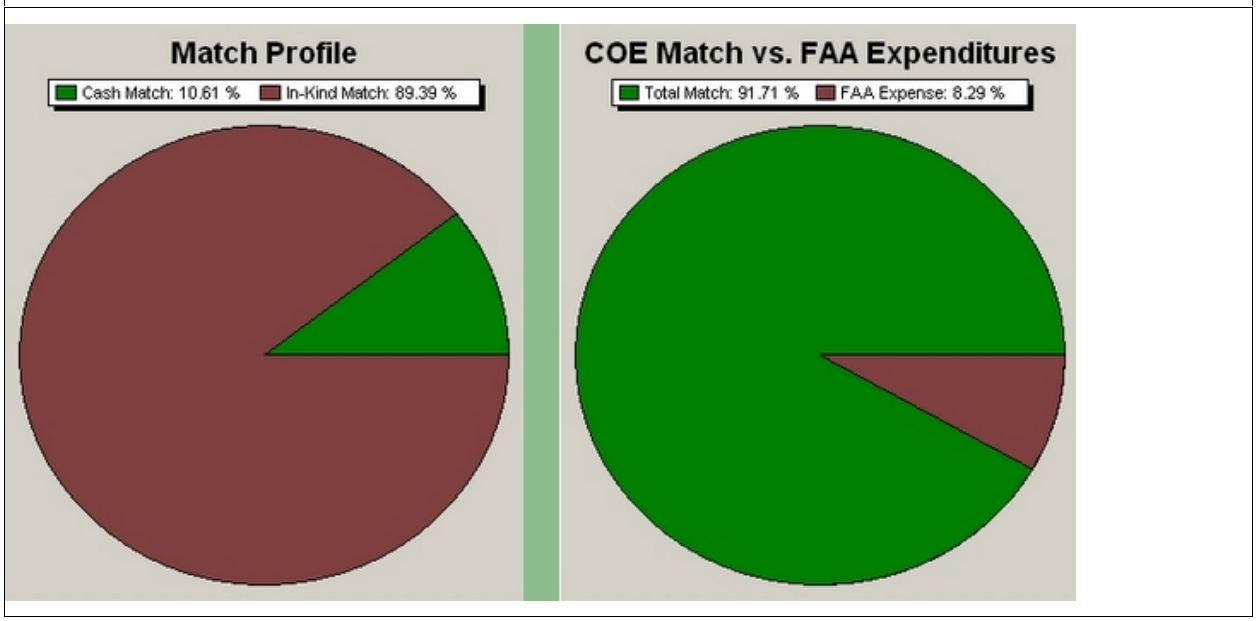
Q2-FY'13
Q3-FY'13
Q4-FY'13
Q1-FY'14


Match Profile
Cash Match: 10.61 %
In-Kind Match: 89.39 %
COE Match vs. FAA Expenditures
Total Match: 91.71 %
FAA Expense: 8.29 %

FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$7,881	$7,881	$1,208	$1,208
Q3(Apr-Jun) FY2011	$7,881	$15,763	$13,198	$14,406
Q4(Jul-Sep) FY2011	$7,881	$23,644	$7,003	$21,409
Q1(Oct-Dec) FY2012	$7,881	$31,525	$6,821	$28,230
Q2(Jan-Mar) FY2012	$8,099	$39,624	$7,375	$35,604
Q3(Apr-Jun) FY2012	$8,099	$47,723	$7,225	$42,829
Q4(Jul-Sep) FY2012	$8,099	$55,822	$6,884	$49,713
Q1(Oct-Dec) FY2013	$8,099	$63,921	$8,488	$58,201
Q2(Jan-Mar) FY2013	$10,470	$74,391	$7,684	$65,885
Q3(Apr-Jun) FY2013	$10,470	$84,861	$9,528	$75,413
Q4(Jul-Sep) FY2013	$0	$84,861	$18,962	$94,375
Q1(Oct-Dec) FY2014	$0	$84,861	$14,803	$109,178
Totals	$84,861		$109,178	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$14,526	$14,526	$0	$0	$14,526	$14,526
Q3(Apr-Jun) FY2012	$14,446	$28,972	$0	$0	$14,446	$28,972
Q4(Jul-Sep) FY2012	$14,775	$43,747	$0	$0	$14,775	$43,747
Q1(Oct-Dec) FY2013	$15,527	$59,274	$60,000	$60,000	$75,527	$119,274
Q2(Jan-Mar) FY2013	$13,973	$73,247	$0	$60,000	$13,973	$133,247
Q3(Apr-Jun) FY2013	$14,951	$88,198	$240,000	$300,000	$254,951	$388,198
Q4(Jul-Sep) FY2013	$25,396	$113,594	$510,000	$810,000	$535,396	$923,594
Q1(Oct-Dec) FY2014	$14,613	$128,207	$270,000	$1,080,000	$284,613	$1,208,207
Totals	$128,207		$1,080,000		$1,208,207	

Task 257-CU Masters Level Commercial Space Operations Instruction Criteria

Project Description

PURPOSE: Increases in commercial launch/re-entry and satellite operations result in the need to create an academically credible program for the education and training, both in theory and in practice, of operators for launch vehicles, space vehicles, and satellites. Such a capability, facilitated by extensive industry involvement, will insure a well trained workforce pipeline to support sustained and expanding space operations. Such operations will require trained and knowledgeable operators to maximize safety of launch and reentry, specifically to minimize the impact of these activities on the uninvolved public and the national airspace. There does not currently exist an opportunity for such training open to commercial providers.

OBJECTIVES:

1. Develop a one semester course covering the fundamentals of launch and on-orbit operations.
2. Develop a hands-on lab to follow the pre-requisite course work to provide real-world training in operations.
3. Refine instruction techniques based on student feedback and industry input.
4. Standardize instruction and identify required co-requisite courses for the establishment of a Certificate in Commercial Launch and Satellite Operations awarded by the University of Colorado at Boulder.

Partners

- Federal Aviation Administration AST *
- University of Colorado at Boulder *

*- indicates primary partner

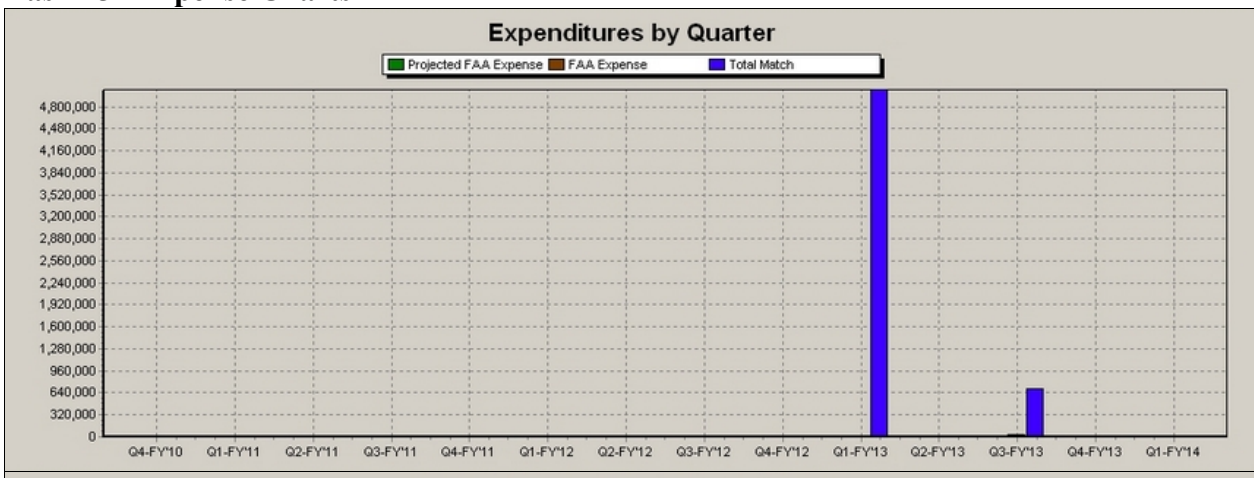
Funding History

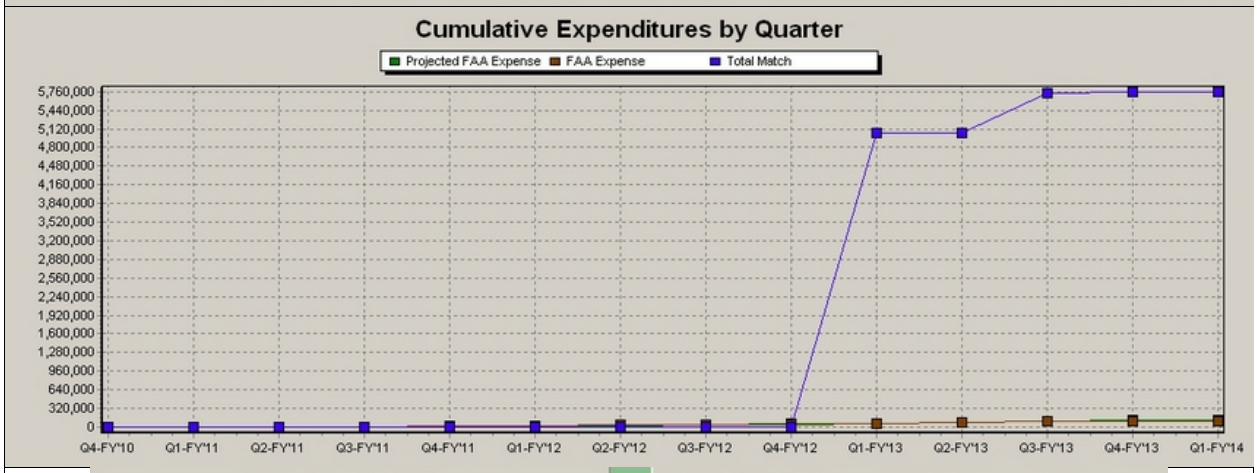
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UC-003	$25,024	$25,024
1/1/2012	12/31/2012	2011	10-C-CST-UC-011	$50,000	$50,000
1/1/2013	5/31/2013	2012	10-C-CST-UC-022	$33,486	$33,486
5/31/2013	5/31/2014	2013	10-C-CST-UC-030	$20,000	$20,000
					Total: $128,510

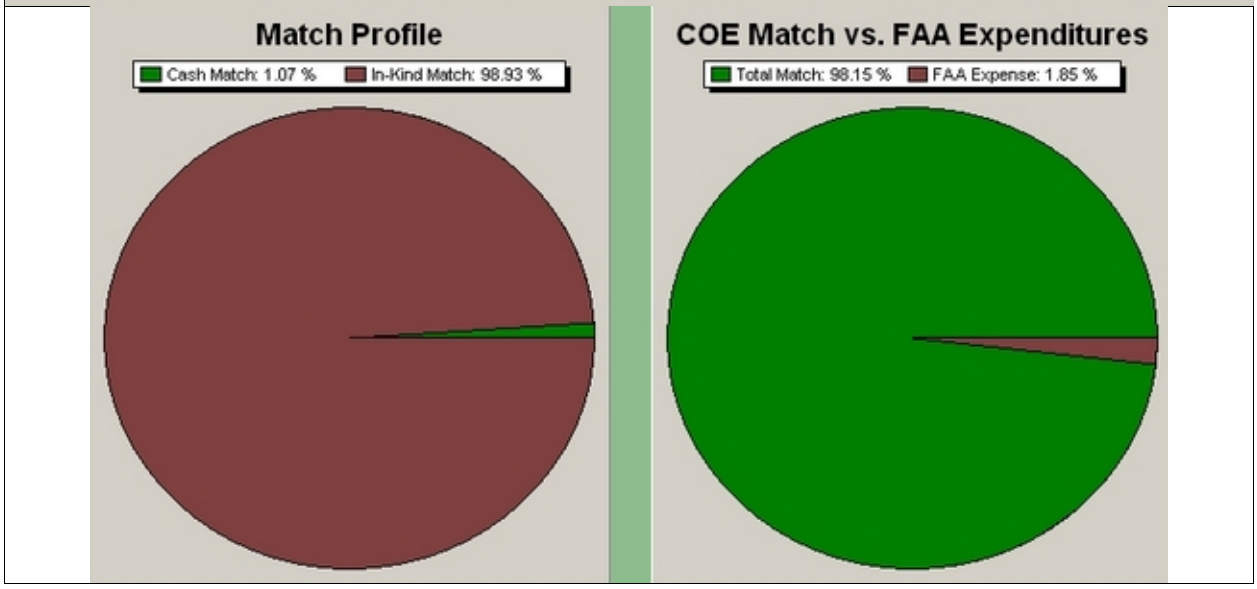
Students

Name	Organization	Department	Discipline	Degree	Graduation
Cheetham, Bradley W	University of Colorado at Boulder	Aerospace Engineering Sciences	Aerospace Engineering	Ph.D.	-
Feldhacker, Juliana	University of Colorado at Boulder	Aerospace Engineering Sciences	Aerospace Engineering	Ph.D.	-
Herman, Jon F.C.	University of Colorado	Aerospace Engineering Sciences	Aerospace Engineering	Ph.D.	5/1/2015
Mcgranaghan, Ryan M	University of Colorado	Aerospace Engineering Sciences	Aerospace Engineering	Terminated	1/1/2013

Task 257 Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$6,256	$6,256	$0	$0
Q3(Apr-Jun) FY2011	$6,256	$12,512	$6,358	$6,358
Q4(Jul-Sep) FY2011	$6,256	$18,768	$9,675	$16,033
Q1(Oct-Dec) FY2012	$6,256	$25,024	$8,991	$25,024
Q2(Jan-Mar) FY2012	$12,500	$37,524	$13,129	$38,153
Q3(Apr-Jun) FY2012	$12,500	$50,024	$1,112	$39,265
Q4(Jul-Sep) FY2012	$12,500	$62,524	$6,170	$45,435
Q1(Oct-Dec) FY2013	$12,500	$75,024	$10,979	$56,414
Q2(Jan-Mar) FY2013	$20,092	$95,116	$17,026	$73,440
Q3(Apr-Jun) FY2013	$16,471	$111,587	$29,031	$102,471
Q4(Jul-Sep) FY2013	$4,615	$116,202	$6,039	$108,510
Q1(Oct-Dec) FY2014	$4,615	$120,818	$0	$108,510
Totals	$120,818		$108,510	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$61,564	$61,564	$4,989,333	$4,989,333	$5,050,897	$5,050,897
Q2(Jan-Mar) FY2013	$0	$61,564	$0	$4,989,333	$0	$5,050,897
Q3(Apr-Jun) FY2013	$0	$61,564	$692,420	$5,681,753	$692,420	$5,743,317
Q4(Jul-Sep) FY2013	$0	$61,564	$12,258	$5,694,011	$12,258	$5,755,576
Q1(Oct-Dec) FY2014	$0	$61,564	$0	$5,694,011	$0	$5,755,576
Totals	$61,564		$5,694,011		$5,755,576	

Task 258-SU: Multi-Disciplinary Analysis of Launch Vehicle Safety Metrics

Project Description

GOALS:

1. Develop high-fidelity tool for the FAA.
2. Assess the confidence in applicant's system reliability claims.
3. Compute a probability of failure estimate for new vehicles using system reliability data provided by applicants.
4. Partner with ULA, SpaceX, Orbital

Partners

- Federal Aviation Administration AST *
- Stanford University *
- NASA Ames Research Center

*- indicates primary partner

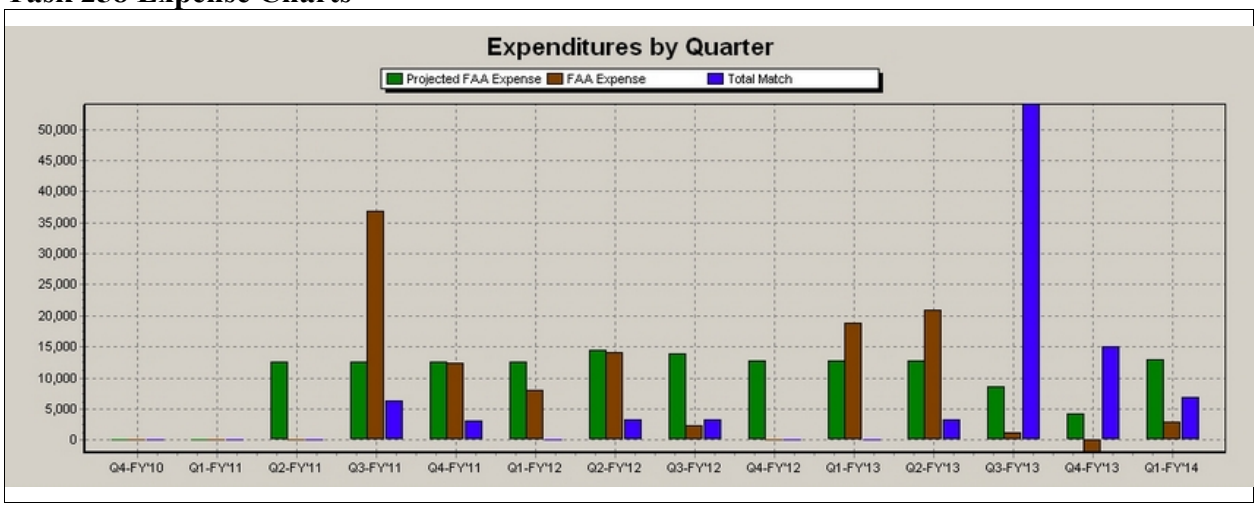
Funding History

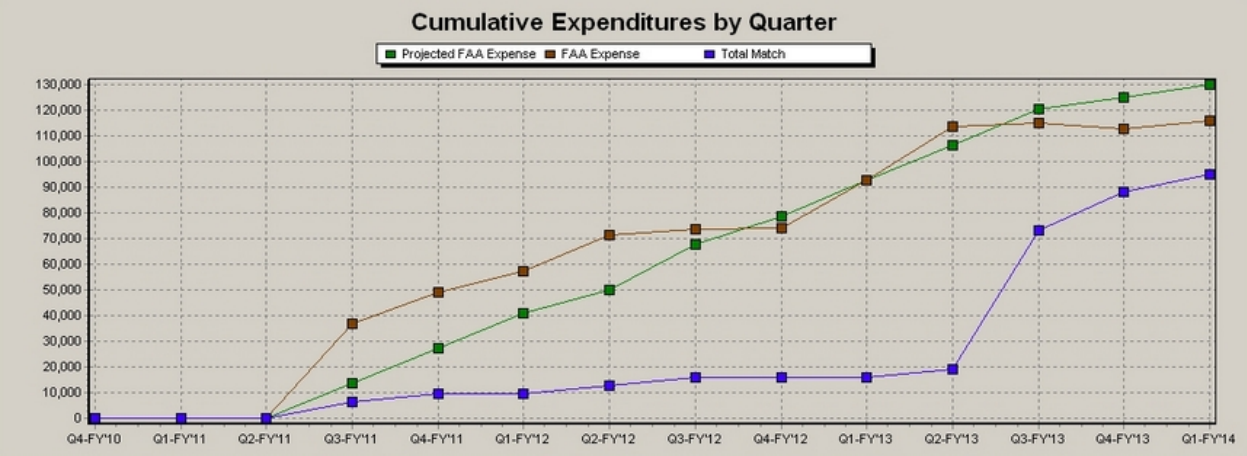
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-SU-008	$50,000	$50,000
1/1/2012	5/31/2012	2012	10-C-CST-SU-016	$24,000	$24,000
6/1/2012	5/31/2013	2012	10-C-CST-SU-020	$51,288	$51,288
5/31/2013	9/30/2013	2013	10-C-CST-SU-029	$0	$0
9/30/2013	5/31/2014	2013	10-C-CST-SU-036	$15,000	$15,000
9/30/2013	5/31/2014	2013	10-C-CST-SU-038	$24,000	$24,000
					Total: $164,288

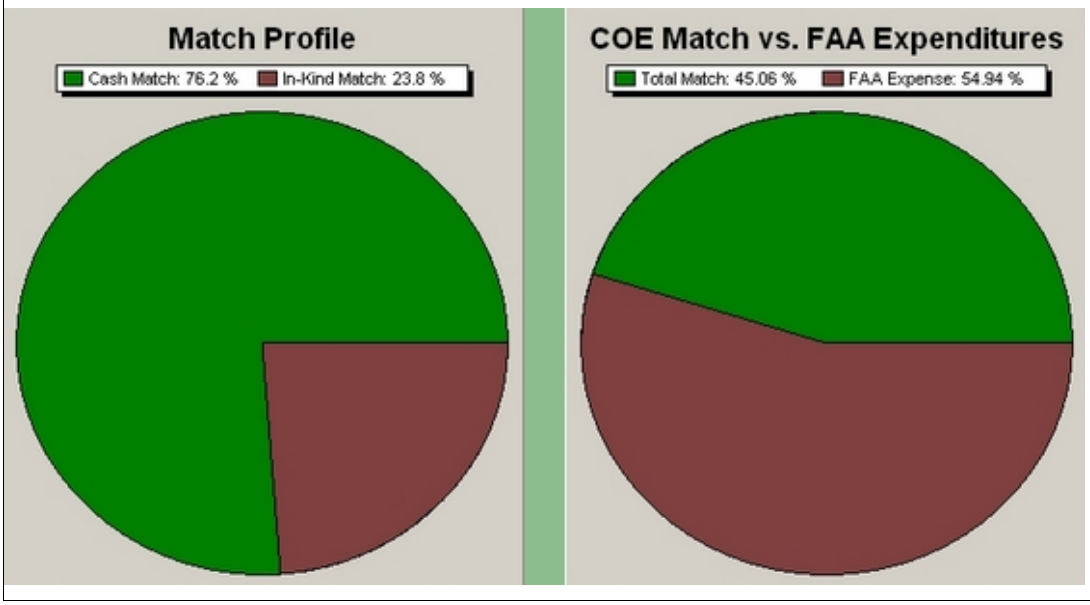
Students

Name	Organization	Department	Discipline	Degree	Graduation
Capristan, Francisco M	Stanford University	Aeronautics & Astronautics	Aerospace Engineering	Ph.D.	6/1/2015

Task 258 Expense Charts




Cumulative Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Q4-FY'10
Q1-FY'11
Q2-FY'11
Q3-FY'11
Q4-FY'11
Q1-FY'12
Q2-FY'12
Q3-FY'12
Q4-FY'12
Q1-FY'13
Q2-FY'13
Q3-FY'13
Q4-FY'13
Q1-FY'14


