

# Student Design Competition Operating Rules

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## Abstract

This is the formal Operating Plan for execution of the Annual AHS Student Design Competition (SDC). It provides a description of the competition, identifies the organizations and individuals involved in it, defines the roles and responsibilities of each, and specifies the rules that govern it. This document is defined and maintained by the Student Design Competition Steering Committee under the authority of the AHS Technical Director and the AHS Technical Council.

## Objective

The objective of the AHS Student Design Competition is to promote student interest in a career in the vertical flight industry, and to provide an opportunity for interested students and industry professionals to meet and interact.

## Description

Each year the AHS challenges the student population to design and analyze a rotorcraft and/or its systems, which addresses the specific requirements of a Request for Proposal (RFP). The RFP is customized each year to describe an application of interest to the industry, and identifies the particular requirements that need to be met, such as the type and size of payload, the environmental conditions, year of service entry, etc. The RFP also includes the specific technical areas to be included in the student responses, categories for participation, award prizes, and the judging criteria.

The competition is sponsored by the rotary-wing industry, typically an individual company. The sponsoring organization(s) are often supported by other industry entities and by government organizations (US Army, US Navy, and NASA) in RFP development and judging of submittals.

## Definitions

Student Design Competition (SDC) – Annual competition sponsored by industry, open to university graduate and undergraduate students for the design and analysis of a vertical flight aircraft, component or system

Sponsor – Industry entity that provides the award monies, RFP, and provides and coordinates judging of entries

Graduate Team – Group of student participants with at least one graduate study student

Undergraduate Team – Group of participants, all of whom are undergraduate study students

Judges – Set of industry/government participants coordinated through the SDC Committee to review and evaluate the student proposals against that year's RFP

AHS International (AHS) – International technical society promoting the advancement of the rotary wing industry

Education Committee (EC) – AHS committee, reporting to AHS Technical Director, consisting of representatives from AHS Educational member institutions, representatives from AHS corporate members, and other AHS individual members

Aircraft Design Technical Committee (ADTC) – AHS Technical Committee responsible for coordinating activities on overall aircraft, subsystem and component design, design technology and criteria and synthesis, interdisciplinary design, and vulnerability and crash safety considerations

AHS Forum – Annual conference and technology display of the AHS International

Award – Honor and prize money presented to the student proposals which are judged to be the best in each category of competition

Stipend – Money presented to the winning teams to go towards expense of attending the AHS Forum

Proposal – Student team responses which are intended to address the requirements of the competition RFP

Request for Proposal (RFP) – Background and requirements of a rotorcraft design project for response by participating student teams

## Participants & Responsibilities

This section defines the organizations and individuals involved in the oversight and implementation of the AHS Annual Student Design Competition, and specifies the responsibilities of each entity.

Sponsor – The sponsorship of the competition is filled by industry on a rotating basis. All AHS corporate members are invited to serve as sponsor. The SDC Steering Committee Chair makes recommendation for sponsor selection to the AHS Technical Council.

- Commit to sponsoring 6 months prior to release of RFP

- Author Draft RFP, and provide to AHS SDC Steering Committee for review

- Release RFP to AHS for distribution to potential participants

- Provide award and stipend funds to AHS with RFP

- Respond to questions as appropriate, coordinated through AHS

- Lead and coordinate judging, with support of SDC Steering Committee and industry representatives

Compile and distribute comments and recommendations from the judges to the teams

**AHS –**

Distribute RFP to AHS Educational Member institutions, Technical Council, and Committees/Technical Committees

Advertise SDC to AHS Educational Member institutions and other schools, as appropriate

Serve as focal point for all communication between participants and sponsor

Provide registration fee to AHS Forum for all representatives of winning team(s)

Ensure SDC winning presentations are included in AHS Forum Aircraft Design technical session(s)

Recognize winning team(s)

Maintain record of annual RFPs, proposal submittals, student participants and winners

