Conference Book
12th Reinventing Space (2014)
Edited by Scott Hatton

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The 12th Reinventing Space (RISpace) conference and exhibition was held in November 2014 at the Royal Society in London, the home of UK science since 1660. It was organized by the British Interplanetary Society and supported by the founder of the conference, Jim Wertz.

In the absence of a foreword to the Conference book the jacket blurb is repeated here:
"The proceedings of the 2014 Reinventing Space conference present a number of questions in the context of a constantly innovating space industry, from addressing the future of global cooperation, investigating the impact of cuts in US government spending on the private space sector, and probing the overall future of the commercial launch sector. Space tourism and new technology promise the revival of interest in space development (the Apollo Era was the first period of intense space activity and growth). The need to create dramatically lower cost, responsive and reliable launch systems and spacecraft has never been more vital. Advances in technology are allowing smaller and cheaper satellites to be orbited - from cubesats to nanosatellites to femtosatellites. Thanks to more efficient new launch possibilities, low cost access to space is becoming ever more achievable. Commercial companies and countries are targeting the industry with new funding."

RISpace brings together industry, start-ups, agency, government, financiers, academia and end users. Organized by the British Interplanetary Society, the presentations at this conference thoroughly address these challenges and opportunities.

The Conference Book is a collection of 19 selected papers, the titles, authors and their affiliations are listed in the order as they appear in the book. Since a grouping according to subjects or other criteria is difficult the reviewer will provide a brief appreciation of each paper according to his judgement. With my over 30 years of experience in the space business and having served on numerous review teams and SpaceOps conference technical program boards – I am aware that may assessments below might deviate from other expert's opinions – however I tried to be as neutral as possible (the abstracts of the 19 papers below can be accessed by following the imbedded link).

1. Skimsats: bringing down the cost of Earth Observation, Andrew Bacon (Systems Engineering & Assessment Ltd).

A cost reduction approach targeting mass production of small satellites to be operated in a very low orbit (VLEO, perigee 160 km) thus reducing weight and launch cost retaining high imaging quality. If the idea catches on the prospects are very promising because of the predicted growing market (see paper 14).

2. Rethinking private property in outer space, Jairo Becerra (Catholic University of Colombia)

This paper is discussing the international "Outer Space Treaty" (see also paper 4) in the light of the emerging activities of "space mining" and the settling of planets. It comes to the conclusion: "there is no contradiction between the protection and preservation of outer space with the permission to claim parts of it." This is a reassuring paper for commercial space entrepreneurs.

3. Cubesats to support Mars exploration: three scenarios for valuable planetary science missions, Sabrina Corpino (Politecnico di Torino).

The paper proposes interplanetary space science with ultra-small and low cost nanosatellites, example missions are described: astrobiology and support of human Mars exploitation i.e., "gap filling activities". I think there is still a long way to go, however the concept has its charm.

4. Technology or law: which will reach Mars first? Benjamin G. Davis (Dulles University)

A profound in depth analysis of space law – all you ever need to know. The paper captures your attention and is also entertaining to read because of its excursions into space law history. It also addresses current controversial subjects like the proposed one-way trip of settlers to Mars. Conclusion: "the issue of private property need not be a barrier to the exploration, development or use of extraterrestrial bodies. The treaty-based legal framework in existence does not prohibit states or other organizations from accessing and using the resources it needs for its own purposes. The door is open for any and all who would enter."
The paper includes over 100 references and an extensive bibliography. Everyone dealing with commercial space exploitation should be aware of this paper.

5. Paradigm change in Earth Observation; SkySat-1 & the Skybox Constellation, Jonathan Dyer (Skybox)

The Skybox Company is currently building up a constellation of small satellites performing high resolution earth imaging in LEO. SkySat-1 was launched in 2013 and claims to achieve a performance per cost 1-2 orders of magnitude higher than comparable systems. Skybox's future plans are outlined in the paper. SkySat-1 obviously has developed a business case already.

