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Paper Session II-A - US Commercial Space Launch in the 21st Century

Sidney Kimhan
Practical Innovations International

Rick Manley
MAMCO Assoc

Jimmey Morrel
MAMCO Assoc

Ryan Morrell
MAMCO Assoc.

Baryy Zilin
Practical Innovations International, Inc.

US Commercial Space Launch in the 21st Century

Introduction

Over the last decade our ongoing analysis of the satellite and space launch markets has revealed that annual satellite launch demand forecasts based on commercial company or other industry related information has consistently exceeded the number of actual launches. This is not a new discovery, nor are we the first to report it. However, we call attention to the consistent trend of inaccurate forecasting because today's commercial space launch market is characterized by a worldwide glut of vehicles and providers. Many factors external to the commercial launch market contributed to this glut, including several satellite program delays and cancellations. However, one external factor precludes a free market adjustment to the number of worldwide space launch providers and implies that overcapacity will not go away. This is the national need for assured access to space. Russia, Ukraine, China, India, Israel, Japan, Europe, and the US will retain their launch vehicles to ensure they have assured access, whether or not these systems are commercially viable. Understanding demand in this market environment is important.

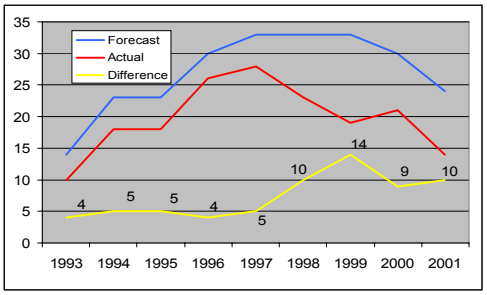

Figure 1. Averaged Forecast vs Actual Launches (GSO)

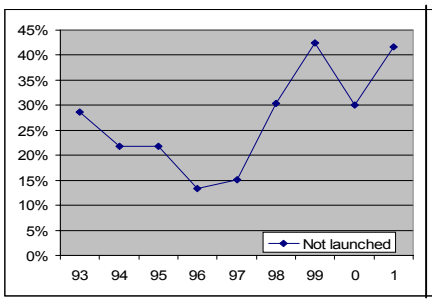

Figure 2. Percentage Difference of Forecast to Actual (GSO)

Figure 1 depicts the difference between the annual forecasted average satellite demand and the actual number of launches occurring each year.[1] In the first five years, the difference between the number of satellites requiring launch and the actual number of launches occurring was between four and five. In the last four years, that difference rose to between 10 and 14. Figure 2 is essentially a barometer of the inaccuracy of the forecasts. The percentage of planned satellites not launched steadily decreased from 1993 to 1996, had a small bump up in 1997, and then doubled to 30% in 1998. This was the largest variance since the first COMSTAC forecast in 1993. From 1998 through 2001, the gap between forecasted and actual launches oscillated between a low of 30% and a high of 42%, at which it now sits.

As we enter the 21st Century, the commercial space launch industry is operating in a market with a staggering oversupply of launch providers and a decreasing launch demand. Figure 3 on the next page illustrates the total capacity of the worldwide inventory of launch vehicles. The COMSTAC forecast is the solid red line across the bottom of the chart. This forecast has not been a reliable measure of actual demand, so we have included the dashed black line to reflect a downward adjustment. The dashed line decrements the forecast by 27%, which is the average annual difference between forecast and actual commercial launches since 1993. We find that only about one quarter of worldwide capacity is needed to satisfy commercial demand[2].

[1] Data are based on the Commercial Space Transportation Advisory Committee's (COMSTAC) annual forecasts for medium and heavier class payloads that began in 1993. Note that the forecasted number of launches of any year is published one year in advance in the annual COMSTAC forecast report.

[2] The capacities illustrated on the chart were derived from the payload planner's guide for each launch system. PII made adjustments based on announced plans for phase in and phase out of the illustrated systems. In some cases, PII also made slight downward adjustments to the capacity of certain systems that had not demonstrated the claimed capability. We note that this technique results in an understatement of capacity for that system. However, if we had used the higher launch rates without adjustment, the overcapacity discussed in this paper would be much worse.

