

Places are not like people: the perils of anthropomorphism within entrepreneurial ecosystems research

Ross Brown^a , Suzanne Mawson^b  and Augusto Rocha^c 

ABSTRACT

The concept of entrepreneurial ecosystems (EEs) has quickly established itself as a major focus within regional development research. A key conceptual framing commonly adopted by scholars theorizing about the growth and evolutionary dynamics of EEs is via anthropomorphized life-cycle models. In this article we offer a critique and argumentation as to why the validity of this approach is spurious and contestable. Arguably, life-cycle-based models overly simplify these complex spatial entrepreneurial phenomena and convey the temporal evolution of EEs as a simplistic, linear, deterministic and path-dependent process. Despite the seductively simplistic appeal of life-cycle models, places are not like people and the uncritical adoption of such crude anthropomorphic framings potentially weakens this research field, at the same time as running the risk of misinforming policymakers.

KEYWORDS

entrepreneurial ecosystems; life cycles; path dependence; public policy

JEL O18, O31, O38

HISTORY Received 22 October 2021; in revised form 8 October 2022

1. INTRODUCTION

During the last decade, the concept of entrepreneurial ecosystems (EEs) has vividly captured the imagination of regional development scholars (Alvedalen & Boschma, 2017; Audretsch & Belitski, 2021; Brown & Mason, 2017). The concept has proliferated so rapidly that it has swiftly assumed the mantle of ‘word du jour’ within regional research (Lowe & Feldman, 2017, p. 2). Regional policymakers have also keenly embraced the concept, marking it out as the latest regional policy ‘blockbuster’ (Brown & Mawson, 2019; Malecki, 2018; Stam, 2015). By entering the policy lexicon, the concept joins a long list of the hot spatial concepts over the last 20 years bridging the gap between academia and public policy including, *inter alia*, clusters, innovation systems, Smart Specialisation and related variety (Rocha et al., 2021).

In the growing entrepreneurship literature on EEs, they are viewed as a systemic constellation of interconnected organizations, institutions, actors and actions facilitating entrepreneurial activity within a localized spatial environment. The EE concept is systemic and ‘fundamentally spatial’ in nature (Malecki, 2018, p. 7; Fredin & Lidén, 2020; Perugini, 2022). Powerful centripetal forces ensure that entrepreneurs are drawn to, and inextricably

bound together with, other core entrepreneurial actors in close geographic, institutional and relational proximity (Alvedalen & Boschma, 2017). The resultant dense myriad of external connections and social capital is considered crucial for spawning and nurturing innovative start-ups and small and medium-sized enterprises (SMEs). Initially, many EE scholars adopted a life-cycle framework from the entrepreneurship literature to depict the temporal evolution of EEs, however over time research has called into question the veracity of this conceptual framing (Cho et al., 2022). We thus believe that a lot has changed since the adoption of early conceptual perspectives within the EE literature and that it is important now, more than ever, to consider the link between the conceptual framings used within EE research and the explanatory power they have for further developing the field. This debate article queries the relevance today of life-cycle models to explain EEs and argues that they are insufficiently nuanced to capture the innate complexities inherent in these multifaceted and ever-changing phenomena.

While the intellectual origins and lineage of the EE concept are somewhat opaque (Acs et al., 2017), its systemic focus is firmly interlinked with other widely deployed conceptual frameworks from regional development such as regional clusters (Alvedalen & Boschma,

CONTACT Ross Brown  Ross.Brown@st-andrews.ac.uk

^aSchool of Management, University of St Andrews, St Andrews, UK

^bHunter Centre for Entrepreneurship, University of Strathclyde, Glasgow, UK

^cUniversity of Edinburgh Business School, University of Edinburgh, Edinburgh, UK

2017). Indeed, scholars (and policymakers) often erroneously conflate the terms (e.g., Li et al., 2022; O'Shea et al., 2021), which may stem from persistent definitional ambiguities surrounding the concepts. A plethora of definitions of EEs exists, some detailed, some sparse (Rocha et al., 2021). An example of the latter, simply and somewhat vaguely view EEs as 'a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship' (Stam, 2015, p. 1765). To avoid any terminological ambiguities herein, we wish to clearly delineate the nature of the EE phenomenon by adopting the following widely used expansive definition of EEs as:

[a] set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organizations (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.

(Mason & Brown, 2014, p. 5)

This detailed definition clearly conceptually differentiates EEs from other spatial concepts such as clusters and shows they 'represent different phenomena with specific socio-economic configurations' (Rocha & Audretsch, 2022, p. 14). While clusters are often indelibly linked to a particular sector or technology (Iammarino & McCann, 2006; Suire & Vicente, 2014), EEs are a much more amorphous concept spanning multiple different sectors, technologies, actors, institutions and contexts. Perhaps a key point of differentiation between EEs and earlier conceptual frameworks is the stronger focus on agency in terms of the key entrepreneurial actors, the lack of sectoral focus and a stronger emphasis on the socio-economic and cultural aspects underlying entrepreneurship within EE research (Muñoz et al., 2020). It is now increasingly recognized that regional social legitimacy influences the relationships between individual entrepreneurial beliefs, intentions and start-up behaviour and how these interaction effects are conditioned by the socio-economic characteristics of a region (Kibler et al., 2014). Added to this is the strong role ascribed to institutions in shaping entrepreneurial behaviour in different locations (Audretsch & Belitski, 2017). Culture and norms that define institutional environments 'are nebulous and difficult to quantify', but they find 'material expression' in how they support and mediate entrepreneurial developments (Lowe & Feldman, 2017, p. 4). Therefore, cumulatively ecosystems are a very complex 'combination of social, political, economic, and cultural elements within a region' (Spigel, 2017, p. 50).

