International Partnerships in the Commercial Space Launch Industry

INTRODUCTION

International partnerships are hardly a new concept in space activities: national governments and space agencies have been collaborating since the early years of the Space Age on projects such as scientific satellites and human space flight missions. National space agencies recognized that cooperation across borders presented challenges but afforded them the opportunity to achieve common goals and complete ambitious projects by sharing costs, risk, infrastructure, and expertise.

While governments undertook the earliest international collaboration projects in space, today increasing numbers of international partnerships involve one or more commercial players and focus on the business of space transportation. Indeed, like other modern, technology-based businesses, private launch-related companies operate in the global economy and have come to recognize the advantages of forging strategic alliances, regardless of the partner's location in the world.

This report explores the range of launch-related international partnerships involving private companies that exists today in an effort to understand the nature of these partnerships, the reasons for their emergence, and the impact they may have on the launch industry as well as the customers they serve. In this report, the term "partnership" refers to a contract between at least two entities in which each entity offers a product, service, or capability of value to the other or makes a contribution toward a common effort in an attempt to improve the economic condition of all entities involved. Partnerships, as discussed herein, are not simply payments of money for purchase or lease of goods or services, even as stipulated within a launch services contract. They also exclude mergers and acquisitions of companies and international launch trade agreements.

All of the partnerships considered herein have launch activity as a central focus, involve at least one purely commercial entity, and encompass players from at least two different nations.[1] This report also addresses only partnerships that have actually been enacted; agreements under discussion are not covered here. This report does not attempt to address every launch-related partnership that has ever existed.

As the next sections show, international partnerships in the launch business have proliferated in recent years. Involving combinations of launch vehicle and component manufacturers, launch service marketers, spaceport developers, satellite operators, and governments, today's launch-related alliances have been formed, most fundamentally, to improve the local and global business prospects of those involved. These partnerships fall into three major

[1] This report does not describe or analyze intra-European launch-related consortia such as Arianespace or the European Aeronautic Defense and Space Company (EADS) because, from the European perspective, these are enterprises of a single, solidified Europe.

categories of launch interest: technology, marketing, and customer relations. *Technology partnerships* encompass relationships formed to produce or assemble launch vehicles and their components as well as launch equipment and facilities. *Marketing partnerships* are relationships designed to expand the reach of various launch vehicles to global markets. *Provider/customer partnerships* involve the teaming of launch service providers with companies who use their launch services in various efforts to bring mutual benefits to themselves and their customers. While some partnerships span more than one category, the enterprises discussed here are listed according to their primary activities.

TECHNOLOGY PARTNERSHIPS

Sea Launch Company

Founded in 1995, the Sea Launch Company is the result of a meeting of minds and resources of companies from four nations. During the early 1990s, the Russian company NPO Energia met with the Boeing Commercial Space Company to discuss Russian design ideas for a sea-based space launch system. The launch-at-sea concept Energia proposed involved the use of Energia M, a launch vehicle design the company desired to promote; Boeing, for its part, had not yet acquired McDonnell Douglas and the Delta launch vehicle but was interested in entering the launch business. Recognizing the many advantages such a system could offer in the launch market, Energia and Boeing, along with SDO Yuzhnoye of Ukraine and Kvaerner of Norway, signed an agreement to form the joint venture Sea Launch. Today, Boeing owns 40 percent of Sea Launch, while Rocket Space Corporation (RSC) Energia owns 25 percent; the Anglo-Norwegian Kvaerner Group, 20 percent; and SDO Yuzhnoye/POYuzhmash, 15 percent.

Sea Launch offers satellite customers heavy-lift launch services (up to 5,700 kilograms to geosynchronous transfer orbit [GTO]), with launches taking place from a platform positioned on the equator in the Pacific Ocean. Instead of using the proposed Energia M vehicle, Sea Launch uses the Zenit 3SL—a model of the Ukrainian Zenit launch vehicle developed for Sea Launch. Launching from the equator enables the Zenit to travel the most direct route possible to GTO and thus maximize the payload mass it can carry there.

All partners in Sea Launch provide hardware and services to make the enterprise a reality. SDO Yuzhnoye/PO Yuzhmash provide the first and second stages of the Zenit 3SL vehicle as well as launch support operations. RSC Energia produces the vehicle's upper stage (the Block DM-SL), integrates the vehicle, and conducts mission operations. The Boeing Commercial Space Company manufactures the payload fairing and performs spacecraft integration and mission operations. The Kvaerner Group provides and operates the launch platform and assembly and command ship.