Match Profile
Cash Match: 76.2 %
In-Kind Match: 23.8 %
COE Match vs. FAA Expenditures
Total Match: 45.06 %
FAA Expense: 54.94 %

FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$12,500	$12,500	$0	$0
Q3(Apr-Jun) FY2011	$12,500	$25,000	$36,846	$36,846
Q4(Jul-Sep) FY2011	$12,500	$37,500	$12,354	$49,200
Q1(Oct-Dec) FY2012	$12,500	$50,000	$8,081	$57,281
Q2(Jan-Mar) FY2012	$14,400	$64,400	$14,176	$71,457
Q3(Apr-Jun) FY2012	$13,874	$78,274	$2,363	$73,820
Q4(Jul-Sep) FY2012	$12,822	$91,096	$180	$74,000
Q1(Oct-Dec) FY2013	$12,822	$103,918	$18,920	$92,920
Q2(Jan-Mar) FY2013	$12,822	$116,740	$20,908	$113,827
Q3(Apr-Jun) FY2013	$8,548	$125,288	$1,224	$115,052
Q4(Jul-Sep) FY2013	$4,333	$129,621	($1,995)	$113,057
Q1(Oct-Dec) FY2014	$13,000	$142,621	$2,955	$116,012
Totals	$142,621		$116,012	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$6,250	$6,250	$0	$0	$6,250	$6,250
Q4(Jul-Sep) FY2011	$3,125	$9,375	$0	$0	$3,125	$9,375
Q1(Oct-Dec) FY2012	$0	$9,375	$0	$0	$0	$9,375
Q2(Jan-Mar) FY2012	$3,234	$12,609	$0	$0	$3,234	$12,609
Q3(Apr-Jun) FY2012	$3,234	$15,843	$0	$0	$3,234	$15,843
Q4(Jul-Sep) FY2012	$0	$15,843	$0	$0	$0	$15,843
Q1(Oct-Dec) FY2013	$0	$15,843	$0	$0	$0	$15,843
Q2(Jan-Mar) FY2013	$3,332	$19,175	$0	$0	$3,332	$19,175
Q3(Apr-Jun) FY2013	$34,532	$53,707	$19,545	$19,545	$54,077	$73,252
Q4(Jul-Sep) FY2013	$11,906	$65,613	$3,102	$22,647	$15,008	$88,260
Q1(Oct-Dec) FY2014	$6,895	$72,508	$0	$22,647	$6,895	$95,155
Totals	$72,508		$22,647		$95,155	

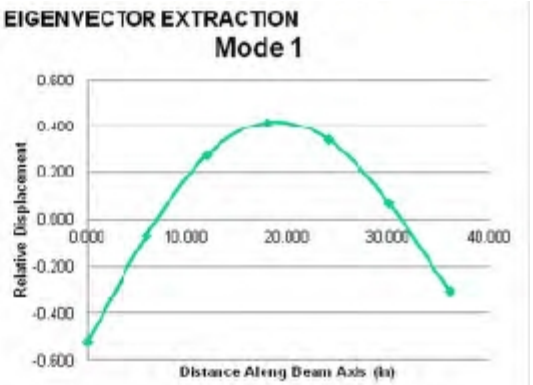
Task 293-NMT: Reduced Order Non-Linear Structural Modeling

Project Description

PROJECT AT-A-GLANCE
- AST TECH MONITOR: Nick Demidovich
- UNIVERSITY: New Mexico Tech
- PRINCIPAL INVESTIGATOR: Dr. Keith Miller
- STUDENT RESEARCHER: Mr. Joshua Mendoza
- STATUS: New

RELEVANCE TO COMMERCIAL SPACE INDUSTRY
- Improve the capability of estimating the performance and safety margins of commercial space vehicles.

STATEMENT OF WORK
- Construct non-linear system level models derived from reduced order non-linear finite element models and also directly from structural test data.
- Numerical Experimentation
- Modal Testing
- FEA Implementing Physical Test Data
- Numerical Experimentation
  - FE Model Basic Concepts
  - Eigenvector Extraction
  - Matrix Manipulation
  - Model Assembly and Analysis
  - Code Analysis



STATUS
- This project has just been initiated.

FUTURE WORK
- Determine Source of Error in Current FE Models
- Re-Condition Matrices
- Properly Couple Test Data to Model

Partners:

- Federal Aviation Administration AST *
- New Mexico Institute of Mining and Technology *

*- indicates primary partner

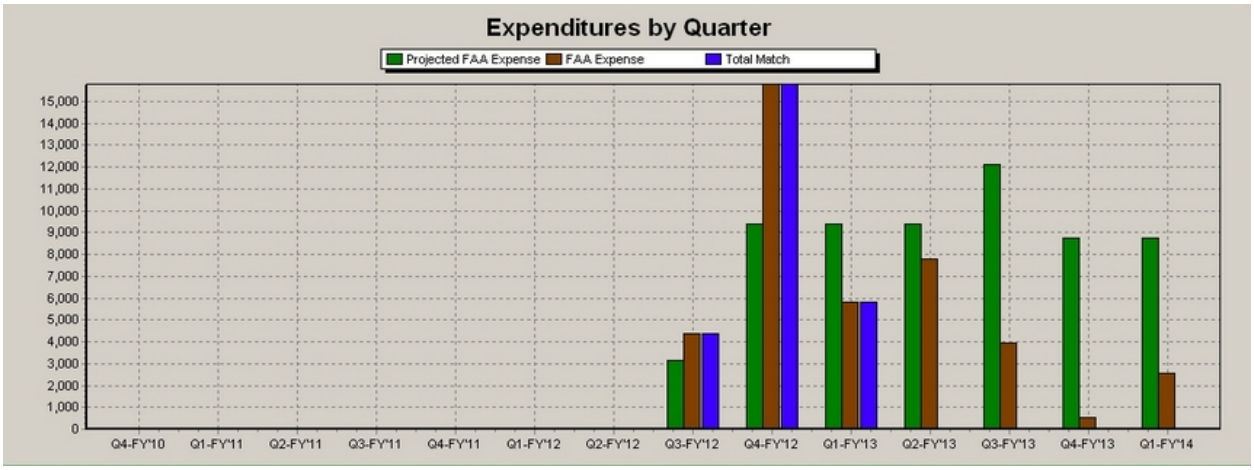
Funding History

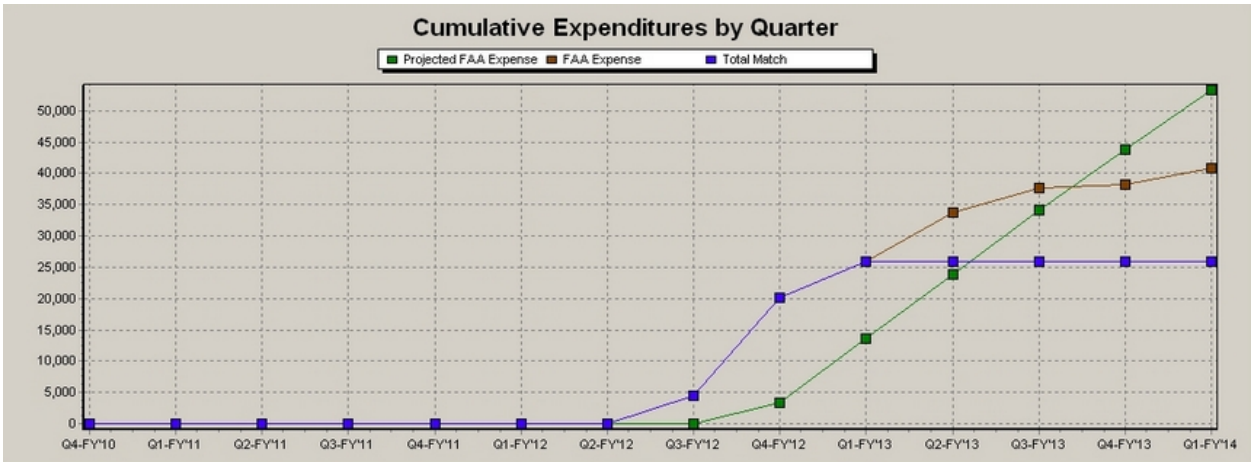
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2012	5/31/2013	2010	10-C-CST-NMT-004	$37,500	$37,500
5/31/2013	5/31/2014	2010	10-C-CST-NMT-007	$0	$0
5/31/2013	5/31/2014	2013	10-C-CST-NMT-015	$8,000	$8,000
5/31/2013	5/31/2014	2013	10-C-CST-NMT-018	$8,000	$8,000
5/31/2013	5/31/2014	2013	10-C-CST-NMT-012	$22,000	$22,000
					Total: $75,500

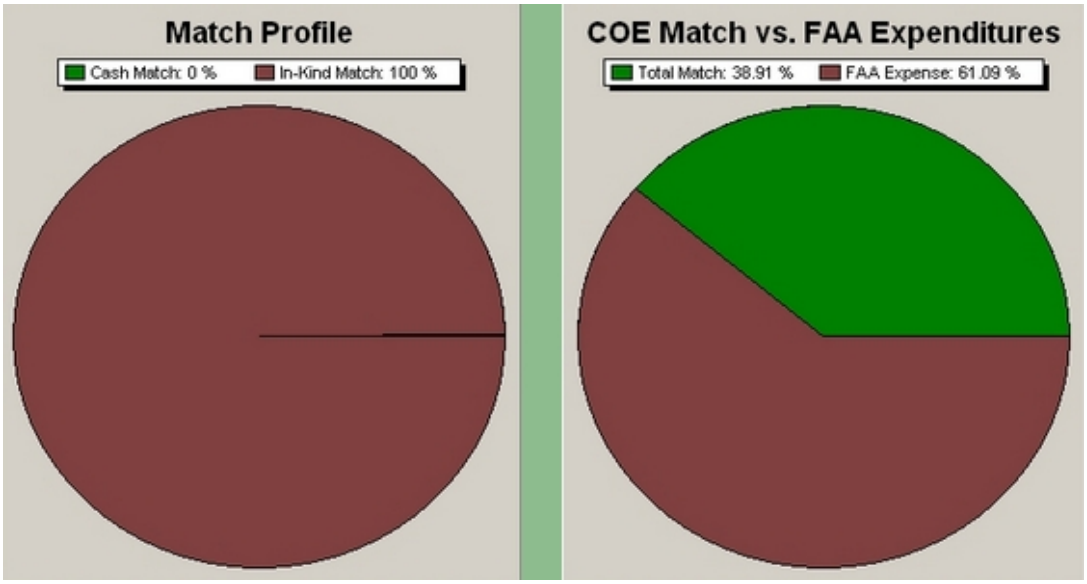
Students

Name	Organization	Department	Discipline	Degree	Graduation
Mendoza, Joshua	NMT	Mechanical Enigeering	Mechanical Engineering	Masters	-

Task 293 Expense Charts







FAA Cash by Quarter

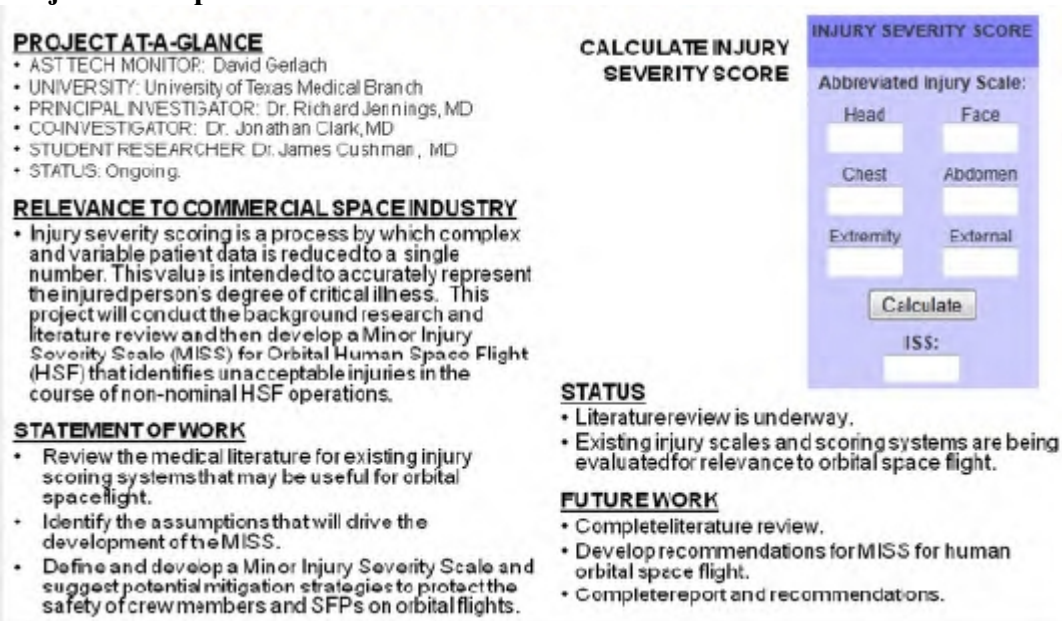
Date	Projected	Running Sum	Actual	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$3,125	$3,125	$4,397	$4,397
Q4(Jul-Sep) FY2012	$9,375	$12,500	$15,794	$20,192
Q1(Oct-Dec) FY2013	$9,375	$21,875	$5,793	$25,985
Q2(Jan-Mar) FY2013	$9,375	$31,250	$7,775	$33,760
Q3(Apr-Jun) FY2013	$12,096	$43,346	$3,933	$37,693
Q4(Jul-Sep) FY2013	$8,769	$52,115	$540	$38,233
Q1(Oct-Dec) FY2014	$8,769	$60,885	$2,556	$40,789
Totals	$60,885		$40,789	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q4(Jul-Sep) FY2010	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$4,397	$4,397	$4,397	$4,397
Q4(Jul-Sep) FY2012	$0	$0	$15,794	$20,192	$15,794	$20,192
Q1(Oct-Dec) FY2013	$0	$0	$5,793	$25,985	$5,793	$25,985
Q2(Jan-Mar) FY2013	$0	$0	$0	$25,985	$0	$25,985
Q3(Apr-Jun) FY2013	$0	$0	$0	$25,985	$0	$25,985
Q4(Jul-Sep) FY2013	$0	$0	$0	$25,985	$0	$25,985
Q1(Oct-Dec) FY2014	$0	$0	$0	$25,985	$0	$25,985
Totals	$0		$25,985		$25,985	

Task 294-UTMB: Development of Minor Injury Severity Scale For Orbital Human Space Flight

Project Description



Partners:

- Federal Aviation Administration AST *
- University of Texas Medical Branch at Galveston *

*- indicates primary partner

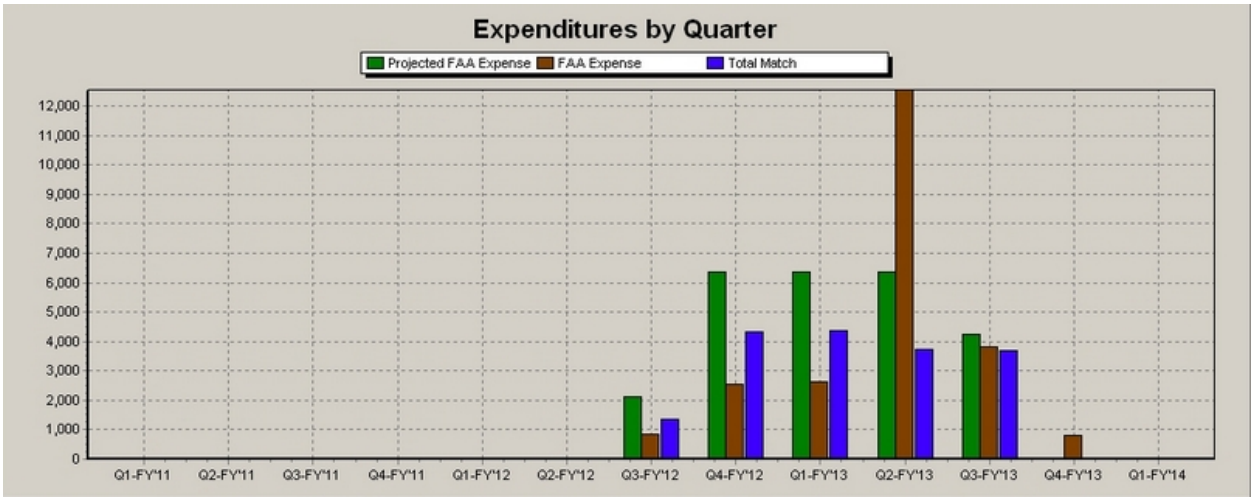
Funding History

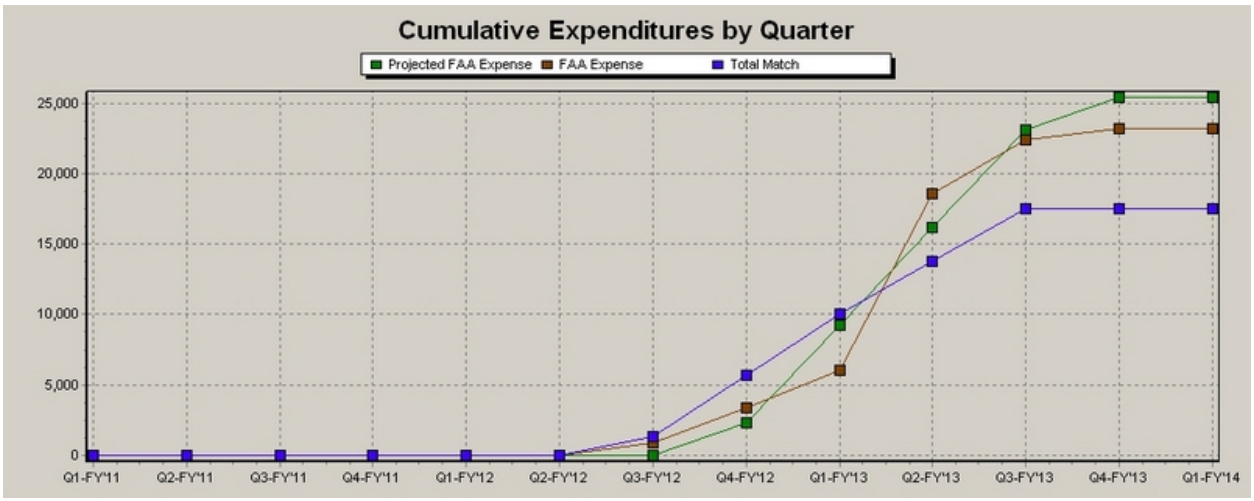
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2012	5/31/2013	2012	10-C-CST-UTMB-014	$25,422	$25,422
					Total: $25,422

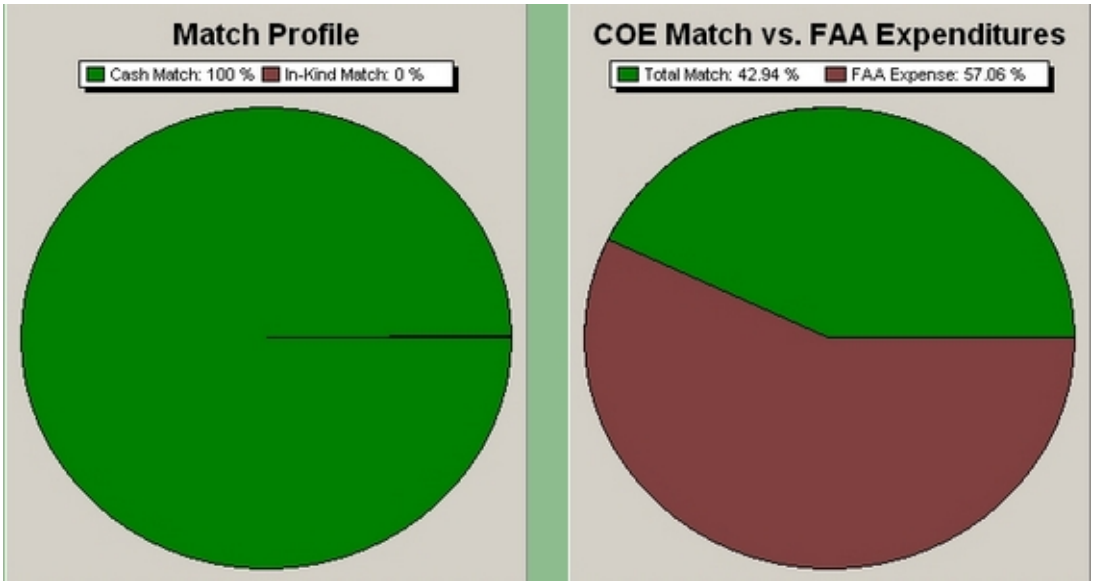
Students

Name	Organization	Department	Discipline	Degree	Graduation
Cushman, James	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2013