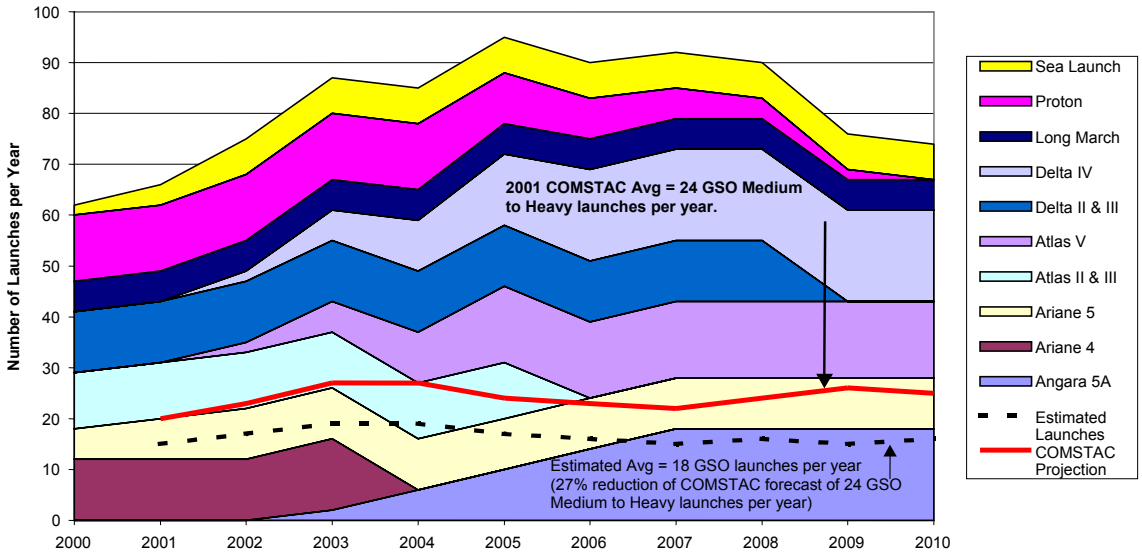

Figure 3. Worldwide Maximum Launch Capacity vs. Launch Demand (Medium to Heavy Launchers)

The Evolved Expendable Launch Vehicle (EELV) was envisioned as the US government's answer to continued access to space at a reduced cost when compared to the costs associated with the heritage fleet of Delta, Atlas and Titan space launch vehicles. However, much of the cost savings analysis was based

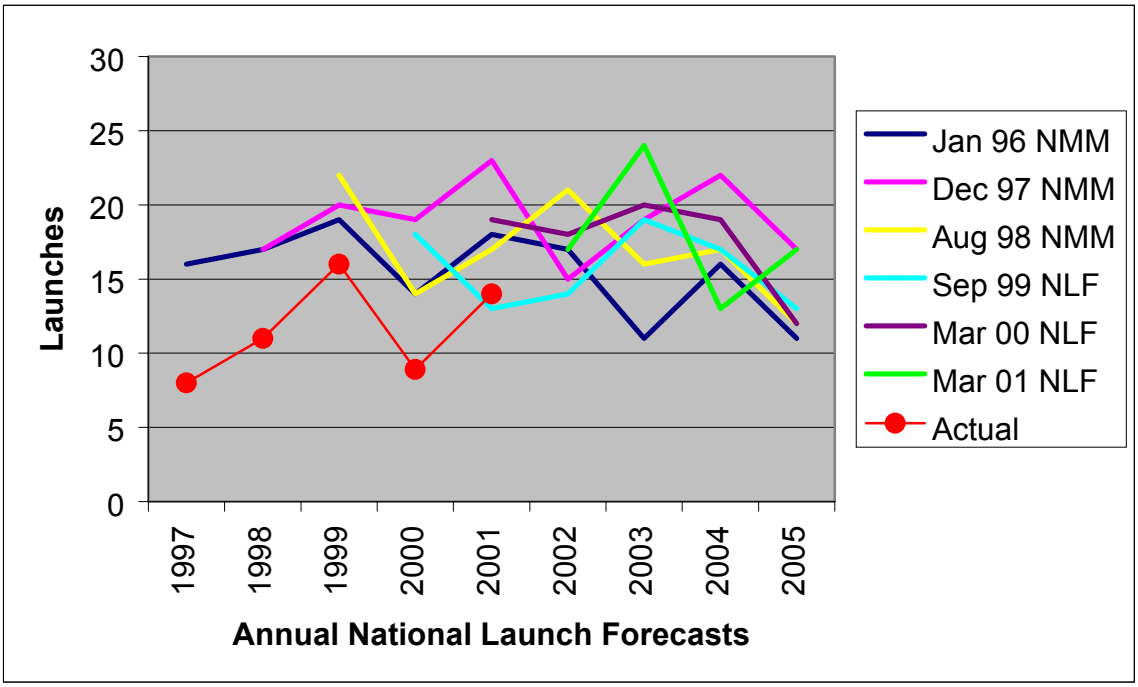

Figure 4. US. Government Forecast vs. Actual Govt Launches (Medium to Heavy GSO)