**SDC Steering Committee -**

Provide feedback on Draft RFP, as requested

Meet annually at Forum, and coordinate regularly

Promote participation in the SDC by industry and academia

Serve as or provide judges

Resolve any disputes associated with judging

Develop/maintain succession plan for SDC Committee

Plan and manage SDC Competition

Maintain SDC Charter / Operating Rules

Provide written report to AHS Deputy Director for Vehicle Design, for each AHS Technical Council meeting

**Winner / Winning Team**

Provide representative(s) to give presentation at AHS Forum

**Aircraft Design TC**

Provide space in Technical Sessions at AHS Forum for presentation for the Graduate and Undergraduate winning teams

Provide representative to SDC Steering Committee to serve as Chair

Maintain cost estimating relationships as a resource for the SDC

Provide cost estimating relationships to student teams and provide support as required

**AHS Education Committee**

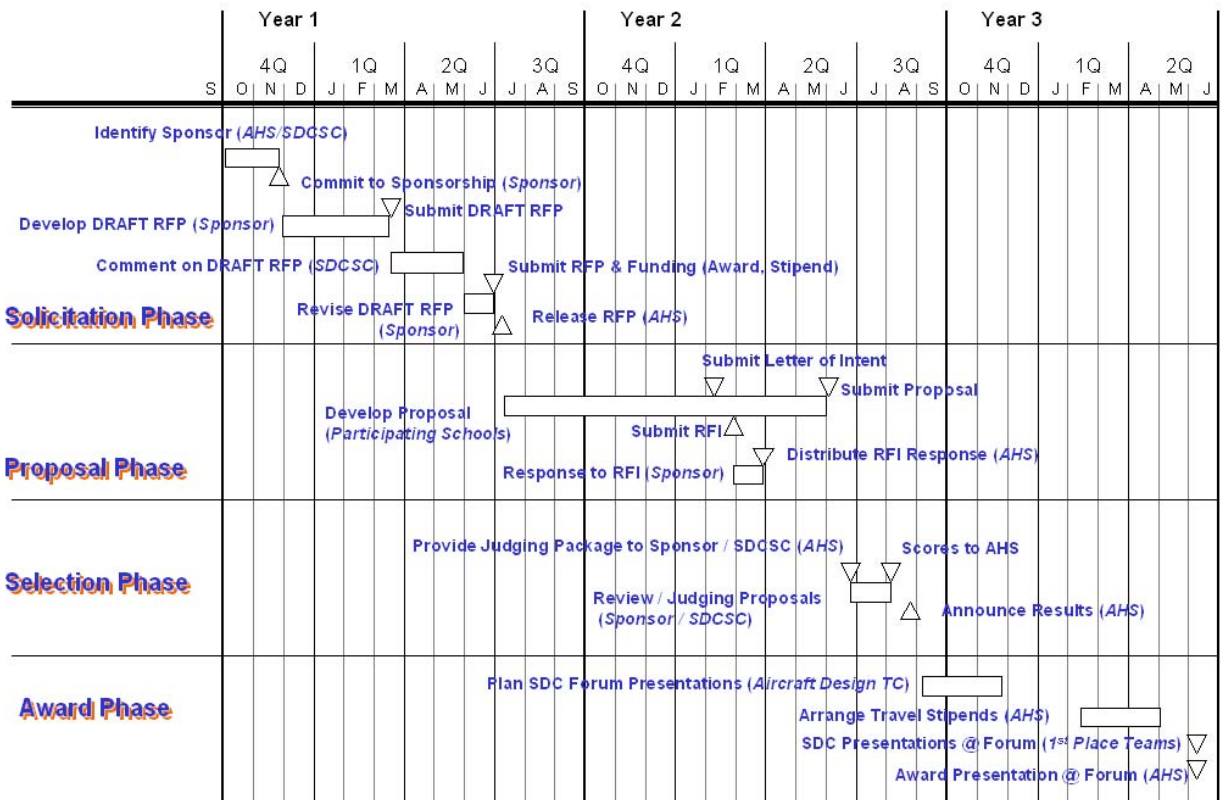
Provide representative to SDC Steering Committee as focal point

