Collegiate Design Series News

Volume 3, Issue 11 November 2006

Issue Highlights

NASA Systems Engineering Award

Introduction

This is a unique opportunity to professionally interact with NASA engineers!

NASA believes in the value that hands-on engineering challenges provide to students. NASA is proud to partner with SAE's Aero Design competition to introduce the new NASA Systems Engineering Award.

The NASA Systems Engineering Award will give students participating in the SAE Aero Design competition an additional opportunity to compete in applying best engineering practices to the design and development of their aircraft. Participation in the NASA competition is optional.

The best practices are a subset of NASA Systems Engineering principles. The NASA competition will include key decision points as outlined in two written documents. Both documents will detail the systematic tracking, control, and integration of the project's design, construction, and implementation.

The first document, the Project Readiness Review/Preliminary Design Review (PRR/PDR) will be limited to three pages in length. The PRR/PDR will be submitted during the design phase of the Aero Design competition and will be evaluated by NASA systems engineering experts. Each team that submits a PRR/PDR will receive feedback and will be expected to address this feedback during the remainder of the design and development of their aircraft.

The second document, the Systems Engineering Report, will consist of four pages containing a "lessons learned" summary, a configuration management list, a risk matrix, and an interface list. Teams will have the opportunity to consult with NASA experts via on online forum. Participating teams will be evaluated by NASA personnel. One $750 award will be given to the winning team at Aero Design East, and another $750 award will be given to the winning team at Aero Design West.

The purpose of this award is to engage students in the systems engineering process. Although not always taught in traditional engineering programs, systems engineering is integral to industry and research in the real world. Because many students lack the level of systems engineering experience necessary, engineering firms and research institutions invest vast resources in systems engineering training and courses to bring early-career employees up to speed. NASA wants to expose more of today's engineering students to systems engineering concepts and practice; this new award is one approach to reaching that goal.

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Overview of NASA Systems Engineering

Continued from page 1

Systems engineering is a logical set of grouped processes performed by multidisciplinary teams to engineer and integrate systems to ensure products meet customers' needs. The logical set of grouped processes forms a systems approach to meeting an organization's development goals. Implementation of this systems approach will enhance an organization's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost. This systems approach is applied to all elements of a system and all hierarchical levels of a system over the complete project life cycle.

The engineering of complex systems requires the application of a systematic, disciplined engineering approach that is quantifiable, recursive, iterative, and repeatable for the development, operation, maintenance, and disposal of systems integrated into a whole throughout the life cycle of a project or program. The emphasis of systems engineering is on safely achieving stakeholder functional, physical, and operational performance requirements in the intended-use environs over the system's planned life within cost and schedule constraints.

A systems engineering plan implements a core set of common technical processes and requirements needed to define, develop, realize, and integrate the quality of the system products created and acquired by or for an organization. Systems engineering processes build upon and apply best practices and lessons learned from NASA, as well as other governmental agencies, academia, trade associations, and industry to clearly delineate a successful model to complete comprehensive technical work, reduce program and technical risk, and improve mission success. The set of common processes may be supplemented and tailored to achieve specific project requirements.

Document Format

The NASA Systems Engineering Award requires two separate documents. Both documents should follow the following format specifications.

Electronic Report Format

The Project Readiness Review/Preliminary Design Review (PRR/PDR) and Systems Engineering Report should be submitted in PDF format only. Supporting documentation (images, graphs, CAD drawings, etc.) may be submitted in PDF or JPG format only.

Font

The minimum size type is 12 point proportional or a 10-character-per-inch nonproportional font.

Margins

1" left; ½" right, top, and bottom

Page Size

All report pages will be ANSI A (8 ½ x 11 inches) page format.

Cover Page

All documents must feature a cover page that states the team's name, school, and team number. The cover page will not count against the page limit.

PRR/PDR Specifications

Page Limit

The PRR/PDR must not exceed three (3) double-spaced, typewritten pages. Supporting documentation (images, graphs, CAD drawings, etc.) may be included without counting against the 3-page limit. If the typewritten report exceeds three (3) pages, the judges will only read the first three pages. NASA reviewers will provide feedback on all submissions.

