Space Universities Network
Supporting the Space Higher Education Community

CASE STUDY

Title

AIAA CanSat project – University of Manchester

Summary

The Manchester CanSat Project was developed by a team of mainly 2nd and 3rd year undergraduate engineers. They took part in the 2017/18 AIAA & AAS CanSat competition held in Texas, USA, which they won. The team designed and built their CanSat to achieve the set mission of the competition over a year with help through funding from sponsors to pay for sub system components and travel costs. They developed review documents with progress through the year and performed a drop from a rocket to test the systems in the US, and then presented the outcomes of their test flight.

Manchester CanSat Project, winners of the AIAA & AAS CanSat competition

Aims/Objectives

Manchester CanSat AIAA & AAS team set out with the aim to finish in the top 5 teams in the AIAA competition to demonstrate the high calibre of the University of Manchester's students. It aimed to develop the team's spacecraft engineering skills such as design and manufacture, electronics and programming experience and teamwork skills. To do this they designed and built the CanSat to satisfy the mission requirements set by the competition. This included designing the structure, the sensing systems, a release mechanism, a deployable heat shield and also creating preliminary and critical design reviews as well as a post flight review, thus developing their critical analysis and presentation skills.

What was the context / background?

Manchester CanSat Project competed in the AIAA & AAS competition in 2016 initially and placed 6th, they

decided to compete again with the aim to do better. They competed as they were attracted by the challenge of designing a miniature satellite to very tight requirements and high complexity giving the team a chance to display their abilities in a relevant and practical way whilst developing their space engineering skills. The setup of the society in 2016 was built upon further in the 2017/2018 year as a means to carry over the expertise and knowledge so as to be useful for future iterations of the project. This gave a solid foundation for their work in this competition.

How was it organised and who was involved?

This project and team was organised as an extra-curricular activity within the ManSEDS society (SEDS=Students for the Exploration and Development of Space). It had assistance and leadership from a staff member at the University of Manchester, Dr Kate Smith -senior lecturer in Aerospace Engineering. Organisation of the project consisted of:

- Organising student selection for the Manchester CanSat project (10 students maximum)
- Initial design proposals
- Selecting components and costing
- Organising funding from sponsors in October 2017
- Completing the application form by the end of November 2017
- Completing the Preliminary Design Review by the start of January 2018
- Completing a Critical Design Review by the end of March 2018
- Completing of the flight test and Post Flight Review in June 2018 in Texas

What resources did you need?

Financial:

Entry into the competition was approximately £75

A budget of £2000 was set using the previous year's costs as a guide and split equally for a flight and backup model of the CanSat. The budget of £1000 for each model allowed the materials and components to be obtained to be of a very high standard.

Travel accommodation and visa related costs totalled £10050 which covers the cost of sending 10 individuals to Texas and stay for 4 days.

Facilities and Academic Support:

The academic supervisor provided guidance and support with administration and organisation.

Use of Faculty machinery including, 3D printers for manufacturing, a PCB machine for manufacturing the circuit boards as well as soldering irons and a laser cutter. Faculty workshops and standard wood working tools were also used.

Describe the activity

The American Astronautical Society (AAS) runs the CanSat competition annually and spans 2 terms over the year with the aim to give students an opportunity to do an end to end life cycle of engineering product as opposed to just designing a space related product without any building or testing. The competition specifically is based on designing and building a satellite that fits within the size of a soda can. The requirements for 2017/18 included:

