2013.02.11
IAF Workshop, UN/COPUOS

Space Debris Related Activities -Japanese Case-

Tetsuo Yasaka
Kyushu University, Prof. Emeritus
QPS Institute

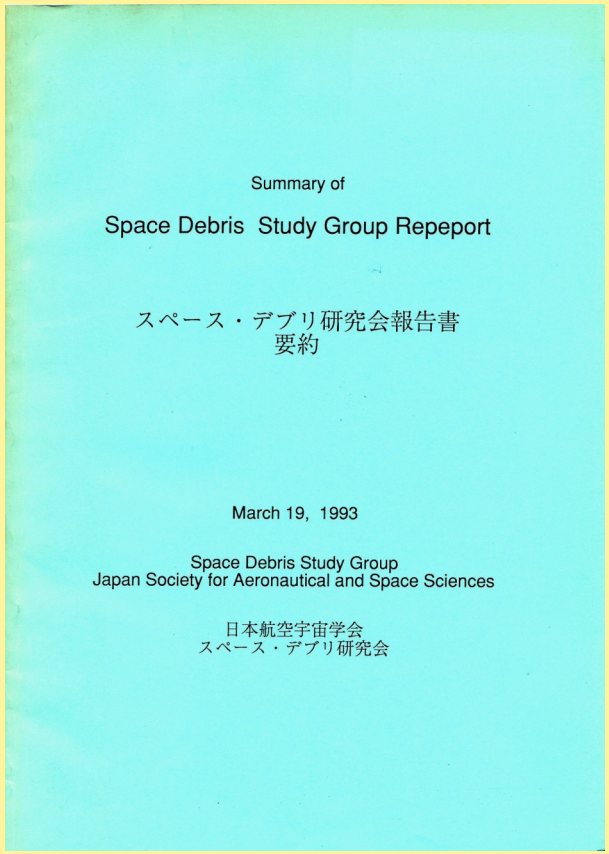
Notable Features –Japan-

1. No significant fragmentation in orbit, yet
   Collisions without long lasting objects (1969, 79)
2. Very early warning of collision hazard possibility
   Nagatomo paper, 1971 *
3. Nation-wide study by academic society
   JSASS, 1990-1993
4. Early adoption of launch vehicle passivation
   NASDA, ~1985
5. IADC founding member
   Japan=NASDA+ISAS+NAL+Academic organizations
6. Early adoption of Debris Mitigation Standard
   NASDA, 1996
7. Leading role in IADC Mitigation Guideline drafting
   NASDA, ~late 1990's

* Nagotomo, et al, "Some considerations on utilization control of the near earth space in future", 9th ISTS, 1971

Space Debris Study Group Report, 1993

Japan Society for Aeronautical & Space Sciences(JSASS)


Summary of

Space Debris Study Group Repeport

スペース・デブリ研究会報告書
要約

March 19, 1993

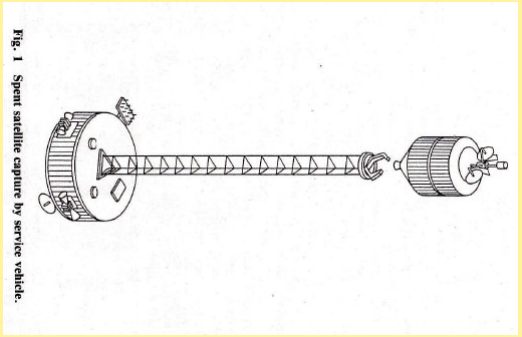
Space Debris Study Group
Japan Society for Aeronautical and Space Sciences

