Introduction

Global suborbital spaceflight market

Enabling factors in the U.S.

The regulatory scenario

Conclusions

Strategy&, formerly known as Booz & Company

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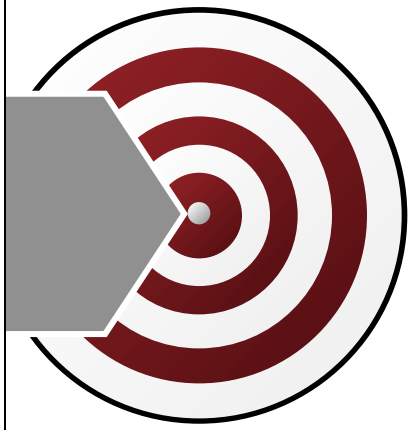
- Strategy& was formed on March 31st, 2014, when the firm formerly known as Booz & Company combined with Price Waterhouse Coopers to form a new kind of consulting firm, offering strategy-through-execution services
- Staff of more than 3,300 people
- 61 Offices in all 6 main regions
- Part of the PwC network of firms in 157 countries with more than 184,000 people working in advisory services, assurance and tax
- Space team in Amsterdam

Background: A study made in 2012 for the European Commission

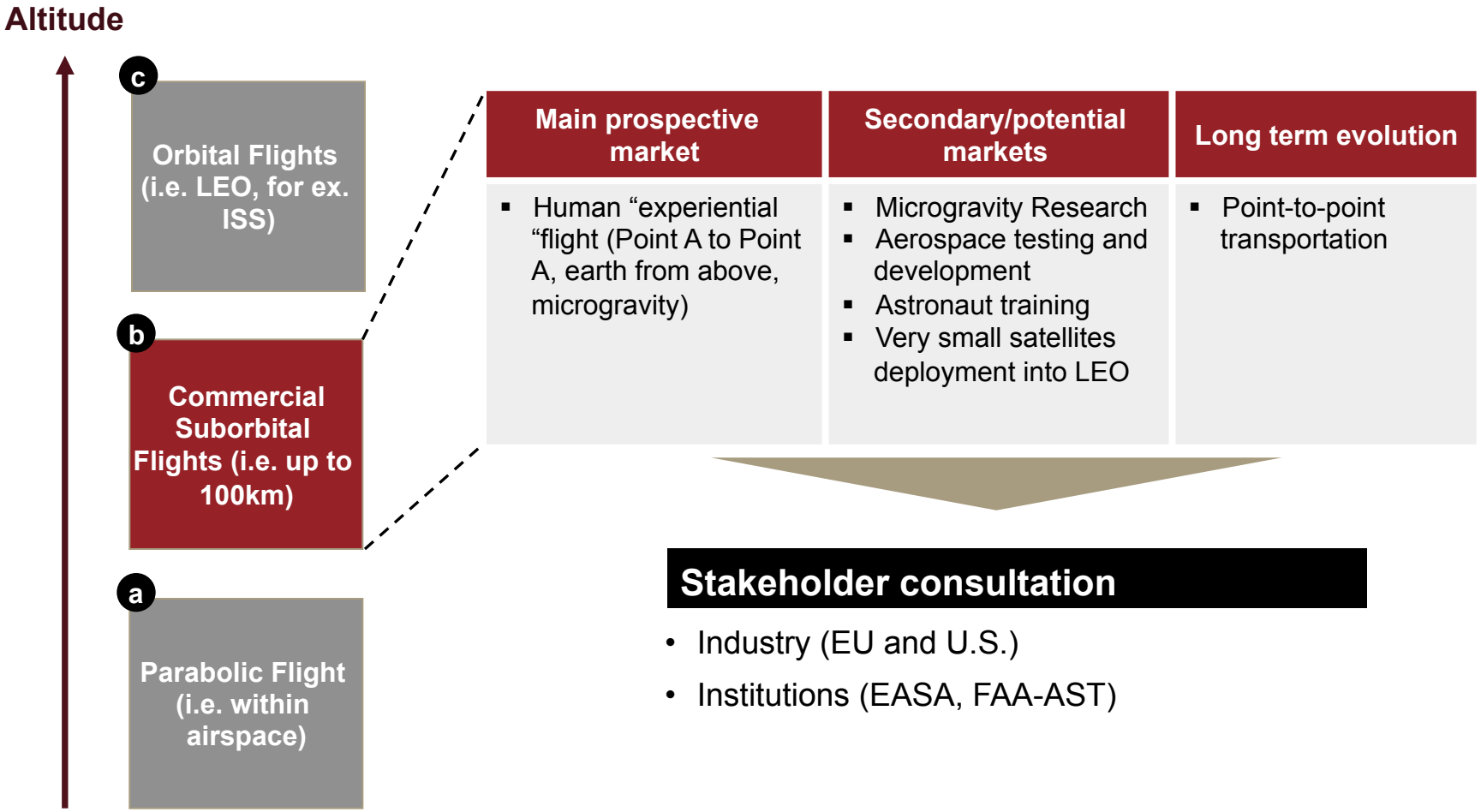
2012 Study Objectives

To conduct an evaluation of the European Market potential for commercial suborbital spaceflights

- Derive a clear picture of the global commercial spaceflight market, its dynamics and trends and any hurdle slowing down or preventing its full development
- Deep-dive in the European scenario, outlining existing gaps with U.S. in terms of industrial capabilities and regulatory frameworks
- Identify possible options for EU actions to boost EU industry competitiveness and evaluate their potential in the market context



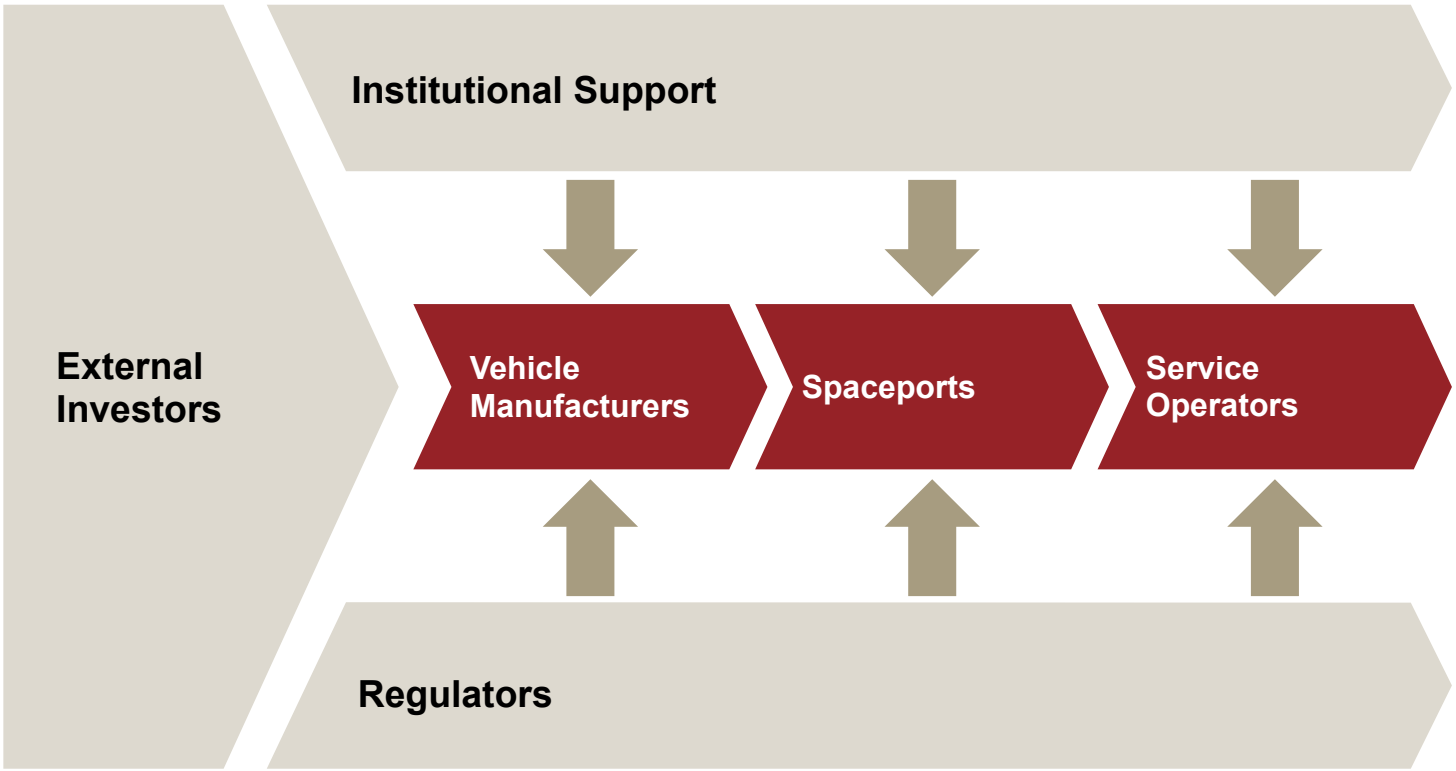
The study focused on suborbital spaceflight, with human "experiential flight" (space tourism) as main market