Task 294 Expense Charts







FAA Cash by Quarter

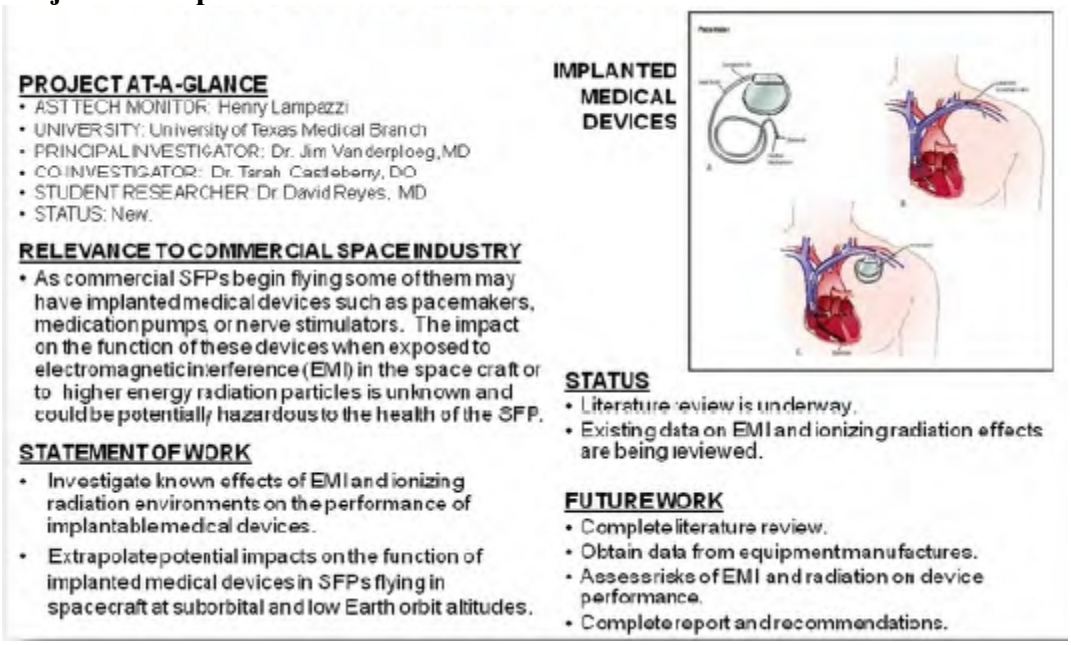
Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$2,119	$2,119	$847	$847
Q4(Jul-Sep) FY2012	$6,356	$8,474	$2,558	$3,405
Q1(Oct-Dec) FY2013	$6,356	$14,830	$2,635	$6,040
Q2(Jan-Mar) FY2013	$6,356	$21,185	$12,557	$18,597
Q3(Apr-Jun) FY2013	$4,237	$25,422	$3,812	$22,409
Q4(Jul-Sep) FY2013	$0	$25,422	$827	$23,235
Q1(Oct-Dec) FY2014	$0	$25,422	$0	$23,235
Totals	$25,422		$23,235	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$1,353	$1,353	$0	$0	$1,353	$1,353
Q4(Jul-Sep) FY2012	$4,343	$5,696	$0	$0	$4,343	$5,696
Q1(Oct-Dec) FY2013	$4,377	$10,073	$0	$0	$4,377	$10,073
Q2(Jan-Mar) FY2013	$3,737	$13,810	$0	$0	$3,737	$13,810
Q3(Apr-Jun) FY2013	$3,676	$17,486	$0	$0	$3,676	$17,486
Q4(Jul-Sep) FY2013	$0	$17,486	$0	$0	$0	$17,486
Q1(Oct-Dec) FY2014	$0	$17,486	$0	$0	$0	$17,486
Totals	$17,486		$0		$17,486	

Task 295-UTMB: Effects of EMI and Ionizing Radiation on Implantable Medical Devices

Project Description



Partners

- Federal Aviation Administration AST *
- University of Texas Medical Branch at Galveston *

*- indicates primary partner

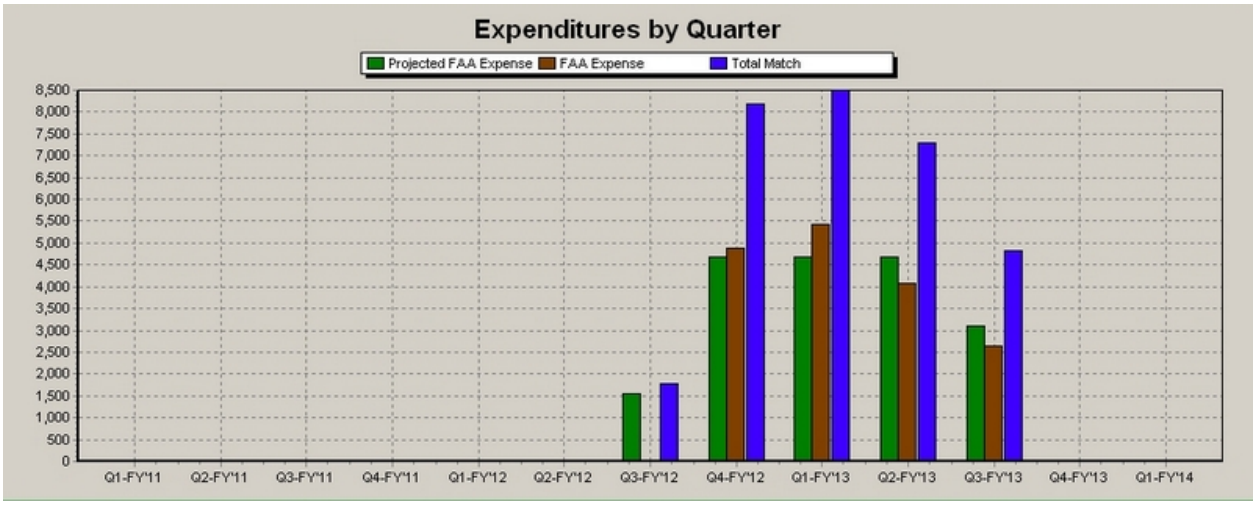
Funding History

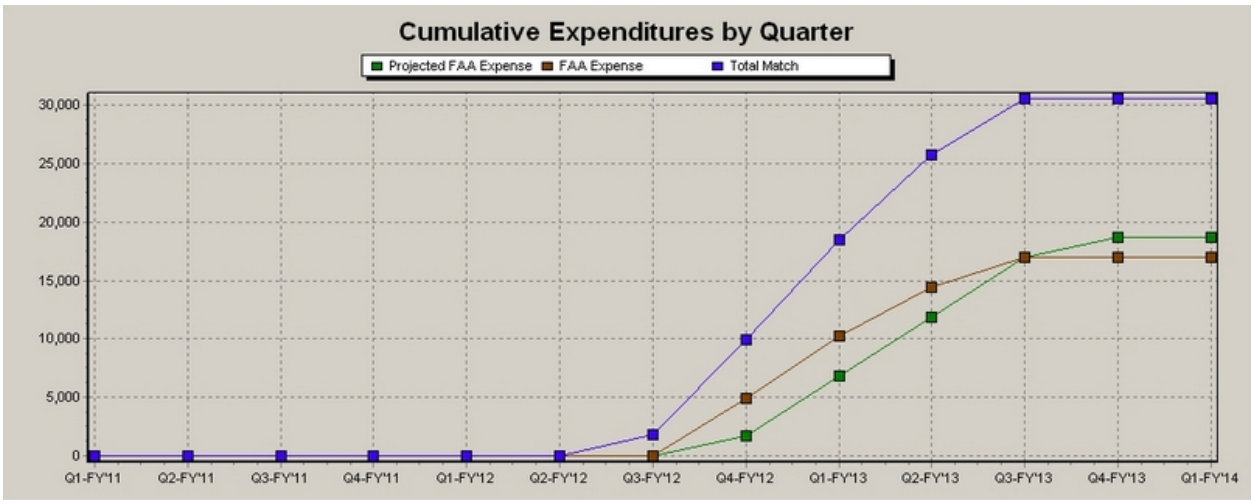
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2012	5/31/2013	2012	10-C-CST-UTMB-015	$18,689	$18,689
					Total: $18,689

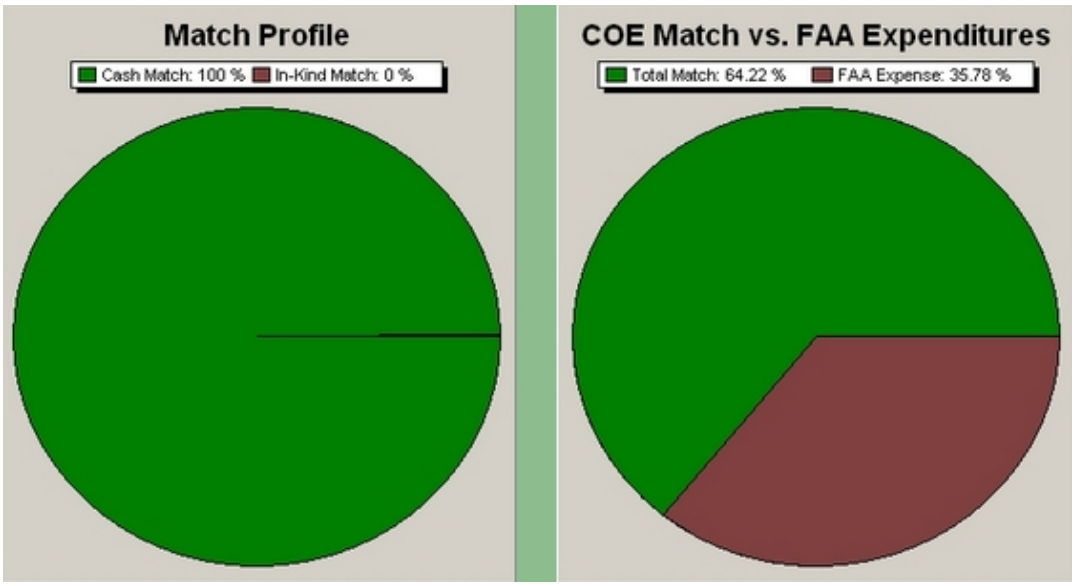
Students

Name	Organization	Department	Discipline	Degree	Graduation
Reyes, David	UTMB	PMCH	Aerospace Medicine	M.D.	8/15/2014

Task 295 Expense Charts







FAA Cash by Quarter

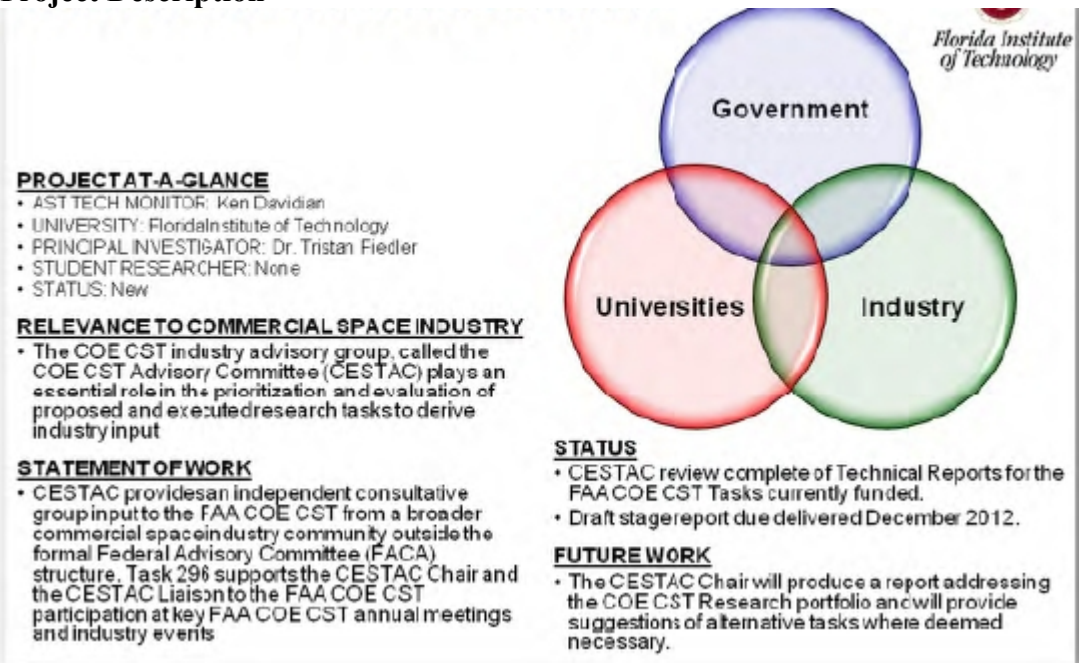
Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$1,557	$1,557	$0	$0
Q4(Jul-Sep) FY2012	$4,672	$6,230	$4,869	$4,869
Q1(Oct-Dec) FY2013	$4,672	$10,902	$5,426	$10,295
Q2(Jan-Mar) FY2013	$4,672	$15,574	$4,081	$14,376
Q3(Apr-Jun) FY2013	$3,115	$18,689	$2,649	$17,025
Q4(Jul-Sep) FY2013	$0	$18,689	$0	$17,025
Q1(Oct-Dec) FY2014	$0	$18,689	$0	$17,025
Totals	$18,689		$17,025	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$1,770	$1,770	$0	$0	$1,770	$1,770
Q4(Jul-Sep) FY2012	$8,181	$9,951	$0	$0	$8,181	$9,951
Q1(Oct-Dec) FY2013	$8,500	$18,451	$0	$0	$8,500	$18,451
Q2(Jan-Mar) FY2013	$7,290	$25,741	$0	$0	$7,290	$25,741
Q3(Apr-Jun) FY2013	$4,822	$30,563	$0	$0	$4,822	$30,563
Q4(Jul-Sep) FY2013	$0	$30,563	$0	$0	$0	$30,563
Q1(Oct-Dec) FY2014	$0	$30,563	$0	$0	$0	$30,563
Totals	$30,563		$0		$30,563	

Task 296-FIT: CESTAC Support & Outreach

Project Description



Partners:

- Federal Aviation Administration AST *
- Florida Institute of Technology *
- Space Florida *

*- indicates primary partner

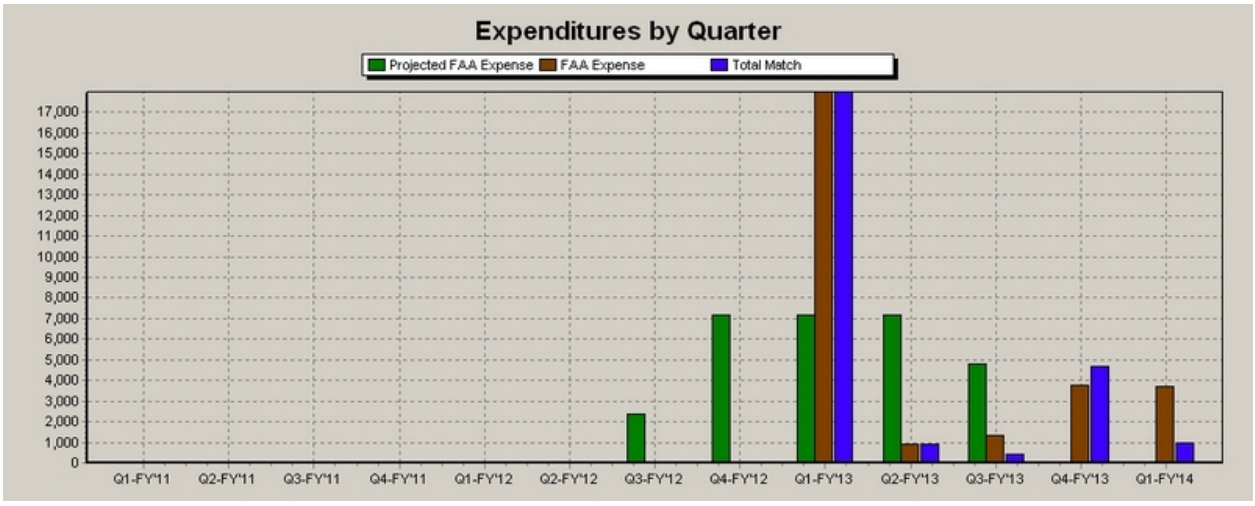
Funding History

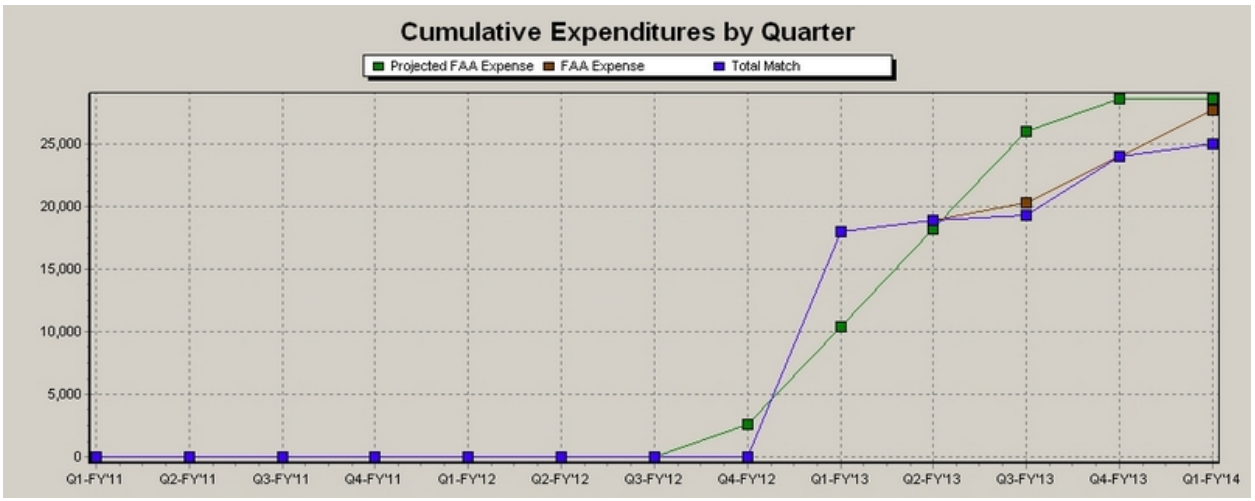
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2012	5/31/2013	2012	10-C-CST-FIT-009	$24,650	$24,650
6/1/2012	5/31/2013	2012	10-C-CST-FIT-011	$4,000	$4,000
6/1/2013	5/31/2014	2012	10-C-CST-FIT-014	$0	$0
					Total: $28,650

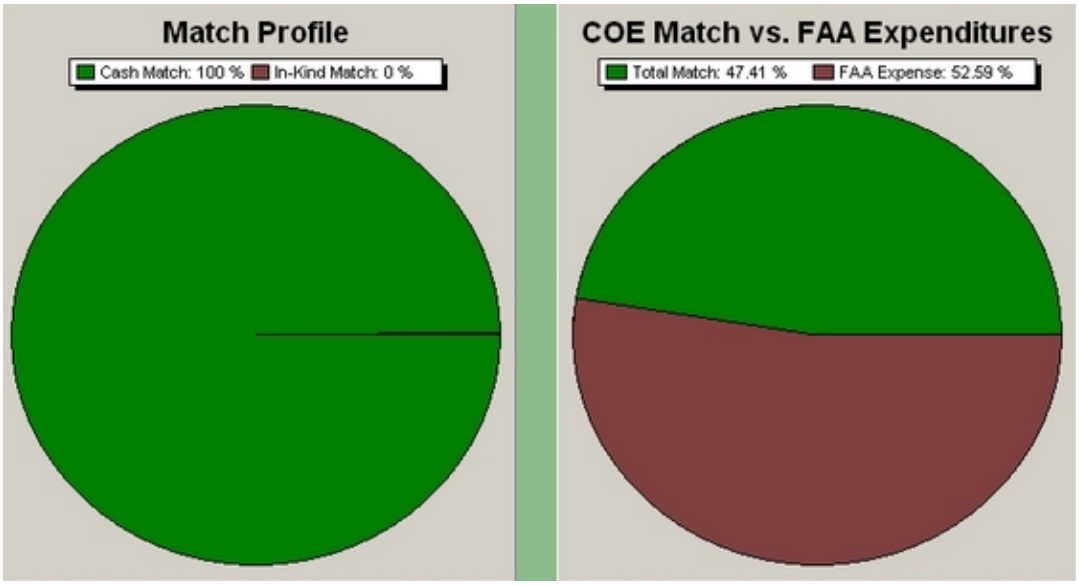
Students

None

Task 296 Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$2,388	$2,388	$0	$0
Q4(Jul-Sep) FY2012	$7,163	$9,550	$0	$0
Q1(Oct-Dec) FY2013	$7,163	$16,713	$18,000	$18,000
Q2(Jan-Mar) FY2013	$7,163	$23,875	$939	$18,939
Q3(Apr-Jun) FY2013	$4,775	$28,650	$1,368	$20,307
Q4(Jul-Sep) FY2013	$0	$28,650	$3,747	$24,054
Q1(Oct-Dec) FY2014	$0	$28,650	$3,711	$27,766
Totals	$28,650		$27,766	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$18,000	$18,000	$0	$0	$18,000	$18,000
Q2(Jan-Mar) FY2013	$939	$18,939	$0	$0	$939	$18,939
Q3(Apr-Jun) FY2013	$428	$19,367	$0	$0	$428	$19,367
Q4(Jul-Sep) FY2013	$4,687	$24,054	$0	$0	$4,687	$24,054
Q1(Oct-Dec) FY2014	$973	$25,027	$0	$0	$973	$25,027
Totals	$25,027		$0		$25,027	

Task 297-FSU: Technical Oversight and OMIS Integration

Project Description

Provide technical oversight and OMIS integration for the COE-CST.