Despite the strong uptake of the EE concept in academic circles, significant knowledge gaps remain. Scholars

have ruminated on the weak theoretical and conceptual underpinnings of the EE concept, which are arguably holding back this field of academic enquiry (Alvedalen & Boschma, 2017; Fredin & Lidén, 2020; Spigel & Harrison, 2018). Indeed, Brown and Mason (2017, p. 15) claim that 'initial conceptualisations of EEs appear to be somewhat under-socialised, lacking a time dimension and fail to incorporate the full complexities of the socio-spatial context mediating entrepreneurship'. As a result, the EE literature has struggled to comprehensively understand both the structure of EEs and their influence on the entrepreneurship process (Spigel, 2017). Thus, a proper understanding of their inner workings, interconnectedness and variance across such systems is lacking (Harris, 2021a). In light of such challenges, scholars have increasingly looked at a range of conceptual framings and theoretical models to develop the EE concept further and thus improve its explanatory power. As with its conceptual predecessors, such as clusters, it appears that scholars may be culpable of going down some theoretical 'rabbit holes' with regard to EEs resulting from the conceptual schemata being adopted.

Over a decade ago, Martin and Sunley (2011) took issue with the rapid adoption of life-cycle models in evolutionary geography research, voicing concern over the implications of this approach towards understanding the complex and dynamic nuances of the cluster phenomenon. The view that all clusters will eventually go through the same uniform process starting with emergence and culminating with decline was seen as too linear and path dependent (Harris, 2021a). While the legitimacy and limitations of life models in the field of economic geography are now well-recognized, they have nevertheless permeated to other related research fields, specifically into the discrete but related field of EE research. Indeed, 10 years on, life-cycle framings are now a 'emerging trend' within EE research (Cloutier & Messeghem, 2021, p. 1) and one that is gaining significant traction in the literature (e.g., Auerswald & Dani, 2017; Cantner et al., 2021; Colombelli et al., 2019; Mack & Mayer, 2016; Nicholls-Nixon et al., 2020). Life-cycle models have long been linked to entrepreneurial and economic phenomena (Martin & Sunley, 2011) within the entrepreneurship literature, where they apply the key developmental stages of the human experience (i.e., birth, adolescence, maturity, decline and, ultimately, death) to organizations or places and, by extension, their activities and processes. Indeed, the firm growth literature is replete with studies adopting this conceptual schema (Brown & Mawson, 2013; Levie & Lichtenstein, 2010), despite the manifest limitations of 'organismic metaphors' to understanding development and growth of firms and organizations (Phelps et al., 2007, p. 1).¹

Predominantly led by the work of entrepreneurship and management scholars, life cycles are now deeply anchored as the conceptual framing of choice within EE research, with a growing number of recent studies explicitly (and many implicitly) adopting this conceptual lens to examine and describe multiple spatial locations around

the world, including, *inter alia*, Phoenix, Washington DC, Turin, Toronto, Tokyo, Bangalore and Porto (Auerswald & Dani, 2017; Colombelli et al., 2019; Kapturkiewicz, 2021; Loots et al., 2021; Mack & Mayer, 2016; Nicholls-Nixon et al., 2020). Some of these early adopters cite the need for overarching conceptual and theoretical framings that account for the dynamism and instability pervasive within EEs, identifying a life-cycle model as an effective mechanism for reflecting temporal developmental changes within EEs (Cantner et al., 2021; Li et al., 2022).

We respectfully wish to disagree. In this critical debate article, we argue that the application of a life-cycle-based approach results in a crude oversimplification of a highly complex, unpredictable and fast changing reality. Furthermore, we argue that the life-cycle concept is not only diametrically opposed to the fundamental nature, principles and assumptions of EEs, it has the potential to limit our comprehension and thus further hinder the conceptual and theoretical development of EEs as a spatial concept. Thirty-five years ago, David Birch (Birch, 1987) warned against crude anthropomorphism with firms – he felt compelled to remind us that companies do not develop like human beings and that to ascribe a human life cycle to them can lead to false conclusions about growth patterns. Despite early warnings regarding the fundamental limitations of life-cycle models (Martin & Sunley, 2011), we are now seeing the same concept widely applied to entire EEs with no explicit or meaningful conceptual justification of its veracity and limitations within these contexts. This uncritical adoption of a crude conceptual framing potentially runs the risk of devaluing the field of academic enquiry within regional entrepreneurship research. Furthermore, an additional adverse knock-on effect is that these models can potentially misinform policymakers regarding how EEs operate, thereby limiting the effectiveness of any interventions. In addition to setting out the incongruence between the life-cycle concept and EEs, we also seek to identify some alternative conceptual frameworks. It is our hope that this paper will encourage others to question the ‘received wisdom’ emerging in the EEs literature, recognizing that *places are not like people* and that further consideration and development of robust conceptual and theoretical framings linked to the specificities of EEs is needed.

The remainder of the article is structured as follows. Next, we examine the intellectual antecedents of the life-cycle concept, looking to the evolutionary economic geography to understand how it has informed current conceptualizations within the entrepreneurship-based EE literature. We then present a critical review of the foundational principles and assumptions underlying life-cycle models. We identify a number of alternative frameworks for conceptualizing EEs that offer greater explanatory power. Following this, we conclude and show how EE framings based on life cycles may also have important detrimental policy implications.

2. AN EVOLUTIONARY PERSPECTIVE OF SPATIAL DEVELOPMENT

The theoretical antecedents of our critique of life cycles in the EE literature are intrinsically rooted in perspectives drawn from evolutionary economics and evolutionary economic geography (EEG). Under this perspective, the key focus is on the processes and mechanisms by which economies transform themselves from within. Under this neo-Schumpeterian perspective, flux and dynamism are the norm whereby ‘new firms, new products, new technologies, new industries and new jobs are added to the economy, whilst old firms, products, technologies, industries and jobs disappear’ (Boschma & Martin, 2007, p. 537).

