

A vertical rectangular image on the left side of the slide. It depicts a rocket launching from Earth, with a bright trail of fire and light extending upwards. The Earth is shown at the bottom, with a large, detailed view of the planet's blue and white clouds. Above the Earth, the Moon is visible in two positions: one larger and closer, and one smaller and further away. The background is a deep space scene with a large, glowing spiral galaxy and several bright stars.

*Reflections on **Space Safety***

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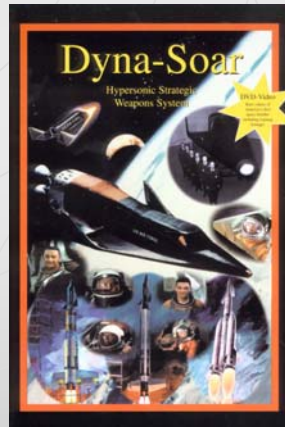
Building a Safer Space Together

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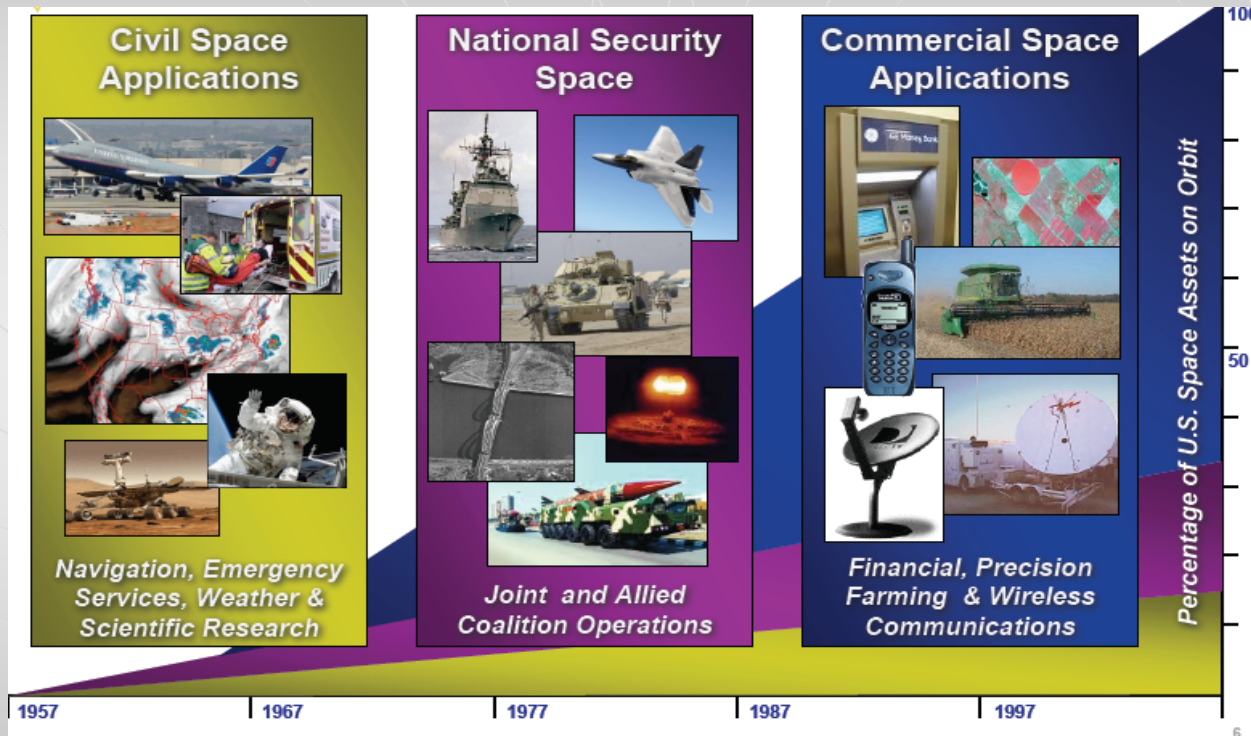
improve safety knowledge + international cooperation