The first privately financed, working launch system and infrastructure, Sea Launch has completed six successful launches and has sold 19 launches to date.

Aerojet/Kuznetsov

Sacramento-based Aerojet and the Russian design bureau Kuznetsov formed an alliance in 1996 to produce and sell liquid oxygen/kerosene NK-33 engines in the United States. An improved version of the engine designed by Kuznetsov for use in Russia's N1 lunar rocket program, the NK-33 itself actually never flew due to the N1 program's cancellation in 1974. However, several hundred NK-33s were manufactured and 70 NK-33s remained stored in Russia.

When the U.S. Air Force announced the Evolved Expendable Launch Vehicle (EELV) program, Aerojet recognized an opportunity to be a major supplier of engines for the new vehicle: if it could secure the rights to NK-33, it could take advantage of the engine's desirable features without expending resources and time developing a new product. Kuznetsov, on the other hand, could sell the warehoused NK-33s while potentially reopening a production line that otherwise had no future. Under the agreement Aerojet and Kuznetsov reached, Kuznetsov is supplying the engine's design and engineering expertise while Aerojet is providing a manufacturing facility and has purchased 70 NK-33s. Aerojet has also acquired intellectual property data and holds rights to build NK-33s in the United States after the existing supply runs out.

While NK-33 engines were not selected for use in the EELV program, Seattle-based Kistler Aerospace Corporation has taken interest in using NK-33s in its K-1 reusable launch vehicle. Kistler has negotiated with Aerojet for exclusive rights for 58 of the 70 total NK-33s constructed, paying $4 million per engine. In addition, the Japanese space agency NASDA granted Aerojet a contract in March 2001 to design an engine based on the NK-33 for its new J1-U launch vehicle.

RD AMROSS

In 1997, Florida-based Pratt & Whitney and NPO Energomash of Russia established the RD AMROSS LLC joint venture to produce the Russian RD-180 engine for the American market. Having partnered to sell other engine models, Pratt & Whitney and Energomash came together again to attempt to meet Lockheed Martin's need for a new engine for its Atlas 3 and 5 vehicles with the RD-180 engine, then under development. Lockheed Martin selected the RD-180 as the first stage engine for its new Atlas models. Government policy, however, required that Lockheed Martin demonstrate the ability to manufacture RD-180s in the United States in order to avoid dependence on Russia to launch national security payloads. Therefore, under the RD AMROSS partnership, Energomash will produce 101 RD-180 engines for the Atlas 3 and commercial launches on Atlas 5 at its Khimky plant in Russia, while Pratt & Whitney will build some two dozen more RD-180s in Florida to launch government payloads. Pratt & Whitney also contributed $25 million to Energomash for upgrades at the Khimky plant. The two companies are 50-50 partners in the joint venture.

Production of RD-180 in the United States was expected to begin in 2005, but technology control issues and changes in Lockheed Martin's production plans have pushed back the

start of domestic production to 2008 at the earliest.

Asia Pacific Space Centre

The most recent of a series of Australian spaceport development concepts, the Australian-based Asia Pacific Space Centre's (APSC) plan is to establish a spaceport on Christmas Island, Australia, and develop a commercial space launch service using Russia's new Aurora launch vehicle design. A private company with investors in Australia, South Korea, and the United States, APSC intends to market the vehicle (capable of carrying 4,100 kilograms to GTO) to commercial payload operators.

APSC has entered into agreements with several Russian organizations, all of whom benefit from securing the use of this favorable launch site. Under the plan, APSC will construct and operate the launch site and market the Aurora vehicle. The Russian Space Agency, Rosaviakosmos, will act as the project's prime contractor and chief coordinator for the Russian companies involved. The Russian Samara Space Center (TsSKB-Progress) will provide the Aurora's first and second stages and fairing while RSC Energia will provide the third and fourth stages. The Russia Design Bureau of General Machine Building (KBOM) will contribute to the facility's launch infrastructure.

Although not technically a partner, the Australian government is heavily supporting this venture. Viewing the space launch industry as a provider of national revenues and jobs, the Australian government has given APSC "Major Project Facilitation" status, which ensures that all government approval processes related to the project are facilitated in a timely manner. The government also plans to support the effort by upgrading Christmas Island's airport, constructing a new port and road, and aiding the development of spaceport infrastructure. Australian and Russian officials signed a cooperative pact in May allowing Russian rockets to be launched from the Christmas Island site as well as from Woomera Rocket Range in central Australia.