EEG also recognizes disequilibrium, disturbances and discontinuity as cornerstones of spatial development. The ‘basic concern’ of EEG deals with the processes which shape ‘the economic landscape – the spatial organization of economic production, distribution and consumption’ and how these are temporally transformed (Boschma & Martin, 2007, p. 539). In other words, economic transformation unfolds differently in different places, and the mechanisms involved originate and operate unevenly across space. Therefore, geography is thought to play a pivotal role in the ‘evolutionary processes of variety creation and destruction, selection and continuity’ (Essletzbichler & Rigby, 2007, p. 566). That is why evolutionary thinking has been applied to define and improve existing theoretical concepts in economic geography, such as regional innovation systems and clusters (Hassink et al., 2014).

Despite this strong recognition of diversity and complexity, one common conceptual framing adopted in EEG within the clusters literature is a life-cycle approach (Bergman, 2007). According to some scholars, clusters ‘often follow an evolutionary path, where stages of infancy are succeeded by a growth phase, followed in turn by increasing maturity and subsequent stages of stagnation or decline’ (Maskell & Malmberg, 2007, p. 611). Central to this viewpoint is the notion of path dependence. In recent years, path dependence has been used to explain the process of cumulative, sequential technological, industrial or spatial development characterized by persistence and self-reinforcing mechanisms (Bergek & Onufrey, 2014). The general idea is that all clusters will eventually go through the ‘same immutable process’ starting with emergence and culminating with decline (Harris, 2021a, p. 3). Unsurprisingly, many of these studies suggest that clusters experience a life cycle closely related to the life cycle of the underlying industry of the cluster (Li et al., 2022).

Some contend there are five stages of a cluster’s life cycle: the initial stage, expansion stage, mature stage and decline stage (Brenner & Schlump, 2011). They claim that supporting start-up activities is most effective in the early phases of the cluster’s life cycle and that it plays a less important role in the mature stage. Some scholars even state that regions themselves can be characterized

as evolving over a predictable and well-defined life cycle (Audretsch et al., 2008). Of course, other scholars have taken issue with these somewhat simplistic pre-ordained linear life-cycle models (Harris, 2021a). According to some, the literature concerning cluster life cycles has grown rapidly and offers some useful points, but may have only collected the 'lowest-hanging fruit' (Bergman, 2007, p. 19). One critique concerns the fact that studies often focus on clusters in a particular 'stage' of their life cycle rather than viewed holistically (Harris, 2021a). Menzel and Fornahl (2010) offer a more nuanced depiction of clusters as going through four discrete stages: emergence, growth, sustainment and decline. Importantly, Menzel and Fornahl (2010, p. 210) claim that 'very few clusters follow a rigid life cycle from emergence to growth and decline. Their model has developed over time to include the processes of "adaptation", "renewal" and "transformation", providing clusters with more possibilities in their evolutionary trajectories' (Harris, 2021a). Indeed, they view their developmental process as iterative and non-linear involving 'a steady oscillation' between the different phases (Menzel & Fornahl, 2010, p. 219).

Other scholars are much more trenchant in their criticisms of life-cycle models stating 'there is no inevitability that a composite system such as a cluster will trace out a simple life-cycle type trajectory over time' (Martin & Sunley, 2011, p. 1303). This view chimes with other recent empirical work in the United States on information and communication technology (ICT) clusters, showing how clusters experience 'different patterns of concentration, dissipation, and stability over time, but we also find that clusters rarely follow stylized descriptions of cluster life cycles' (Kim et al., 2021, p. 20). Martin and Sunley hold that explanations of cluster development continue to be hamstrung by recourse to under-explained 'ageing' analogies and 'life-course' metaphors which 'needs a rethink' (Martin & Sunley, 2011, p. 1303). As well as critically questioning the validity of life-cycle models, they also propose a new way forward to look at the evolution of clusters rooted in complexity thinking. Drawing on institutionally and agency-based perspectives in economic geography others also view life cycles as 'inappropriate biological metaphors' due to their path-dependent nature and lack of consideration of entrepreneurial agency (Harris, 2021b, p. 1).

Interestingly, and perhaps worryingly, this ongoing debate within the EEG literature has not, as yet, permeated the EEs literature. While numerous observers have taken issue with validity and application of the ecosystem metaphor as a whole (Alvedalen & Boschma, 2017; Brown & Mawson, 2019; Isenberg, 2016; Spigel, 2020), to date there has been no specific critique of the use of life-cycle models within the context of EE research. This seems somewhat paradoxical because at heart of the EE metaphor is the importance of key actors and institutions which largely runs counter to the linear life-cycle models which downplay these forms of entrepreneurial agency. We agree with other scholars that it is important to critically reflect on what work has been done and what

knowledge has amassed about the contextual nature of the entrepreneurship process (Wurth et al., 2021) within and across disciplines. Given the marked conceptual differences between EEs and clusters as noted previously, especially the key role ascribed to key entrepreneurial agents and institutional actors, this begs an important question: do life-cycle models have any greater resonance for the phenomenon of EEs than for clusters? To investigate this question, we now turn to an examination of the key underlying principles and assumptions associated with life-cycle models as applied to EEs.

3. THE PRINCIPLES AND ASSUMPTIONS UNDERPINNING LIFE-CYCLE MODELS: A CRITIQUE

According to the early adopters of the concept, at the crux of the ecosystems metaphor is an explicit recognition of innate complexity, interdependency, turbulence, disequilibrium and self-regulation (Isenberg, 2016; Moore, 1993). Different spatial locations are shaped by such unique historical and social specificities that it makes unidirectional causation challenging, if not inappropriate, to explain how EEs emerge and develop over time. Ecosystem emergence thus involves 'feedback loops as well as coevolutionary dynamics between the systems' elements, and, thus, multi-directional causality' (Haarhaus et al., 2020, p. 7). This is in line with the hugely intricate, turbulent and non-recursive nature of wider biological ecosystems that EEs are deemed to mirror, where 'things like air, water and mineral soil, [interact] as a system' (Isenberg, 2016, p. 564).

