New Mexico Commercial Spaceport Economic Impact Study

***for* State of New Mexico Economic Development Department**

December 30, 2005

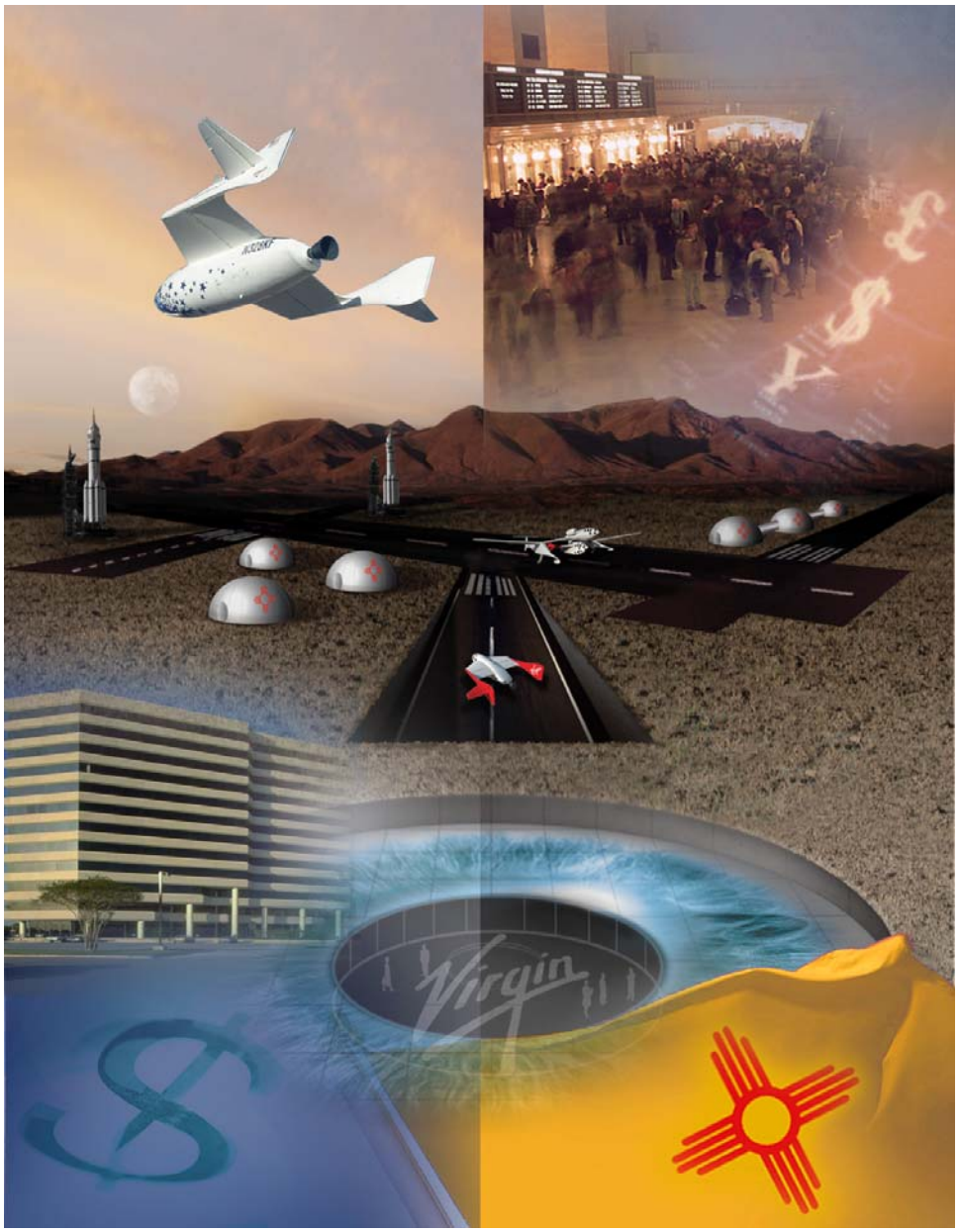

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The commercial space industry in the United States is undergoing a major transformation, with the emergence of new markets and new companies to serve those markets. Suborbital space tourism companies have attracted the interest of thousands of prospective customers, while several tourists have already flown on orbital missions to the International Space Station (ISS). A number of companies are developing small, inexpensive launch vehicles designed to serve commercial and government customers and to launch payloads on short notice. NASA is also fostering the development of a revitalized commercial space industry by offering to help companies develop spacecraft that can transport cargo and crews to and from the ISS.

While there are several spaceports in the United States today, these are primarily older facilities designed to serve large, expensive, expendable launch vehicles, and are ill-suited for the new generation of small, responsive suborbital and orbital vehicles. This situation presents an opportunity for states to develop new spaceports that are more agile and less expensive than the legacy facilities.

The Futron Corporation, under a contract from the State of New Mexico Economic Development Department, has studied the potential economic impact of one such proposed spaceport in southern New Mexico, the Southwest Regional Spaceport. This report provides a forecast for potential spaceport activity and resulting economic impact for the years 2010 through 2020, based on the spaceport beginning operations in 2009. The results of this analysis should be considered forward-looking estimates of the maximum possible economic impact of the spaceport should the spaceport and related industries be developed and utilized to their full potential.

In the first part of this study, Futron developed a forecast of the potential number of launches that could be hosted by the spaceport between 2010 and 2020, as summarized in Figure 1 below. The launch market is divided into three specific classes: suborbital launches, small orbital launches, and large orbital launches. The suborbital market features a strong increase in launches because of growing demand for space tourism, with the potential number of launches from the New Mexico spaceport increasing from 61 in 2010 to 426 in 2020. Orbital space tourism and commercial resupply missions to the ISS may generate up to three launches per year of large orbital vehicles between 2010 and 2020, and there will be no more than one launch a year of small orbital vehicles during the forecast period due to range limitations for small expendable launch vehicles at the spaceport.

Figure 1: Total Forecast Potential Launch Market for New Mexico, 2010–2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Suborbital	61	78	100	127	161	204	241	283	328	376	426
Small Orbital	1	1	1	1	1	1	1	1	1	1	1
Large Orbital	3	3	3	3	3	4	4	2	3	3	3
Total	**65**	**82**	**104**	**131**	**165**	**209**	**246**	**286**	**332**	**380**	**430**

Based on this launch market forecast, Futron developed a forward-looking assessment of the economic impact of the spaceport in 2015 and 2020 based on Governor Bill Richardson's vision for creating a new commercial space transportation and manufacturing cluster in southern New Mexico, along with key assumptions provided by the New Mexico state government. In summary, Futron estimates that the spaceport has the potential to provide the basis for creating approximately **$460 million of additional**

economic activity in New Mexico, with some **3,460 new jobs** in 2015. These figures could increase to about **$550 million of additional economic activity** and **4,320 new jobs** in 2020 (see Figure 2). These projections include the following major categories of economic activities: space transportation, visitor spending and tourism, and Rocket Racing League operations. All economic impact figures and assumptions presented throughout the study are in current 2005 dollars.

Figure 2: Potential Economic Impacts of the Southwest Regional Spaceport (2015 and 2020)

Year	Economic Activity	Earnings	Jobs
2015	$460,033,000	$104,439,000	3,460
2020	$552,780,000	$126,881,000	4,320

Futron projects that southern New Mexico has the further potential to attract an additional **1,000 to 1,500 jobs in space vehicle and aircraft manufacturing, headquarters operations and support services activities** and in excess of **$200 million in related economic activity** by 2020. These estimates are strongly dependent on the ability of the State of New Mexico and early commercial space transportation operators to attract manufacturers of reusable launch vehicles and aircraft, along with their key suppliers, to locate manufacturing facilities in close proximity to customer firms operating out of the spaceport. The analysis is also based on the assumption by the State of New Mexico that one specific major commercial space transportation and manufacturing firm wins a pending NASA award for Space Station cargo and crew re-supply services, and subsequently locates its core operations facilities in New Mexico, along with the assumption that emerging public and federal markets for commercial space transportation services will develop without major interruption for the foreseeable future.

Spaceport construction-related impacts are anticipated to occur prior to the period under consideration in this study. Such impacts will be restricted to the years 2006-2008, and are expected to reach a maximum of approximately **$331 million of additional economic activity** and **2,460 new jobs** in 2007. Additional economic impacts from new hotel and other tourism infrastructure construction are not included in this estimate.

The majority of the economic impact from the spaceport will be concentrated in the vicinity of Las Cruces, with secondary impacts anticipated for Albuquerque and tourism-centric localities elsewhere in the state. The economic impact of this new spaceport is potentially quite large, reflecting the strong upscale potential of the nascent space tourism industry. If successful, the spaceport can serve as the magnet for an emerging commercial space transportation cluster, which leverages economies of scale in spaceport operations and close operator-manufacturer-supplier relationships to attract new launch firms and RLV and aircraft producers to co-locate facilities in southern New Mexico.

INTRODUCTION

The commercial space industry in the United States is experiencing a major transformation. Once the domain of a handful of large aerospace companies that built satellites and launch vehicles, the industry is now home to many small entrepreneurial firms that see new opportunities in space. These opportunities are not in the traditional industries of large expendable launch vehicles and massive satellites, but in new technologies that enable the development of small yet highly-capable spacecraft, small launch vehicles that can operate on short notice to launch those satellites, and the rapidly growing, high profile market for suborbital and orbital space tourism.

