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ILLUSTRATING THE THEORY OF CLUSTERS

using Harwell Space Cluster

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Clusters are an effective mechanism to drive innovation, enable collaboration and enhance commercialisation of research to deliver economic impact. There are many research papers and articles written on the theory of Clusters, including those written by Michael E. Porter, University Professor at Harvard. This paper illustrates how the theory operates in practice at the Harwell Space Cluster. The Harwell Space Cluster is situated at Harwell Science and Innovation Campus, in Oxfordshire and comprises 105 space organisations, which collectively employ over 1,100 people. UKRI, through STFC, provided the catalyst to coalesce the Harwell Space Cluster around the longstanding space instrumentation activities of STFC-RAL Space. The arrival of ESA in 2009, the launch of the Satellite Applications Catapult in 2013 and the actions of the UK Space Agency all contributed to establishing Harwell Space Cluster as the prime gateway to the UK space sector. Companies at the Cluster range from start-ups through early stage companies commercialising new technology and applications, to multinationals, such as Airbus and Lockheed Martin, keen to engage with the innovation taking place. For international visitors, the Cluster acts as a showcase to understand the latest developments in technology and applications across the UK space sector.

Keywords: Cluster, Harwell, Commercialisation, Innovation, Collaboration

1 INTRODUCTION

The UK Government's Industrial Strategy white paper [1] highlighted the importance of 'Innovation Clusters' to the UK economy:

'Innovation clusters' will form and grow around our universities and research organisations, bringing together world-class research, business expertise and entrepreneurial drive.

There are many research papers and articles written on the theory of Clusters, including those written by Michael E. Porter, University Professor at Harvard, who explains Clusters as 'geographic concentrations of interconnected companies and institutions in a particular field' [2].

This paper compares the academic research to an active Cluster in the UK, the Harwell Space Cluster. This Cluster illustrates how the theory works in practice and how Clusters support commercialisation of R&D.

2 HARWELL SPACE CLUSTER

Harwell Science and Innovation Campus is situated half an hour south of the historic city of Oxford and is home to a unique ecosystem of innovation and enterprise. Successive UK



Fig.1 Harwell Science & Innovation Campus.

Governments have invested in world leading science facilities at Harwell including the Diamond Synchrotron and ISIS Neutron Source. In turn this has encouraged over 200 organisations to establish operations at Harwell.

Having many companies in one place is good, but to deliver innovation these organisations need to interact and discuss challenges and opportunities. To achieve this, as proposed by the academic research, Clusters have been formed. Develop-

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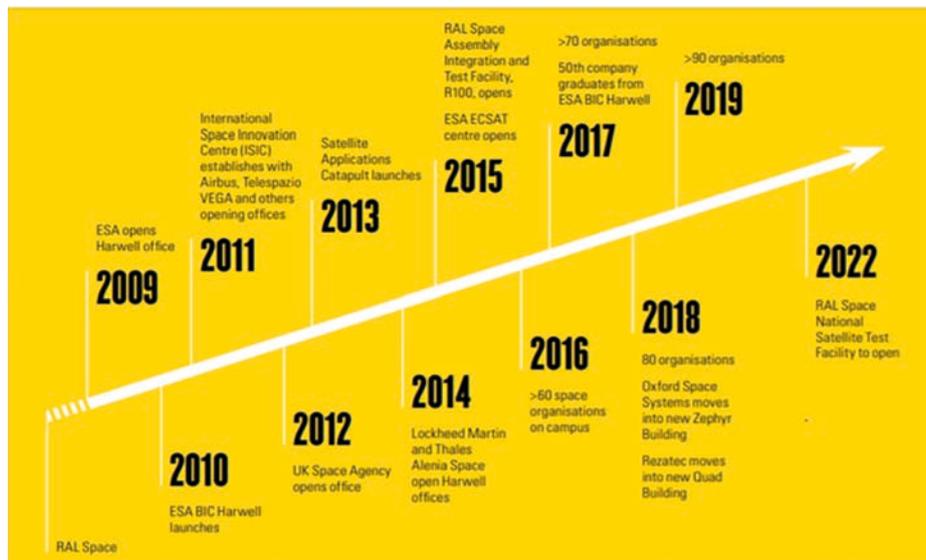


Fig.2 History of the Harwell Space Cluster.

ing a successful cluster requires several things: a strong local industrial base; alignment of research capabilities including proximity to a university; local government support; a governance structure capable of providing leadership; and finally, a specialism that differentiates the Cluster.

