

ENTREPRENEURIAL ECOSYSTEMS AND GROWTH ORIENTED ENTREPRENEURSHIP

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Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship

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Increasing the number of high growth firms (HGFs) is now a major focus for industry policy in developed countries. However, existing approaches are proving ineffective. Simply creating supportive framework conditions is insufficient. Creating favourable environments for business start-ups is not leading to the creation of more HGFs. And transactional forms of support for HGFs (e.g. financial assistance) are proving to have limited effectiveness, at least post-start-up. The entrepreneurship ecosystem approach has emerged as a response. It recognises that HGFs flourish in distinctive types of supportive environment. Distinguishing features of entrepreneurial ecosystems include the following: a core of large established businesses, including some that have been entrepreneur-led (entrepreneurial blockbusters); entrepreneurial recycling – whereby successful cashed out entrepreneurs reinvest their time, money and expertise in supporting new entrepreneurial activity; and an information-rich environment in which this information is both accessible and shared. A key player in this context is the deal-maker who is involved in a fiduciary capacity in several entrepreneurial ventures. Other important aspects of an entrepreneurial ecosystem include its culture, the availability of start-up and growth capital, the presence of large firms, universities and service providers. However, studies have tended to take a static approach to the study of entrepreneurial ecosystems, largely ignoring both their origins and stimulus and also the processes by which they become self-sustaining. Creating entrepreneurial ecosystems poses various challenges for policy-makers. There are several general principles that need to be followed. Policy intervention needs to take a holistic approach, focusing on the following: the entrepreneurial actors within the ecosystem; the resource providers within the ecosystem; entrepreneurial connectors within the ecosystem and the entrepreneurial environment of the ecosystem. Finally, it is important that policy-makers develop metrics in order to determine the strengths and weaknesses of individual ecosystems so that their strengths and weaknesses can be assessed, to identify whether and how to intervene, and monitor over time the effectiveness of such interventions. What to measure, approaches to measurement and access to data at the appropriate geographical scales all pose formidable challenges.

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Introduction: developments in industrial policy

Over the last sixty years there has been an evolution in the manner in which governments in advanced countries have undertaken industrial and enterprise policies (Warwick, 2013).³ Over the past twenty years there has been an escalation in both the quantity of policy initiatives and the level of funding committed to these activities in a process termed the ‘developmental’ state (Rodrik, 2004; Block, 2008). These changes can be summarised as a shift from traditional enterprise policies to growth-oriented enterprise policies and has involved significant changes in the unit of focus, how it operates and how it interconnects with other policies.

This has resulted in a gradual change, varying across different countries, towards a much greater focus on support for growth-oriented entrepreneurship as outlined in Table 1, The consequence is that policy makers across the OECD are now strongly focused on promoting high growth firms (HGFs) (OECD, 2010; 2013). The rationale for this focus is that HGFs are thought to drive productivity growth, create new employment, increase innovation and promote business internationalization (OECD, 2013; Brown et al, 2014). A recent meta-analysis of prior empirical studies concluded that “a few rapidly growing firms generate a disproportionately large share of all net new jobs compared with non-high growth firms. This is a clear-cut result... [T]his is particularly pronounced in recessions when Gazelles continue to grow” (Henrekson and Johansson, 2010; 240). The policy interest in HGFs can therefore be explained largely in one word: ‘jobs’ (Coad *et al*, 2014). An influential UK study covering the period 2002-2008 found that HGFs represented about 6% of the total number of businesses (termed ‘the vital six percent’) but created 54% of all net new jobs in the UK (Anyadike-Danes *et al*, 2009). The majority of these HGFs were small (less than 50 employees) but well established (over five years old). Moreover, these firms are distributed across all industry sectors, with no bias towards technology-based firms. Updating this research to cover the onset of the financial crisis (2008-10) found that the number of HGFs was very similar to both the 2002-2005 and 2005-2008 periods and that, as before, they generated more than half of all new jobs created by firms with 10 or more employees, emphasising that HGFs are equally significant in periods of economic growth and recession (NESTA, 2011). HGFs do not only create jobs directly; they also have important spill-over effects that are beneficial to the growth of other firms in the same locality (Mason *et al*, 2009; Du et al, 2013) and industrial cluster (Feldman *et al*, 2005; Brown, 2011). There is evidence that HGFs also provide an important Schumpeterian stimulus within economies by increasing competition, promoting innovation and increasing the efficient allocation of resources within economies. Certainly, there is evidence that HGFs have above average levels of productivity growth (Mason *et al*, 2009), high levels of innovation (Coad, 2009; Mason *et al*, 2009), strong levels of export-orientation (Parsley and Halabisky, 2008) and a high level of internationalisation (BIS, 2010; Mason and Brown, 2010). Recent research also shows that these firms invest heavily in human capital (Mason et al, 2012) and are more likely than non-HGFs to employ disadvantaged people in the labour market, such as the long-term unemployed and economic migrants (Coad et al, 2014). As Storey and Greene (2010, p. 208) observe: “there is little doubt that small businesses that become middle-sized and ultimately large businesses, over a comparatively short period of time, are central to economic prosperity.... Ultimately, the ability of a country to nurture the growth of such businesses is probably *the* most important element in enterprise development.”

This emerging policy focus has a number of evolving dimensions. First, many start-up programmes are now concentrating their support efforts on high-growth start-ups. This reflects the growing acceptance that not all start-ups are of equal ‘economic value’ and that some new firms may merely displace other

³ Industry policy can be defined as ‘any type of intervention or government policy that attempts to improve the business environment or to alter the structure of economic activity towards sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention’ (Warwick, 2013, p.13).

firms in the same locality (Nightingale and Coad, 2014). Indeed, some academics have described a blanket policy focus on new start-ups as ‘bad public policy’ (Shane, 2009). Further, it is claimed by some that the ‘evidence suggests the contribution of entrepreneurial start-ups to the economy is limited and in some cases can be potentially damaging’ (Nightingale and Coad, 2014, p. 136). Nevertheless, despite evidence that HGFs are not exclusively new businesses (Acs et al, 2008; Mason and Brown, 2010; 2013), policies in many OECD countries continue to emphasise start-ups. Specific policy support instruments to nurture high growth start-ups are primarily ‘transactional’ in nature, notably R&D grants and tax incentives, business accelerators and incubators, proof-of-concept funds and access to funding (OECD, 2010). A strong feature of HGF support instruments has been a focus on innovation support (Mason and Brown, 2013). There has also been significant support for university-based spin-off firms (Lockett et al, 2005; Brown et al, 2014). Increasing the supply of risk finance initiatives is also a key feature of these policy frameworks (Mason, 2009; Lerner, 2009; 2010; OECD, 2010).

Table 1. The Distinction between Traditional and Growth-Oriented Entrepreneurship Policy

Traditional Enterprise Policies	Growth-Oriented Enterprise Policies
Main unit of focus is on specific actors, such as individuals, entrepreneurs, geographic clusters of firms	Main unit of focus is on specific types of entrepreneurs, networks of entrepreneurs or ‘temporary’ clusters
Policy objectives is generate more entrepreneurs and grow more new ventures	Policy objective is to focus on the high potential or ‘blockbuster entrepreneurs’ with the largest economic potential
Policy actors are targeted by specific focused interventions aimed at parts of entrepreneurial systems (i.e. non-systemic)	Policy is targeted at connecting components within ecosystems to enable the system to better function (i.e. systemic)
Main forms of assistance are ‘ <i>transactional</i> ’ forms of support such as grants, tax incentives, subsidies etc.	Main forms of assistance are ‘ <i>relational</i> ’ forms of support such as network building, developing connections between entrepreneurial actors, institutional alignment of priorities, fostering peer-based interactions
Main push by policy makers is to generate and promote entrepreneurial sources of finance aimed at start-ups, particularly in the form of venture capital and business angel funding	Recognition that different businesses have different funding requirements such as debt finance, peer to peer, crowdfunding etc. As businesses grow and upscale different firms require access to a ‘funding escalator’ and ‘cocktails’ of different funding sources
The generation of new firm-based intellectual property and innovation was seen as vitally important. The focus was very much on R&D and the protection of intellectual property rights. Strong encouragement to technology and innovation within high-tech sectors	Focus on developing innovation systems and fostering connections with customers, end users, suppliers, universities etc. Increasing recognition of unprotected and ‘open’ sources of innovation. Innovation is porous transcending many sectors and industries – both new and traditional
The level of policy making is mostly ‘top down’. The implementation of policy is mostly undertaken at national level but some initiatives are devolved.	The bulk of systemic policies are enacted at the regional or local level. Multi-scalar policy frameworks are emerging.

Source: Authors’ elaboration

The effectiveness of these forms of ‘transactional’ forms of support for HGFs is now being debated (Brown et al, 2014). Specifically, they are seen as providing relatively few benefits for the recipients and therefore having limited impact (Lerner, 2010). For example, Isenberg (2010: 8-9) has criticised schemes which provide firms with financial support, arguing that it is a mistake to provide high potential firms with

‘easy’ money: “new ventures must be exposed early to the rigours of the market to ensure that entrepreneurs develop toughness and resourcefulness.... In fact, the hardships of resource-scarce, even hostile environments often promote entrepreneurial resourcefulness.” Instead, it is now being argued that such firms require time-sensitive ‘relational’ support, such as strategic guidance, leadership development and business mentoring. This kind of interactive and ‘experiential learning’ is thought to be of more value to HGFs, especially once they have successfully negotiated the start-up phase. So, whereas ‘money-based’ forms of support, which traditionally are provided through grants and subsidies, may have value at start-up they lose their effectiveness as firms become established whereas networking, peer-based support and customer interaction assume greater significance over time (Brown et al, 2014).

Accordingly, policy makers are now beginning to recognise the merit of a more systems-based form of support for high growth entrepreneurship. This represents a shift away from company specific interventions towards more holistic activities which focus on developing networks, aligning priorities, building new institutional capabilities and fostering synergies between different stakeholders (Rodriguez-Pose, 2013; Warwick, 2013). One emerging approach is the focus on ‘*entrepreneurial ecosystems*’ (Zacharakis et al, 2003; Napier and Hansen, 2011; Malecki, 2011; Kantis and Federico, 2012; Feld, 2012; Isenberg, 2010). The term ecosystem was originally coined by James Moore in an influential article in Harvard Business Review published during the 1990s. He claimed that businesses don’t evolve in a ‘vacuum’ and noted the relationally embedded nature of how firms interact with suppliers, customers and financiers (Moore, 1993). It is argued that in dynamic ecosystems new firms have better opportunities to grow, and create employment, compared with firms created in other locations (Rosted 2012).

