International Space Safety Standards

Over the long run the safety of all human beings in the global commons of space is a responsibility that must be shared by all space-faring powers" - G. Rodney, NASA Associated Administrator S&MA 40th IAF Congress, October 1989, Beijing – China

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IAASS

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Introduction

- "Space Safety" includes the protection of human life during all phases of a space mission (manned or unmanned) from launch to re-entry, and the protection of ground and flight high value systems.

- "Space Safety" should be extended to include the protection of critical space-based services and infrastructure (e.g. global navigation systems).

- A prerequisite for a safe and sustainable use of space are:

  a) the control of the space debris population, and
  b) international rules for space traffic.

- There is a growing awareness that space has become as international sea waters and airspace another realm where it is in the interest of the global community to operate in accordance with common rules.

- Space Safety is a shared interest requiring international cooperative efforts.

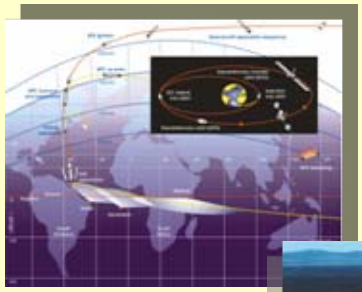
A poor safety record!

- As of today (at least) 200 people have been killed by rocket explosions during processing, testing, launch preparations and launch. 35 fatalities have already been counted in this century. Last explosion in July at the Mojave Spaceport, CA (USA)
- In the last 10 years at least 6 launches were terminated by launch range safety officer to prevent risk for the public. Several more cases of launchers which did not make to orbit and crushed back on Earth.
- A total of 22 astronauts and cosmonauts have lost their lives since the beginning of human spaceflight. Four of which on ground during training, (one Russian, plus the Apollo 1 crew). About 4% of those who flew to space, died.
- The Shuttle Columbia accident in 2003 posed also a serious risk to civil aviation traffic through the huge falling debris “curtain” (risk in the order of 1/1000 for commercial airlines and 1/100 for general aviation)
- As of today, 10 cases of space system failures with dispersal of radioactive material
- The orbital debris population, a major threat to manned and unmanned vehicles, continues to grow and may negate the use of valuable space regions to future generations.

Public safety risk (re-entry)

- Many non-functional satellites, spent launch vehicle upper stages and other hardware do not remain in orbit indefinitely, but gradually return to Earth
- Because of friction with atmosphere at high velocity between 60 and 90% will burn up, but some components and parts can and do survive the re-entry heating
- On average, one non-functional satellite, launch vehicle orbital stage, or other piece of catalogued debris has re-entered every day for more than 40 years
- The increase in worldwide space activities will increase the public safety risk, but no common acceptable risk level is defined. In February 2008 U.S. shot down a malfunctioning satellite (USA 193) because of public safety concern.

