

Airport Cooperative Research Program

University Design Competition for Addressing Airport Needs

2016 - 2017 Academic Year

Introduction:

The Airport Cooperative Research Program (ACRP) is sponsoring a national competition for universities that engages students in addressing issues relating to airports and the National Airspace System. This Competition challenges individuals and teams of undergraduate and/or graduate students working with faculty advisors to consider innovative approaches related to these challenges. Submitters should design innovative solutions that focus on addressing airport issues and constraints that would enhance the management, safety, capacity and efficiency of the nation's airports.

The Competition focuses on design solutions addressing airport needs in the following broad areas: Airport Operation and Maintenance, Runway Safety/Runway Incursions/Runway Excursions, Airport Environmental Interactions, and Airport Management and Planning. Background and some specific challenge areas are defined in the Technical Design Challenges section. Students are not limited to the suggested topical areas listed. They are free to propose design solutions based on other topics that fit the four broad challenge areas. As part of the required literature review, participants are encouraged to explore past ACRP research reports to see what ideas have already been presented and studied.

Competition Goals:

1. Raise awareness of the benefits of the ACRP and the importance of airports and the FAA to the National Airspace System infrastructure.
2. Increase the involvement of the academic community in ACRP and addressing airport operations and infrastructure issues and needs.
3. Engage students at U.S. colleges and universities in the conceptualization of applications, systems and equipment capable of addressing related challenges in a robust, reliable and comprehensive manner.
4. Encourage undergraduate and graduate students at U.S. colleges and universities to contribute innovative ideas

and solutions to issues facing airports and the National Airspace System.

5. Provide a framework and incentives for quality educational experiences for university students.
6. Develop an awareness of and an interest in airports as vital and interesting areas for engineering and technology careers.

The Competition website is the participant's source for complete and up-to-date information:

vsgc.odu.edu/ACRPDesignCompetition



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TRANSPORTATION RESEARCH BOARD

The website contains:

- Competition Guidelines
- Links to ACRP and Federal Aviation Administration (FAA) Reports and Resources
- Online Design Submission Process
- Expert Advisors in Challenge Topics
- Online Notice of Intent Electronic Submission Form
- Link to Winning Designs from the 2007-2016 Competition Years
- Contact Information for Queries

Competition updates will be posted on the website.

About the Airport Cooperative Research Program

The Airport Cooperative Research Program (ACRP) carries out applied research on problems that are shared by airport operating agencies, not adequately addressed by existing federal research programs. The ACRP undertakes research and other technical activities in a variety of airport subject areas involving administration, environment, legal, policy, planning, safety, human resources, design, construction, maintenance, and operations at airports. ACRP is able to draw on its targeted research to help U. S. university students be engaged in contributing innovative approaches to issues facing our nation's airports and the National Airspace System.

Airports are vital national resources. They serve key roles in the transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry.

The ACRP was authorized in December 2003 as part of the Vision 100 - Century of Aviation Congressional Reauthorization Act. In October 2005, the FAA executed a contract with the National Academies of Sciences, Engineering, and Medicine, acting through its Transportation Research Board (TRB), to serve as manager of the ACRP.

The primary participants in the ACRP are (a) the ACRP Oversight Committee (AOC), an independent governing



board appointed by the Secretary of the U.S. Department of Transportation, with representation from airport operating agencies, other stakeholders, and relevant airport associations such as the Airports Council International -North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), Airports Consultants Council (ACC) and the Airlines for America (A4A) as vital links to the airport community; (b) the TRB as program manager and secretariat for the governing board; and (c) the FAA as program sponsor. The ACRP benefits from the cooperation and participation of airport professionals, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

About the FAA

The FAA is part of the Department of Transportation and is responsible for the safety of civil aviation. The activities of



the FAA include:

- Regulating civil aviation, including commercial service airports, to promote safety;
- Encouraging and developing civil aeronautics, including new aviation technology;
- Developing and operating a system of air traffic control and navigation for both civil and military aircraft;
- Researching and developing the National Airspace System and civil aeronautics;
- Developing and carrying out programs to reduce aircraft noise and other environmental effects of civil aviation; and
- Regulating U.S. commercial space transportation.

