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

Janet K. Tinoco  
*Embry-Riddle Aeronautical University, tinocoj@erau.edu*

Chunyan Yu  
*Embry-Riddle Aeronautical University, yuc@erau.edu*

Follow this and additional works at: [https://commons.erau.edu/publication](https://commons.erau.edu/publication)

Part of the Aerospace Engineering Commons, Business Commons, and the Transportation Commons

Scholarly Commons Citation  

This Presentation without Video is brought to you for free and open access by Scholarly Commons. It has been accepted for inclusion in Publications by an authorized administrator of Scholarly Commons. For more information, please contact commons@erau.edu.
Emerging Business Models for Commercial Spaceports: Current Trends from the US Perspective

Janet K. Tinoco, Ph.D. and Chunyan Yu, Ph.D.
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
Commercial/ Government Active Launch Sites

- U.S Federal Launch Site
- Non-Federal FAA Licensed Launch Site
- Non-Licensed U.S Site
- Proposed Site

- Vandenberg Air Force Base
- Cape Canaveral Air Force Station
- Wallops Flight Facility
- Cecil Field Spaceport
- Ellington Field
- Mid-Atlantic Regional Spaceport
- Kennedy Space Center
- U.S Federal Launch Site
- Non-Federal FAA Licensed Launch Site
- Non-Licensed U.S Site
- Proposed Site

- California Spaceport
- Vandenberg Air Force Base
- Mojave Air and Space Port
- Edward Air Force Base
- Spaceport America
- White Sands Missile Range
- Blue Origin West Texas Rocket Flight Facility
- Front Range Airport
- Ellington Field
- SpaceX McGregor Rocket Development and Test Facility
- Cape Canaveral Air Force Station
- Kennedy Space Center
- Cape Canaveral Spaceport
- Camden Spaceport
- Shiloh
- Cape Canaveral Air Force Station
- Front Range Airport
- Ellington Field
- SpaceX McGregor Rocket Development and Test Facility
- Cape Canaveral Spaceport
- Camden Spaceport
- Shiloh
- Cape Canaveral Air Force Station
- Kennedy Space Center
- Cape Canaveral Spaceport
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 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
  • Main Tenants: XCOR Aerospace, Masten Space Systems, Virgin Galactic, The Spaceship Company, Stratolaunch Systems, Firestar Technologies, Orbital Sciences Corporation and Interorbital Systems
  • 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
MARS- Background

- 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><strong>Launch type</strong></td>
<td>Horizontal</td>
<td>Horizontal</td>
<td>Vertical</td>
<td>Horizontal and vertical</td>
</tr>
<tr>
<td><strong>Purpose</strong></td>
<td>“Airport” for space</td>
<td>Test, manufacturing, etc.</td>
<td>Launch – low cost access</td>
<td>Space tourism</td>
</tr>
<tr>
<td><strong>Infrastructure</strong></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><strong>Initial infrastructure costs</strong></td>
<td>$88.3M est.</td>
<td>?</td>
<td>$4.9M</td>
<td>&gt;$200M</td>
</tr>
<tr>
<td><strong>Revenues</strong></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 8. Total orbital launches in 2015 by country and type.**

<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** | 40    | 24       | 22         | 86    |

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>Takeoff</td>
<td>Vertical</td>
<td>Vertical takeoff and landing (VTOL)</td>
</tr>
<tr>
<td>Takeoff method</td>
<td>Rocket powered; capsule separation</td>
<td>Rocket powered; capsule separation</td>
</tr>
<tr>
<td>Uses Carrier Aircraft</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Landing Method</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>Suborbital/Orbital</td>
<td>Suborbital</td>
<td>Orbital</td>
</tr>
<tr>
<td>Manned/unmanned</td>
<td>Both</td>
<td>Both</td>
</tr>
<tr>
<td>Example</td>
<td>Blue Origin New Shepard</td>
<td>SpaceX Dragon with Falcon</td>
</tr>
</tbody>
</table>
Vertical Launch Vehicle Examples

“Concept A”

“Concept B”