Emerging Business Models for Commercial Spaceports: Current Trends from the US Perspective

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Emerging Business Models for Commercial Spaceports: Current Trends from the US Perspective

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Embry-Riddle Aeronautical University
Daytona Beach, Florida USA

SIRIUS Research Workshop
Toulouse, France
13 October 2016
Agenda

• US commercial/government active launch sites
• Why commercial spaceports?
• Spaceport business model drivers
• Spaceport multi-modal facility and infrastructure requirements
• Emerging spaceport business models
• Summary and concluding remarks
Why Commercial Spaceports?

- National space centers are expanding commercial space programs.
- Commercial spaceports developing as commercial space transportation activities grow
- Commercial space transportation activities include
  - Payload and International Space Station (ISS) crew transportation
    - Shift for federal government from launch service provider to customer
  - Space travel and tourism
  - Space mining (ex. planetary resources/asteroid mining)
- Methods of transport
  - Point-to-point (ex. Virgin Galactic)
  - Single point – launch and return
  - Single point launch (ex. SpaceX and Mars)
Spaceport Business Model Drivers – Interrelated

- Shifting US government role
- Expansion of commercial transportation activities
- Enabling legislation tied to commercial space: local, state, and federal laws and policies
- Funding availability for spaceports
- Type of vehicle launch and return—horizontal or vertical
- Airspace and jurisdiction
- Physical infrastructure and feasibility of adding/building infrastructure for spaceport
- Multimodal transportation access for spaceport activities
- Environmental impacts – natural, population
- Market opportunities
- Economic benefit to the community
Spaceport – Multimodal Transportation Facility

Source: Finger, What Happens at a Spaceport, TR news, Nov/Dec 2015
Spaceport Infrastructure Requirements – Safety is Paramount

- Infrastructures for vertical and horizontal launch and landing
  - Launch pads and landing pads
  - Runways (>= 12,000ft), taxiways and ramp areas
- Mission control centers
- Air control towers
- Hangars
- Storage areas (fuel/oxidizers)
- Payload integration facilities
- Emergency facilities
- ……
Emerging Spaceport Business Models

• Airports to air and space ports
  • General aviation (GA) and commercial, former/current military airfields
    • Examples: Cecil Spaceport, Mojave Air and Space Port, Midland Air and Space Port, Houston Spaceport at Ellington
  • Integration of current airport operations and infrastructures

• Greenfield spaceports
  • Examples: Spaceport America; Blue Origin-West Texas (private); Space X- Brownsville, Texas (private)

• National space and military centers
  • Examples
    • Wallops Flight Center/Mid-Atlantic Regional Spaceport (MARS)
    • NASA Kennedy Space Center/Cape Canaveral Air Force Station
Cecil Spaceport Jacksonville, FL
Cecil Spaceport Business Model

• Jacksonville Aviation Authority granted a launch site operator license in January 2010
  Cecil Airport - GA airport, formerly military airfield

• Launch type - departing Cecil Spaceport as an aircraft – horizontal
  Short term: launch and reentry horizontally launched reusable launch vehicles (RLVs) using suborbital trajectories
  Long term: point-to-point transportation

• Assumptions: +250 flights annually within 20 years from the commencement of commercial operations if obtain 10% of commercial space operations market.
Revenues and Cost Estimates for Infrastructure Improvement

• Revenues (assumption)
  • Launch fees
  • Fixed based operator (FBO) - type services
  • Lease agreements: Current lease tenants for Cecil Airport include Boeing Global Services and Support; none directly tied to the spaceport.