This change provides opportunities not just for developers of new satellites and launch vehicles, but also for states not traditionally associated with the space industry. For many of these ventures to be successful, they will require launch facilities—spaceports—that are far more agile and far less expensive than the nation's legacy facilities in California and Florida. A number of states, including New Mexico, have put forward plans to develop new spaceports specifically oriented for space tourism and other emerging space markets.

The purpose of this report is to examine the economic impact of such a spaceport in New Mexico, also known as the Southwest Regional Spaceport. Starting with an overview of space industry trends, the report includes a forecast of the potential launch activity that could be expected at the spaceport during the 2010–2020 timeframe. This forecast will be the basis for computing the economic impact created by the spaceport, using widely-accepted impact models that compute levels of economic activity, earnings, and employment. Other factors that will be incorporated into the analysis include spaceport construction expenditures, revenue generated by other spaceport activities (such as hosting the X Prize Cup and Rocket Racing League competitions), and secondary tourism engendered by spaceport activities.

This report is not intended to provide a recommendation regarding whether the spaceport should be built; that is a decision for stakeholders in New Mexico. Instead, this report is intended to assess the level of economic benefit such a facility could provide to New Mexico, particularly the region of the state in the immediate vicinity of the spaceport.

INDUSTRY TRENDS

The commercial space sector has seen significant changes in recent years. The telecommunications boom of the late 1990s, and subsequent bust at the beginning of this decade, caused a sharp rise and fall in the number of commercial launches, both in the U.S. and worldwide. The limited future demand for the core market of the commercial space industry—the manufacture and launch of large communications satellites—has led to diversification efforts, particularly among entrepreneurial ventures that survived the telecom bust and are rewriting their business plans, as well as new ventures trying to capitalize on new opportunities. This has produced significant interest, from emergent and established companies alike, in fields like space tourism (also known as personal spaceflight) and the development of small satellites, or smallsats. The growth in these two markets presents an opportunity for new commercial spaceports, which may be better positioned than existing facilities to capture the additional launches generated by these new space industries. The evolution and current status of these and other key trends in the commercial space industry are summarized below.

SPACE TOURISM

As recently as five years ago space tourism suffered from the "snicker" factor: many people in the space industry refused to take the concept seriously. That snicker factor, however, has been largely dispelled during the intervening time thanks to a combination of several factors. Orbital space tourism has emerged as a real, if limited, market, as three people—Dennis Tito, Mark Shuttleworth, and Greg Olsen—each paid up to $20 million to spend a week on the International Space Station (ISS), flying to and from the orbiting outpost on a Russian Soyuz spacecraft. Space Adventures, the space tourism company that brokered those flights, has also signed up a Japanese businessman, Daisuke Enomoto, as the fourth ISS tourist, flying to the station in October 2006. The company says that a number of other people have expressed an interest in such flights and have the means to pay for them.

Suborbital space tourism has benefited from the Ansari X Prize, a $10-million award for the first vehicle capable of carrying three people to fly to an altitude of at least 100 kilometers (62 miles) twice in a two-week period. The prize was won by Mojave Aerospace Ventures, a joint project of Scaled Composites and Microsoft co-founder Paul Allen. Their vehicle, SpaceShipOne, performed the two prize-winning flights within a week of each other on September 29 and October 4, 2004; the vehicle previously flew a suborbital spaceflight on June 21, 2004. The flights attracted tens of thousands of spectators to the site of the flights, Mojave Airport in California, and also garnered worldwide media attention.

The success of the Ansari X Prize has generated additional interest in suborbital space flight, particularly space tourism applications. Shortly before the two prize-winning flights Virgin Galactic, a subsidiary of the Virgin Group, signed a licensing agreement with Mojave Aerospace Ventures for the technology associated with SpaceShipOne. Virgin Galactic has since announced a joint venture with Scaled Composites, called The Spaceship Company, to develop a scaled-up version of SpaceShipOne, designated SpaceShipTwo, that would carry up to seven passengers. As of December 2005, Virgin Galactic announced that it has received indications of interest from 38,000 prospective customers, and has already received full payment from its first 100 customers. This demand was one of the factors underlying the partnership announced between Virgin Galactic and the State of New Mexico to support development of the New Mexico spaceport. Several other companies are currently actively developing suborbital space tourism vehicles, including Oklahoma-based Rocketplane Ltd., Texas-based Armadillo Aerospace (funded by computer gaming magnate John Carmack), Washington-based Blue Origin (funded by Amazon.com founder Jeff Bezos), California-based SpaceDev and XCOR Aerospace, and other ventures based in Canada, Russia, and Romania.

Space tourism is the segment of the overall space industry with the biggest potential for growth for the foreseeable future. Market studies, including one by Futron Corp., have demonstrated a demand of dozens of orbital and thousands of suborbital passengers a year within the next several years (see the Launch Forecast section for more details about space tourism passenger demand.) To meet this demand, particularly in the suborbital market, vehicle operators will need to fly frequently, with flight operations more closely approximating those of aircraft than conventional launch vehicles. This provides an opportunity for new commercial spaceports with facilities and ranges that can better serve the needs of these vehicle operators than existing spaceports.

SMALLSATS

The very first satellites, by necessity, were small spacecraft, with very limited capabilities. Over time, as satellites were called upon for increasingly complex, critical tasks, their size has grown in order to match their capabilities. Small satellites continued to be developed, but primarily as a shrinking niche, relegated to technology demonstration, education, and some scientific research applications.

Recent advances in spacecraft design, particularly the growing capabilities of microelectronics, have enabled smallsats to perform tasks that once required larger, more expensive spacecraft. Smallsats not only cost less than their larger counterparts, but can also be assembled more rapidly, an effort being accelerated by the Defense Department (DoD), which is seeking ways to develop modular spacecraft that can be assembled from standardized components in a matter of days. This effort is a part of the DoD's Operationally Responsive Space (ORS) architecture, which seeks to use smallsats, launched on short notice by a new generation of small launch vehicles, to augment or partially replace existing space assets during periods of crisis. Smallsats built for military applications could also serve civil and commercial markets, although the level of demand for smallsats in these areas has yet to be proven.

The increasing capabilities of smallsats has attracted a number of companies, ranging from new ventures specializing primarily in smallsats to large companies who wish to expand their product line into the smallsat realm. In the U.S., companies participating in smallsat development include AeroAstro, Ball Aerospace, MicroSat Systems, Orbital Sciences Corporation, SpaceDev, Spectrum Astro Space Systems (part of General Dynamics C4 Systems), and Swales Aerospace. There is also considerable interest and expertise in smallsats outside the U.S., including MDA Corporation in Canada and Surrey Satellite Technology Ltd. in the United Kingdom.

The combination of smallsats with responsive launch systems provides another opportunity for new commercial spaceports. The desire of DoD officials to be able to launch smallsats on ORS missions on as little as 24 hours notice poses a challenge to existing spaceports, who may lack the necessary ground and range safety infrastructure to permit such launches alongside those of larger conventional launch vehicles. While some DoD plans call for the ability to launch small responsive boosters from unimproved sites, new commercial spaceports, designed from the ground up to support responsive boosters, may be a more attractive alternative in many cases.

RLV DEVELOPMENT

In the latter half of the 1990s there was a surge of interest in the development of reusable launch vehicles (RLVs). The best-known RLV project from that era was the X-33, a joint NASA-Lockheed Martin project to build a suborbital RLV demonstrator that Lockheed planned to scale up into the VentureStar, a full-fledged large orbital RLV. Several other companies also proposed producing RLVs, primarily to serve the surge in demand for commercial launches foretold by satellite ventures like Iridium, Globalstar, and Teledesic. However, when this market for satellite launches all but disappeared because of the financial failures of those satellite ventures, these launch ventures either went under or sought alternative markets. Lockheed also abandoned plans for the VentureStar after the X-33 encountered technical problems; NASA cut funding for the X-33 in 2001.

RLV development continues today, but the emphasis has shifted from orbital vehicles to suborbital vehicles like SpaceShipOne and its counterparts. Suborbital RLVs, which travel at only a fraction of the speed of an orbital RLV, are much less challenging technically and thus more feasible to build with little

or no government funding. Moreover, such vehicles can serve a large, growing market in the form of space tourism, providing a revenue flow that can be used to help fund the development of larger, more capable counterparts. Many of the companies developing suborbital RLVs see these vehicles as steppingstones to orbital RLVs several years in the future. If orbital RLVs do enter service, they would prove particularly advantageous to inland commercial spaceports like New Mexico: the lack of discarded stages would allow vehicles operating from such spaceports to serve a wider range of missions than possible with expendable boosters, whose operation from inland spaceports would be greatly restricted, if not prohibited, because of range safety issues.

COMMERCIAL SPACEPORTS

Nearly all U.S. orbital launches today take place from two facilities: Cape Canaveral Air Force Station and the adjoining Kennedy Space Center in Florida, and Vandenberg Air Force Base in California. The Florida site primarily serves launches to low-inclination and geosynchronous orbits, as well as Space Shuttle flights to the ISS, while the California site supports launches to polar and sun-synchronous orbits. Additional U.S. launch sites exist in Virginia, Alaska, and Kwajalein Atoll in the Pacific Ocean, as well as the floating Odyssey platform used by the U.S.-based multinational commercial venture Sea Launch.

