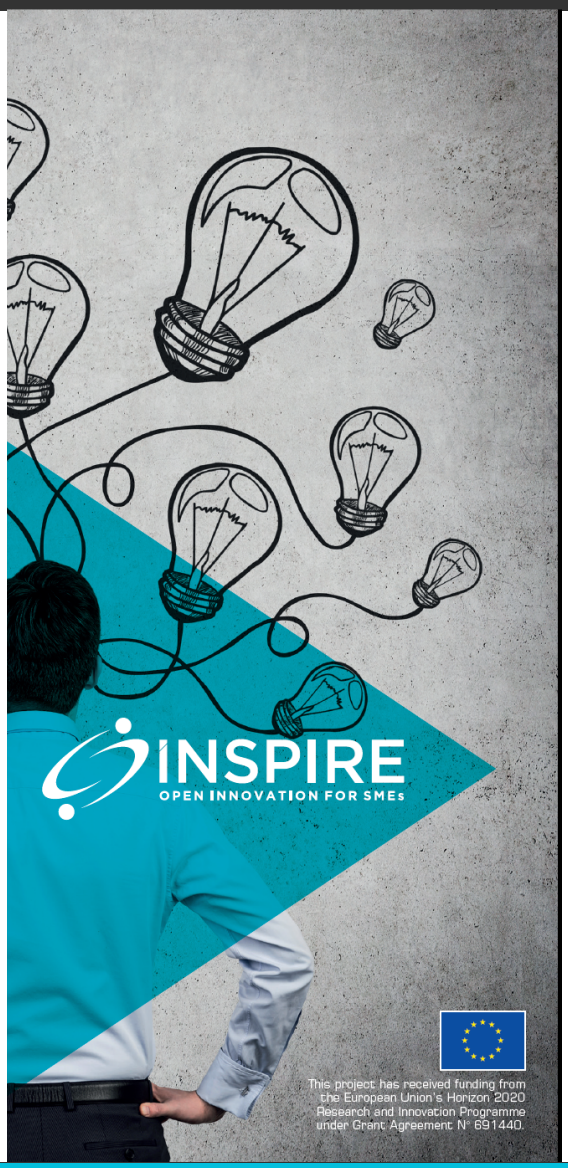

CLYDE SPACE

United Kingdom, www.clyde.space

The UK Space Agency (UKSA) commissioned a small Scottish company as primary contractor to develop a CubeSat for its first space mission. The project was a milestone in the SME's history, as it demonstrated the company's ability to design, integrate and launch a complete satellite system in collaboration with partners

Executive Summary

This is the story of an ambitious new company that started in 2005 with the aim of designing and manufacturing small and micro-satellites components and systems in Scotland. The company's initial focus on developing micro-satellite technology enabled the company to build a business focused on supporting low-cost space missions for a variety of types of customers. This has allowed the company to build a globally-recognized capability in satellite sub-systems and platforms that have proven space heritage.

CASE N°: UKI01

SECTOR: SPACE, MANUFACTURING

TECH INTENSITY: HIGH-TECH

LIFE CYCLE STAGE: ESTABLISHED

INNOVATION VECTORS: PRODUCT

OI PARTNERS: PSR, LARGE CORPORATION, OTHER SME, GOVERNMENT AGENCY

KEYWORDS: Micro and small satellites, CubeSats, space technology, outreach, partnership with UK government agency

- BACKGROUND FRAMEWORK
- INNOVATION CHALLENGE & MARKET OPPORTUNITIES
- OI TRAJECTORY
- BUSINESS IMPACT
- LESSONS LEARNED

BACKGROUND

Craig Clark had an idea of starting Glasgow's first space company. Clyde Space was founded in 2005 by Craig after he had previously developed satellite power systems technology for a UK company over a period of 11 years. Craig recognized that CubeSats, micro-satellites measuring 100x100x100mm, were a disruptive technology that provided a low-cost platform with a standard interface for delivering payloads into space.

