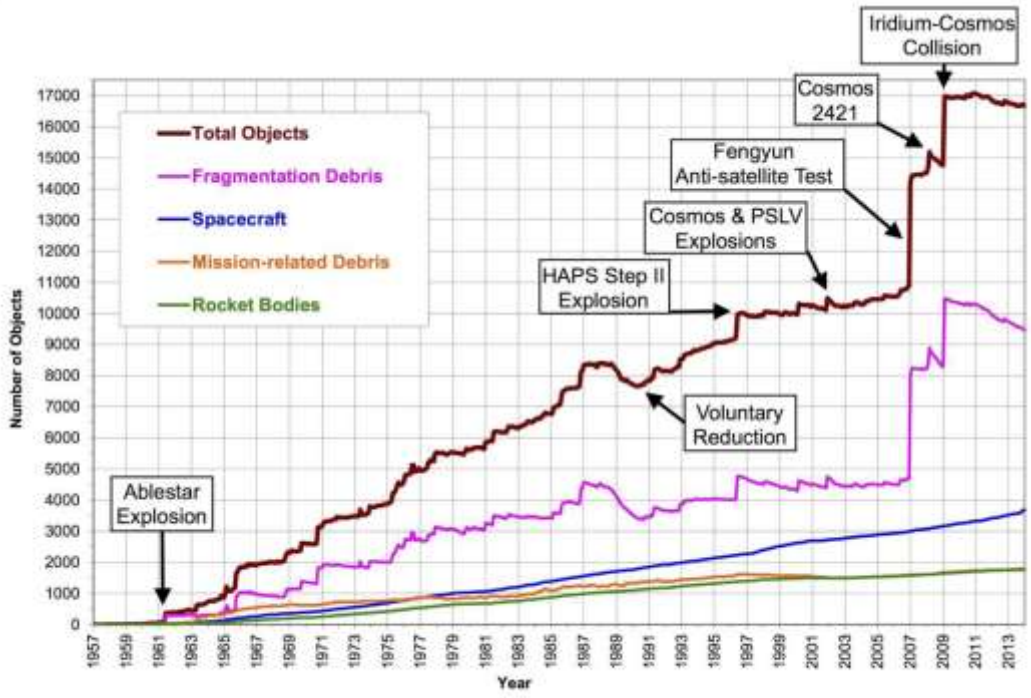
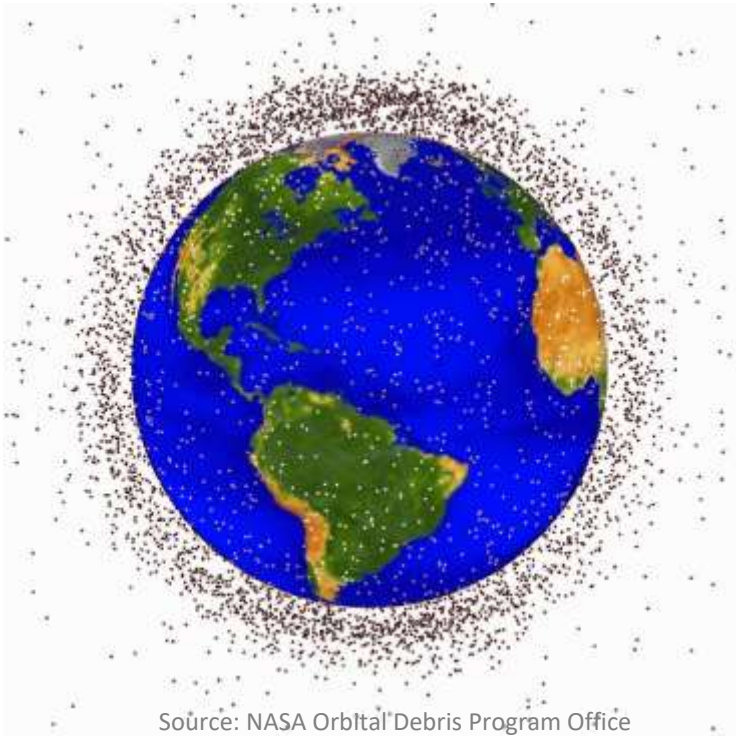
2nd Debris Mitigation Competition Overview

Herman Steyn
Chair, the review team,
Stellenbosch University

Background: Space Debris





Source: NASA Orbital Debris Program Office

- Objects in the chart are limited to larger than 10 cm due to limited tracking capabilities

Reference: NASA Orbital Debris Quarterly News, Vol. 16, Issue 1, January 2012.