Our definition of an entrepreneurial ecosystem, based on a synthesis of definitions found in the literature, is as follows:

‘a set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organisations (e.g. firms, venture capitalists, business angels, banks), institutions (universities, public sector agencies, financial bodies) and entrepreneurial processes (e.g. the business birth rate, numbers of high growth firms, levels of ‘blockbuster entrepreneurship’, number of serial entrepreneurs, degree of sell-out mentality within firms and levels of entrepreneurial ambition) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment’

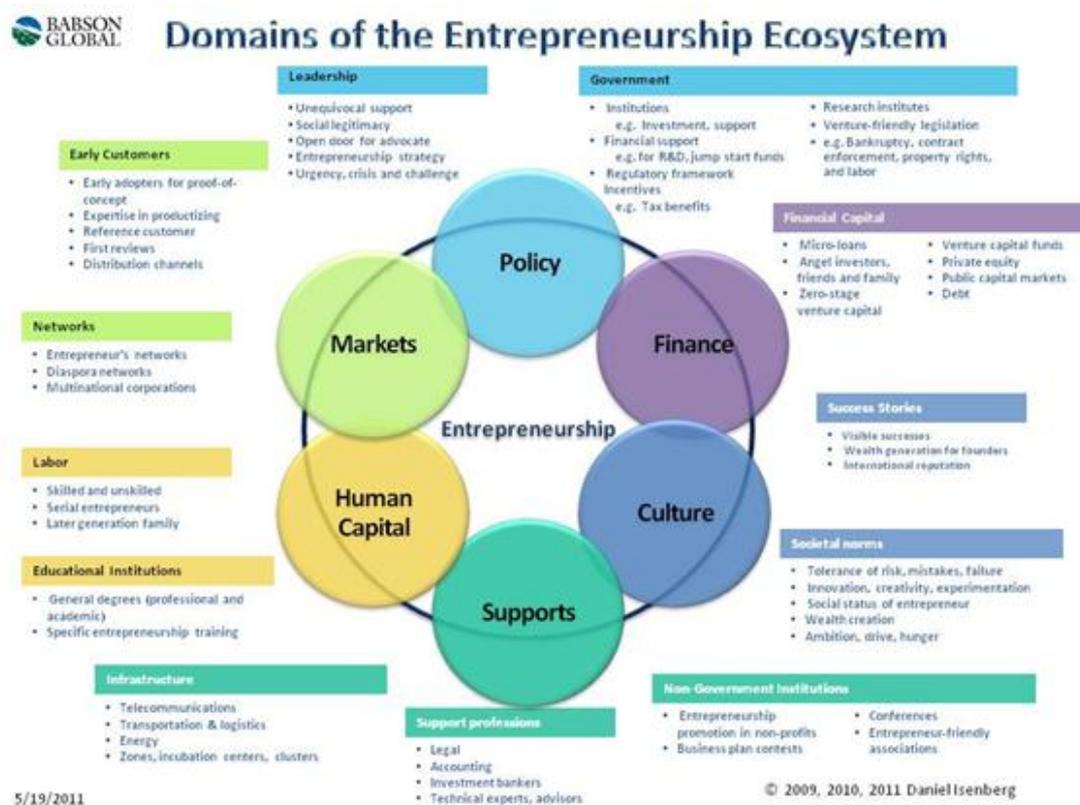
There are now a number of models of entrepreneurial ecosystems. In recent years a particularly influential approach has been developed by Daniel Isenberg at Babson College who has started to articulate what he refers to as an ‘entrepreneurship ecosystem strategy for economic development (2011a, p.1).⁴ He maintains that such an approach constitutes a novel and cost-effective strategy for stimulating economic prosperity. According to Isenberg, this approach potentially ‘replaces’ or becomes a ‘pre-condition’ for the successful deployment of cluster strategies, innovation systems, knowledge economy or national competitiveness policies (Isenberg, 2011a). He identifies six domains within the entrepreneurial system: a conducive culture, enabling policies and leadership, availability of appropriate finance, quality human capital, venture friendly markets for products, and a range of institutional supports (Figure 1). These generic domains comprise hundreds of elements interacting in highly complex and idiosyncratic ways. Identifying generic causal paths is therefore of limited value. He therefore emphasises the importance of context: each ecosystem emerges under a unique set of conditions and circumstances.

Entrepreneurial ecosystems can be industry specific (e.g. pharmaceuticals cluster in Copenhagen, mobile cluster in North Jutland, Denmark) or may have evolved from a single industry to include several industries. They are geographically bounded but not confined to a specific geographical scale (e.g. campus, city, region). And they are not related to particular sizes of city. Indeed, Austin, Texas, Boulder,

⁴ <http://www.babson.edu/executive-education/custom-programs/entrepreneurship/Pages/entrepreneurship-ecosystem.aspx>

Colorado, and Cambridge, England are all examples of small cities with thriving entrepreneurial ecosystems.⁵

Figure 1. Isenberg’s model of an entrepreneurship ecosystem



Unpacking entrepreneurial ecosystems

Related concepts

It is well established that economic activity has a ‘natural’ tendency to cluster in specific geographical locations. Moreover, clustering is associated with the superior economic performance of such regions. There is a voluminous academic literature, stretching back some 100 years, in which economic geographers and geographical economists have sought to explain the reasons for clustering, the internal dynamics of clusters and the economic benefits that arise.

The original contribution goes back to Alfred Marshall’s work on industrial districts at the turn of the 20th century. Here the emphasis was on the role of agglomeration economies. Interest in industrial districts subsequently declined. However, led by the work of Piore and Sabel (1984) in the so-called ‘Third Italy’ industrial districts were rediscovered in the 1980s (Amin, 2000). Saxenian’s work on Silicon Valley

⁵ In Atlantic Canada, which comprises four provinces each with under one million in population and emerging entrepreneurial ecosystems in several cities (e.g. Moncton, Fredericton, Saint John, Halifax, St Johns, Charlottetown), there is an ongoing debate about whether each of the provinces or cities should seek to develop their own ecosystems or whether the focus should be on working together to develop a regional entrepreneurial ecosystem, despite the distances between the cities (‘Pond: we need regionalization’: Entrevestor.com, October 2, 2012).

(Saxenian 1994), also undertaken from a neo-Marshallian perspective, was hugely influential in re-awakening interest in the geographical clustering of economic activity. In this work Saxenian emphasised social, cultural and institutional factors as underpinning regional economies. Silicon Valley's economic success was attributed to its relatively open, non-hierarchically 'regional network-based industrial system' with porous boundaries. This contrasted with the less successful Route 128 which was dominated by larger autarkical firms where 'traditional hierarchies prevailed within firms, and relations with local institutions were distant' (Saxenian, 1994, p. 59). The economic success of Silicon Valley – which Saxenian was amongst the first to document and examine – also gave rise to a huge global 'industry' in which policy-makers have sought – almost entirely unsuccessfully – to replicate the success of Silicon Valley in their own jurisdictions (Hospers et al, 2008). The concept of untraded interdependencies, developed by Storper (1995; 1997), was a further important contribution. These "take the form of conventions, informal rules, and habits that coordinate economic actors under conditions of uncertainty. These relations constitute region-specific assets in production." They are "a central form of scarcity in contemporary capitalism", ... and "of geographical differentiation in what is done, how it is done, and in the resulting wealth levels and growth rates of regions." (Storper, 1997, p.5).

A further approach from the 1990s onwards has focused on knowledge and learning regions (e.g. Asheim, 1996; Morgan, 1997; Maskell and Malmberg, 1999; Keeble and Wilkinson, 1999; Henry and Pinch, 2000). The regional innovation systems (RIS) literature similarly emphasises the role of localised systemic factors in facilitating knowledge development in local firms (Lundvall, 1992; Cooke et al, 1997; Cooke, 2001; Asheim and Isaksen, 2002). Indeed, much of the 'new' work on ecosystems strongly corresponds with the RIS literature, especially the focus on relational elements within regions which govern innovation and entrepreneurship. For example, Storper and Venables (2002) and Bathelt et al (2004) have emphasised the importance of 'local buzz', a concept that can be seen as being similar to Marshall's 'industrial atmosphere', in a cluster. This "refers to the information and communication ecology created by face-to-face contacts, co-presence and co-location of people and firms within the same place or region" (Bathelt et al, 2004: 38). The buzz consists of specific information and continuous updates of this information, intended and unintended learning processes in organised and accidental meetings, the mutual understanding of new knowledge and technologies, as well as shared cultural traditions and habits within a particular technology field which stimulate the establishment of conventions and other institutional arrangements. Individuals continuously contribute to and benefit from the diffusion of information, gossip and news just by "being there" (Gertler, 2003). Moreover, 'being there' enables firms to understand the local buzz in a useful and meaningful way. However, buzz depends on the structure of local social relations and history of local interactions.

The entrepreneurial ecosystems approach offers a new and distinctive perspective on the geographical clustering of economic activity, albeit incorporating many of the themes from this earlier literature. It can claim various origins. Isenberg's (2011) view of entrepreneurial ecosystems has already been noted. In addition, *Start-Up Communities*, Brad Feld's account of the entrepreneurial vitality of Boulder, Colorado, which research from the Kauffman Foundation conforms has the highest high-tech start-up density of any metro area in the USA⁶ (Hathaway, 2013), has attracted considerable attention (Feld, 2012)⁷. The work of Denmark's FORA Group has also been influential.

The key policy challenge that entrepreneurial ecosystems attempt to address is that even in environments which are conducive to business start-ups there is a paucity of high growth businesses.

Although Denmark has developed over some ten years a set of framework conditions for encouraging entrepreneurial activity that judged to be amongst the most favourable in the world, this has not enhanced

⁶ Indeed, four of the top ten metros are in Colorado

⁷ However, it has being criticised for its lack of intellectual underpinnings, superficial and mixing observation with advocacy.

its ability to generate greater numbers of high growth firms (Napier, 2013). The Dutch experience is similar. It has a high and increasing level of entrepreneurial activity (measured by GEM's total entrepreneurial activity rate), but this has largely been driven by self-employed solo entrepreneurs, many of whom have incomes below the poverty line (Stam, 2013). Other evidence from The Netherlands indicates that "there is no strong correlation between regional new firm formation rates ... and the relative number of gazelles" (Stam, 2005: 123). This, and other studies of the geography of HGFs (e.g. Acs and Mueller, 2008; Motoyama and Danley, 2012; Hathaway, 2013), indicate that the environments in which HGFs flourish are distinct from those which have high rates of start-ups. This, in turn, arises because HGFs need access to specialised resources that differ significantly from resources supporting new firms (Napier and Hansen, 2011). Other research indicates that firms that are located in 'clusters' exhibit higher growth than those in other locations (Gilbert et al, 2008).

The policy implications are twofold. First, efforts to stimulate high growth entrepreneurship cannot be restricted to top-down efforts which simply focus on framework conditions. Bottom-up efforts, involving other tiers of government as well as non-government actors, are also required. Second, it needs a distinctive set of policies from those that are targeted at business start-up in general. Merely focusing policy efforts on increasing the number of new businesses have little effect because extremely few firms achieve significant growth.

The entrepreneurial ecosystem approach therefore offers a distinctive perspective on the clustering of economic activity that is either ignored or underplayed in previous studies. First, the explicit focus is on entrepreneurial activity and especially on high growth firms. Second, the emphasis is on local and regional environments and the conditions required to generate and support ambitious entrepreneurship. Third, it emphasises the interactions between framework conditions and local/regional geographical environments. And because of this distinctive perspective the policy agenda that follows is different from that of conventional 'economic development', 'innovation' and 'cluster' policies, emphasising a much more facilitative approach to assistance (Isenberg, 2011a).

