# ISDC 2004
# 23rd Annual International Space Development Conference
***"Settling the Space Frontier"***

# Spaceport Business – Potential Markets thru 2020

**by: Derek Webber, Director, Spaceport Associates, Rockville, MD, USA**

## 1.Introduction

Multiple US States have so far declared an intention of at least evaluating the potential benefits of establishing one or more spaceports within their boundaries. The benefits could indeed be substantial in terms of employment opportunities, and potential increased tax revenues, but at this stage most of this lies within the realm of dreaming or at best preliminary planning. A realistic assessment of commercial space markets is a key building block in the planning of successful spaceports.

This paper therefore brings together, in an easily accessible basis, a summary of all current and projected future global space markets that were identified and quantified in the NASA ASCENT study managed by the Marshall Space Flight Center during 2001 thru 2003. Even before considering the potential market share of a given spaceport, it is necessary to have this understanding of the global demand projections for the totality of space business. The ASCENT Study considered 42 different market sectors, and still remains the best basis for consolidated global launch vehicle forecasts involving both commercial and governmental markets.

It will become apparent from the data presented that it is unlikely that ALL of the proposed US spaceports can be viable, at least within the timeframe up to 2020. Indications will be provided of those parameters that are most likely to lead to the successful spaceports, and this analysis is performed within the global context of the overall space business.

It should be noted, as a caveat, that the work of the ASCENT study was completed in 2003, before the President announced his New Space Exploration Initiative involving an eventual return to the Moon and subsequent preparations for a journey to Mars. Although this would have impacted some of the detailed sector forecasts, it is unlikely to have brought about any major change to the aggregate global findings presented. The same general comment can be applied to any changes to military space needs as a consequence of requirement reviews following the Iraq and Afghanistan wars.

## 2. ASCENT Study Markets

The ASCENT Study was a very thorough assessment of launch vehicle markets, resulting in 20-year forecasts, which took a team of up to 15 analysts nearly two years to complete. This paper cannot give an adequate description of the detailed methodologies employed, and of the ways in which the market data was assembled, but very thorough documentation is provided in Reference 1. More detail is provided of one specific key growth market, namely public space travel, in Reference 2.

However, in order to have confidence in the tables in this paper, it is important to at least be aware of some of the key aspects of the ASCENT study. First of all, it was recognized that launch vehicle markets are global, so the forecasts themselves were global. Secondly, it was recognized that commercial market forecasting should be demand-based. In other words, it was not a reliable technique to simply obtain launch vehicle forecasts from various manufacturers or interested parties, and add them up. Such an approach leads to double counting, and suffers from the dangers of combining numbers based on entirely different environmental assumptions. So, forecasts were derived for each commercial sector, bottoms-up, by understanding the end user demand in each case. For example, how many users of direct broadcast satellite TV are reasonable, in each country, given the common assumptions of GDP growth by country over the next twenty years? When these numbers had been determined for each country, they were then converted into transponder demand for each region, and only eventually into satellites and launches. In doing this conversion, care was taken to allow for expected continuing technological improvements in efficiency of satellite design, and the orbit and mass class of vehicle that would need to be used for the purpose.

To do this work, and avoid double counting, it was important to use very precise definitions of market sectors, and they are provided in Reference 1. Overall, the ASCENT Study considered 42 different market sectors. The analysts began by assembling all the possible markets identified elsewhere, and added some new ones. It was determined, however, that many “familiar” markets that have been discussed for years, if not decades, are not likely to be achievable within the 20-year timeframe of the Study. The timeframe of twenty years had been chosen as a consequence of the perceived need by Marshall Space Flight Center to replace the space shuttle within that timeframe. The study was part of the then Second Generation Reusable Launch Vehicle project effort. Therefore, a major early step was to differentiate between those markets capable of generating launches within a twenty-year timeframe, and those that are not. A filter was therefore set up containing the following criteria:

| | |
|---|---|
| SHORT TERM MARKETS | Current application or market exists |
| | Follow-on application of current in-orbit assets |
| | Minor technology hurdles that can be overcome in 20 yrs |
| VERY LONG TERM MKTS | Significant technology hurdles |
| | Requires new space assets unlike those to date |
| | Significant regulatory or environmental policy barriers |
| | Strong terrestrial competition |
| | Follow-on applications enabled by markets that don’t yet exist |

Following this classification scheme, 18 separate markets were identified that generated launch forecasts over the twenty-year period, and they are listed in Table 1, together with the resulting launch forecasts ( all mass classes and orbits combined) for each segment.

