

INTERNATIONAL REGULATORY STANDARDS FOR SPACEPORTS

By

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Outline

- Success and growth of space transportation will depend upon:
 - Safe design and construction of space vehicle
 - Safe ground facilities (spaceports) & secure operation.

 - There are significant similarities between aviation and new space transport systems. Compare their main characteristics with airports (aerodromes).

 - There is already in place a sophisticated international regulatory system, adopted through the ICAO (Annex 14), the global adherence to which has made aviation the safest mode of transportation.

 - Adapt ICAO standards, especially Annex 14 for (aero)space ports, with special needs of new space transport system
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Developments in launch technologies

Expandable launch vehicle

Partly reusable Launch vehicle



Development in launch technologies

- ❑ Launching from the sea
- ❑ Two-stage horizontal launch



Start of safe, private, affordable routine space transportation

- On 21 June 2004, a craft known as SpaceShipOne made history by 'flying' to 100.12 km (62.5 miles) above California.
- SpaceShipOne and its pilot Mike Melvill (62 years of age) remained 3 minutes in space before returning to land at Mojave airport



SpaceShipOne was carried by White Knight

SpaceShipOne lands after its 90-minute flight

Pilot Mike Melvill celebrates after landing SpaceShipOne

safe, private, affordable routine space transportation

- ❑ **Expensive space orbital flights with traditional and proven launch vehicles – Russian Soyuz spacecraft**
 - ❑ **1st Dennis Tito and the 6th Richard Garriott paying \$20 to \$25 million for a trip to the ISS**
 - ❑ **Might continue for 'rich and exceptionally physically fit'**
 - ❑ **Virgin Galactica with SpaceShipTwo and others are starting commercial space travel operations**
 - ❑ **Relatively significant cheaper space flights for 'ordinary' people**
 - ❑ **Orbiting of satellites, particularly small and/or nano satellites**
 - ❑ **Sub-orbital and orbital flights for point to point travel on Earth as well as for precious cargo, small packages and letters by various courier services operators**
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Spacecraft → aero(space) craft