The New Space Age

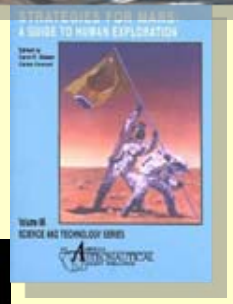


Widening space access

New stakeholders and players

International programs

Increasing international risk

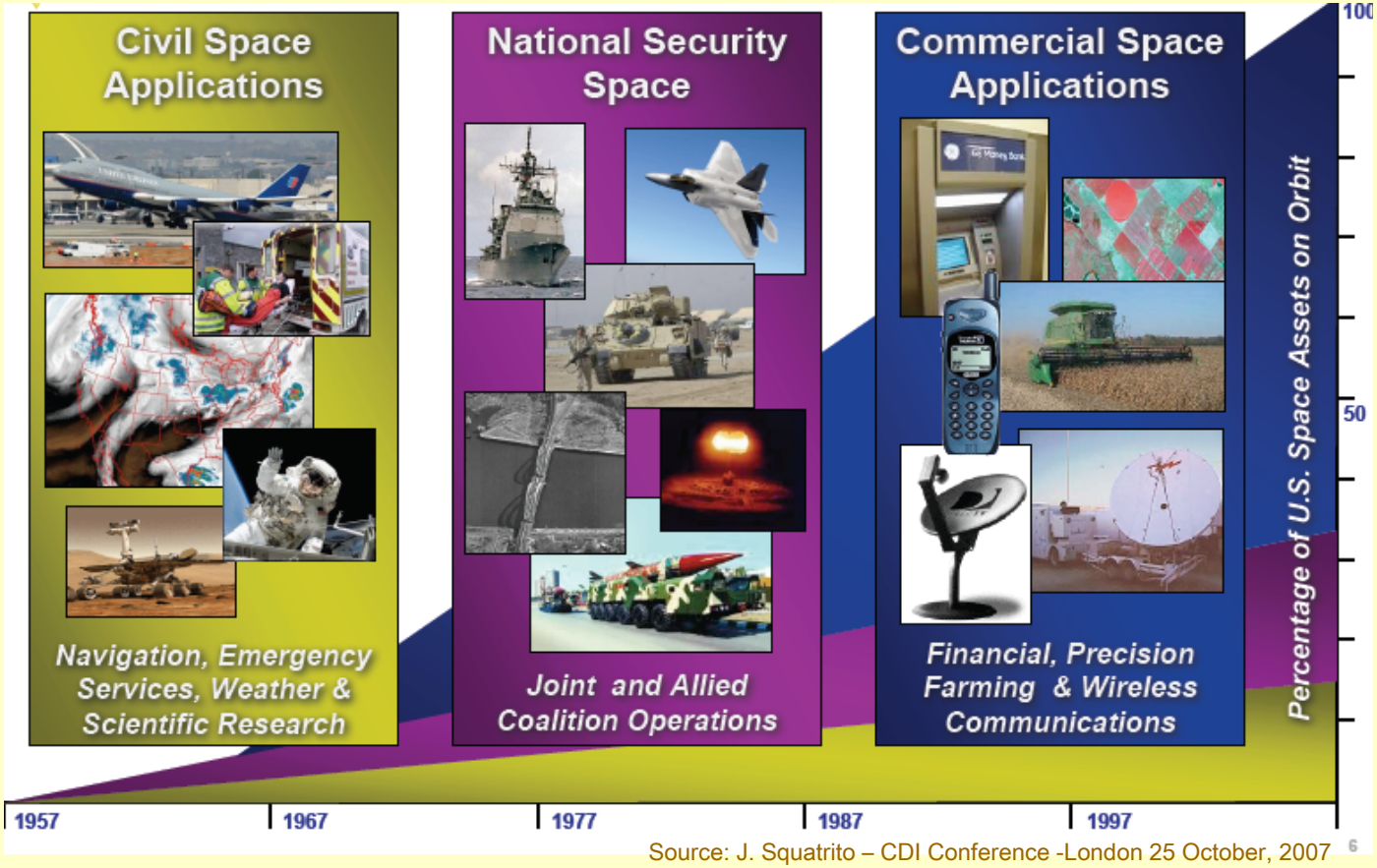


NASA Commercial Crew/Cargo Project

The New Space Age (cont'd)

- The mid of the 20th century saw the beginning of space programs which for more than two decades would be almost complete monopoly of the competing Cold-War powers (US and USSR). Europe lagged far behind but with a substantial presence, later in the century, in commercial launch services and space science
- As of 2007 space access capabilities have widened worldwide:
  - about 50 countries have satellites on-orbit
  - 10 countries have unmanned orbital launch capability
  - A further 19 countries have sub-orbital flight capabilities (from Argentina, to Syria). In February 2007, Iran launched its first suborbital flight.
- In 2003 China became the third country capable of sending humans in space. India has announced plans for a human spaceflight program leading to a first mission in 2014 and landing on the Moon in 2020