Partners

- Federal Aviation Administration AST *
- Florida State University *
- Space Florida *
- Orion America Technologies, LLC *

*- indicates primary partner

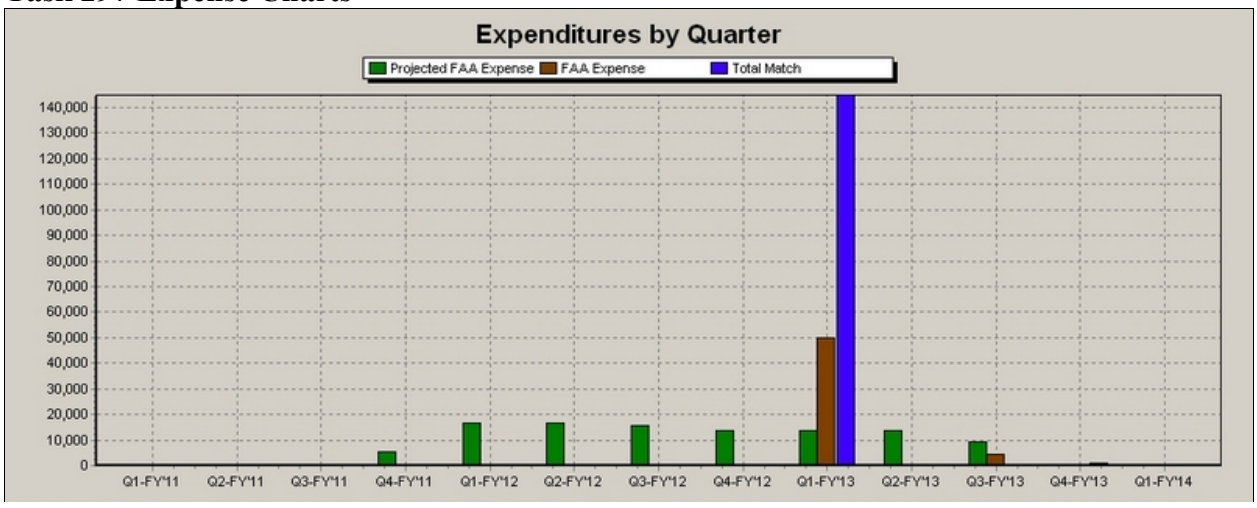
Funding History

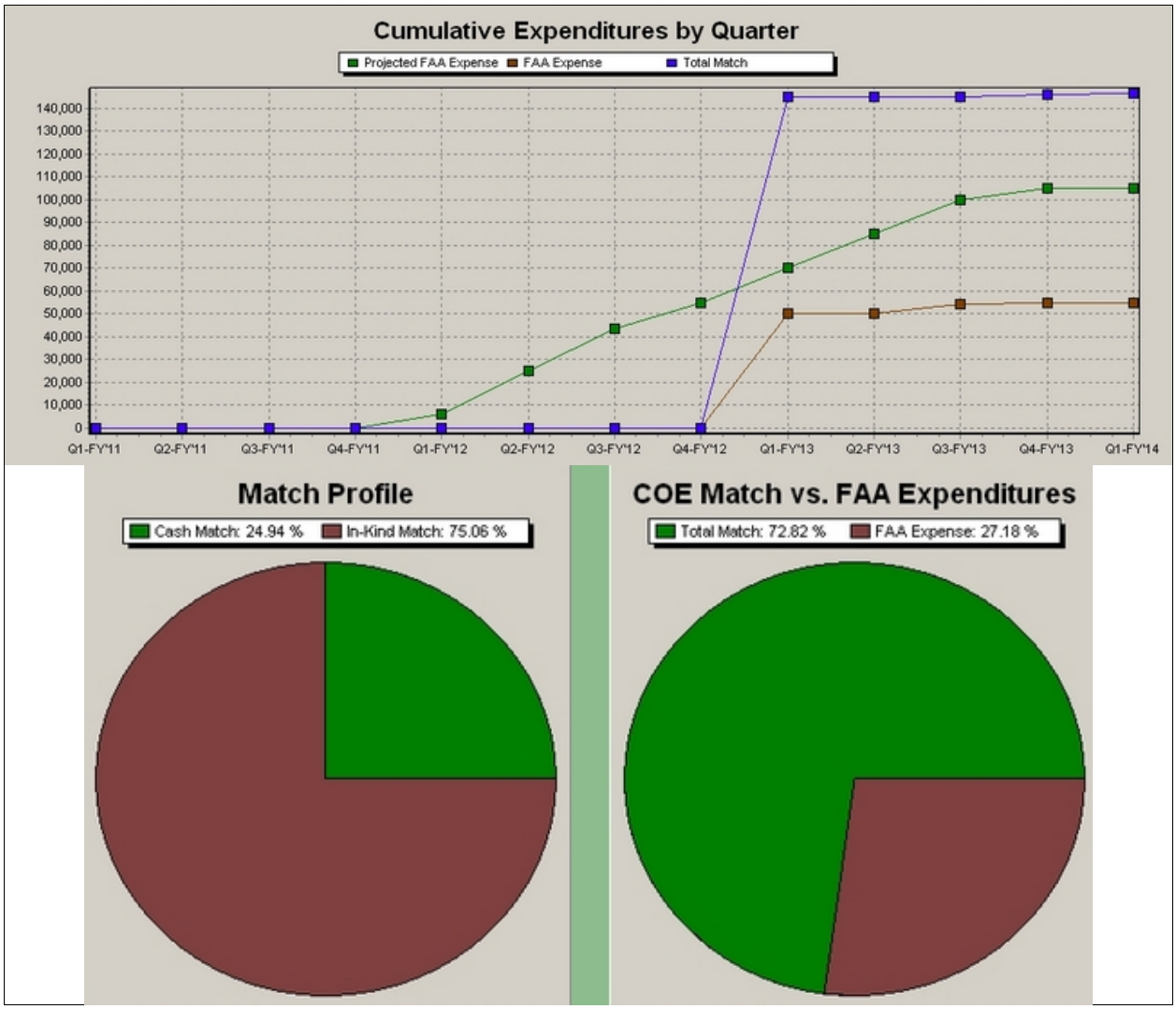
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
9/1/2011	5/31/2012	2011	10-C-CST-FSU-008	$50,000	$50,000
6/1/2012	5/31/2013	2012	10-C-CST-FSU-012	$50,000	$50,000
6/1/2012	5/31/2013	2012	10-C-CST-FSU-014	$5,000	$5,000
5/31/2013	5/31/2014	2012	10-C-CST-FSU-017	$0	$0
					Total: $105,000

Students

None

Task 297 Expense Charts




Cumulative Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Q1-FY'11
Q2-FY'11
Q3-FY'11
Q4-FY'11
Q1-FY'12
Q2-FY'12
Q3-FY'12
Q4-FY'12
Q1-FY'13
Q2-FY'13
Q3-FY'13
Q4-FY'13
Q1-FY'14
Match Profile
Cash Match: 24.94 %
In-Kind Match: 75.06 %
COE Match vs. FAA Expenditures
Total Match: 72.82 %
FAA Expense: 27.18 %

FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$5,556	$5,556	$0	$0
Q1(Oct-Dec) FY2012	$16,667	$22,222	$0	$0
Q2(Jan-Mar) FY2012	$16,667	$38,889	$0	$0
Q3(Apr-Jun) FY2012	$15,694	$54,583	$0	$0
Q4(Jul-Sep) FY2012	$13,750	$68,333	$0	$0
Q1(Oct-Dec) FY2013	$13,750	$82,083	$50,000	$50,000
Q2(Jan-Mar) FY2013	$13,750	$95,833	$0	$50,000
Q3(Apr-Jun) FY2013	$9,167	$105,000	$4,403	$54,403
Q4(Jul-Sep) FY2013	$0	$105,000	$213	$54,616
Q1(Oct-Dec) FY2014	$0	$105,000	$82	$54,698
Totals	$105,000		$54,698	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$34,871	$34,871	$110,000	$110,000	$144,871	$144,871
Q2(Jan-Mar) FY2013	$0	$34,871	$0	$110,000	$0	$144,871
Q3(Apr-Jun) FY2013	$353	$35,224	$0	$110,000	$353	$145,224
Q4(Jul-Sep) FY2013	$1,020	$36,244	$0	$110,000	$1,020	$146,244
Q1(Oct-Dec) FY2014	$306	$36,550	$0	$110,000	$306	$146,550
Totals	$36,550		$110,000		$146,550	

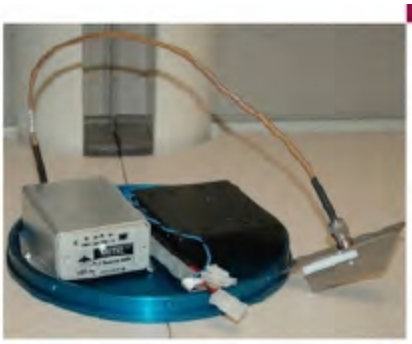
Task 298-NMSU: Integration-Evaluation of ADS-B Payloads

Project Description

PROJECT AT-A-GLANCE
- AST TECHNICAL MONITOR: Nick Demidovich
- UNIVERSITY: New Mexico State University
- PRINCIPAL INVESTIGATOR: Dr. Patricia Hynes
- STUDENT RESEARCHER: None
- STATUS: Ongoing

RELEVANCE TO COMMERCIAL SPACE INDUSTRY
- The long term goal is to mature the Automatic Dependent Surveillance-Broadcast (ADS-B) system by flying it repeatedly in space, using flight data to make future versions lightweight and affordable for commercial space operators. ADS-B on commercial space vehicles will enable their seamless integration into the national airspace without disrupting the flight plans of other aircraft users. This will resolve a significant challenge to unlimited growth of the commercial space transportation industry.

STATEMENT OF WORK
- Comparative analysis from ADS-B captured data transmitted from SL6 and captured by ADS-3 Receiver equipment against and vehicle IMU and WSMR radar data
- Comparative data analysis from SL7 and SL8 from ADS-B data transmitted from those flights and captured against flight data from WSMR radar and vehicle IMU.



STATUS
- Start Date: Contingent on SL7 launch- comparative analysis of flight data from SL6 with SL7 flight data
- Data Sources: White Sands Missile Range, SpaceloftXL rocket, ADS-B

FUTURE WORK
- Comparative data analysis for SL7 and SL8
- Explore launching on other platforms from Spaceport America

Partners:

- Federal Aviation Administration AST *
- ATK *
- Digital Solutions *
- Marketing Consultant *
- National Space Grant Foundation *
- New Mexico State University *
- Space News *

*- indicates primary partner

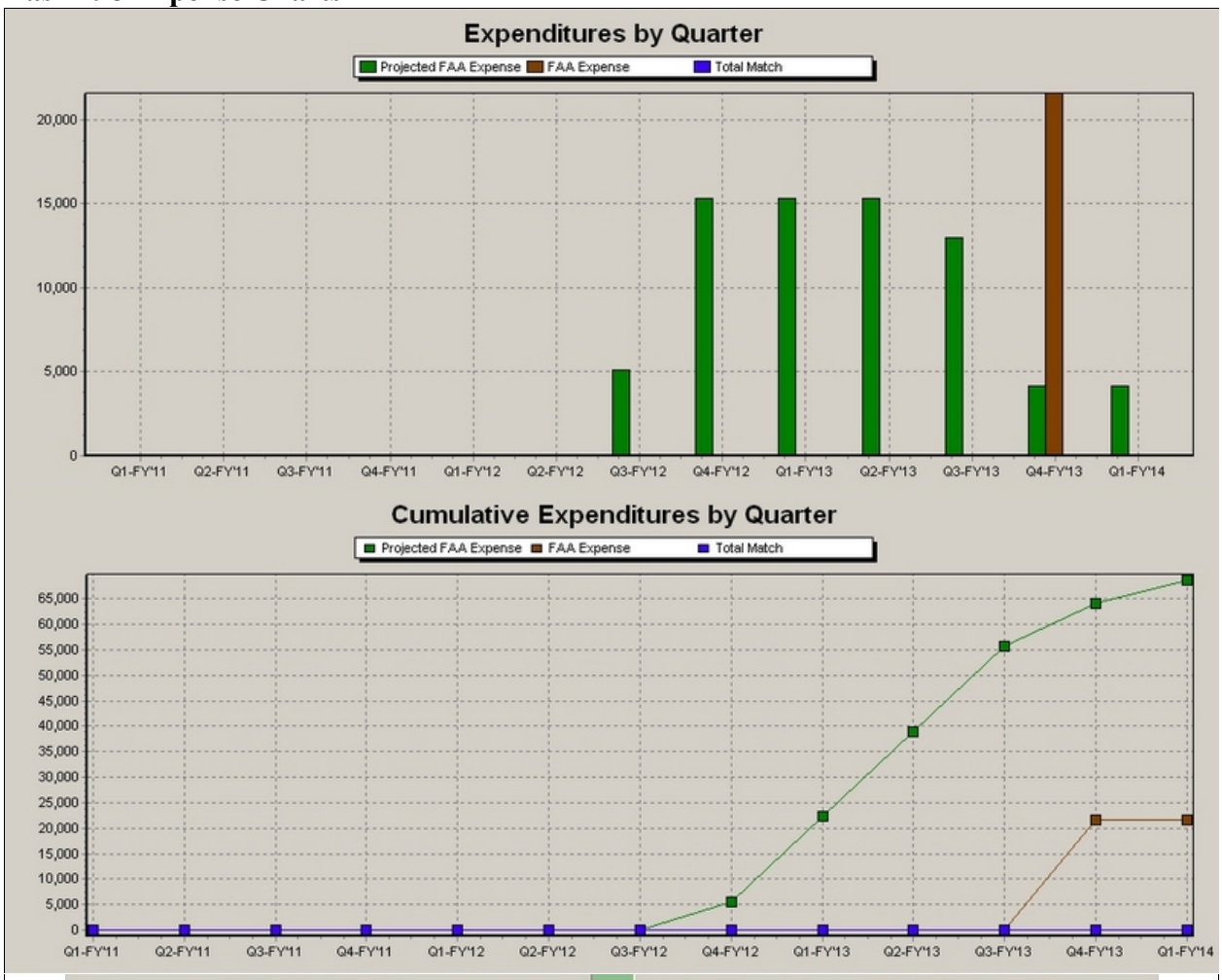
Funding History

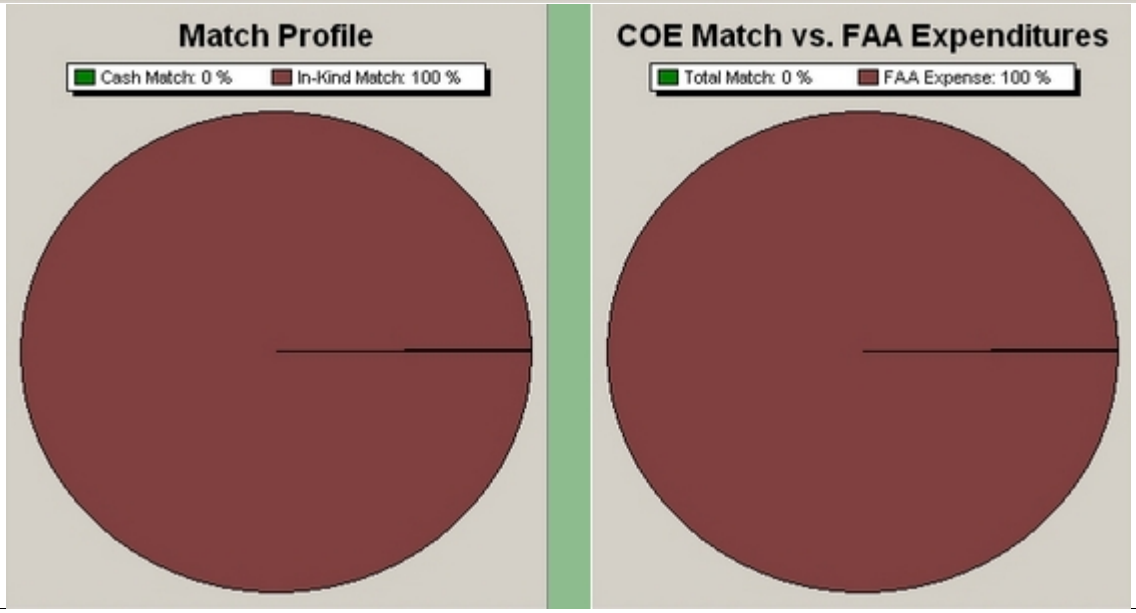
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2012	5/31/2013	2012	10-C-CST-NMSU-009	$61,191	$61,191
5/31/2013	5/31/2014	2012	10-C-CST-NMSU-012	$0	$0
5/31/2013	5/31/2014	2013	10-C-CST-NMSU-014	$14,000	$14,000
5/31/2013	5/31/2014	2013	10-C-CST-NMSU-016	$4,000	$4,000
					Total: $79,191

Students

Name	Organization	Department	Discipline	Degree	Graduation
Michalenko, Joshua	NMSU	ECE	ECE	Bachelors	5/1/2015

Task 298 Expense Charts





FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$5,099	$5,099	$0	$0
Q4(Jul-Sep) FY2012	$15,298	$20,397	$0	$0
Q1(Oct-Dec) FY2013	$15,298	$35,695	$0	$0
Q2(Jan-Mar) FY2013	$15,298	$50,993	$0	$0
Q3(Apr-Jun) FY2013	$12,968	$63,960	$0	$0
Q4(Jul-Sep) FY2013	$4,154	$68,114	$21,588	$21,588
Q1(Oct-Dec) FY2014	$4,154	$72,268	$0	$21,588
Totals	$72,268		$21,588	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$0	$0	$0	$0	$0	$0
Totals	$0		$0		$0	

Task 299-NMT: Nitrous Oxide Composite Tank Testing

Project Description

PROJECT AT-A-GLANCE
- AST TECH MONITOR: Yvonne Tran
- UNIVERSITY: New Mexico Tech
- PRINCIPAL INVESTIGATOR: Dr. Warren Ostergren (PI), Dr. Robert Abernathy(Co-PI)
- STUDENT RESEARCHER: TBD
- STATUS: New

RELEVANCE TO COMMERCIAL SPACE INDUSTRY
- Safety will be enhanced by providing guidelines to protect the public from hazards associated with the failure of space vehicle components.

STATEMENT OF WORK
- Develop a test and instrumentation plan to quantify the fragmentation characteristics of a nitrous oxide explosion in composite cases.
  - Characterize fragmentation and blast hazard
- Utilize test and analysis results to validate or modify existing predictive models.
- Establish guidelines for safe separation distance to protect the public from accidental explosive events.
- Document technical material for the benefit of commercial users.

STATUS
- Initial test planning has commenced.

FUTURE WORK
- Establish a collaborative team of technical experts
- Define test matrix and instrumentation plan
- Procure composite cases

Partners:

- Federal Aviation Administration AST *
- New Mexico Institute of Mining and Technology *

*- indicates primary partner

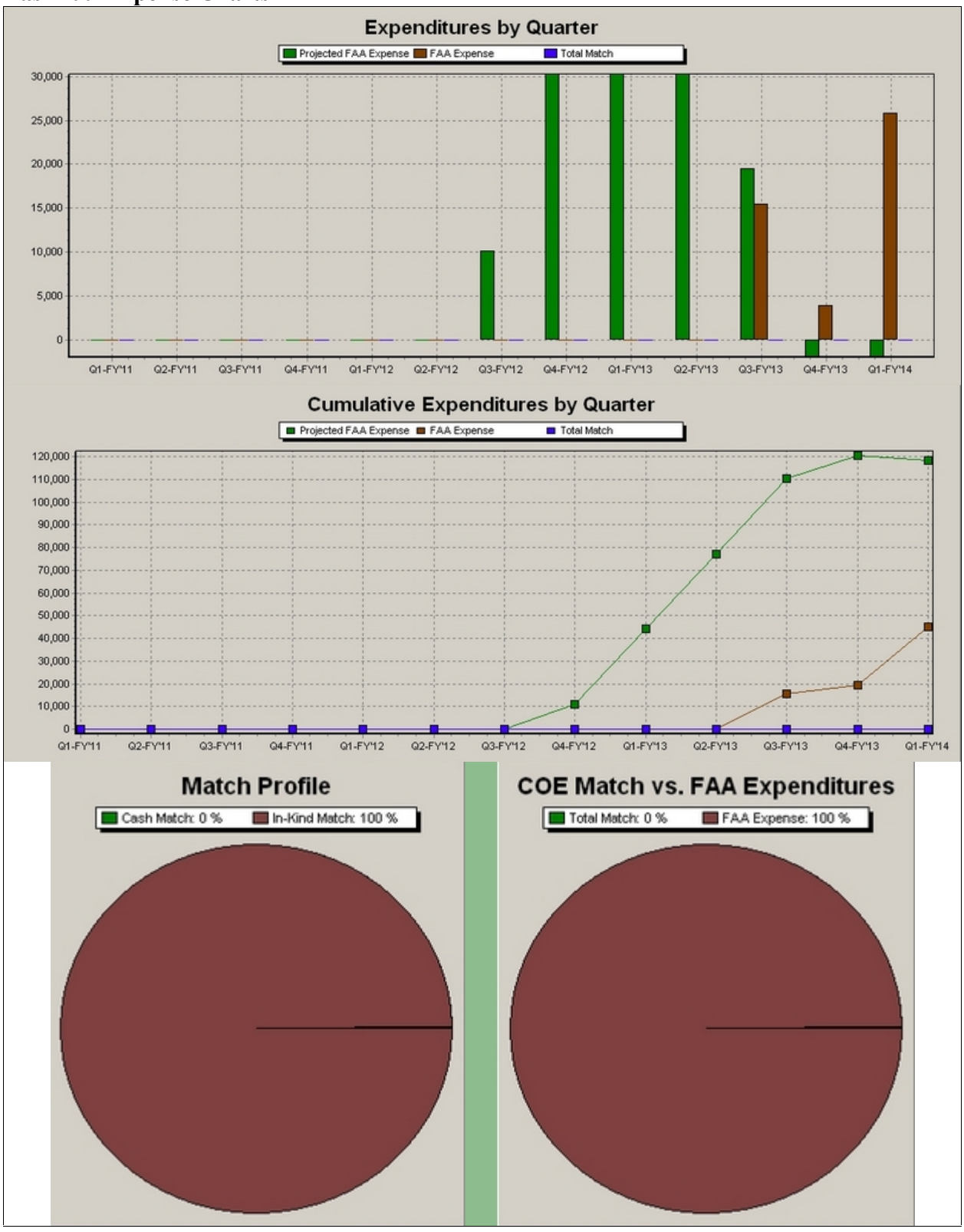
Funding History

Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2012	5/31/2013	2012	10-C-CST-NMT-006	$121,227	$121,227
6/1/2013	5/31/2014	2012	10-C-CST-NMT-008	$0	$0
6/1/2013	5/31/2014	2012	10-C-CST-NMT-010	($50,000)	($50,000)
6/1/2013	5/31/2014	2013	10-C-CST-NMT-016	$33,000	$33,000
6/1/2013	5/31/2014	2013	10-C-CST-NMT-019	$9,000	$9,000
					Total: $113,227

Students

Name	Organization	Department	Discipline	Degree	Graduation
Bayley, Steven	NMT	Mechanical Engineering	Thermal/Fluids	Masters	5/15/2016
Stanley, June	NMT	Mechanical Engineering	Explosives	Masters	5/15/2016
Stotts, Jarrett	NMT	Mechanical	Mechanical	Bachelors	5/15/2014