John Charlick joined Clyde Space in 2006; John and Craig had met while studying physics at university. With a background in telecommunication engineering, John is currently Head of Projects at Clyde Space.

Clyde Space started by developing power -subsystems for micro-satellites. As awareness and recognition of the company has grown, the company now manufactures complete micro- and small satellites. Until recently, most of the satellite systems developed by the company have been one-off or two-off systems for customer payload testing and low orbital demonstrations. It is expected that following the successful testing of these systems, customers will wish to launch and deploy these systems in larger numbers, referred to as constellations of satellites.

It is also expected that there will be interest from customers in satellites larger than the popular CubeSat (1U size) and 3U size small satellites. Clyde Space intends to introduce new offerings to support these customers.

As part of the company's drive to continually innovate and support customers' needs, Clyde Space plans to install their own ground station in 2017 to enable communication with customers' satellites. This will enable Clyde Space to offer further management of satellite command and control operations from its Glasgow headquarters.

INNOVATION CHALLENGE & MARKET OPPORTUNITIES

A key challenge for new companies in the supply chain for space technology is that of verifying the functionality of their products and having a history of the deployment their products in space missions. Without this heritage it is more difficult to attract new customers. The company was aware of this challenge and the need to find an ideally high-profile mission to become involved in.

Clyde Space started collaborating with the University of Strathclyde and formed a Knowledge Transfer Partnership (KTP) in 2008. A KTP associate was recruited who had previously spent two years at the University of Tokyo as a nano-satellite and CubeSat researcher. The objectives of the KTP were to identify payload options for CubeSats, conduct initial system designs of a satellite and build and test an engineering model.

OPEN INNOVATION TRAJECTORY

Concept development

During the KTP project, a decision was made to develop Scotland's first satellite, the SCOTSAT. A proposal for SCOTSAT was submitted to the Scottish government. Further discussions with other organizations led to interest from the newly-formed UK Space Agency.

The UK Space Agency (UKSA) commissioned Clyde Space as primary contractor to develop a CubeSat for its first space mission. The project was funded by Clyde Space and the UKSA and named UKube-1. The aim of the mission was to:

- demonstrate new UK space technology;
- demonstrate useful science being performed in a micro-satellite;
- use the mission for science, technology, engineering and maths education and outreach purposes.

The development process, IPR and competition strategy

To select payloads for the 3U-sized UKube-1 satellite, the UKSA ran a competition. More than 20 payload proposals were submitted as part of the competition. The final payloads selected were diverse and included a CMOS camera developed by the Open University and e2v, a large global systems manufacturer; a space weather observation system from the University of Bath; a payload to investigate random number generation from EADS Astrium and FUNcube boards provided by AMSAT-UK, which represents members of the amateur satellite community in the UK. The FUNcube payload allowed schools to listen to the satellite beacon signal as part of the mission's outreach activities. An On-Board Computer (OBC) was supplied by a local company and an S-Band

Communication Transmitter by Cape Peninsula University of Technology.

The partners were provided access to emulators to test their payloads prior to submission for integration into the UKube-1 satellite. This allowed several iterations of each payload to be tested.

During the development process, the concept for the project did not change; however, several challenges arose and were successfully overcome. The OBC was not ready in time and was replaced by an alternative as the main mission computer, while still being retained as an additional payload. This resulted in changes being required to the software developed for the mission. The UKube-1 also presented a new technical challenge for Clyde Space, as it was the first satellite in which they needed to implement altitude control. Each partner developing a payload required varying levels of support from Clyde Space; they also developed their payloads at different speeds.

The UKube-1 project was unique and provided UK Space Agency with a successful first mission on which it could raise its profile and perform outreach activities. The project for Clyde Space was a milestone in the company's history, as it demonstrated the company's ability to design, integrate and launch a complete satellite system in collaboration with partners. This demonstrated it was capable of offering more than satellite sub-systems and in doing so further differentiated itself from potential competitors who developed sub-systems only. In the meantime, Clyde Space has become one of the key players in the CubeSat market.