UKRI, through STFC, provided the catalyst to coalesce the Harwell Space Cluster around the longstanding space instrumentation activities of STFC-RAL Space. The arrival of the European Space Agency (ESA) in 2009, the launch of the Satellite Applications Catapult in 2013 and the actions of the UK Space Agency all contributed to establishing the Harwell Space Cluster and enabling it to function as the prime gateway to the UK space sector.

Since 2010 the Harwell Space Cluster has grown from a handful to 105 space organisations today, employing over 1,100 people. The number of employees in the Harwell Space Cluster has been growing on average at 16% for the last three years.

3 DEMONSTRATING THE THEORY

To illustrate how the theory works in practice, each of the following sections includes a direct quote from Michael E. Porter's article in the Harvard Business Review in 1998 [2] followed by the description of ongoing activities at Harwell Space Cluster.

3.1 Open Access to National Facilities

Investments made by government or other public institutions—such as public spending for specialized infrastructure or educational programs—can enhance a company's productivity.

Successive Governments have invested in Harwell Campus primarily to develop science facilities on behalf of UK academia, such as the Diamond Synchrotron, ISIS Neutron Spallation Source and Central Laser Facility, as well as the design, test and validation of space instruments at RAL Space. In total, Harwell Campus is home to over £2 billion of large scale, open access facilities that academics can use via a peer review approval process and companies are able to use through academic collaboration or on a commercial basis.

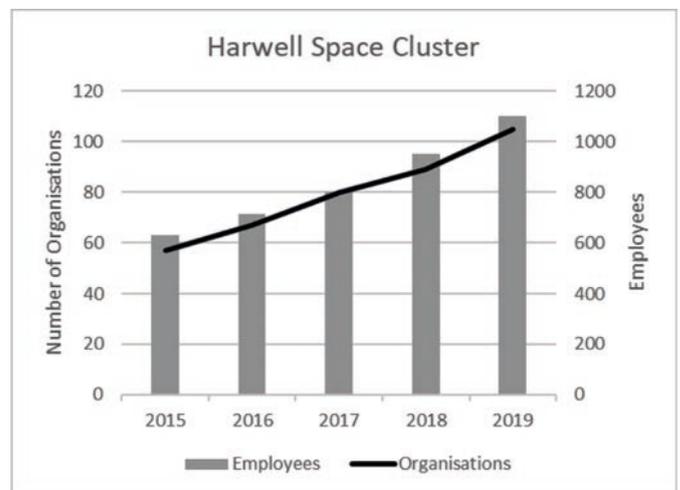


Fig.3 Harwell Science & Innovation Campus.

Other space related facilities at Harwell Campus include ESA's Climate Office, an Advanced Manufacturing Lab, the Sample Analogue Curation Facility and the Satellite Applications Catapult's near and far field antenna range, satellite control room and new Disruptive Innovation for Space Centre to develop new capabilities in an open innovation environment.

Companies that use or supply these facilities began to establish operations at Harwell Campus and now there are over 200 companies. For example, one of the Harwell Space Cluster companies, Cobham RAD, uses the ISIS Neutron Spallation Source to complement its own radiation hardness testing capability and another, AVS, built one of RAL Space's thermal vacuum chambers.

Through the UK Government's Industrial Strategy Challenge Fund, RAL Space is investing £99 million in the National Satellite Test Facility (NSTF). From summer 2022, UK companies will have access to a comprehensive set of satellite test facilities, suitable for satellites up to 7 tonnes, or constellations of smaller satellites, in one location. This will enable UK companies to take on larger contracts without having to build all the supporting infrastructure, which will improve competition for UK contracts and support growth in the UK space sector.



Fig.4 Harwell Science & Innovation Campus.

3.2 Access to Talent

Companies in vibrant clusters can tap into an existing pool of specialized and experienced employees, thereby lowering their search and transaction costs in recruiting.

Globally access to skills is a challenge for all businesses and companies at Harwell Campus are no exception. There are 6,000 people working at Harwell Campus on a daily basis, many of whom are highly skilled. Employees travel from a wide radius with Oxford, Reading and London all commutable. Many choose to live close to Harwell Campus as the Oxfordshire countryside offers a good work-life balance.

The public sector organisations, such as Science and Technology Facilities Council (STFC), focus on developing talent from apprentices to post-graduates. As a result there is a depth in the skills base across the campus from newly qualified to decades of experience. There is also a breadth of skills from space specific engineers through clean room technicians to business development.

Harwell Space Cluster is aiming to have 5,000 people by 2030 to support the UK space sector ambition of 100,000 new jobs by 2030. To ensure that there is sufficient talent available, the organisations at Harwell Campus are working together to identify interventions to address skills gaps and ensure a talent pipeline for the whole of the UK at all levels.

