Commercial Spaceports In the Americas

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Introduction

Commercial spaceports are launch facilities dedicated to serving the needs of the commercial launch industry. The need to move beyond the restrictions and costs of using government facilities was the key driver in the emergence of the industry, and it came about as a result of the gradual commercialization of space launch starting in the 1980s. Today, commercial spaceports serve a key function in the expanding space commerce industry.

This chapter will start with a brief history of the emergence of commercial spaceports and show how their development has paralleled the developing of the space commerce industry, followed by a proposed model for classifying commercial spaceports based on their history and target markets. Finally, the economics of spaceport development will be discussed.

History

The history of commercial spaceports is most easily divided into three eras. The Comsat Spaceport Era, the SSTO Spaceport Era and the Suborbital Spaceport Era. Each era is marked by a different perception of the needs and requirements of the commercial launch industry. The Comsat Spaceport Era spans 1979 to 1995 and marks the need for facilities to launch commercial communication satellites. It was followed by the optimism of the SSTO Spaceport Era of 1996 to 2002. The Single Stage to Orbit (SSTO) Spaceport Era started with the proposal for Lockheed's proposed SSTO called VentureStar. As part of the VentureStar Project, Lockheed requested proposals for launch sites, and eighteen states responded. The third and current era, the Suborbital Spaceport Era, started with the end of the VentureStar and with it plans for developing SSTO. Following the end of the SSTO Era, many spaceports refocused their efforts on the previously ignored suborbital market, stimulated by the growing interest in suborbital tourism resulting from the X-Prize. This is the current era and is driving many of the spaceport efforts today.

The Comsat Spaceport Era: 1979-1995

The demand for commercial satellites, especially communication satellites, created the demand for commercial launch vehicles (Matula and Mitry, 2000). Prior to the 1980s commercial satellites were launched by national space agencies with a cost reimbursement arrangement (Johnson-Freese and Handberg 1997). In 1979, the first successful launch of the Ariane launch system from Guiana Space Centre in French Guiana marked the beginning of the commercial launch industry. The Ariane was designed specifically to serve the needs of the commercial satellite industry, which is why it's considered the first commercial launch system. This makes the Guiana Space Centre in French Guiana the first commercial spaceport.

In the United States, commercial satellites continued to be launched on both expendable launch vehicles like the Delta and Atlas under a cost reimbursement agreement with NASA. The Space Shuttle was also used for launching commercial satellites under the same cost reimbursement arrangement. Following the Challenger accident, commercial payloads were banned from the Space Shuttle by Executive Order, laying the foundation for the commercial launch industry in the United States. In order to accommodate the emerging commercial space launch operations, several commercial space launch facilities, commonly known as commercial spaceports, emerged in the 1990s (Johnson-Freese and Handberg 1997).

In 1989, Spaceport Florida was the first commercial spaceport in the United States, and was created to serve existing Expendable Launch

Vehicles (ELVs) like the Delta and Atlas that were pressed into service for the launching of Comsats following the banning of commercial satellite launches from the Space Shuttle. Spaceport Florida was closely followed by California Spaceport and the Kodiak Launch Complex in Alaska. The Spaceports in both California and Alaska were developed to support the proposed constellations of communication satellites for the satellite mobile phone markets, but demand failed to meet expectations. Spaceport Florida, by contrast, was created to serve the market for Geosynchronous Communication Satellites.

SSTO Spaceport Era: 1996-2002

The Comsat Spaceport Era of commercial spaceports was superseded by the SSTO Era. It was initiated by the flight tests of the DC-X launch system in the early 1990s. The DC-X was a sub-scaled prototype of a Single Stage to Orbit launch system proposed by McDonnell-Douglas. Although it made only a dozen flights, it stimulated the quest for development of a SSTO launch system. This resulted in NASA's X-33 and X-34 Demonstrator Programs. Lockheed Martin won the competition for the X-33 Demonstrator with a lifting body SSTO that was intended to be a sub-scale demonstrator for the VentureStar, a commercial SSTO.