The FAA provides the framework for a safe, secure, and efficient aviation system. As a leading authority in the international aviation community, the agency is responsive to the dynamic nature of customer needs, economic conditions, and environmental concerns. The FAA encourages and supports innovative research to improve airport and aviation safety, improve aviation capacity, and reduce environmental impact.

The FAA funds ACRP to provide this Competition.

Competition Partners

The ACRP gratefully acknowledges the contributions of the following partnering organizations that supply expert advisors for teams, assist in dissemination of the Competition opportunity to organizational members, and participate in design reviews.

The American Association of Airport Executives (AAAE)

AAAE is the largest professional organization for airport executives in the world, representing thousands of airport management personnel at public use airports nationwide. The organization's primary goal is to assist airport executives in fulfilling its responsibilities to the airports and communities they serve.

The Airport Consultants Council (ACC)

ACC is an international trade association representing more than 240 companies that provide development and operations-related consulting and product services to

airports and other aviation system stakeholders. Members offer architectural, engineering, planning, security, environmental, financial, management, economic and construction services, products and equipment.

The Airports Council International - North America (ACI-NA)

ACI-NA is a membership organization representing approximately 160 state, regional, and local governing bodies that own and operate the principal airports served by scheduled air carriers in the United States and Canada. ACI-NA member airports handle approximately more than 95 percent of the domestic and virtually all of the international air passenger traffic and cargo traffic in North America.

The National Association of State Aviation Officials (NASAO)

NASAO was founded to ensure uniformity of safety measures, to standardize airport regulations and develop a truly national air transportation system responsive to local, state, and regional needs. The organization represents the men and women in state government aviation agencies who serve the public interest in all 50 states, Guam, and Puerto Rico.

University Aviation Association (UAA)

UAA is the voice of collegiate aviation education to its members, the industry, government and the general public. Through the collective expertise of its members, this nonprofit organization plays a pivotal role in the advancement of degree-granting aviation programs that represent all segments of the aviation industry.

The Competition is managed for the ACRP by the Virginia Space Grant Consortium based in Hampton, Va. (<http://www.vsgc.odu.edu>).

Overall Requirements

The ACRP University Design Competition for Addressing Airport Needs is open to teams or individuals from accredited U.S. colleges and universities who are working with a faculty advisor. The Competition will be open for student participation from August 2016 through April 28, 2017, allowing participation during fall semester 2016 and/or spring semester 2017. Final due date for all submittals is April 28, 2017. All submissions will be judged after the due date. Challenges might typically be addressed as part of a senior design class or independent study option or through other academic venues, including faculty-mentored, college-based student chapters of professional societies.

The Competition requires evidence of interaction with airport operators and industry experts for feedback on the practicality of the proposed design/approach. Links to expert advisors are provided on the Competition website. The American Association of Airport Executives is offering assistance in linking students to airport operators. Participants should contact the Virginia Space Grant Consortium at acrp@odu.edu to request assistance.

A key criterion for submittal evaluation is innovation. Participants need to carefully review and consider previous research and solutions relating to the challenge they choose as part of the required literature review. ACRP offers a wealth of research papers and other documents that the students should carefully consider in planning their submittal and approach. Links to previous and current ACRP research are available on the ACRP website: <http://www.trb.org/ACRP/ACRP.aspx>. Students should also review previous winning submissions to the University Design Competition for Addressing Airport Needs and its predecessor, the FAA Design Competition for Universities. Links to these resources are provided on the Competition website.

Participants are encouraged to take an interdisciplinary approach to the selected topic and a cross-departmental approach where appropriate. Submissions must be student written and demonstrate a thorough understanding of current conditions/state-of-the-art approaches relevant to the chosen topic. Guidelines for elements of the submittal package are provided below.

Note that additional information, resources, and responses to queries will be posted on the Competition website at vsgc.odu.edu/ACRPDesignCompetition. Scoring criteria for submittal review are also posted on the Competition website. The submittal packages will be delivered both electronically and in hard copy with instructions and necessary forms provided on the website.