Charles Darwin famously explained these complex and ever-changing biological ecosystems using the term 'tangled banks', in which:

plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner.

(Darwin, 1872, p. 429)

Following this, a natural ecological ecosystem is based on Darwinist evolutionary concepts of diversity, selection, diversification, adaptation, resilience and strength (Boschma, 2015). The saliency of the biological metaphor for EEs is the fact that it considers the interrelated concepts of complexity and diversity considered to be at the heart of the entrepreneurial process (Page, 2010; Roundy et al., 2018). No two biological ecosystems are the same: each operates in their own unique way. Scholars have thus emphasized the critical importance of appreciating 'the full complexity of the dynamics of entrepreneurial activity' within EEs (Brown & Mason, 2017, p. 26).

It is due to these intrinsic complexities and interdependencies that a fundamental tension exists between EEs as a spatial concept and the anthropomorphized conceptual framing of life-cycle models. Indeed, we find it somewhat

perplexing that a conceptual framing with theoretical underpinnings so different to those of the EEs concept would be so widely adopted with such little critical reflection. We do recognize, however, that anthropomorphized life-cycle models have become so normalized and widely used within the fields of entrepreneurship, economics and business that they have arguably become the dominant or de facto 'received wisdom'. As such, they are often explicitly adopted without question, or even implicitly (and unknowingly) adopted by virtue of application of their theoretical assumptions and underpinnings. Indeed, many scholars and practitioners have perhaps never thought it necessary to consider these assumptions and underpinnings, let alone their implications for EE research.

In order to identify the relevant EE literature adopting this conceptual perspective we undertook a literature search of the wider EE literature published during the previous five years (i.e., 2016–21). Our search procedure identified 12 life-cycle papers in the EE literature. To the best of our knowledge, this search strategy has captured the vast majority (if not them all) empirical peer-reviewed life-cycle papers published during this period. Relatedly, a recent systematic review of the EE literature shows that of the articles published on the evolutionary nature of EEs, most presented a life-cycle stage-based conceptual model (Cho et al., 2022). We now wish to explore this literature and its conceptual underpinnings. In this vein, we discuss two of the key principles embedded within life-cycle models, specifically (1) simplification of complexity and (2) linear path dependence. We will also consider the implications of these underpinnings for the explanatory power of anthropomorphized life-cycle models in the context of EEs.

3.1. Simplification of complexity

As noted, anthropomorphized life-cycle models follow the stages applied to the human experience – simply put, we are born, we grow, we reach maturity and then we decline until we die. These four stages have thus formed the foundation for the majority of life-cycle models (Moore, 1993).² The number of stages included in life-cycle models can of course vary and often appear to be used quite arbitrarily; authors seldom articulate a rationale or justification for their inclusion (or the exclusion of others). Confusingly, neither are there explicit demarcations staked out of what entrepreneurial metrics (e.g., number of startups, levels of equity finance, improvement in entrepreneurial networks, etc.) signify movement between the discrete stages.

Within the context of Phoenix, Arizona, some of the first scholars to adopt a life-cycle model declared that EEs undergo a fourfold evolutionary process of birth, growth, sustenance and then decline (Mack & Mayer, 2016). One recent study of Porto's creative industries EE identifies just two stages: birth and growth (Loots et al., 2021). Meanwhile other scholars claim that EEs undergo three main phases: birth, transitional and consolidation (Colombelli et al., 2019). Similarly, recent work

by Harima et al. (2021) also identified three key stages in the establishment of an 'resilient ecosystem' and a three-stage taxonomy (emergent, development, growth) was used to depict the Tokyo and Bangalore EEs (Kapturkiewicz, 2021). Others consider a potential fifth stage – one of 'reorganisation' (Auerswald & Dani, 2017) or 'potential re-emergence' (Cantner et al., 2021). Interestingly, this fifth stage is often explained as a possibility (Cantner et al., 2021), rather than an inevitability like every other stage is assumed to be.

Usefully, some more recently adopted life-cycle models are more nuanced than the more basic life-cycle schemas presented above. For example, whilst Spigel and Harrison (2018) offer a threefold life cycle of a nascent, strengthening and then a resilient (or alternatively a weakening) EE, this alternative trajectory acknowledges that there is scope for entrepreneurial agency in terms of an EE's temporal development. Meanwhile, Spigel and Vinodrai (2020) in their examination of the city of Waterloo in Canada also note the importance of different growth 'pathways' after an anchor firm closure. Under a standard life-cycle model this would doom a 'failing' EE to death. However, in adaptive EEs failure can be overcome, and can even serve as a learning experience building resilience in an ecosystem (Cho et al., 2022). Spigel and Vinodrai (2020) demonstrate that the evolution of an EE is subject to variegated outcomes from processes such as entrepreneurial recycling coupled with the retention of skilled workers. So rather than a simple linear process model, EE development is observed to unfold in a 'temporally dynamic, evolutionary process linked to a place's pre-existing institutional, economic, and cultural structures' (Spigel & Vinodrai, 2020, p. 18).

Interestingly, Schäfer and Henn (2018) use a staged approach to assess a sub-element of a wider EE. They identify three stages of transnational entrepreneurs' involvement in the Israeli EE to denote how the role of these actors changed with the stage of ecosystem development (Schäfer & Henn, 2018). Similarly, others note a sequential evolution – i.e., initiation, relationship building (or development), maintenance, and renewal – in terms of network development in EEs (Scott et al., 2022). This tends to demonstrate that while a straightforward life-cycle approach lacks the capacity to capture the inherent flux temporally underlying the evolutionary process of entrepreneurship within EEs as a whole, it may offer some insights into the evolutionary dynamics in the sub-components of an EE.