Content Outline

The PRR/PDR document should address the topics and follow the outline below.

I. Requirements Analysis

a. This paragraph or sketch should provide a top-level approach the team will take in meeting the requirements. Describe top-level relationships (power, weight, volume, etc.) Include your top-level strategy in designing and building your entry.

II. Design Options Considered

a. This paragraph, sketch, or drawings should enumerate the different design approaches considered: materials, structures, shapes, trade-offs, etc.

III. Tests Conducted/Planned

a. This paragraph, sketches, or notes should discuss what kind of tests your team plans to do: wind tunnels, loads, form and fit tests, mockups, etc.

IV. Algorithms/Formulas/Constraints in Consideration/Used

a. This paragraph should indicate what types of constraints are being incorporated, such as size, weight, power, etc., other than what the rules specify. Also indicate if your team is using any formulas to derive shapes, sizes, forms, etc. in designing and/or building the vehicle.

V. Current Design Concepts/Preliminary System Characteristics

a. This section can consist of annotated sketches or drawings of the current vehicle design you plan to build. Use the list below as a guide.

1. Weight
2. Structure Details
3. Materials
4. Propulsion
5. Power
6. Avionics
7. Landing Gear
8. Control Systems
9. Navigation
10. Communications

VI. Work Breakdown Structure (WBS): Project Tasks and Personnel Assignments

a. This section should address the major parts of the vehicle and support equipment broken out into a list. Name of team member(s) who is responsible for any significant tasks (design, manufacturing, testing) should be next to each item on the list.

VII. Schedule: Initial, Top Level, Planned Schedule

a. A simple set of milestones indicating when the WBS items are planned to be completed.

VIII. Project Costs: Current Estimates

a. An estimate for the hardware, software, and services required to purchase by the WBS.

IX. Risks: Current Top 5–10 Project Risks

a. This is a list of risks that the team faces in designing, building, flying and submitting the aircraft and documents for the competition. It should be ranked from first being the highest risk to the last being the lowest risk. See PowerPoint charts (PDF document entitled *Risk_Mgmt_Info.pdf*) for Project Risk Definitions and the Project Risk Management Matrix template.

Systems Engineering Report

Page Limit

The Systems Engineering Report must not exceed four (4) double-spaced, typewritten pages. Supporting documentation (images, graphs, CAD drawings) may be included without counting against the 4-page limit. If the typewritten report exceeds four (4) pages, the judges will only read the first four pages.

Content Outline

The Systems Engineering Report document should address the topics and follow the outline below.

I. Lessons Learned

a. This page should describe in detail the lessons learned throughout the design and development of the aircraft for the competition.

II. Configuration Management List and Changes Since PRR/PDR Feedback

a. Change Request (CR) Title
   i. Short descriptive name/title of request (Example: Wing Performance Shortfall)

b. Change Request Item
   i. Process, organization, or components affected (Example: wing design)

c. Reason for Change
   i. Why the items require a change (Example: insufficient lift generated)

d. Recommended Action/Change
   i. Provide specific course of action to be approved (Example: redesign wing by increasing length)

e. Impact to Other Systems (WBS components)
   i. Enumerate impact to other systems/processes if CR is implemented (Example: weight increase and sufficient structure strength)

f. Cost and Schedule Impact

g. Impact if CR Not Approved

h. Status

i. Owner

III. Risk Matrix

a. Re-address the list of risks submitted in the PRR/PDR. How were these risks handled/overcome? Also discuss unexpected risks and how they were or were not abated.

IV. Interface List

a. Component 1: Name of part/entity

b. Component 2: Name of part/entity

c. Interface Type: Mechanical, structural, electrical, software module,tactile, etc.

d. Implementation Approach: Bolt and washer, adhesives, coupler, etc.

e. Constraints or Issues: Manufacturing, responsibilities, schedule restraints, etc.

