

Table of contents, sub-chapters, length and chapter responsables:

1. Introduction (4 pages, Bonnal)
 - a. Context, history,
 - Introduction: first private human access to orbit, Jake Garn (1985), Christa McAuliffe (1986), Toyohiro Akiyama (1990); Dennis Tito (2001), Mark Shuttleworth (2002), Anousheh Ansari (2006)...Guy Laliberté (2009)...Epiphenomenon, availability of Soyuz, questionable future → Orbital private access to space out of scope of the PP
 - Introduction: history of commercial space operations, Conestoga (1982), early proposals by Kaiser, Roton, Kistler projects
 - Definition of "private": commercial service or ticket paid by non-space-related entity
 - Two domains of access to space: sub-orbital and orbital; short definition, conventional limit of space
 - History: Tsien Hsue-Shen 1949, Ansari X-Prize, flights of Space-Ship 1, 4 October 2004
 - First commercial service = Mir Corp
 - b. General overview,
 - General principle: typical trajectories
 - Difference in energy
 - Dedicated vehicles; current examples
 - c. IAA action description
 - Objective position concerning credibility of future development
 - List of questions with some answers
 - Identification of key open points
2. Societal motivations (6 pages, Peeters – Eymar)
 - a. New transportation culture, Space age
 - Sensations of astronauts :
 - o Weightlessness: 0 g during 3 to 4 minutes, floating in the cabin
 - o Visions of earth: round, blue, fragile; role of witness for environment
 - o Visions of sky: dark, starry even during day
 - Culture of difference:
 - o Fun, new experience: no need for any risk
 - o Adrenalin shot: similar to bungee-jump: the riskier the better
 - o Right-stuff syndrome: the harder the better
 - o Social differentiation with neighbours: astronaut wings, money is the difference
 - b. Effects on society
 - c. Outreach
 - Impact on youngsters : dream is alive, Space adventure

- d. Communication strategy
 - Difference between Tourist and Private passenger
 - Image of the private space flight
 - Student Aerospace Challenge from ACE as an example
 - o 10 WPs
 - o 82 students from 15 teams
 - Planete Sciences as an example
 - o Be a rocket scientist
 - o Progressive approach to space

3. Market analysis (6 pages, Salt – Eymar):

- a. Comparison with other domains:
 - Luxury tourism, cruises, week-ends:
 - o Attraction towards VIP
 - o New culture: bridal, fashion
 - Game, luna-parks
 - Company rewards
 - Similar to first flights in aeroclub
- b. Current analyses and forecast
 - o Abitzch 1994
 - o Futron – Zogby
 - Assessment of sub-orbital market
 - Survey as a function of mission costs
 - Identification of the motivations
 - Question of robustness of market analyses
- c. Space tourism companies
 - VG
 - o Description
 - o Status of the orders
 - Space Adventures
- d. Key elements of business plan
 - Initial investment:
 - o Typology: who are the investors
 - o Current status of the worldwide situation
 - ROI, amortization duration
- e. Consequences of sub-orbital private access growth on space/aeronautics domains
 - Potential mutual benefits between private access to space, public space, aeronautics
 - Identification of the role of the various actors and potential change wrt current industrial order
 - Phased approach to public access to space
 - Quest for new markets, workloads
 - Attraction of new talents, training of new managers
 - Experimentation of unusual program behavior, Skunk-Works type
 - Company image

4. Medical, Physiological and Ergonomics (7 pages, Gerzer – Antuñano):
 - a. Risk factors for the crew and passengers
 - Physiological constraints: identification of acceptable requirements
 - Maximal g load x time
 - Level of vibrations, noise
 - 0 g effects
 - Radiations
 - Psychological constraints:
 - Stress vs age
 - Confinement
 - Promiscuity with other passengers
 - b. Medical selection, dedicated ground infrastructures
 - Selection criteria
 - FAA rules
 - Acceleration / Deceleration
 - Decrease of barometric pressure
 - Microgravity
 - Radiation
 - Practical medical screening
 - Medical history questionnaire
 - Company physician reviews the questionnaire
 - Potential physical examination and medical laboratory testing
 - Identification of counter indications
 - Cardiovascular pathologies
 - Cerebrovascular diseases
 - Chronic dizziness
 - Musculoskeletal disorders
 - Ophthalmologic disorders
 - Strong myopia leading to retinal detachment...
 - Behavioral issues
 - Minimum age for participants; potential rejection of pregnant women or terminal medical conditions people; problems of ethics
 - Typical medical screening:
 - Identification of a set of No-go criteria
 - Extended cardio-vascular stress tests
 - Carotid thickness
 - Tilt table
 - Training facilities
 - Some medical conditions may be cleared through simulated spaceflight environments, 0 g airplanes, high performance airplane, hypobaric chamber, human centrifuge
 - Typical training tests
 - Parabolic flight
 - Centrifugation
 - Very limited medical experience and knowledge on individuals with significant medical problems
 - Up to now, healthy career astronauts
 - Most of medical and physiological data collected on normal and healthy individuals

- Individual medical data from professional astronauts not available
- Open sharing of G. Olsen medical file
- Identification of the inflight medical events among US astronauts
 - Astronauts fatalities
- c. Medical risks
 - Space motion sickness
 - Undisclosed use of medications
 - Disruptive behaviour
- d. Habitability requirements, flight suits
 - Ergonomics
 - Constraints; requirements for space suits
 - Examples, Black Diamond
 - Comparison with other domains: diving, roller coaster, ...
 - 0 g environment constraints
- e. Applicable and similar experiences
 - 0 g plane

