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SPACEPORTOPIA: A PRIMER FOR SUCCESSFUL LAUNCH SITE PLANNING

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Summary

Spaceport site selection is a complex process that involves a range of considerations to ensure long-term success, including some well-defined operational parameters and other less certain variables, such as changing launch market forecasts. Launch sites must also meet safety requirements by avoiding population centers. Impacts to the surrounding environment should also be considered to mitigate harm to natural resources and to protect biodiversity. Less obvious are the potential benefits to a host community and hidden risks to investors and developers. This paper suggests that "spaceportopian" ambitions to claim a piece of the growing global space industry should be grounded by the practical realities of what a spaceport might bring to a host region's long-term economic, social, and environmental well-being, while future-proofing launch capacity and ensuring continued success for all stakeholders.

Introduction

The ability to access and use space has become a key enabler to modern life across a range of civil, commercial, and national security applications. As such, many countries are now prioritizing sovereign access* to space, including both orbital and suborbital launch capabilities. To meet anticipated growth of launch demand, the space industry will continue to plan the expansion of launch capacity at existing spaceports. Additionally, public and private sector actors have been considering new spaceport sites, which is an expensive, arduous, and resource-intensive effort, often with disruptive impacts for the land, sea, and air space around the site as well as the inhabitants.

Within this context, there is little room for mistakes as the wrong decisions could harm a region's long-term economic, social, and environmental goals. Success will depend on building trust, transparency, and planning with reasonable market forecasts to achieve regional compatibility and operational and financial viability. This analysis suggests that by adapting to regional interests and economics, spaceports can more effectively contribute to a thriving space economy and the regions that they operate in.

* Sovereign access could imply either ownership or control over launch facilities, either on domestic soil or through arrangements that guarantee access.

Market Demand: Forecasting Challenges and Congestion

The global space economy has grown at a moderate annual rate of 5 percent* during a time when the world gross domestic product (GDP) grew 3.1 percent.[1,2] Today, many countries are seeking to independently leverage and prioritize their sovereign space capabilities for growing civil, defense, and commercial needs. Meanwhile, the world has witnessed a rapid increase in the number of operating satellites, and some launch demand forecasts could push the limits of already congested spaceports. These growth trends are fueled in part by rising commercial emphasis on broadband provisioning using proliferated low Earth orbit (LEO) constellations and a shift by government buyers from large geosynchronous (GEO) satellites that cover wider areas and last longer (often 20 years or more) to hundreds or thousands of smaller LEO satellites, with narrower fields of view and significantly lower life expectancies (around 5 to 7 years).

By the end of 2024, there were approximately 11,871 operational satellites in orbit[3,4], marking a growth of 454 percent since 2018, driven primarily by large commercial LEO constellations.[5] Over the same period, the annual launch rate across the globe increased by 129 percent. The annual launch increase was considerably less than the operational satellite surge due to rockets releasing "batches of satellites" with each launch.

Not surprisingly, the world's second-largest economy is not remaining earthbound. While China has one commercial spaceport,[6] the country plans to launch more than 36,000 satellites in the near future.[7] The constellation GuoWang ("SatNet") is expected to have about 13,000 satellites and compete with Starlink services.[8] Another project to rival Starlink is Qianfan ("Thousand Sails"), which anticipates 13,904 satellites.[9] Finally, the Honghu constellation is predicted to contain 10,000 satellites.[10]

While launch demand continues to surge, particularly in the United States and China (see Figure 1a),[11] it should not be assumed that this trend will continue. The commercialization of LEO is showing signs of maturity, as early entrants capture market share and later entrants strive to differentiate themselves.[12] Also, as large constellations become operational, the rush to deploy satellites may subside — analysis completed by BryceTech forecasts that an annual average of 3,100 spacecraft will be deployed through 2028, then 2,500 from 2029 to 2033 — consequently lowering future heavy-lift launches open to U.S. providers from an annual average of 110 launches (2024 to 2028) to approximately 50 annual heavy lift launches from 2029 to 2033. [13]

Realistic Expectations and Regional Stakeholder Needs

Economic forecasting combined with regional growth agendas often forms the basis for local agreements and plans to build a new capital-intensive spaceport. However, sometimes general space industry enthusiasm and an escalating sense of urgency to find new sites to meet forecasts leave regional stakeholder interests overlooked or downplayed. In this regard, this analysis emphasizes that some recent spaceport planning and siting efforts have not demonstrated an awareness for what lies beyond the immediate launch market horizon. In fact, some proposed commercial spaceports have been pitched to local taxpayers as an investment in the future, only for it to be discovered later that they were "not the economic engines they were promised to be," as is evidenced by the fact that more than half of the spaceports licensed by the Federal Aviation

*According to the Satellite Industry Association, past industry revenue growth was only 2 percent in 2024. However, without the declining satellite TV market from this statistic, the industry grew 5 percent.

Administration (FAA) have yet to host a single launch.[14] In this respect, this analysis provides some case studies and insights to shed light on how best to plan future spaceports with full consideration of regional interests and economies.

Launch Forecasts

Space analysts have modeled various scenarios to forecast future launch volumes and satellite quantities. A few key drivers can significantly change predictive models, including:

- *Business*: Planned constellations that actually make it to orbit due to a range of financial and market factors.
- *Coverage or capacity*: Changing a constellation's size also changes its capabilities. For instance, an operator may decide to increase or decrease coverage in certain orbits for a remote sensing constellation. Similarly, a SATCOM operator may adjust bandwidth or capacity by increasing or decreasing the number of satellites.
- *Satellite lifetimes*: Constellation replenishment rates depend upon a satellite's operational lifetime. If satellite lifetimes exceed the deployment time of a constellation, then launch demand could decrease.[15]

Imperfect Data Driving Imperfect Forecasts

Satellite filings to both the Federal Communications Commission (FCC) and International Telecommunication Union (ITU) have been used by a range of space sector economists and investors to forecast the future launch market. Although the FCC and ITU are trusted sources, ensuring good data for market projections is challenging due to multiple filings, name/identity confusion, outdated information, and speculative "over filing" (see Appendix A). Hence, a dose of skepticism is advised when reviewing launch forecasts. A 2023 analysis of satellite projects found that out of 478,000 planned satellites across 350 missions, only about 20,000 satellites are expected to make it to orbit by 2030.[16] And despite the perceived tendency to inflate satellite projections, there remains a finite supply of launch facilities, and few new spaceports are opening in the near term.

Bottleneck Vulnerabilities: Spaceport Congestion and Resiliency Implications

Yet, for all the scrutiny of launch forecasts and launch capacity, one overriding problem points to congestion and infrastructure resiliency. Launch rates are increasing on a worldwide basis, particularly in the United States (Figures 1a). And within the United States, most launches are occurring at only two sites: Cape Canaveral Space Force Station (SFS) in Florida and Vandenberg Space Force Base (SFB) in California (Figure 1b).

George Nield, former FAA associate administrator for commercial space transportation and current chairman of the new Global Spaceport Alliance, emphasizes that "[t]he key issue is that our current U.S. spaceport infrastructure is not robust or resilient. A significant natural disaster, such as a hurricane in Florida, an earthquake or wildfire in California, or a launch pad accident or a terrorist attack at any busy launch site could result in major damage, requiring many months or even years to repair, thus resulting in a loss of assured access to space. The only reasonable way to address that issue at the federal government level is to look at other locations to launch from, and that does not appear to be happening."[17]

The space sector is facing what some perceive as a "looming spaceport bottleneck."[18] Congestion typically occurs in industrial sectors with increasing production and growth, and the space sector is no exception. Over the past three years, both eastern

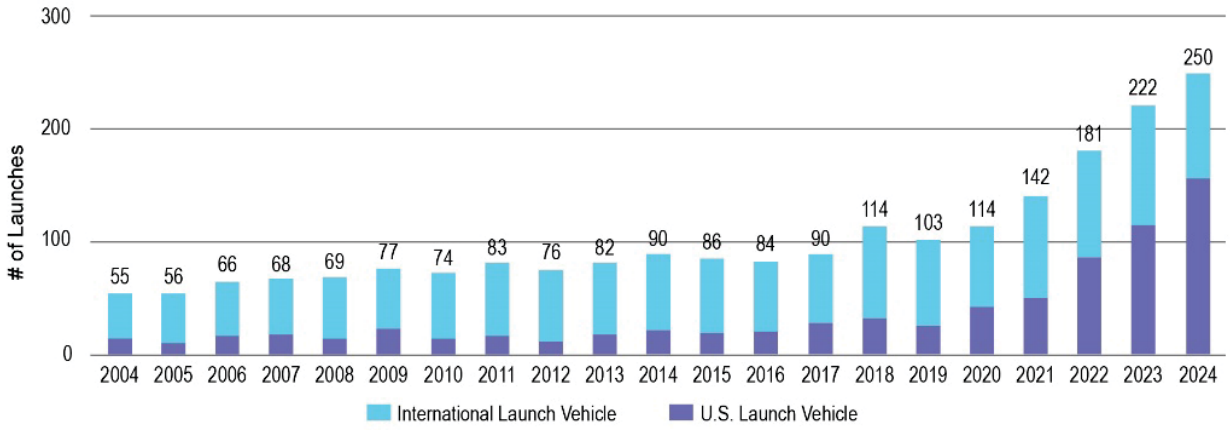

Figure 1a: Launch vehicle annual results, international (non-U.S.) versus U.S.