Deadlines

Aero Design West
Deadline for PRR/PDR submission: January 12, 2007
Deadline for Systems Engineering Report: March 9, 2007

Aero Design East
Deadline for PRR/PDR submission: February 23, 2007
Deadline for Systems Engineering Report: April 27, 2007

Submission

Documents should be submitted via email:

Aero Design West teams submit to nasa_ad_west@nx.arc.nasa.gov
Aero Design East teams submit to nasa_ad_east@nx.arc.nasa.gov

The PRR/PDR and the Systems Engineering Report should be in PDF format. Any supplemental documentation (images, graphs, CAD drawings, etc.) should be in PDF or JPG format and no larger that 20 MB. Teams must use the below naming conventions for their files:

PRR/PDR

TeamNumber_TeamName_PRR.pdf

Systems Engineering Report

TeamNumber_TeamName_SER.pdf

Supplemental Documentation

TeamNumber_TeamName_SD1.pdf, TeamNumber_TeamName_SD2.pdf, etc.
OR
TeamNumber_TeamName_SD1.jpg, TeamNumber_TeamName_SD2.jpg, etc.

Forum

Teams may post their systems engineering questions and comments to the SAE Aero Design Forum at http://forums.sae.org/access/dispatch.cgi/aerodesign_pf.

Evaluation

NASA judges will review and provide feedback on PRR/PDRs; however, the PRR/PDRs will not be scored. The purpose of the PRR/PDRs is to provide the teams with meaningful feedback and experience with the preliminary design review process. The Systems Engineering Report will be scored. NASA judges will consider the following requirements to determine the winning teams.

- Submission of PRR/PDR
- Systems Engineering Report (4 parts)
  - Lessons Learned
  - Configuration Management List
  - Risk Matrix
  - Interface List
- Visual Verification at competition (the aircraft is built as designed)

Award

One $750 award will be given to the winning team at Aero Design East and one $750 award will be given to the winning team at Aero Design West. In addition, special NASA commemorative awards will be given to each of the winning teams.

Resources

For more information on NASA's Systems Engineering Process, please reference this website:

http://quest.nasa.gov/projects/aerodesign/

This award is sponsored and managed by NASA's Aeronautics Research Mission Directorate (http://aeronautics.nasa.gov) in partnership with SAE.

Project Risk Management Slides

- The first slide, *Project Risk Definitions*, is a reference intended to provide instructions and definitions related to risk management. The slide is based on a risk assessment of the NASA SOFIA aircraft. This slide will help your team define and evaluate your risks.
- The second slide, *Example Project Risk Management Matrix*, is an example of what your team should create and submit as item **IX** in the PRR/PDR document.

NASA Systems Engineering Award

Project Risk Definitions

2007 SAE Aero Design Competition

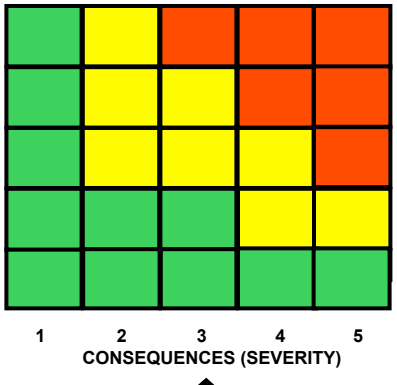
DEFINITIONS:

RISK MANAGEMENT: An organized, systematic decision-making process that efficiently identifies risks, assesses or analyzes risks, and effectively reduces or eliminates risks to achieving program goals.

RISK: A Program "Risk" is any circumstance or situation that poses a threat to: crew or observatory safety, Program controlled cost, Program controlled schedule, or major mission objectives, and for which an acceptable resolution is deemed unlikely without a focused management effort.

PROBABILITY	*What is the likelihood the situation or circumstance will happen?*			
	Level	*Probability*	*Probability (Safety)*	*. . . or—the current process . . .*
	5	Near Certain 80–100%	Likely to occur immediately (X > 10-1)	cannot prevent this event, no alternate approaches or processes are available.
	4	Highly Likely 60–80%	Probably will occur in time (10-1> X > 10-2)	cannot prevent this event, but a different approach or process might.
	3	Likely 40–60%	May occur in time (10-2> X > 10-3)	may prevent this event, but additional actions will be required.
	2	Low Likelihood 20–40%	Unlikely to occur (10-3> X > 10-6)	is usually sufficient to prevent this type of event.
	1	Not Likely 0–20%	Improbable to occur (10-6> X)	is sufficient to prevent this event.