on optimistic commercial launch forecasts. Initially, the US government assumed there would be only one government supported EELV program. That single EELV program would benefit from a robust commercial satellite market. The thought was that EELV would capture a very large share of worldwide commercial launches, benefiting both commercial and government users with lower prices. After revising its strategy and still believing in the optimistic commercial forecasts, the US government maintained that prices would remain low due to the force of competition between the two EELV families.

Healthy projections for government launch requirements further supported the optimistic price outlook. From Figure 4 it is apparent that the actual number of launches occurring in each year is lower than the number forecasted the year before. On average, the actual number of government launches which have occurred annually is only 60% of the number of launches forecasted for that year. We are not being critical of these forecasts. However, we believe the US government used them as a significant input in its analysis and justification for revising the EELV acquisition strategy. Now there will be two EELV families to support government and commercial needs. However, the unintended consequence was to profoundly contribute to the prevailing worldwide commercial launch overcapacity.

With the increased number of commercial launch service providers and the diminishing number of commercial launch needs, the importance of any single sale is substantially elevated. In fact, we speculate that every sale today has become vital and can cause a commercial launch company to teeter between breaking even or realizing a financial loss for the year. A series of issues compound this grim situation. These include longer than expected operating lives of on-orbit satellites, failure of the satellite constellation market to materialize, and cancellation of or delays in launch of new Government and commercial satellites. Each further reduces launch requirements. Finally, dual manifest capabilities could further aggravate the overcapacity problem. We briefed many of these points in the spring of 2000 in support of the Government's Space Launch Reliability Joint Assessment Team review effort. This paper elaborates our updated analysis and provides a stark discussion of what may come about in the commercial space launch market for medium and heavy class payloads early in this new century.

Discussion

Among the many factors contributing to the currently saturated market were the launch demand forecasts of the mid 90's. Based on the optimistic inputs of satellite companies, these forecasts fueled the reentry of US companies into the space launch arena. Figure 5 depicts COMSTAC's GSO forecast