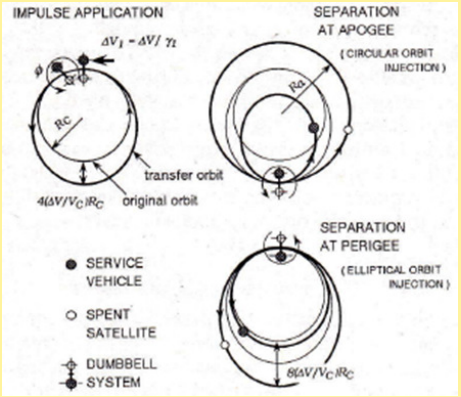
日本航空宇宙学会
スペース・デブリ研究会

Contents

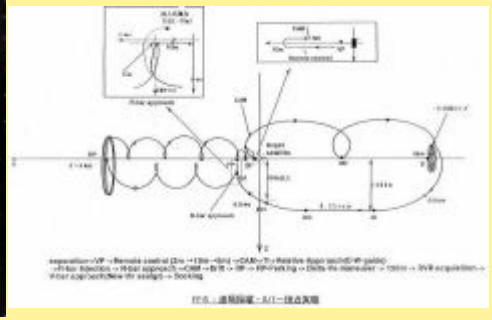
Technology background toward Active Debris Removal

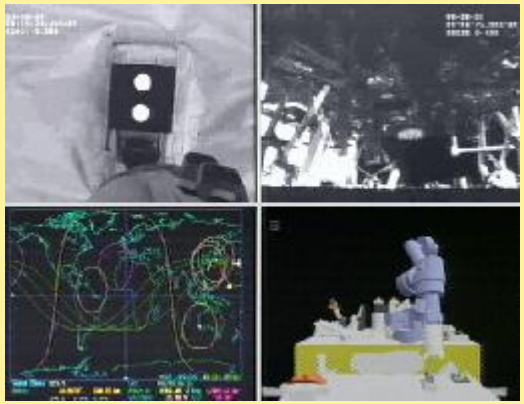
1. Conceptual study on GEO object servicing and disposal
   Geostationary Service Vehicle (GSV), 1989, 92