While these facilities have proven adequate to serve the existing level of launch demand, they are poorly equipped to serve emerging markets such as responsive launch and suborbital or orbital space tourism. Much of the infrastructure at these sites, particularly Cape Canaveral and Vandenberg, is decades old, and in dire need of modernization. Moreover, these facilities have high range fees and many layers of bureaucracy, which can be a major impediment to entrepreneurial ventures seeking a suitable launch site.

To meet the needs of these markets, a number of states have expressed an interest in developing their own spaceports. These spaceports, developed with new technology and with the needs of new markets in mind, could provide access to space for new launch ventures that provide a far better match for space tourism, responsive space access, and other markets. In addition to New Mexico, several other states are pursuing plans for spaceports, with Oklahoma and Texas the farthest along. Other states that have in the recent past expressed interest in spaceport development include Alabama, Nevada, Utah, Washington, and Wisconsin. Even Florida is considering developing a new commercial spaceport designed to serve these emerging markets.

LAUNCH FORECAST

INTRODUCTION

A key factor in the economic impact generated by a New Mexico spaceport will be its level of launch activity: the more launches that take place from the spaceport, the more revenue that will be collected in the form of spaceport usage fees and/or revenue captured by in-state vehicle operators. The number of launches at the spaceport will also affect other factors associated with economic impact, including the number of visitors and, perhaps most importantly, the likelihood that vehicle manufacturers and their suppliers will establish operations in the state, and thus ultimately the economic viability of the spaceport in general.

To address this issue, this report forecasts the amount of launch activity that could take place from the spaceport from 2010 through 2020. These launch forecasts, for orbital and suborbital flights, are based on quantitative analyses of projected commercial and government launch activity. However, these are

forward-looking estimates and represent an upper limit on the amount of launch activity that could take place from the facility—depending on the ability of the state to attract launch vehicle operators to the spaceport—rather than a definitive forecast on the actual number of launches expected to take place there during the forecast period.

METHODOLOGY

Three specific types of launch activity are considered in this analysis: suborbital launch vehicles, small orbital launch vehicles, and large orbital launch vehicles. These classes of vehicles have different modes of operation and serve different markets. As such, each class of vehicles is forecast separately, using methodologies described below. In all three cases, a total "addressable" market, which is the total number of launches that could take place, is forecast, and a market share estimate is later applied to estimate the maximum number of those launches that would take place from the New Mexico spaceport during the forecast period.

SUBORBITAL LAUNCHES

Commercial suborbital spaceflight has emerged as a major growth market in the overall space industry in recent years, thanks to a number of developments. The $10-million Ansari X Prize, won in 2004 by Mojave Aerospace Ventures' SpaceShipOne, attracted worldwide interest to the concept of suborbital space tourism. Later developments, including the formation of Virgin Galactic and its subsequent decision to base its operations in New Mexico, as well as development of suborbital vehicles by other companies, has provided additional momentum to this market.

This forecast uses Futron's *Space Tourism Market Study*, a 2002 report on the demand for orbital and suborbital space tourism. The study is based on a survey of 450 high net worth individuals performed by polling company Zogby International. Respondents were asked to indicate their interest in space tourism, their willingness to participate in such flights at various price points, and related factors. The results became the basis for the calculation of worldwide demand for space tourism through 2021.

The original study has been modified slightly by shifting the start date of suborbital space tourism activity from 2006 to 2008, to reflect developments in the industry, including the introduction of at least one company's vehicle into revenue service. Because the original study forecast demand in terms of passengers, this study translates that demand into launches by assuming that each vehicle will carry an average of five passengers. While some vehicles, like Virgin Galactic's SpaceShipTwo, may carry as many as seven passengers per flight, other vehicles under development may carry three or fewer. Further, this launch forecast assumes that, in any given year, only half of the passenger demand forecast in the original market study will be met, given the availability of flight services during the forecast period.

Space tourism is not the only market for commercial suborbital spaceflight: other potential markets include microgravity research, remote sensing, spaceflight hardware qualification, and other scientific research. UP Aerospace has announced plans to use the New Mexico spaceport for expendable sounding rocket flights starting in 2006. The demand for these markets has not been quantitatively forecast to the same degree as space tourism, however, and qualitative research suggests that these markets combined will still be considerably smaller than space tourism. As such, they have not been included in the suborbital launch forecast, although they may constitute a small additional number of launches per year from the spaceport.

Small Orbital Launches

For this forecast, the term *small orbital launch vehicles* refers to those vehicles classified as "small" by the FAA's Office of Commercial Space Transportation, capable of carrying payloads of no more than 5,000 pounds to low Earth orbit (LEO). Examples of such vehicles include the Pegasus and Taurus from Orbital Sciences Corporation and the Falcon 1 from Space Exploration Technologies (SpaceX), as well as future expendable or reusable vehicles that may be introduced during the forecast period. Two separate markets for small orbital launches exist: commercial and U.S. government missions. (Foreign government launches are not considered because of policy issues that constrain the use of foreign launch vehicles from U.S. spaceports; when foreign payloads are launched on U.S. vehicles, it is through either a commercial launch agreement or a partnership with a U.S. government sponsor.)

To determine the forecast for commercial launches, Futron used the *2005 Commercial Space Transportation Forecasts*, a joint report of the FAA's Office of Commercial Space Transportation (AST) and the Commercial Space Transportation Advisory Committee (COMSTAC) published in May 2005. The report includes a forecast for launches of non-geosynchronous orbit (NGSO) payloads through 2014 using small launch vehicles, the only commercial market for such vehicles. Because of the relatively flat outlook for such launches in the forecast, Futron used the average number of launches from 2010–2014 to forecast future small commercial orbital launches through 2020.

For U.S. government launches, Futron used an updated version of the forecast from the Analysis of Space Concepts Enabled by New Transportation (ASCENT), a study performed by Futron for NASA between 2001 and 2003 as part of the Space Launch Initiative. ASCENT is a comprehensive forecast of orbital launch activity worldwide from 2002 through 2021, broken down by market sector, country, and vehicle class. The U.S. government demand for small launch vehicle services was extracted and then updated to reflect developments such as the Defense Department's proposed Operationally Responsive Space (ORS) architecture, which puts a greater reliance on the rapid launch of small satellites on small launch vehicles. Because the ORS architecture is still under development, Futron made its best estimates of the number of launches such a system would require on average through the forecast period.

Large Orbital Launches

A separate potential market for the New Mexico spaceport is commercial and government launches of larger vehicles. While such vehicles have traditionally been associated with large, expendable vehicles, like the Atlas and Delta families of launch vehicles, which would likely not be able to use the spaceport, a number of alternatives are under development that could operate out of the spaceport. These include air-launched vehicles, as envisioned by Transformational Space Corporation (t/Space), and flyback and other reusable boosters whose stages would return to the spaceport or a designated recovery site, such as Kistler Aerospace's K-1.

Such vehicles would be particularly well-suited to two emerging markets: commercial crew and cargo transport to the ISS, and orbital space tourism. NASA has released a draft request for proposals (RFP) for Commercial Orbital Transportation Services (COTS), a program to promote the development of commercial services to carry cargo and, later, astronauts to and from the station. This forecast assumes that NASA will procure an average of two cargo and two crew flights a year to the ISS, the minimum listed in the COTS draft RFP, through 2016, which is currently the notional retirement date for the ISS. It is possible that NASA will procure additional launches and/or require commercial ISS flight services beyond 2016.

For orbital space tourism this study uses the forecast demand for such services from Futron's *Space Tourism Market Study*. As with the suborbital space tourism forecast, the results from the initial study are shifted out two years to reflect current market conditions. The number of passengers from the demand forecast is converted into flights by assuming that each launch will carry an average of four passengers, and that half of the demand will be satisfied each year through the forecast period.

RESULTS

SUBORBITAL LAUNCHES

The addressable suborbital launch forecast, and the potential New Mexico market share, is shown in Figure 3. The New Mexico forecast assumes that this spaceport will initially have a 75 percent market share; this is consistent with the expectation of having the dominant company in the industry operating from the spaceport by 2010. The market share gradually drops to 50 percent by 2020 to reflect the introduction of additional companies operating from other spaceports outside New Mexico. As noted in the introduction of this section, this forecast should be considered an upper estimate on the amount of suborbital launch activity that would be supported by the spaceport during the forecast period.

Figure 3: Total Addressable Suborbital Launches and Potential New Mexico Share, 2010–2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Addressable Market	82	104	133	169	215	273	345	435	547	684	852
New Mexico Share	61	78	100	127	161	204	241	283	328	376	426

SMALL ORBITAL LAUNCHES

The addressable small orbital launch forecast, and the potential New Mexico market share, is shown in Figure 4. A key limiting factor in the use of the spaceport for orbital launches in general, and particularly small vehicles, is the limited number of launch azimuths available for such missions, and the requirement that any stages jettisoned by boosters either land within the White Sands Missile Range or in the Gulf of Mexico, which is many hundreds of miles away. While the use of reusable vehicles would mitigate this problem, most reusable vehicle development has focused on larger vehicles, although a reusable small orbital launch vehicle may enter service at some point during the forecast period. Because of these limitations, we have given the spaceport only a 10 percent market share for small orbital launches through the 2010–2020 forecast.