SOFIA Risk Matrix



LEGEND

- High - Implement new process(es) or change baseline plan(s)
- Med - Aggressively manage; consider alternative process
- Low - Monitor

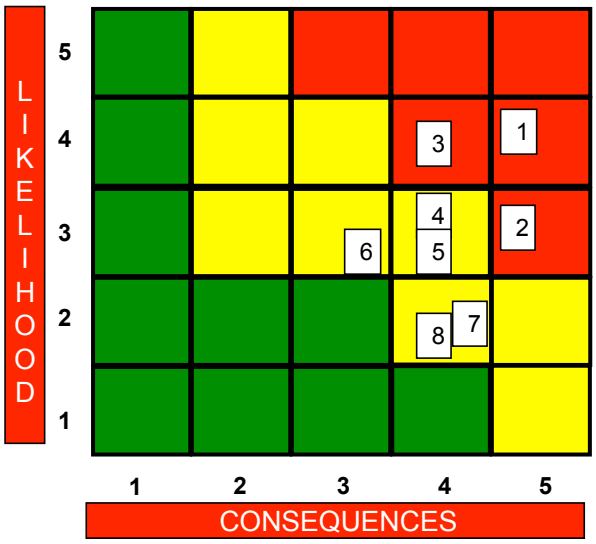
Consequences	*Given the event occurs, what is the magnitude of the impact to the SOFIA Program? . . .*					
	Level →	1	2	3	4	5
	Technical	Minimal or No Impact	Mod. Reduction, Same Approach Retained	Mod. Reduction, But Workarounds Available	Major Reduction, But Workarounds Available	Unacceptable, No Alternatives Exist
	Schedule	Minimal or No Impact	Additional Activities Required. Able to Meet Need Dates	Level 2 Milestone Slip of ≤ 1 Month.	Level 2 Milestone Slip of >1 Month, or Program Critical Path Impacted	Cannot Achieve Major Program Milestone
	Cost	Minimal or no Impact	Individual System Budget Increase of <5%	Individual System Budget Increase between 5%-10% or Program Budget Increase of >2%	Individual System Budget Increase of >10% or Program Budget Increase of >5%	Individual System Budget Increase of >15% or Program Budget Increase of >10%

NOTE: Technical includes everything that is not cost and schedule: e.g., safety, operations, quality of science, programmatic, etc.

NASA Systems Engineering Award

2007 SAE Aero Design Competition

Example Project Risk Management Matrix



Criticality	L x C Trend	Approach
High	⇩ Decreasing (Improving)	M - Mitigate
Med	⇧ Increasing (Worsening)	W - Watch
Low	⇨ Unchanged	A - Accept
	□ New Since Last Period	R - Research

Rank & Trend	Risk ID	Approach	Risk Title
⇨ 1	DFRC-34	R	Landing Gear Door System Failure
⇨ 2	DFRC-12	M	Sched Integration problems structure vs. avionics
⇨ 3	DFRC-07	W	Cost growth for engine components
⇨ 4	DFRC-24	A	Quality Control Resources insufficient
⇩ 5	DFRC-01	W	Avionics software behind schedule
⇩ 6	DFRC-11	R	Payload Capacity & Volume Trade-offs design issues
⇨ 7	DFRC-04	R	Limited Flight Envelope, due to technical issues
⇨ 8	DFRC-02	R	More flight testing may be required for Soft V&V

New Supplier Sponsor for 2007 Aero Design

ALL SAE AERO COMPETITION PARTICIPANTS
CASTLE CREATIONS SPECIAL OFFER

Castle Creations is pleased to offer our support for your competition. Our line of brushed and brushless motor controllers and 72 mHz receivers are very popular with experienced RC and UAV builders and designers.

We would like to offer you the ability to purchase our products at a very deep discount.

This offer is good only through direct purchases from Castle Creations, Inc., and the offer expires on May 31, 2007. Please call Christy Graham, at 913 390 6939 ext. 116 to place orders.