Notice of Intent: Though not required, participants are strongly encouraged to provide a nonbinding "Notice of Intent," which is submitted electronically through the Competition website. The purpose of the Notice of Intent is to allow Competition staff to assist as needed with providing access to Airport Operators and expert sources that can be of help to the student or student team during the design process. ACRP personnel and members of partnering organizations will serve as resources to design teams or individual participants.

A key goal of the Competition is to enhance the educational experience of participating students. The ACRP believes that by providing access to experts, the educational

process can be strengthened; students gain exposure to professionals in the field; and students will be better able to assess the practicality of their designs. The Notice of Intent will also assist the ACRP with planning for the review process to include appropriate subject matter experts. Once a Notice of Intent is received, the faculty advisor will be contacted to see what assistance might be needed.

For maximum effectiveness, the Notice of Intent should be submitted in advance of beginning the design process and by September 30, 2016 for projects commencing with the fall semester and January 27, 2017 for projects commencing in the spring semester. A Notice of Intent will be accepted later; however, teams are encouraged to submit by the suggested date.

Technical Design Challenges

I. Airport Operation and Maintenance

The day-to-day operation and maintenance of an airport involves many tasks. Airport operators must handle both routine matters and unusual circumstances. Their responsibilities include keeping records; hiring and training personnel; maintaining pavement; maintaining markings, signs, and lighting; providing snow and ice

control, if applicable; managing emergency preparedness; overseeing handling of hazardous materials, including jet fuel; conducting airport self-inspections; overseeing procedures for operation of vehicles on the airfield; providing obstruction lighting; protecting navigational aids; protecting public safety; dealing with wildlife control; and overseeing construction projects.

Almost 20,000 airports are located throughout the United States today. Of those, approximately 8,700 feature paved runways, taxiways and ramps/aprons. Paved airport surfaces can be affected by many things: adverse weather, build-up of rubber residue from aircraft tires, and normal wear and tear. The pavement surface must also be kept free of what is referred to as foreign debris. This debris can be in the form of such things as rocks and stones tracked onto the pavement from grass areas adjacent to the pavement, material coming off aircraft during taxiing, landing, or takeoff, and objects blown from the aircraft servicing areas onto the pavement surfaces. This debris can cause major damage to aircraft engines if it is ingested or affect the aerodynamics of a propeller.

Airport operators certificated under 14 Code of Federal Regulations Part 139 are required to keep these surfaces in a condition that meets requirements specified in the regulation. These surfaces are inspected visually on a regular basis so any deficiencies can be found and





corrected. Some automated systems have been developed to supplement aspects of these visual inspections.

In the interest of safety, an airport surface must be closed for a pavement repair. Runway closures reduce capacity at that airport, affecting carriers that may have to juggle flights to accommodate the repair and inconveniencing non-airline (called general aviation, or simply GA) aircraft that need to use alternate airfields, especially if the closure is unplanned. Any technologies or procedures that either improve the structure/longevity of pavement, increase the speed of repairing pavement, or automatically alert the airport operator to hazardous pavement conditions will be a welcome advance for airports.

This Design Category has challenges that focus on new approaches that will help airport operators increase airfield efficiency outside of the terminal and airport buildings. Terminal facilities, exclusive of security, are a secondary consideration. Designs can also consider the potential effects of NextGen on airport operations.

Airport Operation and Maintenance Challenges:

A. Exploring new methods for design and maintenance of pavement surfaces. Ideas include, but are not limited to:

- Methods for innovative pavement repair.
- Innovative pavement materials, installation and maintenance techniques, including nondestructive evaluation methodologies.
- Improved approaches to rubber removal/surface restoration due to aircraft tire friction.
- New or improved techniques for ice removal from runways.