Figure 4: Total Addressable Small Orbital Launches and Potential New Mexico Share, 2010–2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Addressable Market	11	9	10	10	9	9	10	9	10	9	10
New Mexico Share	1	1	1	1	1	1	1	1	1	1	1

LARGE ORBITAL LAUNCHES

The addressable large orbital launch forecast, and the potential New Mexico market share, is shown in Figure 5. This study assumes that at least one company providing commercial ISS transport and orbital

space tourism services (most likely using the same vehicle) will be operating from New Mexico throughout the forecast period, capturing 50 percent of the overall market. Of the three classes of launches considered in this forecast, this is the most speculative, as it relies on the development of vehicles that are currently still in the earliest planning stages, as well as government support of vehicle development to serve the ISS. Thus, as with other aspects of this forecast, this should be considered a best-case scenario for such launch activity at the spaceport and not a definitive forecast.

Figure 5: Total Addressable Large Orbital Launches and Potential New Mexico Share, 2010–2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Addressable Market	5	5	6	6	6	7	7	4	5	6	6
New Mexico Share	3	3	3	3	3	4	4	2	3	3	3

CONCLUSION

The forecasts for suborbital and orbital launch activity, consolidated in Figure 6, show that launch activity at the New Mexico spaceport is anticipated to be dominated by suborbital space tourism launches because of the relatively high demand for such flights compared to orbital space tourism, satellite launches, and related orbital markets. Thus, spaceport infrastructure should be optimized to best serve the needs of suborbital vehicle operators. However, the potential orbital launch market for the New Mexico spaceport, based on the best-case forecast above, is not insignificant, particularly since a single orbital launch will likely be far more lucrative than a single suborbital flight. The revenues and resulting economic impact from the launches in this forecast will be discussed in the following section of the report.

Figure 6: Total Forecast Potential Launch Market for New Mexico, 2010–2020

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Suborbital	61	78	100	127	161	204	241	283	328	376	426
Small Orbital	1	1	1	1	1	1	1	1	1	1	1
Large Orbital	3	3	3	3	3	4	4	2	3	3	3
Total	**65**	**82**	**104**	**131**	**165**	**209**	**246**	**286**	**332**	**380**	**430**

ECONOMIC IMPACT ASSESSMENT

SUMMARY RESULTS

Based on Futron's forecast of the launch market and the opportunity for development associated with manufacturing, tourism and related activities, the Southwest Regional Spaceport has the potential for generating substantial economic activity and creating a large number of jobs for the State of New Mexico. A summary of the results of Futron's economic impact assessment includes:

- Approximately **$460 million of new economic activity** and **3,460 jobs** in 2015. These figures could increase to about **$552 million of new economic activity** and **4,320 jobs** in 2020. Relevant activities included here are suborbital and orbital launch operations, visitor spending and tourism, and Rocket Racing League operations.

- Southern New Mexico has the potential to attract an additional **1,000 to 1,500 jobs in space vehicle and aircraft manufacturing, headquarters operations and support services activities** and in excess of **$200 million in related economic activity** by 2020.

- Spaceport construction-related impacts are anticipated to reach a maximum of approximately **$331 million of additional economic activity** and **2,460 new jobs** in 2007.

INTRODUCTION

The launch forecasts in the previous section provide a means for determining the extent to which a future commercial spaceport in New Mexico could be utilized. This section provides an analysis of the effect of those spaceport operations on the state's economy. Using Governor Richardson's vision as its baseline, along with key assumptions provided by the New Mexico state government as noted below, Futron estimated the potential impacts on the state in terms of economic activity, earnings and jobs. The analysis rests upon the application of aerospace cluster analysis techniques and a tested input-output economic model for gauging the total impact of new industrial projects and the construction of a variety of spaceport-related revenue, expenditure and job impact models. All calculations are derived from the suborbital and orbital space transportation market projections for 2010-2020 presented in the Launch Forecast section, which reflect an optimistic New Mexico market share estimate of 50% for 2020.

This section also includes a qualitative discussion of the economic benefit potential of the spaceport for New Mexico. Specific topics addressed here include the spaceport's capacity for attracting launch operators and manufacturers to New Mexico, its ability to attract ancillary businesses such as tourism and university research and development programs, and the benefits of its geographic location. Based on this assessment of the spaceport's capabilities, a vision for creating a new commercial space transportation and manufacturing cluster in the vicinity of Las Cruces by 2020 is also presented.

While the spaceport is assumed to begin operations in the year 2009, economic impacts for spaceport operations were calculated for the State of New Mexico for the operating years 2015 and 2020. All economic impact figures and assumptions are presented in current 2005 dollars. Further details regarding the methodologies and assumptions behind the analysis are provided in the following sections and in Appendix A.

As part of our data collection effort for this economic impact analysis, Futron interviewed three firms selected by the State of New Mexico Economic Development Department about their prospective investment and operations plans should they locate their primary facilities in the state: Virgin Galactic, Transformational Space LLC, and the Rocket Racing League. A discussion of the plans of these firms, and an estimate of the value of their investment in New Mexico over the 2006-2010 timeframe are provided in Appendix B.

ECONOMIC BENEFIT POTENTIAL FOR NEW MEXICO

Futron's assessment begins with a qualitative review of the economic benefit potential for New Mexico of the Southwest Regional Spaceport. Starting with the vision promulgated by Governor Richardson, specific issues considered here include the opportunities provided by the spaceport's geographic location, its potential for attracting operators and manufacturers to the state, and its potential for attracting tourism and research activities to New Mexico universities. Based on this understanding of the spaceport's potential, we then describe the vision in 2020 for development of a new commercial space transportation and manufacturing cluster in southern New Mexico which leverages the spaceport infrastructure and associated economies of scale.

VISION FOR 2020

New Mexico's long-term vision for the spaceport embraces the creation of a southern New Mexico commercial space transportation and manufacturing cluster that leverages the spaceport infrastructure and economies of scale to attract new industry. The principal economic activities in this cluster will include commercial space transportation, space vehicle and aircraft manufacturing, racing competitions and exhibitions, tourism, and corporate headquarters management and associated services (see Figure 7).

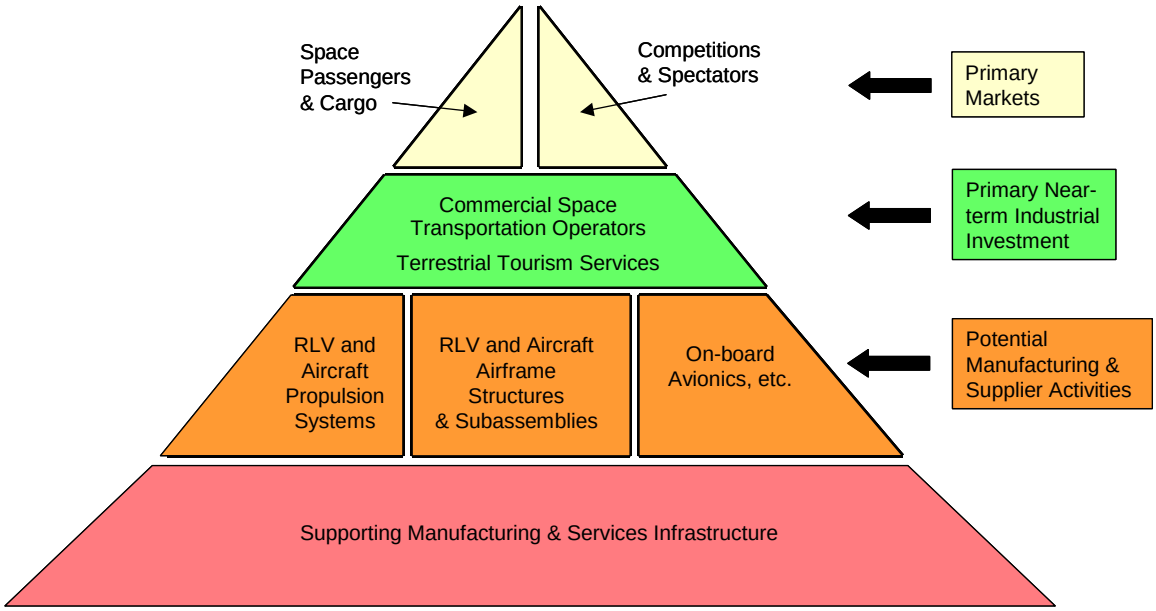
Major near-term markets to be served by cluster corporations are anticipated to include:

- The emerging commercial space tourism sector, including operations of Virgin Galactic;
- NASA contracts for Space Station commercial cargo and crew re-supply services;
- Proposed low-altitude and high-altitude racing competitions, such as those sponsored by the Rocket Racing League and X Prize Foundation; and
- Evolving demand for commercial human-rated reusable launch vehicles, rocket-powered racing aircraft and associated subsystem technologies.

Several US and international firms in the above sectors have indicated interest in establishing their core flight operations, manufacturing and headquarters facilities in New Mexico to take advantage of the Southwest Regional Spaceport infrastructure and economic incentives offered by the State of New Mexico. This cluster is expected to exhibit a high degree of synergy with existing aircraft manufacturing and tourism clusters elsewhere in the state.

Some of the key advantages of New Mexico that support this vision are summarized in the following sections.