Task 299 Expense Charts



FAA Cash by Quarter

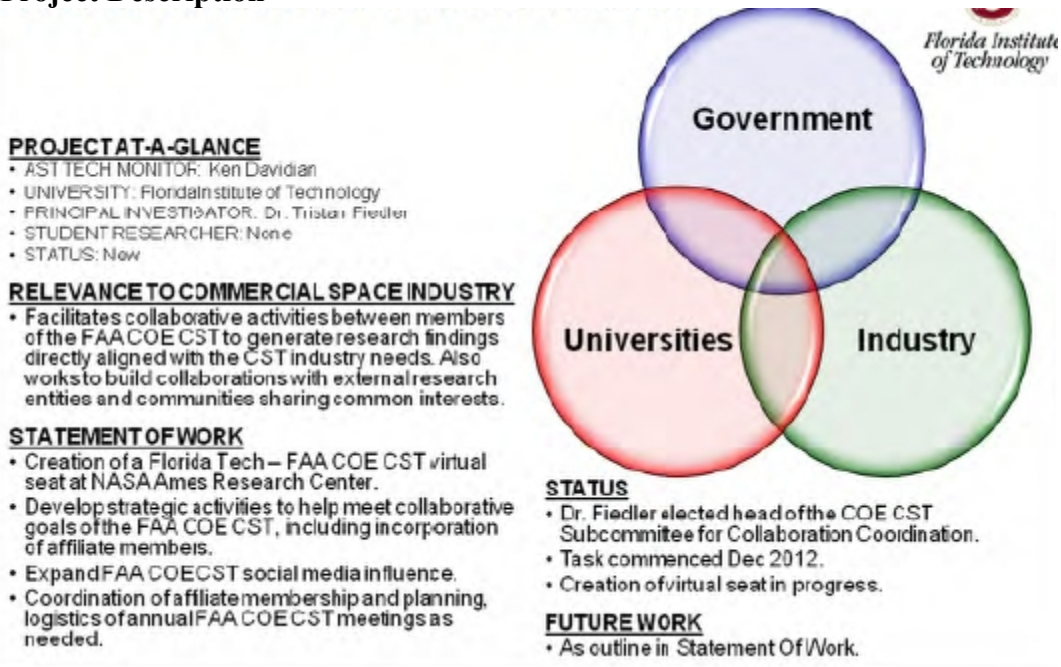
Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$10,102	$10,102	$0	$0
Q4(Jul-Sep) FY2012	$30,307	$40,409	$0	$0
Q1(Oct-Dec) FY2013	$30,307	$70,716	$0	$0
Q2(Jan-Mar) FY2013	$30,307	$101,023	$0	$0
Q3(Apr-Jun) FY2013	$19,538	$120,560	$15,455	$15,455
Q4(Jul-Sep) FY2013	($2,000)	$118,560	$3,863	$19,317
Q1(Oct-Dec) FY2014	($2,000)	$116,560	$25,792	$45,110
Totals	$116,560		$45,110	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$0	$0	$0	$0	$0	$0
Totals	$0		$0		$0	

Task 300-FIT: COE CST Collaboration Coordination

Project Description



Partners:

- Federal Aviation Administration AST *
- Florida Institute of Technology *
- Space Florida *
- NASA Ames Research Center

*- indicates primary partner

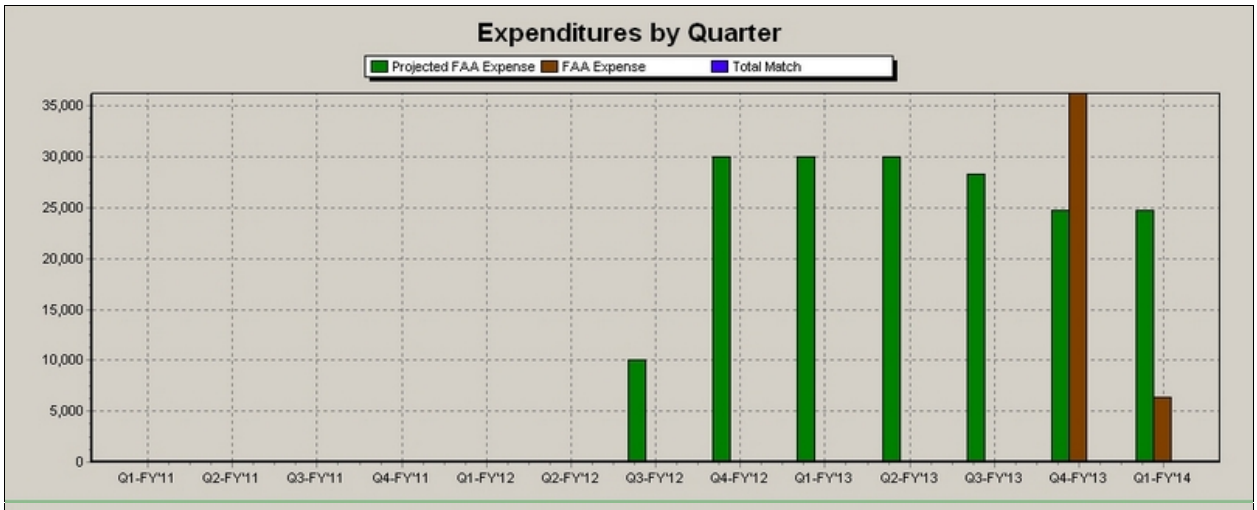
Funding History

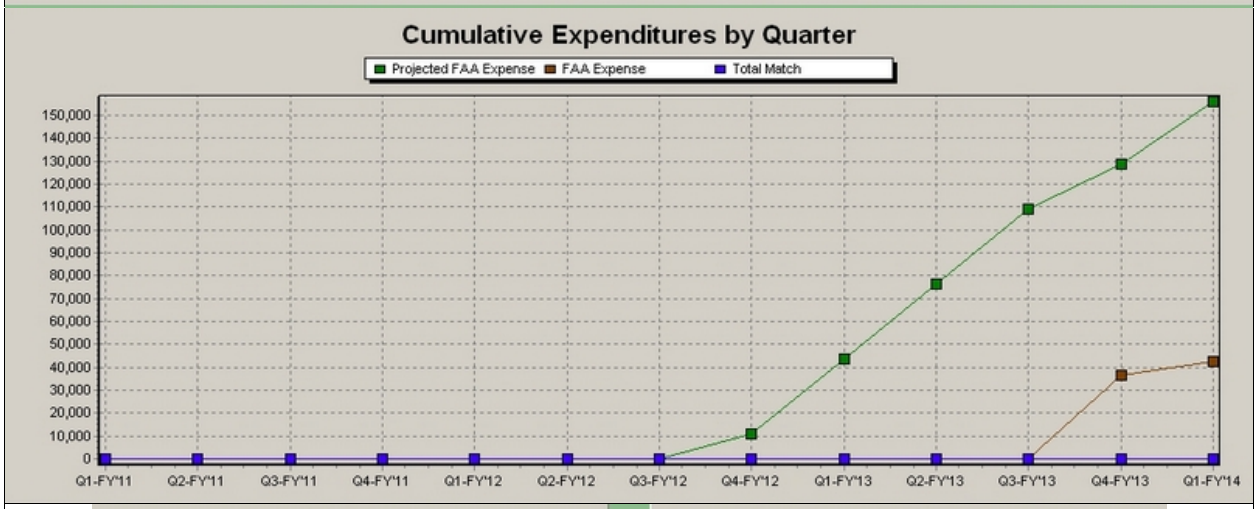
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2012	5/31/2013	2012	10-C-CST-FIT-012	$120,000	$120,000
6/1/2013	5/31/2014	2012	10-C-CST-FIT-015	$0	$0
6/1/2013	5/31/2014	2012	10-C-CST-FIT-019	$0	$0
6/1/2013	5/31/2014	2013	10-C-CST-FIT-20	$99,000	$99,000
					Total: $219,000

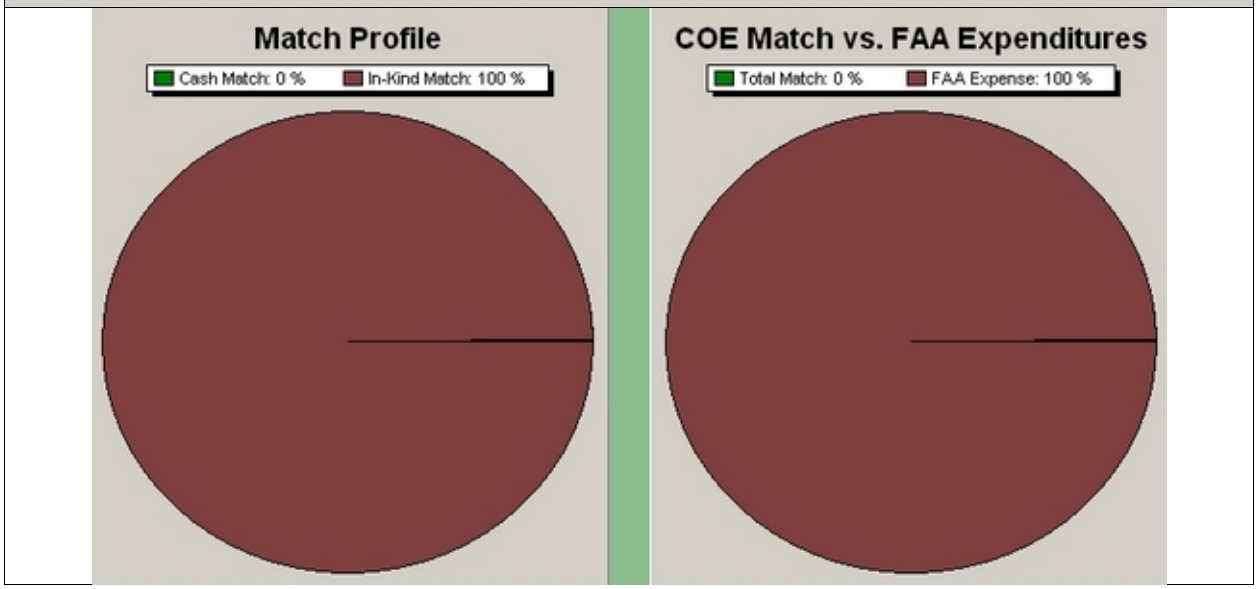
Students

None

Task 300 Expense Charts


Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Q1-FY'11
Q2-FY'11
Q3-FY'11
Q4-FY'11
Q1-FY'12
Q2-FY'12
Q3-FY'12
Q4-FY'12
Q1-FY'13
Q2-FY'13
Q3-FY'13
Q4-FY'13
Q1-FY'14


Cumulative Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
150,000
140,000
130,000
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Q1-FY'11
Q2-FY'11
Q3-FY'11
Q4-FY'11
Q1-FY'12
Q2-FY'12
Q3-FY'12
Q4-FY'12
Q1-FY'13
Q2-FY'13
Q3-FY'13
Q4-FY'13
Q1-FY'14


Match Profile
Cash Match: 0 %
In-Kind Match: 100 %
COE Match vs. FAA Expenditures
Total Match: 0 %
FAA Expense: 100 %

FAA Cash by Quarter

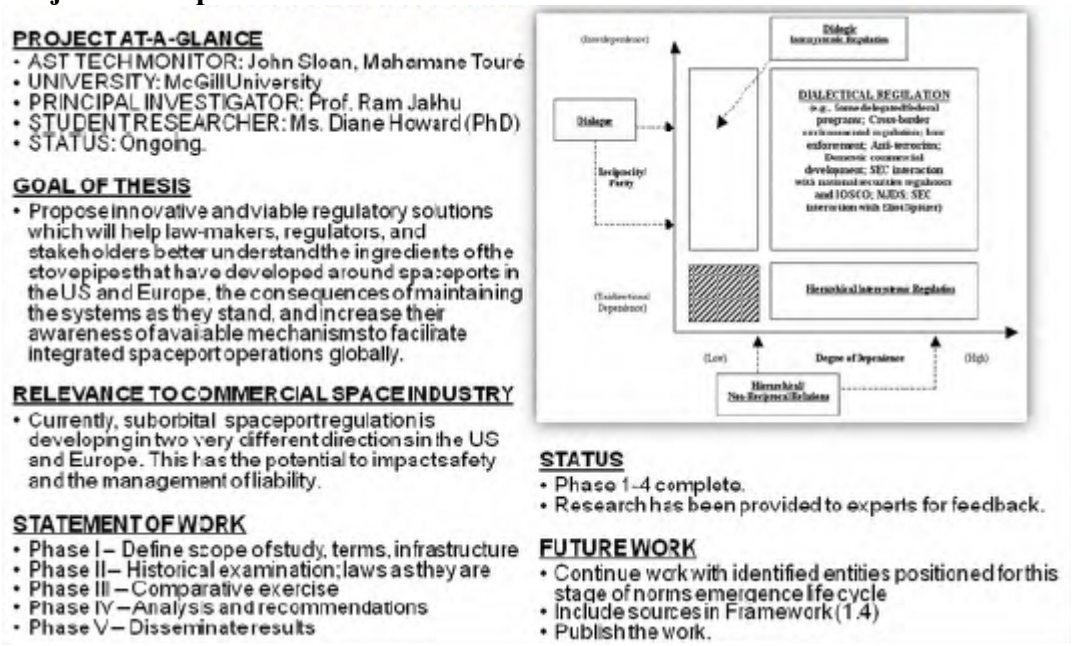
Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$10,000	$10,000	$0	$0
Q4(Jul-Sep) FY2012	$30,000	$40,000	$0	$0
Q1(Oct-Dec) FY2013	$30,000	$70,000	$0	$0
Q2(Jan-Mar) FY2013	$30,000	$100,000	$0	$0
Q3(Apr-Jun) FY2013	$28,250	$128,250	$0	$0
Q4(Jul-Sep) FY2013	$24,750	$153,000	$36,275	$36,275
Q1(Oct-Dec) FY2014	$24,750	$177,750	$6,334	$42,608
Totals	$177,750		$42,608	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$0	$0	$0	$0	$0	$0
Totals	$0		$0		$0	

Task 301-FIT: Spaceport Regulation In A Post Modern World
Affiliate Member: McGill University

Project Description



Partners:

- Federal Aviation Administration AST *
- Florida Institute of Technology *
- Space Florida *
- McGill University *

*- indicates primary partner

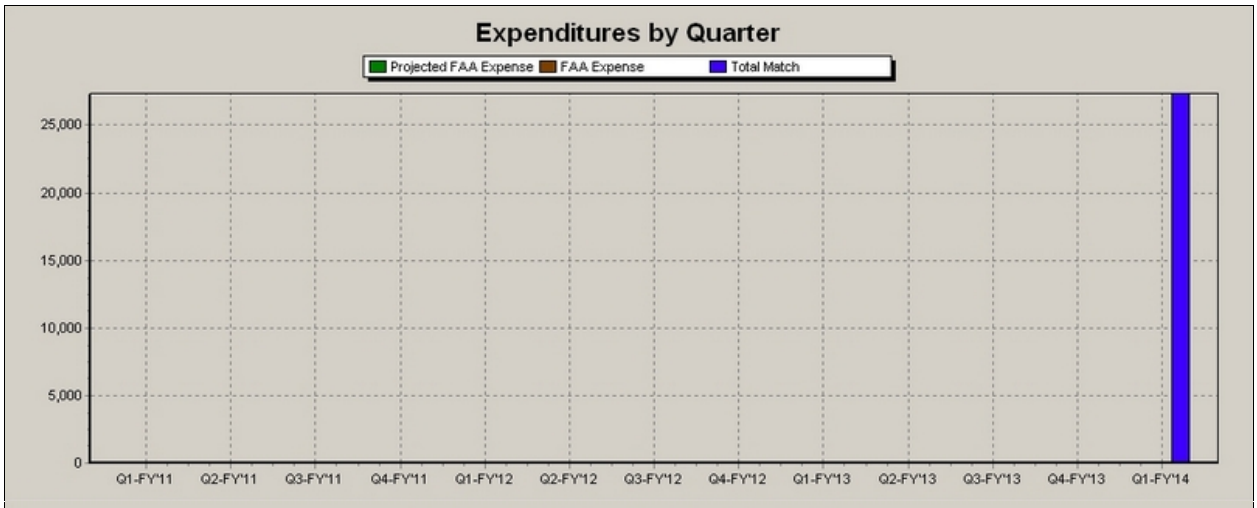
Funding History

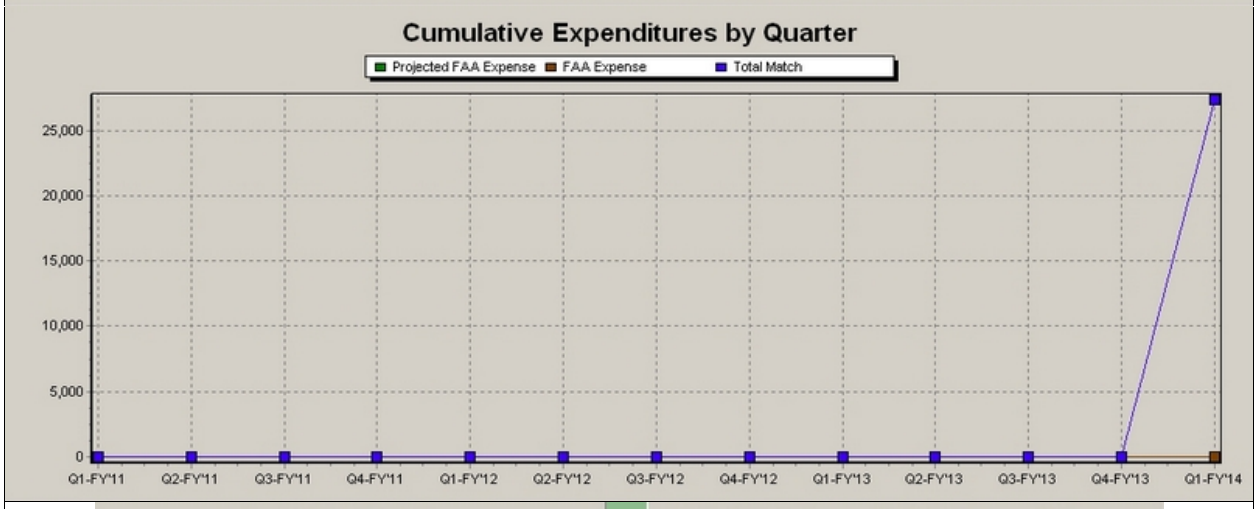
Affiliate Member

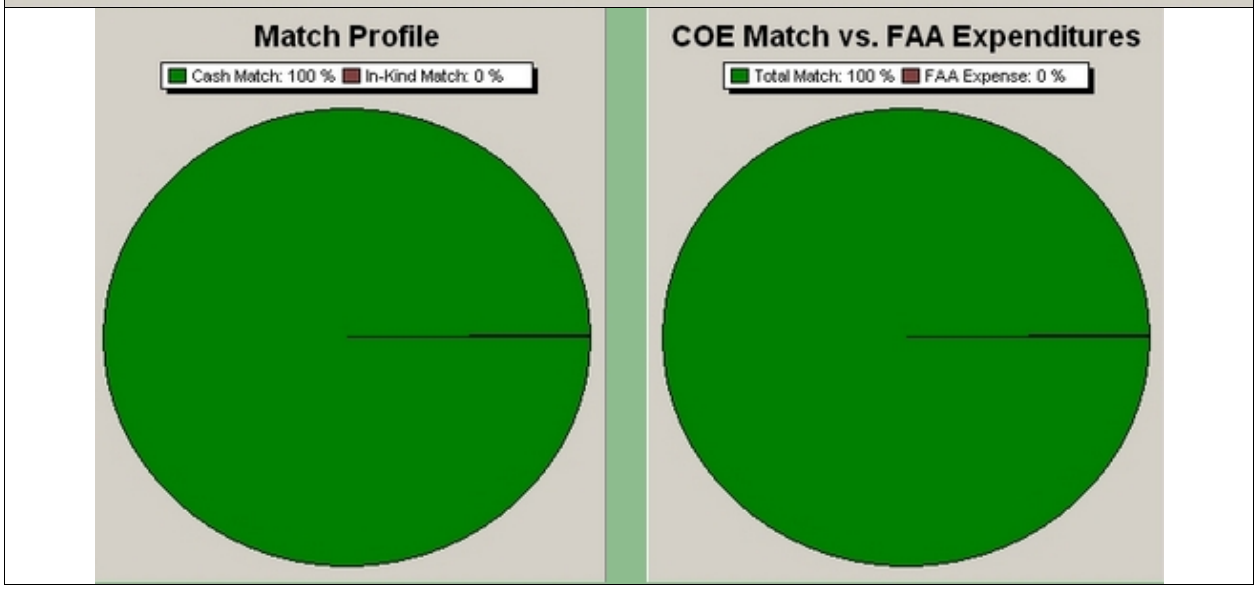
Students

Howard, Diane

Task 301 Expense Charts


Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
25,000
20,000
15,000
10,000
5,000
0
Q1-FY'11
Q2-FY'11
Q3-FY'11
Q4-FY'11
Q1-FY'12
Q2-FY'12
Q3-FY'12
Q4-FY'12
Q1-FY'13
Q2-FY'13
Q3-FY'13
Q4-FY'13
Q1-FY'14


Cumulative Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
25,000
20,000
15,000
10,000
5,000
0
Q1-FY'11
Q2-FY'11
Q3-FY'11
Q4-FY'11
Q1-FY'12
Q2-FY'12
Q3-FY'12
Q4-FY'12
Q1-FY'13
Q2-FY'13
Q3-FY'13
Q4-FY'13
Q1-FY'14


Match Profile
Cash Match: 100 %
In-Kind Match: 0 %
COE Match vs. FAA Expenditures
Total Match: 100 %
FAA Expense: 0 %

FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$0	$0	$0	$0
Totals	$0		$0	

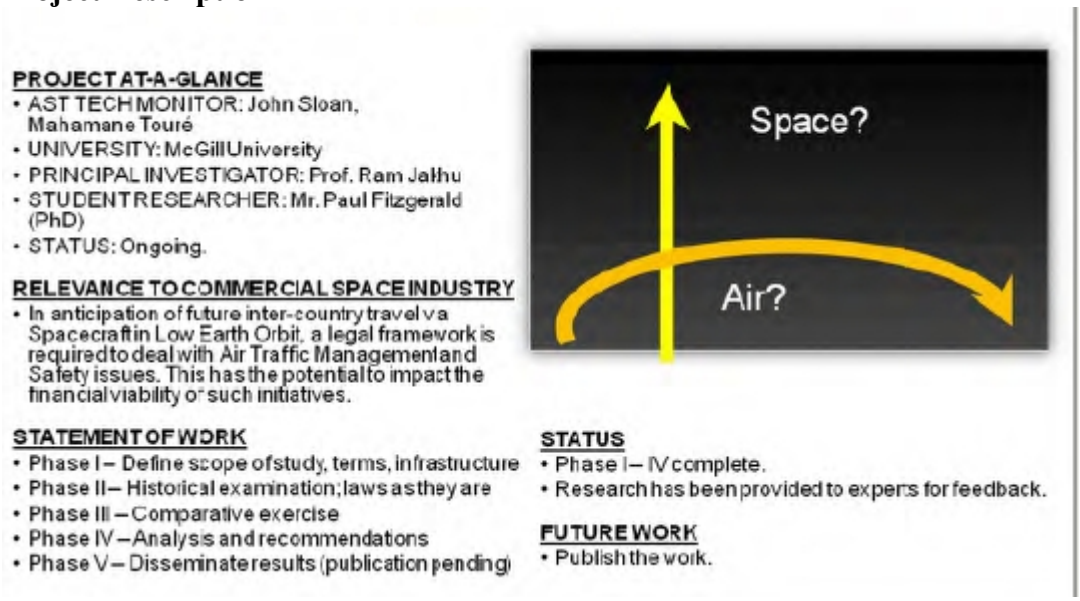
COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$27,350	$27,350	$0	$0	$27,350	$27,350
Totals	$27,350		$0		$27,350	