**AHS Vehicle Design Deputy Director**

Present report to AHS Technical Council at each meeting

**Recommended Annual Competition Timeline**

RFP draft to SDC Committee	March 15
RFP to AHS	by AHS Forum
AHS release RFP	Early July
Letters of Intent Due	October 30
Proposals Due	June 1
Winner Announced	August 15
Award Winning Presentation	at AHS Forum



**Figure 1 Proposed Schedule**

**Awards**

Awards in both Graduate and Undergraduate categories  
 Other Award categories may be created (e.g. new entrant), but must be thoroughly defined in RFP  
 Must be accompanied by stipend for travel to AHS Forum for representative(s) of winner in each category, at time of Forum recognition

**SDC Committee**

The Student Design Competition Steering Committee shall consist of the following members:  
 Representative from AHS Aircraft Design Technical Committee, Chair  
 Representative from AHS Education Committee  
 Serve as Education Committee focal point (the Education SDC focal point shall not be apprised of the nature or content of the SDC RFP for that year until its release)  
 Representatives from government agencies that have significant rotary wing technology investment and facilities, and interest in employing trained and experienced graduates:  
 US Army  
 NASA  
 Representatives from Industry Sponsors – voting rights require one of the following:  
 Having sponsored in past 5 years  
 Having submitted to AHS written commitment to sponsor in next 2 years  
 Having provided judging in three of previous four years  
 Vehicle Design Deputy Director

**RFP Criteria**

The RFP must meet the following criteria in order to meet the needs of industry and academia:  
 The topic must be of military interest or dual use

It must require the development of an overall aircraft configuration

There must be an element of system/subsystem definition

It must carry awards in the following categories –

- Graduate (required)

- Undergraduate (required)

- Not-for-Credit (optional)

- New Entrant (optional)

It should involve some form of recurring cost estimating

It may require the preparation of a presentation briefing

### **RFP Format**

A standard RFP package provides consistency for all competitions. The following format is similar to the AIAA student design competitions:

Cover

- RFP Title (Type of Mission/Aircraft/System)

- n<sup>th</sup> Annual Student Design Competition

- Names/logos for AHS & Sponsoring Company

Section 1 - Design Objectives & Requirements

- Overall Mission Needs (aircraft/system role and mission)

- Design Project Objectives (focus of design competition)

- Requirements & Constraints

  - Mission (ambient, range, speed, altitude, maneuver capability, etc)

  - Aircraft requirements (Certification basis, # crew, etc)

Section 2 - Basic Proposal Info

- Who can participate

  - Graduate/undergraduate

  - Team size should be limited to about ten people

  - One proposal per team, unlimited teams per school

  - Any rules regarding design project as a part of curriculum

  - Instructions on withdrawal from competition

- General RFP Data Requirements

  - Schedule (RFP, Letter of Intent, RFIs, Submittal, Awards)

  - Points of contact (AHS only)

  - Required elements (Executive Summary, Compliance Matrix, etc)

  - Number of Pages (total, per section, etc)

  - RFP delivery (number of copies, where, when)

- Data Requirements

  - Required description of design (drawings, structural design, etc)

  - Attributes data (weights, performance, stress, cost, etc)

  - Format for attributes (weights statement, payload-range, etc)

  - Substantiation (methodology & assumptions)

  - Proposed manufacturing approaches (if applicable)

- Basis for Judging - Weighting Factors

  - Technical / Organization / Originality / Application & Feasibility

  - Written (& Oral?) Presentations

Section 3 - Definitions & References

- Basic cost methodology

- Mission-specific data references (NASA reports, AHS Papers, etc)

## **Judging Criteria (Weighting Factors)**

### Technical Content (40 points)

- Design meets RFP technical requirements
- Assumptions clearly stated and logical
- All major technical issues considered
- Appropriate trade studies performed to direct the design process
- Well balanced and appropriate substantiation of complete system
- Technical drawings accurately describe the complete aircraft and its subsystems