Growing importance of civil/commercial space



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

Current International Space Safety Standards

Exhibit 2-1: ISO Space Safety Standards	
ISO 14620-1e Space Systems - Safety Requirements - Part 1: System Safety	▸ Defines safety program and the technical safety requirements that are implemented in order to comply with the safety policy as defined in ISO 14300-2. ▸ Intended to protect flight and ground personnel, launch vehicle, associated payloads, ground support equipment, general public, public and private property, and the environment from hazards associated with space systems.
ISO 14620-2 Space Systems - Safety Requirements - Part 2: Launch Site Operations	▸ Addresses safety liabilities for countries undertaking space activities or allowing operators to perform space activities on or from their territory under outer space treaties adopted by the United Nations. ▸ Defines safety responsibilities for operators involved in commercial or non-commercial space launch activities ▸ Establishes overall safety requirements to be observed on a launch site for pre-launch (integration, test, checking, preparation, etc.) and launch operations of a space object. ▸ Provides basic principles to enable any operator to implement its own safety methods, tools, and procedures, to ensure the safety of people and personnel, public and private property, and the environment, in a consistent and uniform manner.
ISO 14620-3 Space systems -- Safety requirements -- Part 3: Flight safety systems	▸ Addresses the flight safety systems.
ISO17666e Space systems — Risk management	▸ Defines, extending the requirements of ISO 14300-1, the principles and requirements for integrated risk management on a space project ▸ Explains what is needed to implement a project-integrated risk management policy by any project actor, at any level (i.e. customer, first-level supplier, or lower-level suppliers). ▸ Contains summary of general risk management process, subdivided into four basic steps and nine tasks. ▸ Implementation can be tailored to project-specific conditions. ▸ Risk management process requires information exchange among all project domains and provides visibility over risks, with a ranking according to their criticality for the project; ▸ Risks are monitored and controlled according to the rules defined for the domains to which they belong
ISO146241 to 7 Space systems — Safety and compatibility of materials —Part 1 to 7	▸ These standards deal indirectly with system safety. For example part 1 deals with the determination of upward flammability of materials ▸ Part 2 deals with determination of flammability of electrical-wire insulation and accessory ▸ Part 4 deals with the determination of upward flammability of materials in pressurized gaseous oxygen or oxygen-enriched environments

Current International Space Safety Standards

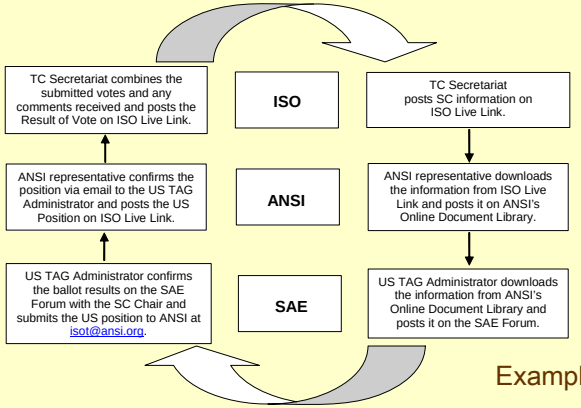
Exhibit 2-2: ISO Orbital Debris Safety Standards	
The "Orbital Debris Co-ordination Working Group" ISO TC20/SC14 is developing Orbital Debris Mitigation Standards which include:	
Space Debris Mitigation – Principles and Management / N318 (WD 24113)	▸ Will define management activities and procedures to be carried out to implement the requirements for mitigation of orbital debris over the life cycle of the space system ▸ Will cover all space systems launched into space, including launch vehicle orbital stages, operating spacecraft, and any released objects.
Re-entry Safety Control for Unmanned Spacecraft and Launch Vehicle Upper Stages Safety (WD27875)	▸ Will provide some principles for spacecraft and orbital stages of launch vehicles in order to assess, reduce and control the ground risks when they re-enter into Earth's atmosphere as the consequences of natural decay, intentional reduction of orbital lifetime, or direct re-entry ▸ Supplements the system safety program specified by ISO 14620-1 from the perspective of re-entry safety

Why ISO is not suitable?