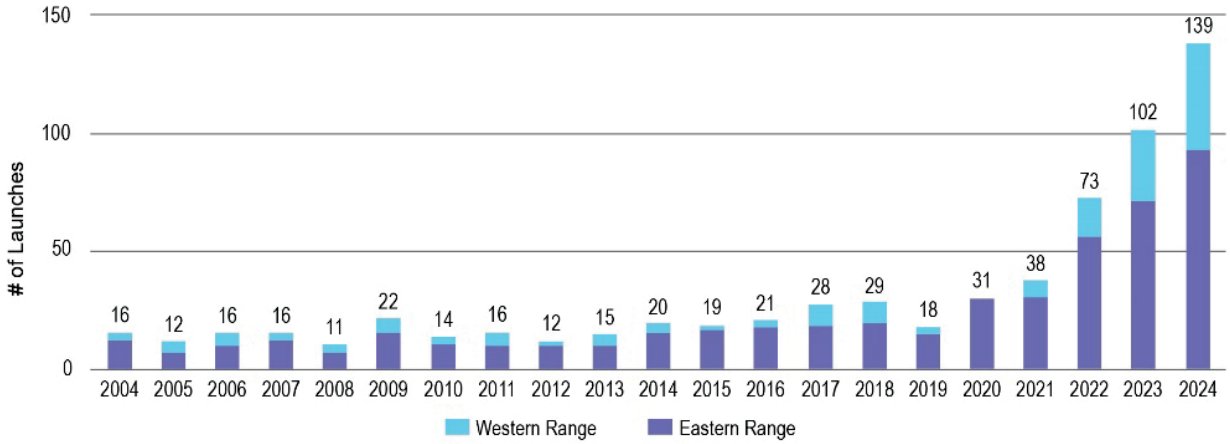

Figure 1b: Launch vehicle annual results, Eastern and Western Ranges in the United States. *Source: The Aerospace Corporation, Acquisition Support and System Engineering Toolset (ASSET). Updated December 31, 2024.*

and western government-owned ranges* in the United States have experienced a dramatic increase in launch activity (see Figure 1b). Looking at future launch demand, the U.S. House Armed Services Committee's draft fiscal year 2025 National Defense Authorization Act† notes that the two main U.S. Space Force spaceports (Vandenberg SFB and Cape Canaveral SFS) "can't meet the rising demand for both military and commercial launches."[19]

In practice, bottleneck analysis has become an important management tool among academics and lean manufacturing practitioners to address production inefficiencies.‡[20] Such studies could

*A range is typically the large safety area around a spaceport where rockets launch and land. However, the terms "spaceports" and "ranges" are often used interchangeably.

†Annual laws that oversee military budgets in the United States.

‡One study indicated that production bottlenecks are responsible for up to 30 percent of throughput losses in manufacturing.[20]

provide insight as the space sector seeks solutions to ongoing congestion at some spaceports, such as Cape Canaveral SFS and Vandenburg SFB. Beyond efforts to reduce congestion, there are also efforts to drive greater efficiencies at existing spaceports through operational improvements and other methods, including regulatory streamlining (see Appendix B). However, even with combined efforts to reduce congestion and improve efficiencies, there is widespread interest in the United States and abroad to consider new launch sites.

Background

Definition of Spaceports (United States)

There is no agreed-upon international definition of the term "spaceport." The FAA defines a spaceport as a launch or reentry site that is operated by an entity licensed by the U.S. Secretary of Transportation. The FAA further recognizes the unique needs and distinctions of spaceports that host "(1) launches to or reentries from orbit; and (2) are involved in suborbital launch activities."[21] Outside the United States, other spaceport definitions apply. However, most refer to sites that launch spacecraft into orbit and/or receive spacecraft from orbit. Furthermore, spaceports can be government owned, privately owned, or be a combination of public and private sector investments, known as public-private partnerships. There is also some fluidity between public and private as some publicly owned spaceports can serve commercial interests and some private-sector spaceports serve government missions or launches.

Some sites labeled spaceports are more focused on space-related businesses rather than launches. The Houston Spaceport in Texas is a case in point. This FAA-licensed facility exists primarily as a "technology incubator" and "center for collaboration and innovation."[22] Given its urban location, the Houston Spaceport has not launched any rockets; however, it has "generated nearly 2,000 jobs and attracted billions in investments,"[23] making a positive economic impact on the region. This analysis does not cover spaceports such as the Houston Spaceport and instead focuses specifically on spaceports intended as launch sites.

Types of Spaceports: Vertical and Horizontal Launch

Spaceports that support vertical launch are used for orbital access to achieve payload insertion to LEO and beyond. On the other hand, horizontal launches provide suborbital access for activities such as scientific research, technology demonstrations, small payload to orbit with expendable boosters (e.g., Northrop Grumman's three-stage Pegasus rocket), two-stage-to-orbit delivery using fully reusable hypersonic launch vehicles,* and an increasing interest in point-to-point suborbital transportation for cargo and space tourism. However, the market size for horizontal launches is largely unproven, and most of the funding, interest, and effort is for vertical launch to orbit.

Horizontal and vertical spaceports have different economic drivers and risk profiles. For instance, horizontal launch sites are more analogous to airports due to the need to cater to business hubs that may require point-to-point transportation. Horizontal launch spaceports represent 64 percent of FAA-licensed spaceports, yet more than 90 percent of launches are vertical.[24] According to one spaceport expert, horizontal spaceports proliferated because they were sited at under-utilized existing airfields and became "an inexpensive way for local communities to get into the space game."[25] Today, however, the horizontal launch market is lagging due in part to the rapidly declining launch costs from vertical launch competition. Additionally, the already small market for horizontal launches has been further dampened

*Several concept designs have been in development for decades; however, none have achieved operational status.

by Virgin Orbit's 2023 rocket failure from Spaceport Cornwall in England and subsequent Chapter 11 bankruptcy. By comparison, vertical launch spaceports are driven by commercial demand for a range of satellite missions, including LEO satellite megaconstellations* to support broadband internet applications.

Geography and International Collaboration

Operators typically select optimal orbits in which to deliver space capabilities to meet their mission needs, and this is where orbital mechanics can play a strong role in launch site selection. For instance, a launch site near the equator and with an eastern trajectory can take advantage of Earth's rotational velocity to provide a significant boost for placing a satellite into a low inclination or equatorial orbit. Conversely, a launch site at a high latitude is more suitable for achieving a polar or high-inclination orbit. Additionally, variables such as payload mass and size, launch latitude, orbital parameters, and escape velocity for interplanetary missions determine the launcher class (e.g., small launch vehicles for small payloads, heavy lift for larger ones or multiple payloads), and therefore the dimensions of the launch pad. In turn, large launch pad requirements can make it more difficult to find a suitable launch site.

Beyond constraints imposed by orbital dynamics and aerospace engineering, most spaceport sites are limited by operational constraints, including the need for several thousand acres,† flight trajectories over unpopulated areas, and adequate buffer areas to avoid disturbing the surrounding communities and environment. These limitations drive most vertical spaceports to coastal areas.