This evidence therefore suggests that certain types of environments – which have been labelled entrepreneurial ecosystems – are conducive to the emergence of HGFs. In the next section we look at the characteristics and growth dynamics of such places.

Distinguishing Features of Entrepreneurial Ecosystems

Entrepreneurial ecosystems generally emerge in locations that have place-specific assets. For example, Oxford's emergence as an entrepreneurial ecosystem is undoubtedly linked to its strategic location with regard to London and Heathrow airport, its attractiveness as a place in which to live, its university and associated global brand and its unique cluster of UK government laboratories (Lawton Smith, 2013). Entrepreneurial ecosystems are typically desirable places to live either on account of their cultural attractions or their physical attributes which provide opportunities for outdoor activities. Florida (2002) has emphasised the importance of such considerations for the creative class. Their existing employment is often biased towards knowledge-intensive sectors, employing large numbers of graduates. In some cases an entrepreneurial ecosystem may emerge from a previous industrial tradition. For example, the emergence of an aircraft industry in the Solent region of England arose out of its establishing boat-building industry. This is because the earliest aircraft were designed to land and take off on water and therefore drew upon boatbuilding skills to design and manufacture the aircraft floats. However, when aircraft began to be designed for airfields the region lost its advantage and the industry expanded in other locations. The Swiss medical technology ecosystem developed out of a background of precision skills developed by the watch industry. The unique combination of biotech and engineering skills was able to produce better medical devices (Vogel, 2013a).

At the heart of an entrepreneurial ecosystem typically there is at least one, and usually several, 'large established businesses', with significant management functions (e.g. head office or divisional/ subsidiary office) as well as undertaking R&D and production activities. These businesses will also be rich in technology. They play significant roles in developing the ecosystem. First, they are 'talent magnets', recruiting large numbers of skilled workers, many of them recent graduates, from outside the area (Feldman et al, 2005). Second, they provide business training for their employees and enable them to progress up the corporate hierarchy. It is through this process that staff who were initially recruited for their technological know-how acquire management skills to become technology managers. This represents a valuable resource for small firms. Third, they are a source of new businesses as some staff will leave to start their own companies. 'Cluster maps' showing where the founders of businesses were initially employed highlight the key role of certain companies as sources of large numbers of spin-offs (for example see Neck et al, 2004 for Boulder). Fourth, large exogenous firms play a major role in developing regional ecosystems, especially in peripheral regions, developing the ecosystem's managerial talent pool (Adams, 2011) and providing commercial opportunities for local businesses. For example, SMEs in the UK's oil and gas ecosystem in Aberdeen have been able to sell to the multinational energy companies operating in the North Sea and in many cases also 'piggyback' on these relationships to access other oil and gas markets around the globe (Raines et al, 2001; Mason and Brown, 2012). Large companies can also make a variety of other contributions, including the provision of space and resources for local start-ups, the creation of programmes to encourage start-ups and the development of companies that enhance their own eco-systems. They also put the ecosystem 'on the map'. Indeed, as Isenberg (2013) states, "you simply cannot have a flourishing entrepreneurship ecosystem without large companies to cultivate it, intentionally or otherwise." But for these benefits to occur requires the businesses to be open and collaborative.

Arguably, the businesses that are most effective in stimulating the ecosystem are those that are locally headquartered rather than being part of multinational businesses. Major shareholders are likely to be local, there will be a significant number of senior management jobs and the business is likely to be embedded, with a strong commitment to the local area. This, in turn, points to the importance of well-functioning stock markets that enable growing firms to achieve IPOs rather than sell-out to large multinational companies. This is implicit in the FORA model which highlights the importance of 'blockbuster entrepreneurship'. This is a successful entrepreneurial firm that has grown to an exceptional size and has created significant wealth for its founders, investors, senior management and employees. These individuals, in turn, maintain an ongoing involvement in the ecosystem, reinvesting their experience and wealth as mentors, investors and serial entrepreneurs. Isenberg (2010; 2011a) stresses with his 'law of small numbers' that only a handful of entrepreneurial successes are needed to have major benefits for the ecosystem with spillover effects in terms of role models, serial entrepreneurs, angel investors, venture capitalists, board members, advisors and mentors. This is confirmed in various clusters (Mason, 2008). An excellent example of this process is the role played by Microsoft in developing Seattle into a dynamic hub for software development. During the 1990s employment in computer and processing sector grew six fold from 11,800 to 60,800 driven by around 148 Microsoft-related spin-offs in Seattle (Mayer, 2013). Another example is Nokia in Finland which has provided the entrepreneurial 'training ground' for a vast number of new start-ups. However, as the entrepreneurial ecosystem in Finland has matured, so it is changing from one based around a single 'hub and spoke' business in the form of Nokia to one where small start-ups are more prevalent, demonstrating that entrepreneurial ecosystems are very much a dynamic rather than a static phenomenon (Mayer, 2013). In short, the presence of a home grown startup that became a global force is a vital narrative in the community: it shows the possibilities of entrepreneurship and the potential rewards of leaving a stable job for the risks of starting your own company.

Moreover, whereas most of the spillover effects of these established large firms on their environment are positive it is also the case – perversely – that in the event that they encounter difficulties this can also have a positive impact on the entrepreneurial ecosystem by releasing talented workers who either start their own businesses or are recruited by smaller companies. This is illustrated in the Waterloo-Kitchener

region of Canada as a result of the decline of RIM (maker of the Blackberry) and in Helsinki where Nokia's decline has resulted in a wave of new start-ups in Helsinki (Financial Times, 2013). A major factor in Boulder's success as a vibrant entrepreneurial community can be attributed to waves of downsizing by IBM over the past three decades (as recently as 2010) which resulted in talented employees starting their own businesses or joining other start-ups (Isenberg, 2011b). The entrepreneurial enrichment to ecosystems provided by corporate failure has been labelled 'whale fall' (Isenberg, 2011b).

A second characteristic of entrepreneur ecosystems is that their growth is driven by a process of 'entrepreneurial recycling' (Mason and Harrison, 2006). Entrepreneurs who have built successful (but not necessarily large) companies which they have gone on to sell typically leave the company soon after it is sold (although some remain as employees for a short time to take the opportunity to gain managerial expertise in a global company). But critically, they remain involved in the cluster, reinvesting their wealth and experience to create more entrepreneurial activity. Some will become serial entrepreneurs, starting new businesses. Others will become business angels, providing start-up funding for new businesses and contributing their experience through a position on the board of directors. Some may even set up a venture capital fund. Others become advisers and mentors, board members and engage in teaching entrepreneurship as so-called 'pracademics'. Some cashed-out entrepreneurs become involved in creating and supporting activities that enhance the entrepreneurial environment, for example, by lobbying government and establishing organisations that support entrepreneurial activity.

The involvement of a critical mass of experienced entrepreneurs who have contributed time, energy and wisdom to support the ecosystem notably by business angels, mentoring of start-ups and establishing and leading organisations that support entrepreneurs is central to Brad Feld's account of the success of Boulder as an entrepreneurial ecosystem⁸ Moreover, the entrepreneurs involved in these initiatives have taken a long-term view, recognising that it takes time to build a vibrant, sustainable entrepreneurial economy. The quality of the leadership is also critical. Leaders need to be inclusive and embrace other members of the start-up community who want to be involved. Leaders also need to be mentorship driven. Leadership also needs to be based on meritocracy not patriarchy. Feld is fairly dismissive of the effectiveness of government in stimulating entrepreneurial ecosystems, not least because of the short-term nature of the electoral cycle. He argues that "when a start-up community starts relying on government to be a leader, bad things happen." (p 63).

The entrepreneurial recycling process is driven by exits. Ideally, entrepreneurs and other senior management shareholders should become sufficiently wealthy that they do not need to work again, so that they can devote their energies to creating and supporting more entrepreneurial activity. This requires that entrepreneurs are able to grow their businesses to a point where significant value has been created. To reach this point may require several rounds of finance. Businesses which exit prematurely, for example because of the inability to raise further finance (on appropriate terms), are likely to limit the possibilities for entrepreneurial recycling because it will limit both the wealth that is created and the entrepreneurial learning to have occurred. This is often a feature of weaker entrepreneurial ecosystems where access to large amounts of growth capital and public stock markets is limited.

Entrepreneurial ecosystems are also characterised as being 'information rich'. In such an environment individuals can access information and knowledge on new buyer needs, new and evolving technologies,

⁸ Examples in Boulder include the following: a local chapter of Young Entrepreneurs Organization, NewTech MeetUp, Open Coffee Club, StartUp Weekend, Ignite Boulder, Boulder Beta, Boulder Startup Digest, Boulder Startup week, Entrepreneurs Foundation of Colorado (to enable entrepreneurs give back to the community). It also includes the TechStars Programme – a business accelerator based on a competitive entry process. Successful applicants are provided with funding and mentor support, the majority of whom go on to raise angel or venture capital funding.

operating or delivery possibilities, component and machine availability, and service and marketing concepts, and thereby can more easily perceive gaps in products, services or suppliers to fill. Geographic proximity and tacit knowledge sharing often go hand-in-hand (Gertler, 2003). Organised and accidental meetings are the main channels by which such information is shared. But typically this is insufficient for such information and knowledge to be shared efficiently. Hence, entrepreneurial ecosystems will also have “bridging assets” that serve to connect people, ideas and resources. These bridging assets – termed *liaison-animators* (Sweeney, 1987) - are individuals whose mission is to connect. Most of the key connectors in an ecosystem are not undertaking this role as a formal job task. Informal connectors are often critical.

FORA identifies individuals that they term ‘deal-makers’ as being central actors in this process of information sharing (Napier and Hansen, 2011). They are defined as well-connected and experienced business people who have the skills, know-how and connections to people and resources to support young companies. By sharing their expertise, information and resources and providing connections to appropriate individuals and organisations (e.g. customers, service providers, talent) they are able to help such companies realise their growth potential. They may be entrepreneurs, investors or service providers. They may act in an informal capacity or may undertake some form of fiduciary role, for example as a board member. Feldman and Zoller (2012) define a deal-maker as someone who has fiduciary responsibility for four or more entrepreneurial firms (less than 10 years old) and concurrently find that dealmakers are important to the functioning of successful entrepreneurial economies. In particular, they are associated with a high level of business start-ups. Conversely, “some of the least successful and anaemic entrepreneurial economies in this study have so few dealmakers that they could gather in a single room.” This suggests that the local presence of dealmakers may be a better measure of successful entrepreneurial ecosystems than just the number of entrepreneurs and investors in a region.