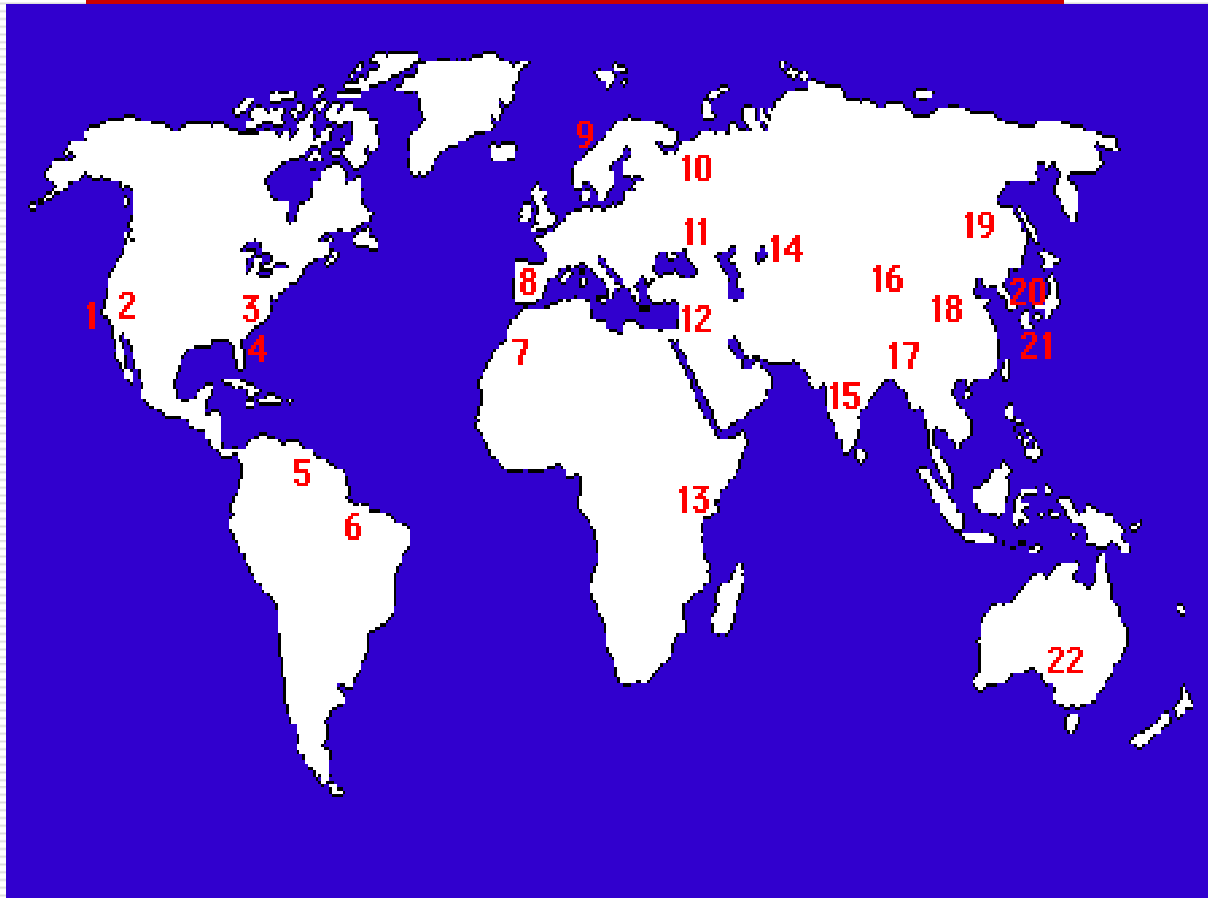
Launch site → aero(space) port

- ❑ New vehicles will 'fly' through airspace and outer space; should be called 'aerospace' vehicles or craft.
 - ❑ Mostly they will take off and land horizontally like aircraft
 - ❑ Vertical launches of expandable (partly reusable vehicles) from launch sites or ranges will gradually be supplemented, if not replaced by horizontally taking off and landing from aerospace ports, which will look more like current airports.
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Internationalization of aerospace transportation

- ❑ Like aircraft, aerospace vehicles most likely would be developed and manufactured by a small group of countries.
- ❑ By constructing and operating appropriate ground facilities (aerospace ports), all other nations would participate in this newest mode of transportation and benefit from space commercialisation.
- ❑ Aerospace crafts will soon be 'flying' not only domestically but also on international routes from and to different countries around the world.
- ❑ Construction and operation of ground facilities (aerospace ports) will have to be appropriate for safe and efficient services to all users.
- ❑ There is a strong and urgent need for international regulation (including technical standards) of aerospace ports

Current space launch sites around the world



- 1 - Vandenberg
 - 2 - Edwards
 - 3 - Wallops Island
 - 4 - Cape Canaveral
 - 5 - Kourou
 - 6 - Alcántara
 - 7 - Hammaguir
 - 8 - Torrejón
 - 9 - Andoya
 - 10 - Plesetsk
 - 11 - Kapustin Yar
 - 12 - Palmachim
 - 13 - San Marco
 - 14 - Baikonur
 - 15 - Sriharikota
 - 16 - Jiuquan
 - 17 - Xichang
 - 18 - Taiyuan
 - 19 - Svobodny
 - 20 - Kagoshima
 - 21 - Tanegashima
 - 22 - Woomera
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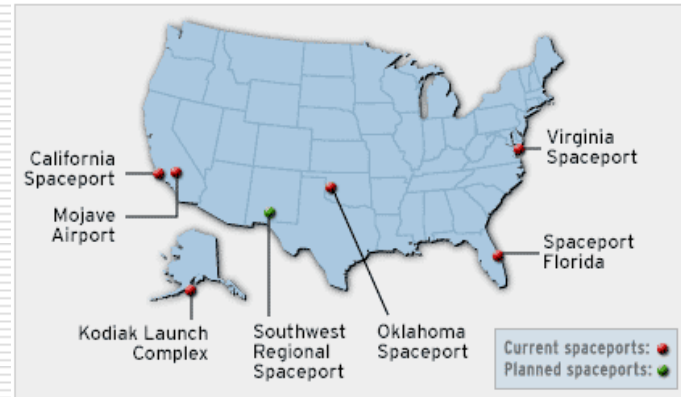
New and emerging commercial (aero)space ports

□ The U.S.:

An aerial view shows the Oklahoma Spaceport's 13,503-foot-long runway.



U.S. COMMERCIAL SPACEPORTS



OTHERS JOINING IN....

- Dubai: UAE
- Scotland
- Singapore
- Sweden

Spaceport America, New Mexico



Mojave Spaceport, California



Oklahoma Spaceport, Oklahoma



Mid-Atlantic Regional Spaceport, Virginia



Kodiak Launch Complex, Alaska



Corn Ranch Spaceport, Texas



Non-U.S. spaceports

United Arab Emirates Spaceport, Dubai



Baikonur Spaceport, Kazakhstan



Spaceport Sweden, Sweden



Spaceport Singapore, Singapore



National → international regulation and safety standards

- ❑ U.S. is ahead of every nation in establishing spaceports, not only their physical construction but also regulation, including safety standards
- ❑ In the U.S., the Space Commercial Launch Act of 1984, as amended, implemented by Federal Aviation Administration – Associate Administrator for Commercial Space Transportation
- ❑ Spaceports have started spreading around the world
- ❑ However, there exists no uniform international regulatory system (including technical standards) for ensuring spaceport safety, efficiency and uniformity in their operations
- ❑ It is useful to have a look at the universally accepted international standards known as Standards and Recommended Practices (SARPs) which ensure safe, efficient and orderly growth of international civil aviation
- ❑ How are SARPs made? Asses if they can be useful for spaceports?

