Public/Private Transportation Partnerships and American Space Transportation

by

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Abstract: Public/private partnerships and intergovernmental interdependencies have played a critical role in the development of all transportation modes that are linked together to form the American transportation system. Transportation system development has been a slow and incremental process shaped by national security, private sector economic demands, and availability of technology, population density and geography. Whether the initial transportation mode began at the private or public level, all sustainable transportation modes evolved through shifting patterns of public/private involvement. The purpose of this paper is to use this pattern to analyze and understand how the formation of public/private relationships have contributed to American transportation development and how the absence of these historical partnerships has inhibited the evolution of American commercial space transportation. The essay provides an overview of the public and private partnerships in the formation of new transportation mode development, explains how the lack of these historical partnerships have hampered American space transportation growth and provides recommendations for space transportation policy change.

The role of public/private partnerships in the development of American transportation systems has been varied and often complex. Growth of transportation partnership networks has been a gradual process generally motivated first by local and regional economic demand to support the growth of population centers and then by national security needs. Transportation partnerships and resulting transportation systems have been dependent on both geography and advancement of transportation technology. These partnerships generally formed in one of two patterns. The first, as witnessed in the formation of canals and railways, was through the formation of public/private partnerships between business, local and state governments, which produced economic gain. The expansion and linking canal and rail systems connected communities and became critical components of national commerce and security. As commerce and security concerns grew nationally, federal government partnership and oversight roles grew. As transportation developed nationally, a second method of partnership formation evolved to form commercial aviation. This second method of public/private partnership formation did not begin at the local level, but at the federal level. In the second method, the federal government initiated recruitment and support of local businesses and governments, to form partnerships that would create and support aviation. Though often fragmented, these many and extensive private and public state, regional and federal partnerships produced a transportation network that developed in a incremental manner (O'Neil and Ebdon 2004). Significantly, American space transportation has not followed the same incremental private/public pattern of development and subsequently has failed to evolve into a viable mode of the national transportation system.

Whether the initial transportation mode began at the private or public level, all sustainable transportation modes evolved through shifting patterns of public/private involvement. The purpose of this paper is to use this pattern to analyze and understand how the formation of public/private relationships have contributed to American transportation development and how the absence of these historical partnerships has inhibited the evolution of American commercial space transportation. This essay is divided into three sections. The first section will provide an overview of how public and private partnerships have historically functioned in the expansion of new transportation modes that meet economic and security demands. The second section will focus on the development of partnerships and how these partnerships have both shaped and hampered American space transportation growth. The final section will examine current space transportation policy and provide recommendations for policy change that will more effectively promote the use of public/private partnerships in the creation of space transportation.

INCREMENTALISM, PARTNERSHIPS AND TRANSPORTATION DEVELOPMENT

Growth of American transportation systems has been an incremental process shaped through the creation and collaboration of partnerships formed between private interests and local, state and federal levels of government. Two forces, economic demand and national security have shaped change in transportation systems and the development of new modes of transport. The creation public/private partnerships were necessary to meet the nation's growing commerce and defense (O'Neil and Ebdon 2003). The examination of public/private relationships and how past private and intergovernmental interdependencies impacted the development of canal, railroad and aviation transportation systems within the United States provides a rational basis for

understanding and predicting how public/private partners must behave in order to develop space travel into a viable mode the American transportation system.

Study of canal, railroad and aviation systems reveals that while initial development of individual transportation modes was generally undertaken by local private interests, growth and sustainability of these modes is a function of alliances formed with state and federal governments.

Canals: Private interests during the late 1700s and early 1800s attempted initial canal construction. Some of these private ventures enterprises were successful, many failed and many construction attempts were never completed. The poor canal construction record has been attributed to several factors, the lack of professional engineers, insufficient funding and the absence of governmental participation (Goodrich 1960). Support for canal construction did exist within the public sector. Presidents Washington, Jefferson and Madison all believed that that a viable canal system could link geographically isolated colonies, providing badly needed communication and commerce in a young nation (Goodrich 1960; Madison 1961; Hull and Hull 1967). However, Presidential support was generally verbal not financial. The federal government attempt to establish partnerships with private industry and states for canal construction in the early 1800s, attempting the implementation of a national canal plan. However, these partnerships failed to form and federal government assumed a minor role in canal construction. The government did sponsor a survey of the Mississippi and Ohio Rivers and their tributaries in 1820 and a follow on general survey of canal and road routes in 1824 (Hull and Hull 1967), but never provided any significant construction funding for canals. Early constitutional and state rights issues prevented formation of federal partnerships with private business and state interests. Many believed that the states themselves had the ability and responsibility to form the necessary alliances linking public and private interests to produce transportation improvements. Goodrich (1960) argues that the major reason for limited federal involvement was because of continuing conflicts between states and regions. Compounding the issue of federal participation was the fact that some states had already performed significant construction on their own and were resisted having to provide aid to less developed states. States tended to form local partnerships that aggressively pursued local interests. Successful local partnerships had little desire to form alliances with other states or regions. The federal government was unable to obtain any consensus to establish a necessary partnership network supporting creation of a viable national transportation policy (Hull and Hull 1967). Partnerships that formed to develop canal transportation systems during the early 1800s remained local.

In 1825 The New York government initiated construction of the most Erie Canal, the most aggressive construction project of its time. New York's decision to use public agencies and funding to construct the canal was believed necessary to avoid disruptive and destructive land speculation along the proposed canal route by private interests (Vance 1986). The state used three funding sources, earmarked state revenues, debt, and tolls, to financé construction. The canal provided significant economic improvement for the state, stimulating economic expansion within New York City, the growth of cities along the canal route, and is credited with the development of lands in the old Northwest. Canals provided a channel for western migration. The Erie Canal was noted by historian Carter Goodrich "as the most decisive single event in the history of American transportation" (Goodrich 1960, 55). Though highly successful, this effort

and its supporting government and private enterprise partnerships would remain local. The local nature of canals remained intact until canals fell victim to newer and improved technology. Canals' local geographical, technological and supporting alliances were unable to compete with emerging railroads.

A shift point in the public/private partnerships of canals occurred in the late 1800s and early 1900s, when the federal government assumed a more aggressive role in canal operations. The federal intervention was due in part to public and local political backlash in response to perceived railroad predatory pricing. Congress answered this demand with a modest amount of improvement funding for rivers and harbors, hoping to create a competitive canal system capable of challenging the market domination of privately owned railroads (Hull and Hull 1967). By the onset of World War I, The federal governments partnership with states and private interests increased substantially to ensure continued operation and sustainability of canals. Citing national security, the government purchased the financially failing Cape Cod, Chesapeake and Delaware canals to ensure sustainability of waterway operations. These canals and the intercostals canals are now maintained by national treasury funds (Vance 1986, 121).

Summary: The development of canals reveals important aspects in the beginning of public/private cooperation in early America for the building of transportation systems. Private interests at local levels first sought to create transportation modes that linked population centers and enabled commercial use of available technology. Local or regional governments seeking to gain economic benefits from trade provided by transportation actively supported private enterprise. When canals demonstrated the ability to expand economics and support security interests beyond the local or regional level, the federal government became increasingly supportive. The Federal roles in public/private canal transportation increased to ensure that canals were viable and sustainable to meet national welfare needs. The federal government demonstrated that it would intervene both financially and operationally to ensure sustainability, when failure of local canal partnerships placed national commerce or security interests at risk.