Other aspects of culture are also important features of ecosystems. Feld identifies several aspects of Boulder’s culture as being important in its success. It has a philosophy of inclusiveness. An attitude of ‘give-before-you-get’ is embedded in the start-up community, culture of widely sharing knowledge experience and expertise. The attitude to failure is also critical: “The local community quickly absorbs the people involved into other companies. Entrepreneurs aren’t shamed when they fail; it’s quite the opposite reaction They immediately are welcomed as advisers for other companies, entrepreneurs in residence for VC firms, and mentors or executives for accelerators ... Although many take a short break to catch their breath, they often get back in the game quickly. That’s what entrepreneurs do.” (Feld, 2012: 50). Linked to this is the philosophy of experimentation and fast failure. Isenberg (2011a) argues that if failure is quick then all is not lost. In vibrant start up communities, Feld argues, lots of people are experimenting with new ideas and are willing to fail fast with initiatives that attract little interest or generate no impact. The community also needs to have porous boundaries – it accepts that people move from one company to another – “when someone leaves one company for another, they aren’t shunned” (Feld, 2012: 53).

The availability of finance is a further critical feature of entrepreneurial ecosystems. Particularly important is a critical mass of seed and start-up investors to provide finance and hands on support. As noted earlier, business angels – both cashed-out and current entrepreneurs and senior-level managers – play a critical role. Seed capital funds and business accelerators are also important. The presence of venture capital funds is, arguably, not essential, since it can be ‘imported’, as the Ottawa example, below, illustrates. However, this requires that the local investors have connections with national and international venture capital funds that make larger and later stage investments and provide the types of value added support needed by growing businesses. The example of the Yozma Fund illustrates this point. It was established by the Israeli government in 1992 explicitly to bring the investment expertise and contacts to Israel from foreign (mainly US) venture capitalists (Lerner, 2009). This is a rare example of policy success in boosting the local entrepreneurial ecosystem through an interaction between the policy and the

ecosystem⁹. This also echoes the argument of Bathelt et al (2004) that wider global linkages – beyond those connecting firms to product markets – play an important role in the development of entrepreneurial ecosystems. They argue that as well as engaging in localised learning, firms also seek to build channels of communication with selected external partners to access more specialised knowledge and assets not available locally. These so-called global pipelines are seen as being particularly important in the early stages of ecosystem formation, providing access to markets, resources and knowledge before a critical mass is available locally.

Universities also play an important role in entrepreneurial ecosystems, but not the re-eminent role that is often attributed to them. First, leading research-based universities are not found in every ecosystems. For example, Ebdrup (2012) has noted that a pharmaceutical ecosystem has emerged in Copenhagen despite the lack of a world leading university. Second, numbers of university spin-out companies are typically small and high growth spin-outs are rare (Harrison and Leitch, 2010). Åsterbro and Bazzazian (2011: 316) note that “the median university among the top US research-based institutions creates less than two academic spin-offs per year and so the relative effects on local and regional economic conditions ... are bound to be marginal.” The practises of university technology transfer offices are sometimes seen as barriers to the commercialisation of research on account of what Feld (p 39) describes as “their absurd licensing terms and overreaching, restrictive IP protection” (p 39). Businesses started by alumni are actually much more significant (Roberts and Eesley, 2011; Åsterbro and Bazzazian). Nevertheless, Feld (2012) is sceptical about the effectiveness of university entrepreneurship programmes because “they are located in the business school, which is exactly the wrong place for them ... They should be juxtaposed with the students and professors creating new innovations... in engineering, computer science, life science departments ...” (p38). In short, Feld rejects “the premise that the start-up community is dependent on the university: I categorise universities as feeders into the start-up community.” (p 37). In his view, the most important contribution that universities make to a start up community is its students who bring new ideas and increase the intellectual capacity of the community. He sees the most effective role for universities as being a convenor of entrepreneurial activities and groups. This is backed up by comment of Mike Lazaridis the former CEO of Research in Motion (the makers of the Blackberry) who famously declared that ‘technology transfer happens twice a year in Waterloo: it’s called convocation (graduation) (quoted in Gertler, 2010, p.8).

Finally, it is important not to overlook the presence of service providers – lawyers, accountants, recruitment agencies and business consultants – who understand the needs of entrepreneurial businesses and can assist young firms in avoiding stumbling blocks and perform non-core activities that are outsourced. Such firms are often willing to offer their support to start ups at no charge with the expectation that long term business relationships will emerge in due course.

The Dynamic Nature Model of Entrepreneurial Ecosystems

There are limits to the value of identifying generic features of entrepreneurial ecosystems. First, each ecosystem has emerged under a unique set of conditions and circumstances. Second, the time dimension is ignored. However, they are discussed as if they emerged fully formed and do not change. There is little understanding of how successful entrepreneurial ecosystems come into being and evolve (Feldman and Braunerhjelm, 2004). Thorny ‘chicken and egg’ questions are ignored. For example, if the availability of local finance is a key attribute, did it predate the emergence of businesses in which to invest, or did the businesses predate the finance, in which case how were the initial businesses financed? It also ignores questions around the trajectories of such regions – how do clusters get started? Why are some successful over a period of time, successfully adjusting to changes in technological paradigm, while other stumble and fail? As Feldman and Braunerhjelm (2004) argue, there is an evolutionary logic to cluster formation. The

⁹ We are very grateful to Dan Isenberg for suggesting this important point.

implication is that the temporal dimension has to be included in any discussion of entrepreneurial ecosystems. Indeed, it is the ability to reconfigure and adapt which marks successful ecosystems from those that are less successful. This discussion of the evolution of entrepreneurial ecosystems draws in part on the experience of Ottawa (Canada) which gained the label of ‘Silicon Valley North’ in the 1990s in recognition of its thriving technology sector (Mason et al, 2002; Harrison et al, 2004; Shavinina, 2004; Novakowski and Tremblay, 2007, Mason, 2008).

The first point is that entrepreneurial ecosystems do not emerge just anywhere. They need fertile soil. As noted in the previous section, entrepreneurial ecosystems have typically emerged in places that already have an established and highly regarded knowledge base which employs significant numbers of scientists and engineers. These organisations are the source of the skilled personnel who start businesses. These knowledge institutions – research universities, public research laboratories and corporate R&D labs – perform several roles in seeding the cluster. First their research generates the scientific discoveries, technological advances, and advancement of knowledge that form the basis for the creation of new businesses. Second they are ‘talent magnets’, attracting talented individuals in the form of eminent scholars, gifted students and ambitious scientists and engineers, further boosting the technological capacity of the region and increasing the pool of individuals who might become future entrepreneurs and employees. Norton (2001) notes that most of the leading Silicon Valley entrepreneurs who pioneered the PC and Internet revolutions had moved from other parts of the USA. Entrepreneurial mobility is also confirmed in an analysis of the founders of the INC 500 from 2000-8, which showed that 75% had started their company in a different city from the one where they obtained their university degree, although only 37% moved to a different region. The high proportion of Indian-born and Chinese-born entrepreneurs in Silicon Valley has also been noted (Saxenian, 2002; Wadhwa et al 2012). The majority of entrepreneurs in Ottawa were attracted from other regions of Canada and overseas by jobs in the Federal Government R&D labs and at Bell Northern Research (later Nortel) (Harrison et al, 2004). In Cambridge (UK) the university has been the main attractor of talent (SQW, 1985; Keeble, 1989). Third, this research base attracts substantial government research funding. Government purchasing is also important. The role of defence spending in Route 128 and Silicon Valley’s early growth is well documented (Saxenian, 1994; Leslie, 2000; Adams, 2011).

But whether entrepreneurial businesses flourish in this fertile soil depends on wider technology and industry conditions. First, technological advances that are disruptive, thereby creating ‘discontinuities’, produce the most new opportunities. Second, the technological trajectory conditions the way in which the technology might be exploited. Third, the technology has to create market opportunities if entrepreneurs are to start businesses. The emergence of entrepreneurial ecosystems therefore depends on the development of markets for newer technologies. Industry conditions also influence the scope for spin-offs. In general spin-offs are more frequent in the emergent phases of industry, where no single product design has gained dominance (Rothwell, 1989).

There also needs to be incubator organisations which foster future entrepreneurs. This is where the entrepreneur acquires technical skills and product and market knowledge and develops understanding about appropriate organisational structures, strategies and systems. It is also where, in the course of their work experience they notice market opportunities and identify ways of exploiting them. Harrison et al (2004) note that most entrepreneurs in Ottawa’s high tech firms had several jobs, either in different organisations or the same organisation, before starting their own business. Indeed, it is often through this process of job mobility that scientists and engineers derive their management experience. This study also noted that although the last organisation that the entrepreneur worked in before starting their own business was often a small firm, they did have significant prior working experience in large firms. The most effective incubator organisations are rapidly growing firms operating on the cutting edge of new technology, active in the early phases of a new industry and generating too many commercial opportunities to take advantage. Garnsey and Heffernan (2005) have identified the importance of Acorn Computers as a

source of spin-offs in Cambridge. Effective incubators also need to provide their employees with exposure to best practice technology and intimate knowledge of markets and customers to uncover business opportunities. In contrast, branch plants, which are typically production oriented, lacking R&D, limited exposure to the market and with a truncated range of management functions, are poor incubators (Malecki and Nijkamp, 1988), as Scotland's 'Silicon Glen' has demonstrated (Haug, 1986; McCallman, 1992; Turok, 1993; Brown, 2002). Indeed, many of the entrepreneurial ecosystems in the emerging economies are heavily mediated by foreign direct investment (FDI) which strongly resembles this truncated model. Often in these ecosystems, government intervention undertakes much more proactive forms of intervention to compensate for a lack of local subsidiary autonomy¹⁰.

Government research laboratories are also ineffective incubators. They lack exposure to markets and their research often does not have an immediate commercial application (Lawton Smith, 1998). For the same reason most universities are also poor incubators. As noted above, while there is evidence of spin-offs such firms typically achieve limited growth (Harrison and Leitch, 2010). Incubator organisations also typically provide the individual's motivation to start their business. Negative reasons tend to dominate, with the most common reason being that their ideas did not gain endorsement from management. This is summed up in Saxenian's (1994) observation that 'Silicon valley entrepreneurs ... were typically engineers who were frustrated by unsuccessful attempts to pursue new ideas within the region's established companies'. Successful entrepreneur-led spin-offs are also important in providing role models.

There is an overwhelming tendency for spin-off companies to be located in close proximity to the incubator organisation. This results in clustering. There are three reasons for this. The most important is that entrepreneurs need to utilize their social networks of business associates and former employees to access the knowledge, human capital and other resources needed to start and grow their business. These networks "bind entrepreneurs to the locations in which they reside because only there do they have the access to the resources and social support required to sustain their entrepreneurial ventures (Sorensen, 2003: 24). Second it avoids disrupting family ties, enabling the spouse to continue working and bring income into the household. Third, locational preferences may play a role. As noted earlier, many entrepreneurial ecosystems have emerged in locations of high residential amenity. Moreover, many of the entrepreneurs had moved to the area earlier in their career, in part for quality of life considerations which now operated to anchor them in the locality when they started their business.