Stakeholder consultation

- Industry (EU and U.S.)
- Institutions (EASA, FAA-AST)

The suborbital flight value chain and the external enabling factors were analyzed, comparing U.S. and Europe



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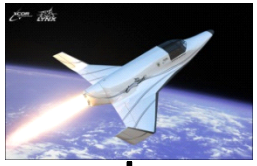
The offering is being channeled through service operators, with two different business models

6 companies have Suborbital Reusable Vehicles (SRV in active development phase

A total of 4 man-rated SRVs are being developed and expected to start operations in 2015 at the earliest

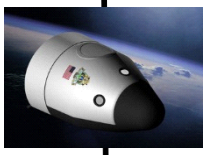
Scaled Composites/Virgin Galactic SpaceshipTwo

Xcor Lynx



Armadillo Hyperion

Blue Origin New Shepard

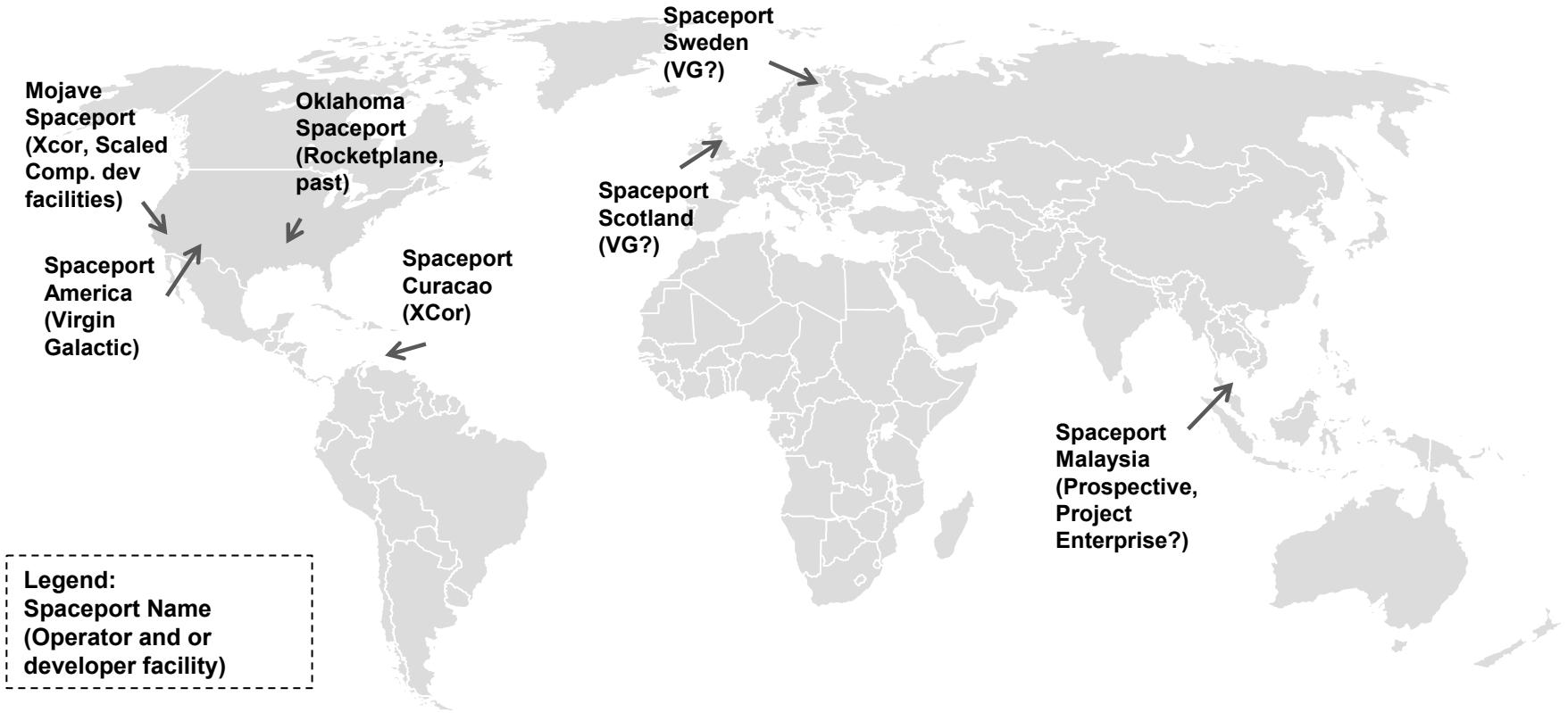


2014-2015? ***2016?*** ***?***

Key Facts

- **Company sizes:** Relatively small start-ups, with the exception of Scaled Composites
- **Private investments:** New economy billionaires:
  - Paul Allen (MS): Scaled Composites
  - John Carmack (ID software): Armadillo
  - Jeff Bezos (Amazon): Blue Origin
- **Large players not in the lead role:**
  - Scaled composites → Northrop Grumman
  - Sierra Nevada Corp. provides Scaled Composites the SpaceshipTwo engine