Railways: Early rail system development was a product of local private enterprise that often received enthusiastic support from local and state governments. Rail systems often began at or interconnected canal systems linking goods and passengers to locations that waterways could not reach. Rail transportation technology offered substantial improvements over canal structures and horse-drawn transportation. Rail possessed greater speed, capacity and comfort. Railroad construction was easier, more affordable and not as constrained by geography as were waterways (Smerk 1992). Rail systems also promised great profits for private enterprise. In the early 1800s, the private railroads enjoyed an era of unrestrained growth. In the thirty years prior to the civil war, private railroad companies dominated public/private partnership alliances, expanding lines without interference or regulation from state and federal governments. Railroad service promised significant economic opportunities for companies, towns and states. Railway companies seeking to expand and connect communities received enthusiastic support from the general public, from state governments and from the federal government (Leary 1985).
The Eastern seaboard was particularly supportive of rail systems that enabled the movement of relatively large numbers of people in densely populated areas. Expansion of railroads into territories moved large numbers of people and goods to what had been relatively isolated areas. Costs of goods went down, towns grew and commerce links expanded (Smerk 1992).

Public/private partnerships were particularly important for financing rail ventures. Financing methods for railroads included public improvement bonds, loans, selling of stocks for individual companies and foreign investment and barter arrangements as well as federal issuance of land grants and subsidies. Private banking funded railroads by using bond strategies that had originally been created for the development of canals. Public improvement bonds were sold by state agencies, and then purchased by private individuals or firms for resell to individual or institutional investors. Public assistance was about 25-30% of the total investment in railroads in the period before the Civil War; governments made much larger investments after the war, but their share was a smaller proportion of the total investment in this period because private investment increased so much at this point (Goodrich 1960). Private railroad companies also sold corporate shares. Barter arrangements that involved stocks to be issued in return for land and labor were also used, as wells as loans from private investors and banks (Greenburg 1980).

Federal participation in rail financing and sponsorship became increasingly important. Federal issuance of land grants proved to be an important provision for the expansion of local, regional and national railroad networks. Land grants were used as a form of aid in the initial development of railroads because provision of federal funds to directly assist in internal improvements within the United States during the early 19th century was considered unconstitutional (Mercer 1982). These land grants enabled the construction of the first transcontinental railroad. Grants proved to be an important source of revenue for railroads because they involved millions of acres of potentially valuable land, which could be sold by railroads to raise capital (Holbrook 1947). After 1860, in addition to land grants of over 100 million acres, the first transcontinental railroad companies received federal loans of $65 million. Local and state governments also continued the sponsorship and financing of rail development within their jurisdictions. From 1861-1890, local aid to railroads was estimated to be have been about $175 million while state contributed aid was estimated to be somewhat smaller (Goodrich 1960).

In the 1850s, railroad expansion experienced a great up swing. However, by the beginning of the Civil War, private domination of the nation's emerging rail system had produced anything but an integrated and uniform transportation network. By the early 1860s, the privately dominated rail partnership resulted in a lack of uniform regulation and standardization of railroads, producing substantial disparities among railroad lines. Individual carrier usage of different track gauges and vehicles when building lines often necessitated frequent car changes. Traveling from Charleston to Philadelphia during this period required changing cars eight times (Stover 1997, 45). Though rail systems proved to be of critical importance to both the North and South during the Civil War, private dominated interests still dominated. Standardization of track and engines would not occur until well after the war. Railway operation and expansion following the Civil War still continued to be largely unregulated, although public and legislative concern increased regarding the railroads' safety, economic influence and national security impact (Stover 1997).
Public criticism of private railroad companies' involvement in speculative and negligent building projects, financial misdealing, unfair rate practices, destructive competition and unfair labor practices gradually forced the federal government to assume an increasingly greater role in of railway regulation. Individual states initiated legislation attempting to regulate railroad conduct, with little success (Kolko 1965). The central agricultural states, in particular, revolted against what was perceived to be excessively high rates charged for grains by passing harsh legislation

to control or fix fares charged by railroads (Cunningham 1922). The linking of multiple private rail systems and the interconnection and participation of multiple local and state public/private partnerships had created a national transportation network critical to the economic prosperity and security of all American States and territories. A national rail system dominated and controlled by private interests was no longer tolerable. A shift in the rail public/private relationship was about to occur. Congress responded to public and state pressure in 1887 by passing the Act to Regulate Commerce. This act created the Interstate Commerce Commission (ICC) (Kolko 1965), empowering commission members to oversee rates, services and railroad financial management (Cunningham 1922).

Continued federal government domination and control of the railway transportation was again evidenced by the government's nationalization of railroad companies during World War I. However, though federal domination of rail may be tolerated or even desired, public ownership of railways, regardless of importance to national transportation has not been popular. Congress considered leaving the railroads under a nationalized system but ultimately chose to relinquish control in 1920, acquiescing to popular demand. The reprivatization of railways was based on the belief that resumption of private rail ownership and management would produce the greatest benefit to the public. Although the federal government continues to maintain a dominant regulatory role in the operation of rail systems, ownership and operation of rail companies would be private (Crumbaker 1940).

Summary: The evolution of railway systems in the United States is an excellent illustration of the formation and evolution of public/private partnerships in the growth of American transportation systems. The initial development of railways was undertaken by local private enterprise in partnership with local and state governments to satisfy demand for expansion of commerce. Private enterprise initially dominated the public/private partnership, while receiving critical political and economic concessions from local and state governments seeking local and regional economic growth. Federal government participation in early public/private endeavors was limited. The federal government considered initial transportation growth to be a private enterprise function and local government concern. For over half a century, rail expansion remained unfettered by government regulation. As rail systems, expanded, crossing state lines and providing critical national linkages, their importance to national commerce and security became critical. Citizens and legislators no longer considered private domination of this critical public/private partnership acceptable. A shift point occurred in the public/private rail partnership balance. The federal government intervened, asserting public dominance in the partnership providing regulation, standardization and direct economic aid. Interestingly, though the federal government assumes a dominate role in public/private transportation partnerships, it is unwilling to assume ownership except in of times of national emergency or in extreme and limited cases of economic hardship where private interests are unwilling or unable to accept ownership.

Air Transport Systems: Public/private partnerships in aviation would experience government domination and control much earlier than witnessed in previous transportation modal development. The Wright brother's first aircraft flight in 1903 created little demand for use of aircraft in transportation. Though there were numerous attempts by early private companies to

establish air transportation companies in the following decade, none of these early companies survived past 1923 (Leary 1989). Unlike early rail, aviation faced stiff national competition. By the middle 1920s, America depended upon wheels for transportation, not wings (Komons 1884). Aviation faced some significant early competitive challenges. The country was already linked by a transcontinental rail system. As the primary private sector transportation mode, rail was being challenged by improvements in automobile technology. Motor vehicles traveling along an expanding highway network that linked with water and rail provided much greater flexibility for passenger travel and goods transport. Aviation was considered a poor competitor for rail and auto, often considered as entertainment for rich adventurers (Smith 1991) not as a tool for commerce, falling "somewhere between a sport and a sideshow" (Komons 1984, 11). Aircraft technology during this period was incapable of competing against faster and more reliable express trains for markets. Commercial aviation to find a viable market that could be successfully exploited by private entrepreneurs. Unlike canals, rail and emerging highway systems, private aviation companies were unable to form the supportive local and state government partnerships needed for commercial aviation transportation growth. Local governments simply failed to recognize aviation as viable economic opportunity.

