UNISEC-Global Challenge: How can we contribute to Sustainable Space Development?

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UNISEC-Global

December 14, 2017 at Stellenbosch, South Africa
United Nations/South Africa Symposium on Basic Space Technology
“Small satellite missions for scientific and technological advancement”
Outline

• What is UNISEC-Global?
  – Vision 2020-100
  – Activities

• The 2030 Agenda and Vision 2030

• Space Debris issues
  – UNISEC-Global’s possible contribution

• Conclusion

  (How to join UNISEC-Global)
What is UNISEC-Global?

- **UNISEC-Global** is an international nonprofit, non-government organization, consisting of local-chapters across the world.
- Since its establishment in November 2013, it has provided an annual forum, training programs, competitions.
- In 2017, it was accepted as permanent observer by UNCOPUOS.
- Its **primary objective** is to help create a world where space science and technology is used by individuals and institutions in every country, rich or poor for peaceful purposes and for the benefit of humankind.
UNISEC Local Chapters

POC in 44 regions: Australia, Bangladesh, Belarus, Bolivia, Brazil, Bulgaria, Canada, Chile, Costa Rica, Egypt, El Salvador, Germany, Ghana, Guatemala, Indonesia, Italy, Japan, Kenya, Lithuania, Malaysia, Mexico, Mongolia, Morocco, Nepal, New Zealand, Nigeria, Peru, the Philippines, Saudi Arabia, Singapore, Samara (Russia), Slovenia, South Korea, Spain, South Africa/Angola/Namibia, Taiwan, Thailand, Tunisia, Turkey, Ukraine, USA and Vietnam

15 Local Chapters and 1 Association of Local Chapters have been acknowledged.
Vision 2020-100

“By the end of 2020, let’s create a world where university students can participate in practical space projects in more than 100 countries.”

Accepted as permanent observer to the United Nations’ Committee on Peaceful Uses of Outer Space (UNCOPUOS) in 2017
<table>
<thead>
<tr>
<th>Year/Activity</th>
<th>CLTP</th>
<th>DMC/DDC</th>
<th>MIC</th>
<th>Nano-satellite Symposium</th>
<th>UNISEC-Global Meeting</th>
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</thead>
<tbody>
<tr>
<td>2010</td>
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<td></td>
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<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
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<td>2011</td>
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<td>1&lt;sup&gt;st&lt;/sup&gt; and 2&lt;sup&gt;nd&lt;/sup&gt;</td>
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<td>2&lt;sup&gt;nd&lt;/sup&gt; and 3&lt;sup&gt;rd&lt;/sup&gt;</td>
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<tr>
<td>2012</td>
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<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
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<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>2013</td>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>Pre 3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
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<tr>
<td>2014</td>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>2015</td>
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<td>Pre 4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>6&lt;sup&gt;th&lt;/sup&gt; (ISTS30)</td>
<td>3&lt;sup&gt;rd&lt;/sup&gt;</td>
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<td>2016</td>
<td>7&lt;sup&gt;th&lt;/sup&gt;</td>
<td>1&lt;sup&gt;st&lt;/sup&gt;</td>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
<td>7&lt;sup&gt;th&lt;/sup&gt;</td>
<td>4&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>2017</td>
<td>8&lt;sup&gt;th&lt;/sup&gt;</td>
<td>2&lt;sup&gt;nd&lt;/sup&gt;</td>
<td>Pre 5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>8&lt;sup&gt;th&lt;/sup&gt; (ISTS31)</td>
<td>5&lt;sup&gt;th&lt;/sup&gt;</td>
</tr>
</tbody>
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CanSat Leader Training Program (CLTP)

Objective: CLTP is a training program for professors/instructors to learn how to conduct CanSat training by experience. Participants are expected to teach their students after training. It has contributed to capacity building in basic space engineering and technology.

Launched: October 2010

Offered: Annually

Graduated: 73 participants from 34 countries
**Mission Idea Contest (MIC) for Micro/Nano Satellite Utilization**

**Objective:** The Mission Idea Contest (MIC) is encouraging aerospace engineers, college students, consultants, and anybody interested in space to share their ideas on how to use micro/nano/pico satellites, and provides opportunities to present their ideas and gain attention internationally.

**Launched:** June 2010

**Conducted:** Annually as PreMIC or MIC

- Regional coordinators from 41 countries
- Four books were published as a part of the IAA book series.
UNISEC-Global Meeting

- **Objective:** The UNISEC-Global Meeting is an annual gathering to expand university community beyond Japan which intends to promote practical space projects at university level. The meeting includes Local Chapter activities report, Group discussion, Student Session, Competitions and Acknowledgement of new local chapter.

- **Launched:** November 2013

- **Conducted:** Annually

*The 5th UNISEC-Global Meeting was held in Rome, Italy in Dec 2-4, 2017*
Debris Mitigation Competition (DMC)

- **Objective:** To facilitate the sharing of innovative solutions for debris mitigation and developing effective deorbit devices that can be demonstrated and validated with Micro/Nano-Satellites. It is also expected to increase awareness of debris problems among satellite developers and university students.