Launches and refueling require safety precautions, such as evacuation, which is a main driver for spaceports to seek unpopulated areas. For example, areas that contain overlapping safety zones, such as Cape Canaveral SFS, risk pausing or delaying other forms of commerce in the area, such as fishing, cruise ships, and local airports.[26] According to a local report in Florida, this causes inter-dependent areas of tourism travel to incur delays that can spill over into international airspace delays.[27] In one case involving a proposed spaceport on Georgia's coast, charter boat captains packed a town hall meeting room to voice concerns to the U.S. Coast Guard about the spaceport activity interfering with their ability to conduct business.[28]

In the United States and elsewhere, coastal property is expensive and valued by local residents and environmentalists. Coastal environments include estuaries and wetlands, which play a significant role for biodiversity and carbon sequestration. Rising sea levels and coastline changes also potentially pose a problem for spaceport longevity and the value and insurance of beachfront properties. This dilemma is pushing some to believe that the best prospects for future spaceports lie offshore to steer clear of populated areas and land use controversy.[29] Ultimately, whether on land or at sea, a future spaceport will need to balance industry and economic development goals with the risk to the community, natural resources, and environment.

*Megaconstellations is a term of art, typically involving hundreds or thousands of satellites. Examples include broadband constellations, such as SpaceX's Starlink or China's Qianfan (Thousand Sails).

†The authors calculated an average area size for 16 spaceports in the United States. The result shows that the average spaceport size is almost 23,000 acres—ranging from 350 acres (SpaceX's owned and leased land for Starbase, Texas) to as high as 144,000 acres (Kennedy Space Center combined with Cape Canaveral SFS).

Figure 2: Active orbital spaceports around the world (excludes sites that are inactive, being proposed or planned, used for suborbital launches, or used exclusively for sounding rockets or missiles). *Map created from BryceTech spaceport list, "Orbital and Suborbital Launch Sites of the World 2024."*[30]

Geographic Distribution

Orbital launches place payloads into orbit or beyond Earth orbit, typically using vertical launch systems, while suborbital launches are typically conducted from airports and often travel at a speed lower than orbital velocity since they are not intended to achieve orbit. Across the globe, there are 34 spaceports but only 22 active ground-based spaceports for orbital launches, mostly located in the United States, China, and Russia, with the greatest number of planned spaceports in the United Kingdom (see Figure 2).

U.S. Spaceports

Half of the world's spaceports are located in the United States, including 14 licensed by the FAA and 2 private* spaceports.[31] However, most rocket launches from the United States and almost all satellite deployments rely on only four vertical launch spaceports:

- Florida: Cape Canaveral SFS (operated by the U.S. Space Force [USSF]) and Kennedy Space Center (operated by National Aeronautics and Space Administration [NASA])†

*Exclusive non-FAA-licensed private spaceports include SpaceX Starbase (Boca Chica, Texas) and Blue Origin Launch Site One (Van Horn, Texas). SpaceX's Rocket Development and Test Facility (McGregor, Texas) is sometimes referred to as a non-FAA private spaceport, but this is actually an engine test facility.
†Cape Canaveral SFS and Kennedy Space Center are adjacent to each other; this paper counts them as one spaceport.

- California: Vandenberg SFB (operated by the USSF)
- Virginia: Mid-Atlantic Regional Spaceport (MARS) operated by the state on Wallops Island, which is owned by NASA
- Alaska: Pacific Spaceport Complex – Alaska (PSCA) operated by the state on Kodiak Island

International Collaboration and a Polycentric Space Environment

Spaceports in the United States and western Europe have emerged to meet the growing demand from civil and defense customers, as well as a variety of private firms. Combined with the growing emphasis on sovereign access* to space, several countries are also focusing more attention on international collaboration and standardization of spaceports based on launch capability. Eight spaceports in six countries (the United States, the United Kingdom, Japan, Australia, Peru, and Sweden) signed a memorandum of understanding in October 2024 to share lessons learned and foster interoperability and resilience of their facilities.[32] This could involve "establishing international spaceport standards," which may include a "spaceport readiness level" scale analogous to a "technology readiness level" scale.

International alliances in commercial space are increasingly forged in furtherance of geopolitical agendas that include the need for spaceports that can enable sovereign space activity across a wider range of geographies among partner countries. Examples of geopolitical alliances related to launch include the Global Spaceport Alliance and North Atlantic Treaty Organization's (NATO's) Starlift. Launch cooperation benefits are also recognized by intergovernmental organizations, such as the nine† BRIC+ member countries (Brazil, Russia, India, China, South Africa, Iran, Egypt, Ethiopia, and the United Arab Emirates). Similarly, China continues to press forward with international collaboration in vital areas such as launch, space traffic management, planetary protection, and space resource utilization. New international launch alliances such as these could gain clout to counterbalance western launch alliances and "deepen relationships with like-minded countries and to demonstrate autonomy on the global scale."[33] The International Lunar Research Station (ILRS) for scientific exploration and resource development is one such example where China aims to work with up to 50 countries.[34]

China's Large-Scale Space Investments

China's large-scale launch infrastructure investment has resulted in three major inland sites (Jiuquan, Taiyuan, and Xichang) being used for national security and human spaceflight, which includes polar and GEO missions. China's launch rate has more than tripled over the past 7 years, from 22 in 2016 to 67 in 2023, which may increase further to include emerging megaconstellation projects.[35] In response to an expanding commercial space sector, China operationalized its first "commercial"‡ launch site on Hainan Island, and during November 2024, the first rocket, called Long March 7, was launched to supply Tiangong, China's permanently crewed space station.[36,37] There are two more commercial spaceports planned in Ningbo and Shaanxin. These launch sites contribute to China's planned network of "coastal and inland areas, high and low altitudes, and various trajectories to satisfy

*Sovereign access could imply ownership or control over launch facilities, either on domestic soil or through arrangements that guarantee access.
†The founding countries were Brazil, Russia, India, and China in 2009 under the name BRIC. In 2023, BRIC expanded to include five other countries and is now referred to as BRIC+.
‡In China, "commercial" usually refers to business entities other than the government or military. This includes state-owned enterprises (SOEs).

the launch needs of manned spaceships, space station modules, deep space probes and all kinds of satellites."[38]

Offshore Launches and Landings

Spaceports can be designed for launching or receiving spacecraft, and offshore launch and landing platforms are one solution to meet increasing demand and relieve the existing spaceport congestion problem. Launching or landing from either floating or fixed marine platforms could offer more flexibility in site selection, more optimized trajectories for specific orbital missions, and minimal noise and environmental impacts on densely populated areas, although impacts on the marine environment must be considered. Offshore sites can also reduce the risk of debris falling over land, making launches safer for surrounding communities. Such factors can ease the launch regulatory process and help achieve a higher launch cadence because offshore launch sites are typically remote from populated areas, which lessens the need for extensive measures to protect the public from the risks associated with launch site activities.[39]

Offshore launch sites are being developed around the world. One historical example is Sea Launch, a former multinational maritime space launch company. Sea Launch conducted 32 successful launches from a converted oil rig between 1999 and 2014.[40] Its ultimate failure was attributed to financial difficulties, technical challenges with maintaining the maritime launch system, geopolitical issues involving Ukrainian and Russian suppliers, and market competition from SpaceX. However, since Sea Launch's bankruptcy more than 10 years ago, there is renewed interest in sea launches and landings, for example:

- China launched its fourth solid rocket from a sea platform in September 2024.[41] Rocket Lab USA acquired an ocean barge in 2024, named "Return on Investment," on which they expect to land their Neutron launch vehicle beginning in 2026.[42]
- SpaceX's four autonomous spaceport drone ships,[*] named "Just Read the Instructions" (I) and (II), "Of Course I Still Love You," and "A Shortfall of Gravitas," in total had 347 successes and 11 failures between 2015 and May 2025.[43]
- Blue Origin acquired a large ship in 2018, named "Jacklyn," to be used as a landing platform, but it was sent to the scrapyard in 2022.[44] Blue Origin revealed a new barge in use in 2024, named "Landing Platform Vessel 1."[45]

Despite renewed interest in marine launches and landings, engineering challenges remain, as stable platforms must withstand harsh marine environments, such as high waves, salt corrosion, and extreme weather. Another offshore launcher, The Spaceport Company, aims to design their platform according to the mission need, based on kilograms to orbit, and to build a network of such offshore launch sites around the world.[46] Building such platforms at scale may involve deciding between a barge, floating vessel, or bulk carrier and the ability to use them interchangeably. Vessels and carriers incur large capital investment costs, not unlike land-based spaceports. Moreover, transporting rockets, fuel, payloads, and personnel to remote sea locations adds cost and logistical complexity.