• Early stages of infrastructure conversion to spaceport

• Initial cost estimates for physical infrastructure improvements
  • Short Term (2012-2016) $21.9M Road, utilities, operator sites - construct
  • Medium Term (2017-2021) $17.8M Taxiways –construct/reconstruct
  • Long Term (2022-2031) $48.6M Reconstruct runway/construct visitor center
    Total $88.3M

• Funding Sources
  Jacksonville Aviation Authority; State of Florida; Federal
Mojave Air and Space Port
Mojave Air and Space Port Business Model

- First facility to be licensed in the United States for horizontal launches of reusable spacecraft. Certified as a spaceport by FAA on June 17, 2004—East Kern Airport District.
- Broad business model
  - 51% of the revenue generated at Mojave Air and Space Port comes from companies engaged in privately-funded commercial spaceflight research and development (R&D).
  - Test, manufacturing, development.
Spaceport Activities – Test, Manufacturing, Development

Source: http://www.mojaveairport.com/directory.html
Mid-Atlantic Regional Spaceport (MARS), Wallops Island, VA
• Located within NASA Wallops Island Flight Center
  • Reimbursable Space Act Agreement with NASA permitted use of land with launch pads
• Managed and developed by Virginia Commercial Space Flight Authority (VCSFA) “Virginia Space”; license 1997
• Approved for **vertical** launch to orbit
• Developed 2 launch pads
  • MARS Pad 0A is a Mid-Class Launch Facility (MCLF) – Orbital ATK Antares
  • MARS Pad 0B is a Small-Class Launch Facility (SCLF)
MARS Business Model

- Operate on government land with mix of NASA and Virginia Space assets
- Two launch pads for commercial vertical launch – low cost access to space
- Range services, ground and flight safety, launch vehicle flight certificates
- Facilities – logistic support
  - Scheduling, maintenance, and inspection to ensure optimal accomplishment of ground processing and launch.
  - Provision of supplies, commodities, and consumables to support mission operations.
- Revenues derived from launch fees and services
- Initial infrastructure costs (1995-2003) $4.9M
- Funding sources: Virginia Space; State of Virginia; Federal
Spaceport America
Spaceport America
Changing Business Model

• +$200 million spaceport – **horizontal and vertical** launch
  • Anchor tenant - Virgin Galactic for space tourism
  • Other business
    • SpaceX – tenant
    • UP Aerospace - Suborbital vertical launches
    • Fly/lease/build
    • Events space
    • Tours
  • Projected 2017 revenues
    • Virgin Galactic lease and user fees ($1.6M)
    • Other aerospace customers (.7M)
    • Other, incl. special events, tourism, merchandising ($1.8M)
    • New Mexico General Fund ($2.2M)
## Spaceport Business Model Summary

<table>
<thead>
<tr>
<th></th>
<th>Cecil Spaceport</th>
<th>Mojave Air and Space Port</th>
<th>MARS</th>
<th>Spaceport America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch type</td>
<td>Horizontal</td>
<td>Horizontal</td>
<td>Vertical</td>
<td>Horizontal and vertical</td>
</tr>
<tr>
<td>Purpose</td>
<td>“Airport” for space</td>
<td>Test, manufacturing, etc.</td>
<td>Launch – low cost access</td>
<td>Space tourism</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>GA airport; formerly naval airfield</td>
<td>GA airport; formerly military field</td>
<td>NASA property</td>
<td>Greenfield</td>
</tr>
<tr>
<td>Initial infrastructure costs</td>
<td>$88.3M est.</td>
<td>?</td>
<td>$4.9M</td>
<td>&gt;$200M</td>
</tr>
<tr>
<td>Revenues</td>
<td>Launch/user fees, FBO-type services; lease fees</td>
<td>Lease fees, projects, services</td>
<td>Launch fees and related services</td>
<td>Lease and user fees; services; tourism</td>
</tr>
</tbody>
</table>
Spaceport Business Model Summary

• Generalities
  • Airports (GA and commercial), spaceport greenfield (port authority, private), and non-government spaceport on government land/assets.
  • Business model drivers are inter-related.
  • Least costly model involves land/property agreements with NASA/government
    • SpaceX 20 Year Property Agreement with NASA Kennedy Space Center for Launch Complex 39A

• Revenue sources
  • Lease (hangars, payload processing facilities, training facilities, test facilities)
  • Launch, user, operations fees
  • Services, including “FBO” type services (maintenance, sale of fuel, propellants, oxidizers), ground and flight safety, vehicle certifications, logistics
  • Other revenues (tourism, events, etc.)
Concluding Remarks

• Challenges
  • Time requirements for spaceport infrastructure development
  • Time and financial requirements for spaceport licensing application
  • Spaceports highly competitive
  • Loss of anchor tenant or lack of focus/purpose

• Positives outweigh the negatives in many cases due to expected return on investment (ROI).