Attracting talent is an important element for companies as many are focused on the global talent pool, not just local as they develop world-leading capabilities. On any one day over 60 nationalities are represented at Harwell Campus, for example at Oxford Space Systems over 30 languages are spoken by its 50 employees. Prospective employees are more likely to relocate to a location if there are multiple relevant job opportunities in the area, rather than just one employer. This gives more confidence that there are future career development opportunities locally. This strong talent pool for R&D organisations to draw on does present challenges in terms of retention, particularly for the larger organisations, which can lose talented staff to start-ups.

3.3 Multidisciplinary Innovation

Cluster development is often particularly vibrant at the intersection of clusters, where insights, skills, and technologies from various fields merge, sparking innovation and new businesses.

Building on the success of the Space Cluster, two further Clusters were launched at Harwell Campus, with HealthTec in 2016, which covers life sciences and healthcare technology, and EnergyTec in 2018, which covers clean growth and battery technology. Each cluster brings together co-located industry, academia and the public sector with investors and entrepreneurs, leading to a powerful combination to tackle global challenges. Increasingly, more companies are exploring the opportunities at the intersections between these clusters delivering multidisciplinary innovation.

The HealthTec and EnergyTec Clusters also provide customer bases for many space companies. For example, Spottitt conducts satellite data analysis for the renewable energy sector and siHealth uses satellite data to advise people when to apply sunscreen to improve health. In some cases, companies have taken technology from the space sector and are commercialising it in a new sector, for example Adaptix has taken x-ray capability developed for space and is using it to improve cancer detection rates in the health industry.

It is not just about direct commercial relationships between the different Clusters, increasingly companies are exploring the opportunities at the intersections between these clusters. For example, Kayser Space is looking at using a space enabled platform to support experiments in microgravity that may lead to a step change in drug discovery and are collaborating with companies across the Space and HealthTec Clusters. Similarly, i-EM Sat sits across the Space and EnergyTec Clusters providing smart energy solutions using information from satellite data. The knowledge sharing and connections through the adjacent Clusters is creating new ideas and opportunities for commercialisation of R&D.

3.4 Knowledge Sharing

The ongoing relationships with other entities within the cluster also help companies to learn early about evolving technology, component and machinery availability, service and marketing concepts, and so on.

The 105 space organisations at the Harwell Space Cluster cover the full value chain of the UK space sector. The companies offer a wide variety of products and services, from those producing space equipment and satellites to those generating services and solutions using the data generated by space instruments, including Earth observation, satellite communications and navigation. There are also companies taking space capabilities to new market sectors, such as Keit, which supplies spectrometers designed for space for use in heavy industrial processes.

These companies range in size from start-ups, many of



Fig.5 Harwell Science & Innovation Campus.



Fig.6 Demonstration of Lacuna Space – Open Cosmos – Oxford Space System collaboration.

which have been incubated at the ESA Business Incubation Centre United Kingdom (ESA BIC UK) in Harwell, through SMEs, such as Thales Alenia Space, Deimos and Rezac, to multinationals such as Airbus, Lockheed Martin and Raytheon that are keen to engage with the innovation ecosystem to identify new technologies and contribute to the development of the UK space sector by strengthening supply chains.

By having this range of companies in one place and regularly meeting at events such as workshops and company roundtables, the companies are able to share latest developments in funding, technology and opportunities. The Satellite Applications Catapult hosts many space related workshops, regularly bringing non-space users together with space specialists to develop new solutions, as well as hosting a monthly networking event for Catapult-engaged individuals or organisations who use satellite technology or data, Satuccino.

Through the public-private joint venture that manages Harwell Campus there is a landscape carefully designed and developed to encourage people to leave their buildings and meet outside of their offices in addition to the well curated ecosystem where knowledge sharing is part of the business model.

Through meeting at and around events, many of the companies have identified projects to work on, for example Deimos and



Fig.7 International delegations visit Harwell.

eOsphere are working together as part of the UK Space Agency's International Partnership Programme; and Lacuna Space's Internet of Things (IoT) network, demonstrated at the Harwell Space Cluster Showcase in June 2019, incorporates Open Cosmos satellites and Oxford Space Systems helical antennas. Being co-located means that meeting up for project discussions or a quick coffee can be done efficiently for both parties.

3.5 Showcasing UK Space Capability

Beyond reputation, cluster members often profit from a variety of joint marketing mechanisms, such as company referrals, trade fairs, trade magazines, and marketing delegations.