APSC's Christmas Island office is responsible for design and construction of the spaceport, while a U.S. office is focused on marketing the spaceport and the Aurora. APSC expects construction of the spaceport to begin in September 2001, with the first launch slated for late 2003.

SpaceLift Australia

Founded in 1999, SpaceLift Australia is a private, Adelaide-based company working with two Russian organizations, the Scientific and Technical Center Complex and Puskovye Uslugi, to develop commercial space launch operations from Woomera. SpaceLift Australia intends to provide the launch site and vehicle marketing services while the Russian partners will provide turn-key Start launch vehicles that will be capable of making flights to low-Earth orbit (LEO). Like APSC, SpaceLift Australia has also received "Major Project Facilitation" from the Australian government.

Kistler/Australia

Kistler Aerospace Corporation and the Commonwealth of Australia have teamed to develop and re-open

Woomera Rocket Range to bring commercial launch activity to central Australia. Under this arrangement, the Australian government has offered Kistler the opportunity to develop the Woomera site for the launch of its K-1 reusable launch vehicle. Australia has also supported the development of commercial launch activity by establishing a legal framework allowing such operations to occur within its borders. Kistler will provide the K-1 vehicle to launch at the site and fund site development, using infrastructure leftover from the former Woomera launch range. The Australian government will also contribute to developing launch facilities for the K-1. Australia hopes the venture will generate revenues and jobs for the nation, while Kistler benefits from having secured a remote launch site for its reusable vehicle in a nation with an appropriate legal regime.

Ground breaking of the Kistler launch site took place in July 1998. Fundraising delays, however, have delayed Kistler's ability to complete construction of the site as well as the vehicle.

MARKETING PARTNERSHIPS

Eurockot

Marketing the Russian Rockot vehicle is the objective of the German-Russian Eurockot partnership. In 1995, three years after the Russians proposed the development of a vehicle using the SS-19 ICBM plus an additional third stage based on Soviet military hardware, Eurockot was founded when Germany's Minister of Economics agreed to allow Russia to repay part of its debt to Germany through profits earned by launches of this new vehicle. According to the agreement reached, Germany would receive a predetermined payment following each Rockot launch sale, which would be deducted from Russia's $35.5 billion debt to Germany. Each launch should help pay down Russia's debt to Germany while also ensuring the flow of hard currency to Russia.

Arranged between governments, Eurockot is presently a 51-49 percent partnership between DaimlerChrysler Aerospace (DASA) of Germany and Khrunichev State Research and Production Center of Russia, respectively. DASA provides marketing and technical management of the Rockot program, while also contributing funding for development, production, and launch facilities. Khrunichev manufactures the Rockot vehicle hardware and will perform mission analysis, payload integration, and mission control and launch operations.

The Rockot is a small vehicle, capable of lifting 1,860 kilograms to LEO from either the Baikonur Cosmodrome in Kazakhstan or Plesetsk in Russia. Eurockot is marketing the vehicle to both commercial and government entities. A successful demonstration flight took place in May 2000. Rockot's first commercial launch is scheduled for late 2001.

International Launch Services

In 1992, Lockheed and Khrunichev formed a commercial joint venture to market Russia's Proton launch vehicle outside of Russia. The following year, the partnership expanded to include Energia, the supplier of Proton's Block-

DM upper stage, and became Lockheed-Khrunichev-Energia International (LKEI). In June 1995, Lockheed merged with Martin Marietta, who was then producing and marketing the Atlas launch vehicle in the West, to form Lockheed Martin. Realizing that the Lockheed Martin Atlas and LKEI's Proton would become competitors for the same customers, the two companies created a new joint venture to market both launch vehicles. The new venture, International Launch Services (ILS), is a 50-50 partnership between LKEI and Lockheed Martin Commercial Launch Services.

Under this arrangement, Lockheed Martin wholly produces the Atlas launch vehicle, an intermediate booster capable of lifting 8,860 kilograms to LEO and 3,600 kilograms to GTO (the new Atlas 5 will be able to achieve much greater performance). Khrunichev produces the Proton vehicle, with Energia building the Block DM fourth stage for the Proton K. The largest Russian vehicle in service, the Proton can launch 20,900 kilograms to LEO and 5,500 kilograms to GTO. Lockheed Martin Commercial Launch Services provides marketing and mission management for the Atlas while LKEI provides the same for commercial Proton launches.

