UK Cubesat Community Workshop, Open University, 22nd January 2013

Key Recommendations & Notes

These notes have been collated from the leads of each break-session chair from numerous institutions and includes views from academia, industry, and government.

1) FOSTERING A STRONGER AND WIDER UK CUBESAT COMMUNITY

1.1 The meeting agreed that a new forum could contribute by identifying potential user groups who would benefit from using CubeSat data (e.g. commercial applications such as utilities companies, telecoms, and government departments etc), and how to engage with them more effectively.

1.2 There was a need for more formal networking to develop coordinated UK community lobbying (Minister, Government) and coordinated responses to the UK Space Agency on calls (e.g. UKube programme, possible future European EU/ESA initiatives – ELIPS, GSTP?) The Forum was invited to provide input to the UK Space Agency in anticipation of the next national CubeSat Announcement of Opportunity (UKube 2, timeline TBA pending next spending review outcome), at proposal and review levels as necessary, to help ensure that Government and community needs are met.

1.3 Opportunities for collaboration/synergy/sharing resources (e.g. qualification – thermal, vacuum testing, vibration & acoustic testing) should be explored via this mechanism, as well as possibilities for community-led PR and communications to schools/media.

Recommendation 1: A small organising committee should be established to lead the Forum in these activities. Key Tasks to include: Identifying key issues and risks in designing, building and launching CubeSat technologies (including innovation and reaching TRLs, partnerships with industry); Developing a web presence (link with UKSA website) and social media, to include a 'broker' page where subsystems / facilities (ISIC now Catapult?) / ideas can be matched with launch/funding opportunities; Representation at CubeSat workshops and conferences and reporting back to the Forum; Coordination of inputs on 1) and 2) above to UK Space Agency and Government, pulling together academia, industry, outreach, and amateur/hobby communities. Focus should be on a) The need to streamline legislation so not prohibitive, possible ways forward b) The benefits to UK of developing/investing in a cubesat programme (accelerating disruptive technologies with implications for economic growth/attracting match funding and international collaboration, training) c) Desirability of identifying and engaging with potential user groups/applications for cubesat data, e.g. utility companies and government depts. (implications for constellations?). Involve Harwell in organising committee, determine approach to fostering a wider user community in the future together with Catapult. d) Providing a conduit for the Forum to inform UKSA on potential launch needs, which could be facilitated by existing Agency-Agency agreements.

2) BARRIERS TO LAUNCH AND HOW TO OVERCOME THEM

2.1 The group discussed common obstacles associated with launching CubeSats, using STRaND as a case study from both industry and academia perspective and how to clarify/streamline them: availability, cost, export controls, applicability of the OSA, licences, radio frequency allocation, issue of CubeSats as space debris. In particular it commented on the 'opaqueness' of the legislation, and noted that the issue of Liability/Insurance was a specific barrier for academic or academic/industry partnerships and would be discussed in the upcoming BIS OSA review. The UK Space Agency contact for this review was Richard Blayber.

2.2 Regarding the difficulty in finding launch opportunities – the possibility was discussed of the UK Space Agency leading on providing information on suitable future launch opportunities and points-of-contact (e.g. Vega, PSLV, Russian LVs, NASA?) via existing Agency MoUs. The Agency could interface with new Community Forum via its organizing committee.

2.3 There was some discussion on the need for a frequency regulatory Group; the Agency were looking into this.

Recommendations to these issues to be further investigated within UKSA and the CubeSat forum.

3) DEVELOPING EDUCATION/OUTREACH BENEFITS FOR THE UK WITH THE UKUBE X PROGRAMME

3.1. Jeremy Curtis briefly presented the philosophy and work of the UKSA with regard to Education: "Space for Education" and "Education for Space" – i.e. a dual role of supporting education in schools, colleges and Universities (and outreach generally) through using space as a motivating factor, and also ensuring that there was a supply of suitable school leavers and university graduates to support the development of the space industry and particularly the users of space, in the UK. To this end, UKSA supports teachers, provides resources, supports students attending the International Space University (ISU), and encourages the development of skills, through its links to ESERO-UK at York (resource development) and the National Space Academy (teacher training).

3.2 Space is a growing area in the UK, with 100,000 new jobs expected by 2030. Recent research at Reading University has established that as far as industry is concerned, there is a real lack of UK graduates with the necessary skills – particularly with regard to literacy, numeracy and language skills; ability to communicate; business skills (management, budgetary control); lack of a "can-do" spirit and professional attitude, and good STEM (Science, Technology, Engineering and Mathematics) capabilities at Masters level. As a result, there is a real issue with recruitment in the UK, and increasingly companies have to look to overseas. Could the UKUBE programme address this issue?

Recommendation 2: Set up a formal pedagogical study on the role of CubeSats in support of skills development and the UKSA's educational/outreach objectives.