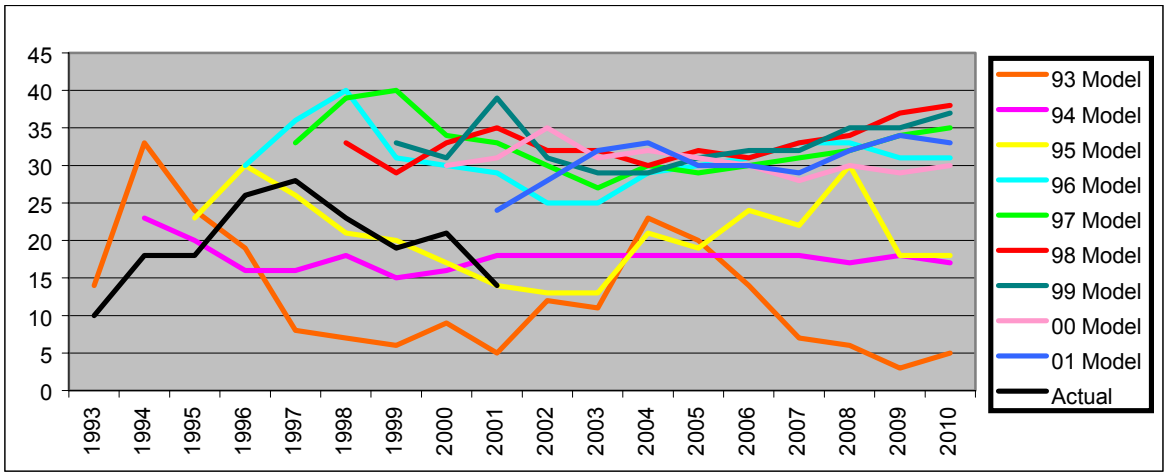

Figure 5. Annual GSO Forecast and Actual Launches

versus actual annual launches. By 1996 a clear trend developed to indicate that the company-input-based COMSTAC annual forecasts portrayed a demand for launches that was greater than could reasonably be expected to materialize. Figure 6 on the following page is a chart from an EELV program office presentation at the 1998 National Space Symposium. It clearly reveals that the program office believed a very healthy commercial satellite industry was about to emerge and dominate the space launch market. It is fair to say this view was widely shared worldwide. With a promising commercial space launch outlook, the program office apparently assumed the revised strategy would not significantly detract from either of the two EELV providers' business base or plans. Its apparent view was that adding a second provider would increase commercial competition. Logically, the government would benefit from the

competition generated between the two US launch providers for government satellites, which are required by US policy to launch on US launch systems. The revised strategy also derived another benefit by establishing and maintaining an alternate US launch system. In the event one of the two EELV families suffered a stand down, the Government would be able to swiftly transfer that family's assigned missions to the other EELV family. This is possible because these satellites must be built to the EELV common interface specification. Unfortunately, as the EELV inaugural launches approach, the robust commercial satellite industry that the world foresaw has failed to materialize. The launch decline continues and makes sustaining two providers more difficult.

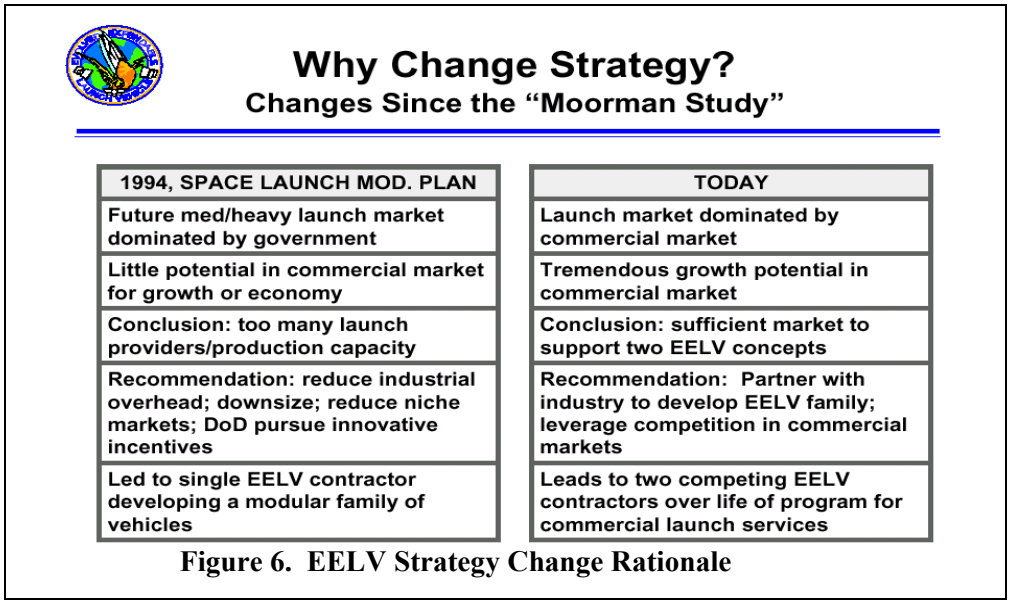

Figure 6. EELV Strategy Change Rationale

Following US government and commercial launch failures between August 1998 and May 1999, enormous concern arose over US access to space from all levels of government. In response to presidential and congressional direction, the Secretary of the Air Force and Chief of Staff of the Air Force ordered an independent Broad Area Review (BAR) of space launch. A major element of the review was a fresh evaluation of the future of the commercial satellite market. Figure 7 contrasts the optimistic