- **Large inherent risk**: Development requires large upfront investment, innovative technological and system design solution and may lead to failures and/ or delays
- **No manned suborbital test flight was conducted since 2004** X-Prize winning performance of Scaled Composites with the SpaceShipOne

Tourism-rated spaceports are being developed in expectation of sustained flight rates and global operations



- **Technology development poles around spaceports (Mojave, Spaceport America - prospective)**
- **Deals already being signed with operators, location seen as a differentiator**

Tourism-rated spaceports are being developed in expectation of sustained flight rates and global operations

Vehicle leasing

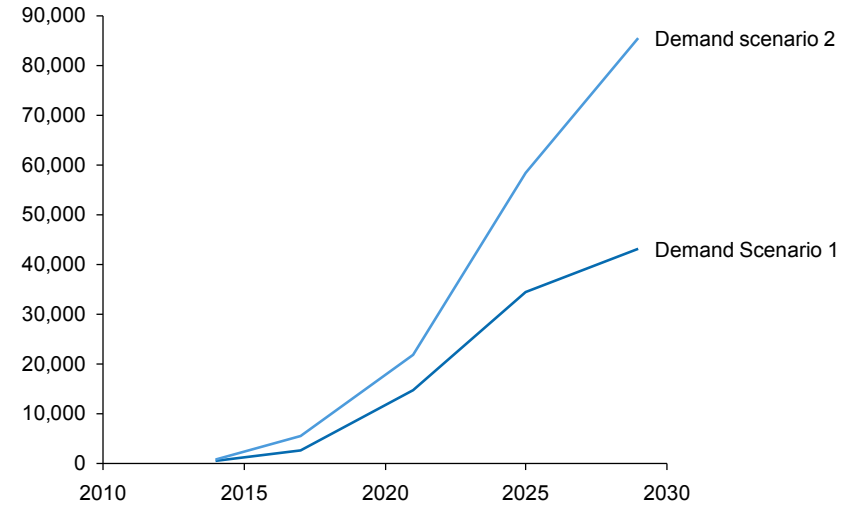
- SRVs fall under ITAR regulation; as such, the only **arrangement realistically allowed in the short term is wet leasing (vehicle, crew for operation and maintenance all provided by the manufacturer)**
- Space Adventures (U.S.), will lease, when available, Armadillo Aerospace's Hyperion vehicle
- Space Expedition Corporation (NL, EU), will lease the XCOR Lynx as, initially, sole operators (taking also over initial presales made directly by XCOR)