TABLE 1
ASCENT STUDY GLOBAL MARKETS (orbital)

| Class | Market Segment | Yr 2001 launches | ASCENT forecasts Yr 2010 | ASCENT forecasts Yr 2020 |
|---|---|---|---|---|
| Existing Commercial (current) | Telephony | 2 | 1 | 2 |
| | Television & Radio | 5 | 8 | 8 |
| | Data Communications | 4 | 3 | 6 |
| | Remote Sensing (Commercial) | 2 | 3 | 4 |
| | On-orbit Sparing | 2 | 2 | 3 |
| | Public Space Travel | 0 | 0 | 10 |
| | Space Burial | 0 | 0 | 1 |
| Existing Government (current & planned) | Positioning | 3 | 4 | 1 |
| | Civil Remote Sensing | 5 | 6 | 5 |
| | Military Remote Sensing | 6 | 8 | 5 |
| | Military Communications | 11 | 5 | 4 |
| | ISS Missions | 14 | 14 | 14 |
| | Space Weapons | 0 | 1 | 1 |
| | Human Space Exploration | 1 | 4 | 4 |
| | Space Science (Non-ISS) | 5 | 8 | 2 |
| | Human Space Rescue | 0 | 0 | 0 |
| | Asteroid Detection & Negation | 0 | 1 | 0 |
| | Other Government Missions | 1 | 2 | 1 |
| Total | | 61 | 70 | 74 |

It should be noted at this point that no significant changes in launch prices were assumed in providing these projections. Overall, the ASCENT Study concluded that there would be very little change from year to year in the total annual launch rate at current prices, and for most of the years the aggregate global total of launches (of all types) was between 70 and 80 launches/year. Table 2 is provided for completeness, to show the 24 other market segments, which however did not contribute to the launch totals within the 20-year period. Of these 24, some of the first four (ie Evolving Commercial) were found to produce a few launches before 2020, but only provided that there would be a major reduction in the level of launch vehicle pricing. The remainder was assumed not to generate any launches before 2020.

TABLE 2
VERY LONG TERM MARKETS
of ASCENT STUDY

| Classification | Market Segment | Notes |
|---|---|---|
| Evolving Commercial (next 20 years) | Commercial ISS Module<br>Space Hardware R&D<br>Orbital Servicing & Salvage<br>Propellant Depot | these four markets did not generate any dedicated launches during the next 20 years at current price levels. |
| Emerging Government and Commercial (Beyond 2020) | Space Traffic Control<br>Law Enforcement<br>Asteroid & Lunar Mining<br>Space Solar Power-on orbit<br>Space Solar Power-to Earth<br>On-orbit Construction<br>Space Crystal Manufacturing<br>Vacuum Processing<br>Space Hotels<br>Space Settlements<br>Orbiting Advertisements<br>Hazardous Waste Disposal<br>Space Debris Management<br>On-orbit Education<br>Space Hospitals<br>Space Athletic Events<br>Artificial Space Phenomena<br>Space Theme Park<br>Space Product Promotion<br>Space Agriculture | <br><br><br><br><br><br>full manufacturing, not R&D, is implied.<br>full manufacturing, not R&D, is implied.<br>a few launches possible near to 2020 |