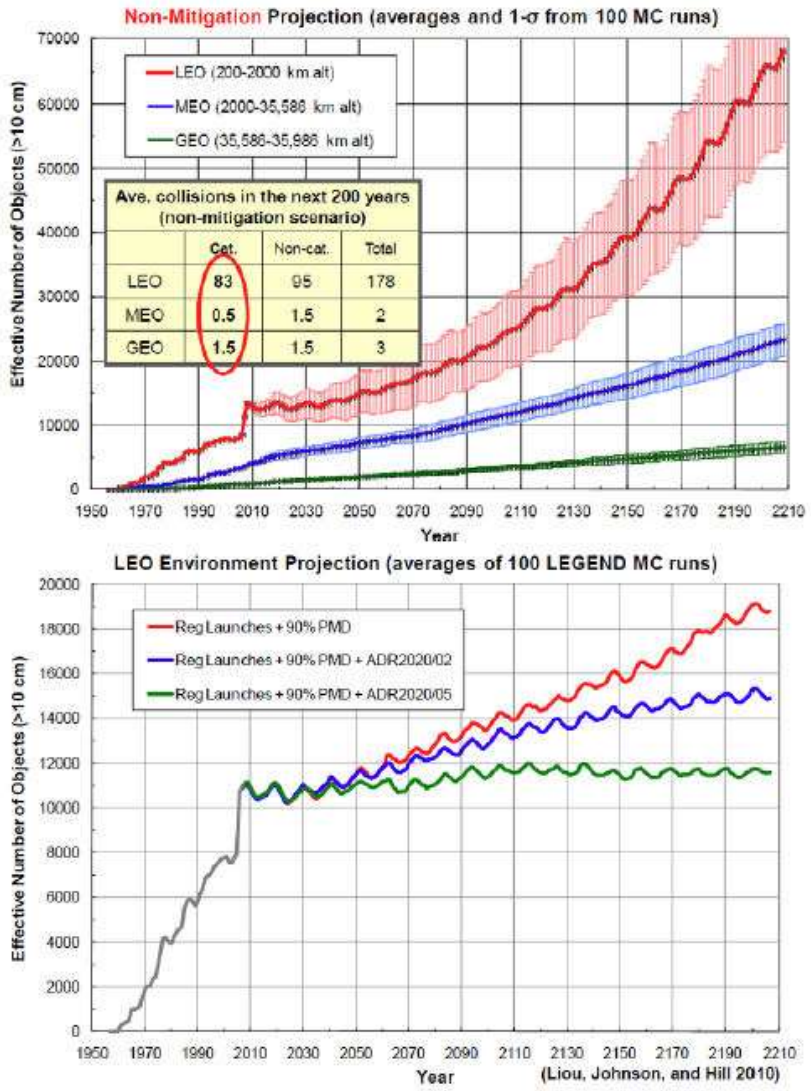
Orbit Debris Predictions

- Euroconsult forecast for next 10 years shows: 400 out of 1200 anticipated launches will be in LEO – this forecast only includes satellites > 50kg

- NASA LEGEND study predicts non-linear growth for LEO region, if no mitigation is followed

- To have a sustainable LEO population requires: Implementation of commonly adopted mitigation measures (PMD – Post Mission Disposal)

- Active Debris Removal (ADR) of 5 large objects or more per year



2016: Deorbit Device Competition

- Objectives
  - Increasing awareness of debris problems among nano/micro Satellite developers and university students
  - Facilitate the sharing of innovative solutions for debris mitigation and developing effective deorbit devices that can be demonstrated and validated with CubeSats.

Be a part of solutions, not a part of problems.

DDC: Results

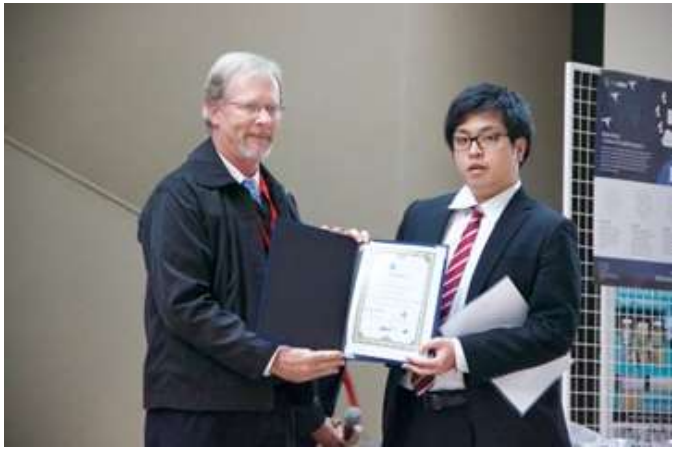
- **22 Abstracts from 15 countries**:
  - Drag sail derivatives - 13
  - Nano-propulsion systems - 6
  - Electrodynamic tethers - 2
  - Unworkable solutions – 1