- ISO - International Standardisation Organization, was established on 27 February 1947 with the purpose of facilitating the international exchange of goods and services through the coordination and unification of industrial standards.

- ISO membership is constituted by representatives of National Standards bodies (e.g. ANSI, DIN, etc.) on the basis of 1 member for each country body. Currently 158 members.

- Proposed standards are reviewed at national level through industrial national advisory groups supporting their national standard body.



Example (US vehicles manufacturers)

Why ISO is not suitable?

- Generally the application of safety standards is mandated by law. Safety standards are developed under the legal authority of specialised national or international agencies (e.g. FAA, FDA, ICAO, IAEA, for aviation, nuclear, pharmaceuticals) and not by national industrial standardization bodies.

- ISO standards are voluntary. ISO standards which compete with national regulations and standards are doomed to be neglected (see Toy Industry).

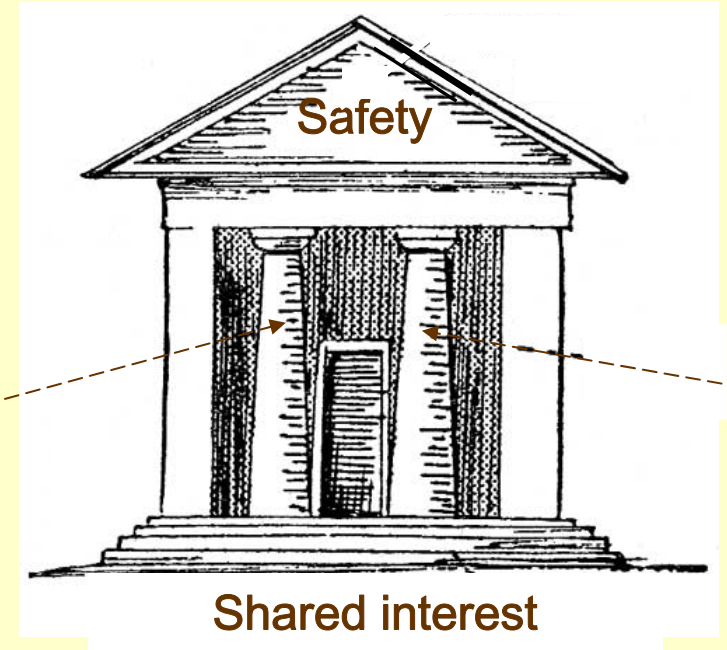
Example: ISO and the Toy Industry

✓"*Over the last three years, the membership has been actively involved in the development of an international toy safety standard through the International Standardization Organization. While the ICTI and ISO standards are supported by the membership, they cannot actually supersede the safety standards, regulations and testing procedures of local or national governments or agencies which are applicable to any product to which these standards apply*". (Website of the International Council of Toy Industries)

✓ BRUSSELS (Reuters) (Thu Nov 8, 2007) - The European Union and the United States want new global toy safety rules. "*If the EU and the U.S. can agree a regulatory framework, then this in essence becomes the global standard and forces other countries like China to follow suit…..*"

Proposal

The International Association for the Advancement of Space Safety (IAASS) is calling for institutional stakeholders of space-faring countries to jointly establish safety consensus standards to become recommended references for national regulations.