Commercialization and follow-up

UKube-1 was successfully launched and deployed from a Russian Soyuz-2 rocket in July 2014. No specific IPR protection was implemented specifically for the satellite systems developed by Clyde Space.

The UKube-1 project resulted in the adoption, enhancement and/or development of new processes to manage technical aspects within the company. Due to the innovative nature of the general product developments within Clyde Space this has been an on-going process. It has also been driven by the expansion of the company from five employees at the time of the initial discussion about SCOTSAT (to become UKube-1) to over 80 employees in 2016.

The company has matured its project management processes. Initially it started with a process similar to Prince2 but found it restrictive and has developed its own iterative agile process. Configuration management, material requirement planning and customer relations management processes have also been further developed to cope with the increase in customers following the UKube-1 project. Emphasis has been placed on expanding the team with an appropriate mix of skills and experience.

Industry standards, templates and technical test procedures have been further adopted by the company. Examples include improving non-conformance handling processes resulting in the faster resolution of the issues raised.

Clyde Space has a good relationship with the local Scottish media. The company disseminated information during the building process of the satellite, at key milestones and when the launch took place. Due to the interesting nature of UKube-1, the project was followed closely by the UK media.

Presentations were made at international conferences on a space-related theme to raise the profile of the project and the company. The company also invests in outreach to the wider public through social media sites, such as Facebook, LinkedIn, Instagram, Google+ and Twitter.

BUSINESS IMPACT

The UKube-1 project resulted in Clyde Space developing its first complete satellite system which has been proven in space. This flight heritage has put the company in a stronger position when attracting and negotiating with customers. New and improved in-house projects and technical management processes have been implemented as a result of the project.

In addition to processes discussed as part of the organizational changes, the company has learnt how to communicate effectively and to manage diverse partners in a collaborative project. A better understanding of the varying timescales that different partners operate to has been gained. The company has also learnt how to focus more on the IP it develops in-house and how to budget and invest to improve its protection.

As a result of the successful project, Clyde Space has since sold approximately 70 sets of platform satellite hardware for customer missions. On average six satellites are manufactured per month. This has had a significant impact on the bottom-line. Turnover for the 2015-2016 financial year was a record £5 million for Clyde Space, compared to £3 million for 2014-2015.

LESSONS LEARNED

John Charlick's advice for SMEs wishing to undertake OI projects is first to check whether partners are credible and can deliver results. This can involve an audit if necessary. Furthermore, it is important to agree requirements and a project scope as early as possible, and to carefully plan the project execution and invest time to put a communication strategy in place. He also recommended to understand partners' issues and any risks they have and to maintain frequent communication among all project partners, the company board and financial backers.

Three areas were identified in which support could be provided to facilitate strategic collaborations. They were:

1. Provision of training to staff who are recent graduates to enhance their communication skills for collaborative projects and to better convert requirements into something that can be delivered in the project.
2. Provision of a supplier auditing tool and a tool to manage the performance of suppliers.
3. Provision of an upstream and downstream supplier directory or sign-posting service.

This is an interesting example of a company undertaking a high-profile public-private partnership with academic, commercial and public service partners and stakeholders. As a result of the project in question, the company managed to develop an internationally recognized capability in its sector. From a satellite sub-system developer, it became a system contractor in supporting missions at all levels, from conceptual design, development, integration, testing, through to launch and on-orbit operations. This has led in turn to the growth of the company and an increase in international sales of which 40% in the US. The project is recognized by the company as a key milestone in its history.

The case also demonstrates how a small knowledge transfer partnership with a PSR can evolve into a much larger strategic collaboration which not only provides substantial benefits for the SME but also takes on national importance as a path-finding mission for a new government agency.

Main lessons learned:

1. Two-year Knowledge Transfer Partnerships can evolve into much larger and strategically important projects.
2. Effective project management processes and communications with stakeholders become more vital in larger OI projects.
3. OI projects can provide the opportunity to greatly expand a company's product and service offerings.
4. OI projects can be a vital catalyst to company growth by validating the company's products through real-world testing and raising the public profile of the company.