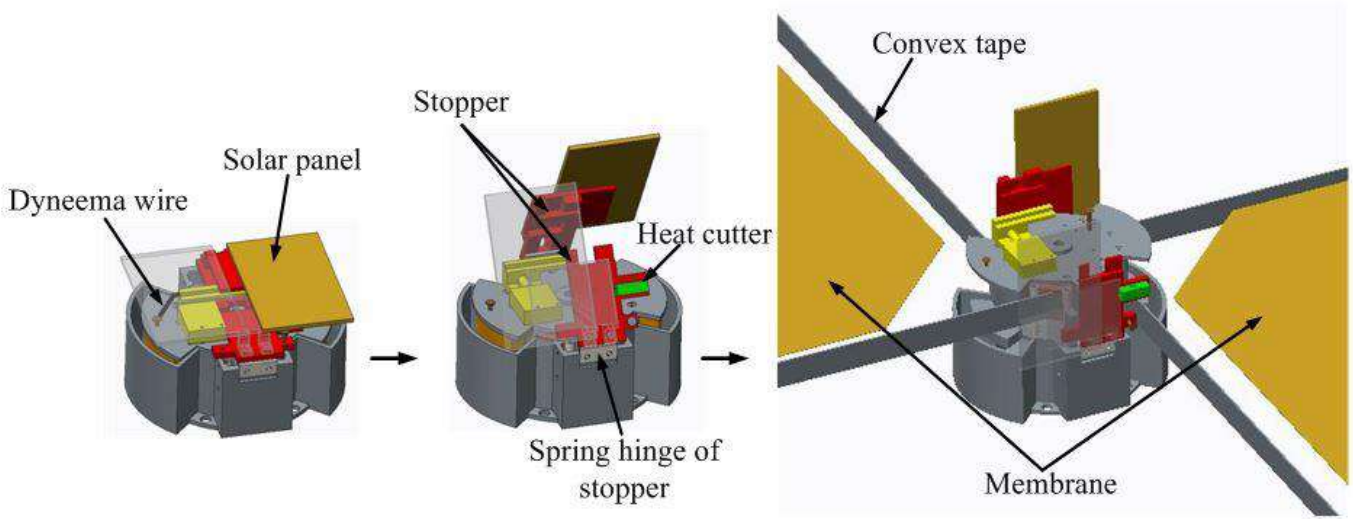
Presenters of the Deorbit Device Competition

- **10 Finalists from 8 countries**:
  - France, Italy, Japan (2), Poland, Russia, South Africa (2), Turkey, USA
- **8 applicants** provided the chance to make poster presentations.
- **8 Withdrawals** due to lack of information to evaluate, unworkable solution or couldn't come for presentation.

DDC: Results

- 1st Place: Mr. **Noboru Tada**, Nihon University, **Japan**.
- Proposal: "*Membrane Deployment de-orbit System by convex tapes*"



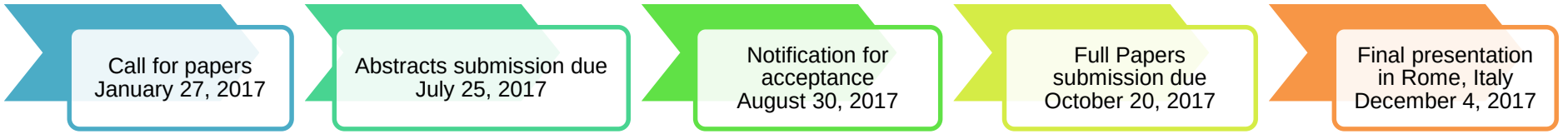


Comparison between DDC and DMC

Parameter	DDC	DMC
Target Satellite	CubeSat (1-3U)	Micro-Satellite (50kg)
PMD/ADR	PMD	PMD and ADR
Semi-major axis	6930 km	7128 km
Orbital inclination	97.6 deg.	98.4 deg.
Eccentricity	0.002	0.001

2017: Debris Mitigation Competition

- 2nd Competition final will be held as “Debris Mitigation Competition (DMC)” during the 5th UNISEC-Global Meeting in December 2-4 Rome, Italy.
- The **objective** is to facilitate the sharing of innovative solutions for debris mitigation and developing **effective post-mission disposal (PMD) and/or active debris removal (ADR)** device that can be demonstrated and validated with a micro satellite.
- Timeline