5. Legal, Insurance and Regulatory aspects (11 pages, Couston – Masson-Zwaan):

- a. General legal frame
 - Definitions
 - Definition of Space:
 - History: X-15 flights with associated astronauts wings
 - Von Karman definition
 - Current definition
 - Definition of an astronaut:
 - No legally binding definition
 - Definition of a space object
 - Definition of Launching State
 - Liability
 - Of passenger
 - Third party
 - Tour operator liability
 - Current techniques used in comparable context
 - 0 g aircraft
 - Conventional launcher + capsule
 - Context:
 - Role of EASA:
 - Creation of a space department
 - Rules of conformity control of the vehicle at European level
 - Short term: simplification of procedures
 - ITAR, export rules
 - US Commercial Spacelaunch Amendments Act of 2004
 - Establishes experimental permit, notion of paying customer, no limit on the number of experimental flights, requires passenger to be fully informed of potential risks, including the fact that there are some unknown risks, participation on spaceflight may result in death
 - Sole authority over licensing of suborbital vehicles
 - Allows informed consent of the customer to accept the risks of spaceflight

b. Risks and Insurances

- Potential effects of a catastrophic failure
- Identification of the risks and insurance markets involved:
 - o Ground
 - o Flight
 - o Tourist
 - o Manufacturers/service providers
 - o Travel agency/tour operator
 - o Financial

c. Regime and Users status

d. Specific national regimes

- US
- Europe, France

6. Technical aspects (12 pages, Calabro – Bultel – Bernard-Lépine):

a. Potential solutions, variants at system level: key elements

- Number of stages
- Shape
- Number of passengers
- From ground or airborne
- Type of trajectory
- Number of propulsive systems: air-breathing in addition to rocket ?
- Level of reusability vs mass production

b. Sub-system level: key elements

- Type of rocket propulsion:
 - o solid, liquid, hybrid: pro and cons
 - o environmental constraints, toxicity, carbon signature, NOX, Reach
- Return strategy: wings, retro-rockets, parachute, ballute, flexible structure

c. Availability of technologies:

- Innovative concepts
- TRL, roadmaps for technologies

d. Growth potential: P2P, hypersonic passenger travels

- Long duration 0 g flights to increase domain of 0 g planes
- Scientific applications:
 - o Examples of NOAA contract with VG
 - o Secondary use of carrying plane for Two Stages concepts: traffic monitoring, cargo transport, small orbital system; examples of VG and Rocketplane proposals
- Production activities: large volume and high mass compared to sounding rockets, highly repeatable
- Global monitoring of Earth zones
 - o Immediate screening after disaster
 - o Repetitive survey of a given zone: agriculture, flooding, pollution, development

- Homeland security: monitoring of borders
- Point to Point access
 - Principles and associated figures: long distance express flights
 - Current limits, acceleration, thermal constraints
 - Some examples: Fast 20XX, V-Prize initiative
- Further evolutions
 - Orbital missions
 - Trip around the Moon
- e. Current examples, short descriptions based on publicly available info (web sites)
 - Virgin Galactic Space-Ship 2
 - Rocketplane
 - Astrium Space Plane
 - X-Cor
 - New-Shepard – Goddard
 - Masten Space System
 - DaVinci – Dreamspace
 - Armadillo
 - Benson SpaceDev Dreamchaser
 - Inter-orbital Systems Neptune
 - Starchaser Thunderstar
 - VSH

7. Ground Infrastructures (8 pages, Droneau – Webber) :

- a. Space tourism and Grand public
 - Main functions of a spaceport
 - Training
 - Lodging for tourist and relatives
 - Side activities: space related theme park
 - Showcase for operator
 - High level of lodging
- b. Spaceports : selection criteria
 - Safety:
 - Safety of ground operations, forbidden perimeter
 - Risks of casualty on ground associated to flight: flight corridor safety
 - Accessibility vs desertness
 - Interest of the overflow zone
 - Constraints associated to air-traffic
 - Meteorological constraints
- c. Current examples
 - Spaceport in Sweden
 - Spaceport America New Mexico
 - Oklahoma Spaceport
 - Numerous other proposals in the US: description and status
 - Ideas of Montpellier spaceport
 - Examples of the Mars Simulation Facilities; applicability to Private Human Access to Space

8. Reliability, Safety, Risk (4 pages, Romero – Bonnal):
 - a. Reliability requirements
 - Preliminary Hazard Analysis:
 - o Identification of critical phases and sub-systems
 - o FMECA
 - FO/FS requirements
 - Abort cases:
 - o Engine-off capability
 - o Tolerance to failure, failure divergence time, containment after failure
 - o Return strategy
 - b. Safety requirements
 - Quantitative requirements
 - Comparison with current state of the art
 - Identification of the domains of improvement
 - Should we talk of the SS2 tank explosion? What do we know about it?
 - c. Flight constraints
 - Feasibility of “floating” passengers, return to seats, potential consequences

9. Conclusions (4 pages, Bonnal):
 - a. Key hurdles to overcome

 - b. Recommendations, role of Agencies
 - No use of public money if no « general interest » objective
 - Potential customers of services or vehicles
 - Role for certification, regalia role associated to national laws
 - o Definition of applicable technical requirements, safety factors, required tests: state of the art development
 - o Role in the development process, technical reviews,
 - o Qualification, certification, licensing
 - Synergies with conventional space activities
 - o Innovative propulsion
 - o Reusability: applicability to future RLVs,
 - Reusable propulsion
 - Health Monitoring, FDIR
 - o Aerodynamics, transsonics, reentry
 - o Human factors
 - Synergies with military activities, from reconnaissance to strike; parallel with modern UAVs
 - Support of competitiveness of industry; country image
 - X-Prize cup, extension of the domain
 - Open-mind attitude
 - o Potentially important domain in future
 - o Comparison to beginning of aviation

Grand total : 62 pages (for comparison : Space Debris = 64 pages)