It should be noted that the largest growth opportunity for commercial space markets was found to be public space travel. For the purposes of the ASCENT Study, only orbital flights were included, and they were assumed to be on Soyuz type spacecraft. The flights were assumed initially to carry a single passenger, then reaching a limit of 2 passengers per launch in the outer years (when it was assumed the Russians will have adapted their spacecraft to make this possible). Reference 2 provides more detail on the forecasts of public space travel that were included in the ASCENT Study results. They were derived from a major market research study of millionaires, where realistic descriptions of the experience (both positive and negative) were presented, including the level of risk, the price, and the need to currently fly from Russia to have the orbital experience. The demand for public space travel is highly dependent on launch prices, as is also described in Reference 2, and the forecasts in Table 1 are based only on the current $20M price for a Soyuz flight. Clearly, any special vehicle that could carry ten or more tourists would bring down the price and have a significant positive impact on projected launch numbers. Reference 3 also provides some perspective on the importance of the space tourism sector, where it is seen to be an enabler of other space markets. Clearly many of the Table 2 markets will not develop unless and until a successful space tourism business is operating.

### 3. Spaceport Status

There is a very comprehensive source document for this material, and it is noted below as Reference 4. Table 3, below, has been provided to summarize the current status of US Spaceports. It should be noted at this point that there are spaceports elsewhere in the world, and to some extent they would represent competitors to the US spaceports. Some elements of this competition are discussed in the next section.

TABLE 3
US SPACEPORTS SUMMARY STATUS

| Class | Spaceport | Location | Status |
|---|---|---|---|
| Federal | Cape Canaveral/KSFC | Florida | Operational |
| | Edwards AFB | Mojave, California | Operational |
| | Vandenberg AFB | Lompoc, California | Operational |
| | Wallops Flight Facility | Wallops Island, VA | Operational (suborbital) |
| | White Sands Missile | New Mexico | Operational |
| Licensed non-Federal | California Spaceport | Lompoc, California | Co-located Vandenberg AFB |
| | Kodiak Launch Complex | Kodiak Island, Alaska | Polar launches |
| | Florida Space Authority | Florida | Co-located with KSFC |
| | Virginia Space Flight Center | Wallops, Virginia | at Wallops Flight Facility. |
| Proposed non-Federal | Gulf Coast Regional | Brezoria County, Texas | Greenfield. No infrastructure. |
| | Mojave Civ Flt Test | Mojave, California | Scaled Composites, XCOR. |
| | Nevada Test Site | Nye County, Nevada | Potential Kistler launch site. |
| | Oklahoma Spaceport | Burns Flat, Oklahoma | Airport. Former Air Force base. |
| | South Texas | Willacy County, Tex | No infrastructure. |
| | Southwest Regional | Upham, New Mexico | No infrastructure. |
| | Spaceport Alabama | Baldwin County, Al | No infrastructure. |
| | Spaceport Washington | Grant County, Wa | STS emergency landing site. |
| | Utah Spaceport | Wah Wah Valley, Utah | No infrastructure. |
| | West Texas | Pecos County, Texas | No infrastructure. |
| | Wisconsin Spaceport | Sheboygan, Wisconsin | Suborbital launch pad. |

Source: Associate Administrator for Commercial Space Transportation/ FAA/ Jan 2004

Note that the existing operational sites were all originally set up as Federal launch sites. Four new spaceports have been granted operating licenses by the Federal Aviation Administration, and these sites are also largely built upon former Federal launch facilities. New infrastructure, and pads, have been built in some cases, in order to provide new commercial access opportunities.

The major new development area, however, is the plethora of proposed non-Federal spaceports. They have so far survived largely by state sponsorship, and generally little has been done beyond studies and initial environmental impact work at the suggested sites. Some are to be located at former airports; others are exploring green field locations. In one state, Texas, three different sites are being considered.

Can all these new spaceports possibly succeed? As the various development authorities work to develop their respective business plans, they must be looking with some concern at today's launch markets, and indeed at the future projections from studies such as NASA ASCENT. Most of them are enthusiastic believers in an eventual thriving public space travel market. Certainly, there is a hopeful indication for the sub-orbital sector, and for instance Reference 2 cites a possible 13,000 a year tourists flying at today's sub-orbital price of $100K, and many more if prices come down. The Mojave Civilian Flight Test Center looks well positioned to support these developments. But at present there is little evidence of development within the US of vehicles capable of providing the orbital space tourism experience. There may be some hope that the CEV currently being developed by NASA as part of the new National Space Exploration Vision could be capable of modular extension to eventually take American tourists into space. The President's Commission on the Future of the US Aerospace Industry in 2002 certainly indicated that such markets should be taken seriously.