Vehicle ownership

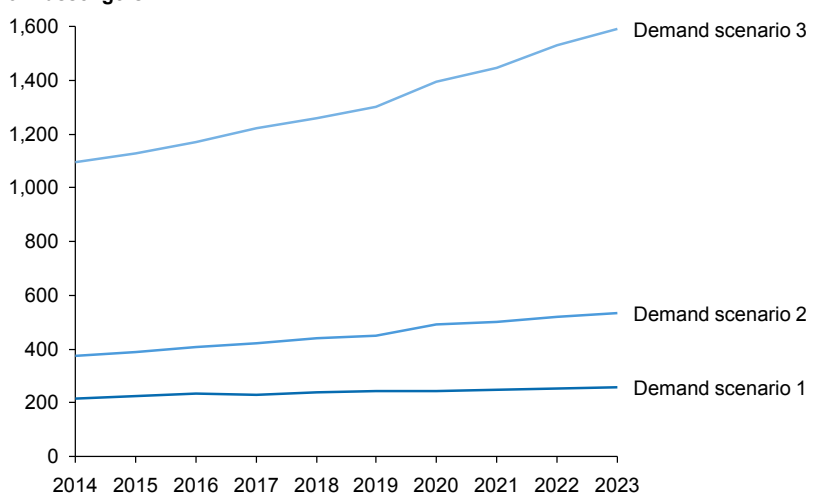
- This arrangement can be achieved if the operator and the manufacturer have shared ownership: Virgin Galactic is the full owner of The Spaceship Company, which will serialize the vehicle prototyped by Scaled Composites

Past assessment studies show significantly different results in forecasted demand

Global Demand – IPSOS/Astrium
Global study 2007-2010



Global Demand – The Tauri Group
Global study 2012



- The main differences in the assumptions at the basis of the two studies lie in
  - Safety level pitched to the respondent
  - Criteria for selection of the base population for the survey results extrapolation

- Main demand drivers identified in:
  - Ticket price
  - Perceived safety level
  - Exclusivity/luxury factor

Even in the worst case scenario, demand outstrips expected supply

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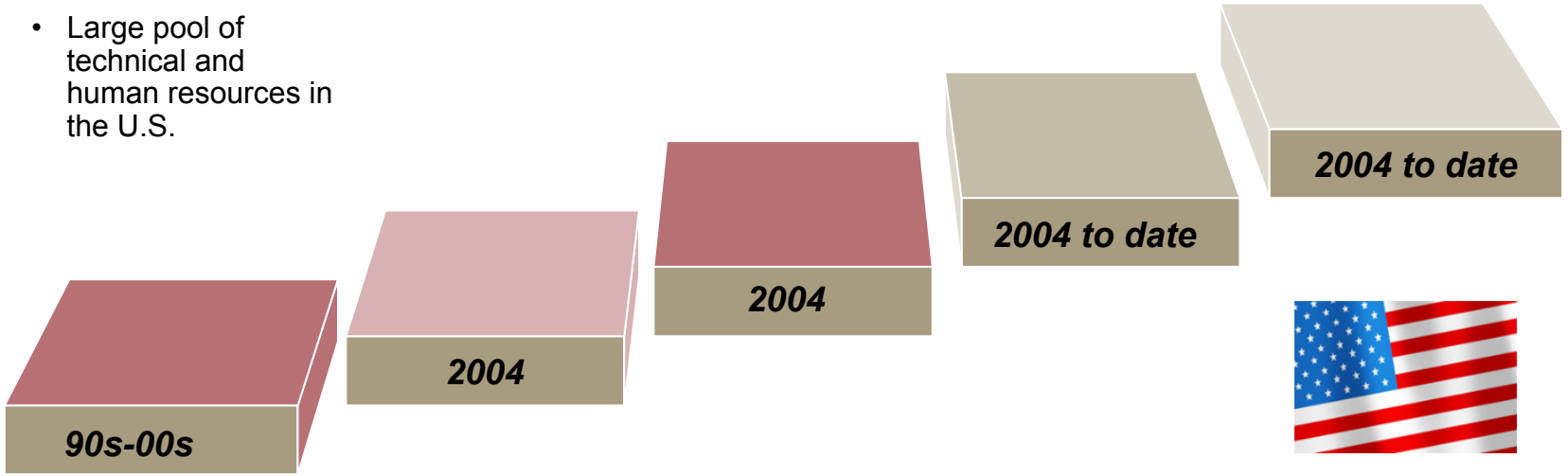
Favourable external conditions and a strong pool of resources were key to the birth of the industry in the U.S.

