Title: Future Growth Prospects for the UK Cyber Security Sector & The Role of Accelerators as Innovation Support Mechanisms

Introduction

It's the purpose of this paper to analyse the current state of growth in the UK cyber security sector and the role of accelerators and incubators in facilitating the development of a healthy cyber ecosystem. The chapter analyses current growth figures relating to the industry followed by an explanation of how accelerators and incubators work. It then considers the problems of measuring the efficacy of high tech accelerators and the importance of ecosystem effects and other external variables and how they may cause regional growth disparities.

This is followed by an overview of what drives innovation success in the US and Israel before considering the components that re likely to ensure a healthy and successful accelerator. This is followed by a set of recommendations relating to public policies going forward.

The Current State of Growth Initiatives in the UK Cyber Security Sector

According to the UK Sectoral Analysis Report 2022, the UK cyber sector grew by 14.1% (exceeding £10.1bn.) in 2021, doubling the growth rate of the previous year. The number of active cyber security firms providing cyber security products and services in the UK also grew to 1,838 in 2021. These firms now employ 52,700 full-time equivalent professionals. An estimated 6,000 new jobs were created, representing growth of 13%. The total cyber security sector GVA also increased by a third and reached c. £5.3 billion. The study also estimated the number of accelerators and incubators across the UK to be 179 and the total number of cyber industry growth mechanisms to be 763 (UK Cyber Security Sectoral Analysis 2022). However, on a region-by-region basis, the study indicated a differing picture of the way the UK cyber security sector was evolving. For example, although there was rapid increase of incubators and accelerators beyond London and the South East, investment was still concentrated in the South.

The Role and Purpose of Incubators & Accelerators in the Growth of Cyber Ecosystems

What are Incubators and Accelerators?

Incubators and accelerators are currently the most predominant cyber support mechanisms in the UK, representing 23% of the existing cyber ecosystem programmes (179). A start-up or seed accelerator was defined by Cohen (2013) and Cohen and Hochberg (2014), as a fixed-term, cohort-based program, including mentorship and educational components, that culminates in a public pitch event, often referred to as a "demo-day." Many accelerator programmes also provide a seed investment (ranging from £0 to £150,000 pounds) to their start-ups and receive an equity stake in the portfolio company in return, typically 5 to 7% (Hochberg, 2016). Incubators are

similar although they are open-ended in terms of duration, they are typically fee based and have rolling admissions (Bone *et al.*, 2019).

Most accelerator programmes offer working space and other services in addition to mentorship and educational and networking opportunities. The full range of services can include direct funding (grants or investments) - and therefore access and connections to potential funders/investors - office space; technical support; access and connections to peers (entrepreneurs); coaching and personal development; testing and refining business models; business skills development; (finance, legal and marketing); help with team formation plus press/media exposure (Bone *et al.*, 2019).

The UK cyber accelerator CyLon invests up to £150,000 in it start-up companies and offers a software platform to take start-ups to the next level including introductions to customers and investors plus advice from CISOs of globally leading companies. Cyber Runway also offer a full range of support services to cyber start-up entrepreneurs.

What has driven the emergence of accelerators and how effective are they?

The emergence of accelerators has been facilitated by a significant fall in the costs over the last decade. The capital requirements to seed a start-up software-based company (e.g. cyber) have fallen dramatically over a ten year period. Where building a software company may have cost 5 million, on average, 10 years ago, today it can often be accomplished with £500,000. Moreover, start-ups can often accomplish with a £50,000 seed investment what used to take £500,000 to £1 million (Kerr, Nanda, and Rhodes-Kropf, 2014). This has allowed accelerators to provide meaningful funding and assistance to their start-up portfolio companies and has been a key driver behind their growth.

While the increasing popularity and use of accelerators is clearly evident, proof of their role and efficacy is less clear. There is a general absence of large-scale representative data sets covering accelerator programs. The accelerator participants are small private companies, often unincorporated at the beginning. Some accelerator programmes even discourage public reporting for competitive reasons (Hochberg, 2016). In the absence of 'hard' quantitative data, much of the limited research on accelerators falls into one of two categories: (1) qualitative assessment of how accelerators may serve to accelerate start-ups; or (2) empirical attempts to assess whether accelerators indeed have a positive effect on the outcomes of the companies that participate in the programs.

In category one, Radojevich-Kelley and Hoffman (2012) described how accelerator programs connected start-ups with potential investors whereas in category two, Hallen, Bingham and Cohen (2014) compared accelerated start-ups that eventually raised VC funding to non-accelerated ventures that eventually raised VC finance. Meanwhile, Winston-Smith and

Hannigan (2015) compared ventures that had participated in leading accelerators to similar ventures that did not go through these programs but instead raised angel funding. An important characteristic of these studies was their focus on the outcomes for accelerator portfolio companies. The authors were interested in the effect of the incubator programmes on individual start-ups. However, outcomes are very difficult to measure due to the early-stage nature of the start-ups and the impact of a broader range of external environmental variables.