• Both private investors and government entities are increasingly looking to commercial space transportation as the new 6th mode of transportation.
Thank you.
Backup Slides
### Total Orbital Launches in 2015

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Civil</th>
<th>Military</th>
<th>Commercial</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Russia</td>
<td>14</td>
<td>7</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>USA</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>China</td>
<td>12</td>
<td>7</td>
<td>0</td>
<td>19</td>
</tr>
<tr>
<td>Europe</td>
<td>5</td>
<td>0</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>India</td>
<td>3</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Japan</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Iran</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

**TOTALS**

- **Civil**: 40
- **Military**: 24
- **Commercial**: 22
- **Total**: 86

*Table 8. Total orbital launches in 2015 by country and type.*

2015 Estimated Revenues for Commercial Launches

Figure 7. 2015 estimated revenues for commercial launches by country of service provider.

# Horizontal Reusable Launch Vehicle (RLV) Concepts

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Concept X*</th>
<th>Concept Y</th>
<th>Concept Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Takeoff</td>
<td>Horizontal</td>
<td>Horizontal</td>
<td>Horizontal</td>
</tr>
<tr>
<td>Takeoff Method</td>
<td>Jet powered/Turbofan engines with integrated rocket motors in single stage-to-space</td>
<td>Rocket powered; ignition on ground and rocket power throughout flight</td>
<td>Jet powered</td>
</tr>
<tr>
<td>Uses Carrier Aircraft</td>
<td>No</td>
<td>No</td>
<td>Yes: spacecraft separates from aircraft</td>
</tr>
<tr>
<td>Landing Method</td>
<td>Glide or jet powered</td>
<td>Glide</td>
<td>Glide or expendable</td>
</tr>
<tr>
<td>Suborbital/Orbital</td>
<td>Suborbital</td>
<td>Suborbital</td>
<td>Either</td>
</tr>
<tr>
<td>Manned or Unmanned</td>
<td>Manned</td>
<td>Manned</td>
<td>Either</td>
</tr>
<tr>
<td>Example</td>
<td>Airbus Spaceplane</td>
<td>XCOR Lynx</td>
<td>Virgin Galactic SpaceShipTwo</td>
</tr>
</tbody>
</table>

*USA Federal Aviation Administration (FAA) designations
Horizontal RLV Concepts: Examples

Concept X: Airbus Spaceplane
Concept Y: XCOR Lynx
Concept Z: Virgin Galactic SpaceShipTwo
### Vertical Launch Vehicles

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>“Concept A”</th>
<th>“Concept B”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Takeoff</strong></td>
<td>Vertical</td>
<td>Vertical takeoff and landing (VTOL)</td>
</tr>
<tr>
<td><strong>Takeoff method</strong></td>
<td>Rocket powered; capsule separation</td>
<td>Rocket powered; capsule separation</td>
</tr>
<tr>
<td><strong>Uses Carrier Aircraft</strong></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Landing Method</strong></td>
<td>Reusable rocket vertical return; Capsule free flight; floats down with parachutes</td>
<td>Reusable rocket vertical return; capsule vertical return</td>
</tr>
<tr>
<td><strong>Suborbital/Orbital</strong></td>
<td>Suborbital</td>
<td>Orbital</td>
</tr>
<tr>
<td><strong>Manned/unmanned</strong></td>
<td>Both</td>
<td>Both</td>
</tr>
<tr>
<td><strong>Example</strong></td>
<td>Blue Origin New Shepard</td>
<td>SpaceX Dragon with Falcon</td>
</tr>
</tbody>
</table>
Vertical Launch Vehicle Examples

“Concept A”

“Concept B”