B. Improved methods for foreign object detection and removal from runway surfaces.

C. Innovative approaches to address wildlife issues at airports including bird strikes.

D. Improved tug systems for aircraft.

E. Innovative applications, including web-based solutions, for airport operations and maintenance.

F. Improved methods for ground traffic flow scheduling.

G. Innovative ways to collect, verify, distribute or use geospatial data to benefit safety or efficiency impacting airport operations. Note: The FAA Office of Airports has developed an Airports GIS program to collect authoritative geospatial data for airport infrastructure and surveys. The NAV Lean Program has developed authoritative databases for sharing geospatial data for airports, obstacles, airspace and navigation aid.

H. Innovative solutions for accommodating new larger wingspan aircraft in airport operations, including, but not limited to, issues such as visual aids, gate access, taxiway and runway considerations, and language.

I. Improved approaches to baggage handling, including solutions to address human factors issues.

J. Approaches to addressing cybersecurity issues with respect to integrity of aircraft and airport systems.

K. New and improved techniques for communicating status and impact of service disruptions such as weather, equipment, accidents or other occurrences, flight delays,

NEW



air traffic disturbances, and computer system breakdowns. While students will need to undertake a thorough literature search, some key documents and resource links to begin the process are listed on the Competition website.

II. Runway Safety/Runway Incursions/Runway Excursions

The United States National Airspace System (NAS) has over 500 FAA/contract towered airports that handle more than 135,000 aircraft operations—takeoffs and landings—a day, averaging approximately 50 million airport operations per year. A runway incursion is any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft. Of the approximately 150 million takeoffs and landings at United States towered airports from FY 2011 through FY 2013, there were 3,326 reported runway incursions. This performance record means that there were approximately 22 runway incursions for every one million operations and just under one serious runway incursion for every five million operations. The National Transportation Safety Board (NTSB) continues to list “Airport Surface Operations” on their Most Wanted List, which “is designed to increase awareness of, and support for, the most critical changes needed to reduce transportation accidents and save lives.”

One of the FAA’s top priorities is to reduce the frequency of runway incursions and the risk of a runway collision. The FAA aims to reduce the severity, number, and rate of runway incursions by implementing a combination of technology, infrastructure, procedural and training interventions to decrease the prevalence of human errors and increase the error tolerance of airport surface

movement operations. The FAA is developing airport design concepts and surface movement procedures, such as the use of perimeter taxiways, to decrease the number of runway crossings and thereby reduce the risk of runway incursions. Related efforts address the errors committed by pilots, air traffic controllers, and airport-authorized vehicle operators and pedestrians.

Also of great concern are runway excursions. A runway excursion occurs when an aircraft departs the runway in use during the take-off or landing run or during taxiing. The excursion may be intentional or unintentional. Runway excursions are mainly of three types—overrun, undershoot and veer-off. Examples of runway excursions include: (1) a landing aircraft is unable to stop before the end of the designated runway is reached leading to a overrun; (2) an aircraft taking off or rejecting takeoff or landing departs the side of the designated runway leading to a veer-off; (3) an aircraft attempting a landing touches down in the undershoot area of the designated landing runway within the aerodrome perimeter; or (4) a runway or taxiway other than the designated one is used for a takeoff or a landing.

Runway excursions are the most frequent accident category worldwide with an average of 30 such accidents annually for commercial aircraft over a 14-year period (1998 – 2008). Although the total number of runway incursions exceeds the total number of excursions, the largest portion of runway-related accidents is a result of a runway excursion. There has been no significant reduction in the runway excursion accident rate in over 20 years. Recent studies of runway excursions have called for appropriate measures to be taken to address this problem.

Runway Safety/Runway Incursions/Runway Excursions Challenges:

A. Expanding situational awareness of pilots and ground operators on the airfield. Ideas include, but are not limited to:

- Mobile tools for pilots, pedestrians and vehicle operators that aid in situational awareness.
- Direct warning systems to alert pilots that they are approaching a runway and if the runway is occupied.
- Direct warning systems to alert air traffic controllers for situations leading to runway incursion.
- Direct warning systems to alert airfield drivers that they are approaching a runway they are not authorized to cross.
- Development of innovative techniques to record, analyze and display annotated spatial data for improved situational awareness of ground operations.
- Methods for aircraft/runway interface that address issues caused by new energy efficient lighting not being visible to heat sensing, enhanced flight vision systems.