Resources	Incentives	Regulation	Federal Support	State support
• Wealthy investors with an enthusiasm for space (willingness to push the envelope) Paul Allen, Jeff Bezos • Large pool of technical and human resources in the U.S.	• Ansari X-Prize – The onset of the "commercial space race", spurred interest and fostered fast-paced development	• Commercial Space Launch Amendments Act in 2004 – licensing/informed consent approach	• USAF and NASA contracts – VG, Xcor • Use of facilities	• Grants and tax benefits – New Mexico (VG and Xcor – Oklahoma (Rocketplane)



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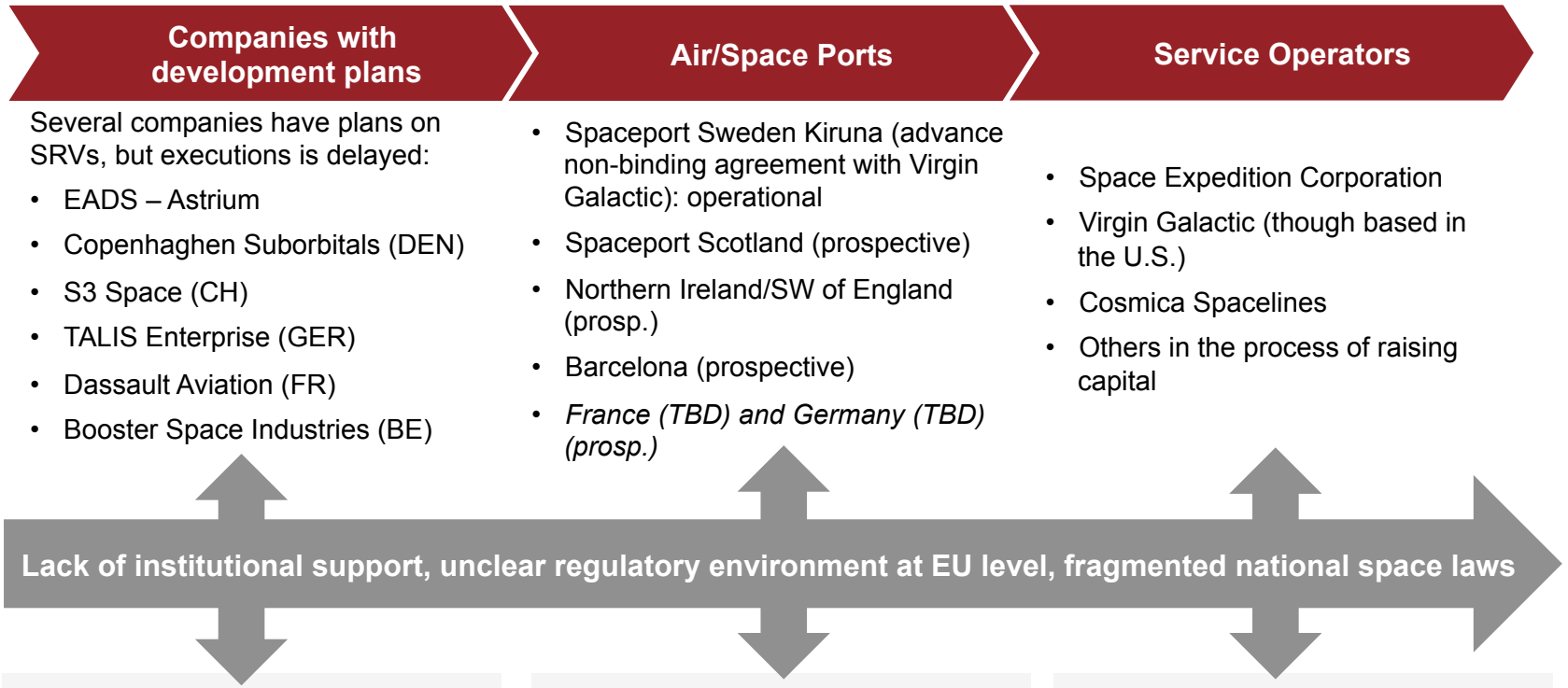
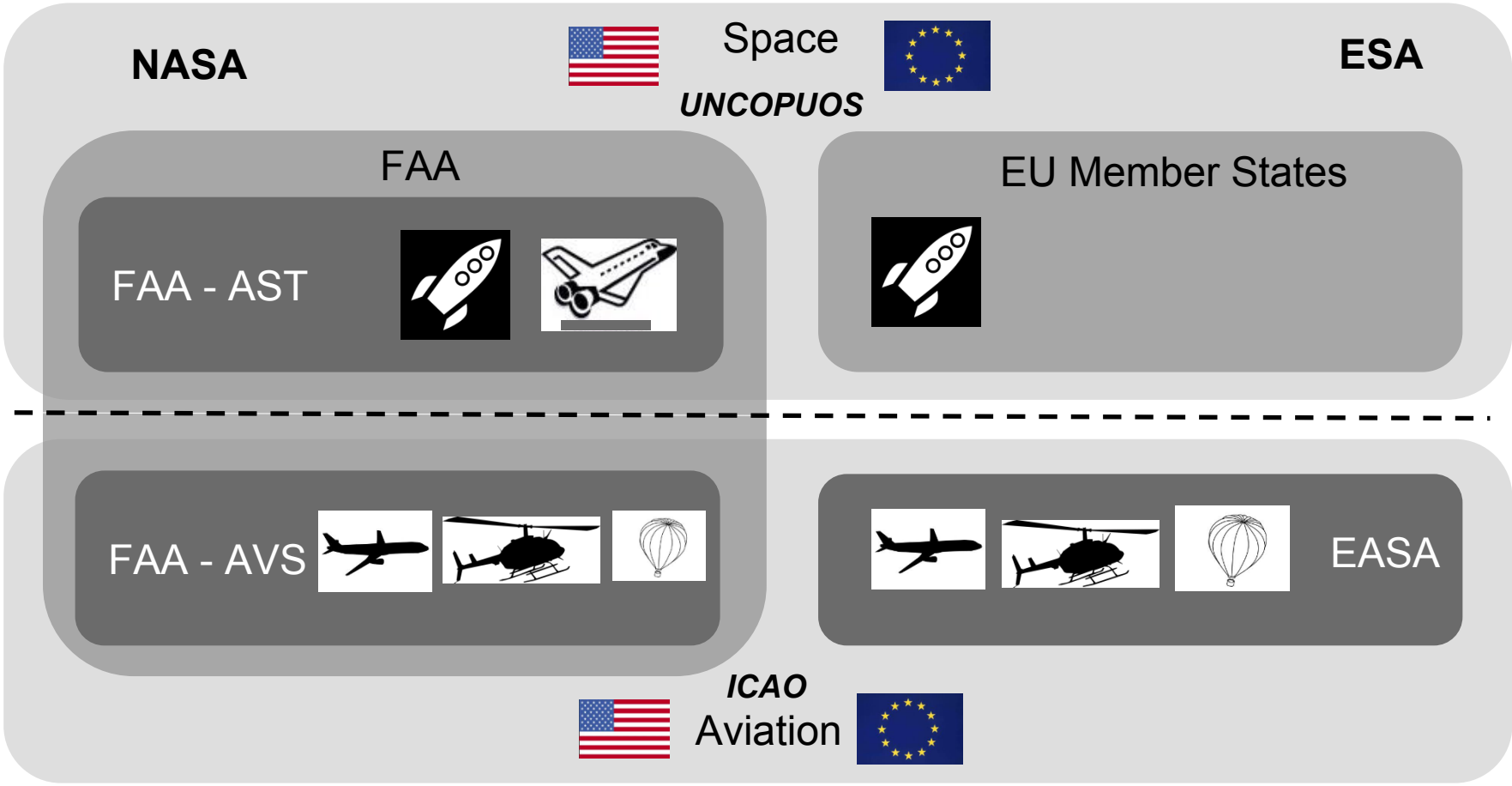
EU SRV dev. plans are at earlier stages , and unclear external conditions make prospective operations uncertain