### Organization & Presentation (15 points)

- Self contained Executive Summary that contains all pertinent information and makes a compelling case for why the proposal should win.
  - Introduction clearly describes the major features of the proposed aircraft
  - All pertinent and required information included and easy to find
  - Continuity of topics
  - Figures, graphs and tables are uncluttered and easy to read and understand
  - All previous relevant work cited
  - Overall neatness of report
- ### Originality (20 points)
- Treatment of problem shows imagination
  - Aircraft concept shows originality
  - Unique vehicle attributes and subsystem integration show innovative thinking
  - Overall vehicle aesthetics

### Application & Feasibility (25 points)

- Current and advanced technology levels used are justified and substantiated.
- How affordability considerations influenced the design process.
- How reliability and maintainability features influenced the design process.
- Manufacturing methods and materials are considered in the design process.
- Proposal shows an appreciation of how the vehicle will be used by the operator.
- Consideration of additional applications and capabilities other than those in the RFP.

## **Judging Package**

Judging Instructions & Schedule

Judging Criteria/Weighting Factors

Technical / Organization / Originality / Application & Feasibility

Written & oral presentations (if appropriate)

Scoring sheet

RFP

Proposals

## Appendix A – Summary of Prior AHS Student Design Competitions

	<b>Proposal</b>	<b>Submittal</b>	<b>Sponsor</b>	<b>Topic</b>	<b>Inspiration</b>
1st	1983	1984	Boeing	Combat Search & Rescue	LHX Utility
2nd	1984	1985	Boeing	Sport Helicopter Kit	
3rd	1985	1986	Hughes	One-Man Rotary-Wing Racer	
4th	1986	1987	Bell	Low Cost Commuter Tiltrotor	CTR
5th	1987	1988	Sikorsky	Heavy-Lift Helicopter	ACA
6th	1988	1989	MDHS	Light Utility Helicopter	MDX
7th	1989	1990	Boeing	Surveillance RPV	TRUS
8th	1990	1991	Bell	High Speed VTOL	NASA HSR
9th	1991	1992	Sikorsky	VTOL Package Express	S-92
10th	1992	1993	MDHS	Army Attack Rotorcraft	FAAV
11th	1993	1994	Boeing	Dual Use MLR	MLR
12th	1994	1995	Bell	UAV	Eagle-Eye
13th	1995	1996	Sikorsky	Fire-Fighting Helicopter	S-92
14th	1996	1997	MDHS	V-22 Escort	MAMBA-V
15th	1997	1998	Boeing	Civil Rotorcraft Family	Model 609
16th	1998	1999	Bell	High-Speed VSTOL	
17th	1999	2000	Sikorsky	Personal Transport VTOL Planetary Surface Explorer	NASA PAVs MARS Pathfinder
18th	2000	2001	Boeing	Search & Rescue	Perfect Storm
19th	2001	2002	Bell	Light Helicopter Upgrade Program	206B+
20th	2002	2003	Sikorsky	High Rise Emergency Rescue	September 11th
21st	2003	2004	Agusta	Design for Certification Mountain	A109K2
22nd	2004	2005	Boeing	Heavy Lift VTOL Acft	Heavy Lift
23rd	2005	2006	Bell	2-Place Turbine Training Helicopter	Turbine
24th	2006	2007	Sikorsky	Advanced Deployable Compact Rotorcraft in Support of Special Operations Forces	
25th	2007	2008	Eurocopter	Advanced VTOL Concept SMART-COPTER	
26th	2008	2009	AgustaWestland	Non-Conventional Rotor Drive	
27th	2009	2010	Boeing	Lift! More Lift!	
28 <sup>th</sup>	2010	2011	Bell	Multi-Mission Aircraft	
29 <sup>th</sup>	2011	2012	Sikorsky	Rotary Wing Pylon Racer	
30 <sup>th</sup>	2012	2013	Eurocopter	The HealCopter	2008 China Earthquake

## Student Design Competition Past Winners

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### 2012 Sponsor – Sikorsky Aircraft Corporation

**Project** - To design a purpose built helicopter to race on a prescribed pylon course. Graduate students were also required to submit a simulation package with a video.