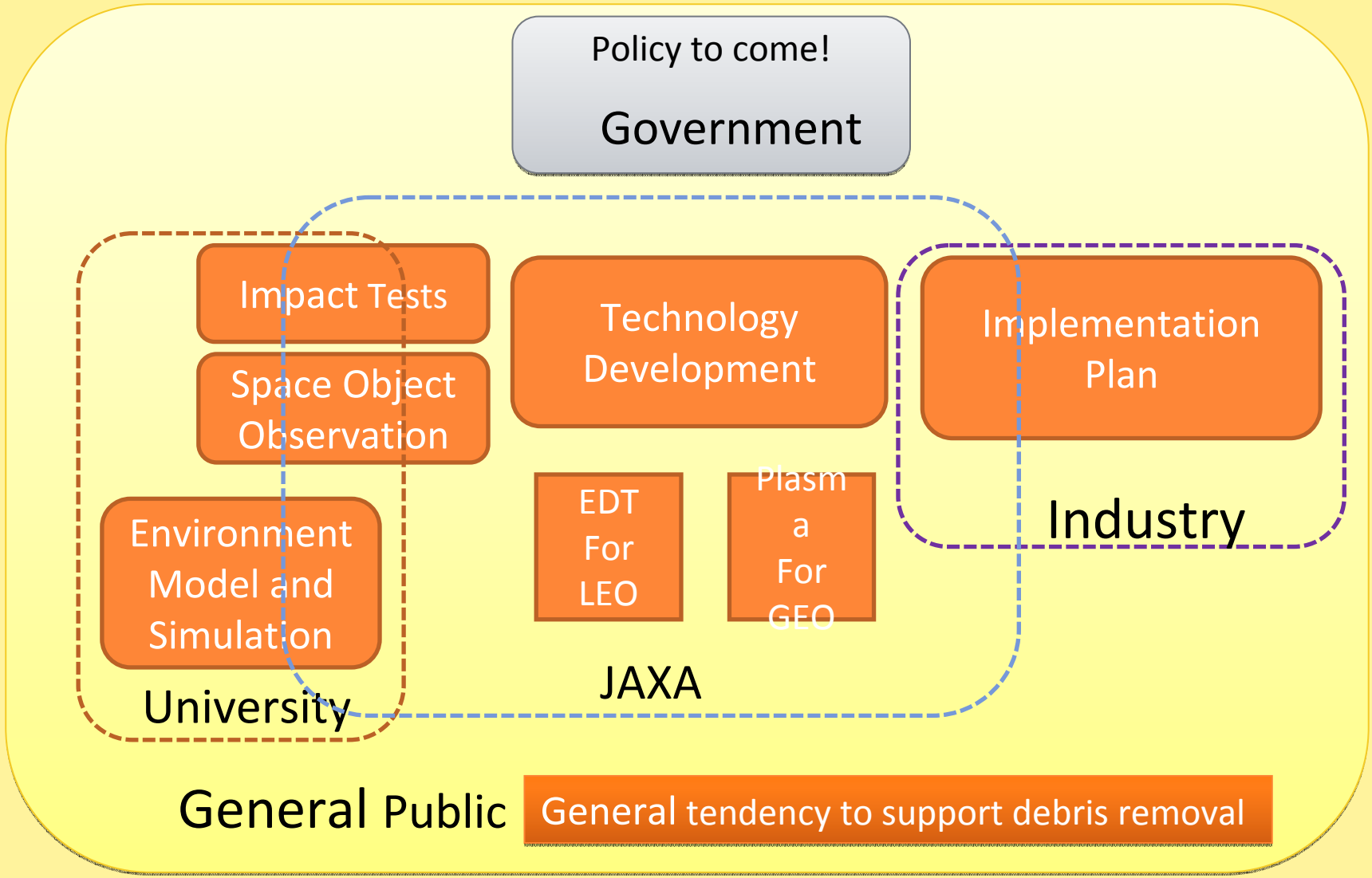


2. On orbit robotic rendezvous/docking demonstration
   ETS-VII, 1996



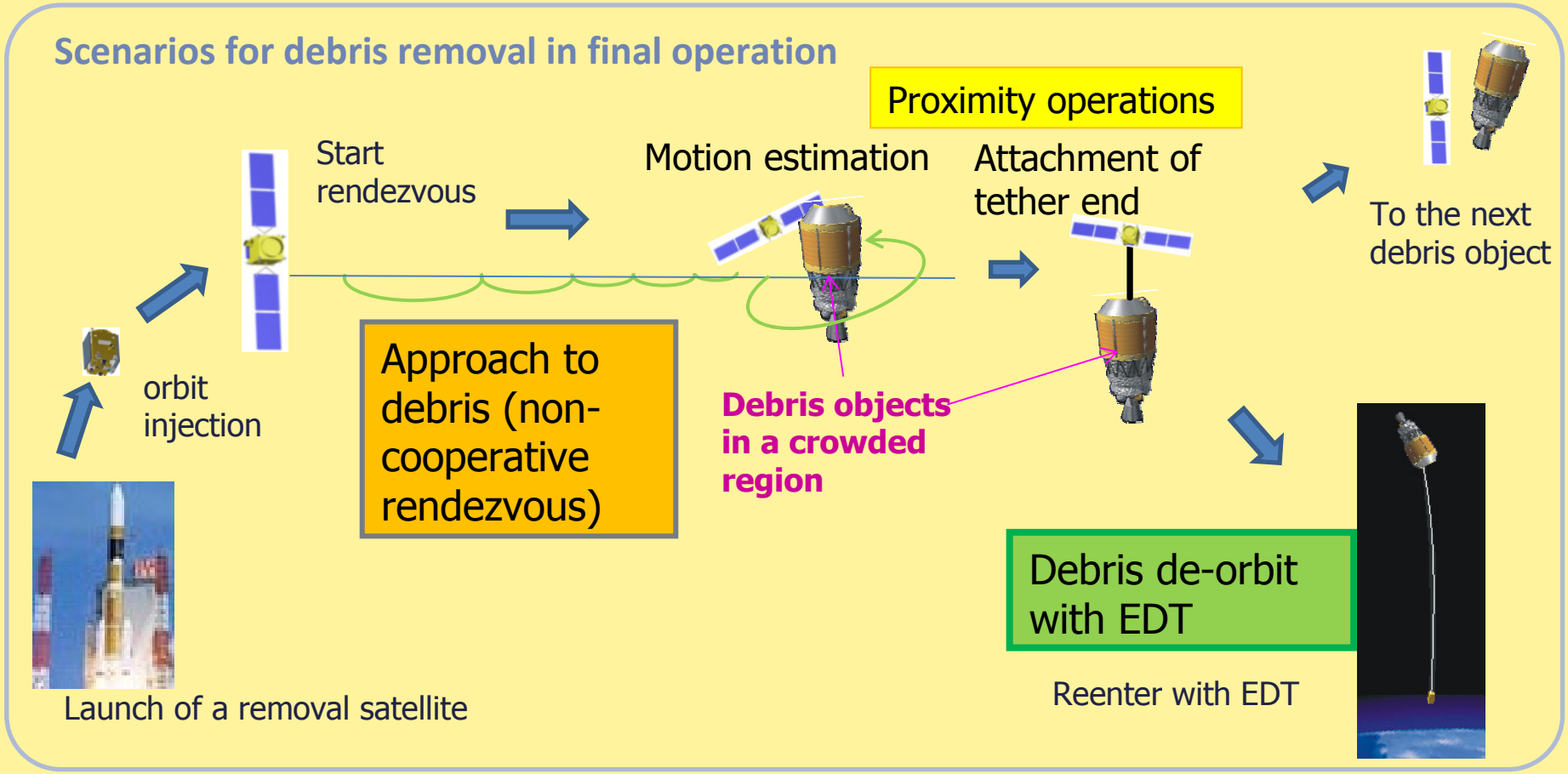


ADR Activities, Overview



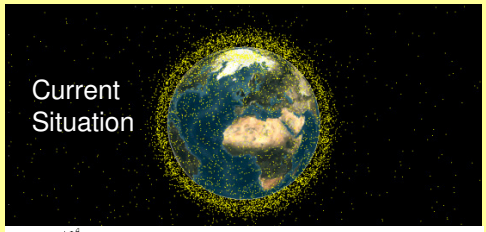
Scenarios for debris removal

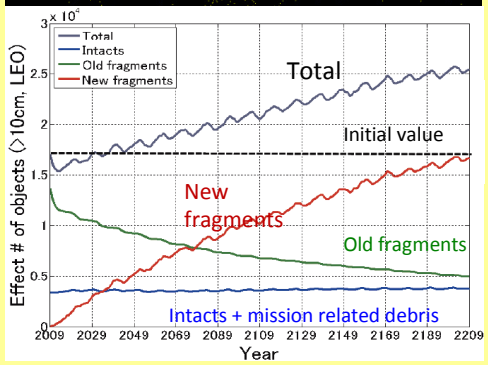
- Technologies to realize ADR have been studied and key technologies to be demonstrated identified



Kawamoto, , et al, "Current status of studies on active debris removal at JAXA", 5th Space debris Workshop, JAXA, Jan, 2013

Roadmap for debris removal





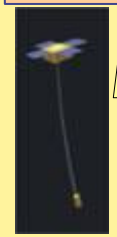
- Mitigation guidelines were enacted
  → Reentry within 25 years is required
- Collisional cascading started
  → Removal of existing debris is needed

Space Environment Preservation

Satisfy 25-year-rule

De-orbit Device for New S/C

EDT for Small Sat.