Though lacking private economic applications, aviation operations in the early 1900s were sought out to a limited extent by the military. The federal government was to champion and fund aviation vehicle and system development before local and state governments, forming direct relationships with private companies. As a result of this partnering, frail aircraft used for aerial observation in 1914 were replaced by faster, more maneuverable and more reliable vehicles in 1918 by aircraft manufacturers. During WWI, the U.S. War Department built a number of airfields throughout the country to support military training (Bednarek 2001). Government support again aided aircraft development when the Post Office expended a total of $700,000 in 1918 and 1919 in its exploration of using air carriers for transporting mail (Leary 1985). The government began experimental airmail operations in the Northeast. Operating at a loss and subsidized by taxpayer dollars, the Post office was responsible for the creation of a transcontinental airway system that supported both day and night operations.

Unlike rail system development, in aviation there would not be a period of public/private partnership domination by private enterprise. One time market oriented private entrepreneurs pushed aggressively for government intervention and oversight, realizing that regulation was an "absolute prerequisite for the orderly exploitation of the air" (Lewis. 2000. 2.). The demand for regulation and support of private companies by the government resulted in the Air Commerce Act of 1926. Under this act the government assumed responsibility for the construction and maintenance of airways, navigation aids, the licensing of aircraft and airmen and for the safe and orderly operation of the nations' air transport system (Lewis. 2000). These early efforts provided the foundation for an air system market that could be sustained by private companies. By 1927, all mail operations had been turned over to private operators.

Charles Lindberg kindled public interest in aviation during this period. His historic non-stop flight from New York City to Paris in 1927 received worldwide press coverage (Bilstein 1983). Following Lindberg's flight, however, aviation's commercial transportation potential received only limited support by private enterprise. Local business and government simply lacked sufficient interest. As a result commercial aviation lacked sufficient support to grow (Lewis

2000). Federal domination in the form of the Waltres Act of 1930 would again occur. The Waltres Act gave the Post Master General of the United States the ability to set and consolidate airway routes, form and dissolve carrier contracts and set rates. Under federal direction, a fare strategy that provided a strong financial incentive for airlines to establish passenger services was instituted (Leary 1989). These incentives spurred a three-fold increase in airline passengers in just three years in the early 1930s (Leary 1985). As the airborne postal service and commercial passenger market expanded, so did commercial ground facilities. The growing demand for airborne transport of mail to growing population centers stimulated demand for airfield development. Federal government sponsorship of early aviation provided the catalyst for a commercial passenger and cargo aviation market and the subsequent formation of partnerships by local private businesses and city and state governments seeking aviation system development (Bednarek 2001). By 1940, these partnerships prepared the foundation for creation of pioneering airline companies such as Eastern, TWA, American and United.

Local business and government support for aviation expansion of airway systems was greatly aided by the War Department for WW II. In 1938 Congress enacted the Civil Aeronautics Act which removed a previous ban of federal aid to airports and also ordered the drafting of a comprehensive national airport plan to more orderly develop airports as part of the national transportation system. By 1939 National defense interests provided a program for improvement of commercial airports, under War Readiness, even though the airports remained primarily owned and operated by local governments. In 1940, Congress appropriated $40 million for airport work at 250 facilities, in addition to other federally funded work projects. Other cities gained from the War Department and Air Service development of airfields as many localities gained possession of fields following national emergencies. Localities gained substantial benefits when the United States Army Air Force (USAAF) directed defense funds to many strategic municipal airports across the country. The USAAF typically entered into relationships with municipalities using one of three methods: (1) a lease agreement for military purposes, (2) the lease of the entire air facility (often also assuming the responsibility for airport operations) and (3) total militarization of all or part of the facility with the expressed intention of returning control of the airport to localities at the end of the war (Bednarek 2001).

Following WWII, the federal government continued to dominate and guide public/private aviation partnerships by initiating the Federal Airport Act in 1946, beginning an aid to municipal airports program that would remain in effect for almost 25 years. The government continued its heavy regulation and control of a now rapidly growing American domestic and international airline industry. The government carefully supervised and established safety and operational requirements for airline companies and airports as well as providing supplementary funding for locally owned airport construction and improvements. Under federal government domination, this public/private partnership between private businesses, local and state governments and the federal government, produced a steady expansion of American commercial aviation into the most commercially lucrative aviation market in the world (Owen 1997; Wilson 1996).
The federal government continued to nurture commercial aviation and stimulate local interests by passing the Airport and Airway Development and Revenue Acts in 1970. These acts established a trust fund to sustain airport and aviation improvement supported by taxes on airline tickets, air cargo, fuel, and on the airlines themselves.

One of the most significant changes in the public/private relationship between airline industry, airports, local governments and the federal government occurred in 1978 when the federal government relinquished federal regulation of economic control and scheduling of airlines. While the federal government still paid for air traffic control and regulated safety and certification of airlines and pilots, it no longer controlled the airline's operational routes and frequencies. Deregulation enabled companies to compete and grow rapidly. Airlines employed hub and spoke strategies in key city locations forming more intense commercial relationships with municipal airport owners (Reynolds-Feighan 1992). A period of tremendous competition followed deregulation, fares decreased, and passenger travel increased dramatically.

Although deregulation of the American commercial airline system was intended reduce the federal dominance of the public/private aviation partnership, making the industry self sufficient, this did not mean airlines and localities would not continue to receive substantial federal government funding and protection. From 1999 through 2001, approximately $12 billion was provided for airport-planned capital development. The funding of bonds accounted for almost $7B, federal grants provided $2.4 billion and passenger facility charges produced $1.6 billion (GAO 2003). Following the terrorist attacks of September 11, 2001, the federal government took action to protect local airports and the airline industry. To offset the airlines' financial losses and civil liability claims as a result of terrorism, Congress passed the Air Transportation Safety and System Stabilization Act, *Public Law 107-42-Sept 22, 2001*. This act provided immediate fiscal and tax relief for airlines as well as limiting potential civil liability resulting from the use of commercial aircraft in the attacks. To strengthen aviation security, the Aviation and Transportation Security Act, *Public Law 107-71 [S. 1447] of Nov.19, 2001*, established the Transportation Security Administration, paid for by federal dollars. In addition, the Terrorism Risk Insurance Act of 2002, *Public law 107-297, Nov 26, 2002,* was passed to protect American companies' future insurance losses and liability stemming from terrorist acts.

Summary: The development of aviation public/private partnerships was distinctly different from those previously formed for growth of canal and rail systems. Though, modern American commercial aviation is a complex collaboration between private companies and local, state and federal governments, it was guided and dominated by the federal government from infancy. Unlike the earlier local public/private partnerships that would give birth to canal and rail systems, which would gradually expanded nationally to include the federal government, aviation partnerships ere first formed by the federal government. The federal government crafted and funded formation of the local private/private partnerships that would eventually form an aviation transportation network. The federal government assumed the denominate public/private partnership role critical from the onset to ensure that evolving national commerce and security needs were met. It signaled a new period in national transportation development where the federal government's provision of financial and regulatory support was considered vital by both private and public entities. The change in the public/private relationship evident in the development of American aviation would play a key role in the growth of American space launch.