**Winners** - The University of Maryland placed first in the graduate category with their entry [Dart T690/E550](#) (PDF 3MB); a video of the flight simulation of the UMD Dart can be found on the [AHS YouTube Channel](#). Georgia Institute of Technology/Liverpool captured second place with their Advanced Racing Concept ([ARC](#)) (PDF 15MB); a video of the flight simulation of the ARC can also be found on the [AHS YouTube Channel](#). First place undergraduate went to Georgia Institute of Technology/Middle East Technical University with [BADGER](#) (PDF 4.5MB). The Pennsylvania State University came in second with [Altair](#) (PDF 2MB).

### 2011 Sponsor – Bell Helicopter Textron

**Project** - To design a multi-mission vertical lift system that optimally blends the competing requirements of three very different missions – Search and Rescue, Insertion and Resupply. The aircraft must be reconfigurable.

**Winners** - The University of Maryland's [Excalibur](#) (PDF 7MB) came in first-place in the graduate category, with Georgia Institute of Technology / University of Liverpool's [Odyssey](#) (PDF 6MB) capturing second-place. In the undergraduate category, Georgia Institute of Technology's [Golden Retriever](#) (PDF 3MB) won first place and The Pennsylvania State University's [Phoenix](#) (PDF 3MB) came in second. Indian Institute of Technology, Kanpur captured the prize for best new entry with [RC2](#) (PDF 16MB).

### 2010 Sponsor – The Boeing Company

**Project** -- To design a technology demonstrator multi-lift system such that two rotorcraft could be cooperatively operated and lift 75% more payload than either aircraft. Graduate students were also challenged to design and conduct a flight test program for their system.

**Winners** -- The University of Maryland's Goliath came in first-place in the graduate category, with Georgia Institute of Technology's Thor capturing second-place. In the undergraduate category, The Pennsylvania State University's SPARCL won first place and Rensselaer Polytechnic Institute with GunSmash and the Atlas came in second. M.S. Ramaiah Institute of Technology (India) captured the prize for best new entry with Silver.

### 2009 Sponsor – AgustaWestland

**Project** – to design a rotor/drive system which could include NOTAR, or Fenestron, tandem rotor or coaxial rotor or even an intermeshing rotor (synchropter) configuration. The purpose of this year's competition was to design a new, non-conventional rotor drive system for a helicopter .

**Winners** – Georgia Institute of Technology and Liverpool University came in first place in the 27th Student Design Competition graduate category and the University of Maryland captured second place honors. In the undergraduate category, Georgia Institute of Technology Blue Team won first-place and the Pennsylvania State University came in second. Nanjing

University of Aeronautics and Astronautics captured the prize for the best new entry.

### 2008 Sponsor – Eurocopter

**Project** – to design of an advanced VTOL concept capable of operating from an unprepared area and which minimizes energy consumption throughout the operational envelope.

**Winners** – the team of University of Maryland and Korea's Konkuk University (Volterra - The Era of Green came in first place while the Georgia Institute of Technology captured second place honors. First place in the undergraduate category was bestowed upon the Pennsylvania State University with second place going to Georgia Institute of Technology. The "Best New Entrant" was Turkey's Middle East Technical University.

### 2007 Sponsor – Sikorsky Aircraft Corp.

**Project** — to develop an Advanced Deployable Compact Rotorcraft in Support of Special Operations Forces.

**Winners** — Georgia Institute of Technology came in first place while the University of Maryland captured second place honors. First place in the undergraduate category was bestowed upon the team of Pennsylvania State University and Technion — Israel Institute of Technology with second place going to Georgia Institute of Technology. The "Best New Entrant" was Pennsylvania State University and Technion — Israel Institute of Technology.