Fundamental to all the above life-cycle models, irrespective of the number of stages, is the simplification of complexity. An EE's developmental journey is mapped to a generalized stage, within which generalized behaviours, characteristics and interactions are expected to be observed. As Cantner et al. (2021, p. 13) state, EEs 'follow an archetypical life-cycle model from birth and an initial phase towards phases with an increasing population up to a maximum followed by a subsequent decline as the market and entrepreneurial opportunities also decline, followed by a potential re-emergence'. This simplification is

of significant concern when attempting to understand the inherent complexity of EEs. In order to be meaningfully applied, such generalized stages require the development of ‘archetypes’ that fit within that stage, resulting in significant generalization and simplification of the spatial locations being studied. This reliance on simplification of complex phenomena and equilibrium reflects the use of assumptions underpinning theoretical economics within entrepreneurship and EEG research, whereby archetypes built on simplified conditions are developed to minimize or eliminate the range of complex factors affecting a given situation.

Ironically, in his seminal work the famed American economist Frank Knight (Knight, 1921) argued that such simplification when used to explain complex situations affecting economic action will always be ineffective and incomplete. From an EE perspective, the idea of an archetypal EE runs counter to the fundamental assumptions of EEs as varied, diverse, distinctive and complex (Brown & Mason, 2017). In trying to map EEs based on simplified stages, scholars need to at best simplify (and at worst *discount*) the complexity that is contained within these places – and the very complexity that we seek to better identify and understand.

This issue of simplification of complexity has further implications linked to the assumption underpinning life-cycle models that an ‘object of study’ will become bigger, more developed, more complex and more capable over time. Just as this assumption has been largely discounted in recent years with regards to firm growth, we need to query whether this assumption is relevant for different EEs. Can we really assume that all places undergo an ‘ageing’ process akin to human beings, with incremental shifts in activity, complexity and outcomes? Not only is there significant difficulty in pinpointing when an EE is ‘born’, the varied nature of EEs means that development is inherently relative – some ‘young’ ecosystems may already demonstrate significant complexity aligned to inherent spatial variations. In this vein, Spigel and Harrison (2018) observe that nascent ecosystems should be treated as locations with lower connectivity levels, leading to issues about retaining and recycling entrepreneurial resources. Their process model recognizes a series of actors and processes already sustaining an ecosystem, although weakly connected. There is thus a terminological misconception with research that assumes that ‘nascent’ EEs can be pinpointed when there are in fact already a series of complex conditions in place supporting these ecosystems. Indeed, we are inclined to agree with other scholars who state that given the intrinsic complexity of EEs, identifying the most ‘influential mechanisms in their evolution is nearly impossible’ (Harima et al., 2021, p. 102).

We also need to consider historical and cultural specificities shaping the nature of an ecosystem, which are largely overlooked in basic life-cycle models. This may be because of the tension between longer term historical development and mapping to set developmental life-cycle stages and archetypes. It is also important to note that the temporal boundaries of EEs are inherently

‘fuzzy’ (Audretsch et al., 2021, p. 8) making delineation into distinctive or coherent life-cycle stages (or phases) deeply problematic. For example, when examining the city of Turin, some scholars claim that the EE originated in the 1980s (Colombelli et al., 2019), despite the city being a major hub of automotive production for over a century with an associated vibrant economic environment. This historical experience will undoubtedly mediate and shape the nature of the entrepreneurial culture at the present time. Thus, developing generalized archetypes based on a ‘one size fits all’ assumption of development stages is likely to hinder rather than improve the explanatory power of studies adopting a life-cycle framing (Martin & Sunley, 2011).

A possible by-product of this rather simplistic logic is shown in the huge dominance in policy frameworks focused on promoting start-ups as a means of conceiving or giving ‘birth’ to EEs (Brown & Mawson, 2019). Indeed, despite their central importance in fostering successful EEs, bespoke initiatives to encourage the internal connectivity within EEs are overwhelmingly overlooked in favour of basic replicative start-up programmes (Motoyama & Knowlton, 2016; Rocha et al., 2021; Roundy, 2019), regardless of the fact that most scholars strongly emphasize that public policy cannot overly engineer ecosystems through forms of ‘artificial insemination’ (Isenberg, 2016).

3.2. Linear path dependence

A second foundational principle underpinning life-cycle models is linear development, a unidirectional movement from one stage to the next in an orderly (and predictable) manner. Not only is this linear development inherently problematic, but also it gives rise to fundamental assumptions about path dependency – i.e., that development is a direct result of previous decisions/actions/interactions. Path dependency is based on non-reversible, linear and non-ergodic processes (Wurth et al., 2021), whereby paths are stable, self-reinforced and ‘locked in’ until altered by an exogenous change or ‘shock’ (Martin, 2010).

In the context of EEs this assumption is fundamentally self-limiting, implying a ‘closed system’ with little room for spontaneity, serendipity and consideration of the impact of (and potential for) unplanned/unforeseen developments regardless of scale. Indeed, such unifinal conceptions of causality are ill-suited towards capturing the inherent complex interactions that ultimately create the non-linear dynamics of EEs (Haarhaus et al., 2020), despite EE scholars starting to argue that path dependency can be viewed flexibly and in a non-linear (Cloutier & Messeghem, 2021) or determinist form (Wurth et al., 2021). Instead, there must be some consideration that actors have the ‘potential agency to enact moments of transformative change at times that would significantly change the evolutionary trajectories of the systems they are embedded within and break free from lock-ins’ (Harris, 2021a, p. 177). An in-depth empirical examination of Vienna’s EE (Radinger-Peer et al., 2018) provides scant evidence for the balanced evolution of the EE from birth

to growth, sustainment and decline, as postulated by some life-cycle theorists (Mack & Mayer, 2016). In contrast, it shows a non-linear evolution of the EE, with often contradictory developments within the various pillars of the ecosystem (Radinger-Peer et al., 2018). Therefore, the gradual accretion of entrepreneurial resources, institutional actors, entrepreneurial finance, innovative ideas and human capital ensures that EEs operate in a constant state of flux.