Figure 7: Potential Commercial Space Transportation and Manufacturing Cluster Activities that could be Supported by the Southwest Regional Spaceport



ADVANTAGES OF GEOGRAPHIC LOCATION

New Mexico has many advantages supporting the establishment of an inland spaceport and year-round national launch facility. Key technical features of the spaceport site include its high altitude, consistently excellent weather, lack of air space traffic restrictions and low population density. Important economic factors that can also serve to attract new commercial space industry (and thus promote development of a new aerospace cluster) are the area's low real estate and labor costs.

Current coastal launch facilities in other parts of the U.S. can face substantial operating limitations due to weather and restrictions imposed by commercial air traffic patterns. The Southwest Regional Spaceport, in contrast, will offer year-round flying conditions (340 days of sunshine) with a minimum of interference from outside air traffic due to the presence of a large controlled airspace. This can be a significant factor in conducting routine commercial space tourism flight operations where passengers expect a highly reliable service that can meet stated launch schedules. The combination of launch site elevation (4,600 feet) and southern latitude is also favorable for launching and landing reusable launch vehicles (RLVs) and results in significant fuel savings and increased payload and revenue per launch when compared to a coastal launch site.

Low real estate prices and labor costs are an additional incentive for new commercial space transportation operators and manufacturers to locate in southern New Mexico. Manufacturing facility lease rates in the Las Cruces area can be as low as 50% of those in more densely populated markets. Property taxes in Doña Ana County are among the lowest in the nation[1]. Average wage rates in the region are more than

[1] Mesilla Valley Economic Development Alliance, (http://southwest-advantage.com/html/building___lease.html), accessed on December 28, 2005.

17% below U.S. national averages with manufacturing wages being up to 48% lower than the national average.[2]

The absence of conflicting launch and air traffic operations, federal facilities, and environmental constraints thus provides a unique opportunity to design and develop a purpose-built launch complex that meets the needs of a new generation of commercial space transportation customers and reusable launch vehicles.

Potential for Attracting Operators and Manufacturers to New Mexico

Virgin Galactic's agreement with the State of New Mexico, announced in December 2005, puts New Mexico in a potentially strong position to attract commercial space transportation operators and manufacturers to the state over the next five to ten years. As the current industry leader in the suborbital space tourism market, Virgin's decision to base its headquarters and operations activities out of the spaceport strengthens New Mexico's bid to rapidly secure a critical mass of operators, and a leadership position in the emerging global commercial space transportation sector. Companies that could use a new commercial spaceport include emergent firms such as t/Space and its booster supplier AirLaunch LLC; the Rocket Racing League; as well as a number of US and foreign suborbital RLV operators and developers such as Armadillo Aerospace, Blue Origin, PlanetSpace, Rocketplane Ltd., SpaceDev, Starchaser, and TGV Rockets. Discussions with three leading operators and their key suppliers, together with an analysis of US aerospace cluster demographics and growth patterns, indicates there is a strong likelihood that major suppliers would seek to co-locate with these operators in the vicinity of the spaceport in order to develop next generation technology in close collaboration with a major customer (see Appendix for profiles of these three operators). Specific types of suppliers that could locate to the vicinity of the spaceport include manufacturers of RLV and rocket-powered aircraft propulsion, airframe and avionics subsystems.

The achievement of such a critical mass of operators is likely to generate economies of scale in spaceport operations, which in turn increases the probability of attracting additional launch vehicle operators to New Mexico. This cascade effect could provide further incentives to major suppliers to co-locate design and manufacturing activities around the spaceport.

New Mexico's success here depends strongly on the ability of the state government to offer incentive packages of interest to operators and manufacturers of reusable launch vehicles and rocket-powered aircraft. In particular, Futron's assessment is based on the assumption provided by the State of New Mexico that one specific major commercial space transportation and manufacturing firm will win a pending NASA award for Space Station cargo and crew re-supply services, and subsequently locate its core operations facilities in New Mexico.

Potential for Attracting Ancillary Businesses to New Mexico

A new commercial spaceport also increases New Mexico's potential for attracting ancillary businesses in the tourism and university technology research and development sectors. The agreement with Virgin, a leading international tourism operator, together with the attendant future publicity from space tourism flights, positions New Mexico to potentially raise its profile as a leading tourist destination for both Americans and foreigners. Virgin has indicated that its future plans may include development of additional vacation resort marketing at New Mexico facilities for its suborbital flight customers. This type

[2] Mesilla Valley Economic Development Alliance, (http://southwest-advantage.com/html/regional_labor_force.html), accessed on December 27, 2005.

of secondary impact from additional in-state visitor spending has the potential to yield construction of new tourism infrastructure such as resorts, hotels and restaurants during the 2010-2020 timeframe considered in this study.

The presence of a vigorous commercial space transportation and manufacturing cluster based around the spaceport is also likely to raise the profile of New Mexico universities with federal technology R&D agencies such as NASA, and the Departments of Defense and Homeland Security. Major aerospace firms and new local commercial space transportation systems manufacturers can also be expected to take increased notice of the capabilities of in-state higher education and research institutions in space-related research and development. As a result, New Mexico universities can reasonably expect to attract an increasing number of aerospace-related R&D funds and programs from government agencies and private industry. Spaceport activities are also likely to provide an ongoing stimulus to the development of high quality undergraduate and graduate engineering, science and management education programs in New Mexico.

ECONOMIC IMPACT RESULTS

Using the above vision and assessment of New Mexico's potential as its baseline, Futron applied independent expert analysis to develop forward-looking estimates of the economic impact of the Southwest Regional Spaceport in 2015 and 2020. The assessment is based on the following assumptions:

- Space transportation market forecasts discussed in the Launch Forecast section,
- Data provided by the State of New Mexico and commercial space transportation firms considering locating facilities in-state,
- The most recent multipliers for New Mexico provided by the US Department of Commerce, and
- Specific assumptions as to market share, prices, local expenditures of space transportation companies, and out-of-state spectator attendance and spending, derived from specific statements by the companies involved, or analysis of published data on comparable programs or activities

The following sections provide details of this projected economic impact broken out by major categories of activities: space transportation, visitor spending and tourism, Rocket Racing League, manufacturing and headquarters operations, and spaceport construction.

SPACE TRANSPORTATION

Commercial space transportation activities are expected to be the largest contributor to the spaceport's economic impact. Futron estimates that space transportation has the potential to generate about **$370 million** of additional economic activity and **2,530 new jobs** in the State of New Mexico in 2015 (see Figure 8); by 2020, this impact is projected to increase to approximately **$405 million** and **2,770 new jobs** (see Figure 8). These activities include suborbital tourism flights of multiple operators, orbital cargo, crew and commercial passenger operations, and spaceport facility activities. Space tourism operations are expected to account for approximately 82% of this impact in 2020, compared with smallsat launch activities, which will comprise around 2%.

Figure 8: Potential Economic Impacts Generated by Space Transportation Activities (2015 and 2020)

Year	Economic Activity	Earnings	Jobs
2015	$369,883,000	$79,326,000	2,530
2020	$405,702,000	$87,008,000	2,770

Based on discussions with leading commercial space transportation operators, and independent expert analysis, Futron adopted the following assumptions for 2020 in developing these impact estimates:

- Average suborbital tourism prices: $100,000 per passenger
- New Mexico suborbital space tourism market share: 50%
- Average prices of large orbital launches: $20 million (Includes NASA ISS crew/cargo re-supply, and orbital tourism)
- Average prices of small orbital launches: $9 million
- New Mexico large orbital launch market share: 50%
- New Mexico small orbital launch market share: 10%
- Average percentage of suborbital launch-related revenues remaining in-state: 60%
- Average percentage of orbital launch-related revenues remaining in-state: 40%

These impact figures reflect the anticipated reduction in NASA Space Station cargo and crew re-supply flights in 2016 when the ISS is due to be retired. Space transportation impacts include local spending by suborbital and orbital vehicle operators for spaceport facilities, crew, maintenance, fuel, and management services.

VISITOR SPENDING AND TOURISM

Visitor spending and tourism are projected to become significant contributors to the spaceport's economic impact during the 2010 - 2020 timeframe. Futron estimates that by 2015, annual combined spending by spectators attending the X Prize Cup (XPC) and Rocket Racing League (RRL) finals and space tourism passengers and their families have the potential to produce total economic impacts on the order of **$27 million** and **300 new jobs**. These impacts could grow to **$69 million** and **770 new jobs** by 2020 (see Figure 9).

Figure 9: Potential Economic Impact of Visitor Spending and Tourism (2015 and 2020)

Year	Economic Activity	Earnings	Jobs
2015	$27,491,000	$6,789,000	300
2020	$69,035,000	$17,050,000	770

Based on an analysis of historical attendance data from major air show events such as the Albuquerque International Balloon Fiesta, and discussions with the X Prize Foundation and Rocket Racing League, Futron adopted the following assumptions for 2020 in developing these impact estimates:

- XPC/RRL finals attendance: 200,000 spectators
- Percentage of XPC/RRL finals spectators from out-of-state: 50%
- Average length of visitor stay for XPC/RRL finals: 4 days
- Average visitor spending per day: $70
- Percentage of suborbital tourism passengers staying in New Mexico for additional vacation time: 55%
- Average length of stay for suborbital tourism passengers: 4 days
- Average spending per day for suborbital tourism passengers: $350

Spectator data from the annual Experimental Aircraft Association's AirVenture Fly-in in Oshkosh, Wisconsin and major air and car racing events such as the Reno Air Races, Albuquerque International Balloon Fiesta, and the Indy 500 and Daytona 500 were also considered in this assessment.