6. Next Generation NovaSAR Development, Owen Hawkins (SSTL)

With a small satellite design (below 500 kg) Surrey Satellite Technology Ltd (SSTL) and Airbus want to enter into the growing Earth observation market for SAR payloads at affordable cost. Flight Readiness Review (FRR) and launch of the satellite was announced for 2016. Benefits as promoted by the authors would be further improvements on performance "without breaking the bank" growing into constellations to enable payloads to be run longer during one orbit thus widening the user range. This is a promising market since Earth observation demands are expected to grow by 7,5 % per year (SpaceNews, May 2016)

7. Designing for cost effectiveness results in responsiveness: demonstrating the SSTL X-Series, Shaun Kenyon (SSTL).

Another SSTL approach to become a player in the small satellite market: developing a small, low cost spacecraft for individual missions, clusters swarms or constellations. SSTL has developed the X-series platform for users wanting to develop their own payloads. It is a modular approach with standardized manufacturing principles implying a custom-tailored design at low cost, time reduced development process and thus reduced overall mission cost – which in turn will widen the user market. The X-series is another plan by SSLT to capture part of the commercial small satellite market.

8. Thinking differently about standard small-sat interfaces: let adapters take the brunt, Daniel Lim (TriSept Corporation).

In this paper the interface (I/F) between small satellites and launch vehicles (L/V) is proposed to be standardized for quicker, less expensive accommodation of "auxiliary" payloads (APL) on launch vehicles. A governmental body is proposed to develop industrial standards. Problematic might be the suggestion that the US should do this. Long negotiations will be unavoidable.

9. Low-cost end-to-end in orbit demonstration of key technologies for the MSR mission, Emanuele Monchieri (Airbus DS).

As the title suggests the paper describes a feasibility study for an in orbit demonstration to prepare a Mars Sample Return (MRS) mission. The demo would take place in earth orbit with the following design and operational goals: demonstration of long range optical detection of very small objects, autonomous GNC for uncooperative targets and capture mechanism. Well founded study which easily could be the basis for a follow on Phase-A study. The proposed 100 M€ for this follow on study would be well invested to mitigate the risk for a realistic MRS mission.

10. The Small Satellite Integrated Communication Environment (I.C.E.), John E. Ploschnitznig (Riverside Research)

This is a proposal for using existing cell phone technology instead of dedicated expensive ground stations for tracking (data reception and commanding) small satellites and Nanosats. The idea is to modify existing cellular towers with fixed upward pointing narrow beam antennas. Together with the introduction of smart phone technology onboard this will reduce overall cost thus enabling more academia and private entrepreneurs to participate and eventually commercialize space activities. Clever idea – Riverside Research owns the patent for this communications environment already.

11. SPARTAN: Scramjet Powered Accelerator for Reusable Technology, AdvaNcement, Dawid Preller (University of Queensland)

This project investigates the use of an innovative three stage rocket-scramjet-rocket configuration for launching payloads up to 500 kg into sun-synchronous orbits. Candidates are earth science and earth surveillance missions.
"The first stage is being developed as an advanced academic program in Australia, South Africa and France, and is named the Austral Launch Vehicle (ALV). The ALV is a re-usable liquid rocket stage used to accelerate the stack to the point of Scramjet ignition at Mach 6, after which it is recovered by flying back to the launch site (see also paper 15 below). The reusable second stage named the Scramjet Powered Accelerator for Reusable Technology AdvaNcement (SPARTAN) is based on a winged-cone vehicle initially developed for the US National Aerospace Plane program."
This very promising project will find its market – the next step is the demonstration of the feasibility of the indicated key systems.

12. The disruptive potential of subsonic air-launch David, J. Salt (Telespazio-VEGA).

This is a study of how to improve subsonic air launch systems. Following an overview of past and current air launch systems the paper proposes a new, highly improved system of air launched single stage to orbit (SSTO) reusable (RTL) boosters. Key technologies are identified. The reviewer agrees that this approach might introduce significant improvements to bring the cost down for further launch systems for suitable payloads and missions.

13. Sprite: A very low-cost launch vehicle for small satellites, Nicola Sarzi-Amade (Microcosm)

Due to its simplicity, the pressure-fed launch vehicle Sprite is low in cost compared with pump-fed and solid rockets. This is made possible by the development of new, all-composite propellant and pressurization tanks, which have about half the mass of metallic tanks. Sprite is derived from the Scorpius architecture and delivers 480 kg to LEO.
This project reminds me of a proposal of the German Technologieforschung GmbH in 1977 which represented a radical new concept: a "Buendelrakete" (cluster rocket), consisting of modular, low cost elements and pressure fed tanks (Lutz Kayser proposal - OTRAG). Unfortunately the project failed due to political reasons. May the Sprite project have more luck – the concept still holds true!