SPACE TRANSPORTATION DEVELOPMENT

Era of Space Flight: From its inception, space flight has been almost completely dominated by the federal government in the name of national security. World War II produced many significant technological advances in aviation that directly lead to the development of space transportation systems. The Germans developed and deployed the first winged rocket interceptor capable of transonic speeds (Bergman 1960). Rocket technology would become very important to American and Russian governments post WW II. Following Germany's capitulation, America and Russia actively sought out rocket German scientists. Both countries recruited these scientists to work in missile development. Americans used a team of relocated German scientists headed by Werhner von Braun to test and improve the V-2 that was then capable of lifting 2,000 pounds of cargo. During the same period, the Russians actively pursued two programs that alarmed western defense agencies. In August of 1949, the Soviet Union detonated its first nuclear weapon. In addition there were reports that the Russians were aggressively pursuing an extremely advanced program to produce missiles capable of carrying significant payloads at increasing ranges. The belief that Europe was vulnerable to attack from Russian missiles carrying nuclear warheads motivated Americans to aggressively pursue their own missile programs. The Huntsville and Redstone Alabama facilities were selected for missile research and development; Cape Canaveral Florida was selected to serve as a launch site (Bruerer 1993). The federal government paid for the cost for these sites and programs.

Following WW II, America proceeded with what it considered to be a superior technological missile development program. However, funding problems and conflicts over what missiles should be developed and which military service should develop and control the effort severely limited American missile advancement. On October of 1957 America was stunned by the report of a successful orbital satellite launch by the Soviet Union. The *Sputnik* satellite was 23 inches in diameter, weighed approximately 30 pounds and orbited the globe every hour and 35 minutes at an altitude of 560 miles. On November 3, the Russians launched *Sputnik II*, a vehicle carrying a much heavier payload, including a dog. America hurriedly attempted a launch of a Vanguard test vehicle in December of that same year. However, the Vanguard rose three feet from its launch pad and burst into an inferno of flames (Bilstein 1989). America's reaction was one of both humiliation and fear. Americans had been extremely proud of both its defense and aerospace programs, programs that then appeared to be second rate to their Cold-War adversary.

In January of 1958, America achieved a limited amount of success by launching a small *Explorer I.* It was quickly eclipsed by the Soviet Union's launch of *Sputnik III. Sputnik III* was another significant scientific and technological accomplishment. It weighed nearly 3000 pounds and presented grave military ramifications for the west. The Russians were not only ahead in development of missiles that represented a clear strategic nuclear threat, but they were also believed to be rapidly building a program that would allow them to conduct manned orbital flights as well as flights to the moon (Bruerer 1993). The Russians were perceived to be pursuing domination of the ultimate military high ground, space.

The federal response was a strategy to be accomplished through development and testing of vertically launched rockets capable of providing the needed heavy lift for both programs (Heppenheimer, 1999). It entered directly into partnerships with private companies like Convair

(Atlas), L.T.V./Ford (Scout), Douglas (Thor) and Martin Marietta (Titan II & III) (Parsch 2004) in a crash defense program to development both intercontinental ballistic missiles (ICBM) and lift vehicles for manned lunar missions. This program produced the Atlas missile series that served both as an ICBM and also as a vehicle for four manned orbital flights in the Mercury program. ICBM development produced an operational Minuteman missile in 1961. The success of the Minuteman was quickly followed by the development of the versatile Titan series that included many variants including the Titan I (ICBM only), the Titan II (ICBM & Gemini) and the Titan III launch vehicle capable of lifting 33,000 pounds of cargo into orbit. America was successful in regaining its military footing against Russia with ICBMs and over-taking Russia in space by sending men to the moon, but this success came at an enormous public economic cost. Commercialization of space was not a priority, so the federal government did not develop partnerships with localities for commercial purposes other than production of defense missile systems. Vertically launched rockets, rather than space planes with the potential for operation at local commercial airports were the chosen vehicles for American space flight.

Winged Space Vehicle Development: The space race to the moon and rapidly developed ICBM development programs had significant impact on future space economic partnerships. Since the basic motivation for both programs was national defense, funding was almost exclusively federal. Commercial applications that might help offset program developmental and operational costs were extremely limited. This lop-sided public/private economic partnership and the immense cost associated with manned space flight would result in the eventual crippling of American manned space flight.

The federal NASA-directed space program was expressively chartered to land men on the moon and return them safely to earth (Breuer 1993). Though extremely successful, the cost of the Apollo program would hamper follow-on space efforts. The immense cost of the moon race took a toll on programs deemed not crucial or directly related to the Apollo program. Originally estimated to cost $12 billion in 1963, the cost of the Apollo program had increased to over $21 billion at the time of the first moon landing in 1969 (Heppenheimer 1993). Early winged space vehicle development was perceived as showing little potential to supply the heavy lift needed to support orbital missions. Winged vehicle funding was diverted to heavy lift and expendable lift vehicle (ELV) programs.

Following WWII, only the federal government pursued the testing and development of experimental (X-series) aircraft capable of high altitude and sub orbital flight. These included the famous X-1 as well as the X-2, X-3, X-4 and X-5 variants that were designed to explore various aspects of high speed and high altitude flight. Probably the most successful X series aircraft was the X-15, which underwent testing during the same time that Mercury, Gemini and Apollo craft were being flown and developed. For a decade starting in the late 1950s until 1968, the X-15 flew 199 flights, achieving a maximum speed of 6.7 Mach and a maximum altitude of 354, 200 feet (Thompson 1992). X-15 tests of flight controls and instruments, alloys, aerodynamic configurations, life support and hypersonic flight regimes were documented in over 765 research papers and reports and a significant body of lessons learned for future hypersonic test programs. Of the twelve pilots that flew the X-15, five received astronaut wings (Jenkins 2000). Even though productive beyond initial expectations, the X-15 was cancelled, a budgetary victim. Previous budget constraints for space vehicle development under the Eisenhower administration

had replaced with an aggressive multi-billion dollar government program (Breuer 1993). Winged hypersonic craft, like the X15 were incapable of providing the heavy lift needed to achieve desired orbital altitudes to support the moon program. The immense cost of the moon race took a toll on programs deemed not crucial and directly related to the Apollo program (Heppenheimer 1993).

The demise of the X-15 series effectively terminated winged vehicle hypersonic development. This was done despite the fact that the X-15 test series demonstrated that winged reusable launch vehicles (RLV) were capable of rudimentary space flight as early as 1959. Significantly, these vehicles clearly showed potential for future interface with existing airport systems as well as representing a developmental program that could eventually produce vehicles that would be capable of flying not only sub-orbital profiles but orbital profiles as well. The cessation of winged spacecraft that may have become capable of interfacing with commercial aviation markets prevented the creation of private sector partnerships that had been so crucial in past transportation mode development.

