World Commercial Space Projects

Present and Future Activities

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A **sampling** of commercial space projects outside of the USA.

Some are "NewSpace" involving advanced technologies.

Others are using more traditional means.

Europe *activity '09-present*

- **Excalibur Almaz** – Isle of Man
  - Build a space transport and habitat business based on the Russian Almaz system.
  - Includes reusable re-entry capsule and a habitat module for in-space operations.
  - Opened up to the public in summer 2009.
  - "raised 'tens of millions of dollars' to initiate what will become a several hundred million dollar program"
  - "EA intends to begin flight tests of the Almaz hardware by 2012 and to launch its first revenue flight as early as 2013."
  - Leadership includes Art Dula & Leroy Chaio.
  - Involved in Sea Launch refinancing.

Europe *activity '09-Present*

- **Sea Launch**
  - Russian, Ukrainian, American and Norwegian joint venture
  - Zenits launched from off-shore platform and land (Baikonur)
  - Zenits powerful enough to launch space stations
  - Bankrupt 2009 – 10 years, no profit
  - Space Launch Services – Excalibur Almaz and Heinlein Prize Trust

Kazakhstan *activity '10*

- **Land Launch**
  - Sea Launch subsidiary at Baikonur
  - 2- and 3-stage Zenits
  - $100 million investment
  - 33 percent share
  - Infrastructure investments
- **Kosmotras**
  - Russian-Ukrainian venture at Baikonur
  - Dnepr (SS-18 Satan ICBMs)
  - Satellite launches
  - 33 percent share

Russia *activity '09-present*

- **Vostochny Spaceport**
  - Far Eastern Amur Region
  - $14 billion
  - First launch in 2015
- **Angara Rocket**
  - Khrunichev built
  - Funded by South Koreans (1st stage KSLV-1) and France (2nd stage - Soyuz)
  - Payloads to LEO range from 2 – 40 tons
  - First launch in 2012
- **Soyuz Replacement**
  - 6 person crew
  - LEO, lunar and beyond
  - First human launch in 2017

Russia *activity '09-present*

- **NASA COTS Program**
  - Taurus II first stage engine
  - NK33 – N1 moon rocket
  - Aerojet purchased 40 engines – 40 more in storage in Russia
  - Restart assembly line
  - Taurus II segments sourced in Russia, Ukraine, Italy and U.S.
- **NASA Commercial Crew Program**
  - RD-180 engine
  - First stage of Atlas V
  - NASA Capsule, Bigelow, Dream Chaser

Russia *activity '09-present*

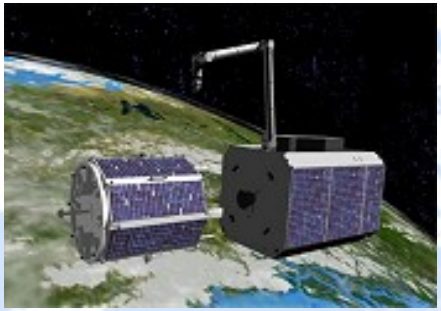
- **Soyuz transport to ISS –** Roscosmos + Space Adventures
  - 2 "spaceflight participants" taken to ISS in 2009 – Charles Simonyi (2nd flight) & Guy Laliberté.
  - No private passengers until at least 2012 due to ISS crew requirements.

- **TAKS-55-5 Aerospace System** - Myasishchev Design Bureau
  - Space Adventures announced project in 2006 but no follow through.
  - Recent Russia Today article says they need $200M to create 1 pilot, 2 passenger vehicle.

