

Singapore Space Challenge 2010

Version 1.0

ENGINEERING COMPETITION GUIDELINES

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INTRODUCTION

- 1. This Engineering Competition is designed and organized by the Singapore Space and Technology Association.**
 - 1.1. SSTA strives to promote the development of space technology and heighten the local awareness of the space industry.
 - 1.2. SSTA also organizes initiatives in space and related technology projects with the intention of jump-starting the space industry and further intensifying aerospace education in Singapore.
 - 1.2.1. This Singapore Space Challenge is one such initiative.

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OVERVIEW OF THE SPACE CHALLENGE

2. **2009/10 marks the launch of the third Singapore Space Challenge.**
 - 2.1. The aim of this Competition is to inspire space interests among the tertiary-education students and encourage participation in space related activities.
 - 2.2. SSTA also hopes to educate the public on the issues of space technology and exploration through this Competition.
 - 2.3. It is the primary goal of the Competition to promote technical and industrial research, challenge the thinking process and creativity of students, and at the same time, prove practicality as well as simplicity in engineering concept and design.
 - 2.4. The Competition also aspires to provide beneficial, practical and feasible solutions to the space industry in general.

TIMELINE

3. **TIMELINE**
 - 3.1. This Competition is open from 1 September 2009.
 - 3.2. All teams and entries must be registered with SSTA. Registration to this competition will be closed on 31 October 2009.
 - 3.3. The final submission of entries must be delivered to SSTA by 30 April 2010.
 - 3.4. Results will be published on the Competition website by end June 2010.
 - 3.4.1. Winners will be notified by mail.

RULES AND REGISTRATION

4. **RULES, TERMS AND CONDITIONS**
 - 4.1. This Competition is open globally to all tertiary-education¹ students, with the exception of the members of the Executive Committee of SSTA.
 - 4.2. Team submissions are limited to seven team members including one Team Manager. A minimum of 4 members are required to form a team.
 - 4.2.1. As the goal is to encourage awareness and interests in the space industry as well as to promote participation within the Singapore communities, the Team Manager must be a Singapore citizen or Singapore permanent resident.
 - 4.3. The teams do not have to be affiliated with an educational institution to participate.
 - 4.3.1. For teams associated to educational institutions, there is no limit to the number of entries from any educational institution.
 - 4.4. All submitted entries are the property of SSTA.
 - 4.4.1. SSTA may elect to exhibit these entries at any events at its discretion, without a prior, written approval of the participating teams.
 - 4.5. SSTA has the final interpretation of the rules.
5. **REGISTRATION**
 - 5.1. All teams and entries must be registered with SSTA. Registration forms can be found [\[here\]](#).
 - 5.2. There is a nominal registration fee of \$15 per person to compete in this challenge.
 - 5.3. Registration to this competition will close on 31 October 2009.
 - 5.4. All registered entries will be published on the Competition website.

¹ Tertiary-education is typically of students within the age group of 15 to 25, but not exhaustively limited to this range. Please check with the organizers for competition eligibility.

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PRIZES

6. PRIZES

- 6.1. There will be one Grand Prize and up to two Merit Prizes on top of the national recognition, public exposure and media publicity.
- 6.2. Details of the prizes will be posted shortly.
- 6.3. All participants will be presented with a certificate of participation.
- 6.4. SSTA is the final authority on the judging (please refer to section [8] on judging criterion), and the award of prizes in this competition.
- 6.5. For a participating team which has clinched a Prize and is associated with an educational institution, the educational institution should ensure that the team will receive at least 50% of the monetary prize award.

DELIVERABLES AND JUDGING

7. DELIVERABLES

- 7.1. Completed and final entries must include a mission (project) paper and a computer simulation. A scaled 3-D mockup of the designed spaceplane is optional.
 - 7.1.1. The mission (project) paper is to be not more than 20 pages, inclusive of illustrations, graphics and schematics.
 - 7.1.2. A complete bibliography is also required.
 - 7.1.3. The computer simulation must show the spaceplane in action, be of good quality simulation and on a commonly-playable format, such as wmv, mov, avi, mpeg, mp4 or qt. Please check with the organizers for other allowable formats.
 - 7.1.4. The recommended length of the simulation is between 120 and 180 seconds.
- 7.2. Other additional deliverables are also encouraged to add value to the entry submission.
 - 7.2.1. These additional deliverables may include, but not limited to, full-colored posters and banners, and an interactive CD-ROM of the mission.
- 7.3. All final entries must be submitted to SSTA by 30 April 2010.
 - 7.3.1. See section [4.4] on the terms pertaining to the ownership of these deliverables.

8. JUDGING

- 8.1. Judging of the Competition is by a panel of professionals elected by SSTA.
- 8.2. The judging criterion is as follows:

Mission (Project) Paper	
Discussion Content, Idea and Creativity	30.0%
Calculations and Scientific Accuracy	20.0%
Technical Reporting, Illustrations and Graphics	15.0%
Computer Simulation	
Graphical Contents	15.0%
Graphical Aesthetics	12.5%
Others	
Additional Deliverables	7.5%
Total	100.0%

- 8.3. The Judges decision is final.