B. Enhancing Airport Visual Aids

- Improved lighting, marking, and signage for runways, taxiways and the airport apron.
- Lighting other than traditional incandescent.
- Providing surface navigation guidance to pilots in the cockpit via electronic alternatives in limited visibility conditions (in lieu of outside visual cues).

C. Runway Excursions

- Identification of major causal/contributory/contextual factors leading to runway excursions.
- Risk analysis of runway excursions due to overrun/undershoot/veer-offs.
- Innovative approaches to reducing runway excursions and associated risks.

D. Safety Assessment Tools

- Mobile tools to support assessments conducted by runway safety action teams that aid in compliance evaluation as well as hazard identification and correction.
- Systems analysis to determine areas of greatest risk for runway incursions and excursions in the National Airspace and proposing corrective action plans.
- Innovative processes to identify the hazards that present the greatest risk to air carrier operations within the runway environment and strategies to mitigate those hazards and improve safety of airport surface operations.

E. Optimizing safety through retrofit and redesign of existing runways and taxi ways.

F. Safety considerations for drones operating in or near the airport environment—issues and constraints as well as benefits and costs.

G. Innovative concepts for virtual/remote towers at non-towered airports. NEW

While students will need to undertake a thorough literature search, some key documents and resource links to begin the process are listed on the Competition website.

III. Airport Environmental Interactions

As the FAA carries out its mission, it must comply with regulations protecting the environment. All airport operations must be carried out with consideration for how the environment could be adversely affected. Airport environmental concerns may include many things: noise; land use; social impacts; air quality; endangered and threatened species; energy supply and natural resources; light emissions; solid waste impacts; or construction impacts. For the purpose of this Competition, the ACRP has chosen to focus on: making snow and ice removal

more environmentally friendly, improved methods for containment and cleanup of fuel spills, storm water management, noise reduction, air quality around airports, and energy efficiency.

As mentioned in Section I, Airport Operations and Maintenance, one of the airport operator's responsibilities is snow and ice control on paved surfaces. Air carriers/pilots must ensure their aircraft are free of ice/snow to enable a safe takeoff. In many cases, this involves application of a chemical agent, which for both aircraft and airport pavements must meet strict corrosivity requirements. After the aircraft is treated, the airport operator is left with the problem of how to dispose of these chemicals or other cleanup required. Any improvements in aircraft and/or pavement anti-icing and/or de-icing agents themselves, new methodologies or procedural improvement would be welcome.

Another environmental hazard is fuel spills. While a hazard on the airfield itself, airport operators must also ensure the spilled fuel does not enter the water supply where it can do even more damage. Storm water management at airports is important to prevent contaminants such as chemicals and fuels from entering the water table. Air quality around airports is also a factor.

Energy efficiency is another factor of environmental responsibility at airports. Energy is required for all airfield buildings, vehicles, and the airfield itself. It can be a challenge, especially at remote airports that may not have an independent power source, to keep the airfield properly lit.

This Design category has challenges that focus on improvements in snow and ice removal, containment and cleanup of fuel spills, storm water management, noise reduction and energy efficiency that will help airports carry out their mission in a way that will be environmentally sound and energy efficient.

Airport Environmental Interactions Challenges:

A. Making snow and ice removal more environmentally friendly. Both chemical and nonchemical options can be considered. The ACRP is seeking designs that offer:

- Improved means and methods of complying with aircraft and airfield anti- and de-icing requirements.
- Environmentally safe aircraft and airfield anti- and de-icing products that are compatible with both aircraft structures and airport pavements.
- Improved containment and cleanup of anti- and de-icing products.

B. Improving methods for containment and cleanup of fuel spills.

- Bioremediation techniques for fuel spill cleanup.
- Techniques/substances for neutralization of toxic components of fuel.
- Techniques/substances that delay the biological and chemical breakdown of fuel, allowing cleanup to occur without causing rapid decreases in dissolved oxygen in receiving waters that result from biological and chemical degrading of the fuel.
- Techniques for prevention of percolation of fuel into ground water.