EDT for Large S/C

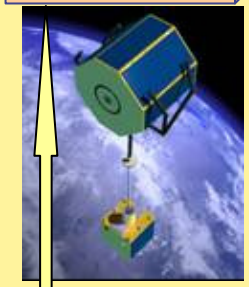
On-orbit servicing

Non-cooperative rendezvous

Prevent Collisional Cascading

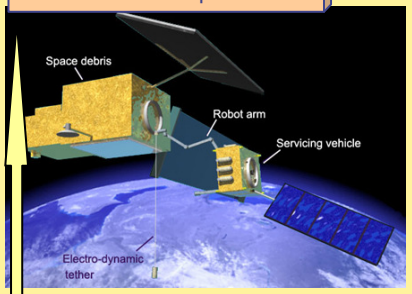
Removal of one debris

Micro Remover to remove one debris



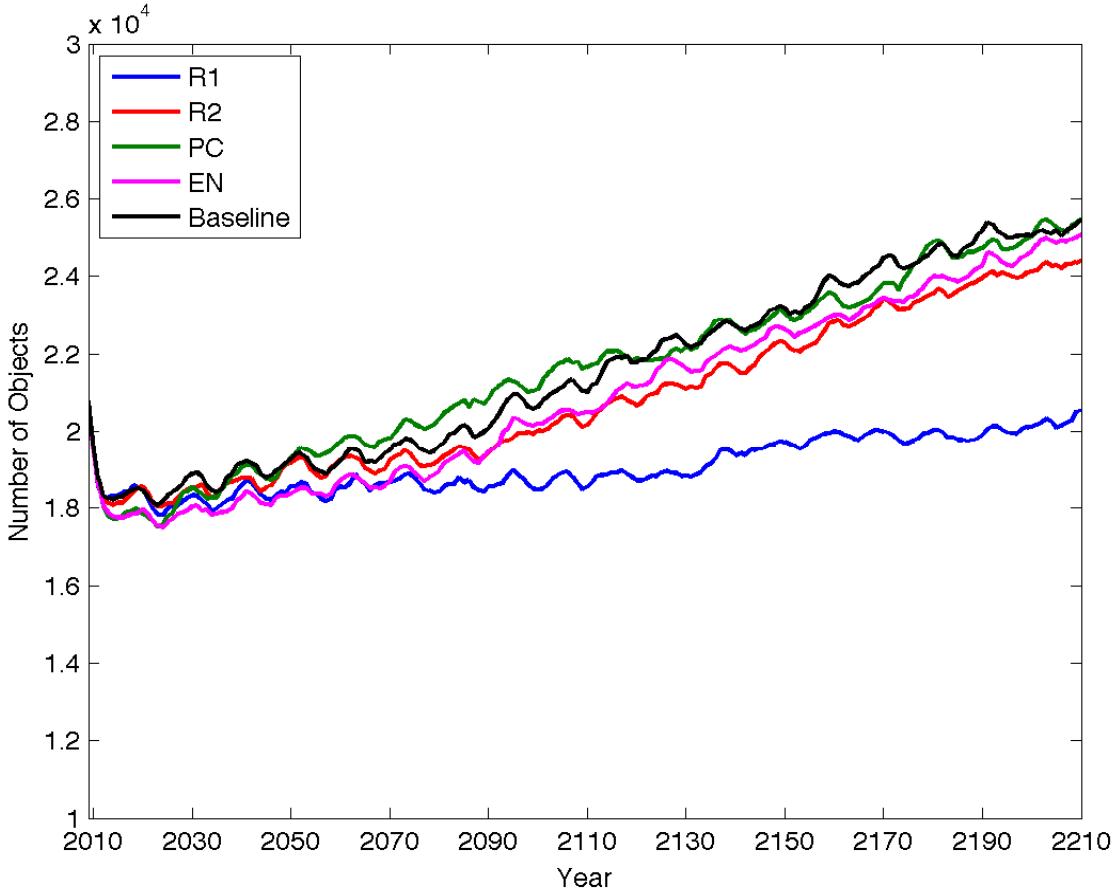
Removal of multiple debris (by international Cooperation)

Debris Removal System to remove multiple debris



International Cooperation with IADC, IAA, etc.	Cooperation		Multiple Debris Removal
Proximity Operations			←Attachment of EDT
Enlargement of EDT		Removal of One Debris Demonstration	← 5-10km EDT
Non-cooperative rendezvous			
Flight Experiment of EDT	EDT Demo		← Demonstration of <1km EDT
	2008	2013	2018