Ukraine *activity '09-present*

- **Zenit Launchers**
  - Sea Launch and Land Launch
  - Kazakhstan investment
- **Dnepr (SS-18 Satan ICBMs)**
  - Kazakhstan investment
- **NASA COTS**
  - Taurus II first-stage fuel tank
- **Cyclone-4**
  - Brazil Alcântara Launch Center
  - Late 2010

Europe *activity '09-present*



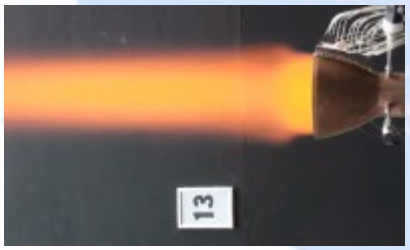
- **OHB/DLR – Germany**
  - In-orbit servicing and de-orbiting demo project.
  - Separate servicing and target spacecraft.
- **Spaceport Sweden – Northern Sweden**
  - Waiting for SpaceShipTwo in Kiruna
  - Working on regulatory issues.
- **Odyssey Moon -** Isle of Man/Canada
  - Google Lunar X PRIZE team
  - No announcement of arrangements for a ride to the Moon from Odyssey Moon (or from any of the GLXP projects around the world).

Europe – UK *activity '09-present*

- **Virgin Galactic** – US hardware, UK funding
  - WhiteKnightTwo test flights
  - SpaceShipTwo rollout & first captive carry
  - Venture with Surrey Satellite on development of a 2nd stage microsat launcher for SS2
  - RAF Lossiemouth – Scottish Spaceport
- **Starchaser**
  - Hybrid rocket engine development
  - Test flight of 6.5 metre rocket with hybrid engine planned for "later this year"
- **Reaction Engines**
  - Hardware demo program
  - Fluyt orbital transfer stage design
  - D1 Skylon redesign

Europe – UK *activity '09-present*

- **Bristol Spaceplanes**
  - Tested H2O2 engine in Mojave



- **STERN Project** – *Static Test Expansion deflection Rocket Nozzle* – altitude compensation for possible use with Skylon.
  - Evolved into Project STRICT - Static Test Rocket Incorporating Cooled Thrust Chamber

- **Canary Sounding Rocket –** Reusable sub-orbital rocket designed by Airborne Engineering to test expansion deflection nozzle.
  - No news posted.

Europe *activity '09-present*

- **Project Enterprise - Germany/Switzerland**
  - High altitude (35km) 2 seat test vehicle, *Black Sky*, followed by suborbital space tourism vehicle, *Enterprise,* with 6 seats.
  - Collaboration with Malaysian group
  - Preparing for IPO
  - New interior design
  - Tests with a Czech L-39 at Peenemünde
  - Agreement with firm *Space Travellers* for marketing and training.

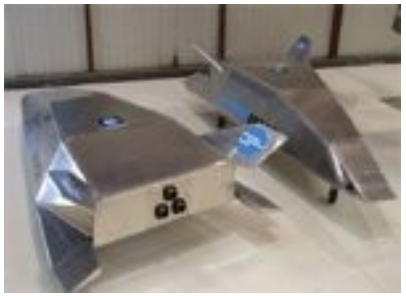
Europe *activity '09-present*

- **ARCA Space - Romania**
  - Suborbital balloon launch attempt failed
  - Will try again this spring or summer
- **Copenhagen Suborbitals - Denmark**
  - Small unmanned sounding rocket
  - Suborbital single person vehicle
  - Testing hybrid motors
  - Heat 1 sounding rocket test to 100km planned for summer 2010.
- **Orbspace – Austria**
  - Suborbital VTVL rocket vehicles
  - No hardware progress shown on website

Canada *activity '09-present*

- **MDA Corp. – Servicing spacecraft**
  - Designing demonstration project
  - Refuel satellites in orbit
  - Push derelict satellites into graveyard orbits.
  - Privately financed.

- **PlanetSpace**
  - Two quarter scale Silver Darts with turbojet propulsion used for tests.