C. Increasing energy efficiency in the management of airfields, the terminal area and other airport buildings.

Topics that might be considered include:

- Alternative energy/energy efficient airport equipment such as tow vehicles, emergency generators, power units, heating systems, etc. for use in airfield areas.
- Alternate energy sources and approaches to providing lighting at remote airports that don't have access to electrical power.
- Innovative approaches to solid waste reduction at airports.
- Integration of alternative energy-producing and energy-saving technology into the airport environment.

D. Innovative methods for storm water management at airports.

E. New tools and approaches to noise reduction at airports.

F. System level methodologies for strategic assessment of environmental interactions beginning at the airport planning phase.

G. Enhanced methodologies for improving air quality around airports.

H. Approaches for adaption and risk mitigation for climate change effects.

I. Innovative strategies for management of natural environments to minimize negative impacts on and to enhance compatibility with Airport Operations.

NEW

While students will need to undertake a thorough literature search, some key documents and resource links to begin the process are listed on the Competition website.

IV. Airport Management and Planning

In today's airport environment, especially at the busier airports, any change in "normal" operations affects that particular airport and also may ripple across the NAS



and affect many other airports and passengers. To meet this challenge, the FAA, airport operators, and airport users must work together to develop action plans that provide the best solutions for local and regional areas, as well as the nation. An integrated approach is preferred which includes improving technology, air traffic control procedures, and expanding airport and airfield infrastructure.

Airport Management and Planning Challenges:

This Design Category has challenges that focus on airfield management and planning that will help airport operators optimize the use of existing airport resources and plan for upcoming functional needs.

A. Maximizing Airport Capability

- Strategies for accommodating aircraft that experience extended delays on the tarmac and in line for takeoff, including dealing with human needs as well as airport and airline capabilities.
- Innovative approaches to demand forecasting and management for airports.
- Innovative strategies for reducing airline fuel consumption, such as new ways to reduce gate-to-gate time or revise procedures.
- Effective alternatives to current ramp and gate controls.
- Creative approaches to airport revenue generation for general aviation airports.
- Models for collaborative decision making and data

sharing at airports.

- Improved aircraft and airport design factors affecting aircraft compatibility to decrease the risk of aircraft wing tip collisions in the non-movement apron areas.
- Improved strategies for airport asset management, including land use.
- Innovations to accommodate the aging passenger demographic at airports.
- Effective uses of social media in airport planning, marketing, development and customer service.

NEW

While students will need to undertake a thorough literature search, some key documents and resource links to begin the process are listed on the Competition website.

Guidelines for Design Submission

It is strongly recommended that participants review the Tips for Proposers section of the Competition website. Each of the following should be identified as a separate section of the design.

Design Package Components:

1. Main Body of the Design Submission

The main body of the report must contain the following sections. There is a limit of 40 pages. Only required appendices are allowed. See format on page 11.

- Cover page to include: Title of Design; team member(s)