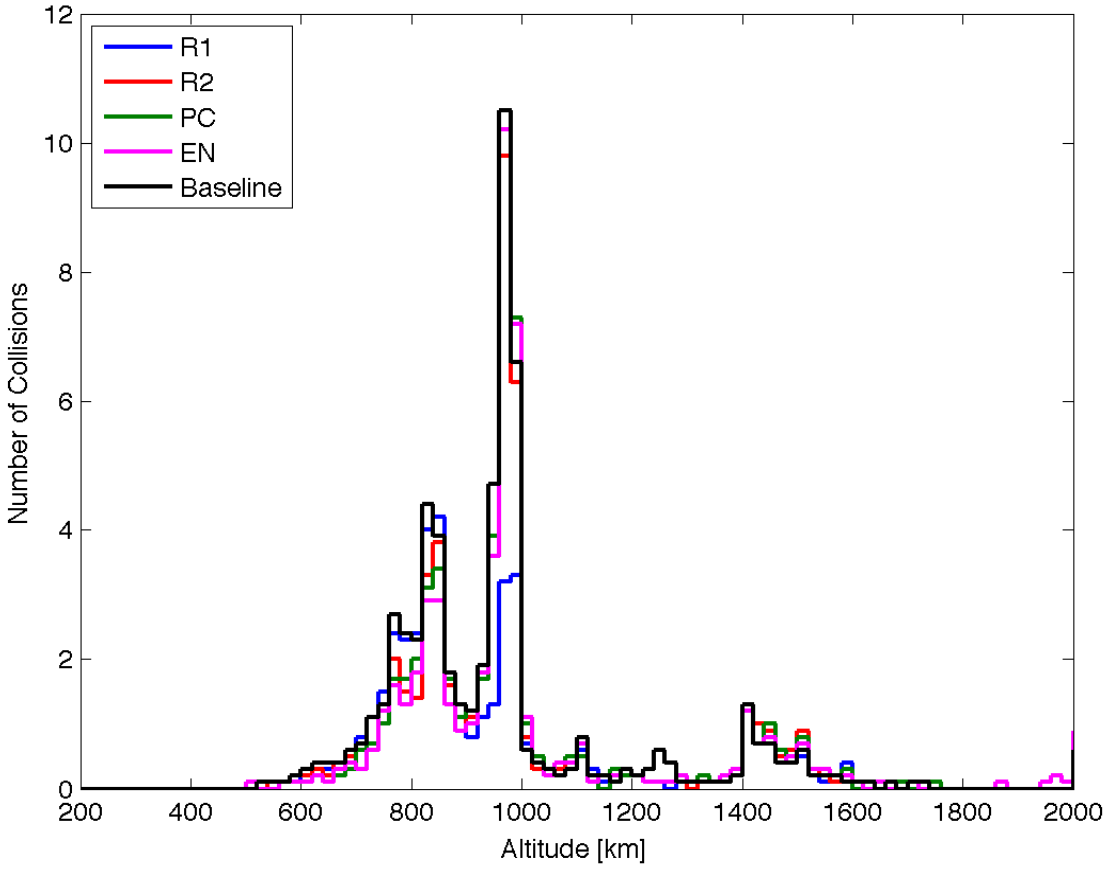
Population Growth



ASSUMTIONS:
No launch
No explosion
During 200 years

Ariyoshi, Hanada, Kawamoto, “How Can We Identify Colliding Objects to be Removed”. IAC-12-A6.5.1

Collision Locations



ASSUMTIONS:

No launch

No explosion

During 200 years

Business Model for Orbital Debris Removal
- SJAC proposal 2008-

- Proposal: An ODR business model, considered by SJAC introduced at ISO Conference in 2008.