Task 302-FIT: International Commercial Space Regulations

Affiliate Member: McGill University

Project Description



Partners:

- Federal Aviation Administration AST *
- Florida Institute of Technology *
- Space Florida *
- McGill University *

*- indicates primary partner

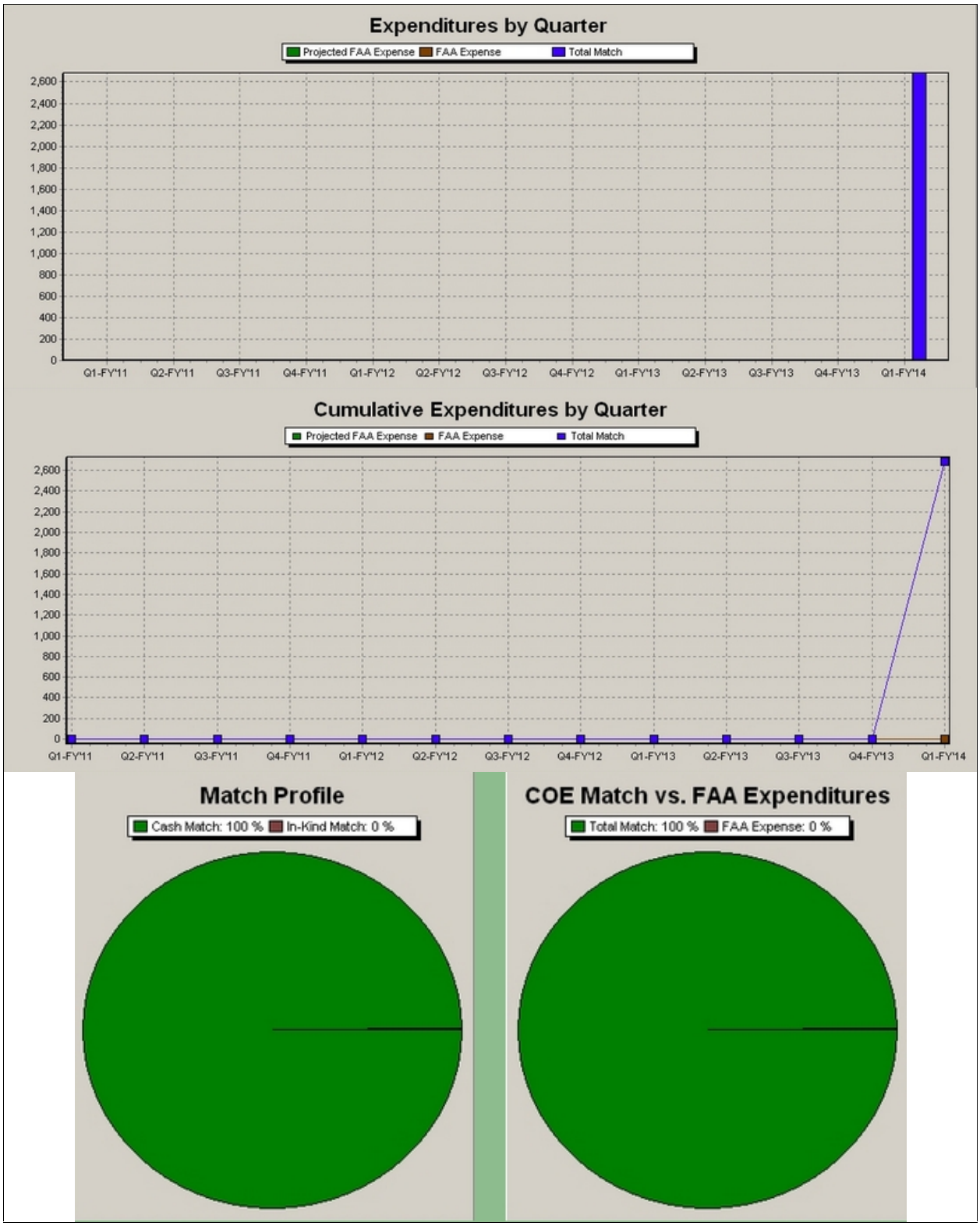
Funding History

Affiliate Member

Students

Fitzgerald, Paul

Task 302 Expense Charts


Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Q1-FY'11
Q2-FY'11
Q3-FY'11
Q4-FY'11
Q1-FY'12
Q2-FY'12
Q3-FY'12
Q4-FY'12
Q1-FY'13
Q2-FY'13
Q3-FY'13
Q4-FY'13
Q1-FY'14
Cumulative Expenditures by Quarter
Projected FAA Expense
FAA Expense
Total Match
Match Profile
Cash Match: 100 %
In-Kind Match: 0 %
COE Match vs. FAA Expenditures
Total Match: 100 %
FAA Expense: 0 %

FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$0	$0	$0	$0
Totals	$0		$0	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2012	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2012	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2013	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2013	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2014	$2,686	$2,686	$0	$0	$2,686	$2,686
Totals	$2,686		$0		$2,686	

Task 303-NMT: OMIS Integration

Project Description

Provide technical oversight and OMIS integration for the COE-CST.

Partners

- Federal Aviation Administration AST *
- New Mexico Institute of Mining and Technology *
- Orion America Technologies, LLC *

*- indicates primary partner

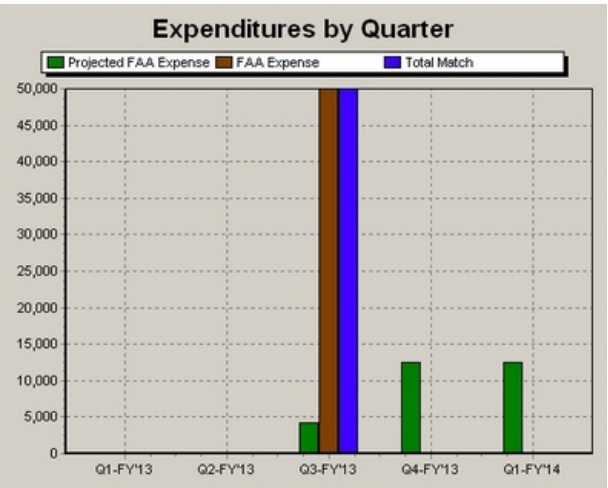
Funding History

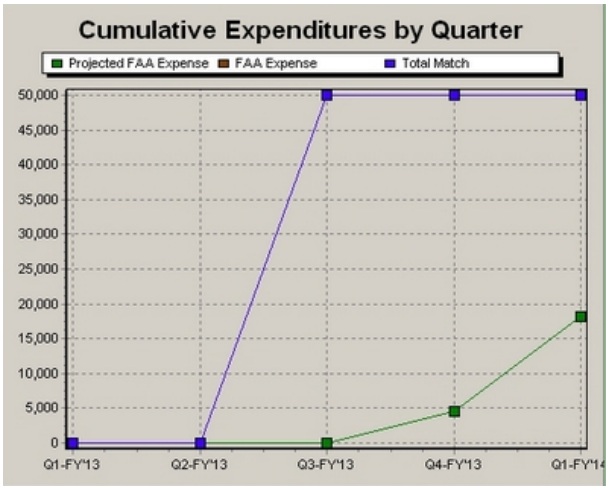
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
6/1/2013	5/31/2014	2013	10-C-CST-NMT-010	$50,000	$50,000
					Total: $50,000

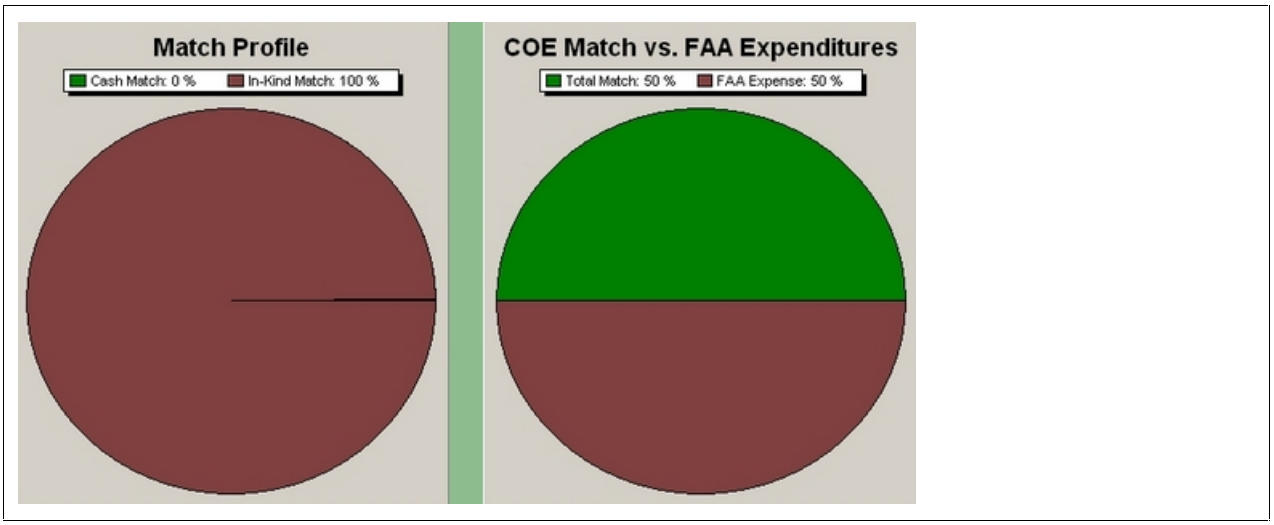
Students

None

Task 303 Expense Charts







FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2013	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$4,167	$4,167	$50,000	$50,000
Q4(Jul-Sep) FY2013	$12,500	$16,667	$0	$50,000
Q1(Oct-Dec) FY2014	$12,500	$29,167	$0	$50,000
Totals	$29,167		$50,000	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2013	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2013	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2013	$0	$0	$50,000	$50,000	$50,000	$50,000
Q4(Jul-Sep) FY2013	$0	$0	$0	$50,000	$0	$50,000
Q1(Oct-Dec) FY2014	$0	$0	$0	$50,000	$0	$50,000
Totals	$0		$50,000		$50,000	

6.0 Completed Projects

Task 181-UTMB: Medical and Physiological Database System

Project Description

PURPOSE: This is a highly significant project in that the developing industry of commercial space tourism will soon involve hundreds to thousands of individuals. These individuals will cover a wide range of ages and medical conditions about which we have very limited information.

OBJECTIVES: The objectives of this project are to identify appropriate data elements about the health and physiologic status of commercial space flight participants (SFPs), and to recommend a scalable design for a database system to store this data.

GOALS: Enable safe space flight for a wide range of individuals with a variety of existing medical problems by improving pre-flight medical screening criteria and a solid basis on which operators can make informed decision about the suitability of prospective customers.

Partners

- Federal Aviation Administration AST *
- University of Texas Medical Branch at Galveston *
- Wyle *
- FAA-CAMI Federal Aeronautical Center
- NASA-JSC NASA-Johnson Space Center

*- indicates primary partner

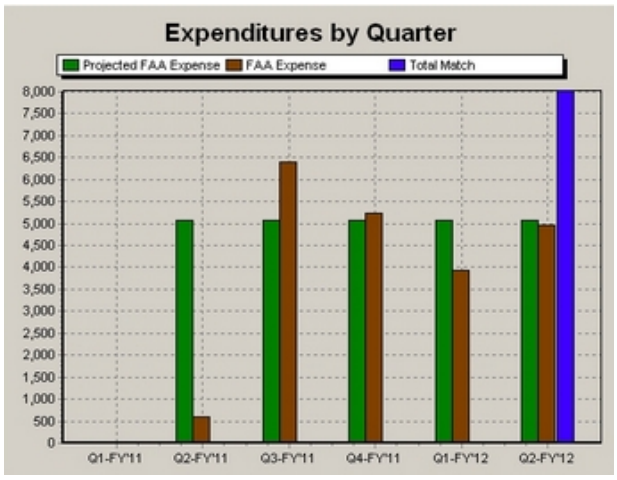
Funding History

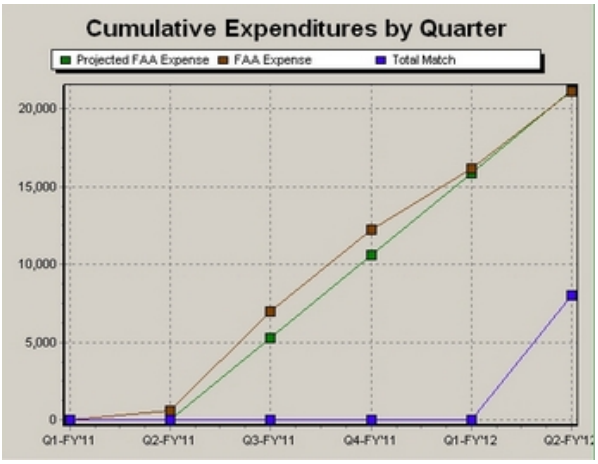
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2012	2010	10-C-CST-UTMB-007	$25,190	$25,190
1/3/2011	12/31/2012	2010	10-C-CST-UTMB-008	$20,646	$20,646
1/3/2011	12/31/2012	2010	10-C-CST-UTMB-019	($5,178)	($5,178)
					Total: $40,658

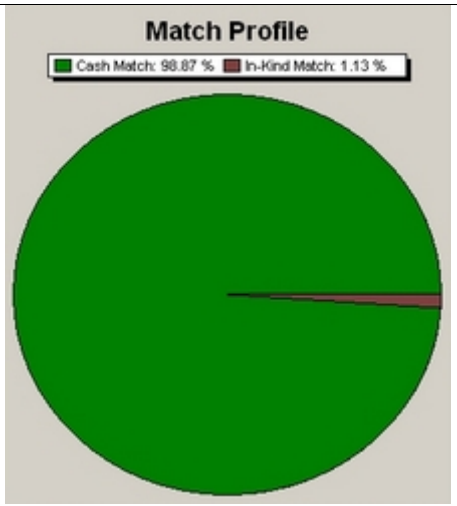
Students

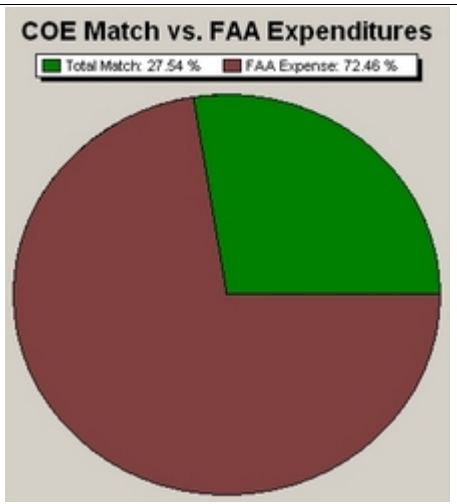
Name	Organization	Department	Discipline	Degree	Graduation
Reyes, David	UTMB	PMCH	Aerospace Medicine	M.D.	8/15/2014
Mathers, Charles	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2012
Law, Jennifer	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2012

Task 181 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$5,082	$5,082	$603	$603
Q3(Apr-Jun) FY2011	$5,082	$10,164	$6,388	$6,991
Q4(Jul-Sep) FY2011	$5,082	$15,247	$5,226	$12,217
Q1(Oct-Dec) FY2012	$5,082	$20,329	$3,940	$16,157
Q2(Jan-Mar) FY2012	$5,082	$25,411	$4,956	$21,113
Totals	$25,411		$21,113	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$7,936	$7,936	$91	$91	$8,027	$8,027
Totals	$7,936		$91		$8,027	

Task 182-UTMB: Human System Risk Management Approach to CST

Project Description

PURPOSE: This research has significant relevance as an approach to assessing and managing risks related to human health and performance of the many commercial SFPs who represent a much wider range of health status and level of training than has historically been the case in government space programs.

OBJECTIVES: The objective of this research project is to investigate the feasibility of applying the work that has been done by NASA in assessing human system risks for midand long-duration spaceflight for highly trained astronauts to the risk assessment for relatively untrained commercial SFPs.

GOALS: Investigate the extension of Johnson Space Center's Human System Risk Management process for design reference missions of the commercial suborbital and orbital regimes.

Partners:

- Federal Aviation Administration AST *
- University of Texas Medical Branch at Galveston *
- Wyle *
- NASA-JSC NASA-Johnson Space Center

- indicates primary partner

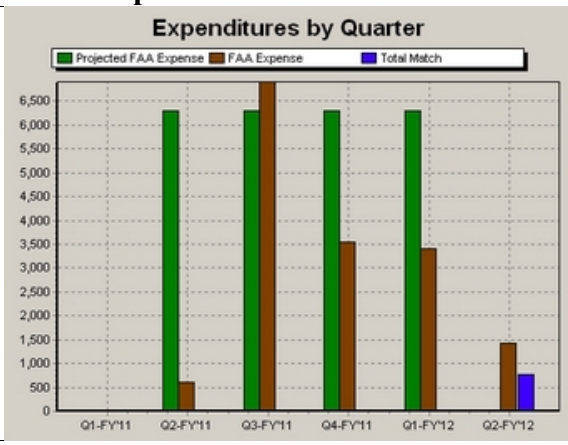
Funding History

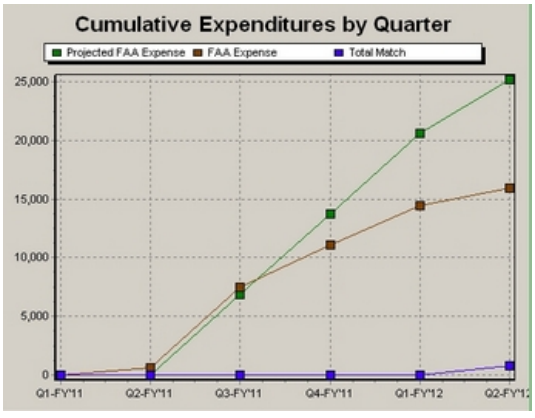
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UTMB-003	$25,190	$25,190
					Total: $25,190

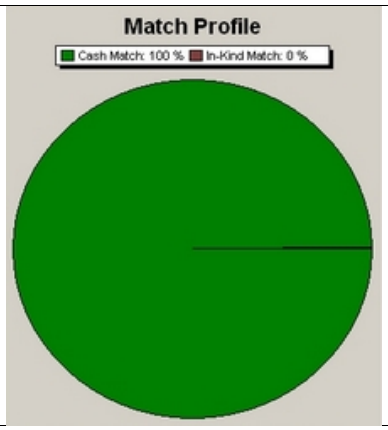
Students

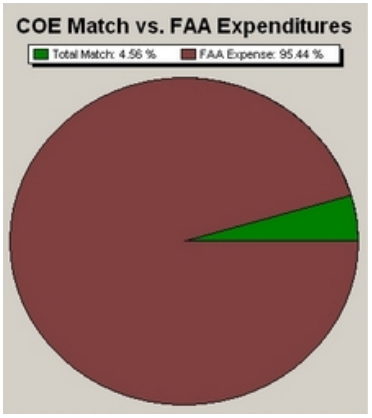
Name	Organization	Department	Discipline	Degree	Graduation
Mathers, Charles	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2012
Law, Jennifer	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2012

Task 182 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$6,298	$6,298	$604	$604
Q3(Apr-Jun) FY2011	$6,298	$12,595	$6,907	$7,511
Q4(Jul-Sep) FY2011	$6,298	$18,893	$3,549	$11,060
Q1(Oct-Dec) FY2012	$6,298	$25,190	$3,411	$14,470
Q2(Jan-Mar) FY2012	$0	$25,190	$1,435	$15,905
Totals	$25,190		$15,905	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$760	$760	$0	$0	$760	$760
Totals	$760		$0		$760	

Task 183-UTMB: Spaceflight Crew Medical Standards and Participant Acceptance Criteria

Project Description

PURPOSE: A number of standards documents and guidelines publications have been produced by various organizations. However, there has not been a consolidation and integration of these various recommendations, guidelines and standards into a cohesive approach that can be relied upon by space launch operators and passengers. The anticipated outcome of this research project is a consolidated set of recommendations, guidelines, and forms that will be useful to both operators and passengers embarking on a space flight.

OBJECTIVES: The three objectives for this research project are: (i) development of recommendations for the medical standards for suborbital and orbital space vehicle crew members, (ii) development of recommendations for passenger acceptance criteria for suborbital and orbital space flight, and (iii) development of a model passenger 'Informed Consent' document for use by space launch operators to convey the risks related to personal medical status to their passengers.

GOALS: The anticipated outcome of this research project is a consolidated set of recommendations, guidelines, and forms that will be useful to both operators and passengers embarking on a space flight.