As part of the VentureStar program, Lockheed solicited proposals for launch sites for the system. Eighteen states responded with plans for commercial spaceports designed to meet Lockheed's needs (Matula and Mitry 2000). Since the VentureStar was a SSTO system, it did not need a coastal location such as expandable launch vehicles required, but could actually overfly land areas safely (Matula and Mitry, 2000). As a result, spaceport proposals were submitted from both existing commercial spaceports like Spaceport Florida and California Spaceport, and from inland states including Nevada and Oklahoma, which had no existing facilities or previous history of space launch.

The most serious efforts were from Montana, Oklahoma and Washington, which had existing facilities in the form of closed military bases that would be converted to serve the needs of VentureStar. Some states went as far as creating state spaceport authorities and funding detailed business plans. However the failure to complete the X-33 demonstrator vehicle and changes in market demand for space launch resulted in the VentureStar program being cancelled. This in turn led to most of the proposed commercial spaceport projects lapsing into inactivity and being abandoned due to the lack of any market drivers. However a few did survive to be reorganized into the next Era, the Suborbital Spaceport Era.

Sub-Orbital Spaceport Era: 2002 - Present

The end of the SSTO Spaceport Era resulted in a refocus of the surviving commercial spaceports into a new direction, servicing the emerging demand for suborbital launch systems. The redirection was most apparent in the newly proposed spaceports, while the existing ones, Spaceport Florida, California Spaceport, and Mid-Atlantic Regional Spaceport, continued their focus on the commercial Expendable Launch Vehicles (ELVs) that were already using their facilities.

The stimulus for the new direction of commercial spaceports was the Ansari X Prize (NASA, 2010). The Ansari X Prize was created to stimulate the development of suborbital space tourism. The result was an explosion of proposed suborbital launch systems, which created a demand for commercial spaceports to serve their needs. Spaceports previously proposed for the VentureStar system were refocused towards the needs of suborbital systems, the most prominent among them being New Mexico's proposed Southwest Regional Spaceport, the Oklahoma Spaceport, the proposed Gulf Coast Regional Spaceport, and the Mojave Air and Space Port.

Burt Rutan and Paul Allen won the Ansari X Prize in 2004 (NASA, 2010). Following their victory, Richard Branson announced that he was licensing their system for a suborbital tourism spaceline called Virgin Galactic. (*Editor's note*: Please see Chapter 7, *A Tourist's Perspective on Space*.) Shortly after its creation, Virgin Galactic selected New Mexico's Southwest Regional Spaceport as the base for its launch operations (Gomez, et al, 2007). Other suborbital tourism ventures selected other commercial spaceports. Rocket Plane Kistler selected Oklahoma Spaceport for its base of operations, although later the venture failed to secure the financing needed. Blue Origins, another suborbital tourism venture, made a different choice, and is building its own private spaceport in West Texas. Although not selected for its operations, Mojave Air and Space Port has positioned itself well as a research and test facility. Another facility considered for VentureStar, Cecil Field in Northern Florida has also gone ahead with licensing as a commercial spaceport.

Spaceport Classification

One challenge when discussing spaceports is the wide range of facilities that call themselves spaceports, from major existing facilities like Spaceport Florida to the proposed Spaceport Wisconsin. In this chapter, a classification system is proposed that is based on the history and capabilities of the different facilities. The proposed classification system is based on a two by two matrix, with the horizontal axis based on capability to support suborbital and/or orbital launches. The vertical axis is based on

the facility's history: Is it an existing facility that has been converted to commercial needs, or is it a clear sheet development? The result is a simple but practical classification system shown in Figure 1. Examples of different commercial spaceports are provided in each element of the matrix. It is not intended to be a comprehensive survey of commercial spaceports either globally or in the United States.