Guiding Principles

International space safety standards should pursue the following overall goals:

- ✓ *I. Ensure that citizens of all nations are equally protected from the risk of overflying rockets, space vehicles and returning spacecraft;*
- ✓ *II. Ensure that any spacecraft (manned or unmanned) is developed, build and operated according to uniform minimum safety standards which reflect the status of knowledge and the accumulated experience.*
- ✓ *III. Prevent the risk of collision or interference during transit in the airspace and on-orbit operations.*
- ✓ *IV. Allow mutual assistance and cooperation in case of emergency*

Standards Groupings

Five groups of space safety standards are proposed for initial development because of general interest and mutual benefits:

I) Public Safety Risk of Space Missions

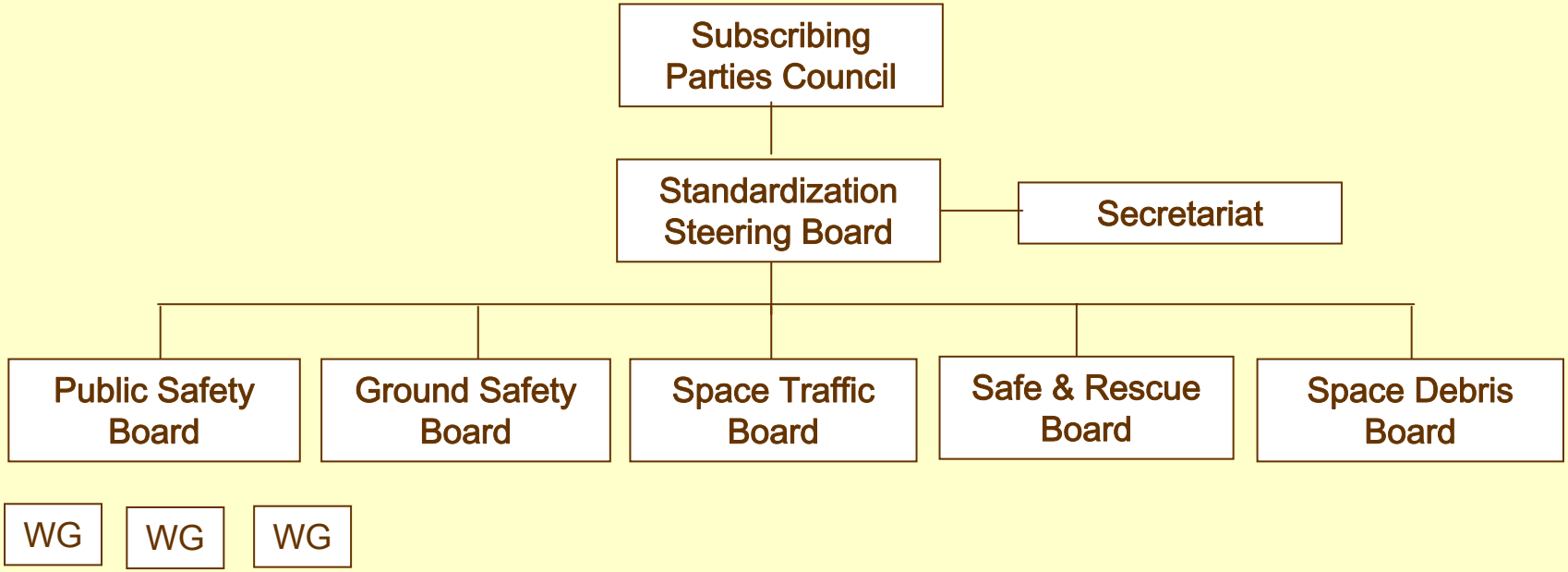
II) Ground Processing Safety

III) On-orbit Space Traffic Control

IV) Safe and Rescue

V) Space Debris

Proposed organization



Roadmap

- **Establish an international Working Group for drafting a Memorandum of Understanding (MoU) (organisation, operational rules, etc.)**
  December 2007 **(completed)**

- **Circulate the draft MoU for review and comments among national, governmental and regional space standardisation organisations. Implement changes**
  May 2008-September 2008

- **Circulate a letter of intent inviting signature by interested parties and collect responses.**
  September 2008

- **Convene a gathering of committed organisations officials to formally sign the Memorandum of Understanding (MoU) and nominate the Steering Board.**
  20 October 2008

January 2009: initial operations