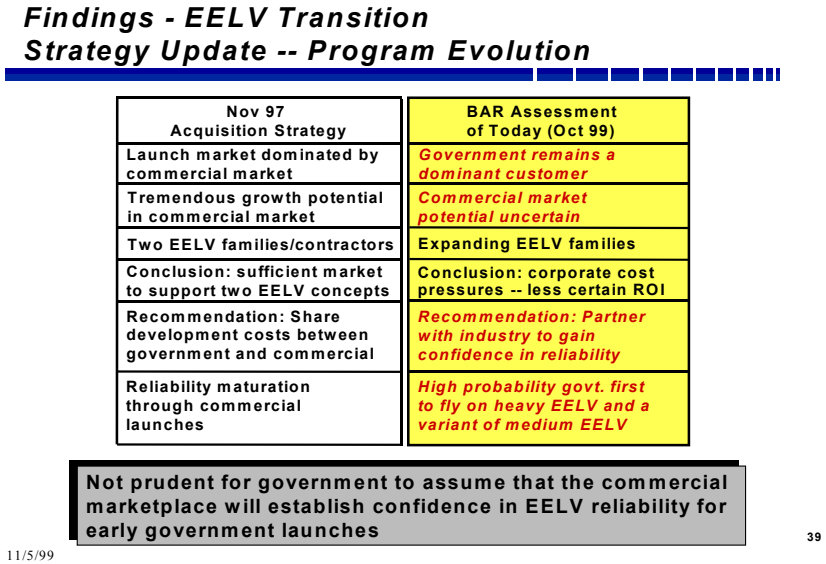

Figure 7. 1999 BAR Recognizes Market Downsize

November 1997 beliefs against the October 1999 BAR assessment. Barely two years after predicting a robust commercial satellite demand, the BAR found the environment very different. The vision had deteriorated from one of a robust market with tremendous growth potential that would fly several commercial missions before the first government payload and would sustain two EELV programs. Instead, the BAR believed government missions would dominate early launches and then would continue to dominate EELV. Therefore, they said a poor business case would place a heavy burden on corporations and recommended government partnerships with industry to increase EELV reliability for early flights. We take this last finding of the BAR to mean Government funding of the EELV programs was needed and would continue beyond the completed development programs and introduction of the operational vehicles.

Since the 1999 Broad Area Review, conditions have not improved in the space launch arena. What then might we expect to be the character of the medium and heavier US commercial space launch industry in the EELV era? Figure 8 begins the discussion of a vision for the foreseeable future. The figure contains a line for a total EELV capacity of 24 launches a year, and a capacity line of 12, which will be used as the operating capacity for either the Boeing Delta IV or the Lockheed Martin Atlas V[3]. The pink line in the top half of the chart is the 2001 COMSTAC forecast adjusted downward by 27% (the average historical percentage difference between COMSTAC forecasted and actual launches). From this decremented COMSTAC line, which we believe more closely approximates the addressable commercial launch market, we develop three lines depicting assumed US commercial market captures of 20, 30 and

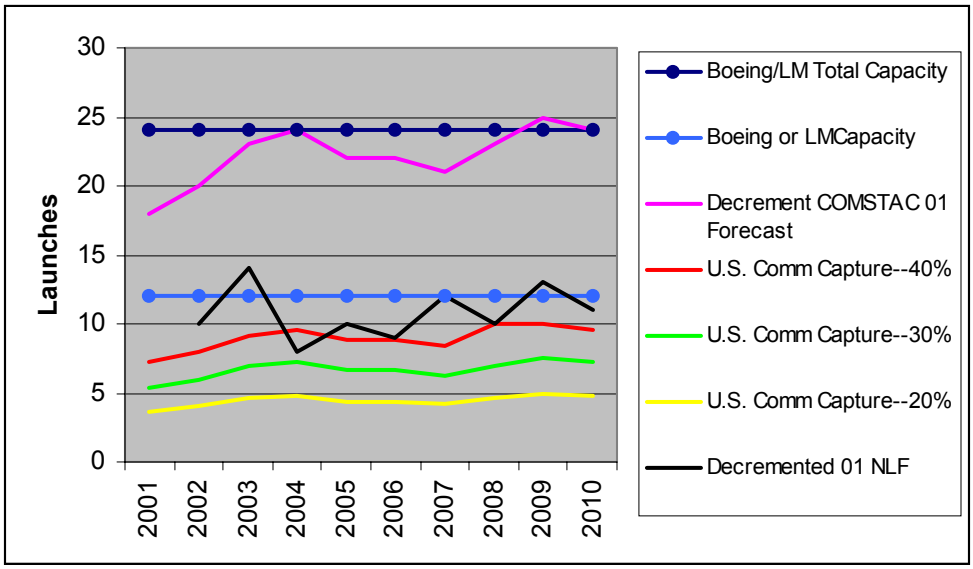

Figure 8. US Medium and Heavy Government vs US Capture of Commercial Launches

40%. Last, we include a black line, which is from the December 2001 National Launch Forecast (NLF) adjusted downward by 40% (the average percentage difference between government forecasts and actual launches for the years 1993-2001[4].