Through attending events, developing online and social media channels, with supporting written materials, such as brochures, there are significant opportunities to raise the profile of a Cluster as a whole and the organisations within it. The Harwell Space Cluster the development team, supported by stakeholders, highlights the activities within the Cluster using a variety of published material, social media and attending events. In addition, each of the individual organisations are able to reference that they are part of a larger group of related organisations, creating an echo of the central messaging.

This amplification is of collective benefit, even if it means highlighting competitors. A customer is more likely to visit if there is the potential to meet more than one supplier in one day. This competition also encourages companies to step up their level of service and delivery to ensure that they ultimately win the business, raising the capability of all the organisations in the Cluster.

Due to the large scale facilities and presence of the key stakeholders in the UK space sector, ESA, Satellite Applications Catapult, STFC-RAL Space and UK Space Agency, many international delegations and potential inward investors visit Harwell Space Cluster. This offers the opportunity for companies of any size within the Cluster to meet potential customers and collaborators on a regular basis.

Many space companies have operations at other locations in the UK, but find benefit from having a presence at Harwell Campus to knowledge share on a regular basis with other organisations and to meet with visitors. It is one thing stepping away from the desk for an hour to give a short pitch to a visitor as part of a roundtable, it is another to travel across the country for it. For example, AAC Clyde Space is primarily located in Scotland, with a small office at Harwell Campus and Orbital Micro Systems set up its first UK operation at Harwell and then as its business developed added an additional team in Scotland.

Through its links to other Clusters, Harwell Space Cluster is able to provide a 'one-stop-shop' to understand the latest developments in technology and applications across the UK space sector. Aside from the companies with a small presence at Harwell Space Cluster and main operations elsewhere, there are direct connections to the wider UK space sector including: the Satellite Applications Catapult's Centres of Excellence, which are supported by the UK Space Agency; STFC's other campuses at Daresbury and Edinburgh; ESA Business Applications' network of regional Ambassadors; and the UK Space Agency's Space Incubator Network.

3.6 Support for Start-ups

Many new companies grow up within an existing cluster rather than at isolated locations.

For any start-up, spin-out or entrepreneur, coming up with a great idea is just the first step. Turning it quickly and effectively into a winning commercial offering can be an even bigger challenge. The ESA BIC UK helps young space-related companies to meet this challenge, enabling them to leverage the funding, support, skills and facilities they need to transform technology into successful, vibrant businesses.

Set up by ESA in 2010 at Harwell as part of its rapidly-growing Europe-wide BIC network, and managed and co-funded by STFC, the ESA BIC UK draws the strengths of both organisations in high-tech business incubation. This provides a unique environment at the heart of the Harwell Space Cluster geared exclusively to accelerating innovation. Each year, 10 or more start-ups are accepted into the ESA BIC UK and are provided with a comprehensive incubation package of technical support, access to specialist facilities and equipment, business support, grant funding to accelerate product development, networking events and office accommodation.

By May 2020, the ESA BIC UK had helped 85 start-up companies, the majority of which were incubated at Harwell Campus, and the alumni had collectively raised investment of over £73m. Harwell was chosen as the first ESA BIC UK location on account of the wide range of technical expertise and facilities

available through STFC, ESA, the Satellite Applications Catalyst and other organisations within the Harwell Space Cluster.

4 CONCLUSION

This paper highlights how Harwell Space Cluster is demonstrating the theory of Clusters as put forward by University of Harvard Professor Michael E. Porter. In line with the theory, the Harwell Space Cluster has open access facilities, broad talent pool, opportunities to engage at the intersection with other Clusters, regular knowledge sharing events and the ability to showcase constituent organisations. As a result of this many companies from start-ups looking to launch their business with the help of ESA BIC UK to inward investing multinationals looking to engage with UK innovation have chosen Harwell Campus as a location for their business, so that they become part of the Harwell Space Cluster.

Whilst Harwell is not the UK's only space cluster, it is the most mature, which enables lessons to be learnt from its experiences and opportunities to be leveraged to enable the whole of the UK to benefit – in particular, opportunities for showcasing UK capability to international visitors, identifying global challenges to work on with other Clusters, and developing UK-wide supply chains to support the opportunities created. Overall Harwell Space Cluster is working to help the UK reach its target of 10% of the global space market by 2030 by commercialising R&D and highlighting the strength of capability and rapid innovation taking place across the UK.

REFERENCES

1. HM Government, "Industrial Strategy: Building a Britain fit for the future", November 2017
 2. Michael E. Porter, "Clusters and the New Economics of Competition", *Harvard Business Review*, November-December 1998
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