Partners

- Federal Aviation Administration AST *
- University of Texas Medical Branch at Galveston *
- Wyle *
- FAA-CAMI Federal Aeronautical Center
- NASA-JSC NASA-Johnson Space Center

* - indicates primary partner

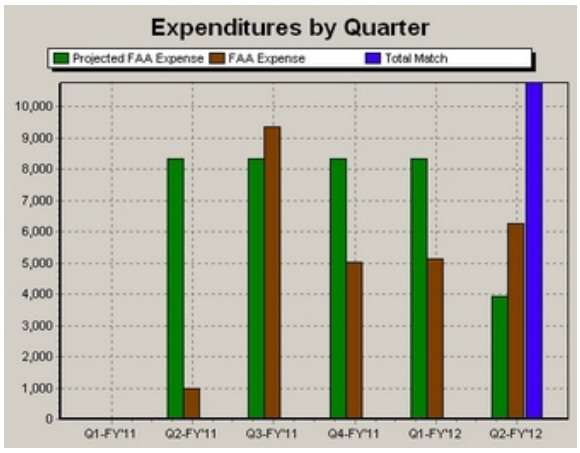
Funding History

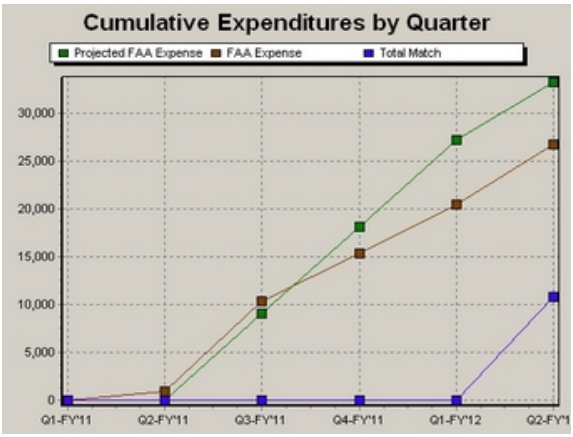
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UTMB-004	$33,284	$33,284
1/1/2012	12/31/2012	2011	10-C-CST-UTMB-012	$35,000	$35,000
1/1/2012	12/31/2012	2011	10-C-CST-UTMB-018	($3,516)	($3,516)
1/1/2012	12/31/2012	2011	10-C-CST-UTMB-019	($15,762)	($15,762)
					Total: $49,006

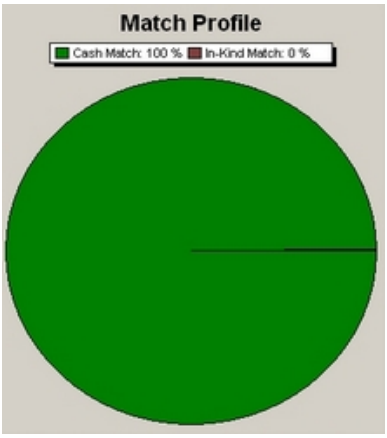
Students

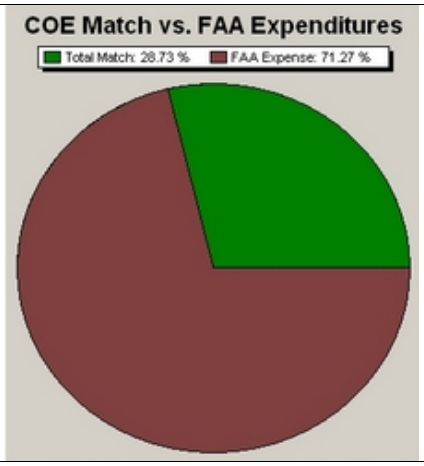
Name	Organization	Department	Discipline	Degree	Graduation
Lewis, Leigh	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2012
Mathers, Charles	UTMB	PMCH	Aerospace Medicine	M.D.	6/1/2012

Task 183 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$8,321	$8,321	$966	$966
Q3(Apr-Jun) FY2011	$8,321	$16,642	$9,347	$10,313
Q4(Jul-Sep) FY2011	$8,321	$24,963	$5,022	$15,335
Q1(Oct-Dec) FY2012	$8,321	$33,284	$5,133	$20,467
Q2(Jan-Mar) FY2012	$3,931	$37,215	$6,268	$26,736
Totals	$37,215		$26,736	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$10,778	$10,778	$0	$0	$10,778	$10,778
Totals	$10,778		$0		$10,778	

Task 259-SU: Flight Software Validation and Verification For Safety

Project Description

PURPOSE: Software Independent Validation and Verification is regarded as one of the major issues today and in the future for the timely and cost-effective development and certification of launch and re-entry systems.

OBJECTIVES:

1. Formulate a coherent plan of research to impact flight software V&V for commercial space transportation systems.
2. Produce a research roadmap of activities that may lead to a full project pursued under the umbrella of the COE.

Partners:

- Federal Aviation Administration AST *
- Stanford University *

*- indicates primary partner

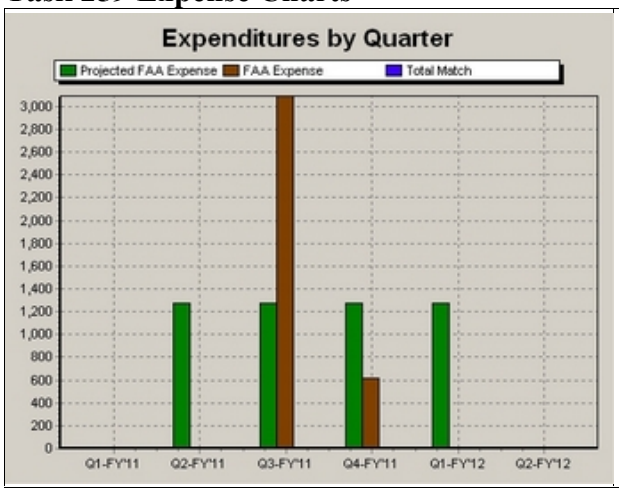
Funding History

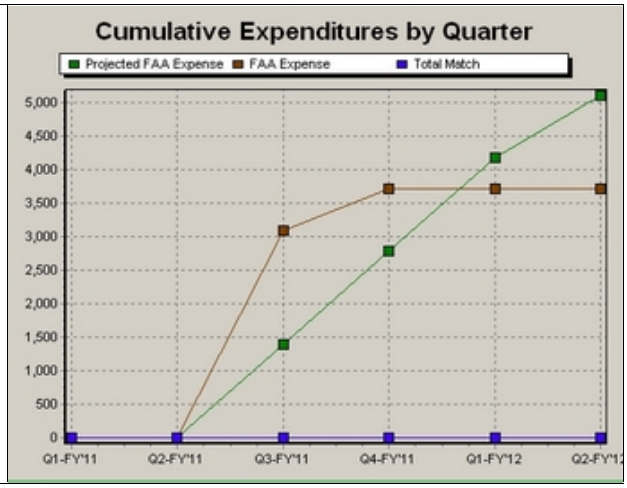
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-SU-006	$5,110	$5,110
					Total: $5,110

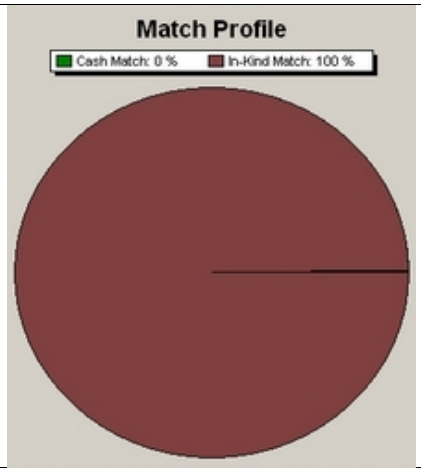
Students

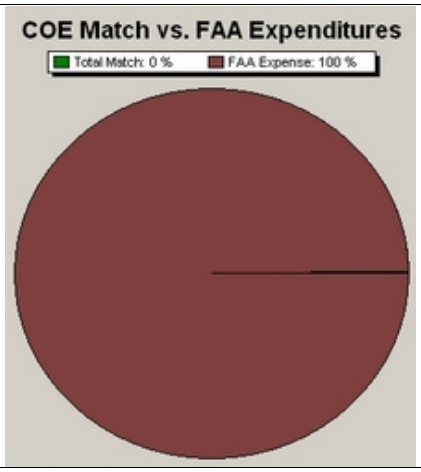
None

Task 259 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$1,278	$1,278	$0	$0
Q3(Apr-Jun) FY2011	$1,278	$2,555	$3,093	$3,093
Q4(Jul-Sep) FY2011	$1,278	$3,833	$618	$3,711
Q1(Oct-Dec) FY2012	$1,278	$5,110	$0	$3,711
Q2(Jan-Mar) FY2012	$0	$5,110	$0	$3,711
Totals	$5,110		$3,711	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$0	$0	$0	$0	$0	$0
Totals	$0		$0		$0	

Task 281-CU: Technical Oversight

Project Description

Provide technical oversight for the COE-CST.

Partners:

- Federal Aviation Administration AST *
- University of Colorado at Boulder *

*- indicates primary partner

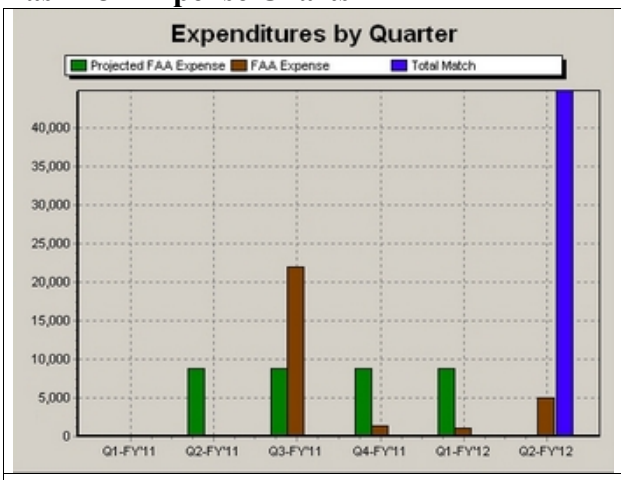
Funding History

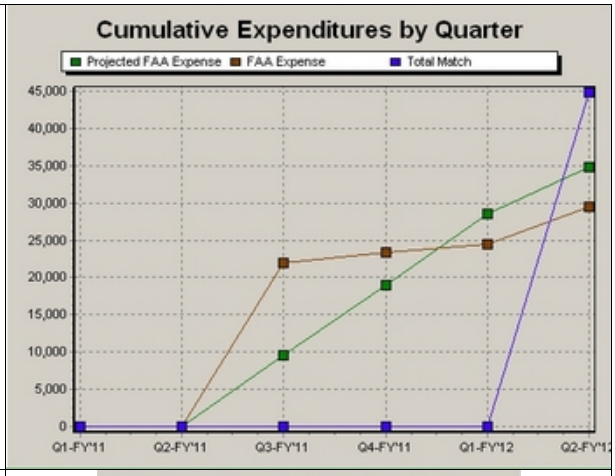
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UC-005	$34,884	$34,884
1/1/2011	8/31/2012	2010	10-C-CST-UC-014	$0	$0
					Total: $34,884

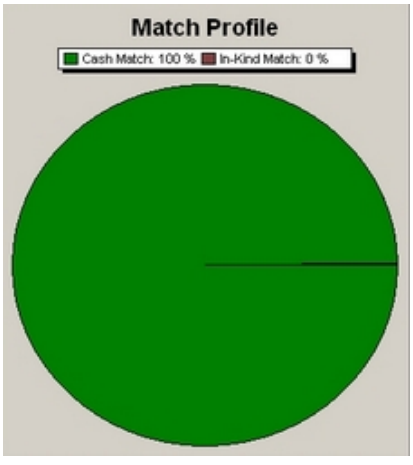
Students

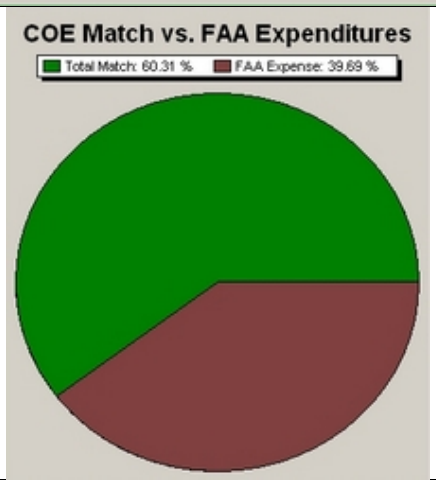
None

Task 281 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$8,721	$8,721	$0	$0
Q3(Apr-Jun) FY2011	$8,721	$17,442	$21,921	$21,921
Q4(Jul-Sep) FY2011	$8,721	$26,163	$1,424	$23,345
Q1(Oct-Dec) FY2012	$8,721	$34,884	$1,111	$24,456
Q2(Jan-Mar) FY2012	$0	$34,884	$5,066	$29,522
Totals	$34,884		$29,522	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$44,860	$44,860	$0	$0	$44,860	$44,860
Totals	$44,860		$0		$44,860	

Task 282-FIT: Technical Oversight

Project Description

Provide technical oversight for the COE-CST.

Partners:

- Federal Aviation Administration AST *
- Florida Institute of Technology *
- Space Florida *

*- indicates primary partner

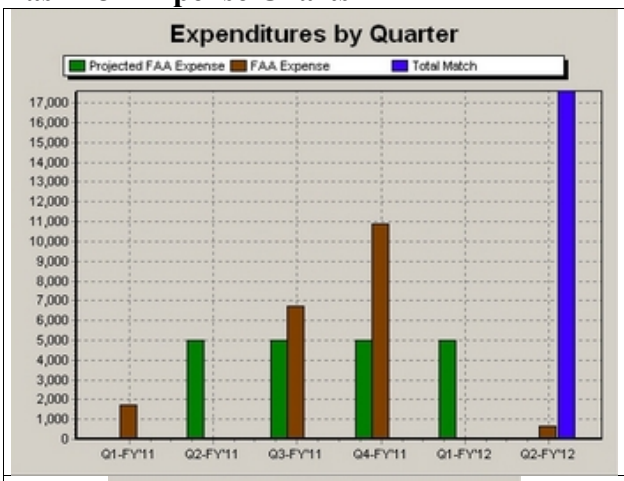
Funding History

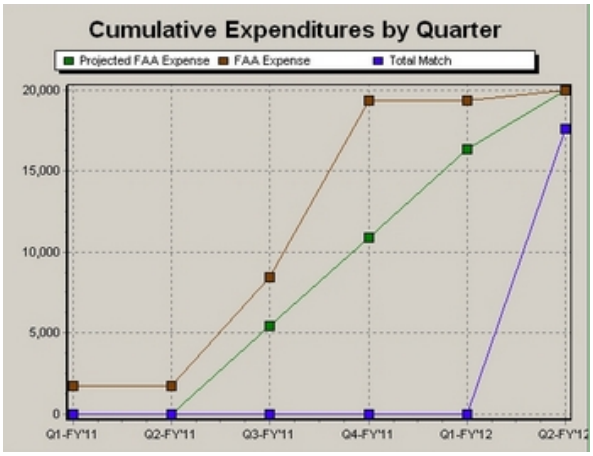
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-FIT-003	$19,988	$19,988
					Total: $19,988

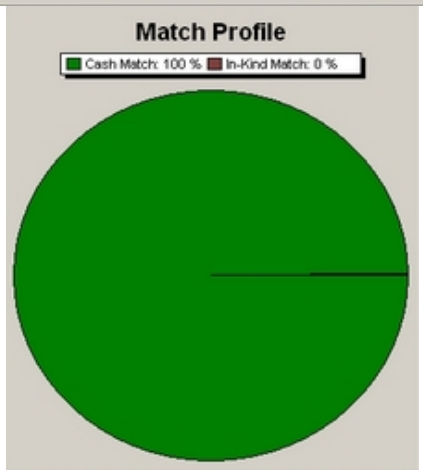
Students

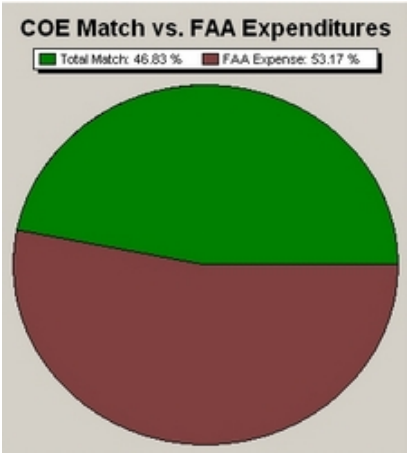
None

Task 282 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$1,745	$1,745
Q2(Jan-Mar) FY2011	$4,997	$4,997	$0	$1,745
Q3(Apr-Jun) FY2011	$4,997	$9,994	$6,708	$8,453
Q4(Jul-Sep) FY2011	$4,997	$14,991	$10,898	$19,351
Q1(Oct-Dec) FY2012	$4,997	$19,988	$0	$19,351
Q2(Jan-Mar) FY2012	$0	$19,988	$637	$19,988
Totals	$19,988		$19,988	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$17,606	$17,606	$0	$0	$17,606	$17,606
Totals	$17,606		$0		$17,606	

Task 283-FSU: Technical Oversight

Project Description

Provide technical oversight for the COE-CST.

Partners:

- Federal Aviation Administration AST *
- Florida State University *
- Space Florida *

*- indicates primary partner

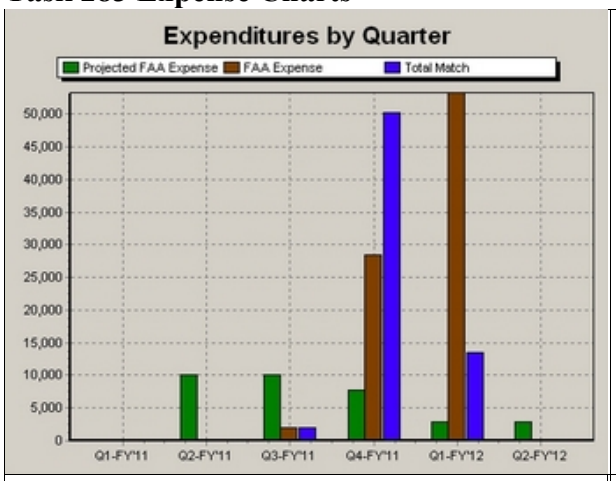
Funding History

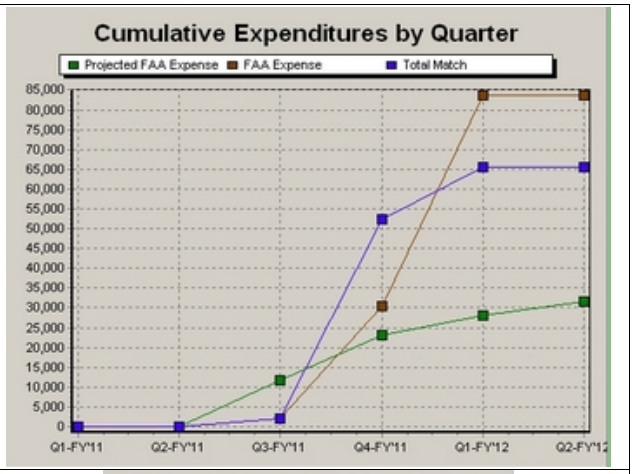
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	3/31/2012	2010	10-C-CST-FSU-002	$26,969	$26,969
1/3/2011	3/31/2012	2010	10-C-CST-FSU-005	$6,891	$6,891
					Total: $33,860

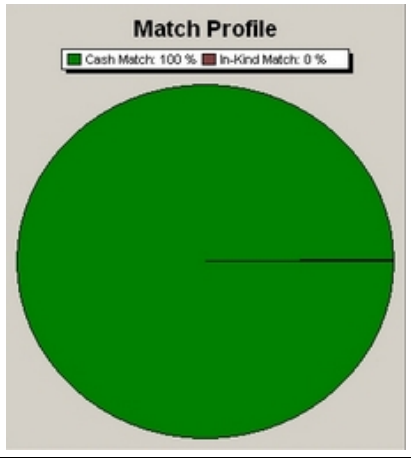
Students

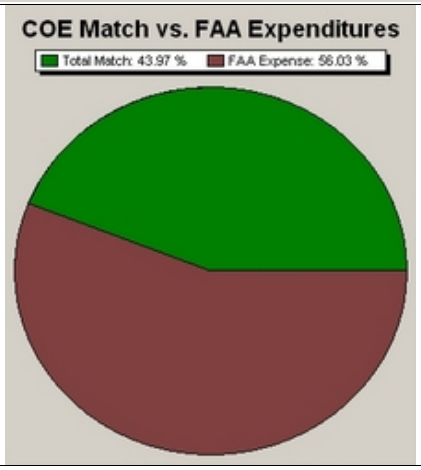
None

Task 283 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$10,113	$10,113	$0	$0
Q3(Apr-Jun) FY2011	$10,113	$20,227	$1,958	$1,958
Q4(Jul-Sep) FY2011	$7,727	$27,953	$28,444	$30,402
Q1(Oct-Dec) FY2012	$2,953	$30,907	$53,280	$83,682
Q2(Jan-Mar) FY2012	$2,953	$33,860	$0	$83,682
Totals	$33,860		$83,682	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$1,958	$1,958	$0	$0	$1,958	$1,958
Q4(Jul-Sep) FY2011	$50,274	$52,232	$0	$0	$50,274	$52,232
Q1(Oct-Dec) FY2012	$13,449	$65,680	$0	$0	$13,449	$65,680
Q2(Jan-Mar) FY2012	$0	$65,680	$0	$0	$0	$65,680
Totals	$65,680		$0		$65,680	

Task 284-NMSU: COE CST Admin Lead Activities

Project Description

Provide administrative lead activities for the COE-CST.