Investment and Operating Models

Amid seismic shifts in the space sector and increased commercial participation, a range of business models are emerging for spaceports. Traditionally, launch sites were designed to support government-sponsored missions and the commercial community "on a best effort basis."[47] Today, commercial launch providers are

[*]As of May 2025, three of the drone ships are active.

demonstrating agility, efficiency, and technical know-how. Within this increasingly commercial emphasis, the space launch sector has expanded to include three basic investment models for spaceports: public sector, public-private partnership (P3), and private sector.

Public Sector

Government-owned spaceports are vertical launch sites—often large, multi-use facilities, with long histories and established customers. These traditional launch sites face increasing demand on their resources due to maturity of the infrastructure and a reduced need for investment from private actors, which can aid in the acceleration of launch timelines. However, management and governance structures of public sector spaceports can vary depending upon international context. For instance, the European Union (EU) Space Program and European Space Agency (ESA) member states must coordinate and reach consensus on mission planning, budgeting, regulation, etc., prior to launch approval and have historically focused on scientific missions, which means longer time frames. However, a change in this mindset has been implied by a 2024 ESA Council decision to foster more commercial partnerships for launch services to maintain Europe's position in the global space market.[48]

Some publicly owned sites in the United States are now also hosting private sector use for greater agility, which can raise fairness issues around the allocation of launch pads. Vandenberg SFB, for example, is currently leasing two space launch complexes* to SpaceX, with one lease starting in 2015 and another in 2023.[49] Additionally, Cape Canaveral has become a popular neighborhood for small launch startups. The Cape recently granted the use of three launch complexes to four small launch vehicle startups: Stoke Space, ABL Space Systems, Phantom Space, and Vaya Space.[50,51]

Public-Private Partnership (P3)

P3 models balance commercial interests with community engagement and economic development and require an understanding of shared risk and investment between public and private actors. P3s are well suited to horizontal launch sites as they share common economic and risk profiles with airports and are often colocated. They differ from simple leasing arrangements, as summarized above in the public sector investment and operating model. Instead, the commercial sector assumes a larger investor and ownership role and increased capital risk, for example:

- Spaceport Cornwall, which is the United Kingdom's first commercial spaceport located on a former Royal Air Force military airport that became a civil airport (Newquay Airport).
- Oita Airport, which will be Japan's first spaceport. The project involves significant upfront planning and coordination to maintain an open and coordinated structure with the community.
- Spaceport America, which is managed and operated by the New Mexico Spaceport Authority, who has partnered with the Borderplex Alliance, a private sector–led organization focused on bringing jobs and opportunity to the region.[52] Like many large-scale infrastructure projects, airports tend to operate under P3 models to balance public stakeholder and private sector investor needs. Airports are also subject to strict regulations on public safety and environmental risk. Such models benefit governments by enabling access to private sector funding and expertise while retaining public ownership and control over critical infrastructure.

*A launch complex includes the launch pad and a collection of facilities to support specific launch operations.

Commercial or Private Sector

This model, employed by sites like SpaceX's Starbase in Texas, Blue Origin's Launch One in Texas, Rocket Lab USA's Launch Complex 1 on the Māhia peninsula in New Zealand, and SaxaVord UK Spaceport in Scotland, are driven by short-term private sector needs, which may occasionally lead to conflicts with local communities and environmental regulations. Compared to public spaceports, which typically involve public land use planning and community participation, private sector spaceports can sometimes lack transparency. Most of these spaceports are designed for vertical launches and are driven by commercial and defense payload deployment contracts.

Spaceport Planning Principles

This analysis highlights best practices to manage risks across economic, social, and environmental expectations. From this perspective, lessons from past spaceport development case studies have emerged and can serve as a starting point for developers, local communities, industry, and government bodies to begin the process of siting, developing, and sustaining a spaceport and its supporting ecosystem. These guiding principles (each listed below with additional information following) apply to all three business and operating models (public, P3s, and commercial/private spaceports) and can help investors, government and commercial stakeholders, and surrounding communities avoid flawed assumptions and strategic errors:

- Consider regional compatibility and opportunity costs
- Apply rigorous economic analysis for a regional economic assessment
- Improve and expand spaceport ecosystems
- Establish transparency and build trust
- Avoid irrational exuberance—establish realistic forecasts and expectations

Consider Regional Compatibility and Opportunity Costs

The widely cited "The Competitive Advantage of Nations" by Michael Porter emphasizes regional economies as the building blocks for national competitiveness wherein a "nation's ability to produce high-value products and services depends on the creation and strengthening of regional clusters of industries that become hubs of innovation." And once a cluster forms, a group of industries become mutually supportive, and the benefits from interconnections with the cluster become evident, such as new research and development (R&D) approaches, freer information flows, increased innovation diffusion, and new opportunities.[53] Unlike regional clusters, ecosystems (mentioned later in this paper) are not necessarily dependent upon geographic connectivity, but they can also offer similar advantages.

Although the benefits of regional hubs are well known, a justifiable economic assessment of business clusters, or specifically a spaceport cluster, involves a significant amount of research and data. Fortunately, there are some established methodologies and tools that can help determine if a spaceport makes economic sense in certain regions.

Economic Development

Initially, an immediate business boom can be expected as spaceport construction begins and temporary workers inject new activity and revenues into the region. On a longer-term basis, however, how a spaceport fits into the region's growth plans and economic development plans needs to be examined. One senior executive of an engineering and government solutions company warned, "If space is not featured in their economic development strategic plan, you have a problem because you cannot go it alone."[54]

The U.S. Federal Management Regulation that was implemented in recent years addresses sustainable siting regulations for federal facilities. While not all spaceports are considered federal facilities, the regulations offer sensible guidelines, including requiring "compatibility with State and local economic development objectives, such as local and regional comprehensive plans, housing and transportation plans, neighborhood scale plans and local plans covering sustainability and resilience goals. When planning for location decisions, agencies should align, where possible, with local and regional planning goals."[55] This alignment creates an economic stimulus or multiplier effect, such as an increase in jobs and demand for goods and services.

Space Florida: Space as Public Infrastructure and Creative Financing Options

Space Florida, an aerospace economic development agency in Florida, is an example of how a P3 proactively encourages economic growth in a region. The State of Florida strategically designated space as an official mode of transportation in 1999 and works with the Florida Department of Transportation's (FDOT's) Spaceport Office to fund capital infrastructure projects and other cooperative efforts across the state from the Spaceport Improvement Program (SIP)[*].

Rob Long, President and CEO of Space Florida, points out that the Florida Legislature established a 2006 unique state statute[56] emphasizing a strong public and private sector commitment and "an aggressive strategy that enhances the state's workforce" and a "focus on the state's economic development efforts in order to capture a larger share of activity in aerospace research, technology, production, and commercial operations, while maintaining the state's historical leadership in space launch activities."[57]

Opportunity Costs

Regional planners should assess the investment cost and ask themselves, "what is the opportunity cost for siting, building, and operating a spaceport versus another type of facility that might offer a greater return?" This type of query is known as the "counterfactual method," which allows for comparative results. Such analysis could have been helpful for Spaceport America, located in Truth or Consequences, New Mexico, on approximately 18,000 acres of State Trust Land leased from the State Land Office. Its location, adjacent to the White Sands Missile Range, provides access to 6,000 square miles of restricted airspace. Although Spaceport America is now licensed by the FAA for both vertical and horizontal launches[†], many local citizens have become increasingly frustrated by the delays, unrealized potential, and diversion of local taxes towards the spaceport. Moreover, local officials feel that "the money could be used more effectively elsewhere."[58,59]

Competing Local Interests

An additional consideration is the effect of the spaceport on the pre-existing local economy. In Cape Canaveral, precautions to maintain safety zones around launches sometimes interfere with local fishing, cruise liners, and even other space industries, and vice versa.[60,61] Brian Rogers, Vice President of Rocket Lab's Global Launch Services, remarked that because more space-interested parties are looking to launch every day, the seashore at Cape Canaveral has many "keep-out zones" that overlap with one another.[62]

[*]SIP investments cover Florida's Spaceport System Territory expanded in July 2024 across seven launch sites or aerospace "hubs," including Cape Canaveral Spaceport, Cecil Spaceport, Eglin Air Force Base, Cape San Blas, Space Coast Regional Airport and Spaceport, and Patrick Space Force Base.

[†]One of only two such sites in the United States, licensed for both vertical and horizontal takeoffs.