	Suborbital	Orbital
Converted Facilities	Mojave Air and Space Port Oklahoma Spaceport Cecil Field Spaceport	Spaceport Florida Mid-Atlantic Regional Spaceport California Spaceport
New Start Facilities	Spaceport America Blue Origin Spaceport Spaceport Sheboygan	Guiana Space Centre Kodiak Launch Complex

Figure 1
Classification of Commercial Spaceports

Converted Suborbital

Converted Suborbital Spaceports are commercial spaceports limited by location to only suborbital launches. All existing converted suborbital spaceports started as airfields, either commercial or military, in locations that enabled them to provide the airspace and facilities needed for suborbital launch operations. Converted Suborbital commercial spaceports have the advantage of lower start-up costs since they have existing infrastructure to use, especially expensive facilities like long runways, hangers, and associated support buildings. Three examples are highlighted below.

Mojave Air and Space Port

(http://www.mojaveairport.com/)

Mojave Air and Space Port is located in southern California near Edwards Air Force Base. The home to Burt Rutan's Scaled Composite Corporation, it was the site of the successful test program for SpaceShipOne, the vehicle that won the Ansari X Prize. It is currently home to a flight test program for Virgin Galactic's SpaceShipTwo, as well as other entrepreneurial suborbital space ventures. Mojave Air and Space Port was already an existing commercial airport with an emphasis on pilot training and flight test operations, and the conversion into a suborbital facility was a logical extension of those existing aviation activities.

Cecil Field Spaceport

(http://www.cecilfieldspaceport.com/)

Cecil Field Spaceport in located in Jacksonville, Florida at the former Naval Air Station Cecil Field. Vacated by the U.S. Navy in 1999, Cecil Field pursued licensing to serve the needs of air launch suborbital systems. In 2010 it became an FAA licensed spaceport for air launched suborbital vehicles. Its main advantage is its proximity to the Atlantic Ocean, which makes it ideal for testing of air-launched suborbital systems.

Spaceport Oklahoma

(http://www.okspaceport.state.ok.us/)

Spaceport Oklahoma, located in Burns, Oklahoma, was originally Clinton-Sherman Air Force Base, a former U.S. Air Force Strategic Air Command base. When it was closed in 1969 it was converted into an industrial park. Its remote location and large runways stimulated interest in the facility as a site for Lockheed's VentureStar. After the VentureStar project was cancelled, the decision was made to use it as a suborbital launch facility. Rocket Plane Kistler, a suborbital launch venture located there with the intention to use it as its base of operations. Although Rocket Plane Kistler went bankrupt in 2010, the field continues to be used by other suborbital launch ventures.

New Suborbital

New Suborbital spaceports are facilities that are being built from the ground up at locations with no space launch history. Limited by their geographic location to suborbital launches, they are focused on the emerging demand for suborbital launch facilities. New suborbital commercial spaceports are much more expensive to develop then Converted Suborbital commercial spaceports because they start with bare land and few, if any, improvements. This means that all of the necessary infrastructure, from runways to hangers, must be built new, often an expensive proposition. This of course creates a much higher barrier to their development, and has significant consequences for their eventual economic success.

Spaceport America

(http://www.spaceportamerica.com/)

Spaceport America is located in Upham, New Mexico near the White Sands Missile Range. Spaceport America originally was started in the early 1990s as the Southwest Regional Spaceport. The stimulus to its development was the military's DC-X program, a subscale prototype of a Single Stage to Orbital system that was being tested at nearby White Sands Missile Range. McDonnell Douglas had plans to develop it into a

commercial launch system, and the valley of ranches that Upham, New Mexico was located in was considered an ideal site.

Following the failure of McDonnell Douglas to win the NASA X-33 competition, the focus of the Southwest Regional Spaceport shifted towards attracting the winner, Lockheed's VentureStar. But then with the cancellation of the VentureStar, Southwest Regional Spaceport shifted its focus again, this time to the emerging suborbital tourist industry. In 2006 it was selected as the launch site for Virgin Galactic Space Lines, and actual construction began. Its name was also changed from the Southwest Regional Spaceport to Spaceport America. Current plans are to finish the spaceport in 2010 to support Virgin Galactic launch operations beginning in 2012.

Figure 1
Illustration showing Spaceport America
Image courtesy of Ad Astra Rocket Company

Blue Origin Spaceport

(http://www.blueorigin.com/)

Blue Origin is a Seattle, Washington based firm that is develop a private Single Stage to Orbit system based on the original DC-X design. As part of its program, it has developed its own private spaceport in west Texas on a cattle ranch just north of the town of Van Horn. Currently the company is conducting its space launch test program at the site.