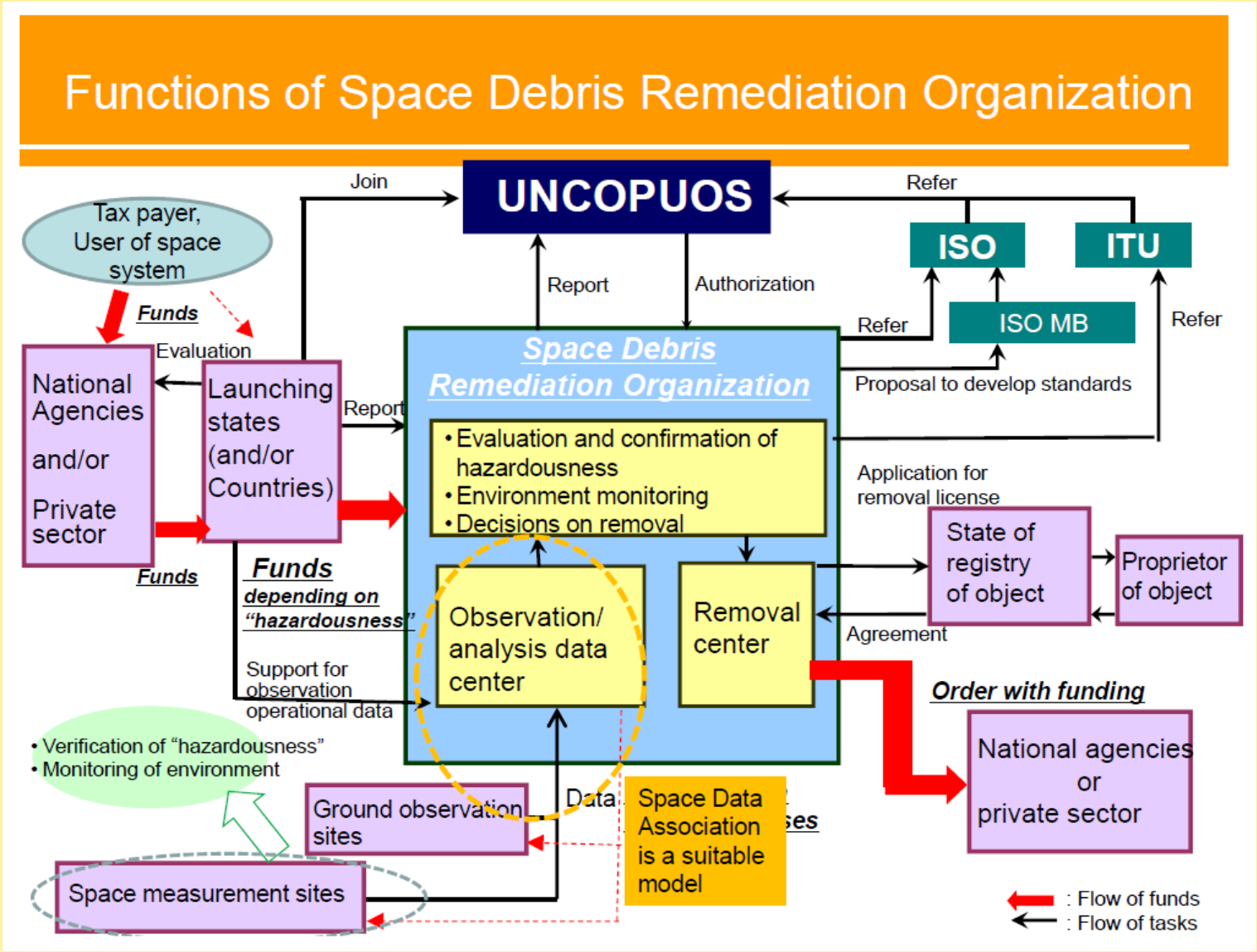
- Fund Raising:
  (Plan 1) Fund depending on the level of responsibility for generating debris in the past
  (Plan 2) Space environment utilization tax
  2.1 (Allocation simply depending on the volume)
  2.2 (Allocation based on debris index)

- Implementation body:
  International public company
  International coordination body

From report of "Committee for Next Generation Space Projects", SJAC
(Society of Japanese Aerospace Companies)