ILS is targeting the global telecommunications satellite market and intends to serve commercial operators as well as governments. The partnership combines the experience of more than 800 launches of two mature space launch systems. ILS is currently in the process of developing a system by which payloads scheduled for one of the vehicle models could be moved to the other in case of schedule delays. While the payload/vehicle interfaces for this type of back-up system are not yet in place, the ILS partnership can still provide greater flexibility for customers.

In 1999, ILS also received exclusive marketing rights to the new Angara family of launch vehicles currently under development at Khrunichev. ILS paid a "franchise fee" to Khrunichev for marketing rights. Lockheed Martin, in exchange, will receive a commission on the sale of each Angara vehicle.

LeoLink

Israel Aircraft Industries (IAI) and Coleman Aerospace (a division of Coleman Research Corporation) partnered in 1998 to bring the Shavit family of launch vehicles to the United States and market it here as LeoLink (LK). Capable of placing 200 kilograms into LEO, the LK-1 is a Shavit vehicle that will use a solid propellant motor for its first and second stages and a Star third stage motor, all built by Cordant Technologies (formerly Thiokol). The Shavit was modified in this way to market the vehicle in the United States, where Government payloads may only be launched on vehicles that are at least 51 percent comprised of American-made components. NASA approved the LK-1 for procurement under the agency's Small Expendable Launch Vehicle Services multi-launch procurement.

LeoLink plans to launch its first LK-A vehicle from Israel in late 2001, carrying the Ofeq 5 observation satellite. The first commercial flight of the LK-A is scheduled to launch an unidentified commercial payload from Alcantara, Brazil, in late 2002.

Starsem

During the mid-1990s, four organizations from France and Russia came together to bring to the commercial market various Russian spacecraft including Earth-observation satellites and launchers. Today, the consortium, called Starsem, focuses exclusively on marketing the highly reliable Russian Soyuz booster to both commercial and government entities desiring to launch satellites to LEO.

Partners in France-based Starsem include the European Aeronautic Defense and Space Company (EADS, originally Aerospatiale) with 35 percent ownership); Arianespace, 15 percent; Rosaviakosmos, 25 percent; and Russia's TsSKB-Progress, 25 percent. While the Russian entities produce the Soyuz vehicle and their engines, all four partners fund work to modernize Soyuz and upgrade the Soyuz's Baikonur Cosmodrome launch site in Kazakhstan. Involvement in the consortium offers the Russian partners access to Western customers while giving Europe a foothold in the LEO launch market without the need to develop a new vehicle.

Soyuz vehicles currently launch exclusively from Baikonur. Russian officials, however, have been in negotiations with the European Space Agency (ESA) about launching Soyuz from the ESA-owned Guiana Space Center.

PROVIDER/CUSTOMER PARTNERSHIPS

Boeing/Alenia Spazio

Boeing Space & Communications of Seal Beach, California, and Alenia Spazio of Rome formed an innovative partnership in March 2001. Boeing has agreed to purchase Alenia-built fuel tanks at "better than standard" prices for use in all five variants of its Delta 2 launchers. In exchange, Alenia Spazio will be able to purchase launch services on any Delta vehicle for its satellite customers at "better than standard" prices. This arrangement saves Boeing the time and expense of developing its own fuel tanks while allowing Alenia Spazio to receive launch services at discounted prices. Boeing expects to take delivery of the first group of tanks by the end of 2001.

Boeing/Mitsubishi

In June 2001, Boeing and the Mitsubishi Electric Corporation signed an agreement to formalize and expand the cooperation between the two companies in areas including launch services as well as space-based communications, air traffic management, multimedia, space infrastructure markets, and navigation. The agreement includes up to six Boeing Delta launches for Mitsubishi payloads (one firm Delta 4 launch and options for five other Delta launches) and names Boeing's Delta Launch Services as Mitsubishi's preferred non-Japanese launch provider. The arrangement will also allow Boeing to access the market for satellite construction in Asia. In return, Mitsubishi hopes to improve its ability to attract customers in the region by taking advantage of Boeing's

experience building and selling satellites. Subject to both companies' approval, the agreement is expected to be finalized before the end of 2001.

Previously, in February 2000, Boeing's Rocketdyne Propulsion and Power business and Mitsubishi Heavy Industries announced that they had teamed to develop a liquid oxygen/liquid hydrogen upper-stage engine for next-generation expendable launch vehicles.