Though extremely successful, the NASA run Apollo program dictated how America would pursue future space efforts. The federal government considered winged space vehicle development as incapable of supporting orbital missions. Private companies saw no demand for winged space vehicles and were unable or unwilling to invest in these systems. America became solely dependent on vertically launched rocket vehicles. The government-dominated and limited public/private partnership excluded the majority of localities and states. There was no effort to create a space transportation partnership network seeking to meet commercial and security demand. Because of this, American space "transportation" was destined to remain principally funded and controlled by the federal government, excluding private entrepreneurs, local governments and private markets capable of helping offsetting system operational costs. This sole proprietorship severely inhibited the development of an expanding transportation system in space.

America's First *Space Transportation System* (STS): In March of 1958, the administration decided that America needed a national space program spearheaded by an agency capable of channeling technology, science, and military security requirements to meet the Soviet challenge. In October of 1958, the administration commissioned the National Aeronautics and Space Administration to meet the space race challenge (Bilstein 1989, 44-48).

While NASA accomplished its mission to win the space race, the American aerospace industry that emerged after Apollo was a "government-dominated" organization where cost containment was not considered an "important criteria for success." Despite initiatives to correct this practice, NASA's inability to control costs still plagues the agency today (Hoban 1997, xiii-xvi).

As Apollo neared its first landing on the moon, NASA was looking ahead to the next phase of space exploration. NASA considered a space station as the critical next step, absolutely crucial to the future establishment of a lunar base or Mars manned missions. But the tremendous costs incurred in the Apollo program resulted in significant budget reductions during the economic downturn of 1970s. In reaction to the cutbacks, NASA abandoned plans for a space station, lunar colony and manned Mars mission. NASA sought an alternative to the reliable but expensive

system of expendable launch vehicles that had been used in the past. NASA proposed a system combining a RLV with vertical rocket launch technology. Under pressure from the Office of Management and Budget, NASA commissioned studies that would be used to economically justify the construction and use of the proposed shuttle fleet. The NASA-commissioned studies claimed that flight costs of the shuttle would be less than using conventional ELVs. In the wake of the successful but enormously expensive Apollo moon missions, American space policy debate had suddenly changed from a strategy of "beating the Russians" to one of program "cost-effectiveness" (Pace 1990). The problem was how to impose efficiency onto an American space launch system that had been constructed, dominated and operated by the federal government with little cost constraint.

In response to efficiency concerns, the shuttle program was marketed based on cost effectiveness assessed by projecting an exceptionally robust operational schedule that would meet both NASA and DOD (USAF) mission requirements, eliminating the need for the use of ELVs. The shuttle model construct proposed the use of five shuttles each flying once a month, every month, to achieve a yearly total of 60 flights. However, even relatively simple simulated reliability analysis by the Rand Corporation of the proposed shuttle schedule model produced serious doubts as to the sustainability of such an ambitious schedule (Leinweber 1984). Critical analysis specifically cited concerns regarding the longevity of orbiters (aging and loss), vehicle turnaround and relaunch time requirements and the consequence of mishaps (stand-down periods following incidents). Prophetically, the studies recommended supplementing the fleet with additional orbiters or with "an alternative launch system" as a means to ensure adequate space launch capability (Leinweber 1984, vi). Other agencies appeared to question original promises made by early shuttle advocates.

The Air Force was extremely uncomfortable with the prospect of relying solely on the shuttle to support critical DOD missions. When faced with ultimately having to phase out the Titan series, the USAF undertook two strategies. The first was to encourage Titan contractors to develop a Titan commercial variant for launch of commercial satellites. The second was to seek authority to purchase complementary ELVs based on the shuttle solid rocket booster design (Pace 1990). The loss of the Challenger in 1986 validated the concerns about deficiencies in the shuttle program as originally forecast in the original Rand shuttle operational model reliability analysis. It also enabled the USAF to once again actively procure ELVs to meet its operational requirements. Of significance, even though a replacement shuttle orbiter was built and the shuttle fleet returned to service, the STS fleet would only carry shuttle-unique payloads. To this date, the shuttle program has never delivered on its original promises, having flown only 113 missions. Projects delayed by repeated shuttle groundings and long turnaround times became a priority well before the loss of the Columbia. By the 1990s, limited commercial missions were no longer part of the shuttle launch plan and were launched by ELVs. This action clearly signaled the end to any pretense to "justify the shuttle on cost-effectiveness grounds" (Pace 1990, 8).

An internally fragment and federally dominated space effort has resulted in an expensive and less than dependable system, simultaneously maintaining an ELV launch system that had been previously judged as too expensive along with substantial Shuttle program costs. Lack of competition has resulted in soaring costs. Titan 4 missile launches originally projected to cost approximately $100M, reach $500M plus the cost of the payload. Like the shuttle, the Titan's

reliability was also less than desired, achieving 30 successful launches out of 34. In the late 1990s, three Titan Air Force Mission failures cost the government $3 billion (Kelly 2004). The Titan has been retired because of cost concerns, but the end result is that the American government now pays for two expensive launch systems, the shuttle that is currently grounded and a less than reliable ELV system.

The failure of the American STS has had severe operational repercussions for American space launch. American access to the International Space Station (ISS) is now extremely limited and dependent on others. The United States is currently working hard to return the Shuttle fleet to operation, but since losing the Columbia has been solely dependent on Russian space lift to keep the ISS in operation. Interestingly, there are reports (Sieff 2004) that beginning in 2006, the Russians will only fly U.S. astronauts into orbit on a commercial basis. The Russians are stated to be seeking more profitable commercial ventures and are in the process of contracting with the European Union to send member nation astronauts to the ISS. After return to service, the shuttle is expected to fly approximately 25-30 more missions before an expected retirement at the end of the decade, even after accomplishing extensive and expensive safety improvements stemming from the Columbia mishap (Shaw and Cabbage 2004). With no real replacement vehicle slated for operation in the near term, the future of American space launch is questionable.

Emerging Sub-Orbital Space Vehicles: The successful sub orbital launches of SpaceShipOne and proposed development of other sub orbital craft by private entrepreneurs may signal a return to the incremental development of balanced public/private partnerships. Winged space vehicles, unlike current space missile systems, possess the potential to interface and expand the existing American national transportation system, by using existing runways. Research and development of these vehicles appear to be additionally fostering the formation of the local, state and federal private/public partnerships that have been historically critical for formation, growth and sustainability of transportation networks. Proponents of these vehicles hope to meet future commercial and defense space market demands.

The development and successful sub orbital flights of SpaceShipOne built and flown by Burt Rutan's Scaled Composites Company is in many ways similar to the development and introduction of aircraft in the 20th century. SpaceShipOne represents a serious return by aerospace pioneers to incremental development of winged space vehicles through the creation of enabling partnerships, partnerships that form the foundation of a new transportation mode.