SAE AERO COMPETITION SPECIAL PRICING			
Pixie-7 or Pixie-7P	$10.00	Phoenix HV-110	$90.00
Pixie-20P	$15.00	Thunderbird-9	$12.00
Sprite-25 or Sprite-XLR	$25.00	Thunderbird-18	$15.00
Pegasus-35P	$25.00	Berg MS-4L Receiver	$15.00
Griffin-40	$25.00	Berg MS-4 Receiver	$20.00
Griffin-55	$30.00	Berg 7 Channel Receiver	$30.00
Dragon-35	$40.00	Barracuda-80	$55.00
Dragon-55	$60.00	Barracuda-125	$75.00
Phoenix-10	$25.00	Mamba-25	$30.00
Phoenix-25	$25.00	Mamba-25/CM-20xx	$60.00
Phoenix-35	$30.00	Mamba-25/CM-2080	$70.00
Phoenix-45	$40.00	CM-2036 Motor	$30.00
Phoenix-60	$50.00	CM-2042 Motor	$30.00
Phoenix-80/80M	$55.00	CM-2054 Motor	$30.00
Phoenix-125	$70.00	CM-2068 Motor	$30.00
Phoenix HV-45	$55.00	CM-2080 Motor	$40.00
Phoenix HV-85	$70.00	Castle Link	$8.00

Please go to our web site at www.CASTLECREATIONS.com for full details on these products.

Note: Orders will only be shipped to the department head of your school.

Best of luck for your competition!

Team Castle

235 South Kansas Avenue
Olathe, Kansas 66061 USA
(913) 390-6939
(913) 390-6164
www.castlecreations.com

Have one sheet per team member with the below information.

Returning this sheet will speed up your onsite registration process

1. SAE Member number
2. Insurance Information: (Photo copy preferred)
   (Include; Company, Group number, ID number and a telephone number)
3. Photo copy of photo ID, Drivers MUST have a valid driver's license
4. Emergency Contact Information:
   (Include; Name, relationship and telephone number)
5. School Name
6. Email Address/Telephone Number

1. SAE number: 611124898
2. Highmark Blue Cross; ID # YBC999999999 99, Group # 27250000001, Telephone number 1-816-232-8396
3. See Copies Above
4. Angela Sample, mother, 920-845-7798
5. University of Nebraska
6. fsample@gmail.com; 920-845-7632

Hard copies (photo ID and insurance) must also be with you on-site.

FASE and BAJA SAE (events only):

These competitions may hold a pre-registration the night before the competition starts (pending on schedule posted), only teams who have submitted this document will be permitted to pre-register.

Return to: BY MARCH 1, 2007

Jessica Cutler (Aero, Baja, or Supermileage) to jcutler@sae.org

Kaley Shellhammer (FSAE, FSAE-West, Clean Snowmobile) to shellham@sae.org

Mail To: SAE International /Attn:-, 400 Commonwealth Dr, Warrendale, PA 15096

Washington Internships for Students of Engineering (WISE)

Who can apply:3rd & 4th year engineering students

Nomination deadline: December 31, 2006

Description: This program offers a unique opportunity for 3rd and 4th year engineering students, or recent graduates beginning study in an engineering policy-related Master's program, to spend the summer of 2007 in Washington, DC. Its goal is to groom future leaders of the engineering profession who are aware of and can contribute to the important intersections of technology and public policy. During the internships, students are under the guidance of a nationally prominent engineering professor. The interns learn how government officials make decisions on complex technological issues and how engineers contribute to legislative and regulatory public policy decisions. Throughout the 10 weeks, students interact with leaders in the Congress and the Administration, prominent non-governmental organizations, and industry. In addition, each student will research and complete a paper on a current and topical engineering-related public policy issue that is important to one of the seven sponsoring societies.

Submission: Visit http://www.sae.org/students/internships

SAE has college funds available for your son or daughter

SAE is accepting applications for the scholarships and loans listed below. Details and applications are available on the SAE Web site at www.sae.org/students/scholarships.