The Ecosystem Effects of Accelerators

From a policy perspective, it is important to measure the effects of the accelerators on the overall ecosystem – in this case the cyber ecosystem - rather than just the small number of companies that attended accelerators since investments in these programmes would have a broader impact and multiplier effect on the region. These were what Hochberg *et al.* (2015) referred to as 'ecosystem effects'. Fehder and Hochberg (2015) measured the impact of start-up accelerator formation on the VC financing activity in a metropolitan statistical area (MSA) region. Accelerators are important because they lower the search costs for both start-up entrepreneurs and investors by acting as aggregators and providing a matching service. The researchers also found that start-up accelerators stimulated an increase in the level of seed stage investment activity in a region and at the same time, accelerators were more likely to be founded in regions that had higher levels of start-up investment activity or had experienced swift growth in that activity.

External Variables

However, other elements of the entrepreneurial ecosystem may be affected by the establishment of an accelerator such as the nature of the local region, its existing institutions and its ecosystem more generally. This may cause certain types of programs to be more or less effective in a given region. While accelerators appear to have an impact on the entrepreneurial funding environment, other types of variables may impact funding availability such as industry composition, wealth, education and entrepreneurial culture.

Acs *et al* (2008) highlighted the importance of educated founders and the role of University accelerators. These factors have been flagged up as reasons for the inter-regional disparities within countries and between nations. Research has shown that members of the leading accelerators in the US were most frequently educated to Masters and doctoral level as well as having strong technical and engineering knowledge particularly in computer science (Winston-Smith and Hannigan, 2015), Meanwhile, research by Lasrado *et al.* (2015) revealed that University accelerator firms consistently outperformed non-accelerator firms across a range of performance dimensions including growth in jobs and sales. A key reason given for this success was the quality of the resources provided by the universities which was superior over relatively impoverished incubators. Incubator quality is therefore important. This view was supported by

Winston-Smith and Hannigan (2015) who found that the longest established and leading accelerators such as Techstars and Y Combinator, in the US, owed their success to the high quality of mentoring training and rich contact networks built-up over many years.

The strong start-up ecosystem in London and the South of England also owes its success to the strong Loxbridge "golden triangle" where there is a concentration of funding and R&D around the leading Universities in London, Oxford and Cambridge. Moreover, the South of England also has a greater concentration of wealth available for investment with a strong banking and Fintech sector and a rich entrepreneurial culture residing in clusters such as Silicon Roundabout, Tech City and Silicon Fen. Meanwhile, industry composition and skills are also critical to the successful development of a start-up accelerator and a healthy cyber ecosystem. The City of London, Canary Wharf (finance) and the M4 corridor - stretching from Heathrow airport to Bath and Bristol in the west - is home to companies such as Hewlett Packard and Sony who are involved in research and development (quaternary industry) and have links with universities who provide well-qualified graduates. This also includes cyber clusters such as Qinetiq (Malvern) and GCHQ (Cheltenham).

The USA and Israel

All of these variables go some way towards explaining why there have been regional differences in the growth and development of accelerators and incubators in the UK. However, it does not fully cover the reasons for the UK's performance against other countries such as the United States (US) and Israel. The US's strong growth dates back to the technological ecosystem that it developed during the space programme of the 1960s. The space programme enabled it to usurp some of the world's top scientists and engineers. Leading institutions such as NASA and the world-class technology cluster, Silicon Valley, were a direct result of the moon landing of 1969. A strong risk-taking entrepreneurial culture and world class universities (Stanford, MIT and Harvard) plus a large defence sector, have also resulted in a resource-rich cyber ecosystem. America's leading role in the development of personal computers and the Internet also spawned a portfolio of world class technology companies that now dominate cyber security such as Cisco Systems, IBM Corporation, Fortinet, Proofpoint, Microsoft Corporation, Palo Alto Networks, Zscaler, Broadcom and F5 Networks. These companies also have large R&D budgets that often represent 16% of sales revenues. America has also been a leader in financial innovation by creating new sources of entrepreneurial funding such as venture capital, private equity, the NASDAQ, junk bonds and crowd funding. Moreover, its bankruptcy laws are far more lenient than the UK and Europe with Chapter 11 bankruptcy protection helping to underpin a risk-taking culture.

Several years ago Israel became known as the "Start-up-Nation" . It also currently ranks third in the world by number of AI and machine learning start-ups. The global average for early-stage start-up funding is US$431 million whereas in Tel Aviv, the average is US$3 billion. Israel also

exports US$6.5 billion in cybersecurity products and services every year. There are a number of important drivers underpinning the Israeli ecosystem. Israel is ranked second in the world in R&D expenditure per capita. Israel invests about 4.1% of its GDP in R&D, the average among the OECD is 2%. Israel has the highest percentage of engineers and scientists per capita in the world and one of the highest ratios of university degrees and academic publications per capita. Israel has a high-quality educational system and it is among the most educated societies in the world (Deloitte, 2021).