- name(s) and status (undergraduates or graduates); advisor(s) name(s) and university attending.
- Executive Summary – 1 page.
 - Table of Contents with page numbers referenced for each section and appendix.
 - Problem Statement and Background on the Design Challenge being addressed. This section should demonstrate that the individual or team has a clear understanding of the issues surrounding the design challenge as well as current conditions and state-of-the-art approaches.
 - Summary of Literature Review. This is an overview of what was gleaned from the literature review with a discussion of primary sources and their influence on the design. Specific reference citations are to be provided in Appendix F.
 - Individual or Team's Problem Solving Approach to the Design Challenge. This section should include a thorough description of individual's or team's work including a description of both interdisciplinary and systems engineering approaches as appropriate to solving the problem.
 - Safety Risk Assessment: The FAA promotes a culture of safety throughout all its operations. Examine existing FAA safety management system guidance as it relates to your proposed design solution. Consider inherent risks and describe how these risks should be addressed to ensure safe operations. Be sure to reference Introduction to Safety Management Systems for Airport Operators (FAA Advisory Circular 150/5200-37) and FAA Safety Management System Manual available under the Resources section of the Competition website. See video with additional guidance on this section at the competition website.
 - Description of how the technical aspects of the Design Challenge are addressed through drawings, mockups, computer codes, etc. as appropriate to provide evidence of a thorough design process.
 - Description of interactions with airport operators *and* industry experts in the design process. Be explicit. Identify contacts and interactions. **This is a required Competition component.**
 - Description of the projected impacts of the team's design and findings with a thorough discussion of how the design/solution meets ACRP goals. This section should address commercial potential for the design, including a description of processes that would need to be undertaken to bring the design to the product/implementation state. Emphasis should be on increased affordability and utility. This section should provide a financial analysis that reflects a realistic approach to projected cost/benefit determination and for the team's design. Guidance for acceptable cost/benefit analyses for the purpose of the Competition is provided on the Competition website.

Important Note: The Competition anticipates posting on the website instructional videos on the following topics: *How to Do a Cost Benefit Analysis; How to Do a Safety Risk Assessment; and Pointers for a Winning Proposal.* These should be available to teams by September 30, 2016.

2. Appendices A-F as described below are required but not included in the 40-page limit. **No other material may be included as an appendix.**

- Appendix A. List of complete contact information (use permanent addresses) for all advisors and team members. Include email, fax and phone numbers. This information is crucial as student participants may have graduated prior to receiving an award and all award checks are mailed directly to the participants.
- Appendix B. Description (approximately one page) of the university or college.
- Appendix C. Description of non-university partners involved in the project.
- Appendix D. Sign-off form for faculty advisor(s) and department chair(s). Sign-off form is available at the Competition website.
- Appendix E. Evaluation of the educational experience provided by the project. Evaluation questions for both student and faculty are provided on the Competition website.
- Appendix F. Reference list with full citations using APA or other standard format. APA reference format is available at <http://writing.wisc.edu/Handbook/DocAPA.html>.

Format: Double-spaced, single-sided, minimum 12-point type, Times New Roman or Helvetica font. Captions and charts may be at a minimum of 10-point type. Pages, including appendices, must be numbered and referenced in Table of Contents.

Due Date: The design package shall be submitted electronically following guidelines provided at the Competition website. In addition, one hard copy of the full design plus the original Sign-off form (available on competition website) must be mailed to the Virginia Space Grant Consortium, 600 Butler Farm Road, Suite 2253, Hampton, VA 23666. All electronic and hard copy submissions must meet the 5 p.m. (Eastern Daylight Time) deadline on April 29, 2016. It is strongly recommended that a mail service that certifies delivery be used. The faculty advisor will receive a submission acknowledgement via email.

By submission of the design package, Competition participants are agreeing that their design may be publicly shared.

Awards:

A cash award will be given to the student or shared equally among the student team members in each of the four technical design challenge areas as follows:

First Place - \$2,500; Second Place - \$1,500; Third Place - \$1,000.

First place award-winning team representatives will be invited to accept their award and present their design

at a ceremony at the National Academies of Sciences, Engineering, and Medicine in summer 2016, date to be determined. A travel allowance will be provided for at least two individuals (two students or one faculty advisor and one student) from each first place winning team.

Key Dates:

Competition Announcement August 2016

Notice of Intent (NOI) is strongly encouraged but not required. The NOI allows Competition staff to facilitate connections with airport operators and industry experts. Fall semester NOI deadline is September 30, 2016. Spring semester NOI deadline is January 27, 2017.

Design submissions will be accepted from November 2, 2016 through April 28, 2017.

Note: Students may work on their designs at any time throughout the Competition period.

Winners will be announced in June 2017.

The Award Ceremony with presentations by First Place winners will take place in Summer 2017 and is anticipated to be in Washington, DC.

Contact:

Questions on the Competition should be sent to:

acrp@odu.edu

At the ACRP's discretion, queries and responses may be made available to all design teams via the Competition website.