Finally, some entrepreneurial ecosystems have emerged for exogenous or even serendipitous reasons. Feldman (2001) attributes the downsizing of the Federal Government a key factor for the emergence of technology ecosystem in Washington DC in the 1970s and 1980s. By reducing the threshold for risk taking, this meant that entrepreneurship became a viable career option for many employees. Increased outsourcing by government provided opportunities to provide goods and services back into government. Entrepreneurial opportunities were also opened up as a result of changes in IP regime and in Federal financial support for new technology business opened up entrepreneurial opportunities. Serendipitous circumstances for ecosystem emergence include 'critical moments' in the evolution of technologies or companies. It was previously noted that commercialisation possibilities for new technologies arise at certain points in time. There are also critical moments in the history of companies – often when they are in turmoil – which are associated with people leaving to start their own businesses. As noted earlier, the contraction or closure of a technology business may also provide the stimulus for business start-ups, especially if the quality of life discourages employees from moving elsewhere to seek employment. For example, the origins of Silicon Gorge, a cluster of around 30 microchip companies around Bristol and Bath in the South West of England, one of the largest concentrations of semiconductor design skills in Europe,

¹⁰ For example, owing to the recent increases in labour costs in China, the local government in Dalang which is dominated by foreign owned knitwear firms has used government funds to buy 40,000 computerised knitting machines, reducing the need for 200,000 workers (Sevastopulo, 2014)

can be traced back to the then labour Government's decision in 1979 to create INMOS, a state-owned company to create a UK microelectronics industry, receiving £211m of government funding over six years. According to its former managing director, "the government lost its nerve and pulled out, so Inmos lost its way". It was sold to Thorn EMI in 1984 for £192m before it had become profitable and in 1994 was absorbed into ST Microelectronics which had bought the company in 1987. However, it had been an important training ground for the many electronics graduates who sought out employment with the company. Twelve companies came directly out of Inmos¹¹ (Marston et al, 2010).

Once the spin-off process gathers momentum it sets in motion a virtuous, self-reinforcing process which leads to the creation of an ecosystem that nurtures and supports further entrepreneurial activity. One of the consequences is that founding a firm at an early stage in a cluster's development is very different to founding a firm when the cluster is established (Bresnahan et al, 2001). First, successful businesses provide role models and create legitimacy for further entrepreneurial activity. As Jervetson (2000: 125-6) observes in the context of Silicon Valley, "for those who live in the region, there are many within a couple of degrees of separation who say 'Hey, I can do that too! I could be a Marc Andreessen [founder of Netscape] or a Jerry Yang [co-founder of Yahoo!]. The process of entrepreneurship seems less mysterious and daunting to them than to those outside the region, to whom it can seem very magical and mystifying." Spin-offs also have the effect of diffusing high level expertise and competencies within the region when individuals carrying technical and management know how and 'embodied expertise' move to new organisations as founders or key employees, taking ideas that they have acquired in other local organisations, creating a process of regional collective learning (Keeble and Wilkinson, 1999). A further effect of spin-offs is that they create the critical mass which stimulates the emergence of an entrepreneurial support network (Kenney and Patton, 2005) that sustains and nourishes the creation and growth of entrepreneurial businesses. This comprises three types of service:

- Specialist business services: notably, law firms with deep expertise in handling IP, marketing firms, executive search firms, accountancy practices that are familiar with the unique needs of technology start-ups, technology marketing and PR firms, management consultants, and technology assessment consultants
- Technical services: precision machining, prototyping, precision moulding, testing, etc.
- Finance providers: venture capital firms, investment banks specialising in IPOs

These support services facilitate the process of business start-up and growth by enabling new firms to focus on their area of expertise while buying-in specialist service and support (Saxenian, 1994).

As the spin-off process gathers momentum so institutions emerge – often through the collective action of the entrepreneurial community - to nurture and encourage the formation of new firms and to solve problems which individual firms cannot solve individually, skilled labour is attracted to the region, and local institutions to develop specialist training courses (Wolfe and Gertler, 2004). These are of two main types (Corona et al, 2006): (i) technology incubation mechanisms, such as incubators, innovation centres and science parks, to provide physical space and intangible support to new technology based firms; these can be public or private sector and often designated as not-for-profit; and (ii) partnership organisations, usually comprising government, universities and the private sector, to promote networking and collaboration between members and which can 'champion' the region both internally and externally.

¹¹ Tech clusters; How the west was won, *The Economist*, 6th August 2011. Microelectronics cluster emerged from initiative, *Financial Times*, 8 March 2010.

The important point to note is that the supportive conditions for entrepreneurship spontaneously follow the process in which entrepreneurship takes hold in an ecosystem. This is particularly the case with the availability venture capital – which is widely seen as a necessary attribute for technology clusters (Malecki, 1997; Norton, 2001), being required for the sustained growth and development of a cluster (Llobrera et al, 2000). Without venture capital the cluster is likely to stagnate or decline (Feldman et al, 2005). But as several authors have noted, venture capital lags rather than leads the emergence of entrepreneurial activity: it is not part of the initial environmental conditions (Saxenian, 1994; Feldman, 2001; Mason et al, 2002; Garnsey and Heffernan, 2005). Ottawa's emergence as a technology cluster in the 1970s and 1980s occurred despite the lack of local sources of venture capital. The investors in the initial waves of new technology businesses are often private individuals and families who had made their money from earlier technologies, or from the service economy, and from 'old economy' companies. Subsequently a handful of local investors emerged, the most significant being, first, Newbridge Networks, a telecommunications firm founded by Terry Matthews (after selling his first company, Mitel) which funded spin-outs that were developing products that were compatible with Newbridge equipment and could leverage Newbridge's sales force, and second, Celtic House, a venture capital fund established by Matthews. In an example of Bathelt et al's (2004) pipelines theory, much of Ottawa's initial venture capital was therefore 'imported' from Toronto and the USA (notably Boston), attracted by its reputation for expertise in telecommunications¹² (Nortel, JDS-Uniphase, Newbridge) and three mega-exits at the height of the late 1990s¹³ technology boom which signalled Ottawa "as being a great place to make money" (Mason et al, 2002; Doyletech Corporation, 2005).

Indeed, there is a general tendency to overstate the importance of venture capital in entrepreneurial ecosystems. This type of financing is predominantly used by high growth, technology-based firms (Lerner, 2010). Indeed, a recent study of high growth SMEs in the UK found that less than five percent of growth-oriented firms were funded by venture capital (Brown and Lee, 2014). A study of INC 500 companies in Kansas City – that is, companies that have achieved substantial growth over a short period of time - noted that only a small proportion has raised venture capital (or, indeed, angel funding); moreover, this was post-start-up. Most firms were initially funded through a combination of self-financing, loans from family and friends and bootstrapping. So, whereas venture capital may accelerate the growth of successful firms it does not create such firms (Motoyama et al, 2013). Nevertheless, policy makers continue to put greater provision of venture capital at the heart of entrepreneurship policies (Brown et al, 2014).

A process of entrepreneurial recycling (Mason and Harrison, 2006; Bahrami and Evans, 1995) will also take root, triggered by the acquisition or stock market flotation of successful young companies as the entrepreneurs and other members of these businesses recycle and re-invest their capital gains and

¹² One VC observed that "companies like Nortel ...[and] ... Newbridge have put this city and this country on the map. Even the recent visibility with Alcatel taking over Newbridge has brought tremendous testimonial to Ottawa in terms of the visibility that it has garnered" (interview). This is attracting US venture capitalists "[who are] saying, wow, there's a hot bed. First of all there are people. It's brains. The brains are here and the brains don't necessarily want to move. So you have to go to the brains" (Hewson, interview). This gives Ottawa entrepreneurs credibility to get through the front door of venture capitalists. It is well known that venture capitalists will rarely look at deals that arrive cold, without a referral. To quote one US venture capitalist: "Things that just come across the transcom or show up via e-mail you rarely read them. VCs don't have the time because you're getting several hundred business plans a week. Those don't get as much consideration as something that's referred ..." (McClern, 2000). However, as Fred Abboud of Ernst and Young notes, referring to Boston venture capitalists, "when [entrepreneurs] call and say we're from Ottawa and we're working in this area they get attention. As soon as you say Ottawa, because Ottawa now is really on their map" (interview). He goes on to quote one Boston-based venture capitalist who asked him that "if you see a deal involving ex-Nortel guys, I want to see it" (interview). Indeed, US venture capitalists are now coming to Ottawa "and looking for ex-Nortel engineers or whatever engineers and funding their ideas." This sets off a virtuous circle - by investing in Ottawa US venture capital investors gives the region a vote of confidence in the quality of its entrepreneurs and technology.

¹³ The first of these companies was Skystone Systems which was acquired by Cisco Systems in 1997 for \$89.1m (US) just six months after it was started (equivalent to \$3m per engineer!). In 1998 Cambrian Systems was sold to Nortel for \$300m in cash. Soon after, 11 month-old Extreme Packet Devices - which had raised \$30m in venture capital - was bought by PMC-Sierra of British Columbia for \$450m (US), equivalent to \$10m per engineer (OBJ 10 April 2000).¹³ Another high valuation exit was Philstar Semiconductor which was acquired by Conexant Systems Inc of California for \$186m (US).

capabilities by becoming serial entrepreneurs, investors in new companies, mentors to new entrepreneurs and institution builders (Feldman, 2001). This process of entrepreneurial recycling is most effective when driven by ‘blockbuster’ entrepreneurs. The effect that Sir Terry Matthews has had on Ottawa offers a good example of this phenomenon (Box 1).¹⁴ Herman Hauser, best known as one of the founders of Acorn Computer and subsequently founder of Amadeus, a venture capital firm, has had a major impact on Cambridge’s development (Garnsey and Heffernan, 2005; Garnsey et al, 2008; Ferriani et al, 2012). Mike Lynch, founder of Cambridge-based software group Autonomy which was sold in 2011 to Hewlett Packard for £7.1bn, might have a similar effect in Cambridge through his establishment of a \$1bn technology fund. However, this impact may be diluted on account of the fund’s Europe-wide investment focus.¹⁵ Universities may also benefit from the philanthropy of successful entrepreneurs, providing a boost to the quality of their research and ability to attract top class academics. For example, 20 of Stanford University’s 41 engineering chairs have been endowed by Silicon Valley-based high tech companies, entrepreneurs and venture capitalists (Huffman and Quigley, 2002).

However, a spin-off process does not necessarily take hold. This could occur for several reasons. There may be no tradition of spin-offs from the major companies in the ecosystem. If entrepreneurial exits are all small then limited wealth that is generated and managerial learning opportunities are truncated. Moreover, if such exits are seen as the norm then this limits ambition on the part of both subsequent entrepreneurs and also early stage investors.