Scaled composites received financial backing from Microsoft's Paul Allen to build SpaceShipOne in order to win the Ansari X-Prize. The Ansari X-PRIZE was modeled after the Orteg Prize of $25,000 motivated Charles Lindbergh's historical non-stop flight between New York and Paris. Backers of the Orteg Prize hoped that this contest would spark public interest in aviation that would further development of the commercial aviation industry. The Ansari award was established in 1996, offering a purse of $10 million from various private contributors to the company that could successfully launch the same vehicle twice in two weeks into space (Ansari 2004). The Ansari foundation, based in St. Louis, hoped to spark interest and develop of technology that would support interest in developing vehicles that would support space tourism and travel. Scaled Composites manufactured SpaceShipOne, using a test and evaluation protocol that was very similar, to those used in NASA's X-15 testing. This testing led to three successful sub orbital flights. The last two flights occurring on September 29 and October 4 2004 launching and landing at Mojave Airport in California clinched the XPRIZE purse.

Scaled Composites notable achievements included establishing a network of partnerships. The flight of SpaceShipOne laid the groundwork for experimental launch licensing from the FAA's Office of Commercial Space Transportation (AST), designation of the first civilian astronauts by the federal government and played an instrumental role in the certification of Mojave Airport as a spaceport. Mojave became the first spaceport in the United States that did not operate vertical launch rocket systems, but simply operated a runway and control tower. SpaceShipOne's flights were tracked by a new radar system developed by the Air Force Test Center with support of the California Space Authority (CSA). The experimental multifrequency, continuous wave radar system has the capability to simultaneously track the trajectories of multiple vehicles (SpaceToday, 2004).

Importantly, there are many companies undertaking the development of sub orbital and low orbit vehicles. Following SpaceShipOne's historic flights, Richard Branson of Virgin Airways joined in partnership with Scaled Composites to construct a fleet of commercial sub orbital passenger vehicles (SpaceDaily 2004). Private entrepreneurs are now offering larger prizes for technological development of private commercial space vehicles capable of reaching Earth's orbit. Robert Bigelow of Bigelow Aerospace is offering $50 million to the first company that by January 10, 2010 can fly a vehicle to 400KM, orbiting the earth at least twice. NASA is also considering sponsoring its own form of competition to spark private sector space technology development. NASA's Centennial Challenges hopes to "tap the nation's ingenuity to make revolutionary advances to support the Vision for Space Exploration and NASA goals" (NASA 2004).

Burt Rutan initially partnered with Paul Allen and then partnered with the publicly owned Mojave Airport and is continuing to stage operations from that site. SpaceShipOne's operations also involved a public partnership with the California Space Authority (CSA), which recognized wing space flight development as an important source of potential economic growth for the state. Scaled Composites has also formed working relationships federal government agencies, the USAF and the FAA. These public/private partnerships a basic cooperative network that is necessary for the growth and incorporation of space flight as a viable component of the national transportation system. The flight of SpaceShipOne demonstrates the future feasibility of space vehicle technology to move people and goods using existing aviation facilities within the national transportation infrastructure. Winged space vehicles can to be used both commercial enterprise and government defense needs.

Just as in the creation of early canal, rail and aviation systems, commercial space transportation interests are being explored and championed by private interests and partnerships. Like their preceding aviation pioneers of the 20th century, 21st century space pioneers, like Burt Rutan spark public interest, private entrepreneurial financial investment and government sponsorship and cooperation. SpaceShipOne is important because it demonstrates the important reemergence of private industry forming partnerships seeking to expand space transportation markets. It makes a potential shift in the balance federally dominated public/private space partnership.

Partnerships are evolving and expanding. Richard Branson has joined Burt Rutan's Scaled Composites joint venture with Microsoft's Paul Allen that produced the successful sub-orbital launches of SpaceShipOne in a venture hoping to establish viable space tourism. Branson named his new undertaking Virgin Galactic and is promising regularly conducted flights in just a few years (Tabarrok 2004). An another space entrepreneur, Robert Bigelow, is attempting to build a launch and support network that will support tourism and hotels in space.

The cultivation and expansion of public/private partnerships in winged space vehicle development by the private enterprise and the governmental sectors promises a dual benefit. The first is the sharing of cost of incremental development of space vehicle technology that will allow for expansion of routine flight into space for commercial and defense needs. The second benefit is a result of the first. Gradual development of new technology and shared cost will allow for sustainability of space exploration missions to the moon, Mars and beyond creating opportunities for commercial expansion beyond the confines of earth. As rail systems developed across the American continent costs fell. As aviation systems developed across the nation, costs decreased and service improved. As winged sub orbital vehicles gradually transition into orbital vehicles, the cost to travel into earth's orbit and beyond will decrease. Transportation network expansion and sustainability is directly dependent on commercial and governmental interests and participation. Viable transportation systems are directly dependent on the formation of private and public local, regional and federal partnerships. These partnerships and their eventual success in turn become dependent on legislative policy and law that ultimately funds and directs transportation development and operation.

States and Space Launch: The lack of a balanced public/private partnership in space transportation development has produced an extremely limited number of space launch sites. There are a total of five potential operating launch locations in the United States with only the isolated coastal complexes located in Florida and California being extensively used. California and Florida complexes are located on government property. There are a limited number of partnerships comprised of federal and state governments and private companies that are actively seeking space launch and related economic development and educational opportunities.

But these partnership arrangements are very limited in scope. Currently, launch sites are built, operated and maintained in one of three ways: directly by the federal government, by the federal government in agreement with private companies or under an agreement between state agencies and private companies. The California Space Authority, a nonprofit corporation, and the Florida Space Authority, an established state government agency, are supporting facilities and equipment for the construction of payloads, space flight hardware, rockets and other launch vehicles, and for other spaceport facilities and related systems. Both California and Florida agencies actively seek and enter into private launch development and operational agreements with commercial enterprises. At the present time, the shuttle is the only space transportation vehicle in the American inventory capable of launch, recovery and relaunch. It is used in a very limited and restricted capacity serving mostly government security and research functions and is controlled by NASA. Because of environmental and safety considerations associated with the launch of large rocket-powered lift vehicles, remote coastal locations isolated from population centers are required for operational space facilities within the United States. The one exception is Mojave spaceport from which multiple SpaceShipOne flights were conducted.

Cost, safety and environmental restrictions associated with launch of vertical launch missiles makes it extremely difficult for other states to build and operate spaceports. The operating limitations of these rocket systems have resulted in three categories of states that participate in commercial space transportation within the United States accompanied by public/private partnerships formed to support state interests (O'Neil, Box and Bowen 2003). The first category contains states with active space launch facilities and established supporting aerospace industry.

The second consists of states that possess well-established aerospace industry. The last category contains states that are seeking benefit from developing supporting aerospace industry or actively participate in space grant and space related educational outreach programs. In conjunction with the private aerospace industry, these state governments, , have developed a quasi-government to government relationship with the federal government for the operation and support of commercial and DOD space launch within their respective states.

Only four states fall into the category of states that possess active space launch sites: Alaska, California, Florida and Virginia. Of these states, California and Florida have the most extensively developed partnerships between localities, state and federal government and private industry. Both states have agencies that sponsor and oversee economic development of space launch and associated enterprise. The California Space Authority (CSA) is a nonprofit corporation governed by a statewide board of directors that represents community and state interests in development of commercial, civil, and national defense/homeland security interests. The board's membership is selected from the states diverse industry, government, academia, and workforce. The CSA also serves as the states' spaceport authority, which actively seeks to further develop and expand spaceports within the state. The CSA coordinates with NASA, the USAF, local and state government officials and agencies as well as private corporations companies to operate and expand commercial and DOD space launch and supporting industry within the state (CSA 2004). CSA also sponsored the development of Mojave spaceport, the nation's first FAA certified inland space launch facility.