These impacts are likely to increase by 2020 as the mix of visitor spending moves towards a higher percentage of upscale hotels and resorts, and as a result of inflation. These figures likely underestimate the extent of spectator spending because they do not include ticket sales or local sales of spaceflight merchandise and memorabilia. Attendance figures for the X Prize Cup and Rocket Racing League finals are combined because it is expected that these events will be held at the same time and location, and that there would be crossover attendance by spectators at both events.

Rocket Racing League

Futron estimates that by 2015, annual in-state spending by the RRL and associated racing teams based in Las Cruces could result in total economic impacts on the order of **$62 million** and **630 new jobs**. These impacts could grow to **$78 million** and **780 new jobs** by 2020 (see Figure 10).

Figure 10: Potential Economic Impact of Rocket Racing League Activities (2015 and 2020)

Year	Economic Activity	Earnings	Jobs
2015	$62,659,000	$18,324,000	630
2020	$78,043,000	$22,823,000	780

Based on discussions with the RRL and the NASCAR automobile racing league, Futron adopted the following assumptions for 2020 in developing these impact estimates:

- Number of teams: 20
- Number of annual races: 15
- Percent of teams locating in New Mexico: 70%
- Jobs per team: 8
- Average team staff salary: $60,000
- Race preparation costs, per race: $50,000
- Annual investment in technology development: $10 million
- Percentage of technology development expenditures remaining in-state: 75%

These impact figures for RRL activities include local spending by the league for new vehicle development and testing, pilot training, spaceport facilities, headquarters operations, and team operations such as crews, maintenance, and fuel purchases. It is also assumed that key manufacturers and suppliers would co-locate their activities to Las Cruces, and that the RRL follows through on stated investment and operations plans for New Mexico. Expenditures by spectators attending league finals at the spaceport are not included here, as they have been accounted for in the above section discussing visitor spending and tourism.

Manufacturing and Headquarters Operations

Economic impacts from establishing new commercial space transportation manufacturing and headquarters operations in the vicinity of Las Cruces are projected to become significant contributors to the spaceport's global impact during the 2010 - 2020 timeframe. Analysis of US aerospace cluster demographics and development patterns (see Appendix A), together with information provided by leading commercial space transportation firms as to their prospective investment, operations and supply chain plans for the Southwest Regional Spaceport (see Appendix B), indicate that by 2020 southern New Mexico may reasonably expect to attract and sustain an **additional 1,000 to 1,500 new space vehicle and aircraft manufacturing, headquarters and support services jobs**. This employment base implies an associated increase in total economic activity **in excess of $200 million** for the same period. Markets assumed to be supporting this manufacturing cluster would include reusable launch vehicle purchases by US government agencies and commercial space tourism operators, as well as sales of aircraft to Rocket Racing League teams in the US and overseas.

These estimates strongly depend on the ability of the State of New Mexico and early commercial space transportation operators to attract manufacturers of reusable launch vehicle and aircraft, along with their key suppliers, to locate manufacturing facilities in close proximity to customer firms operating out of the spaceport. As noted earlier, Futron's analysis is also based on the assumption by the State of New Mexico that one specific major commercial space transportation and manufacturing firm will win a pending NASA award for Space Station cargo and crew re-supply services, and subsequently locate its core operations facilities in New Mexico.

The development of this aerospace cluster is anticipated to generate economies of scale in spaceport operations which are likely to attract other launch vehicle operators to New Mexico, in turn potentially providing additional incentives to major suppliers to co-locate design and manufacturing activities around the spaceport.

SPACEPORT CONSTRUCTION

The earliest economic impact of the spaceport project is expected to come from spaceport construction, which is scheduled to begin as early as 2006, and be completed in 2008. As shown in Figure 11, construction of the runway/taxiway, launch pads, hangars and buildings, roads, and utilities infrastructure could bring a maximum impact in 2007 of $331 million in total revenues, and 2,460 total jobs. Additional spaceport construction beyond 2008 is expected to result in an increase in these economic impacts. These estimates do not include the potential impact of new hotel or resort construction that might be required to accommodate additional visitors to Las Cruces or elsewhere in New Mexico during the 2010-2020 timeframe.

Figure 11: Potential Economic Impact of Spaceport Construction, (2006–2008)

Year	Economic Activity	Earnings	Jobs
2006	$61,421,000	$15,199,000	470
2007	$331,485,000	$82,030,000	2,460
2008	$118,607,000	$29,351,000	850

Job creation related to construction activities applies only to the 3-year construction period. Impacts resulting from the demand for construction of the spaceport will create jobs in construction, related building and materials industries, and in other industries that provide inputs to the construction sector. Construction-related jobs are not expected to extend beyond the immediate 3-year construction period, and may not be added together across multiple years to provide a "cumulative" jobs impact estimate. Construction-related impacts are not dependent on achieved space transportation market share.

These economic impact estimates are based upon New Mexico State University/Physical Science Laboratory's (NMSU/PSL) assessment of total annual construction costs for the spaceport during 2006-2008. Futron applied these cost projections without adjustment as they were deemed realistic and in line with recent construction costs at other US spaceports.

ADDITIONAL ECONOMIC BENEFITS FOR NEW MEXICO

The successful development of a New Mexico Spaceport can also be expected to produce a number of unquantifiable economic benefits. While this study was not tasked with a detailed assessment of such benefits, the following key areas are likely to be most affected:

- **Synergies with and Expansion of Existing Industrial Clusters**. It anticipated that the spaceport and associated commercial space transportation and manufacturing cluster would develop significant synergies with the Albuquerque aircraft manufacturing and statewide tourism clusters. Complementary activities include aerospace parts fabrication and hotel accommodation and related services. This growth could also be expected to strengthen New Mexico's position in various federal and commercial markets, leveraging the spaceport infrastructure for programs such as unmanned aerial vehicle (UAV) development and testing, and border surveillance for the Department of Homeland Security.
- **Workforce Development and Education**. The influx of sophisticated space transportation engineering, manufacturing and operations firms into the Las Cruces area is likely to have a significant positive impact on the development of workforce technical and management skills, which could be applied across many of New Mexico's high technology industries. This in turn could enhance the state's stature and competitive position for additional investment in a number of technology sectors. Spaceport- and cluster-related jobs, particularly in the space transportation and manufacturing sectors, might be heavily weighted towards technical and management professions. This large and highly skilled workforce should contribute to higher average salaries and wages in southern New Mexico.
- **Improved Domestic and International Profile for the State of New Mexico**. New Mexico can expect a higher profile among investors and the world public by virtue of increased press and television coverage, visits by high net worth foreigners for space tourism trips, and film and digital media productions focused on spaceport activities.

SOUTHWEST REGIONAL SPACEPORT: A PROJECT OF NATIONAL SIGNIFICANCE

Much of this economic impact assessment has been based on markets such as suborbital space tourism, as well as the tourism associated with competitions like the X Prize Cup and the Rocket Racing League. These ventures can, to some, seem somewhat trivial compared to existing space efforts like satellite launches, assembly of the International Space Station, and human and robotic exploration of the solar system. However, while tourism markets can have strong economic benefits, the same spaceports that support such activities can also serve other markets and programs that are of considerable importance to the nation as a whole.

NASA in particular has expressed strong interest in procuring commercial services to transport cargo and crew to and from the ISS. In June 2005 NASA Administrator Michael Griffin said that his agency would pursue commercial ISS resupply services to help bootstrap the commercial space industry as well as to provide a U.S. alternative to the Space Shuttle—scheduled to retire in 2010—or purchasing Russian launch services. Since then Administrator Griffin and other agency officials have reiterated their commitment to commercial ISS resupply, with some saying that while the Crew Exploration Vehicle (CEV)—the successor to the Shuttle currently under development, primarily to support human missions to the Moon and beyond—could be used to support the ISS, it would be preferable and less expensive for the agency to use commercial alternatives instead.

As further evidence for the agency's support of commercial ISS resupply services, the agency released in December 2005 a draft RFP for its Commercial Orbital Transport Services (COTS) program, designed to support the development of commercial ISS resupply vehicles and later purchase services from those vehicles. NASA plans to issue the final RFP in early 2006, and select one or more proposals for development in May 2006. The agency has pledged to spend $500 million over the next several years on COTS.

Many commercial space companies see COTS as a springboard for other commercial markets, such as orbital space tourism, satellite launch, and future commercial support of NASA's Vision for Space Exploration. By providing the funding needed for one or more companies to develop their vehicles, and then serving as an anchor customer for those companies as they bring their vehicles into service, NASA is helping stimulate a commercial market that could prove profitable to several companies, but which may otherwise be difficult to develop given the high costs of launch vehicle development.

The formation of new commercial orbital markets may provide an opportunity for new spaceports, such as New Mexico's. In order for these companies to meet the needs of NASA and other customers and remain profitable, they will need to keep overall launch costs as low as possible and be responsive to the needs and schedules of their customers. Many entrepreneurial launch firms have complained about the high costs and bureaucratic hurdles associated with "legacy" spaceports, most notably Cape Canaveral Air Force Station/Kennedy Space Center. A new "clean sheet" spaceport, on the other hand, can be developed with the needs of such launch vehicle operators in mind, and with the latest in launch processing and range technology to permit responsive, low-cost launch operations. New Mexico is particularly well situated in that respect, since it has the opportunity to build a new spaceport that can meet the needs of both suborbital and orbital operators, serving commercial and government customers alike. Construction of the spaceport can be viewed as critical to the development of private sector alternatives for use by NASA, enabling the agency to focus its budget on lunar and Mars missions.