Equally, the virtuous, self-reinforcing processes of ecosystem growth described above may come to a half. Here again Ottawa provides a useful illustration (Financial Post, 2011). Its technology employment declined from 79,000 in 2000 to 63,000 in 2003, then recovered to reach 82,000 in 2007 and then fell back to 44,000 in 2011. This is attributed to several factors. The demise and ultimate bankruptcy of Nortel (from 17,000 employees in 2000 to 3,000 in 2007) and the major contraction of JDS (from 10,000 in 2001 to 2,500 in 2002), both major blockbuster companies, have been critical. So, too, has the loss of other home-grown champions through acquisition and as a consequence “disappearing into divisions of multinationals, never to be heard of again” (Financial Post, 2011). There has been a lack of recycling by the millionaires created by the tech boom of the late 1990s. Venture capital has largely disappeared, not just from Ottawa but nationally. The telecom sector, which was Ottawa speciality, has declined, and the large capital requirements now required to undertake next generation R&D has eliminated entrepreneurial opportunities. Local angel groups report say they tend not to make money when they invest in start-ups that require multiple rounds of venture capital to build a profitable business. This tends to be the case with telecoms, which require tens of millions of dollars to bring a new chip to market, and hundreds of millions to develop a system of chips, such as a router or communications switch. Yet, paradoxically the number of technology companies in Ottawa has increased since 2000, almost doubling. This reflects a new entrepreneurial business model involving the formation of smaller companies that have a highly skilled work force but might not own their own factories. Instead, they will own the idea, the prototypes and control the sales force, while farming out everything else (Globe and Mail, 2011). Clearly, this reduces the opportunities for high growth businesses to emerge.

Box 1. The impact of blockbuster entrepreneurs: Sir Terry Matthews’ impact on Ottawa

(Sir) Terry Matthews was born in Newport South Wales in 1943. After graduating from Swansea University in

¹⁴ Matthews provides an interesting contrast to another Ottawa entrepreneur Michael Potter, former CEO of Cognos which was sold to IBM in 2007 for \$4.9bn. He has made no secret of his desire to move on to other things, including sailing and flying vintage airplanes (Life after Cognos, Ottawa Business Journal, 11 June 2012). . Indeed firms such as JDSU Cognos had minted hundreds of millionaires during the later 1990s tech boom, but surprisingly few of those who cashed out have contributed meaningfully to the development of new startups.

¹⁵ Autonomy founder turns to cyber security for first investment, *Financial Times*, 17 September 2013.

1969 and a brief spell at British Telecommunications' Research Laboratory in Martelsham he moved to Ottawa, Canada to join Northern Telecom (later known as Nortel). With Michael Cowpland, who he met at Northern Telecom, he started Mitel, initially as a technology consulting company and subsequently developed an innovative telephony component based on Cowpland's PhD thesis that they were able to sell at a fraction of the cost of competing versions. Mitel subsequently used microprocessors to develop small PBX systems. The company floated in the NYSE in 1981. It was sold to BT in 1985. Cowpland went on to found Coral. Matthews founded Newbridge Networks which he turned into a leader in the world wide data networking industry, manufacturing data communication products. When it was acquired by Alcatel in 2000 its workforce was over 6,500. Matthews' personal stake in Newbridge Networks was worth over \$1bn. In 2000 he re-acquired the Mitel PBX business and name, taking it private. He invested heavily in the business to turn it into a broadband company. It went public again in 2011.

Matthews has an extensive range of other business interests:

- Tech Businesses: March Networks (IP video systems, IPO in 2005), Bridgewater Systems (telecoms software, sold in 2011), Ubiquity Software (software platform, sold in 2007), Convedia (VOIP, sold in 2006), Magor Communications (chairman, stated in 2007 and IPO in 2013)
- Venture capital: (i) Celtic House, investing in emerging technology businesses in Canada and the UK: Matthews was initially the only limited partner but following a further round of fund raising it became independent of Matthews in 2002. (ii) Wesley Clover, headquartered in Ottawa but with offices around the world.
- Other businesses: Major hotel and research park in Kanata, Ottawa and Celtic Manor in South Wales (host of the 2010 Ryder Cup).

He has also invested personally in around 80 businesses. He has also created substantial wealth for others in Ottawa through his entrepreneurial activity. For example, Mitel was funded informally by loans from family, friends and initial employees. Their loans were repaid in three years. In addition they were given shares worth \$1 which subsequently were worth \$2.5m.

In summary, much of the discussion of entrepreneurial ecosystems has lacked a time dimension, hence it is uncertain how they get established and develop momentum, and why some wither away. Nor does it satisfactorily resolve issues of causality – if X is needed to produce Y, but only appears after Y is present, then how does X initially emerge? But it is clear that there are various preconditions for the emergence of entrepreneurial ecosystems. Previous research has suggested that they often emerge in places that are judged to be attractive areas which include the presence of one or more technology-rich organisations that act as talent magnets, attracting skilled workers to the area. The growth in entrepreneurial activity occurs through a spin-off process, with people leaving the initial organisations to start their own businesses, and these businesses in turn are the source of farther waves of spinoff activity. Once the spin off process starts it appears to develop a momentum of its own, with each wave of spin-offs stimulating further waves as well as prompting the emergence of both commercial and community oriented support organisations, such as business angels and venture capital funds, lawyers and accountants, mentors, support activities, to provide entrepreneurial both hard (e.g. finance) and soft (e.g. advice) resources. Equally significant is the process of entrepreneurial recycling in which entrepreneurs who have exited from their businesses (through sale or failure) put their expertise and capital to work as serial entrepreneurs, business angels and venture capitalists, mentors and advisers. Blockbuster entrepreneurs who generate substantial wealth for themselves and others are particularly significant in this process through their spill-over effects. Business failures also give a boost to the ecosystem by releasing knowledge and people to start their own businesses or take senior positions in growing companies. However, these virtuous processes may, at some point, cease, for example as a result of broader industry or technology developments, leading to the contraction of the ecosystem, at least for a period of time.

Supporting Entrepreneurial Ecosystems: the role of policy

Both framework conditions and general start-up policies have proved to have limited effectiveness in increasing the number of number of HGFs. The objective of ecosystem policy is to achieve this goal by improving the environment that surrounds such firms. But, this poses challenges for public policy since it is not obvious from this discussion how government intervention might promote the emergence of entrepreneurial ecosystems or stimulate the key processes of spin-offs and the emergence of entrepreneurial support in its various forms. Indeed, it is difficult to point to any entrepreneurial ecosystem that has arisen through direct government intervention. There are certainly no simplistic policy solutions or 'silver bullet' (Isenberg, 2011a).. This section is in two parts. First, it discusses a number of general principles that underlie the development of policies to promote entrepreneurial ecosystems. It then develops taxonomy of approaches to intervention at the level of the individual ecosystem.

General Principles

First, policy-makers need to recognise that 'you cannot create something from nothing'. We noted earlier that entrepreneurial ecosystems are based on pre-existing assets and not just a tool for high-tech industries. Traditional industries like food and drink, energy, logistics, water industry, manufacturing all provide the platform to create dynamic, high-value added entrepreneurial ecosystems. They were generally perceived to be nice places in which to live and already had some significant notably knowledge-based organisations. At best, government might be able to contribute to the pre-conditions for the emergence of entrepreneurial ecosystems, for example, through highly selective inward investment policies. However, it is doubtful that policy can systematically 'create' entrepreneurial ecosystems.

Second, policy approaches need to evolve over time. Ecosystems are dynamic, complex organisms. Appropriate forms of intervention will therefore be related to the maturity of the ecosystem. For example, at the emergence stage the emphasis may need to be on supporting the start-up processes, but as the ecosystem matures the need to help firms with organisational development, human capital development, internationalisation support and access to growth capital will increase..

Third, here is no 'one size fits all' approach. Every ecosystem is unique. Many of the components will differ from one ecosystem to another. Local cultural attitudes, the structure of local banking systems and educational policies will all affect the nature of these local ecosystems. An approach which simply seeks to duplicate other ecosystems is therefore inappropriate and likely to fail.. Every ecosystem needs a different approach that is customised to local circumstances. This is underlined by the proliferation of 'Silicon Somewhere' (Hospers et al, 2008) which have largely turned out to be policy-driven promotional exercises which paid little attention to the specific nature and capabilities of the specific localities (Martin and Sunley, 2003).

Fourth, initiatives are likely to be ineffective if introduced in isolation. For example, increasing the supply of venture capital is unlikely to be effective if there is no deal flow. Encouraging more people to create start-ups is likely to have little impact if many occur in low growth areas. Introducing entrepreneurship education will be ineffective if graduates move to more conducive entrepreneurial environments. Policy implementation has to be holistic.

Fifth, developing entrepreneurial ecosystems has to be a blend of 'top down' and 'bottom up' approaches. Appropriate framework conditions are essential. For example, immigration laws should not provide a barrier to the attraction of talented individuals. Property rights need to be enshrined. Both corporate and individual taxation needs to provide appropriate incentives both to reward risk-taking and encourage reinvestment. On the other hand, grants and subsidies should be avoided as they may distort entrepreneurial behaviour. But there also a need for 'bottom up' initiatives to improve the environment.

FORA sees this as providing the ‘glue’ to connect the various actors in the ecosystem. Moreover, these bottom up initiatives should not be seen as the exclusive responsibility of government. As noted earlier, Feld strongly argues that the development of entrepreneurial ecosystems requires active input from the entrepreneurial community. FORA argues that strong support from the major businesses in the ecosystem is also essential and, critically, that such involvement is motivated by commercial, rather than corporate social responsibility, considerations (Ebdrup, 2013). Yet policy-makers rarely seek to engage with the larger firms in the ecosystem. Isenberg (2012) sees the possibility of ‘tipping points’ when ecosystems become self-sustaining, thereby enabling government involvement to be significantly reduced.

Sixth, it is important to recognise the distinction between small business policies and entrepreneurship policies. Small business policy is a rather scattergun approach which focuses on increasing the number of business start-ups. Shane (2009) has memorably described this approach as ‘bad public policy’ on account of their limited growth, short survival and high failure rates and high displacement of the vast majority of start-ups. Nevertheless, this approach is deeply embedded in public policy (Nightingale and Coad, 2014). Entrepreneurship policy, in contrast, is concerned with supporting businesses with high growth potential. Such firms are more likely to require relational rather than transactional assistance. Moreover, they are likely to benefit most from peer-based support (Fischer and Reuber, 2003; Mason and Brown, 2013) on account of the greater opportunities for experiential learning and tacit knowledge sharing. Moreover, in view of the “idiosyncratic and unstable” nature of firm growth (Vinell and Hamilton, 1999) such support needs to be time-sensitive, aimed at supporting firms that have experienced ‘growth triggers’ and therefore experiencing systemic changes to their structure and workings (Brown and Mawson, 2012).

Finally, policies to promote high growth entrepreneurship need to recognise the diverse nature of HGFs rather than basing them on stereotypes (Mason and Brown, 2013; Brown et al, 2014). At least ‘six myths’ can be identified (Brown et al, 2014): HGFs are not all new/young; they are not predominantly in high tech sectors; universities are not a major source of HGFs; few HGFs are venture capital-backed; they do not exhibit liner growth – fast growth is episodic; and they do not only grow organically – acquisition is also significant.

Approaches to Policy

We propose a taxonomy which recognises four aspects of the entrepreneurial ecosystem that can be targeted by policy makers (both national and regional). These are as follows:

- entrepreneurial actors within ecosystems
- entrepreneurial resource providers within ecosystems
- entrepreneurial connectors within ecosystems
- entrepreneurial orientation with ecosystems

Entrepreneurial actors within ecosystems.