Ralph K. Hillquist Honorary SAE Scholarship - A $1,000 nonrenewable scholarship will be awarded at the SAE Noise & Vibration Conference in 2007. Eligible applicants will be U.S. citizens enrolled full-time as a junior in a U.S. university as of October 1, 2006. A minimum 3.0 GPA with significant academic and leadership achievements is required. The student must also have a declared major in mechanical engineering or an automotive-related engineering discipline, with preference given to those individuals with studies/ courses in the areas of expertise related to noise and vibration (ex: statics, dynamics, physics, vibration). Application deadline: February 1, 2007

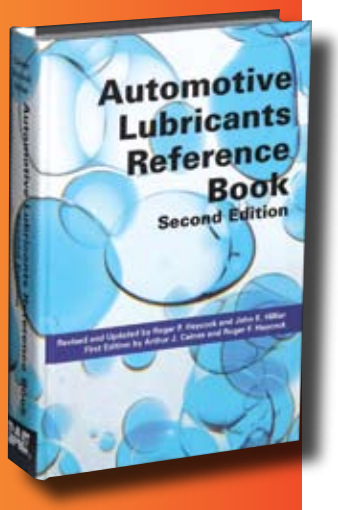
Yanmar/SAE Scholarship - This scholarship was established by the Yanmar Diesel America Corporation and awards a $2,000 scholarship to a student who is pursuing a course of study or research related to the conservation of energy in transportation, agriculture and construction, and power generation, with emphasis placed on research or study related to the internal combustion engine. Applicants must be citizens of North America. Application deadline: April 1, 2007

SAE Long Term Member Sponsored Scholarship - The scholarship continues to be supported through generous contributions from long-time members of SAE. Several $1,000 nonrenewable scholarships are awarded annually to SAE student members who actively support SAE, the collegiate chapter or the local SAE Section and its programs. Student grade point average is not a determining factor within the scope of this scholarship. Application deadline: April 1, 2007

William G. Belfry SAE Memorial Grant - Two $1,000 grants sponsored by the SAE Foundation Canada and the SAE Central Ontario Section are awarded annually. Eligible applicants will be citizens of Canada and will be juniors entering their senior year of full-time undergraduate engineering studies at a Canadian university. Application deadline: April 1, 2007

Siegel Service Technology Scholarships - Six $1,000 scholarships are available for second-year students enrolled at Montana Colleges who are pursuing careers in the mobility community and that demonstrate academic achievement and community spirit. A list of applicable colleges is available on-line. Contact the college guidance office for applications prior to April 1, 2007.

Doctoral Scholars Forgivable Loan – A number of $5,000/year forgivable loans are available for PhD students in North America who plan to teach engineering at the university level upon graduation. For each year of eligible teaching, one year's loan is forgiven. Applicants must be citizens of North America. Apply at http://students.sae.org/awdscholar/loans/ by April 1, 2007.



Automotive Lubricants Reference Book, Second Edition

By Roger Frederick Haycock, Arthur J. Caines, and John Hillier

The automotive lubricants arena has undergone significant changes since the first edition of this book was published in 1996. Environmental concerns have dominated both newspaper headlines and industry board rooms in recent years, with particular attention being given to the improvement of air quality. Reduced emissions are directly related to changes in lubricant specifications and quality, and the second edition of the Automotive Lubricants Reference Book reflects the urgency of these matters by including updated and expanded detail.

This second edition also considers the recent phenomenon of increased consolidation within the oil and petroleum additive arenas, which has resulted in fewer people for research, development, and implementation, along with fewer competing companies. Of significant importance is the consideration that a more consolidated oil industry -- in need of greater and longer-term returns on investments -- may be less apt to respond to automobile manufacturers' requirements for rapid specification changes.

The Automotive Lubricants Reference Book, Second Edition addresses these and many other important issues by providing a solid foundation to this important element of automotive engineering. Comprehensive and timely, this important publication is an ideal reference for anyone involved in the automotive lubricants industry.

Chapters include:

- Introduction and Fundamentals
- Constituents of Modern Lubricants
- Crankcase Oil Testing
- Crankcase Oil Quality Levels and Formulations
- Practical Experiences with Lubricant Problems
- Performance Levels, Classification, Specification, and Approval of Engine Lubricants
- Other Lubricants for Road Vehicles
- Other Specialized Oils of Interest
- Blending, Storage, Purchase, and Use
- Safety, Health, and the Environment
- The Future

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