One thing is clear. Any new green field spaceport will not be able to rely on public space travel revenues in its early years. And the forecasts above suggest that traditional space markets are unlikely to provide enough launches to support the full range of spaceports listed in Table 3 (quite apart from the foreign competition that takes a major share of the 70 or so global launches a year). This is discussed further in the subsequent section.

## 4. Commercial Spaceport Business Plans

A spaceport can potentially be very beneficial to a State and a Region. If we assume that the new public space travel markets develop as predicted, then the future travelers will need all kinds of infrastructure support. If a traveler spends $20M for a space flight, then that person expects some associated benefits on the ground. For example, there will be a need for training facilities. There will be a need for medical centers. And importantly there will be a need for accommodation and facilities for families and friends of the traveler. One could even envisage, at such prices,eg a pre-flight themed cruise to prepare the family for the experience. If so, a spaceport with an associated cruise liner port, such as KSFC, would have an advantage. Even without a cruise, the family and friends will need to be entertained/educated for maybe a week in advance of the launch, and even during the mission, at spaceport facilities such as IMAX theaters and Space Camp-type arrangements where downlinks from the spacecraft can be monitored. Restaurants, hotels, etc would all benefit from revenues generated by these activities. To a lesser extent, the above thesis holds true even for sub-orbital flights costing $100K. Certainly, differentiation between spaceport facilities can be expected to eventually have an impact, together with a large number of other things, on the selection of the space tourism operator by the prospective public space traveler.

Table 4 has been assembled to indicate the vast number of differentiators that will potentially be considered by those who in future make decisions regarding choice of spaceport. Some of these decision-makers will be the end users, such as space tourists. Some others will be launch vehicle or RLV manufacturers. Other people who have an interest could include States establishing business incubators, and future potential business entrepreneurs who intend to take advantage of the markets. States will be interested in possible tax revenue streams and the employment opportunities at the spaceport itself and in its neighborhood. Each type of decision-maker will consider its own relevant subset of spaceport features in making its choices.

## TABLE 4 SPACEPORT FEATURES

| Class | Feature Description | Class | Feature Description |
|---|---|---|---|
| Geographical/ Technical | Country<br>Altitude<br>deg Latitude<br>possible Easterly azimuths<br>possible southerly azimuths<br>proximity to sea<br>weather-humidity<br>weather-wind<br>weather-rain<br>weather-overcast<br>weather-lightning | Local Infrastructure | Runway<br>Port<br>Railhead<br>Road Access<br>Hotels & Restaurants<br>Qualified local workforce<br>Proximity to University<br>Proximity to NASA facilities |
| Site Facilities | Pads for sounding rockets<br>Pads for small ELV<br>Pads for medium ELV<br>Pads for large ELV/RLV<br>Landing pad for RLV<br>Horizontal takeoff/landing<br>Multiple pads for each veh type.<br>Fuel Handling-Solid<br>Fuel Handling Liquid | Space Tourism Specific | Health check facilities<br>Training facilities<br>Simulators<br>Space Camp/Academy<br>Family facilities -residential<br>Family facilities-entertainment<br>Amateur rocketry facilities. |
| | Fuel Handling - Hybrid<br>Fuel Handling - Nucl Generators<br>Chemical Analysis facilities<br>Ordnance/Pyro facilities<br>Vehicle Integration/Checkout<br>Payload Processing-hazmats<br>Processing - dynamic balance.<br>Spacecraft storage facilities<br>Engineering/Miss Mgt Offices<br>Control facilities for LEOP, IOT<br>Met Office/Radiosonde<br>Range Radars, cameras<br>Telemetry data retrieval<br>Payload processing-vibration<br>Engine test stands<br>Materials testing facilities<br>Hazmat training<br>On-site research labs<br>Broadband access<br>Emergency Response teams<br>Downrange payload retrieval. | Financial/Admin | Years of Operations<br>On-time launch record<br>Financial Incentives/trade zones<br>Int'l facilities-customs<br>Int'l facilities-foreign cuisines,etc<br>Security for military users<br>Veh manufacturer partnerships<br>High Tech company incubators<br>Simplified Admin<br>(ie reg, safety, environment) |