Israeli's undergo mandatory military service and receive advanced technical training. The country's Intelligence Directorate, Unit 504, is responsible for developing information gathering tools and analysing, processing and sharing data to preserve national security. This has resulted in high levels of cyber innovation (Deloitte, 2021).

The Israeli government founded the Technology Incubator program in the early 1990s. Today there are over 25 incubators across the country, all of which have been privatized. The incubators offer government funding of up to 85% of early-stage project costs for two years. They nurture companies from seed to early stage, thus minimizing the risk to the investor. More than 1100 projects have graduated from the incubators, with over 45% successfully attracting additional investments from different investors. The Israel Innovation Authority (IIA) provides a variety of support programs, on an annual budget of about 400 million dollars. The main program is the R&D Fund, that offers R&D grants of up to 40% of the approved R&D programme cost (Deloitte, 2021).

Israel's start-up industry is supported by a strong venture capital market. Israel's venture capital industry has approximately 70 active venture capital funds, 14 of which are international VCs with offices in Israel. This outperforms any other country in VC volume per capita (Deloitte, 2021).

A Framework Model of Components for a Successful Accelerator Programme

Table 1 (below) illustrates the main components for a successful accelerator. This is based on a research paper titled: *The Impact of Business Accelerators and Incubators in the UK* (Bone *et al.*, 2019). The types of support listed in the table are designed to help start-up ventures overcome the "liability of newness" problem (Stinchcombe, 1965).

Type of Support	**Very Useful**	**Moderately Useful**	**Not Useful**
Direct funding from the programme (grants or investments)	75%	20%	5%

Office space	59%	30%	11%
Laboratory space or technical support	58%	29%	13%
Access and connections to peers (entrepreneurs)	48%	41%	11%
Coaching and personal development	47%	38%	15%
Testing and refining business models	42%	43%	15%
Business skills development (finance, legal and marketing)	33%	50%	17%
Help measuring social impact	32%	43%	25%
Access and connections to potential partners and customers	34%	45%	21%
Press/media exposure	20%	61%	19%
Help with team formation	25%	48%	27%
Access and connections to potential investors/funders	33%	32%	35%

Table 1: Components for a successful accelerator/incubator (Bone & Haley, 2019)

These start-up organizations have a high-risk of failure or limited growth potential due to insufficient resources for long-term survival. They also have under-developed operational and managerial capabilities and lack legitimacy with customers, employees and other key stakeholders (Gavetti & Rivkin, 2007; Henderson, 1999; Levinthal, 1997; Siggelkow, 2001). In some cases, ventures may address these liabilities of newness through the knowledge and networks that they inherit from their founders (Dencker, Gruber, & Shah, 2009; Eesley & Roberts, 2012; Eisenhardt & Schoonhoven, 1990). Yet many founders are deficient in knowledge or networks so components in Table 1 help to overcome such difficulties.

Conclusion

The paper has demonstrated quite clearly the important role and contribution that start-up accelerators and incubators play in developing healthy cyber ecosystems. The UK cyber sector is demonstrating positive growth and there are signs of new accelerators emerging outside the traditional strongholds in the South-East and South-West regions of the country. The North-West of England has been the home of several unicorn start-ups representing 43% of all UK Unicorns (young, high growth companies worth $1 bn. or more). It is imperative that these growth methods are allowed to continue since, despite its growth in cyber security, the UK still lies a

long way behind leading cyber nations such as the US and Israel. The following public policy recommendations should therefore be considered.

Public Policy Recommendations

To nurture the growth of a robust and internationally competitive cyber and information security sector by:

1) Building industry support mechanisms in regions with an existing cyber ecosystem.
2) Leveraging the resources and capabilities developed in the established cyber ecosystems into newly emerging ecosystems in other regions.

Building industry support mechanisms in regions with an existing cyber ecosystem.

This option will require a range of resource initiatives including:

- Linking cyber security clusters with large enterprises to generate shared benefits.
- Developing innovation campuses and science parks to enhance the management of cyber innovation.
- Development and expansion of university accelerator programmes.
- Maintaining strong partnerships between local government, industry and academia and offering match funding with the private sector.
- Further development of regional innovation ecosystems using private sector and investor community support to achieve long-term sustainability.
- Encouraging the flow of highly skilled people into the cyber security sector through programmes that incorporate education institutions, schools, colleges, apprenticeships and upskilling programmes.

Leveraging the resources and capabilities developed in the established cyber ecosystems into newly emerging ecosystems in other regions.

This could be achieved by:

- Establishing satellite facilities outside the main cyber ecosystem regions.
- Extending accelerator programmes such as Cyber Runway into new areas of the country.
- Developing virtual cyber incubators and accelerators where there are cost and funding issues.
- Consider the franchising of established accelerator programmes across multiple locations.
- Acquire resources through alliances with accelerators based overseas.

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