Diminishing Returns

Expanding launch services to include super heavy launch providers can also cannibalize a spaceport's overall launch capacity. Tory Bruno, CEO of United Launch Alliance, underscores this point by noting that Starship's demands for a high quantity of propellant "requires an evacuation zone whenever fueled that includes other people's facilities."[63] It could reach a point where the launch tempo is reduced as other providers are forced to evacuate their facilities whenever a neighboring spaceport vehicle is fueled. Congestion and overlapping space activity also extend beyond the launch pad. For instance, payloads often require special handling and security procedures. However, the support infrastructure for increased payload preparation activity now constrains spaceport capacity, prompting the commander of the Eastern Range at Cape Canaveral to call out that "we just don't have enough payload processing space."[64]

Municipal Revenue Bonds

The 2006 "Space Florida Act" designates space as a mode of transportation, like airports or seaports, which means that spaceport bonds can gain tax-exempt status.[65] The goal is to allow for more opportunity through creative financing options and infrastructure to make aerospace ventures easier to kick-start. However, under an unfavorable outcome, such as a spaceport's inability to generate sufficient revenue, investors face a financial loss—potentially up to the entire face value of the bond. Additionally, a spaceport funded by tax-exempt municipal revenue bonds could result in possible credit rating downgrades for the issuing government, meaning that a local government's future bond-funded projects will require higher interest rates, perhaps impairing its ability to access new capital. Such a downside must be weighed against typically very low municipal bond default rates, and positive benefits from federal tax exemption for interest income for the issuer (in this case, Space Florida).

Once planners determine that a spaceport could be compatible in a specific region, the next logical step is to determine the regional economic impact.

Apply Rigorous Economic Analysis for a Regional Economic Assessment

A lack of a rigorous economic analysis can be an early red flag that a spaceport plan is ill conceived. For instance, the private sector promoter behind Spaceport Michigan initially suggested that the spaceport, located on the Upper Peninsula, could attract 40,000 jobs statewide. That estimate was eventually revised down to 650 jobs.[66] IQM Research Institute conducted a comprehensive study on this spaceport construct, which included orbit access, workforce development, and environmental and economic elements, that was commissioned by the Michigan Aerospace Manufacturers Association for the Michigan Economic Development Corporation. The study findings determined that a vertical launch spaceport in Michigan was highly constrained by inherent negative factors. IQM's Michael Dudzik noted that Spaceport Michigan "did not make sense from a return on investment perspective as it offered no competitive advantage to develop a sustainable launch use cadence over the intrinsic advantages of existing spaceports servicing the same orbits." Scenario forecasts showed that the "annual revenues at best would be the equivalent to two fast food restaurants and the operating costs would be even higher."[67] Furthermore, Dudzik added that multiple local civic groups opposed the spaceport location due to the environmental impact to the pristine Upper Peninsula area as well as environmental security issues due to Lake Superior being a freshwater source for more than 40 million Americans and Canadians. Beyond the environmental concerns, the plans for Spaceport Michigan were also missing details on how the operation would be able to address the flight safety of launching rockets into populated Canadian territories and airspace.[68] Conversely, the IQM study did identify several Michigan locations with existing runways that were potentially suitable for

future horizontal launch point-to-point space transportation operations as that mode for space access matures in future years.

Fortunately, whether developing spaceports or other large facilities, most developers recognize the need for conducting an economic impact assessment, as discussed below.

The Multiplier Effect

Although a spaceport and related launch activities can generate jobs and attract high-tech industries, launch support services, and even tourists to the host region, planners should avoid some common false assumptions when considering a potential site.[69] For instance, the multiplier effect, which is the degree of amplification or gain that occurs when money is spent at local businesses. That capital injection results in an increase of economic activity and jobs.[70,*] Notwithstanding the potential of spaceports to inject energy and capital into a local economy, the benefits of siting any facility—stadiums, data centers, spaceports, etc.—are often exaggerated. Within this framework, a methodology known as input-output analysis can be applied to examine the local or regional effects of an "exogenous change to a relevant economic system," such as introducing a spaceport to a region.[71]

A rigorous regional economic assessment using input-output analysis is one such way to establish an economic model to measure and describe the interdependent relationships between industrial sectors within a local economy where the outputs of one sector flow into another sector as inputs. Input-output models require a deep database of regional and local economic statistics. IMPLAN is one such company offering economic impact analysis,[†] including a breakdown of impacts by industry and information to estimate tax impacts on counties, municipalities, special tax districts, the state, and the federal government.[72] This type of service also offers the ability to conduct multi-regional models to select the best site from an economic perspective.

However, one difficulty with estimating the economic benefit of a spaceport is that there is no clear consensus on the economic cost or benefit a spaceport produces for the local, national, or global economy. As the spaceport industry is nascent, little data is available to establish long-term baseline economic trends. This is further complicated by the fact that "information about spaceports' rates and charges is virtually nonexistent in the public domain" and "although there is some anecdotal information about commercial launch fees, there is little-to-no information about how much the launch operators pay the spaceport." [73]

Building the Local and Regional Talent Pipeline

A skilled workforce is essential to a thriving space launch economy. Internships, research projects, and partnerships with universities or research institutions can improve access to a talent pool. For example, many graduates from the Auckland Programme for Space Systems[‡], a student-led CubeSat development program at the University of Auckland in New Zealand, are now in key roles at Rocket Lab, both in New Zealand and the United States. The program was first launched in 2016 by the university around the same time Rocket Lab began operating commercially and received in-kind support from CEO Sir Peter Beck, who recognized

[*]The reverse is true as well; the amplification of a loss could result in decreased economic activity and jobs.
[†]An input-output modeling system, IMPLAN, was developed by the U.S. Department of Agriculture Forest Service. The system includes county-level secondary data for input-output models and is designed for accurate and timely economic impact projections. IMPLAN, now privatized, offers a detailed database and flexible applications and is widely used for various regulatory and federal government economic models.
[‡]This program led to the successful deployment of the first New Zealand-built payload aboard Rocket Lab's Electron vehicle in 2020.

the CubeSat mission as a "significant step for the New Zealand space industry overall."[74] Educational programs are critical to building a skilled workforce in regions where talent pools can be the limiting factor to success and growth of a company; for instance, Rocket Lab's education program reached 20,000 students by 2023, with dedicated teacher training.[75]

Meanwhile, in established aerospace-centric regions, such as California or Texas, rather than competing for the same pool of talent, space players have extended their pipeline development efforts to other strong aerospace regions.[76] Extending recruitment outside the space sector is also becoming a strategy to find new talent. For instance, Blue Origin recently partnered with University of Florida and Space Foundation to launch a business accelerator program called "Space-Edge." The program targets students who are outside (on the "edge") of the space sector whose expertise, such as biomedical science, could "open new markets in the global space economy."[77] Amid escalating concerns that finding qualified labor for precision manufacturing jobs has become increasingly difficult, there is growing recognition that building a talented workforce now extends to skilled labor positions.[78] In response, the National Space Council published "Interagency Roadmap to Support Space-Related STEM Education and Workforce" in 2022 to emphasize the need to attract local blue collar workers with crucial skillsets for the industry.[79, 80]

Improve and Expand Spaceport Ecosystems

A spaceport's success can depend in part on how individual members, working as part of a business cluster or network, can contribute to the spaceport's economic health. Strong relationships among these members support resilience and long-term growth.[81] A space launch ecosystem could involve a full range of activities to deliver a successful launch, including a network of infrastructure, technology, policies, and partnerships to support various stages of space operations, from launch preparation to on-orbit operations (see Figure 3). These actors have distinct but interconnected roles through interactions that go beyond direct financial or contractual links, involving nontangible aspects, such as shared knowledge, influence, reputation, and historical partnerships.

Segments of the launch ecosystem include launch infrastructure, supply chain and manufacturing, regulatory and policy frameworks, skilled workforce, funding and investment, and R&D and innovation. A network strategy, linking segments of the space sector, has been central to Space Florida's thinking, recognizing that "space is not a program; it is a collection of high-value destinations for cargo and people—destinations that require safe, reliable, and sustainable transportation operating on market-driven schedules."[82] Space Florida facilities, distributed across the state, currently include an aerospace business ecosystem encompassing a technology and innovation hub, two launch complexes, an operational storage facility, and a space life sciences laboratory (SLSL).