It should be pointed out that individual spaceport managers may opt to support only a subset of the possible types of missions. Indeed, this is the most likely outcome. For example, not all spaceports will be able to handle a full mix of large ELVs, small sounding rockets, horizontal and/or vertical tourist flights, etc. And there are geographical limitations that affect the kinds of orbital parameters that are even possible from any given site. There are, however, certain common elements of all spaceports, such as facilities for handling hazardous materials. Note that this table is equally applicable to non-US spaceports. And recall that, from Table 1 above, there are only around 70 global orbital launches a year. If the sub-orbital tourism markets do not develop as predicted, then the prospects for most of the new spaceports are bleak. If non-US spaceports handle say 70% of orbital launches each year (which is approximately correct), then all the US spaceports would be fighting for a share of around 20 such launches a year. Most of the 20 projected US orbital launches/ year are likely to be from the 5 current existing Federal spaceports – because they already have the pads and facilities for today's launchers, and the associated operational experience. At present, all orbital space tourism missions will go from Kazakhstan, and eventually from the European center in Kourou, French Guiana where they are building a Soyuz pad. The Chinese may also make their Shenzhou spacecraft available for tourism, probably from a Chinese launch site.

So, what guidance can be given to new spaceport management in the US? What are the most likely success parameters for a business plan?

First of all, it is best to start where possible with existing infrastructure, such as an airfield. Secondly, arrange for some revenues in the early years to come from non-launch related endeavors. This can be from, eg high tech incubator businesses. Only build out the infrastructure in line with these revenue flows. Thirdly, try to focus on a subset of the launch business where the spaceport can dominate, due eg to its geographic position. Fourthly, do everything possible to support the creation of the new space tourism industry –initially as a sub-orbital phenomenon, but eventually for orbital public space travel. Finally, try to do anchor tenant deals with certain new vehicle operators, to ensure that the most beneficial set of infrastructure and facilities is gradually put in place to serve the chosen market segments.

## 5. Conclusions

This paper has provided a, perhaps sobering, assessment of the potential market opportunities open for new commercial spaceports. In the near term, it is unlikely that all the current US spaceport business plans can be successfully closed. A few may succeed, but only by taking care to be focussed on the particular space markets that they intend to eventually address, and finding non-space sources of revenue until the tourism markets fully develop. Prospects may improve somewhat if new low-cost launchers such as the SpaceX Falcon are successfully introduced.

Sub-orbital space tourism, once it gets started, will be an important driver of the spaceport business, and some of the US spaceports and operators have an opportunity to take advantage. Sub-orbital flights will have to provide most of the momentum for the next decade, or even longer if no steps are taken to develop an indigenous US spacecraft and RLV to address the orbital space tourism markets. Without such steps, the long-term future of this new industry, with its implications for the aerospace industry in general, associated benefits in employment, tax revenues and new technology leadership, will be outside of the US.

## 6. References

1. NASA ASCENT Study Final Report, Marshall Space Flight Center, 31 January, 2003
2. Webber, D. "The First 100 Years of Public Space Travel" AIAA International Air and Space Symposium, Dayton Ohio, July 2003
3. Webber, D. "Space Tourism – the Enabler" Spaceflight Vol 46, April 2004
4. "2004 US Commercial Space Transportation Development and Concepts: Vehicles, Technologies, and Spaceports". Associate Administrator for Commercial Space Transportation, FAA, January 2004
5. http://www.spaceportassociates.com