3.3 Prof. Craig Underwood provided a brief overview of the UK's space education efforts over the last 30 years and particularly the key role of AMSAT (amateur radio enthusiasts) and the University of Surrey, through the UoSAT programme – particularly UoSAT-OSCAR-9 (UoSAT-1) and UoSAT-OSCAR-11 (UoSAT-2), which transmitted telemetry and science data directly compatible with school computers of the day, and also transmitted synthesised voice messages (Digitalker) which were particularly easy to pick up on simple radio equipment . Many hundreds of schools and colleges made use of these space missions and many lessons had been learned, notably: the importance of a keen and enthusiastic teachers supported by appropriate teacher training; the need for school/college learning resources to be available; the need for a link in to the curriculum; the ability of live data from space to motivate and enthuse students; the unique way that space and space data can add interest and excitement to STEM subjects, but also the ability to make use of space technology across the curriculum – not just in STEM.

The workshop then discussed some of the current outreach activities associated with UKUBE-1.

3.4 The OU's C3D payload had an associated outreach activity: Four extra payloads had been built to take out into secondary schools locally. These had been modified for use with a USB port and laptop. This would be an "enhancement" activity – i.e. the presentations and demonstrations would be used as a "hook" into the curriculum rather than to directly support specific national curriculum objectives. "Were there plans to extend this activity to a wider audience?"... no, this would need resourcing.

3.5 The AMSAT FUNcube payload was also intended to support education. As with the UoSATs of a previous generation, this could provide a live signal from space into a very simple to use ground receiver – in this case a USB "dongle" software defined radio. Data would also be available via a web-link. Telemetry would be available, and there was the capability of uploading nine 256 character messages per day. In discussion on how this resource could be best exploited, it was felt that the STEM Ambassadors would be a good group to get involved (via STEMNET), although often these we unable to spend the 3 hour type sessions in schools most valued by teachers – instead they perhaps could best support out-of-hours "club" activities. It was noted that after-school clubs were a good way to engage students. Again it was identified that, although enthusiastic teachers would probably take up the challenge of making use of this on-orbit resource, for other teachers to get involved, the availability of off-the-shelf learning resources was key – as was the appropriate availability of teacher training. For this the Space Academy could play a major role, as could ESERO-UK.

Recommendation 2: Engage ESERO-UK and the National Space Academy in developing educational resources and teacher training in the use of UKube-1 and build this into the development of on-going UKUBE missions. Coordinate with ACTION 1.

Recommendation 3: Make STEMNET aware of UKube opportunities.

3.6 The workshop also considered education at primary level. It was felt that UKube had much to offer here as well, and the multidisciplinary nature of space was particularly suited to learning at primary level – before the specialisation of secondary education. It was noted that the availability of good models and graphics would be particularly key to encouraging primary schools, and all educational institutions, to make use of UKube as visualisation. It was felt that students themselves could get involved in developing such models/graphics and data visualisations tools (the inevitable "app") – both at school and college level (perhaps through competitions) and also at further and higher education level (e.g. perhaps as undergraduate or masters level projects). The OU pointed out the role that lifelong learning could play in this, with its huge resource of mature (and multi-skilled) students. To this end, web resources needed developing, as did the ability to stream live data via the internet to ease the access to data. Setting these development exercises up in an educational context would help build teams – developing the communications and professional skills desired by industry. Any "apps" developed should not just focus on the upstream spacecraft end – but also on the downstream applications end. How can we make use of the data and future UKube flights to support SMEs and UK industry in general to develop applications (noting the high gearing between upstream technology development and downstream applications).

Recommendation 4: Set up a competition open to schools, colleges and universities to develop educational and/or commercial "apps" for UKube-1. (Possible support from TSB in this?).

3.7 Such downstream applications developments are not just contingent of UKube. Balloonsats and other initiatives can engage young people just as much. It is important the UK provides an environment to encourage such initiatives. It was noted that the UK's interpretation of the Outer Space Act was a severe constraint on UK University groups developing CubeSats, as it placed much more onerous conditions than similar regulations in the USA or even in Europe.

Recommendation 5: The UK Space Agency should use its influence to press for as much freedom and as light-a-touch as possible in helping the development of educational space technology including CubeSats and balloonsats.

4) ACCELERATING DISRUPTIVE TECHNOLOGIES

4.1 The meeting discussed the benefits of identifying key technology developments with implications for economic growth and possible sources of external co-funding. The forum could potentially contribute towards defining a UKube-X roadmap to tie in with the NSTP roadmaps. Possibilities for synergies and collaborations with international partners could also be explored. The lessons learned from UKube 1 should be applied to any UKube 2 programme (the Agency would conduct a lessons learned exercise post-launch). When the strategy for UKube-2 is being considered, the review should include both critical systems developments (thrusters, bio-chamber) as well as the possibility of a full CubeSat. Alternatives to the UKube-1 model should be considered i.e. are there are other options apart from a CubeSat built in industry with diverse and entirely unrelated payload elements? UKSA could be involved in the

launch opportunity procurement but might also provide support in initiatives where this opportunity is already secured.

4.2 QB50 was proving interesting and was an example of a science mission which could be included transparently and to a large extent seamlessly across a range of platforms. In this model, science users are not necessarily particularly aware of which satellite the data comes from, and the interface with the platform providers is very simple and empowering for them. This could be template for future programmes.