- **Launched:** November 2015

- **Conducted:** Annually
The 2030 Agenda for Sustainable Development

Key principle: No one will be left behind.
Vision 2030

“By the end of 2030, let’s create a world where university students can participate in practical space projects in all countries.”

– How can we achieve it..?
  • Each of us should think what we can do for it.

– How can we solve potential problems?
  • Debris issues, lack of radio frequencies, and..?
  • Once we can identify a problem, we can find a way.

Let’s start thinking...

Your thoughts and inputs are important!
More and more satellites will be launched? Debris problem?

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

Two ways to reduce university satellite debris problems

• Seek effective ways for post mission disposal.
  – Debris Mitigation Competition - 2016, 2017
  – IAA study group – 2017-2020
    • Study for Post mission disposal strategies
    • UNISEC-Global will help dissemination the recommendation and other information.

• Increase success rate
  – Training program
  – Review meeting (from Mission Design Review)
  – Guide book for successful satellite project
Deorbit Device Competition (DDC) (1st Debris Mitigation Competition)

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

• Timeline

- Call for papers: November 1, 2015
- Abstracts submission due: May 31, 2016
- Notification for acceptance: June 30, 2016
- Full Papers submission due: September 8, 2016
- Final presentation in Rome, Italy: October 20, 2016
DDC: Results

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

• **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

- 1\textsuperscript{st} Place: Mr. Noboru Tada, Nihon University, \textbf{Japan}.
- Proposal: "\textit{Membrane Deployment de-orbit System by convex tapes}"
2nd Debris Mitigation Competition

• 2nd Competition was held as “Debris Mitigation Competition (MDC)” on Dec 4 during the 5th UNISEC-Global Meeting (Dec 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

  - Call for papers: January 27, 2017
  - Abstracts submission due: July 25, 2017
  - Notification for acceptance: August 30, 2017
  - Full Papers submission due: October 20, 2017
  - Final presentation in Rome, Italy: December 4, 2017
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:

<table>
<thead>
<tr>
<th>Semi-major axis</th>
<th>7128 km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbital inclination</td>
<td>98.4 degree</td>
</tr>
<tr>
<td>Eccentricity</td>
<td>0.001</td>
</tr>
<tr>
<td>R.A.A.N</td>
<td>30 degree</td>
</tr>
<tr>
<td>Argument of Perigee</td>
<td>210 degree</td>
</tr>
<tr>
<td>Mean Anomaly</td>
<td>190 degree</td>
</tr>
</tbody>
</table>
DMC: Evaluation Criteria

The proposed Deorbit Mitigation concept is evaluated according to the following criteria:
2\textsuperscript{nd} 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
Debris Mitigation Competition 2016-2017

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DDC(2016)</th>
<th>DMC(2017)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Satellite</td>
<td>CubeSat (1-3U)</td>
<td>Micro-Satellite (50kg)</td>
</tr>
<tr>
<td>PMD/ADR</td>
<td>PMD</td>
<td>PMD and ADR</td>
</tr>
<tr>
<td>Semi-major axis</td>
<td>6930 km</td>
<td>7128 km</td>
</tr>
<tr>
<td>Orbital inclination</td>
<td>97.6 deg.</td>
<td>98.4 deg.</td>
</tr>
<tr>
<td>Eccentricity</td>
<td>0.002</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Be a part of solutions, not a part of problems
IAA-Study Group

• **Title of Study:** Trade Study for Post-Mission Disposal Devices for Micro and Smaller Satellites

• **Members:**
  – **Chairs:** Darren McKnight (USA), Toshiya Hanada (Japan), Alex da Silva Curie (UK), and Peter Martinez (South Africa)
  – **Secretary:** Rei Kawashima (Japan)
  – **Experts:** IAA members and non IAA members

• **Overall Goal:** Provide framework for a practical implementation to assure compliance with Space Debris Mitigation guidelines for micro and smaller satellites.

• **Target Communities:** Universities, micro/nano/pico-satellite manufacturers, and new spacefaring entities
  – UNISEC-Global will help disseminate the information and recommendation.
Conclusion

• UNISEC-Global was established to promote practical space projects at university level worldwide, and provided training programs, conferences and technical competitions.

• To increase awareness of debris problems and facilitate sharing of innovative solutions for debris mitigation, the Deorbit Device Competition (DDC) which was renamed the 1st Debris Mitigation Competition and 2nd Debris Mitigation Competition were conducted in 2016 and 2017 respectively.

• If it is a right direction to realize the world where university students can participate in practical space projects in all countries in 2030, we need to prepare and start thinking what to do.
How to join UNISEC-Global?

• Join an existing local chapter.
• No local chapter in your region? Then establish it.
  – 2 or more universities that work for/promote practical space projects
  – Attend annual meeting and report your activities
• “UNISEC-Africa” is not a dream....(2 or more local chapters in Africa)
  – UNISEC-Egypt, Tunisia, Nigeria, South Africa Region...
Process to Establish LC

1. Apply for POC
2. Explore the possibility to form a UNISEC-LC
3. Apply for LC
4. Review and Acknowledgement
5. Website Open Reporting of Activities
If you want to go faster, go alone.

If you want to go further, go together.