[3]A Boeing press release dated 27 July 1998 states that 12 per year is the maximum single pad launch capacity. This paper does not consider the west coast Delta IV pad in the capacity analysis, but that would just make the overcapacity situation much worse. At its 2002 user's conference, Lockheed Martin claimed a capacity to launch 12 per year from Cape Canaveral, although they decremented that to 8 per year until they demonstrate a higher number. The remainder is for surge. Using the higher number would also make the overcapacity situation much worse.

[4] PII reviewed National Mission Models and National Launch Forecasts provided by Air Force Space Command for the years 1993-2001. A comparison to the number of actual launches conducted in each of those years results in the 40% average per year decrement used in this paper.

The first observation is that US government launch demand still dominates the space launch market for the two EELV launch companies. We can see that except for minor variances in 2003 and 2009, either Boeing or Lockheed Martin could fully satisfy this separate segment of launch demand, which could be covered most likely by surge. If we consider just the commercial market at the assumed capture rates shown, it can be been seen that either Boeing or Lockheed Martin by themselves has the full capacity to launch more than the most aggressive capture rates we postulated.

Figure 9 combines the decremented commercial and US government demand forecasts shown in Figure 8. The blue line depicts the operational capacity of either Boeing's or Lockheed Martin's EELV system. The other three lines represent one EELV contractor's share of government and commercial launches. To get the three lines, we added the decremented NLF forecast plus 20, 30, and 40% of the decremented COMSTAC forecast, respectively. We assume each contractor will get an equal share of the resulting totals, so we divide by two. Each line represents the likely total launches for either of the EELV contractors under varying degrees of successful market capture. We expect that it will take a few years before either EELV is operating at full capacity, which is why these lines start in 2005.

We conclude from Figure 9 that by 2005 with a 50/50 split in US government and the postulated degrees of commercial capture, both contractors will operate below capacity with a level of reserve that is

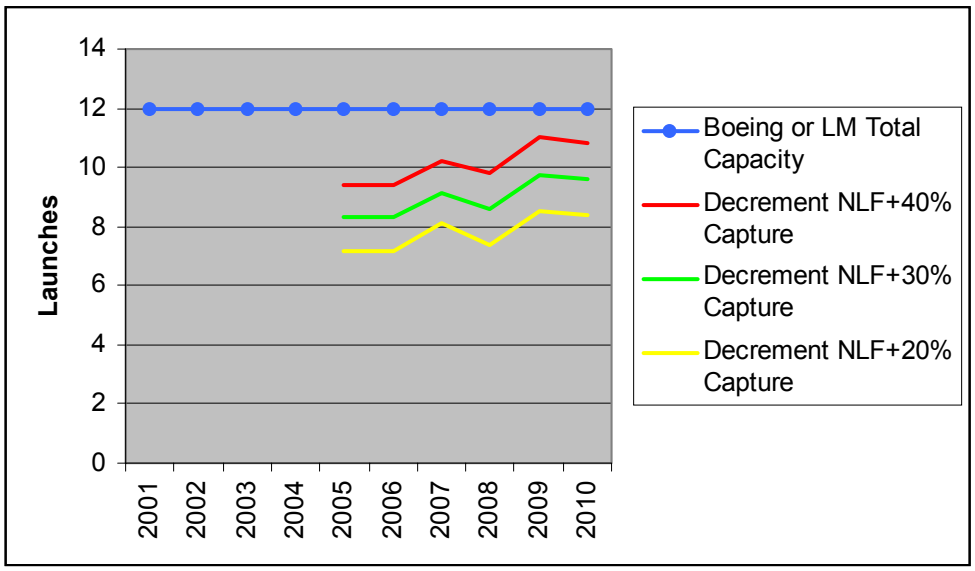

Figure 9. 50/50 Split of USG Requirements and Commercial Capture

based on the success of their commercial programs. This reserve is available to address a surge in government requirements or to aggressively pursue additional commercial sales. The reserve can also be used to launch scheduled missions if there is better fidelity in the future between forecasts and actual need. The other point to be drawn is that the USG requirements provide a very important anchor business base for both contractors. It is noteworthy that the total capacity of the two EELV contractors at 24 launches per year exceeds government requirements in most years by more than 200%.