14. The International Space Station and the commercialization of Low-Earth Orbit, Sam Scimemi (NASA).

Based on NASA's and its partners' commitment to operate the ISS until 2024, the paper examines the intersection of the growing commercial transportation and research markets, as well as the ways in which the transition from government to commercial activity in LEO might unfold. Based on a solid background the paper predicts a vibrant commercial market not only for launch and communications industries but also for biomedical firms, educations industries and technology developments.

15. The Austral Launch Vehicle: 2014 Progress in Reducing Space Transportation Cost through Reusability, Modularity and Simplicity Adriaan Schutte, Peter Thoreau.

This paper describes in detail the first stage of the novel launch vehicle configuration: rocket - scramjet – rocket, as described in paper 11 above. This rocket stage is called ALV and features flyback boosters with deployable wings to be returned in airplane mode. If successful, this approach indeed would revolutionize the L/V business. A scaled down prototype flight called ALV-0 was

successfully carried out end of 2015, ALV-2 design work was reported going on well as of December 2016 (see ALV homepage).

16. Quantifying the Cost Reduction Potential of Earth Observation Satellites, Anthony Shao (University of Southern California).

The paper is based on the assertation that small satellites are underused for earth observations and have the potential to bring down the overall cost significantly. By using quantifying cost models for analyzing design, development and operation costs trading them off against parameters like altitude, coverage, resolution, risk etc., the author of the paper comes to the conclusion that small satellites are best suited to satisfy the growing demand for weather and climate information. Further work is announced for other than low circular orbits. The potential of small satellites is well demonstrated – it all depends on the market.

17. Air-launched space transportation systems, Oleg A. Sokolov (Commercial Space Technologies Ltd.).

This is one of the view studies trying to compare conventional, surface based launchers with air launch systems for almost equal payload capabilities on an economic basis. A thorough overview of existing and planned air launch systems is given, the Ukrainian Cyclon-4 launcher, requiring a new launch site at Biak Island in Indonesia is used for comparison. The conclusion in the paper is that there is a slight preference of air launch systems "provided the optimum use of all capabilities provided by the adopted components is ascertained". Plans for air launch systems for small satellites are around aplenty, let's see what is transpiring.

18. Solar Orbiters for Imaging Asteroids (S.O.F.I.A.), Markos Trichas (Airbus DS)

S.O.F.I.A. - not to be confused with the joint NASA/DLR project Stratospheric Observatory for Infrared Astronomy (SOFIA) - is a study for in-situ determination analysis of near Earth orbiting (NEO) Asteroids. The study by Airbus DS proposes a swarm of heliocentric cubesats (360 cubesats in a 0.9 AU heliocentric orbit, spaced 0.015AU apart) integrating components developed by JPL already (propulsion, camera). Mission analysis includes launch scenarios and defines the cubesat subsystems including a clever, "sharing"- communications concept and describes its operational advantages. Airbus is convinced of its concept and carries on with the next step on its own expenses. Looking forward to an update during one of the next RISpace conferences.

19. The North Star rocket family, C.J. Verberne (Nammo Raufoss AS)

This is a hybrid-motor (LOX/HTPB), low cost rocket development combining existing and proven rocket motors into a two-stage launcher family (North Star 1 & 2). The approach is very logical and systematic without any visible big risk factors. In my opinion this development is bound to be successful for launching small satellite LEO missions, 20-25 kg into a 250-350 SSO orbit.

In summary the book contains a collection of high quality papers with varying depth ranging from conceptual ideas to feasibility studies, phase A results and even the description of already existing hardware components centering around cost reduction for the topics of small satellites and their operations, launch vehicles and the special topic of the outer space law agreements and its consequences for space commercialization and claiming space property.
The paper collection reminds me of a basket filled with fruits of different maturity but all ready to be sampled.As said above, the book provides excellent ideas to lower cost for building small satellites and deliver them into their orbits with innovative, less expensive launch vehicles. Data reception and satellite control is covered as well – in addition fundamental legal aspects for space exploitation and commercialization are discussed and interpreted.

The book is inspiring and breaking (realistic) new ground – it is recommended for everyone who wants to participate and take space exploration and commercialization to the next level in space or on the ground.