The Florida Space Authority (FSA) was created in 1989 to aid in expansion and diversification of the state's space launch and aerospace industry. The FSA possesses the same governmental powers as other Florida transportation authorities to regulate space transport. FSA membership is composed of seven Governor-appointed members that form the Board of Supervisors. The Florida Senate and House of Representatives also assign two additional ex-officio members to the Board. The Florida Space Authority is located under the office of Tourism, Trade, and Economic Development. The Lt. Governor serves as the Chair of the FSA Board. FSA was formed with the intention of extending the quasi-governmental model used by airport and seaport authorities to operate and expand the commercial space industry. A critical partnership was sought with the USAF to create a civilian/commercial authority that would jointly operate activities on Cape Canaveral. This type of government-to- government arrangement has enabled the FSA to develop underutilized property and facilities at the government owned spaceport for subsequent use by private commercial customers. The FSA and its partners now use these facilities under a dual-use, non-interference, and right-of-refusal basis with the Air Force. Two additional organizations have been created to support Florida Space Commerce, the "spin-off" the Florida Space Research Institute which provides support for space academic and research programs and the Florida Commercial Space Financing Corporation which is tasked with finding financing for commercial space projects (FSA 2004).

Alaska's space launch and supporting aerospace industry is far less developed, than the industries that exist in California and Florida. The Alaska State Legislature formed the Alaskan Aerospace Development Corporation (AADC) in the early 1990s with the explicit intention of bringing into the state the high-technology industry associated with space launch. A launch site was completed on Kodiak Island in 2000, becoming the first non-federally owned space launch

facility, with the hope of attracting both DOD, NASA and private commercial polar orbital launches. The AADC is seeking to form partnerships with academia and space technology firms to expand the aerospace industry. One proposal is to establish an earth down link station in Fairbanks to receive data from remote sensing platforms, research or observation satellites in orbit. Kodiak has struggled, completing few rocket launches. In 2003, the AADC forged its first significant operational partnership with the USAF for testing of the national missile defense system under a five-year contract (AADC 2004).

The Virginia Commercial Space Flight Authority (VCSFA) is a political subdivision of the Commonwealth of Virginia. The VCSFA promotes growth of both aerospace industry and the development of commercial space launch from Virginia Space Flight Center (VSFC) located on Wallops Island. The VSFC rents space on Wallops Island from NASA. It hopes to serve the space market by conducting commercial launches from two pads designed to launch small and medium boosters carrying payloads up 10,000 pounds. The business plan hopes to capitalize on its ideal location for launching low orbiting equatorial smallsat systems, encompassing primarily remote sensing and communications satellites. NASA and VSFC have formed a partnership for launch services under a 30 year Reimbursement Space Act Agreement. This arrangement allows VCSFA to have access to NASA's payload integration, launch operations and monitoring facilities on a cost-reimbursement, non-interference basis. Actual operations of the VSFC have been contracted to the DynSpace Corporation, a subsidiary of DynCorp, of Reston, Virginia, by the VCSFA. The federal government maintains ownership of ninety percent of the spaceport, while the State maintains ownership of spaceport assets. Operational funding for the VSFC is provided by the state and supplemented by operational revenues. A partnership with Old Dominion University provides space-related academic and research programs. Virginia Economic Development Partnership and Virginia's Center for Innovative Technology generates aid in aerospace industry development and marketing (VFCSF 2004).

In general, states that fall within the second category do not currently have active spaceports, but possess significant aerospace industry. Similar to states that operate active launch sites, states in the second category tend to create and fund independent agencies, that form partnerships with aerospace businesses, concentrating on the economic development and/or continuance of technically based industry that manufactures technical equipment, products, or provides technical consulting or research. Academic institutions are also partners in this effort, conducting research and education that support high space and high tech related spin off businesses. These second category states create organizations that aggressively seek the development and retention of existing technical space-related enterprises as well as the recruitment of out of state tech companies. In some cases, they may also be actively seeking to establish spaceports.

States seeking support and growth of technical aerospace industries, like Alabama, Mississippi and Ohio, Oklahoma and Texas, tend to form government-appointed and guided commissions composed of broad based members from state and federal agencies, business and academia. Commission members are normally appointed directly by the governor or by a panel of state officials composed of the governor, the lieutenant governor and the speaker of the House. These commissions are charged with promoting strategic plans fostering aerospace commerce, education, outreach and research. Mississippi, New Mexico, Ohio, Oklahoma and Texas all employ commissions or councils comprised of state appointed members to perform similar

functions. These commissions are not federally mandated; they seek partnerships that serve local (state) purposes. These organizations pursue the formation of coalitions with federal, state and local governments, the aerospace industry, academia and supporting interests to bolster economic development within their respective states. [1] Of particular interest, New Mexico, Oklahoma and Texas all have spaceport development incorporated into their commission's strategic plan.

The third category contains states that seek benefit from developing supporting aerospace industry. Essentially, this is an "all the rest category," consisting of states that seek technical space related industry for economic development but generally have historically lacked an established technical industrial base. These states generally lack specific aerospace commissions or councils, relying on generic economic development departments for recruitment of technical and other businesses into the state. These states are isolated from existing space commercial infrastructure and lack the technical industrial infrastructure have lacked the ability to attract space related enterprise. Development of spaceports within these states have been previously unfeasible because of environmental and safety concerns. Some of these states have formed academic and research partnerships with the federal government through participation in NASA sponsored programs. These programs specifically fund competitive research academic institutions in states lacking significant space related industry. Mid western states like Arkansas, Montana, Nebraska, North and South Dakota, and Montana are examples receiving space grant funding and possess active space-related outreach programs (NASA 2004).

PARTNERSHIPS, SPACE TRANSPORTATION AND POLICY

Transportation development may be considered the result of the development of partnerships at various levels of private enterprise and government, which formed a network of public/private relationships. These public/private partnership networks in turn produced a sustainable national transportation network. Balanced public/private partnerships consisting of commercial and security interests are responsible for the development and sustainability of individual water, rail, and air modes that form America's transportation system. Establishment of similar balanced partnerships consisting of private industry, local, state and federal governments is similarly required to develop a sustainable space transportation mode. Just as the building of transcontinental railroad, highway and aviation modes have linked the states and territories in America, the creation of space transport will link American to world and beyond. Policy must be structured to foster and nurture partnerships that will allow space transportation to meet commercial and security demand just as canals, rail and aviation have.

Federal government domination of the public/private partnership since the late 1950s and its dependence of prohibitively expensive vertical lift technology has severely limited the local public/private partnerships that were the fundamental sponsors, investors and champions of transportation mode growth and sustainability in the past. The prohibitive cost of a federally dominated space program has progressively hampered, if not crippled, expansion of space exploration, security and commercial transport.