The core assumption of path dependency also conceptually challenges the notion of 'entrepreneurial agency' within different contexts and infers universalism in how EEs evolve and develop. Whilst used disparately, the implicit assumption within this viewpoint seems to be that all EEs somehow automatically make the linear transition beyond inception to a growth stage, then to maturity and ultimately decline. Despite this simplistic assertion, arguably many nascent or less dense EEs never really progress from inception into growth or a maturity phases. Indeed, there is now compelling evidence from rural, peripheral and fragile EEs (Miles & Morrison, 2020; Pickernell et al., 2022; Roundy et al., 2017) suggesting that structural and cultural barriers exist which prevent many EEs from becoming more developed let alone becoming 'mature' (Kibler et al., 2014; Xu & Dobson, 2019). Numerous studies also reveal new firm formation and survival is significantly more problematic in peripheral and remote EEs, where entrepreneurial deficits, population outmigration and resource deficiencies remain endemic and enduring (Freitas & Kitson, 2018; Roundy, 2019; Vedula & Kim, 2019). This often results in lock-in, whereby a weak entrepreneurial culture and intergenerational unemployment result in institutional hysteresis (Gherhes et al., 2018).

Under the linear path-dependent process implicit within life-cycle models, EEs are assumed to eventually wither and die (if they do not manage to 're-emerge'). However, there is a substantive lack of empirical support for this supposition. Indeed, dynamic EEs such as London, New York, Shanghai and Silicon Valley are constantly being reconfigured and reinvented to the extent they never (or only rarely) move into a decline, let alone death phase, as predicted by the life-cycle models. We often see that dynamic EEs continually reconfigure themselves and consolidate their locational advantages, even when disruptive new technologies could potentially undermine them. The case of London as a hub for fintech firms makes a good illustrative example (Sohns & Wójcik, 2020): despite these firms being able to operate anywhere in the world, London remains the primary European hub for fintech companies (Spigel, 2022). Even less illustrious locations such as dormant former industrial towns, such as Warren in the United States, which may be perceived as being in a period of terminal decline have managed to re-invent themselves through local entrepreneurial activity (Roundy, 2019). We also see evidence of some rapidly growing EEs that have never reached so-called maturity and yet are already beginning to revitalize themselves and 're-emerge', as shown by Canada's city of Waterloo

following the closure of the firm synonymous for the 'Blackberry' mobile phone, Research in Motion (Spigel & Vinodrai, 2020).

As a result, not only does linear stage-based development linked to age contradict much of our existing understanding of EE dynamics, but also the foundational assumption of path dependency is fundamentally problematic. We are inclined to agree with Wurth et al. (2021, p. 18) that we are better to consider 'past dependency', where 'the past influences the current options for ecosystems without completely ruling [out] alternative trajectories, thereby offering elasticity'. Not only does this allow for recognition of complexity, innovation and change, it also helps move away from the causal and predictive argumentation that can arise from anthropomorphic life-cycle thinking.

Indeed, life-cycle-based path-dependent predictive thinking is arguably damaging the potential for effective EE public policy interventions. As policymakers look to idealized anthropomorphized stages, often with the view of predicting what may happen next, there is a strong temptation to replicate what others have done to support EEs at particular stages. This is highly problematic as categorization to particular stages is inherently backward looking; it is only possible when 'outcome' data starts to become available, by which point further change and evolution is already under way. Thus, life cycles offer little reliability as predictive tools. Yet, many EE specific policy interventions seek to replicate programming and needs for EEs at a general stage level, based on what is perceived to have worked in other contexts at that same stage. As research strongly suggests, such mimetic public policy initiatives are often deeply flawed (Stam, 2015) and effective policies have to be strongly aligned to the place-based specificities of each particular host environment, where change and evolution is uniquely configured (Brown & Mawson, 2019).

4. ALTERNATIVE FRAMEWORKS FOR CONCEPTUALIZING AND EXPLORING ENTREPRENEURIAL ECOSYSTEMS

This paper has questioned the validity and legitimacy of adopting life-cycle models based on their two fundamental theoretical foundations. Due to this innate heterogeneity 'the lifecycle represents an inappropriate lens since the evolution of an EE is not linear across stages but rather recursive as with an adaptive system' (Cho et al., 2022, p. 11). We do of course recognize that not all scholars adopting such approaches are equally uncritical of simple binary and sequential developmental patterns in EEs (Auerswald & Dani, 2017; Spigel & Harrison, 2018; Spigel & Vinodrai, 2020). Whilst it is not our intention to unduly criticize those who have adopted to life-cycle models, we do urge scholars to make a clearer and more compelling justification for the theoretical framing adopted – be they life cycle or otherwise. Such transparency and rigour is, after all, the foundation for good academic research, particularly within the EE domain as it

strives for a critical accumulation of knowledge closely linked to practice (Kuckertz, 2019; Wurth et al., 2021). This may be particularly important from those scholars coming to the topic from an entrepreneurship background who are (perhaps inadvertently) less familiar with debates around the limitations of life-cycle concepts being applied to spatial contexts.