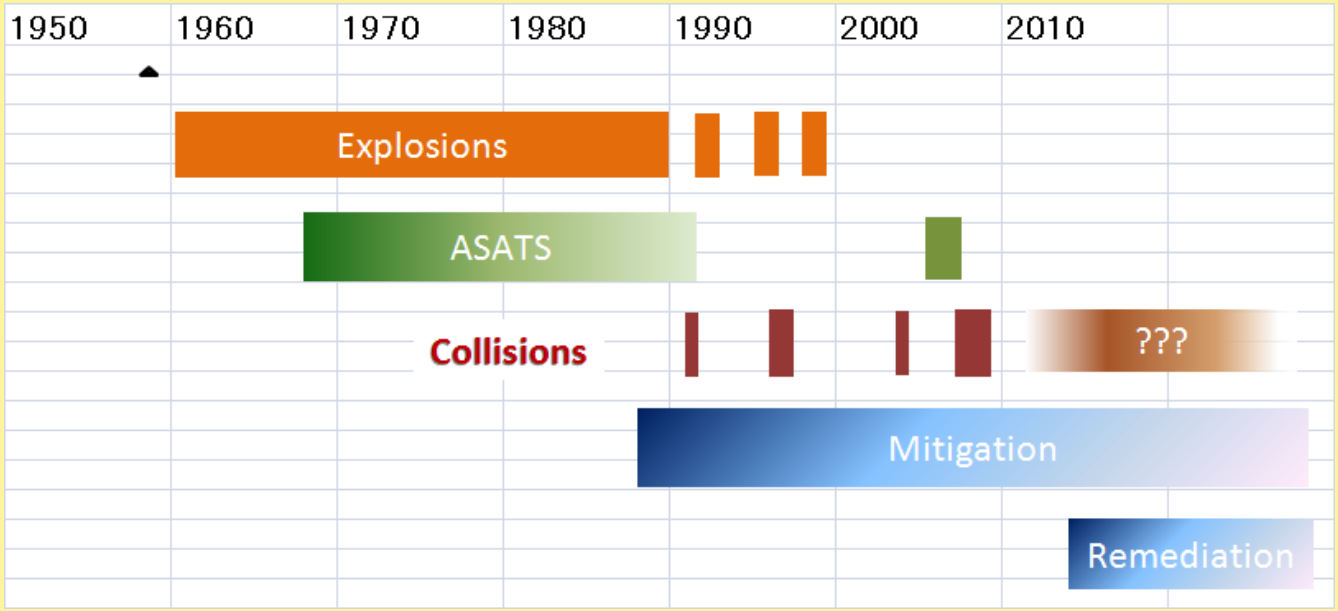
Mine, "Promoting the Active Debris Removal Project on Business", 5th Space debris Workshop, JAXA, Jan, 2013

Organization under International Framework



Kitazawa, "Organizational and Operational Requirements for Space Debris Remediation", International Interdisciplinary Congress on Space Debris Remediation, 2011, McGill University

What are done, what are to come.



Fragmentations due to Explosions, ASATs, Collision of new and operational satellites will be suppressed by Mitigation practices.

Collisions among orbiting old objects are our future concern. This could only be suppressed by Remediation practices where the ADR is the main issue.

Needed are: technology development and demonstration, cost and money flow for implementation, organizational consideration, legal consideration.

Above all, have the government establish a policy toward ADR which ensures internationally coordinated action.

Conclusions

- Actions toward Active Orbital Debris Removal are prevailing at wide levels
- Technology is ready with a possible demonstration in near future
- A coherent strategy not yet established
- An international consensus first
  to drive national level policy establishment
- Understanding and PUSH by general public
  could be a key to national consensus

References and Contact address

Nagotomo, et al, “Some considerations on utilization control of the near earth space in future”, 9th ISTS, 1971

T. Yasaka, “Tumble Orbit Transfer of Spent Satellites” J. Spacecraft, May-June 1990

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Contact: QPS Institute, Fukuoka, Japan
yasaka@i-qps.com