The cost and failure of the shuttle program has prompted Congressional action to shift the cost and balance of the public/private partnership towards the private commercial sector. In 1994 Congress passed the National Space Transportation Policy, which called on the NASA to pursue "technology development and demonstration efforts to support future government and private sector decisions on the development" of operational second- and third-generation reusable launch vehicles (O'Neil, Box and Bowen 2003). In response, NASA attempted to expand limited public private space partnerships thorough introduction of a strategic initiative intended to expand future space exploration by encouraging commercialization and privatization of existing missile spaceport and launch functions. To support the development of innovative new technologies, NASA initiated the Integrated Space Transportation Plan (ISTP) managed by a partnership consisting of NASA, industry, the Department of Defense and academia (Vanneri 2001). This partnership, in the near term, will determine an appropriate course of action and provide funding for America's space shuttle program. In the long-term, the ISTP will use funding under the Space Launch Initiative (SLI) to produce the technology that will yield second generation and follow-on RLVs (Golden 2001).

NASA Kennedy, in 2001, also formed the Advanced Space Technology Working Group (ASTWG). ASTWG was to provide a forum for private industry, federal and state agencies, and academia to work together in the development of technologies, governmental policies, and business enterprise models that will foster successful commercial spaceport growth. ASWTG's impact has yet to be determined, but sub-groups seeking commerce solutions have become heavily involved with developing the commercial potential of sub orbital flight.

The most recent public space policy proposal by President Bush was presented on January 14, 2004. Named "A Renewed Spirit of Discovery" introduced a new program of space exploration involving both human and robotic exploration not only to advance scientific and security interests, but to gain economic benefits as well. The following are the central goals of his vision:

- Sustained and affordable human and robotic program to explore the solar system and beyond;
- Extend human presence across the solar system, starting with a human return to the Moon by the year 2020, in preparation for human exploration of Mars and other destinations;
- Develop the innovative technologies, knowledge, and infrastructures both to explore and to support decisions about the destinations for human exploration; and
- Promote international and commercial participation in exploration to further U.S. scientific, security, and economic interests. (Bush 2004).

NASA proposed the following courses of action to implement the President Bush's space program for analysis by the Congressional Budget Office (2004).

- Completion of the International Space Station and retirement of the Shuttle by 2010,
- Development of a new exploration vehicle to support human space flight missions to be placed in operation no later than 2014,
- Reliance on international partners to support the ISS in the period following the shuttle retirement and operation of its replacement

- Resumption of robotic missions to the moon in 2008 in conjunction with the continuance of robotic mars missions,
- Return of U.S. manned moon missions between 2015-2020

The Congressional Budget Office (CBO) analysis of NASA's proposal reported the following. NASA intended to fund the above actions through reallocating funding from other programs and through the receipt of some budgetary increases. CBO raises the concern that previous NASA budgets have been prone to very high overruns. Their analysis of 72 NASA programs revealed that cost overruns averaged 45% over normal increases for inflation. In addition, NASA's historical average cost overrun for complex technical programs was reported to be almost 60%. CBO reports that if NASA robotic moon and mars support mission expenditures through 2020 follow the same historical expenditure patterns as experienced in Apollo and other previous robotic missions, then an additional $61 billion would be required above NASA's total projected budget of $271 billion. This is a budgetary increase of 23% just for robotic missions (CBO 2004, xiv). This figure does not include likely cost overruns in other program areas such as the crew exploration vehicle or manned missions to the moon. Nor does any of the stated NASA plan articulate how any of the cost can be offset by development of commercial partnerships. President Bush's current space policy appears similar to previous proposals that have relied on federal domination of partnerships and programs. The proposal repeats the same imbalanced public/private partnerships and programs that produced the prohibitively expensive and unreliable launch system that is currently dependent and proposed to be dependent again on other nations. The question becomes, given the current federal budget deficits, is it realistic to expect long term funding of a program where costs are forecast not only to be substantial, but uncontainable? Is there a better course of action to the President's stated policy goals of manned exploration and colonization of space?

The answer lies in a shifting to a more balanced public/private partnership for development of space transportation demonstrated in the development of other national transportation modes. Local private businesses as well as local and state government participation must be stimulated. The way to stimulate this interest is to demonstrate real economic gain from participation across many sectors. The development and flight of SpaceShipOne serves as an example of how public/private partnerships form at local levels.

Scaled Composite formed a relationship with Mojave Airport. The airport operated by the East Kern Airport District of California served as the launch site for SpaceShipOne and received FAA licensing as the nation's first inland space launch facility. Mojave now hosts other companies seeking to enter the space launch market. Scaled Composites has expanded its private partnership with Richard Branson with the goal of conducting regular commercial operations. The impact of this expanding partnership is significant in that it produced and intends to routinely employ space launch technology that no longer requires vast and isolated launch complexes. Other local airports in other states have the capability to operate similar vehicles. As partnerships form and spread to other states and localities, states will actively pursue zoning, financing and operational initiatives to support local facilities and businesses. The expansion of spaceports to inland states represents economic opportunity and expansion of viable space transportation network. As the space transportation network expands and newer more capable vehicles are produced, more competition will occurs and economies of scale will result. A system that produces economies of

scale that efficiently moves people and goods into earth's orbit will result in a true public/private transportation partnership that serves both commercial and DOD demand.

As sites like Mojave increase in economic importance, local government interests become aggressively supported by state governments. State governments seek to expand existing partnerships by forming organizations to champion and protect economic interests. State-created or sanctioned agencies encourage private businesses and seek support from the federal government in the form of regulation, funding, certification and regulation. The economic importance of space launch motivated California to create the California Space Authority and Florida to form the Florida Space Authority to promote and protect space industry commerce. States create internal policy and lobby for federal policy to support local commerce. As other sites in other states demonstrate the economic benefit of operating spaceports, they too will receive support from local and state governments. State governments will seek public private partnerships that will promote economic growth and expansion of space transportation.

For this to be achieved the following actions are recommended. The government must continue to sponsor space commercialization. The passing and signing of *The Commercial Space Launch Amendments Act of 2004*, H.R. 3752 enables the FAA to license and regulate commercial human space flight while providing liability protection for companies. That legislation was an important step. However, the federal government should also provide financial incentives and funding and technical assistance to emerging private companies for space vehicle development. Just as the federal government guided development of airmail and passenger services, it can guide development of space transportation cargo and passenger services. The federal government should enter into limited partnerships with companies like Scaled Composites that have demonstrated credible potential to build and operate spacecraft. The federal government should provide both financial and technical support for these companies. Financial support should include direct funding for R & D of vehicles as well as the provision of NASA technical engineering support and joint use of existing and underutilized facilities like Kennedy Space Center. Winged vehicles capable of operation from existing airports will enable the interconnection of local communities and states to national and international markets, creating a truly viable and sustainable transportation space network capable of meeting both commercial and security demand. The balancing of commercial and government interests in the public/private space transportation partnership in will incrementally build an affordable network that is capable of achieving President Bush's vision of manned missions to the moon and Mars and enabling man's colonization and expansion into space.

Endnotes:

[1] For more detailed descriptions of respective state commissions and councils see: Alaska **http://aerospace.state.al.us/acasi,** Mississippi **http://www.mda.state.ms.us/, New Mexico http://www.edd.state.nm.us/SPACE/nmsp.html, Ohio http://www.oai.org/, http://www.okspaceport.state.ok.us Texas Aerospace Commission report of August 15, 2001 at http://www.sunset.state.tx.us/ser78/tacser.pdf,**

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