Some scholars are now seeking to understand and view the complex dynamics underpinning EEs via alternative conceptual perspectives. To this end, Roundy et al. (2018) and others (Daniel et al., 2022; Fredin & Lidén, 2020) have suggested that EEs can be conceived as 'complex adaptive systems' (CAS) through the lens of complexity science. Interestingly, this was also the conceptual approach advocated by Martin and Sunley (2011) to explore the temporal evolution of clusters. EEs are shaped by interactions among its constituent elements, which therefore results in growing complexity and adaptiveness (Radinger-Peer et al., 2018). CAS theory stems from general systems and cybernetic approaches towards understanding system dynamics and is now being deployed in the EE literature (e.g., Harris, 2021a; Roundy et al., 2018). Such systems are made up of numerous components with functions and interrelationships which feature a large number of interacting elements, non-linearity and interdependency, emergent behaviours, self-organization and adaptation to changing conditions (Abootorabi et al., 2021). Perhaps most significantly, they can produce 'multiple possible evolutionary trajectories and unpredictable courses of change' (Martin & Sunley, 2011, p. 1304).

As a framing for EE research, we agree with other scholars who view that a systemic CAS approach holds significant promise given the focus on non-linear system-based dynamics where 'change is unpredictable and difficult to foresee' meaning that 'an EE is in a state of continuous transformation and adaptability' (Fredin & Lidén, 2020, p. 95). Adopting a CAS perspective enables some of the true dynamics, non-linearities and complexities of EEs to be properly captured. Under a CAS viewpoint 'the actions of agents within an EE will produce continuous modifications to the system, which shape how the system responds to endogenous and exogenous disturbances and allow it to adapt to changing and novel conditions' (Roundy et al., 2018, p. 4). We see strong potential conceptualizing and visualizing EEs as dynamic complex systems through a complex systems lens, as shown in Figure 1.

While this approach may well provide a more effective conceptual lens for examining complex entities such as EEs, protagonists of a CAS approach have yet to fully demonstrate the methodological mechanisms for empirically exploring EEs via this theoretical framing.³ However, one novel attempt in this direction is a recent study in Norway which applied concepts and nomenclature derived from ecology and evolutionary biology, such as carrying capacity, habitat and disturbance effects (Abootorabi et al., 2021). It found that these processes are clearly important to the EE and 'disturbances' such as changes

to public grants or intellectual property (IP) legislation seem to have profound effects on the population in the EE. Another interesting attempt to empirically unpack ecosystems using a CAS lens explored the nature of the Montpellier EE (Cloutier & Messeghem, 2021) and found that Montpellier's ecosystem was composed of different sub-ecosystems (specific and transversal) whereby successive experiments, paths not taken and multiple interactions occur over time in a non-linear fashion. Using this framework, the research then illustrated an understanding of the 'sinuous and unpredictable' evolution of the EE (Cloutier & Messeghem, 2021, p. 12), which not only shed light on the Montpellier region but also shapes our understanding of how we can (and perhaps should) view EE development.

Adopting a CAS approach to examine the Great Southern region in Western Australia, Daniel et al. (2022) hold that four constituent elements (so-called 4Ps) underpin EEs: place (system evolution based on recombination), people (actors, institutions and interactions), purpose (self-organizing networks), and processes (co-evolution, interdependencies and feedback). Given the interplay between these different dimensions the effective examination of an EE 'needs to consider where the critical dynamics are, how and when they occur, and the effects of these changes' (Daniel et al., 2022, p. 8). Meanwhile, a CAS approach has also been used to comparatively examine the unique nature of different fintech ecosystems in London and Singapore. Whilst focusing on the same sector, the dynamics of the two fintech EEs are fundamentally distinctive and driven by 'actors, their agency, and their potential for moments of transformative change' which are 'nested' in the wider EEs in these locations (Harris, 2021a, p. 182). Han et al. (2021) conducted an interesting case study of the Chinese city of Zhongguancun and propose there are six interrelated complexity properties of a viable EE: a large number of self-organized agents, non-linear interactions, (in)sensitivity to initial conditions, adaptation to the environment, emergence of successful entrepreneurial firms, and coevolution. This echoes claims by some that one of the main assumptions is that disequilibrium is normalized and that complex systems constantly change and adapt through 'interaction between the parts of the systems and between the system and its environment' (Fredin & Lidén, 2020, p. 91).

In addition to these CAS perspectives, other novel conceptual and methodological approaches are also now being advanced within the EE literature, again potentially yielding much greater explanatory power than linear life-cycle approaches. One such treatment draws on chaos theory to explore EEs. Chaos theory is a subset of complexity science and is concerned with the behaviour of deterministic non-linear dynamical systems which are highly sensitive to their initial conditions. Haarhaus et al. (2020) claim that the evolution of EEs is a chaotic process in which an initial period of critical instability is followed by a continuous phase of order generation which, in turn, is marked by repeated chaotic fluctuations. It appears