Partners:

ATK *
Federal Aviation Administration AST *
New Mexico State University *
NMSU Space Development Foundation *
Spaceport Sweden Swedish Institute of Space Physics *
AIAA
American Institute of Aeronautics and Astronautics
Ball Aerospace Civil and Operational Space
Cimmaron Software Services Inc.
CSSI Inc.
Dynetics, Inc. Test & Operations
Jacobs Technology Inc. NASA/White Sands Test Facility
Lockheed Martin Space Systems Company
Penn State University Aerospace Engineering
Qinetiq
Space Works Enterprises
Spaceworks Washington DC Operations
The Tauri Group
Webster University Space Programs
XCOR Aerospace, Inc.
* - indicates primary partner

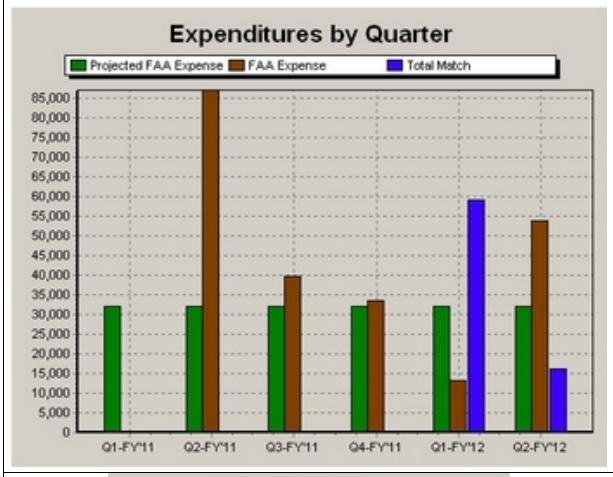
Funding History

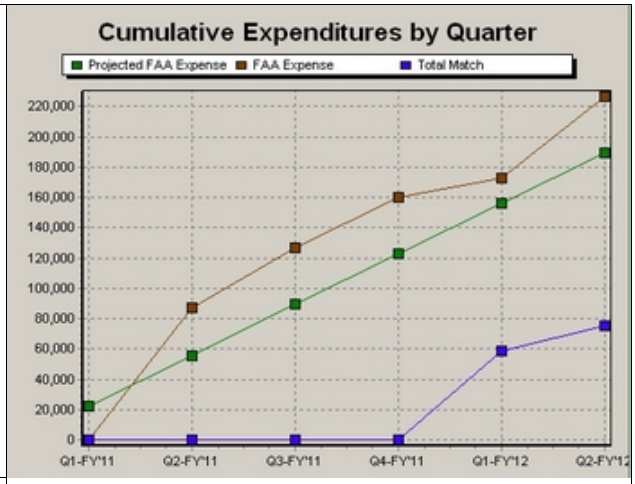
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
8/18/2010	8/17/2012	2010	10-C-CST-NMSU-003	$297,640	$297,640
8/18/2010	5/31/2012	2010	10-C-CST-NMSU-006	($26,310)	($26,310)
					Total: $271,330

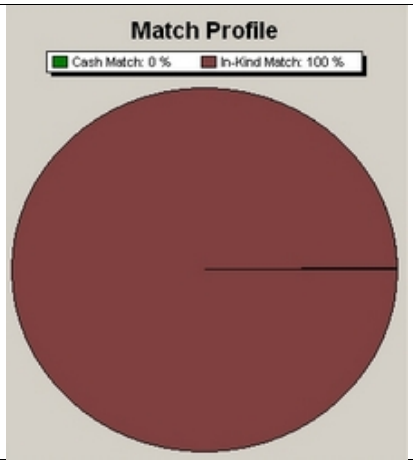
Students

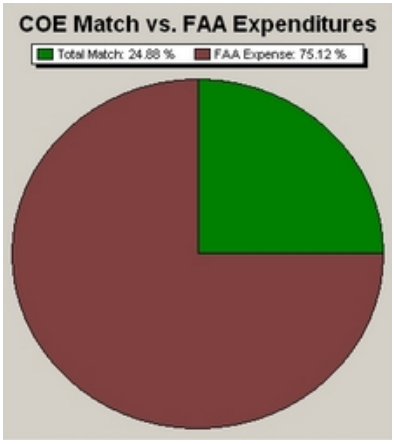
None

Task 284 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$32,129	$32,129	$0	$0
Q2(Jan-Mar) FY2011	$32,129	$64,258	$86,941	$86,941
Q3(Apr-Jun) FY2011	$32,129	$96,387	$39,548	$126,489
Q4(Jul-Sep) FY2011	$32,129	$128,516	$33,353	$159,842
Q1(Oct-Dec) FY2012	$32,129	$160,645	$13,072	$172,914
Q2(Jan-Mar) FY2012	$32,129	$192,774	$53,766	$226,680
Totals	$192,774		$226,680	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$58,979	$58,979	$58,979	$58,979
Q2(Jan-Mar) FY2012	$0	$0	$16,080	$75,059	$16,080	$75,059
Totals	$0		$75,059		$75,059	

Task 286-SU: Technical Oversight

Project Description

Provide technical oversight for the COE-CST.

Partners:

- Federal Aviation Administration AST *
- Stanford University *
- United Launch Alliance*

*- indicates primary partner

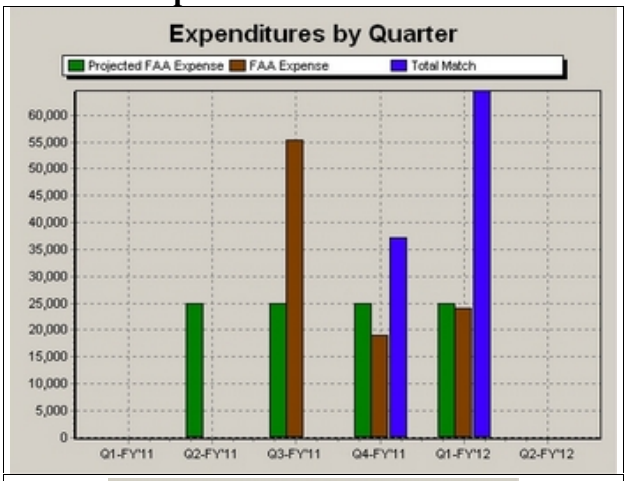
Funding History

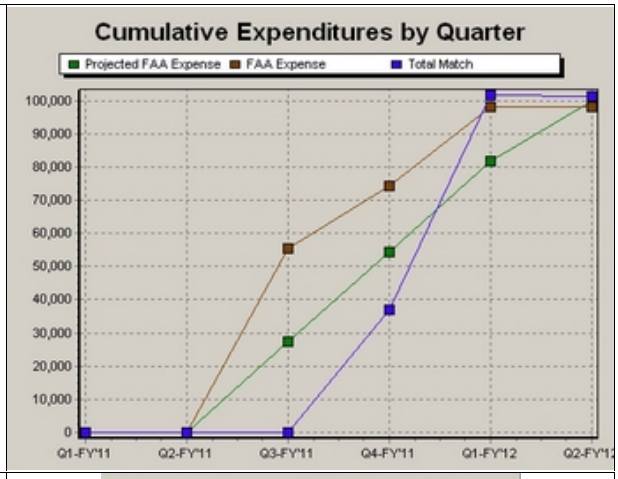
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-007	$100,000	$100,000
8/18/2010	12/31/2011	2010	10-C-CST-010	$0	$0
					Total: $100,000

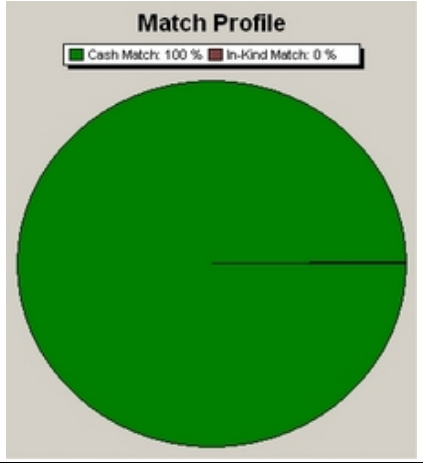
Students

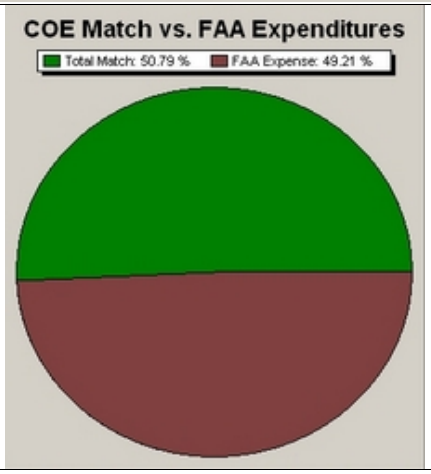
None

Task 286 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$25,000	$25,000	$0	$0
Q3(Apr-Jun) FY2011	$25,000	$50,000	$55,289	$55,289
Q4(Jul-Sep) FY2011	$25,000	$75,000	$18,926	$74,215
Q1(Oct-Dec) FY2012	$25,000	$100,000	$23,995	$98,210
Q2(Jan-Mar) FY2012	$0	$100,000	$0	$98,210
Totals	$100,000		$98,210	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$37,074	$37,074	$0	$0	$37,074	$37,074
Q1(Oct-Dec) FY2012	$64,562	$101,637	$0	$0	$64,562	$101,637
Q2(Jan-Mar) FY2012	($273)	$101,364	$0	$0	($273)	$101,364
Totals	$101,364		$0		$101,364	

Task 287-UCF: Technical Oversight

Project Description

Provide technical oversight for the COE-CST.

Partners:

- Federal Aviation Administration AST *
- University of Central Florida *
- Space Florida *

*- indicates primary partner

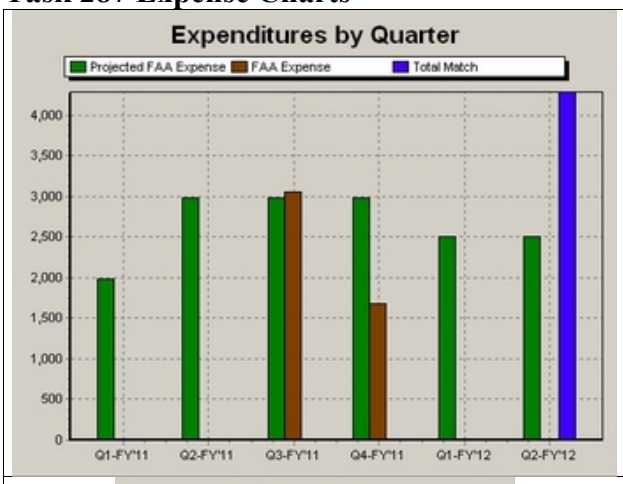
Funding History

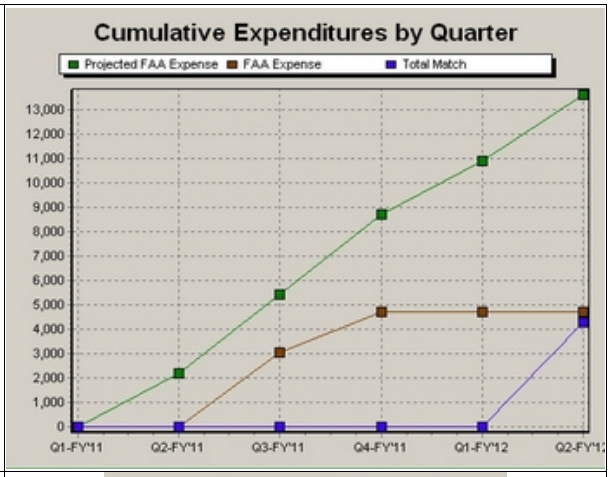
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
11/1/2010	9/30/2011	2010	10-C-CST-UCF-003	$10,910	$10,910
10/1/2011	9/30/2012	2011	10-C-CST-UCF-004	$10,000	$10,000
					Total: $20,910

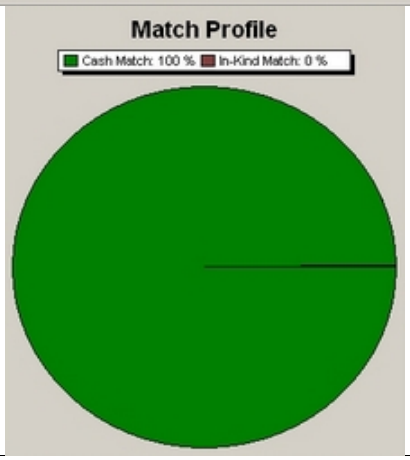
Students

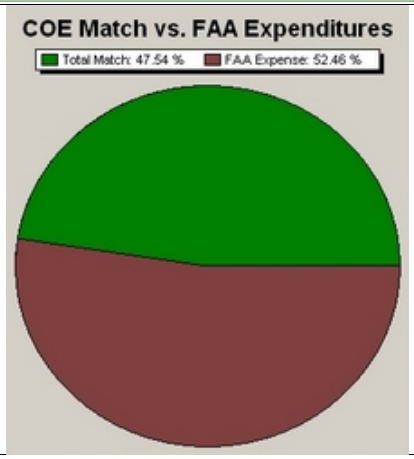
None

Task 287 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$1,984	$1,984	$0	$0
Q2(Jan-Mar) FY2011	$2,975	$4,959	$0	$0
Q3(Apr-Jun) FY2011	$2,975	$7,935	$3,050	$3,050
Q4(Jul-Sep) FY2011	$2,975	$10,910	$1,679	$4,729
Q1(Oct-Dec) FY2012	$2,500	$13,410	$0	$4,729
Q2(Jan-Mar) FY2012	$2,500	$15,910	$0	$4,729
Totals	$15,910		$4,729	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$4,285	$4,285	$0	$0	$4,285	$4,285
Totals	$4,285		$0		$4,285	

Task 288-UF: Technical Oversight

Project Description

Provide technical oversight for the COE-CST.

Partners:

- Federal Aviation Administration AST *
- University of Florida *
- Space Florida*

*- indicates primary partner

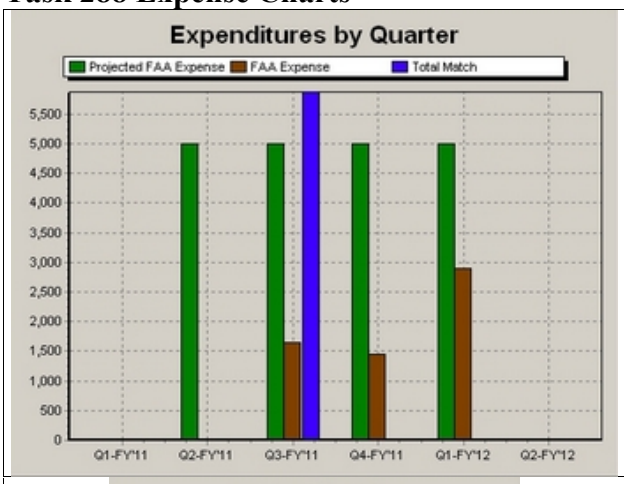
Funding History

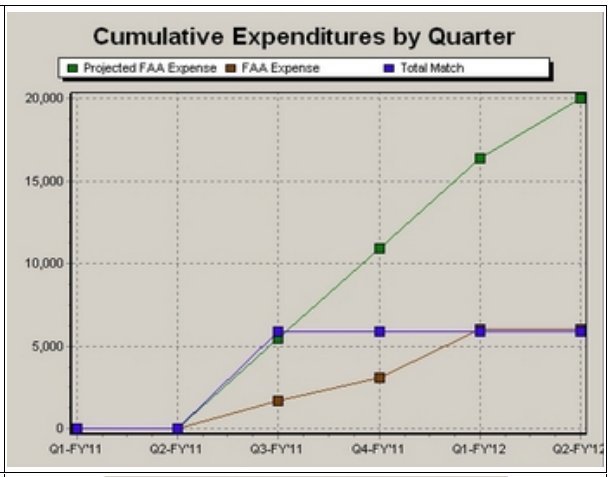
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
1/3/2011	12/31/2011	2010	10-C-CST-UF-004	$20,000	$20,000
1/1/2012	12/31/2012	2010	10-C-CST-UF-010	$0	$0
					Total: $20,000

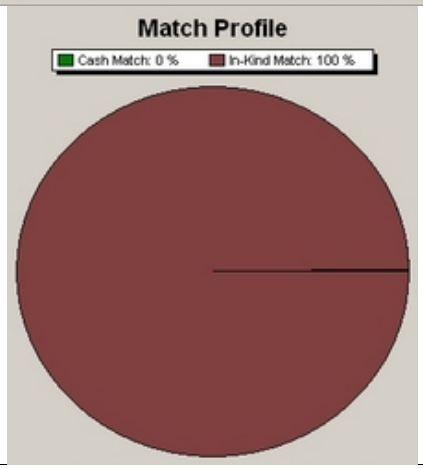
Students

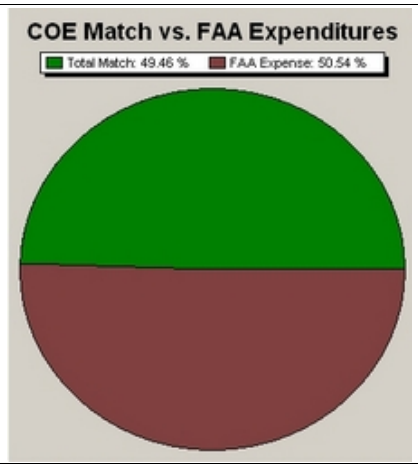
None

Task 288 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$5,000	$5,000	$0	$0
Q3(Apr-Jun) FY2011	$5,000	$10,000	$1,647	$1,647
Q4(Jul-Sep) FY2011	$5,000	$15,000	$1,450	$3,097
Q1(Oct-Dec) FY2012	$5,000	$20,000	$2,902	$5,999
Q2(Jan-Mar) FY2012	$0	$20,000	$0	$5,999
Totals	$20,000		$5,999	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$5,870	$5,870	$5,870	$5,870
Q4(Jul-Sep) FY2011	$0	$0	$0	$5,870	$0	$5,870
Q1(Oct-Dec) FY2012	$0	$0	$0	$5,870	$0	$5,870
Q2(Jan-Mar) FY2012	$0	$0	$0	$5,870	$0	$5,870
Totals	$0		$5,870		$5,870	

Task 289-UTMB: Technical Oversight

Project Description

Provide technical oversight for the COE-CST.

Partners:

- Federal Aviation Administration AST *
- University of Texas Medical Branch at Galveston *

*- indicates primary partner

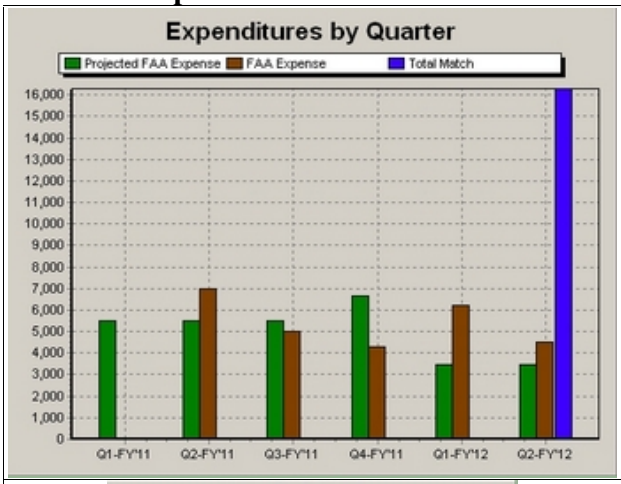
Funding History

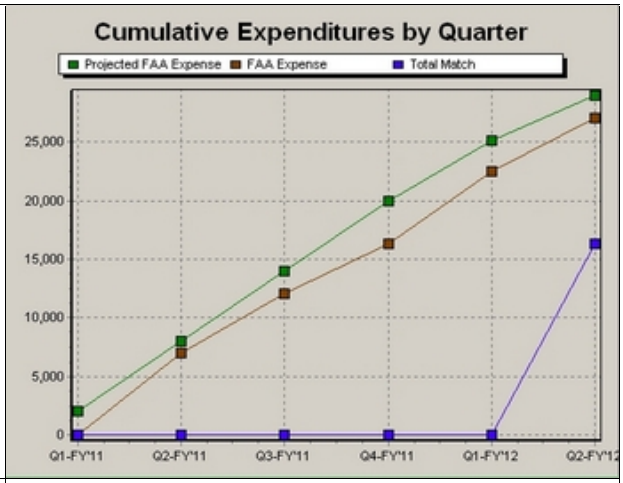
Start Date	End Date	FY Funding Source	Modification Number	Funding Obligation	Amount Funded
9/15/2010	12/31/2012	2010	10-C-CST-UTMB-002	$23,907	$23,907
9/15/2010	8/17/2012	2010	10-C-CST-UTMB-011	$13,941	$13,941
					Total: $37,848

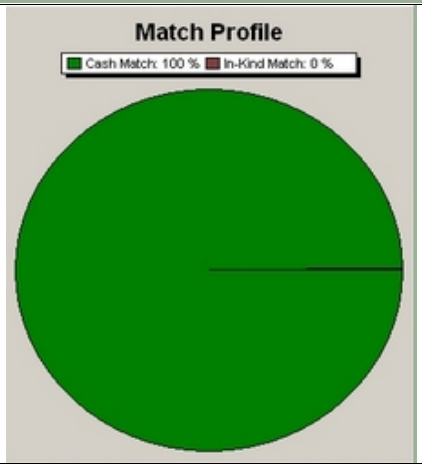
Students

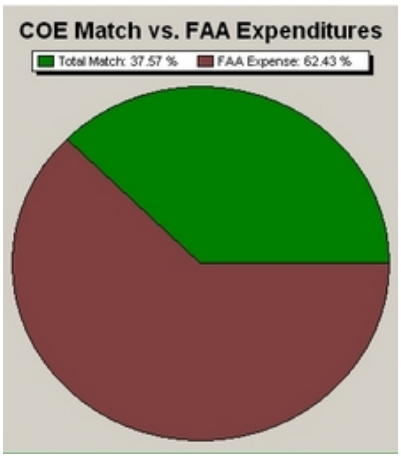
None

Task 289 Expense Charts









FAA Cash by Quarter

Date	Projected	Running Sum	Actual	Running Sum
Q1(Oct-Dec) FY2011	$5,517	$5,517	$0	$0
Q2(Jan-Mar) FY2011	$5,517	$11,034	$7,015	$7,015
Q3(Apr-Jun) FY2011	$5,517	$16,551	$4,996	$12,011
Q4(Jul-Sep) FY2011	$6,679	$23,230	$4,304	$16,315
Q1(Oct-Dec) FY2012	$3,485	$26,715	$6,218	$22,533
Q2(Jan-Mar) FY2012	$3,485	$30,200	$4,533	$27,066
Totals	$30,200		$27,066	

COE Matching by Quarter

Date	Cash Match	Running Sum	In Kind Match	Running Sum	Total Match	Running Sum
Q1(Oct-Dec) FY2011	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2011	$0	$0	$0	$0	$0	$0
Q3(Apr-Jun) FY2011	$0	$0	$0	$0	$0	$0
Q4(Jul-Sep) FY2011	$0	$0	$0	$0	$0	$0
Q1(Oct-Dec) FY2012	$0	$0	$0	$0	$0	$0
Q2(Jan-Mar) FY2012	$16,291	$16,291	$0	$0	$16,291	$16,291
Totals	$16,291		$0		$16,291	

Concluding Statement

The primary responsibility of the FAA COE CST is to promote responsible research in the field of Commercial Space Technology and Operations and to enhance the relationships among the FAA, university researchers and the commercial space community.

During the third year of operation, the total FAA funding in the approximate amount of $1,000K was matched through industry and university contributions by a ratio of almost 3:1. Over the entire life of the COE CST, the approximate amount of FAA total funding ($5,300K) has been matched by a ratio of almost 2:1.

The Executive Committee thanks all those contributors who are developing the world of commercial space transportation.

Center of Excellence for
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