### 2006 Sponsor – Bell Helicopter Textron, Inc.

**Project** - To develop a two-place single turbine engine training helicopter that was affordable.

**Winners** - Georgia Institute of Technology came in first place in the graduate category while the University of Maryland captured second place honors. First place in the undergraduate category was bestowed upon the team of Pennsylvania State University and Technion – Israel Institute of Technology with second place going to the Royal Melbourne Institute of Technology Team. The "Best New Entrant" was Istanbul Technical University.

### 2005 Sponsor – The Boeing Co.

**Project** - To develop the conceptual design of a modern military Heavy Lift VTOL aircraft. The aircraft had to be designed to operate from existing naval ships and be able to transport a 20-ton FCS combat-ready vehicle.

**Winners** - University of Maryland came in first place in the graduate category and Georgia Institute of Technology captured second place honors. The University of Alabama Huntsville won as the "Best New Entrant" category. In the undergraduate category, Rensselaer Polytechnic Institute won first-place and the Royal Melbourne Institute of Technology came in second.

### 2004 Sponsor - AgustaWestland

**Project** - To develop a helicopter specifically designed for high altitude rescue operations. The aircraft had to be certified for single pilot, day/night operations with cruise speeds of at least 145 knots.

**Winners** - University of Maryland came in first place in the graduate category and Georgia Institute of Technology captured second place honors. The US Air Force Institute of Technology won third place as well as the "New Entrant" category. In the undergraduate category, Embry-Riddle Aeronautical University won first-place.

#### **2003 Sponsors - Sikorsky Aircraft Corp. and NASA**

**Project** - To design a VTOL urban disaster response vehicle for high rise firefighter deployment, rooftop occupant extraction, disaster command and control and other emergency response missions.

**Winners** - University of Maryland came in first place in the graduate category and Georgia Institute of Technology captured second place honors. In the undergraduate category The Pennsylvania State University won first-place with Rensselaer Polytechnic Institute coming in a close second and Iowa State University placing third.

#### **2002 - Sponsor - Bell Helicopter Textron, Inc.**

**Project** - To upgrade and remanufacture a 4-6 place turbine helicopter for commercial applications, that can operate at 140 Kt cruise speed and have a range of 400nm.

**Winners** - The first-place winner in the graduate category was the University of Maryland and Georgia Institute of Technology came in second. Rensselaer Polytechnic Institute captured first-place honors in the undergraduate category

#### **2001 - Sponsor - Boeing Philadelphia**

**Project** - To develop a VTOL platform with an innovative method of controlling the cyclic pitch of the rotor blades. Methods that do not depend upon the use of traditional swashplate mechanisms were sought.

**Winners** - The first-place winner in the graduate category was the University of Maryland and Georgia Institute of Technology came in second-place.

#### **2000 - Sponsors - Sikorsky Aircraft Corp. and NASA**

**Project**- To develop an autonomous rotorcraft for exploration of Mars. The mission was to be a proof-of-concept demonstration for rotary wing flight in the Martian atmosphere.

**Winners**- Georgia Institute of Technology took first place honors in the Graduate Propulsion System and in the Graduate Flight Computer competitions as well as a second place in the Graduate Vehicle Design category. Pennsylvania State University captured first place honors in the Undergraduate Vehicle Design section and the University of Maryland won first place in the Graduate Vehicle Design portion of the competition.

#### **1999 - Sponsor - Bell Helicopter Textron**

**Project**- To develop a VTOL four-to-six place aircraft minimizing the the number of man hours required to fabricate the components.

**Winners**- The University of Maryland won 1st Place in the graduate category and Rensselaer Polytechnic Institute won first place in the undergraduate division. The U.S. Naval Postgraduate School took second in the graduate category.

Second place in unsegraduate category and Best New Entrant was given to Princeton University.

#### **1998 - Sponsor - Boeing Philadelphia**

**Project**- To develop a modern 12-seat civil VTOL transport rotorcraft with the capability to grow to 19 seats with minimum changes.