Virtually every country has a range of enterprise policies to promote the creation and growth of new business ventures. The key forms of support are typically information and advice for new entrepreneurs (Bennett, 2008; 2012). These policies typically do not differentiate between the types of start-ups targeted (Shane, 2009). And, as noted earlier, these approaches are not designed to promote high growth entrepreneurship. Hence, there is a need to focus specifically on encouraging the formation of *high-growth* start-ups within regional ecosystems. The main approaches are as follows: (i) the provision of assistance to entrepreneurs during the pre-start-up, start-up and early post-start-up stages through the provision of

intensive support and mentoring (Roper and Hart, 2013); and (ii) support for start-ups through business incubation which provides business premises, advice, networking opportunities and finance (Miller and Bound, 2011).

Private sector-led business accelerator programmes are also being established to help nurture the fledgling ventures (Miller and Bound, 2011). These are particularly common in ‘entrepreneurial rich’ ecosystems such as Silicon Valley (e.g. Bluseed, Y Combinator, 500 Start-Ups), Boston (Techstars) and New York (NYC Seedstart). Some operate in both the USA and other entrepreneurial hot-spots like Israel (e.g. DreamIt Ventures). In contrast to traditional incubators, which were based on a rental income approach (Kemp and Weber, 2012), these newer versions typically operate on an equity-based funding model characterised by competitive entry and time-capped presence in the programme. A significant feature of these programmes is the fostering of entrepreneurial communities which, in turn, facilitates tacit knowledge sharing (Gertler, 2003; Gray, 2006). This private-sector model is less common outside on the USA, and those accelerators which do exist frequently have public sector support.¹⁶ Accelerator programmes are typically located in physical premises. However, some are virtual. A good example of a public sector-led, virtual approach towards business is the Scottish Enterprise’s High Growth Start-Up Unit (HGSU) which works intensively with a small number of high potential early stage firms to help them access public sector resources (e.g. innovation support, access to finance etc.) to enable them to grow rapidly. Embedded within this new policy focus is the belief that firms need to be able to be better connected to other entrepreneurial actors, such as business angels and mentors. Many public sector incubators also involve universities because connections to universities are seen as a vital source of new knowledge and innovation for firms to access and exploit. Unlike, the private sector approach towards business incubation most public sector programmes, like the HGSU, are undertaken with nascent businesses irrespective of where they are located. A consequence of this is that they do not gain the networking benefits which accrue to the firms which actually co-locate within a physical incubation or accelerator space.

Entrepreneurial resource providers within ecosystems

A second strand of policy is a focus on organisations within ecosystems which provide resources to entrepreneurs. This includes finance providers such as banks, angel groups and venture capital firms and also service providers. A key focus is enhancing ‘access to finance’ by increasing the supply of risk finance (Lerner, 2010). In response to perceived market failures, the public sector has been actively involved both directly and indirectly in creating new sources of venture capital to mixed effect (Murray, 2007; Lerner, 2009; Mason, 2009). This has included the creation of regional venture capital funds, usually taking a ‘hybrid’ form in which both public and private sector money is combined under private sector management. However, there is growing criticism of this approach (Murray, 2013). Encouraging business angel investment is arguably more effective as it provides seed and start-up capital and its hand-on nature means that investor’ typically invest in businesses that are close to home. Underwriting the operating costs of business angel networks which operate as ‘dating agencies’ to enable investors and entrepreneurs seeking finance to more easily find one another has been a common form of support over the past twenty years (Harrison and Mason, 1996; Mason, 1999).

However, over-emphasis on risk capital is inappropriate as only a small minority of firms utilize this form of finance (as shown earlier.) Greater attention should be given to connecting growth-oriented SMEs

¹⁶ Although the overwhelming majority of growth accelerator programmes in the US are private sector led, a number of them, such as Betaspring accelerator programme in Providence, Rhode Island, are supported using public money. However, data on the effects of public sector involvement in this programmes is limited and merits further examination (Miller and Bound, 2011).

with sources of conventional expansion capital such as banks loans and newer former of finance such as crowdfunding, peer-to-peer lending and invoice-based finance (Collins et al, 2013). This is especially important as policy makers try and move firms from start-up phase to ‘scaling up’ (Isenberg, 2013). Improving access to stock markets is another important objective (Amini et al, 2012). Beyond finance, HGFs require relational resources, including include peer-to-peer interactions, connections to growth capital and organizational development (Brown et al, 2014). Indeed, this is one of the central aims of the UK’s new Future-Fifty programme established by the UK government which is creating a virtual ecosystem of UK HGFs (Box 2) More collaborative engagement between policy makers and large firms to help develop and accelerate the process of entrepreneurial incubation within ecosystems is also appropriate.

Box 2. The UK’s Future-Fifty Scheme programme

This programme is funded by the UK Department for Business Innovation and Skills (BIS). The UK government launched the Future-Fifty programme in October 2013 with the aim of promoting 50 of the UK’s most rapidly growing businesses. This approach specifically targets very rapidly growing companies who are experiencing critical growth trigger points or ‘pivot points’ (Pickford, 2013). An additional key feature of this policy intervention is the recognition it pays to the need for a more connected or systemic approach towards policy intervention. This brings together a network of entrepreneurial companies for intensive levels of support and connections to key sources of funding, entrepreneurial mentoring and government support. It is a competitive scheme and applicants must have £10m in net revenue with 30 per cent growth in revenue over the previous two years. The programme is highly customised towards the specific needs of these highly dynamic growth-oriented businesses which are embarking upon a period of transformative growth. The participants will be introduced to institutional investors and receive guidance from professional services companies, investors and veteran entrepreneurs on how to approach a public listing or undertake a big expansion. Another unique facet of this policy is that it will adopt a ‘concierge-style’ approach which connects these firms with key resources within various government departments such as BIS, UKTI and HMRC. The first batch of applicants has just been announced and includes mostly digital media, software and life science firms across the UK. An interesting feature of the programme is that it has recruited a foreign-owned firm from outside the UK on to the programme.

Source : <http://www.futurefifty.com/>

Entrepreneurial connectors within ecosystems

The third strand is public policies that have been implemented to foster connections between different components within entrepreneurial ecosystems. Policies have sought to build bridges between different entrepreneurial actors through the creation of communities of practice or entrepreneurial networks. These can take many forms including professional networking organisations, entrepreneurship clubs, VC-backed groups, professional associations, and diaspora associations. They can be formal organisations which operate various rules, regulations and membership criteria. For example, some professional networking organisations only allow entry to established entrepreneurs who have grown a sizeable business with a certain level of turnover (e.g. Scotland’s Entrepreneurial Exchange). CONNECT, based in San Diego, USA is widely regarded as one of the world’s most successful organizations linking inventors and entrepreneurs with the resources they need for commercialization of innovative products (Walshok et al, 2002) (Box 3). The program has been modeled in more than 50 regions around the world. Alternatively, connectors can be very informal organisations designed to foster various entrepreneurial communities. For example, the rapidly growing digital media hub in London called Silicon Roundabout runs a social club called the ‘London Tech Meetup’ which includes a ‘Minibar’ and ‘Open Coffee’ to promote networking and knowledge exchange in early-stage entrepreneurs (Miller and Bound, 2011). Similarly, the Banks Foundation for Young Entrepreneurs in Seoul, South Korea has created the hub, called D Camp, to give members contacts to mentors and banks. Finally, we noted that particular individuals – the *liason-*

animateur - also play an important role as connectors and should also be identified and supported. In some cases these individuals will be in the public sector but may also be found in the third sector.

Box 3. CONNECT Programme

CONNECT is a regional program that catalyzes the creation of innovative technology and life sciences products in San Diego County by linking inventors and entrepreneurs with the resources they need for success. It was originally founded as a part of the University of California (UC) San Diego in the mid-80s at a time when traditional industries in the region were on the decline, the attraction of companies to the San Diego region was very difficult and region leaders were searching for a path to economic renewal and sustained growth. Meanwhile, innovative high tech and life sciences companies were quietly developing in the San Diego region, fueled in part by technology and scientists at the region's research institutions. This was recognized an opportunity for CONNECT to transform San Diego's growing research capabilities into commercially viable products and businesses that would ultimately increase the prosperity of the region.

By leveraging the various assets within the region, CONNECT focuses its efforts on accelerating the commercialization of new technology and life sciences products. While that mission has stayed relatively true since its initial creation, the organization and its program offerings have continued to evolve in response to the changes in the region's economic climate.

The organization views its "sweet-spot" as the "beginning of the food chain" – the point when the market potential of an innovation is being assessed and then commercialized. Toward this end, CONNECT works with innovators in research institutions, early stage and growth companies and major corporations. Whether a company is looking to spin out or license an innovation, launch a second or third product into a new market or evaluate the commercial potential of a discovery CONNECT has experienced entrepreneurs-in-residence who can assess the innovation and coach the innovators through the process.

Source : <http://connect.org/about-connect/>

Entrepreneurial orientation with ecosystems

Culture, and specifically, positive societal norms and attitudes towards entrepreneurship, have been recognised as a key component of entrepreneurial ecosystems (Isenberg, 2011). Entrepreneurial aspirations will be inhibited in societies where the societal contribution of entrepreneurs is not valued, where the social status of entrepreneurs is low, where their financial success is resented and where failure is viewed negatively. For example, in Singapore entrepreneurs do not enjoy a high social status and families prefer their children to seek jobs in large multinationals. As a consequence foreigners are the sources of most new start-ups on the island. Perceptions of entrepreneurship which are measured in the Global Entrepreneurship Monitor (GEM) survey are fairly stable over time, suggesting that these attitudes are deeply engrained. Some evidence suggests that they make require a generation to alter (Davidsson, 1991). Moreover, there is a cumulative and reinforcing nature of low levels of entrepreneurship in many ecosystems (Venkataraman, 2004). Regions with the greatest numbers of entrepreneurs have the most positive attitude towards entrepreneurship.

Three policy approaches can be recognised. First, there has been a strong focus on enterprise education in schools, colleges and universities to promote positive attitudes towards entrepreneurship and the creation of entrepreneurial campuses (Mason, 2014) to support current and recent students to start businesses. Second, in view of the strong association between entrepreneurship and in-migration and, more broadly, Florida's (2002) argument that the 'creative class' is a key driver of economic development, many places have sought to implement place-based initiatives, particularly based around culture, in an effort to become attractive to this group. Third, there is a need for events to serve as rallying point for local entrepreneurship and to promote and celebrate local entrepreneurship (box 4). In some countries, policy

makers are now beginning to explore the importance of entrepreneurial ambition as a key factor which shapes and drives the entrepreneurial process within economies.

Box 4. Celebrating entrepreneurship and innovation: the Bezos Center for Innovation, Seattle

Seattle's Bezos Center for Innovation, located at the Seattle Museum of History and Industry, funded by Jeff Bezos, founder of Amazon, is an attempt to explore the idea that innovation is a key part of the city's identity. Throughout the galleries are a series of lined video interviews with twenty local innovators, speaking about why they chose to live in Seattle and what it is about the region that inspires their work. This creates a sense that Seattle is not another secretive, silo-heavy Silicon Valley, but rather a network of multidisciplinary personalities working alongside each other and who have influences each other's work. The design addresses how aspects of the innovation process pervade all disciplines, not just technology, and that it is possible to find inspiration from innovators working in different disciplines to one's own and well as within it. Bringing this collaborative process to life was one of the primary goals of the space.