- The CanSat must act as a space probe entering planetary atmosphere

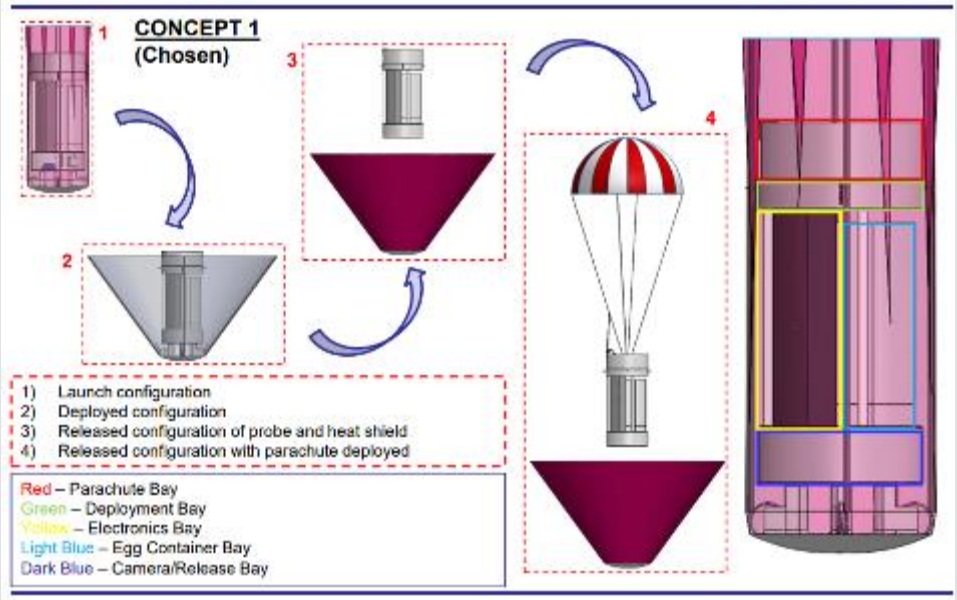
- It must carry a single large hen's egg which must survive all portions of flight
- It must operate in the following manner:
    1. The probe is launched to an altitude of 670 meters to 725 meters and then deployed from the rocket. Orientation of deployment is not controlled and is most definitely violent.
    2. Once deployed, the probe shall open an aero-braking heat shield. The descent rate shall be kept at 10 to 30 meters/sec. The aero-braking probe must maintain a stable orientation with the heat shield facing the direction of descent during descent. Tumbling is not allowed. Active control surfaces or other non-pyrotechnic mechanisms can be used to maintain orientation.
    3. At an altitude of 300 meters, the probe shall release the aero-braking heat shield and simultaneously deploy a parachute to reduce the descent rate to 5 meters/sec.
    4. The probe shall land leaving the egg intact.
- The probe shall include sensors for tracking altitude using air pressure, external temperature, battery voltage and GPS position.
- A compartment shall be included to hold a large hen's egg.
- The purpose of the egg is to simulate a delicate instrument

(These requirements are taken from the CanSat Competition Mission website)

Teams must follow the procedure given in the competition: Mission Guide - Oct 20, 2017 of conducting a Preliminary and Critical Design review and give a Post Flight review following a test launch in Texas.

After completing the application form and initial designs, the Preliminary Design Review was completed on the 2nd of January. This reviews the design, trade-offs and how well the design meets the requirements. The design was presented over a 30-minute presentation to judges of the competition through a teleconference.

The Critical Design Review was due by March 29 and was similar in format to the PDR but contained details of how the systems were fabricated, tested and evidence that the design will meet all the requirements set. This implied that in those 3 months, key components of the design needed to be built and tested.



Both these documents were completed following set templates: PDR Outline - Jan 25, 2018 and CDR Outline - Mar 19, 2018

Manchester CanSat Project performed well in both of these reviews performing in the top 40 teams in the PDR. This allowed continuation into the CDR where the top 5 teams compete.

This is followed by the test flight where the CanSats were launched and released by rockets at a launch site in Texas provided by the AIAA.

Finally, a Post Flight Review was completed involving a 15-minute presentation on their findings from the test flight and 5 minutes for questions from the judges.

Has it been evaluated? What feedback have you had?

The feedback the team gave was that the structure for the project is good for sustainability. The project gave them international recognition as well as useful experience in space engineering, whilst developing their team working skills and applying their learnt knowledge to a practical situation.

Key Learning Points

The sustainable nature of the organisation that Manchester CanSat Project used for this competition is of utmost importance in the success of a CanSat project of this type. By creating a subdivision dedicated to the competition, applying for funding to Airbus (MCP_Sponsorship_Proposal_17/18.docx and Stategic Roadmap and Outreach Potential Report 2017/2018), BAe Systems to obtain appropriately high performance components and materials, and sticking to the tight schedule and review document requirements of the competition, the team was able to succeed in the competition. Building on previous years' knowledge and resources allowed the development of an improved design. Having a multi-disciplinary team was especially beneficial when developing the various subsystems of the CanSat. The team met once a week for 1-2 hours through the first semester week with approximately 8 hours of individual work per week. In the second semester the team met during weekends often both the Saturday and Sunday working throughout the day. This consistent hard work, alongside studying, was required to be successful.

Thematic Categories (tick any that apply to your case study)

Method		Topic	
Online Text and Notes	☐	Orbits and Trajectories	☐
Assessment Materials	☐	Rocket Propulsion	☐
Video and Audio Lectures	☐	AOCS/ADCS	☐
Lecture Slides	☐	Payloads	x☐
Curricula	☐	Power	x☐
Video and Audio Clips	☐	Communications	x☐
Recommended textbooks	☐	On Board Data Handling	x☐
Useful software	☐	Systems	x☐
Worksheets and Projects	☐	Mechanical	x☐
Simulations	☐	Thermal	☐
Tutors' Guides	☐	Astronomy	☐
	☐	Earth Observation	☐
	☐	History of Spaceflight	☐
	☐	Other	☐

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