Spaceport Sheboygan

(http://www.spaceportsheboygan.org/)

Spaceport Sheboygan is located near Sheboygan Wisconsin on the shore of Lake Michigan. A number of NASA sounding rockets have been launched from the site, and the proposed spaceport is being designed to serve the space educational needs of the Great Lakes region.

Converted Orbital

Convert Orbital commercial spaceports generally have the fewest barriers to development since they are located at facilities that have already been launching satellites into orbit for many years. It should be noted that although these are designated as orbital commercial spaceports, they are also able to serve the suborbital market as well, which gives them a competitive advantage in attracting customers. The infrastructure required for launch operations, from launch pads and runways to tracking and payload integration facilities, is already in existence, and as a result, the conversion is largely administrative, with specific pads and facilities turned over to commercial spaceport for its use. As a result, expenses beyond administrative and operation costs are usually limited to modifications and upgrading of the launch pads and payload integration facilities, usually to meet the needs of specific customers.

Spaceport Florida

(http://www.spaceportflorida.com/)

The oldest commercial spaceport in the United States is located on the Cape Canaveral Air Force Station, and uses launch pads originally built for U.S. Air Force needs. Created in 1989 to meet the demand for a commercial facility to launch payloads on existing systems like Delta and Atlas, it has developed into the premier spaceport in the United States. The majority of commercial launches to orbit from the United States are from Spaceport Florida.

California Spaceport

(http://www.calspace.com/SSI/Welcome.html)

Like Spaceport Florida, California Spaceport is located at an existing facility for launching orbital vehicles, Vandenberg Air Force Base. It was created in 1990 to provide a launch site for Expendable Launch Systems like Atlas and Delta following the banning of commercial payloads on the Space Shuttle. It is currently the premier location in the United States for launching commercial satellites into polar and high inclination orbits.

Mid-Atlantic Regional Spaceport

(http://www.marsspaceport.com/)

Developed from NASA Wallops Island launch facility on the coast of Virginia, the Mid-Atlantic Regional Spaceport, nicknamed MARS due to its initials, was created to serve the needs of small and medium size launch vehicles. Since the NASA Wallops Island facility is home to NASA's suborbital research program, MARS is also a major player in the suborbital launch market.

New Orbital

New Orbital commercial spaceports have the biggest barriers to overcome. Because orbital launches require a large safety area under the launch track, orbital facilities are usually located on coastal land that is usually highly desirable for other uses. This usually brings them into conflict with other potential users, driving up the cost of land. Orbital launch facilities also require the most infrastructure, from launch pads to extensive launch tracking systems, and this also increases the cost of their development.

Guiana Space Centre

(http://www.esa.int/esaMI/Launchers_Europe_s_Spaceport/)

The Guiana Space Centre is located near Kourou in French Guiana in South America. It was constructed in the late 1970's by the European Space Agency (ESA) specifically to serve the needs of the Ariane launch system. Since the Ariane launch family was designed to meet the needs of the commercial communications satellite industry it has a strong claim to being the first commercial spaceport, although it is still owned by the European Space Agency.

Kodiak Launch Complex

(http://www.akaerospace.com/)

The Kodiak Launch Complex is located on Kodiak Island in the Gulf of Alaska. It is owned and operated by the Alaska Aerospace Corporation, which is in turn owned by the state of Alaska. It was developed in the 1990s to serve the needs of the emerging satellite mobile phone market. Satellites for these mobile phone systems required high inclination and polar orbits, making a high latitude site like Kodiak Island ideal for launching them. However the collapse of the satellite mobile phone industry eliminated the original target market for the Kodiak Launch Complex. Since then it has only served a limited number of suborbital launches for the Department of Defense related to testing systems for missile defense.

Commercial Spaceports and Economic Development

There are two major differences between commercial spaceports and traditional government and military spaceports. The first is that like seaports and airports, spaceports are seen as a tool to attract economic activity to a region, and thus the driving factor behind most commercial spaceports is the desire to stimulate local economic development. By contrast, traditional government launch facilities are focused on simply meeting the need for access to space for the programs that fund them.