Source : <http://gizmodo.com/a-bezos-funded-center-for-innovation-explores-seattles-1493378901>

A final question concerns the method of intervention. The literature is largely silent on this issue. However, Isenberg (2012) argues that whereas governments have the mandate to intervene they do not necessarily have the competence to do so effectively. He therefore advocates that intervention should be created by a new organisation – an entrepreneurial enabler - that has the competence and motivation to enhance the ecosystem. Such an organisation, he suggests, would have the following features: a public mandate; the perspective; the training; the resources. It would have to be independent, not owned by any single part of the community. It would know how to experiment, learn, re-orientate, scale and spin-off activities. It would be accountable for reaching a tipping point where intervention is no longer required. And it would be temporary, with a clear lifespan and sell-by date.

Metrics for Entrepreneurial Ecosystems

Policy-makers need to have an understanding of entrepreneurial ecosystems in order to intervene effectively. This requires that entrepreneurial ecosystems are measured. As Vogel (2013: 9) has argued, “if we do not measure the effectiveness of the various components in an ecosystem as well as the ecosystem as a whole, we will not be able to improve existing programmes and put in place new and complementary sources” (Vogel, 2013b: 9). Metrics can help to determine the strengths and weaknesses of individual ecosystems, which in turn can help to interpret its special qualities or deficiencies and the strength of the ecosystem over time. It also enables the impact of policy intervention to be gauged. From an external perspective the measurement of individual entrepreneurial ecosystems enables them to be benchmarked against other ecosystems, both in the same country and in other countries. This can highlight aspects of individual entrepreneurial ecosystems that that may be underdeveloped. The FORA Group's approach to benchmarking was based on four measures: deal makers (as defined earlier), venture capital, patents and location coefficients (Ebdrup, 2013). At the other end of the spectrum, Vogel (2013a; 2013b) has used a variety of secondary sources to create an entrepreneurial ecosystem index based on three levels: individual,

Table 2. An ecosystem index

Scale	Measures
Individual	<ul style="list-style-type: none"> • Culture index • Personal wealth index • Work and life satisfaction index

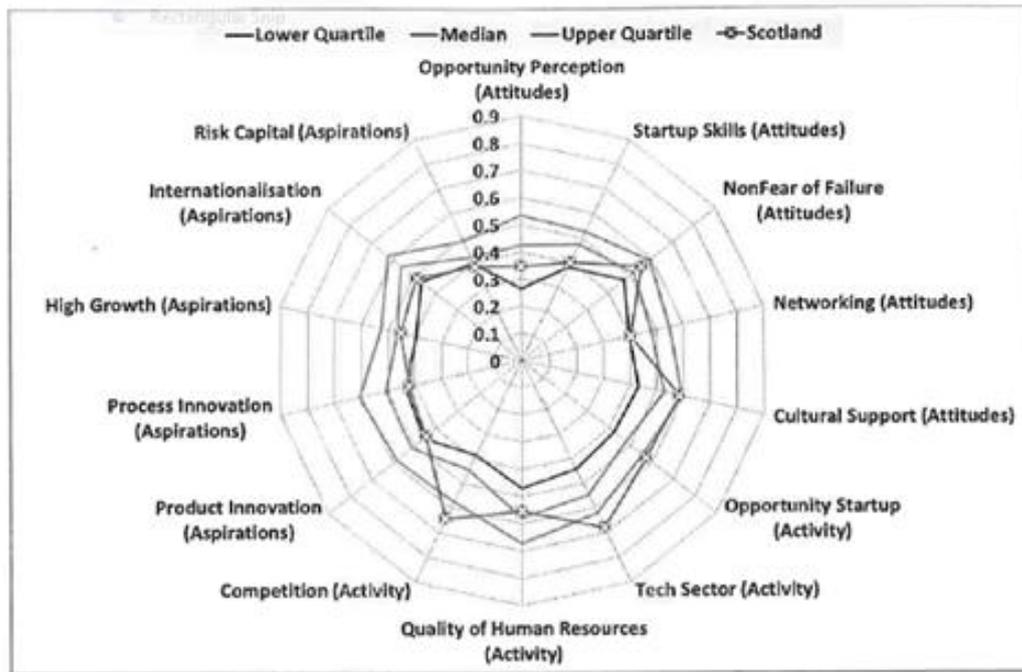
Organisation	<ul style="list-style-type: none"> • Organisational performance
Community	<ul style="list-style-type: none"> • Policy index • Market index • Location index • Job creation index • Infrastructure index • Visibility index • Support index • Network index • Talent index • Funding index • Education index • Innovation index • New venture index

Source: Vogel, 2013

However, measurement is far from straightforward. It poses challenges both in terms of defining what to measure and how, and identifying appropriate data which may not be available at the necessary level of geographical disaggregation. The reality is that there are few appropriate data sources available to measure entrepreneurial ecosystems, hence proxy measures are typically used. This has prompted various organisations to propose their own systems of entrepreneurial ecosystem metrics. This can meet the challenge of measuring the performance of specific ecosystems to be measured over time. On the other hand, a diversity of approaches to measurement militates against benchmarking. Accordingly, it is essential that the development of policy-relevant metrics for measuring entrepreneurial ecosystems is done on a collaborative basis under the auspices of an international organisation such as the OECD, analogous to the way that it has promoted a single measurement for defining HGFs (OECD, 2008).

An alternative approach to measurement is the Regional Entrepreneurship Accelerator Programme (REAP) which has been developed by The Massachusetts Institute of Technology (MIT) as a tool for policy makers to measure the regional entrepreneurship ecosystem using a combination of objective data (to measure ‘activity pillars’) and perceptual measures to identify bottlenecks and weaknesses (although strengths could also be identified in this way). This assessment is structured around six themes: people, funding, infrastructure, policy, rewards and norms, and demand. The networks that are in place to link these capabilities is also assessed. The analysis is performed on a comparative basis using a spider diagram (see Figure 2). The next stage involves the assembling of experts to examine those aspects of the ecosystem that have been identified as weaknesses. These meetings each produced summary reports which the REAP team used to identify priority themes for action. High Level Task Forces were then established to develop solutions.

Figure 2. REAP analysis: Scotland versus 27 innovation-driven economies



Source: Levie et al., 2013

Here again, the problem with this approach is that it is data-driven. Some aspects of an ecosystem can more easily be measured than others. Moreover, much of the data is only available at the country scale, making it potentially difficult to apply at the sub-national scale. It is therefore fairly crude and partial in terms of what it tells us and mainly focuses on inputs (such as risk capital, attitudes towards start-ups) rather than outputs such as number of HGFs, levels of high growth ambition and demand for and access to sources of growth capital from banks etc. The metrics used to assess ecosystems require further enhancement before determining which are the best and most practical criteria to use.

Conclusions

The concept of entrepreneurial ecosystems draws upon a long and rich lineage of intellectual inquiry by scholars from economic geography, economics and other disciplines, all seeking to explain why firms cluster together in geographical space and benefits that arise from this clustering for individual businesses. So, what does the entrepreneurship ecosystem perspective offer that is intrinsically 'new' or original? First, it has merit as a metaphorical device which offers a holistic understanding how clusters of economic activity come into being and specifically to offer a new perspective on firm growth which emphasizes the firm's external environment rather than its internal characteristics and operations. Second, it shifts the unit of analysis away from the 'firm' to the entirety of the ecosystem where it is situated. This is important because often these externalized and relational aspects strongly mediate firm performance. It is also important to stress the dynamic nature of ecosystems as evolutionary rather than a static phenomenon that can be captured, like a picture, by a snapshot at a given point in time. Third, its biological metaphor links to the 'economic gardening' approach to local economic development (SBA, 2006). It therefore emphasises the importance of viewing the wider ecological environment in which firms operate. Specifically, it emphasizes that firm growth occurs in specific types of environments. Moreover, and perhaps surprisingly, such environments are different to those which promote high rates of new business

starts. Fourth, it also de-emphasises the importance of firm size. First, ‘small’ size is not emphasized at the expense of the ‘large’ firm. Indeed, a key finding and perhaps an unexpected lesson from this work is that big firms still matter (Harrison, 1994; Isenberg 2011b). A key contributor to the dynamics of all ecosystems is large incumbent firms which spawn entrepreneurial managers who are capable of establishing and growing businesses. Finally, with the emphasis on firm growth, size is seen as a ‘temporary state’ and hence not given undue emphasis. Nevertheless, the entrepreneurial ecosystem perspective recognizes that high growth firms make a disproportionate contribution to economic growth and need to be actively fostered to generate further rounds of ‘blockbuster entrepreneurship’.

From a policy perspective, the implication from the entrepreneurial ecosystem view is that the goal of generating more HGFs requires the cultivation of an ecosystem that is supportive of the needs of ambitious entrepreneurs. Beyond that, its value as a tool to guide policy – and HGF policy in particular – is less obvious. Indeed, it emphasizes the limits of policy. Certain basic economic and social factors need to be present for the emergence of ecosystems, but these on their own are insufficient. Entrepreneurial ecosystems emerge and evolve in response to specific circumstances, usually operating in combination. In some cases it is triggered by the contraction or closure of an established company. Hence, policy is unable to influence when an entrepreneurial ecosystem develops momentum. On the other hand, the spin-off process, which drives the growth of the ecosystem, is facilitated by particular environmental attributes, notably the presence of talented people, knowledge, networks, the presence of role models and the availability of advice, mentoring and resources to support entrepreneurial activity. Indeed, the more entrepreneurial activity there is, the more that further entrepreneurial activity is stimulated. This provides greater opportunities for policy intervention. However, some of the leading proponents of the entrepreneurial ecosystem approach question whether government has the competence to intervene directly and so urge caution, recommending instead that it should encourage, facilitate and enable both the entrepreneurial community themselves and the large established businesses that anchor the ecosystem to drive it forward.

This brings us back to the point that has recurred throughout this paper, namely that despite sharing various common characteristics every ecosystem is different. So, what works in Boulder (or wherever) may be less effective, or not work at all, somewhere else. Efforts to create or, more realistically, cultivate entrepreneurial ecosystems need to develop an individualised approach that works sympathetically with a region’s existing entrepreneurial assets. In turn, newer forms of customised and collaborative business support are needed to help foster the entrepreneurial conduits – like large firms and funding institutions- and inter-linkages within ecosystems. These newer forms of policies will require a significant shift away from the dominant focus on conventional transactional incentives which continue to dominate most policy frameworks (Brown et al, 2014).

A final thought concerns policy outcomes. First, since successful entrepreneurial systems are likely to have had some pre-existing economic advantages, this approach will involve governments supporting locations that are already favoured over those that are not. Second, the successful promotion of entrepreneurial ecosystems will create spatial inequality. Third, as Silicon Valley shows, successful entrepreneurial ecosystems generate huge internal inequalities. What is done for the spatial ‘losers’ that are produced by this policy is unclear.

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