Followers of the EELV program would be quick point out that there is not a 50/50 split between Boeing and Lockheed Martin in the Initial Launch Services contract. They might also point out that Lockheed Martin is no longer required to provide a west coast or a heavy lift EELV. Boeing will launch all west coast launches and heavy class payloads because they are the only launch provider with this capability. In the past, we analyzed the uneven split of government requirements. We hypothesized that for a year in which the government had a need for 12 launches that the difference between awarding a 50-50 split and a 67-33 split changed the business case for that year from six to each contractor to eight and four. In a vibrant commercial market, that was a recoverable event. In the poor commercial climate we are experiencing today, recovery from such an award must be much more difficult. Over time, this imbalance could result in the exit of one of the EELV contractors unless the government took

extraordinary measures to migrate to a more evenly split award or added significant money to the EELV contracts.

We believe that at least in the near term, the government is committed to a two EELV family strategy and that if the commercial market environment persists over time, more evenly split launch awards could be expected. In fact, a recent Wall Street Journal article reported that the government is prepared to provide aid packages to the EELV contractors and is looking for ways to provide earlier government launch requirements to Lockheed Martin and additional money to both contractors[5]. This provides strong evidence that the government is prepared to intervene to ensure each EELV contractor is sustained as a capable launch provider. With further government assistance to ensure both contractors remain viable and capable, and barring any significant technical difficulties or early catastrophic failures, it is reasonable to expect both companies to remain credible competitors within the bulge of commercial launch operators. Further, if the government elects to relieve the EELV contractors from a "most favored customer" clause in their contracts, each could sustain themselves with the government business bases, and would likely offer early attractive low entry prices to entice commercial sales.

It would be naïve to fail to recognize the importance of the difference in program risk in the Delta IV and Atlas V programs. Unlike the Atlas V, which uses a flight proven Russian engine and has also qualified many subsystems on the Atlas III, Boeing's Delta IV remains fully unproven in flight. Certainly, an early Delta IV program failure would result in a major financial drain and would probably result in the Government implementing its strategy to use the competing EELV as a back up. Interestingly, this would mean that the US government would find itself in the awkward position of relying on a foreign source for the main propulsion system of its only operational EELV.[6] The Space Launch Broad Area Review recommended that the US government partner with industry to ensure that success of the EELV programs was a "do or die" edict. If the government and industry have followed through on the relevant BAR recommended actions, then we believe the EELV programs may experience some start-up transients, but both have a very good chance of success.

Summary

The programmatic foundations for the optimistic technical and competitive outlook for the EELV systems have not materialized. The commercial launch business began again in earnest in the US after the Space Shuttle Challenger accident in 1986 caused a major revision to US space launch policy. US industrial ventures into commercial space launch and then the EELV program's strategy revisions to develop two viable launch provider sources were all based on robust launch demand forecasts that do not exist today. Out of the combined US government and industry review of the string of successive US space launch failures in the late 90's, the Government and industry agreed to jointly undertake additional measures to ensure mission success of the EELV systems. However, neither EELV has flown and perceived risks have resulted in an intensified USG sensitivity for mission success.

This means that for the first few years of EELV operations the US government and industry will focus on detecting and preventing early problems and demonstrating reliable performance. Assuming successful EELV launches, the companies should have established confidence in their launch programs by 2005. By that time, better predictive and analytical means may come about to forecast launch demand. Hopefully a more realistic characterization of commercial launch opportunities will exist. With the unique advantage of being the sole sources for the US government anchor business, we believe both EELV contractors could well become formidable international competitors who could dominate the international space launch market.

[5] "Boeing, Lockheed seeking aid for rocket programs", WSJ, 1./25/02

[6] To date, the contractually required US production line for the RD-180 engine is not operational.

Contributing Editors

Sidney Kimhan, Vice President, Programs and Operations, Practical Innovations International, Inc.
Rick Manley, MAMCO Associates
Jimmey Morrell, Maj. Gen., USAF (Ret), advisor
Ryan Morrell, MAMCO Associates
Barry Zilin, President and CEO, Practical Innovations International, Inc.