CONCLUSION

New Mexico's vision for the Southwest Regional Spaceport is bold yet feasible, and has the potential to rapidly vault the state and the United States into the position of world leader in commercial space transportation and manufacturing. If successful, the spaceport can serve as the magnet for an emerging commercial space transportation cluster which leverages economies of scale in spaceport operations and close operator-manufacturer-supplier relationships to attract new launch firms and RLV and aircraft manufacturers to co-locate facilities in southern New Mexico.

The spaceport is positioned to generate significant potential economic benefits for the state of New Mexico and the US civil space program. Analysis indicates that the state-level impact of this project is potentially quite large in both total output and employment, reflecting the strong upscale potential of the emerging space tourism industry. At the national level, the spaceport can make a significant contribution to NASA's Vision for Space Exploration program and to cost-effective commercial resupply of the Space Station, thereby allowing the agency to focus its budget on lunar and Mars missions. The Southwest Regional Spaceport could thus yield substantial returns and economic benefits for New Mexico and the nation within the next 15 years.

APPENDIX A: METHODOLOGY

Futron employed two methodologies in developing estimates for the economic impact of the Southwest Regional Spaceport: aerospace cluster analysis and regional impact multipliers. Both of these approaches are described below.

AEROSPACE CLUSTER ANALYSIS

Futron analyzed US aerospace cluster firm demographics, growth characteristics and lifecycle patterns with particular attention to comparable clusters in California, Arizona, Oklahoma and New Mexico (see Figure 12). Clusters were selected for analysis based on the following criteria: the presence of existing spaceport and aerospace transportation and manufacturing activities, the number of firms and employees, and geographic proximity to New Mexico. An exact analogue to the proposed Southwest Regional Spaceport cluster does not exist, as present clusters are typically based around federally funded space R&D activities or commercial aviation operations and production.

Figure 12: US Aerospace Clusters Selected for Comparison

Aerospace Cluster	Cluster Scope	Principal Activities	Number of Firms and Government Facilities	Employment	Year
Albuquerque, NM	Metropolitan area, including Rio Rancho	Commercial aviation, aircraft manufacturing, avionics production, aerospace parts and components, research, Kirtland AFB, AFRL	100+	4000+ (not including federal facilities)	2004
Antelope Valley, CA	Multiple Counties: includes Kern County, Mojave Spaceport, Palmdale	Aerospace R&D, aerospace manufacturing, Mojave Spaceport, Edwards AFB, NASA Dryden, China Lake	52	9,000+	2004
Mojave, CA	Spaceport/Airport	Commercial inland spaceport, launch vehicle and aircraft manufacturing, flight training	13	1,300	2004
Oklahoma	Statewide, principal regions include Oklahoma, Jackson, Comanche, Garfield and Tulsa counties	Commercial aviation, aircraft servicing, aircraft manufacturing, flight training, air traffic control, USAF	134	42,000	2005
Phoenix, AZ	Metropolitan area	Commercial aviation, aircraft manufacturing, aircraft engine and parts manufacturing, avionics equipment manufacturing, missile and space vehicle manufacturing, flight training	279	38,960	2003

We then combined the results of this cluster analysis with order-of-magnitude employment projections provided by commercial space transportation firms considering investing in New Mexico, along with RIMS II employment multipliers, to estimate a range of anticipated employment scenarios and impacts for new spaceport-related manufacturing and headquarters operations in 2015 and 2020. Futron assumed that a new southern New Mexico commercial space transportation and manufacturing cluster would evolve in a manner consistent with the historical development, life cycles and industrial demographics of other US aerospace transportation and manufacturing clusters.

These manufacturing and headquarters impact estimates are strongly dependent on the ability of the State of New Mexico and early commercial space transportation sector entrants to attract manufacturers of reusable launch vehicle and aircraft, along with their key suppliers, to locate manufacturing facilities in close proximity to customer firms operating out of the spaceport. The analysis is also based on the assumption by the State of New Mexico that one specific major commercial space transportation and manufacturing firm will win a pending NASA award for Space Station cargo and crew re-supply services, and subsequently locate its core operations facilities in New Mexico.

ECONOMIC IMPACT MODEL

Futron utilized the Regional Input-Output Modeling System II (RIMS II) developed by the U.S. Department of Commerce Bureau of Economic Analysis to calculate the anticipated economic impacts of spaceport construction, operations and associated visitor spending. RIMS II tracks the regional flow of goods and services to determine the interconnection of producers and consumers, and it measures individual industries' contribution to regional economies. Quantitative economic impacts reported in this study refer to the goods and services demanded by the regional economy as a result of new "final demand" generated by spaceport construction and commercial operations activities. RIMS II employs a top-level approach to determining regional economic impacts of new projects. Costly empirical "bottom-up" surveys conducted by the Department of Commerce have demonstrated that the RIMS II model can overestimate impacts by as much as 10%.[3]

Futron employed the North American Industry Classification System (NAICS) codes to determine the appropriate RIMS II multipliers for the State of New Mexico. The multipliers chosen in this study were those associated with industry sectors "Air Transportation", "Hotels and Motels", "Spectator Sports", "Manufacturing", "Management of Enterprises", and "Construction". We considered civil air transportation activities a close analogue to future commercial space transportation activities from the perspective of technical and operational complexity. Economic impacts were calculated for the regional economy of the State of New Mexico.

Because RIMS II is a static model, the same multipliers were used for each year the economic impacts were estimated (2006 – 2008 for construction, 2015 and 2020 for operations). The changes in operations-related economic impacts are due to: 1) increases in the estimated flight rate (and number of passengers) over a ten year period (based on the 2010 – 2020 market assessment presented in Part I); and 2) assumed reductions in suborbital passenger prices over this same timeframe. It was assumed that 2015 and 2020 industry multipliers would be approximately the same as the most recent multipliers available.

Economic impacts are measured in terms of economic activity (revenues or output), earnings and jobs. Annual impacts were calculated for construction of the spaceport over a period of 3 years, and 5- and 10-year impacts were calculated for operations of the spaceport (2015 and 2020).

The following sections describe methodologies and assumptions used in assessing potential economic impacts from space transportation activities, visitor spending and tourism, Rocket Racing League operations, manufacturing and headquarters operations, and spaceport construction.

[3] Department of Commerce, Bureau of Industry and Security, http://www.bxa.doc.gov/DefenseIndustrialBasePrograms/OSIES/DefMarketResearchRpts/TSVReportAppendix.htm

SPACE TRANSPORTATION

Space transportation-related economic activity includes commercial launch vehicle operator flight and flight preparation activities, passenger and cargo handling, and spaceport facility operations. In order to measure the economic impact of space transportation operations in the State of New Mexico, Futron estimated annual revenues resulting from both suborbital and orbital launch activity using passenger and launch prices derived from industry interviews and Futron's proprietary databases and space tourism demand model. Suborbital passenger prices were assumed to decline over time as demand matures and more operators and competition enter the marketplace. Prices for small and large orbital launches were expected to remain relatively constant, due to the lower volume of passengers and cargo over the 2010-2020 timeframe.

Because some portion of operator vehicle revenue is anticipated to flow out-of-state (in the form of profits and expenses such as hardware purchase or depreciation, financing and administrative costs), we estimated average in-state expenditures in 2020, across all operators, to range from 40% for orbital launches to 60% for suborbital flights. A lower percentage of in-state spending was assumed for orbital launches due to greater uncertainty as to whether key expendable launch vehicle suppliers might relocate to New Mexico. Interviews on this issue with leading launch operators and their suppliers provided additional information used in developing these assumptions.

New Mexico's share of the suborbital space tourism market was assumed to start at 75% in 2010, and decline to 50% by 2020 as additional space tourism operators and spaceports enter the market place. The state's market share for small and large orbital launches was assumed to remain relatively constant at 10% and 50%, respectively.

Combined economic impact estimates were generated for suborbital and orbital launch activities. We employed the RIMS II multiplier for the "Air Transportation" industry sector as most suborbital and orbital launch vehicles under current consideration are air-launched, and thus are assumed to enjoy a long-term cost structure approximating that of commercial airlines.

VISITOR SPENDING AND TOURISM

Futron estimated an order-of-magnitude goods and services final demand for X Prize Cup and Rocket Racing League spectator spending based on attendance data for comparable events, an approximate visitor length of stay, and visitor vacation spending-per-day statistics for Las Cruces. Relevant air events considered include the Reno Air Races, Albuquerque International Balloon Fiesta, and the Experimental Aircraft Association's annual AirVenture Fly-in in Oshkosh, Wisconsin. Car racing events such as the Indy 500 and Daytona 500 were also taken into account in developing spectator projections for 2015 and 2020.

Futron's analysis also included potential tourism spending by suborbital passengers who extend their stays in New Mexico by a few days to vacation near the spaceport or in Santa Fe, Taos, or other cities. We assumed that such spending is in addition to their purchase of seats on suborbital flights. This impact was relatively small compared to the above spectator impacts due to the small numbers of passengers involved.