ICAO: Making of SARPs

- ❑ SARPs are created through international cooperation, consensus, compliance and commitment (the four "C's" of aviation); i.e. cooperation in the formulation of SARPs, consensus in their approval, compliance in their application, and commitment of adherence to this on-going process
 - ❑ Creating and updating SARPs is the responsibility of the [International Civil Aviation Organization](#) (ICAO) of 180 states, which was created in 1944
 - ❑ ICAO is the specialized agency of the [United Nations](#) for all aviation related matters, particularly aviation safety
 - ❑ Thanks to ICAO, today aviation is the safest mode of public transportation globally. The enormous growth of aviation is almost exclusively due to its safety and consequently the ICAO.
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Forms of ICAO standards

- ICAO standards and other provisions are developed in the following forms:
 - Standards and Recommended Practices - collectively referred to as SARPs;
 - Procedures for Air Navigation Services - called PANS;
 - Regional Supplementary Procedures - referred to as SUPPs; and
 - Guidance Material in several formats.

 - The formulation of new or revised SARPs begins with a proposal for action from ICAO itself or from its Member States.
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ICAO's ANC drafts SARPs

- New proposals for SARPs are analysed by the Air Navigation Commission (ANC):
 - The ANC is composed of fifteen experts with appropriate qualifications and experience.
 - They are nominated by Member States and are appointed by the IACO Council.
 - They function as independent experts and not as representatives of their States.
 - ANC is assisted by the technical personnel of the Air Navigation Bureau
 - ANC drafts SARPs and recommends them to the ICAO Council
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ICAO Council adopts SARPs

- ❑ ICAO Council reviews the ANC's recommendations and adopts them as Annex (or amendments) to the Annex, if two-thirds of the members are in favour
 - ❑ Council dispatches them to ICAO member States seeking their approval.
 - ❑ If a majority of States have not registered disapprovals, new Annexes or the amendments become effective
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SARPs (ICAO Annex 14) related to aerodromes (airports)

- Following the above-described process, ICAO has adopted (and keeps updating) Annex 14 that contains regulations, standards and recommended practices relating to aerodromes (airports).

 - The Annex, in its two volumes, contains highly complex and comprehensive standard covering all aspects of aerodrome design and operations in order to ensure aircraft safety and smooth operation of air traffic. For example:
 - Certification of Aerodromes,
 - Safety Management, Airport Design,
 - Aeronautical data,
 - Runway strips, Runway end safety areas,
 - Visual Aids for Navigation, Markings, Lights, Signs,
 - Air Navigation Facilities,
 - Aerodrome Operational Services,
 - Aerodrome emergency planning,
 - Ground servicing of aircraft,
 - Surface movement guidance and control systems, etc.
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Annex 14 for (aero)space ports

- ❑ Almost all the matters dealt in the current Annex 14 are relevant and necessary for new (aero)space ports
 - ❑ No need to reinvent the wheel
 - ❑ Segregated regulatory regimes and safety standards for aviation and space transportation systems could result in duplication, wastage, confusion and disasters for both
 - ❑ Member States of ICAO should ask Council to amend and expand Annex 14 in order to cover (aero)space ports
 - ❑ ICAO possesses legal authority to undertake such expansion; i.e. under Article 37 of the Chicago Convention, in adopting SARPs, ICAO can address and act upon “any such other matters concerned with the safety, regularity, and efficiency of air navigation as may from time to time appear appropriate.”
 - ❑ In revising and expanding Annex 14, special needs of aerospace operations must be taken into consideration and appropriate standards must be adopted
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Finally

- ❑ National implementation and application of the revised Annex 14 – as suggested – might need changes in national legal regimes; e. g. the U.S. Commercial Space Launch Act
 - ❑ Eventually, for all relevant matters like aerospace vehicle air/space worthiness, pilot-astronaut certification, navigation services, etc., should be covered by ICAO
 - ❑ Paul Dempsey and Michael Mineiro correctly recommend that ICAO could promulgate a new Annex 19 on space matters covering sub-orbital and orbital vehicles.
 - ❑ Evolutionary approach should be followed by ICAO and its Members States
 - ❑ International cooperative regulatory system, including uniform technical safety standards for aerospace ports, is not a luxury or burden but an imperative for the successful evolution of the global aerospace industry and operations
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Thanks for your attention