EU has not decided on jurisdiction for Commercial Spaceflight and on a suitable regulatory framework



Scattered regulatory efforts on SRV are ongoing in Europe

Netherlands: Regulation is to be launched in Curacao for Space Expedition Corporation operations of *XCor Lynx* vehicle

Sweden: there is work towards a licensing-like national regulation to allow VG to fly from Spaceport Sweden (and treat *SpaceShipTwo* as a sounding rocket)

UK: the UK Space Agency and the Airworthiness authority have instituted a working group running since the end of 2011 to address regulatory matters for commercial space at large (dealing with both suborbital,point-to-point and orbital), driven by Reaction Engine Limited (SKYLON project)

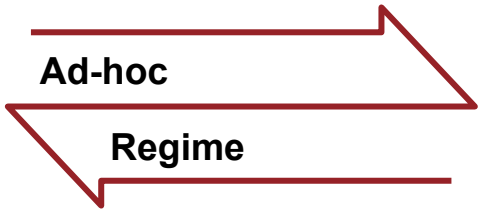
Two approaches are conceivable for suborbital flight regulation, with intermediate ones also possible

Regulatory Approach	Pros	Cons	Impact on Vehicle Developers	Impact on Operators	Impact on Spaceports
US Licensing approach (FAA-AST): - Treats suborbital flight as spaceflight - Informed consent for passengers - Liability to third parties	- Lean approach - Allows new entrants to get to operations quickly - Allows for continual technical improvements without the need to cease operations	- Possible fragmentation in safety levels - The licence to fly is related to the ensemble of vehicle, operator, location - Low perceived safety of flight	- Lower time and cost to market - Continual technology and system development - Lower perceived safety of flight by end customers may slow down the market after initial early adoption spike	- Higher Risk - Possibly higher Insurance premiums	Requires dedicated spaceports
Aviation-like Certification: liability to manufacturer/ operator and to certification authority	- Creates standard safety requirements Increases perceived safety of flight, and appeal to customers - Certification is product related	- Higher cost and time requirements may represent a barrier to entry for smaller players	- Higher time to market - Higher development CapEx - Increased perceived safety level is a competitive advantage	- Lower Risk - Lower Insurance premiums - Higher OpEx	Certified vehicles may be able to fly from any conventional airport, making dedicated spaceports less strategic

An ad-hoc regulatory regime is seen at this stage as the best option for Europe

FAA-AST-like

- Not applicable to EU operations (liability issues
- Not solving the needs of large EU players looking to protect their brand equity



Aviation-like

- Could crush a nascent industry
- Too demanding for small start-ups

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The study showed a highly strategic market in the making in the U.S., and a rising level of interest in Europe

- The study showed the importance of this market for European competitiveness and the need to pursue institutional actions in order to foster its development in the EU

- Almost all stakeholders along the value chain, including U.S. players, see a clear regulatory framework in place as a mandatory step to for market development, as the only measure that can:

    - Create a safe business environment
    - Raise investors' confidence
    - Provide business sustainability in the long run

- An ad-hoc intermediate regulatory regime en route to a full vehicle certification approach is seen at this stage as the best option for Europe