We employed here the RIMS II multiplier for the "Hotels and Motels, including casino hotels" industry sector.

ROCKET RACING LEAGUE

Futron estimated Rocket Racing League (RRL) annual expenditures in New Mexico based on financial projections provided the RRL, RRL's tentative plans for investment and operations in the Las Cruces area, discussions with the NASCAR car racing league, and independent expert analysis by Futron as to likely growth rates for rocket-powered aircraft racing as a spectator sport. Our economic impact estimates assume that the State of New Mexico is successful in attracting key RRL technology development and manufacturing partners to locate in the state within the 2010-2020 timeframe.

We employed here the RIMS II multiplier for the "Spectator Sports" industry sector.

MANUFACTURING AND HEADQUARTERS OPERATIONS

Futron estimated a range of potential economic impacts resulting from locating RLV and aircraft manufacturing and headquarters activities in the vicinity of the spaceport using cluster analysis techniques, RIMS II employment multipliers and information provided by key firms considering locating to New Mexico (see Appendix B).

We assumed that a new southern New Mexico commercial space transportation and manufacturing cluster would evolve in a manner consistent with the historical demographics and development of other US aerospace manufacturing and services clusters. We then used order-of-magnitude employment projections provided by the above firms and their major suppliers, along with appropriate multipliers, to estimate a range of anticipated employment scenarios and impacts for new spaceport-related manufacturing and headquarters operations in 2015 and 2020. Adjustments to these estimates were made in order to avoid double counting with economic impact figures derived from local expenditure projections of these firms.

Futron employed here direct-effect RIMS II employment multipliers for the "Management of Enterprises", "Aircraft Manufacturing", "Guided Missile and Space Vehicle Manufacturing" and "Miscellaneous Fabricated Metal Product Manufacturing" industry sectors.

SPACEPORT CONSTRUCTION

Estimates for spaceport construction economic impact were estimated on an annual basis for the period 2006-2008. Projected spaceport development costs over the 3-year construction period provided by NMSU/PSL were the basis for the impact assessment. These jobs are typically not sustained once construction is completed.

The RIMS II construction sector final demand multipliers for "Construction" were applied here.

APPENDIX B: COMPANY PROFILES

VIRGIN GALACTIC

Virgin Galactic of London, England, was formed in 2004 by Sir Richard Branson's Virgin Group to develop the emerging market for space tourism. The firm will own and operate privately built spaceships modelled on the SpaceShipOne vehicle.

Business Model and Key Suppliers. Virgin Galactic will generate revenues through the sale of suborbital passenger transportation services to private individuals, corporations and government agencies. The firm has contracted with The Spaceship Company (SSC) to design and build the first generation of Virgin Galactic RLVs. SSC, which is jointly owned by Virgin and Scaled Composites, will manufacture launch aircraft, spaceships and support equipment and market them to spaceline operators, including the launch customer, Virgin Galactic.

Tentative Investment and Operations Plans for New Mexico. Virgin Galactic agreed in December 2005 to locate its corporate headquarters and Mission Control in New Mexico, and to base its flight operations out of the Southwest Regional Spaceport. The company anticipates extensively investing in "the passenger experience" which is expected to include the construction of an upscale spaceport lounge, an observation area for families, and training and simulator facilities for astronauts and crew. Ongoing operations in the vicinity of the spaceport will include headquarters management, passenger relations and handling staff, and routine, day-to-day spacecraft maintenance activities.

Forward-looking Economic Impact for 2010. Virgin Galactic estimates that its spaceport operations will require approximately 200 support personnel by 2010, to be distributed between State of New Mexico employees and Virgin staff. Headquarters staffing could range from 40 to 50 additional people.

Estimated Value of Investment in New Mexico through 2010. Virgin has negotiated with the State of New Mexico for a 20-year lease on the use of spaceport facilities. Under the terms of this agreement, Virgin would be the spaceport's launch customer and would make yearly payments capped at $1 million for the first five years, with subsequent annual payments to be determined according to the scale and growth of Virgin's operations at the spaceport. Total annual in-state expenditures would also include payroll expenses, various operating costs such as fuel and routine daily maintenance, and off-site leases of office space. The construction of new passenger facilities is expected to exceed $15 million in cost. Virgin anticipates that it will reinvest significant portions of passenger revenues in its New Mexico operations during the initial years of operation.

TRANSFORMATIONAL SPACE CORPORATION LLC

Transformational Space Corporation (t/Space) of Reston, Virginia, was formed in 2004 to develop the emerging market for Earth-to-orbit commercial space transportation, and to enable prompt, affordable, safe and sustainable lunar exploration and development. The company was one of eight winners in NASA's "Concept Exploration and Refinement" competition to advise the agency on the best architecture for Moon-Mars exploration and the best initial design for the Crew Exploration Vehicle (CEV). Since August 2004, t/Space has received NASA study contracts in the amount of $6 million.

Business Model and Key Suppliers. t/Space will initially generate revenues through the sale of orbital passenger and cargo transportation services to NASA, other government agencies and the private sector. The firm is a potential bidder for ISS cargo and crew re-supply demonstrations and services contracts under NASA's Commercial Orbital Transportation Services (COTS) program. The company has contracted with Scaled Composites LLC of Mojave, California, to design and build the first generation of Crew Transfer Vehicle (CXV) reentry capsules. AirLaunch LLC of Seattle, Washington, is providing an upgraded version of its two-stage QuickReach booster to launch the CXV into orbit. Other key suppliers include Constellation Services International, Orion Propulsion Inc., and Universal Space Lines.

Tentative Investment and Operations Plans for New Mexico. t/Space is currently in discussions with New Mexico regarding basing its engineering and final integration facility in New Mexico. Should t/Space win a contract with NASA, initial launches for cargo and crew would occur at Kennedy Space Center in Florida; manufacturing of the capsule, mating of the launch vehicle with the carrier aircraft, and post-flight refurbishment of the capsule for reflight would occur in New Mexico. t/Space is considering utilizing the spaceport for later flights for non-NASA customers. The company plans to commence operations in New Mexico in the second half of 2006.

Forward-looking Economic Impact for 2010. t/Space estimates that its New Mexico operations by 2010 will require approximately 300 employees and support personnel as a result of the location of key supplier manufacturing facilities in the state.

Estimated Value of Investment in New Mexico through 2010. Total annual in-state expenditures would include leases for airport facilities and office space, payroll expenses, various operating costs such as fuel and maintenance, and financing expenses. Depending on the terms of the agreement reached with the state, this could reach a total of approximately $100 million by 2010. t/Space anticipates that it will reinvest significant portions of its revenues in its New Mexico facilities and operations during the initial years of operation.

ROCKET RACING LEAGUE

The Rocket Racing League (RRL) of New York, New York, and Santa Monica, California, was formed in 2005 to develop the nascent market for low-altitude rocket-powered aircraft racing. As an aerospace entertainment organization that combines the competition of racing with the excitement of rocketry, the league's mission is to serve as a technology accelerator in the areas of airframe, propulsion and spacecraft design, and to inspire the next generation of spaceflight enthusiasts. Similar to auto racing organizations, the RRL will organize, host and run competitions across the United States, with the finals taking place each year at the X PRIZE Cup in Las Cruces, New Mexico.

Business Model and Key Suppliers. The RRL will generate revenues through six channels: sponsorships, ticket sales, broadcast rights, merchandising, tours, and gaming. The league has contracted with XCOR Aerospace of Mojave, California, to design and build the first generation of X-Racers. Next generation vehicles will be using an airframe provided by Velocity of Sebastian, Florida.

Tentative Investment and Operations Plans for New Mexico. The League is currently in discussions with New Mexico regarding basing its headquarters and technology development operations in the vicinity of the spaceport and Las Cruces. RRL Global Headquarters has oversight responsibility of all operational and management aspects of the racing league, as well as, marketing, sales, public relations, legal and finance, research and development, systems support, merchandise fulfillment and other support operations. Related operations to be based directly at the spaceport would encompass research and development, equipment testing and pilot training. Technology development activities would focus on engineering R&D for future X-racers, including airframe, propulsion systems, telemetry and avionics development. The RRL anticipates that if league headquarters and technology development operations are based around Las Cruces a majority of teams would choose to co-locate their operations to the spaceport as well. League merchandising and distribution activities could also be based in Las Cruces.

Forward-looking Economic Impact for 2010. The RRL estimates that its New Mexico operations could require approximately 50 or more headquarters personnel by 2010. Teams located in Las Cruces could contribute another 30 to 60 direct positions. Application of RIMS II employment multipliers to these figures suggests that the total employment impact of the league's in-state operations would be approximately xxx to xxx jobs in this timeframe. Additional impacts may accrue from the location of key supplier manufacturing facilities in the state.

Estimated Value of Investment in New Mexico through 2010. These investment figures for RRL activities include local spending by the League for legal and financial services, marketing and public relations, advertising, hospitality and convention services, engineering and technical services, research and development, internet programming and support, information systems support, merchandise manufacturing, warehousing and distribution, retail sales, media production and broadcasting. It is also assumed that one or more key manufacturers and suppliers co-locate their activities to Las Cruces, and that the RRL follows through on stated investment and operations plans for New Mexico. The RRL also expects to generate awareness and traffic for the state from businesses seeking sponsorship, team ownership, business affiliation, promoter relations, technology advancement and products development as well as participants in RRL-related training and technical seminars.