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MISSION OVERVIEW

9. MISSION OVERVIEW

- 9.1. The main objective of this Competition is to design a spaceplane for launch from a city in Southeast Asia.
- 9.2. The aim is for the spaceplane to carry at least two human passengers (including the pilot if required) to an altitude of 100 km above the Earth's sea level - the Kármán Line commonly used to define the Earth's atmosphere and outer space.
- 9.3. The spaceplane is to provide a unique tourism experience, but its design should be robust enough to accommodate for other future applications, such as for the launch of microsatellites, or for the conduct of microgravity experiments.

MISSION BACKGROUND

10. MISSION BACKGROUND

- 10.1. Space tourism today is a very expensive affair. Space tourists such as Dennis Tito and Mark Shuttleworth for instance have paid more than US\$20 million each for their visit to the International Space Station.
- 10.2. Having heard how lucrative the market could be if space travel were to be made more affordable, your team has come together to conceptualize and design a spaceplane to launch from Singapore or a nearby city in Southeast Asia. This will be for suborbital flight only.
- 10.3. The spaceplane has to reach a minimum altitude of 100km and a maximum of 102km above the Earth's sea level, and allow the tourist(s) at least the experience of two minutes of weightlessness in Space.
- 10.4. Your team is also keen to explore other possible markets/uses for the spaceplane outside of space tourism, such as microsatellite deployment, and would like to factor such considerations in the design of the first-generation spaceplane.

MISSION SPECIFICATIONS

11. SYSTEMS SPECIFICATIONS

- 11.1. The maximum take-off weight of the spaceplane must not exceed 12,500 kg.
- 11.2. The lifespan of the spaceplane has to exceed 10 years.
- 11.3. The design cost of the spaceplane must not exceed S\$500 million over 10 years.
- 11.4. The spaceplane must be able to support a minimum of 2 passengers (inclusive of Pilot), or a maximum of 3 passengers (inclusive of Pilot).
- 11.5. The spaceplane must sustain a total mission time of no less than 45 mins (+5 mins).
- 11.6. The spaceplane must takeoff from a runway length of between 6,000 to 8,000 feet.
- 11.7. The spaceplane must attain a minimum altitude of 100km and a maximum altitude ceiling of 102km.
- 11.8. The spaceplane must be designed with a payload delivery system to deploy a microsatellite not weighing more than 200kg.
- 11.9. The spaceplane must land with at least 1 engine on: Powered landing.
- 11.10. The spaceplane is designed to take-off from a commercial airport. Hence considerations of busy civilian/military air traffic must be taken into account. This might determine the optimum time of departure for the spaceplane.
- 11.11. The spaceplane should have a realistic flight profile that includes: a) Take-off, b) Initial Atmospheric Climb, c) Rocket burn trajectory to suborbital position, d) Re-entry, e) Landing.
- 11.12. Maintenance, repair and overhaul (MRO) of the spaceplane must be able to be carried out by existing MRO players in Singapore.
- 11.13. The spaceplane structure and integrity must be able to sustain the rigors of suborbital flight (e.g. stress patterns, heat, pressure, radiation etc).

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DELIVERABLES

12. STRUCTURE/AIRFRAME DESIGN

- 12.1. Mechanical design and concept
- 12.2. Material design and concept
- 12.3. Advanced surface design and concept
- 12.4. Space worthiness analysis
- 12.5. Drafting

13. AERODYNAMICS AND CONFIGURATION

- 13.1. Computational fluid dynamics (CFD) analysis
- 13.2. Advanced surface design
- 13.3. Reverse engineering
- 13.4. Product lifecycle management (PLM)
- 13.5. Drafting

14. PROPULSION SYSTEM DESIGN

- 14.1. Propulsion choice
- 14.2. Propulsion system design and concept

15. INTERIORS

- 15.1. Functional design and concept
- 15.2. Ergonomics

16. ANALYSIS AND SIMULATION

- 16.1. Structural analysis
- 16.2. Assembly analysis
- 16.3. Mechanisms
- 16.4. Fitting simulation

17. AVIONICS SYSTEMS & OTHERS (OPTIONAL)

- 16.1. Monitoring, communication and navigation systems
- 16.2. Electrical harness design
- 16.2. Piping/tubing design

OTHER CONSIDERATIONS

18. OTHER NON-QUANTIFYABLE SPECIFICATIONS

- 18.1. The launch, operations and maintenance of the spaceplane must provide unambiguous considerations to human safety, and as far as possible, prevent any harm to the earth and space environment.

ACRONYM GLOSSARY

19. ACRONYM GLOSSARY

SSC	Singapore Space Challenge
SSTA	Singapore Space and Technology Association

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FREQUENTLY ASKED QUESTIONS

20. FAQ

20.1. There are no inquiries presently.

CONTACTS

21. CONTACT EMAIL

21.1. All questions should be directed to Cammy Goh, Corporate Development Executive at this email address: ssc2010@space.org.sg

VERSION UPDATES

22. DOCUMENT UPDATES

22.1. There are no updates to Version 1.0 dated 1 September 2009.

ACKNOWLEDGEMENTS

23. ACKNOWLEDGEMENTS

- 23.1 The Competition organizers would like to express their thanks to Dassault Systèmes, and the Association of Aerospace Industries (Singapore).
- 23.2. Copyrights SSTA 2009/10.