Satellite and spacecraft operators, defense and security organizations, and space agencies form a vital part of the customer base for a space launch economy. They need to be engaged early to understand the true demand, risks, and opportunities that lie ahead. To this end, thinking up, down, and across the space economy value chain can help identify which supply chain and business partners will be useful in the long term. For instance, a new generation of spacecraft designed for future in-space logistics, cislunar activities, and other services may involve refueling, debris retrieval, orbital transfers, etc. In the long term, relationships built on an informed vision of the future and emerging new space competencies can lead to diverse and mutually beneficial revenue streams. One expert noted that the current mindset of launch service providers needs to shift from, "just give me my launch pad that has everything I need at the lowest cost," to a more collaborative and forward-thinking paradigm.[83]

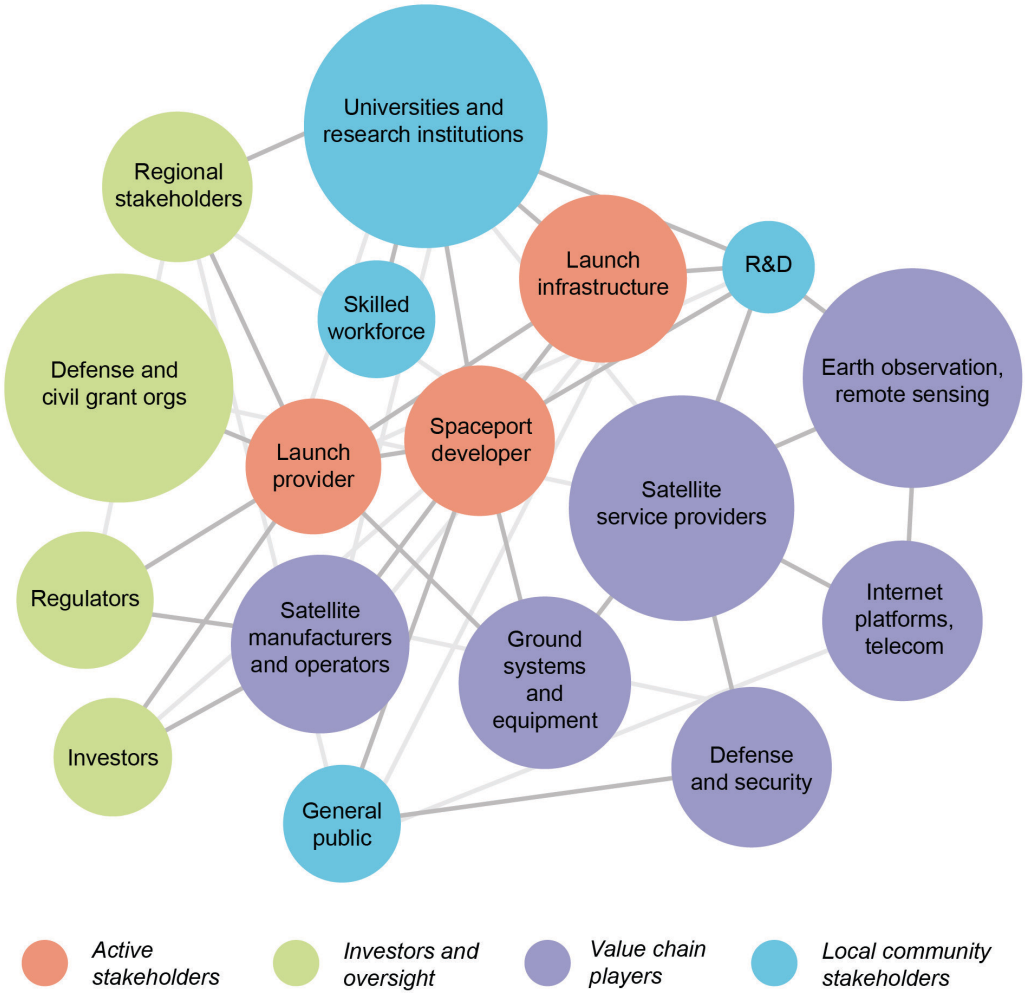

Figure 3: A notional example of a spaceport ecosystem. *Adapted from Alina Orlova, Roberto Nogueira, Paula Chimenti, "The Present and Future of the Space Sector: A Business Ecosystem Approach."*[84]

Early and Diverse Partnerships

Partnerships with customers, suppliers, regulators, and funders can be a mix of local and global actors; for instance, Rocket Lab operates globally with major partnerships in New Zealand, Japan, and the United States. However, the company's success is also tied to the region and the development of a local launch economy. Rocket Lab's early engagement with the New Zealand government's business development ministry, which promptly led to the formation of the New Zealand Space Agency in 2016, has ensured continued government support. This, in turn, has facilitated launch regulatory support, R&D funding, and tax incentives.

Space supply chains can be global, convoluted, untraceable, and often with significant exposure to market disruptions. Components that depend upon specialty parts and materials are particularly vulnerable.[85] Investing in local partnerships and supply chains can result in benefits other than financial gain, such as knowledge retention, longer-term resilience, and adaptation after failure. The head of Spaceport Cornwall emphasized the

strategic importance of a diverse mix of businesses, stating, "…what we did was future-proof the site and take advantage of the opportunities of launch to create a more sustainable business model by looking at building facilities that can be used by Virgin... and other businesses as well."[86] Despite Virgin Orbit's Chapter 11 bankruptcy following its 2023 launch failure, the spaceport continues to attract new partners, with a potential launch scheduled for later in 2025. Spaceport Cornwall's public-private partnership arrangement highlights how public and commercial interests can structure and derisk a partnership to make it more resilient to an uncertain future, building upon both commercial incentives and public interests.

Vertical Integration

While vertical integration strategies (not to be confused with vertical launch) have been historically common for satellite industry manufacturers, operators, and service providers, they are still new to launch provision. However, highly capitalized launch companies, like SpaceX and Rocket Lab,[*] have formed vertically integrated models to control more of the assembly process and to diversify their revenue streams.[87] This has meant acquiring or establishing multiple companies in their value chain to consolidate services and supply chains. Inevitably, vertical integration requires large upfront capital investment. Moreover, the benefits may be attractive to companies but a mixed blessing for governments because it creates more barriers for startups to enter and compete in the market. Taken to an extreme degree, controlling several levels of the supply chain can stir up antitrust concerns, although behavioral remedies could discourage anticompetitive behavior and mitigate such legal issues.

Horizontal Integration

Strategic horizontal integration that involves sharing of infrastructure, technical capabilities, and talent pools, can provide more resilience against market domination of larger companies. Spaceport infrastructure lends itself well to this horizontal integration scenario because it alleviates the resource-intensive nature of a launch facility by reducing capital expenditures, especially for smaller-scale operators, for any one company while promoting a mutually beneficial and shared spaceport infrastructure for all participants.[†] New spaceport developers should consider multiple launch provider companies, satellite operators, and other ground support suppliers to maximize the level of collaboration, rather than prioritizing exclusive launch vehicles. This would also contribute to more national and global alliances and better spaceport standardization and access to orbit.

Outside the increased focus in the United States to ensure efficient use of existing spaceport infrastructure, international initiatives are encouraging further collaboration and integration. For instance, the Global Spaceport Alliance (GSA) was organized in 2015 "for commercial spaceport operators at all stages of their development to come together and privately discuss their progress, obstacles, and challenges."[88] More recently, during October 2024, the STARLIFT project was launched at the meeting of NATO defense ministers to strengthen access to space, through participation with 14 Allies: Belgium, Finland, France, Germany, Hungary, Italy, Luxembourg, the Netherlands, Norway, Spain, Sweden, Türkiye, the United Kingdom, and the United States. According to NATO, "STARLIFT aims to develop a network of

[*]For example, SpaceX has integrated upstream with manufacturing capabilities and owning launch sites (e.g., Boca Chica, Texas) and downstream with their satellite internet services, Starlink. Rocket Lab has vertically integrated through its manufacturing of satellite componentry, subsystems, and software.

[†]Mutual benefits could be reduced significantly if there is high demand from one or a few launch providers, which obviates the need to share infrastructure with many launch providers.