AO Polyot/Final Analysis

In 1995, Final Analysis and AO Polyot, the Russian manufacturer of the Cosmos launch vehicle, created a partnership whereby Polyot would launch Final Analysis' FAISAT satellites aboard Cosmos vehicles and in exchange would market Final Analysis' satellite communications services in Russia. Final Analysis entered the agreement because of the Cosmos vehicle's affordability, reliability, and small size. With this agreement, Final Analysis became the first American company to launch a commercial payload, FAISAT 1, on a Russian rocket from Russia. As a result of FAISAT launch contract renegotiation during the 1998 Russian consolidation of commercial launch services using Cosmos and Start vehicles, FAISAT launches were captured by Russia's State Company Rosvooruzhenie.

Various: equity investments

Several launch providers have partnered with satellite customers in arrangements whereby the launch providers agree to invest in the satellite companies in exchange for their launch business. Such partnerships yield launch sales and potential returns on equity investment in the satellite systems for the launch providers while enabling the satellite companies to finance their ventures. Recently formed partnerships involving a launch provider acquiring an equity share in a satellite system include deals between Starsem and satellite broadband service provider SkyBridge; Boeing and global mobile satellite communications system company Ellipso; Arianespace and Ellipso; and Arianespace and the European space company Astrium.

CONCLUSIONS

The past few years have witnessed the formation of numerous international partnerships designed to strengthen and fulfill commercial and national business interests in space transportation activity. Comprised of innovative ideas to develop launch hardware and infrastructure, market vehicles, and attract customers, today's launch-related partnerships involve a range of players with space interests. They include not only companies but also governments. Some of the entities hail from nations with a long history of space launch capability: Russia's design bureaus, in particular, have become heavily involved in partnerships with foreign entities to sell their excess supplies of boosters for much-needed cash. Today's partnerships also include companies from countries such as Australia and Israel as well as start-up satellite companies that hope partnering with more mature players will help them gain a prominent place in the space launch industry. These partnerships exist despite the political risks, cultural differences, and conflicting priorities that could potentially hinder them.

In a business environment where launcher supply outstrips demand, launches are costly, and world markets are freer than they were a decade ago, the recent flurry of international partnerships in launch enterprises makes sense. Pooling resources—hardware, facilities, land, knowledge, marketing capabilities, and funds—enables the contributing partners to pursue business opportunities that would be too costly or risky for an individual entity to undertake. Joint efforts can also prove more efficient for partners, sparing them from having to develop, for example, designs, processes, or facilities in order to access a particular opportunity or market. The companies involved in these partnerships have also begun to engage in strategic alliances with long-time competitors in an effort to avoid preemption and instead leverage their strengths. Special arrangements between launch providers and their customers can encourage the customers to continue to patronize them. With launch capability and facilities so rare in the world, companies have often had little place other than foreign countries to seek partners.

There are still other reasons why companies have specifically pursued international alliances in the launch industry. Many companies have entered into international launch marketing partnerships as a means to gain access to new, foreign launch markets. Physical geography has also fostered international partnerships, bringing together launch vehicle manufacturers with nations or companies from nations that have land or facilities available and are situated in locations advantageous for launch. National governments have teamed with foreign-based companies in the area of launch to develop or improve their own space capabilities, generate revenues and jobs, repay outstanding debts and strengthen international relations. Governments and companies alike see merit in international partnerships as means to foster long-term relationships in the interest of cooperating on aerospace projects in the future.

In addition to benefiting the involved launch companies, the new wave of international partnerships in launch also has the potential to positively impact the commercial and government satellite owners and operators that depend on launch services. As already noted, those satellite companies involved in partnerships will enjoy discounted launches of their payloads as well as investment in and marketing of their satellite systems and services. But all satellite customers may benefit from the back-up launch arrangements toward which some launch providers are moving via partnerships. The partnering of several Russian launch vehicle manufacturers with Western entities in marketing arrangements and emergence of several spaceport partnerships will offer satellite operators more choices of launch vehicles and launch sites. As launch options grow, competition for satellite customers will increase, potentially driving down launch prices.

If the launch business environment remains unchanged and the launch industry continues to evolve in this way, it may be possible that within a few years an American launch vehicle with Russian engines will be launching a Japanese payload from a launch site in Australia. Over time, the benefits and implications of international partnerships will become understood more fully.