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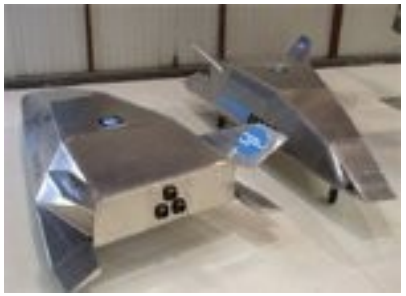
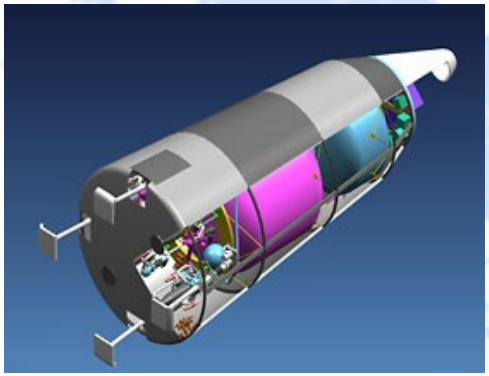


Asia/Pacific *activity '09-present*

- **C&Space Inc. – South Korea**
  - Developed CHASE-10 (10 ton thrust) LOX/Methane engine - “now taking orders”
  - Icarus sounding rocket and Proteus space tourism vehicle in development.
  - No updates on website since 2008.



- **Reusable Sounding Rocket - Japan**
  - JAXA follow-on project to RVT vehicles
  - Yoshifumi Inatani now has his own lab
  - 2006-2009 focused on LH2/LOX 30kN engine with long life, deep throttling, health monitoring.
  - Aiming for a vehicle capable of fast turnaround (5 flights per day), long operational life, low cost operations (“$0.15M/Flight”), 100km alt with 40kg.

Asia/Pacific *activity '09-present*

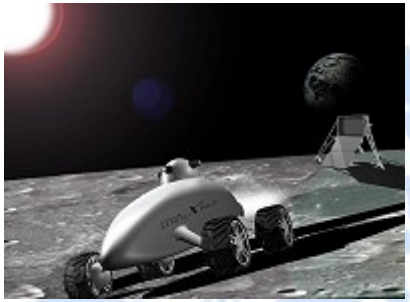
- **Yecheon Astro Space Center & XCOR - South Korea**
  - XCOR will provide "suborbital space launch services" with the Lynx II
  - Yecheon Center (240 km southeast of Seoul) is a non-profit organization that offers a range of space related services including planetarium, space camp, aerospace training, etc.
  - Will fund $30M to bring Lynx II to S. Korea "for space tourism, educational, scientific and environmental monitoring missions".

Asia/Pacific *activity '09-present*

- **Rocket Lab – New Zealand**
  - Ātea low cost sounding rocket launched in Nov. 2009.
  - First stage recovered but not second stage so the don't know for certain if it reached 100km
  - If it did, they would be the first private firm to launch in Southern Hemisphere to launch a commercially developed rocket to space.

- **Spaceport Singapore**
  - Originally with Space Adventures.
  - Seems to be inactive currently.

Asia *activity '09-present*



- **Selene Team - China**
  - GLXP team with Chinese, German & British member

- **Independence-X Aerospace** and **Team Advaeros - Malaysia**
  - Google Lunar X PRIZE teams

- **PD Aerospace - Japan**
  - Pursuing a sounding rocket. Followed by a low cost manned suborbital vehicle.
  - Business plan competition NewSpace 2009
  - “This year's goal, the next prototype (X02) is the production and flight test.”
  - Pulse detonation propulsion

India *activity '09-present*

- **RLV-TD -** Reusable Launch Vehicle Technology Demonstrator
  - Similar to X-37 - launches on expendable booster
  - “first step towards realising a Two Stage To Orbit (TSTO) fully re-usable launch vehicle”.
  - “flying test bed to evaluate various technologies, viz., hypersonic flight, autonomous landing, powered cruise flight and hypersonic flight using air breathing propulsion. First in the series of demonstration trials is the hypersonic flight experiment (HEX)”
  - India space agency long term still focused on scramjets. E.g. Avatar SSTO project since late 90s.

Comments

- Some general progress outside of US in 2009 but no dramatic developments with New Space projects on scale of WK2/SS2 except perhaps the joint XCOR/Yecheon venture.
- Number of NewSpace projects in a given region affected by factors such as
  - Size and scope of the private aerospace infrastructure.
  - Regulations governing private rocket/space activities.
  - Entrepreneurial resources, e.g. access to capital, grants, scale of barriers to starting a small company, etc.
  - History of space development in the country.
  - Cultural factors