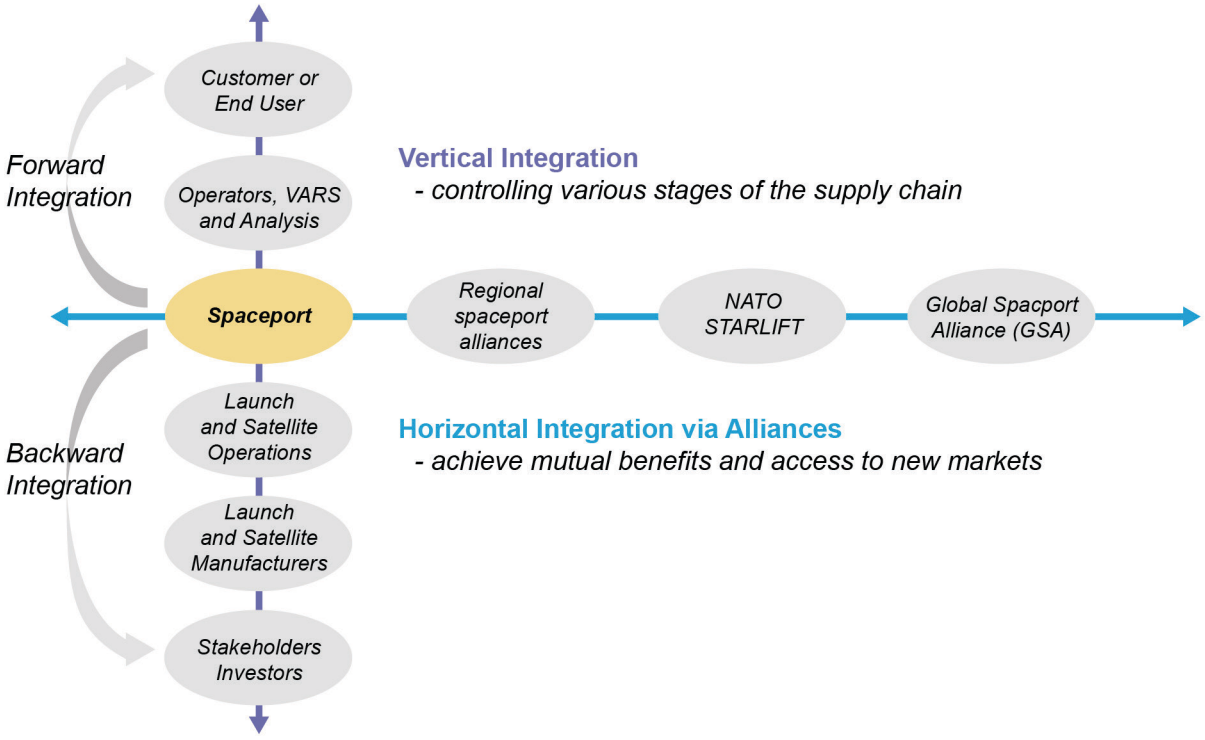

Figure 4: Horizontal and vertical spaceport integration.

launch capabilities that will help Allies launch assets at short notice from space ports across the Alliance, boosting NATO's ability to react more quickly to threats from space. It will also explore options like maneuvering pre-positioned spare spacecraft or buying data from commercial partners during a crisis or conflict." [89]

Establish Transparency and Build Trust

Openness and clarity are crucial for building trust and positive perceptions. Mistakes can start upstream with poor project selection, which can negate any potential benefits from downstream risk and investment sharing. This results from "the capture of government objectives in the interest of only a subgroup of society."[90] Despite the many successes of P3s, they are often "opaque" and are sometimes associated with their ability to "hide" public debt and distort public policies.[91]

Pork Barrels, White Elephants, and Bridges to Nowhere

The distortion of public interests for a large infrastructure project has many unflattering monikers:

- ***Pork barrel***: a project that involves the capture of government officials in an appropriation scheme to channel government spending for localized projects in exchange for political support.
- ***White elephant***: an infrastructure project that is expensive to maintain and difficult to dispose of.
- ***Bridge to nowhere:*** a metaphor for frivolous earmarks for a project. This phrase originated with a proposal for a bridge to connect the town of Ketchikan, Alaska, with a small airport, with an expected cost of $398 million.[92]

In fact, some spaceports have become tarnished by public perception. A few examples:

- Pacific Spaceport Complex – Alaska (previously known as Kodiak Launch Complex) was referred to as "space pork" a result of "Congress forcing the DOD to build the launch site as part of an illegal kick-back scheme over the objections of the military."[93]

- Spaceport Michigan, which was referred to by one state lobbyist as "a poster child of those last-minute, lame-duck supplementals" wherein lawmakers approve budget items late during a legislative term.[94]

- Spaceport America in New Mexico started with a small federal earmark of $1 million.[95] Virgin Galactic operates from this spaceport to provide suborbital spaceflights to space tourists; however, some locals refer to the whole situation as "a bit of a farce since Virgin Galactic aircraft could theoretically take off from some airports."[96]

- Spaceport 1 in Scotland is a proposed site for the launch of suborbital sounding rockets. Some opponents believe that the site is being developed prematurely and at considerable public cost, with some locals warning that the launch site could be "an expensive 'white elephant' as it has not attracted private sector investment and has yet to be fully licensed by the Civil Aviation Authority."[97] On the other side, government ministers support the project, arguing it will help Scotland win a significant part of the global space industry.

In short, siting and developing a large facility, such as a spaceport, is more likely to succeed if the planners earn the public's trust. For instance, a 2019 study of a P3 light rail infrastructure in Spain found that actual outcomes are largely dependent on the effective transfer of operational risk to the private partner. However, when private partners push for poorly conceived projects wherein the risks are carried by government, white elephants are born, along with "negative social outcomes and inefficient redistribution of wealth."[98]

Public Feedback and Involvement

When considering a proposed spaceport site, federal agencies and local government collect public feedback through local meetings and environmental impact statement assessments. Community-level meetings usually involve a development company's or a commercial space company's "pitch" to the community showing how the location is unique to the mission with an emphasis on how the spaceport will benefit the community in return. The scope and tone of the conversation depend on the degree of community engagement, corporate buy-in to the community, and use-case of the spaceport. Equally, the conversation is directed by community questions and concerns, which, in turn, determine the level of transparency into the process. Without the knowledge of what questions to ask, it is difficult for community members and planners to evaluate the spaceport proposal and business case and offer their support. And without community support, the development of a spaceport can become very time-consuming, potentially futile, and astronomically more expensive, sometimes resulting in a waste of taxpayer dollars and lingering ill will.

Spaceport Camden in Camden County, Georgia, provides an example of how a lack of transparency can eventually derail a project. Megan Desrosiers, Executive Director of One Hundred Miles a coastal conservation organization, shared that the questions began with average citizens diving into flightpath information. "There was no information available, we were literally reading physics textbooks to educate ourselves on flightpath trajectories," Desrosiers said, noting that few had any idea how a spaceport would impact the community. "Maybe it's like an airport, maybe it's like a parking lot.

People have no clue what the noise could be." Desrosiers emphasized that it was the community's lack of familiarity with spaceports combined with a confusing and ineffective public engagement process that left many asking, "How can Camden communities feel assured that millions of their taxpayer dollars are being spent wisely when they are denied any semblance of transparency?" [99,100]

In a bid for greater transparency, the coastal conservation group, One Hundred Miles, backed by concerned citizens sought to evoke the Georgia Open Records Act (GORA) and the federal Freedom of Information Act (FOIA) laws. They were told, in response, that all papers were considered "exempt" due to property acquisition laws. A subsequent lawsuit, led by Southern Environmental Law Center, challenged that Spaceport Camden proponents unlawfully withheld important public documents and failed to meet requirements under GORA.[101] In 2022, it was determined that the situation violated GORA. The construction of the spaceport was halted in 2023 after 9 years of local efforts, at a cost to the community of more than $12 million.[102]

Historical and Cultural Issues— New Zealand Examples

New Zealand has one private spaceport, owned and operated by Rocket Lab, which is located on the Māhia Peninsula of the North Island, and a second being planned on the South Island in a P3 arrangement between the New Zealand government and an indigenous-led organization. Despite a certain level of transparency and a public release of the 2016 contract between the New Zealand government and Rocket Lab, friction between stakeholders can persist, particularly if a spaceport operator unwittingly agitates long-running disputes or socioeconomic disparities.[103]

Rocket Lab's spaceport at Māhia, for instance, offers an example of the importance of transparency with local citizens. Since its siting in 2016, the spaceport has amplified tensions arising from New Zealand's founding treaty between indigenous Māori and the British Crown. The land for the private orbital launch site at Māhia was leased in 2015 from the Tawapata Incorporation, a Māori land trust that holds ancestral land in the Māhia [104] The local *iwi* (tribes), whose members are shareholders of the land trust, consider the land significant from both a historical and cultural perspective. While Tawapata Inc. has the legal right to lease the land, multiple tribal members have repeatedly raised concerns.[105] During an invited visit by local tribal members, Green Party MP Teanau Tuiono noted, "shareholders... have not seen the contract with Rocket Lab, which shows the lack of consultation done with *tangata whenua* (people of the land)."[106] When the New Zealand government revealed their new strategy for space and advanced aviation in 2024, news reports indicated that "the Māori Working Group on Aerospace said they have not been consulted at all."[107] The issue remains unresolved. Such disagreements that are due to a lack of sufficient transparency can hinder the progress and overall reputation of spaceports with the general public.