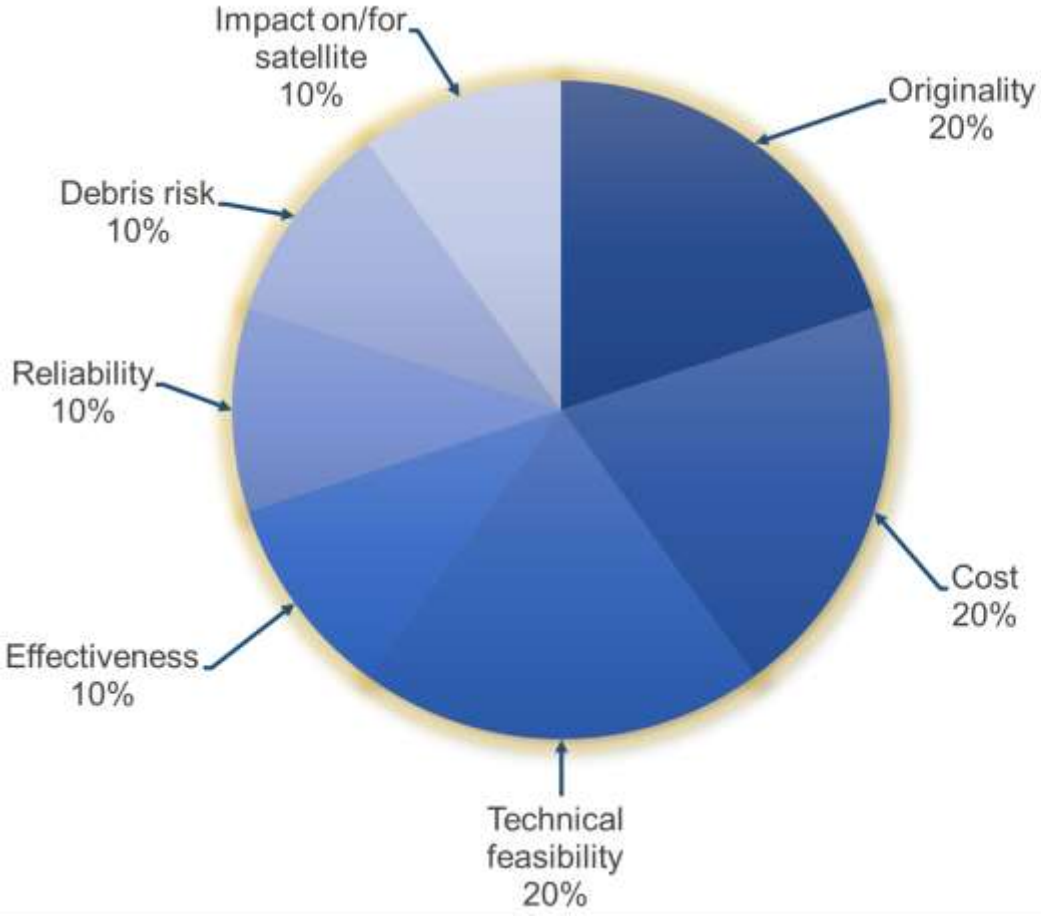
DMC: Requirements

- Propose a post-mission disposal (PMD) or active debris removal (ADR) device that satisfies the following requirements:
- The device must be designed for the removal of a potentially non-cooperative lean satellite of 50 kg mass and maximum dimension of 1 meter. Total mass of a satellite and device can exceed 50 kg.
- The device will enable the satellite to re-entry within 11 years (i.e. one solar cycle) after activating. You can use any systems such as thruster, tether, membrane or electric propulsion.
- The device will be activated at 00:00:00 UTC, January 1, 2020 with the following orbit element:

Semi-major axis	7128 km
Orbital inclination	98.4 degree
Eccentricity	0.001
R.A.A.N	30 degree
Argument of Perigee	210 degree
Mean Anomaly	190 degree

DMC: Evaluation Criteria

The proposed Deorbit Mitigation concept is evaluated according to the following criteria:



DMC: Results

- **11 Abstracts from 7 countries**:
  - Drag sail derivatives - 4
  - Propulsion systems - 2
  - Electrodynamic tethers – 1
  - Laser beam – 1
  - Unworkable solutions – 3

- **5 Finalists from 5 countries**:
  - Argentina, Japan, Russia, South Africa, Turkey

DMC Reviewers Final

1. Herman Steyn – Univ of Stellenbosch (Chair)
2. Rustem Aslan – Istanbul Technical Univ
3. (Mengo Chu – Kyushu Institute of Technology)
4. Yasuyuki Miyazaki – Nihon Univ
5. Shinichi Nakasuka – University of Tokyo
6. Rainer Sandau – IAA
7. Fabio Santoni – Sapienza University of Rome
8. Toshiya Hanada, Kyushu University
9. (Sir Martin Sweeting, SSTL)

(All other pre-final reviewers listed on p8 of program)

Thank you to all participants and reviewers !

Debris Mitigation Competition

Award

- 1st Place (Monetary Prize : 500 euro)
- 2nd Place (Monetary Prize : 200 euro)

(Sponsored by Canon Electronics)

UNISEC GLOBAL
University Space Engineering Consortium