The second major difference is funding. Traditional government spaceports are funded as part of the programs they serve, while commercial spaceports are expected to be self-funding from the revenue streams they create. The underlying problem is that the revenue models generally used for airports and seaports will not work for commercial spaceports (Matula and Mitry, 2002).

The revenue streams from commercial airports and seaports are a result of the high volume of traffic that moves through them on daily basis. The typical commercial airport will see many flights a day, with thousands or even millions of passengers a year, not to mention hundreds of thousands of pounds of airfreight. Similarly, active seaports see hundreds of thousand of tons of cargo in a typical year.

> (*Editor's note*: See Chapter 16, *A Space Commercialization Model: Ocean Ports and Inter-Modal Transportation*.)

In contrast, a commercial spaceport is considered busy if there are more then a dozen launches a year.

These key differences have had a major impact on the commercial spaceport industry. Although commercial spaceports have been around for many years, few have achieved the desired level of economic success. Like the commercial launch industry, the commercial spaceport industry has left a trail of failed projects and failed ventures, and a key factor has been that the projected drivers of demand, often used in the business plans of commercial spaceports, and typically high volumes of satellite launches or high volumes of suborbital tourism, have failed to develop on the timelines expected by the developers of the spaceports.

Another factor is the relatively small size of the launch industry, with few firms or launch systems. The long lead times and high development costs for new systems, combined with a lack of demand, have created major barriers to profitability, in fact even breaking even is a challenge for commercial spaceports.

This is why Matula and Mitry (2002) have argued that a new business model is needed for commercial spaceports, a model designed around their economic assets and less dependent on demand for launch services.

We suggest that the key economic assets of a spaceport are:

- Large land area for use as a safety zone.
- Advanced telecommunication infrastructure.
- Storage and handling facilities for cryogenic gases and other chemicals used in launch operations.
- A runway capable of handling commercial jets and controlled airspace.
- A skilled technical workforce.
- Access to educational and research institutions.

The key to developing commercial spaceports is therefore to leverage these assets to attract complementary business activities, which then create additional revenue streams (Matula and Mitry, 2002). Examples include alternative energy research, explosives research, rocket engine research, security training, flight testing, ecotourism, biotech research, manufacturing, agricultural research, and educational activities.

All would have the potential to generate significant revenues in the near term while the launch traffic models develop as space commerce industry itself matures and demand increases. In addition, activities such as biotech, rocket engine development and education have the potential to add to the launch traffic for the facility. The key point that Matula and Mitry (2002) make is that developers of commercial spaceports must cast a wide net to attract complementary business and economic activities to drive the development of any spaceport facility.

Summary

Commercial spaceports emerged with the demand for commercial launch services, with the first facilities appearing in the 1980s. Since then, many of commercial spaceports have been developed. The most successful have been facilities like Spaceport Florida and California Spaceport, which were based on existing launch infrastructure and demand. New start commercial spaceports have had a much more difficult challenge due both to higher costs of development and the need to create new demand. Although some, like the Guiana Space Centre and Spaceport America, have overcome these difficulties through the strong government support, ultimately the long term success of the commercial spaceport industry will be dependent on the creation of new demand for commercial launch services.

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Dr. Matula has a Bachelors degree from the New Mexico Institute of Mining and Technology (1983) and both an MBA degree (1984) and Ph.D. in Business Administration from New Mexico State University (1994). His dissertation focused on development of a model designed to identify factors that would influence public support for commercial spaceports. He since has published numerous articles on space policy and economic development strategies for the space industry. Dr. Matula has served on the American Society of Civil Engineer's Space Engineering and Construction Committee and its Subcommittee on Space Education Initiatives. His academic career includes over twenty years of teaching and research on business strategy and marketing.

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> *(Editor's note:* Please see the following Chapter 18, *A New European Spaceport: Law and Politics in Spain* for a discussion of a European perspective, with a focus on the underlying legal issues.)