The Māhia Peninsula's controversy is in contrast to a more cooperative scenario, a planned spaceport on New Zealand's South Island, operating in a 50:50 partnership between Tāwhaki, a Māori-led aerospace company, and the New Zealand government.[108] While the site also has cultural and environmental significance for the local *hapū* (sub-tribes), the agreement to build a suborbital spaceport aims to fulfill dual intentions: to rejuvenate the local land as well as grow the local aerospace industry, initially through suborbital launches and uncrewed vehicle testing. Buy-in from tribal members was sought from the beginning through discussions between the government and tribal leaders.[109]

Avoid Irrational Exuberance—Establish Realistic Forecasts and Expectations

Although the space industry has made impressive and tangible technical and business progress, the sector is prone to exuberance and, in some cases, unchecked science fiction fantasies. According to *Astrotopia: The Dangerous Religion of the Corporate Space Race*, a popular 2022 book by Mary-Jane Rubenstein, the utopian dreams of the space industry can sometimes cloud the economic, environmental and scientific realities.[110]

No Tourism Silver Bullet for the Local Economy

A commonly held belief, by both spaceport developers and communities, is that the awe of a launch will naturally draw tourism. This is where likening spaceports to futuristic airports first goes awry: though commercial aviation was once a technological wonder, airport takeoffs no longer attract swaths of tourists. Furthermore, viewing a spaceport launch can be difficult to plan since it requires finding an adequate distance with a clear view, safe from the loud noises and risk of explosive disassembly. Often, launches are "scrubbed" or indefinitely delayed due to inclement weather or unmet conditions necessary for launch. These delays can last days at a time and occur up to the last minute, providing an unsteady basis upon which to plan a trip or excursion. Even in New Zealand, where residents are within a feasible travel distance to spontaneously view launches at its single orbital spaceport, there is no infrastructure to support launch tourism, e.g., no public restrooms, no road signage, and limited parking.[111]

When asked how spaceports interact with their local economies, Brian Rogers, Vice President of Rocket Lab's Global Launch Services, explained that because launch sites are not typically situated in densely populated areas, they are at a disadvantage to attract tourism. He explained that Rocket Lab had instead set up their Māhia launch complex in New Zealand with supply chain support, adding that the company's presence "keeps the people who want to be there with interesting things to work on."[112] Another area with similar rural challenges is Wallops Spaceport, a flight facility used by NASA.[113] Kurt Eberly, Director of Space Launch at Northop Grumman, shared that "the Eastern Shore of Virginia is a historically depressed area," but it has since seen growth due to launch activity. Wallops Island now has an increased year-round presence, with one new hotel and several restaurants remaining open in the winter.[114]

Despite some modest success, a "build it and they will come" mentality towards generating a local tourist economy from scratch can be well intentioned but naïve. Moreover, the novelty of a rocket launch can fade as occurrences become more commonplace, like the barnstorming aerial performances during the 1920s, which disappeared within a decade as aviation became more commonplace.[115] Ultimately, there is no tourism silver bullet to the business case of a spaceport.

Valuation of Nature and Local Environment

Notwithstanding the economic and year-round benefits provided by the injection of capital, jobs, and tourist activity to a region, such activity must also be examined to determine if it is welcome or perhaps discordant with local values and the interests of residents. One contemporary analysis of spaceport case studies emphasized that "[i]n general, spaceports are being added to areas where population densities are typically low, often near coastal areas, and where the landscape is dotted with longtime residents and small towns. Nature and quiet surroundings are highly valued."[116] In fact, underestimating or ignoring the intrinsic value of nature is a common practice in the general economy as well as among spaceport developers.[*] For example, Steve Howard, Camden County

[*] The concept that nature has intrinsic value even if it does not directly or indirectly benefit humans.

Administrator and Spaceport Camden project leader, referred to the region as a "blank slate."[117] Such an assessment potentially belies the concerns of residents and their valuation of the local environment. During the public comment period related to the proposed spaceport's public engagement process*, an exhaustive list of local environmental concerns was prepared. Airing these local concerns was designed to evaluate economic gains against environmental losses and other disruptive impacts to the community.[118]

Conclusion: Future-Proofing Launch Capacity

The future is uncertain, and the stakes are high. Spaceport developers and operators will need to keep pace with ongoing market trends and technical, geopolitical, social, regulatory, and economic developments. Likewise, commercial, civil, and defense space decisionmakers must be prepared for a range of future scenarios that can spur or stall demand for spaceports, including possibilities for changing rates for satellite deployment and replenishment, unexpected decisions by a large commercial-sector market participant, technology disruptions that impact business models and markets, regulatory changes, unmet revenue and market projections, rising geopolitical tensions, and the pace and scale of defense activity in orbit.

Spaceports lie at the fault line between society's space aspirations and earthbound economic ambitions and environmental concerns. The space industry will continue to consider new sites for spaceports on land and at sea, large and small, and for government and commercial customers. But to do that, we need the right practical foundations in place to avoid flawed "spaceport-opian" assumptions, strategic errors, and a general tendency to overlook local and regional needs. Within this context, spaceport planning principles can guide investors, government and commercial stakeholders, and surrounding communities towards a shared and realistic vision of success. A region's long-term economic, social, and environmental goals and national and commercial space ambitions will depend upon the space sector's ability to manage these practical realities while keeping eyes on the stars.

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*The National Environmental Policy Act (NEPA) requires public engagement during the preparation of an environmental impact statement (EIS).

Appendix A: Satellite Forecasting Challenges

It is difficult to find a single, comprehensive source of data on future satellite launches. Since most satellites require radiofrequency spectrum, filings with the Federal Communications Commission (FCC) and International Telecommunication Union (ITU) are among the most often cited sources. However, ensuring good data for market projections is still challenging due to:

- *Multiple filings*: A single constellation may consist of multiple ITU filings, including filings by multiple countries.
- *Name/identity confusion*: Filing names and the operating agency names in the ITU database may not reflect the actual constellation names.
- *Outdated information*: Operators may not proactively withdraw filings or reduce the size of their planned system, so filings often stay in the ITU database until their expiration.[119]
- *"Paper" satellites*: Some operators intentionally "over file" as a speculative move known as "warehousing." This tactic is used to attract investors or acquire spectrum/orbital priority with the intention of reserving for oneself or preventing others from using spectrum or orbital slots.[120]

Of course, uncertainty surrounding satellite demand projections extends well beyond actual satellite filings. There are a range of market and technology drivers that could influence and change a company's commitment to launch large numbers of satellites, including launch costs, market demand, emerging technologies, new constellation architectures, market partnerships and mergers, and financial strength.

Appendix B: Regulatory Streamlining and Efficient Spaceport Operations

Although the current analysis focuses on spaceport planning efforts, existing spaceport efficiency and responsiveness persists as a priority goal to address capacity demand and future launch bottlenecks. A 2022 U.S. Space Force report to Congress underscores this point, noting, "if we do not implement needed changes in response to the paradigm shift in commercial space and across the launch enterprise, our spaceports or ranges will quickly become the limiting factor to launch success and to national security assured access to space."[121] To modernize and increase capacity at existing spaceports, the Space Force has projected spending $1.3 billion from fiscal years 2024 through 2028 on its "Spaceport of the Future" initiative to improve infrastructure at the Eastern and Western Ranges.[122]

In the United States, the Federal Aviation Administration (FAA) Office of Commercial Space Transportation (AST) is working to improve regulatory and licensing efficiency by updating the FAA's Part 450 launch and reentry licensing regulations.[123] An effort to update these regulations was recommended with this express task in November 2024 to the sponsor of an aerospace rulemaking committee, called SpARC. [124] As of mid-February 2025, the House Committee on Science, Space, and Technology has also sent a letter to the comptroller general, requesting the Government Accountability Office (GAO) investigate commercial launch and reentry applications and focus on the role and efficiency of Part 450.[125] Efficiency efforts include reducing weather-related launch cancellations with improved weather and lightning detection systems; investing in R&D to protect launch vehicles and space vehicles against lightning strikes; and standardizing smallsat form factors to reduce integration costs and maximize launch fairing efficiency, allowing more satellites to fit into each ride to space.[126,127]

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