**Winners**- The University of Maryland won 1st Place in the graduate category and Rensselaer Polytechnic Institute won first place in the undergraduate division. The U.S. Naval Postgraduate School and Pennsylvania State University took second place in the graduate and undergraduate categories.

#### **1997 - Sponsor - Boeing Mesa**

**Project**- To develop the conceptual design of a VTOL aircraft which could serve as an armed escort for the V-22 high-speed rotorcraft.

**Winners**- Georgia Institute of Technology won first place in the graduate category and the U.S. Military Academy won first in the undergraduate division. The U.S. Naval Postgraduate School and Pennsylvania State University took second place in the graduate and undergraduate categories.

#### **1996 - Sponsor - Sikorsky Aircraft Corp.**

**Project**- A cost-effective, dedicated fire fighting rotorcraft that could best perform a 200 acre, 10 hour forest fighting job for the least overall cost.

**Winners** - Georgia Institute of Technology and the U.S. Naval Postgraduate School placed first and second in the graduate category, and Pennsylvania State University and the U.S. Military Academy tied for first place in the undergraduate category. Rensselaer Polytechnic Institute placed second in the undergraduate category.

#### **1995 - Sponsor - Bell Helicopter Textron, Inc.**

**Project**- A UAV capable of extracting two people, delivering a payload capsule weighing up to 400 lbs., and equipped with video surveillance.

**Winners** - The U.S. Naval Postgraduate School and Georgia Institute of Technology placed first and second in the graduate category, and Georgia Institute of Technology and the U.S. Military Academy placed first and second in the undergraduate category.

#### **1994 - Sponsor - Boeing Helicopters**

**Project**- VTOL system with dual-use applications as a civil transport and as a troop assault vehicle.

**Winners** - Georgia Institute of Technology and the US Naval Postgraduate School placed first and second in the graduate category and the US Military Academy placed both first and second in the undergraduate category.

#### **1993 - Sponsor - McDonnell Douglas Helicopter Systems**

**Project**- Scout Reconnaissance

**Winners** - US Naval Postgraduate School and Arizona State University placed first and second in the graduate category and the US Military Academy placed both first and second in the undergraduate category.



1992 - Sponsor - Sikorsky Aircraft

**Project-** VTOL Package Express Aircraft

**Winners** - Georgia Institute of Technology and Rensselaer Polytechnic Institute. Penn State placed first and second in the undergraduate categories

**1991 - Sponsor - Bell Helicopter Textron, Inc.**

**Project-** High Speed VTOL

**Winners** - Georgia Institute of Technology in all categories

**1990 - Sponsor - Boeing Helicopters**

**Project-** Remotely Piloted Surveillance Vehicle

**Winners** - Georgia Institute of Technology in all categories

**1989 - Sponsor - McDonnell Douglas Helicopter Systems**

**Project-** Light Utility Helicopter

**Winners** - Georgia Institute of Technology in all categories

**1988 - Sponsor - Sikorsky Aircraft**

**Project-** Heavy Lift Helicopter

**Winners** - Georgia Institute of Technology placed first and second, University of Maryland placed third

**1987 - Sponsor - Bell Helicopter Textron, Inc.**

**Project-** Low Cost Tilt Rotor for Commuter Operations

**Winners** - Georgia Institute of Technology placed first and second, Rensselaer Polytechnic Institute placed third.

**1986 - Sponsor - Boeing Helicopters**

**Project-** One Man Rotary Wing Racer

**Winners** - Georgia Institute of Technology in all categories

**1985 - Sponsor - Boeing Helicopters**

**Project-** Sport Helicopter for Home Construction

**Winners** - Georgia Institute of Technology 1st and 2nd Place- Penn State 3rd Place

**1984 - Sponsor - Boeing Helicopters**

**Project-** Combat, Search and Rescue

**Winners** - Rensselaer Polytechnic Institute & Georgia Institute of Technology

## Student Design Competition Steering Committee

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