The Old Space Age



The New Space Age



Source: J. Squatrito – CDI Conference -London 25 October, 2007

Global Stakeholders

- 10 countries have orbital unmanned capability
- 18 countries have suborbital capabilities
- 50 countries have assets on-orbit
- China has human spaceflight capability since 2003
- India started a human spaceflight program
- orbital space tourism started in 2001 (government systems)
- suborbital space tourism starting in 2009 (?) (private systems)



Various Aspects of Space Safety

- Safety is about **personal responsibility** at any level in the hierarchy, about **understanding the applicable rules**, ensure that an **effective (safety) organization** is in place, and finally **knowing the safety status** and promptly **managing deviations** and emergencies.
- All aspects of space safety have an **international** interest:
 - ✓ **safety of the industrial activities on ground,**
 - ✓ **safety of personnel at space centers**
 - ✓ **safety of the uninvolved public**
 - ✓ **safety of the humans on board**

Safety rules are (at least) non homogenous

Manufacturing Accidents

- **Since 2001 there have been three major industrial accidents at space manufacturing companies:**
 - ✓ 2001, Russia rocket processing, 4 killed
 - ✓ 2004, India rocket processing, 7 killed
 - ✓ 2007, US (Scaled Composites) testing, 3 killed

Launch Pad Explosions Casualties

- 1960, R-16 at Tyuratam, 122-200 killed
 - 1973, Cosmos 3-M at Plesetsk, 9 killed
 - 1980, Vostok 2-M at Plesetsk, 50 killed
 - 1994, Long March at Xichang, 1 killed
- 2001, Soyuz, at Plesetsk, 1 killed
- 2003, VLS-1 at Alcántara, 21 killed



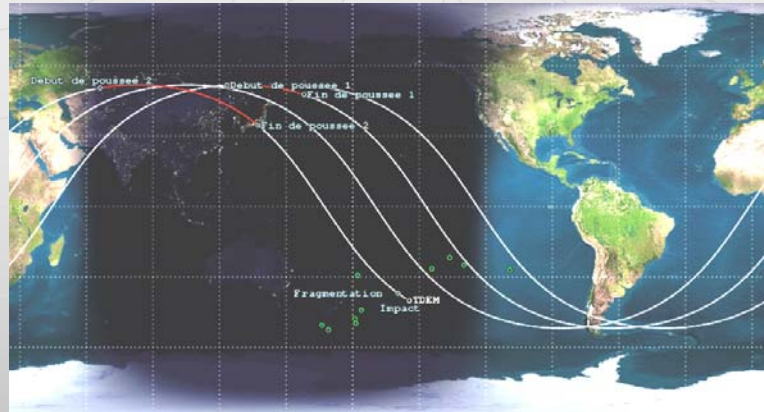
Need for Common Range Safety Standards

- Example: relocation of launchers to foreign spaceports (**Russian Soyuz to the European spaceport in Kourou**, and the Ukraine Cylone to Alcantara in Brazil)



Launch & Re-entry Public Safety

- The risk for overflown population during launch and re-entry is **managed by the launch country based on their national space safety standard**
- **Differences in risk criteria.** For example no agreement about what represents an acceptable re-entry risk, with figures as high as 10^{-4} and as low as 10^{-7}



Shooting down of satellites creates debris

- **January 2007:** Chinese (ASAT) test. Orbital debris collision risk for the ISS increased by:

> 10cm	+14%
> 1cm	+59%
> 1mm	+23%



- **February 2008:** US shot down a satellite with a modified tactical Standard Missile-3, hitting the satellite 247 kilometers over the Pacific Ocean. Exchange of data with ESA to avoid collision of debris with ATV.

Future international human spaceflight

Future programs require:

- o Mastering new/advanced technologies for hazards control (e.g. debris remediation, moon dust, radiation, etc.)
- o New crew escape/safe haven concepts
- o Common understanding about what it is safe and what is unsafe (absolute safety does not exist!)
- o Interoperability standards to allow for mutual aid and rescue during emergencies



ESA Contribution to a Safer Space

- o **Establish** Space Situational Awareness and cooperate to global space traffic management
- o **Develop** full understanding of re-entry risks (observation campaigns, mathematical models validation, high altitude explosion models, etc.)
- o **Cooperate** to develop international space safety standards
- o **Maintain** a robust independent space safety engineering and certification organization in ESA