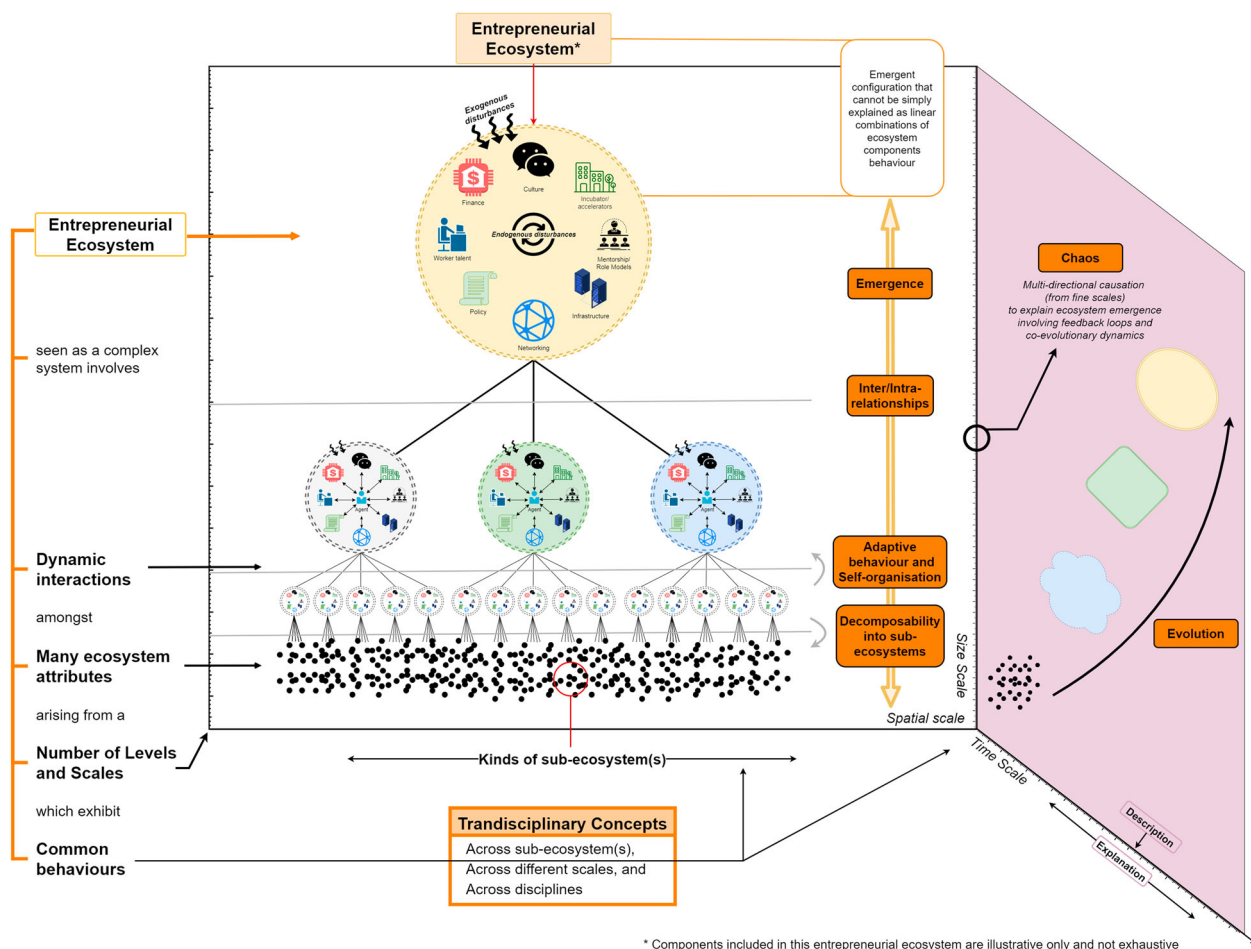


Figure 1. Entrepreneurial ecosystem through a complex system lens.

that far from being an orderly linear sequential process, non-linear dynamics remain central in the temporal evolution of EEs and confirm the intrinsic individuality of the development process of EEs (Haarhaus et al., 2020). To illustrate the non-linear and convoluted dynamics of ecosystems, Haarhaus et al. (2020) examine monthly start-up data from Singapore's EE between 1970 and 2018 using a complex range of methodological techniques. In the study, they applied three statistical methods from chaos theory, the Pointwise D2 (PD2), the Brock–Dechert–Scheinkman (BDS) test and Local Largest Lyapunov Exponents (LLEs), to examine the complex dynamics of EEs. Their work strongly shows there to be major variances in the complexity/chaoticity of the data over the course of the time period which is often connected to external (i.e., 1997 Asian Financial Crisis) and internal stimuli (i.e., major policy initiatives). Thus, they propose that scholars take into consideration the complex causalities inherent in the evolution of EEs and contend that 'unidirectional causation is inappropriate to explain how order emerges in EEs, since ecosystem emergence involves feedback loops as well as coevolutionary dynamics between the systems' elements, and, thus, multi-directional causality' (Haarhaus et al., 2020, p. 7).

Evolutionary game theory may be another approach. This originated as an application of the mathematical

theory of games to biological contexts. Applying evolutionary game theory could help understand the implications of fluctuations on different ecosystem elements and interactions. For example, EEs frequently use supportive cultural attitudes to advocate for the normalization of entrepreneurial activities (Spigel, 2017), justifying further investigation to understand processes of cultural transmission affecting entrepreneurship. Evolution is not necessarily related to biological evolution in evolutionary game theory, but can be understood as a way to capture changing norms concerning cultural beliefs or social learning (Roca et al., 2009). Thus, its applicability for EEs should be treated as a way to query the dissemination of entrepreneurship as behaviour, especially if it relates to cultural processes (e.g., when entrepreneurship emerges from cultural evolution via imitation) (Kuechle, 2011). In this vein, evolutionary game theory may help to address some of the big unanswered questions within EE research, for instance 'under which conditions long-run aggregate behavior will settle into some equilibrium, and when certain behaviors will become extinct' (Kuechle, 2011, p. 459).

In recognition of the discontinuous and non-linear dynamics of EEs, researchers will also have to adapt their methodological toolkits linked to these alternative conceptual framings. Life-cycle approaches may have

partly arisen owing to a reliance on somewhat backward-looking narrative-based accounts of how EEs grow and evolve. Typically, these are based on single case studies which historically analyse EEs, often drawing on informant interviews and/or analyses of historical documentation (e.g., Colombelli et al., 2019; Kapturkiewicz, 2021). Owing to a reliance on these partial forms of data collection it may be inevitable that authors see the historical evolution of places as a somewhat neat, orderly, linear and sequential process since these approaches lack the ability to tease out or capture the messy, granular and complex nature of how EEs actually develop and evolve in real time. That is not to say that deeply immersive single case studies cannot provide rich detailed findings on the complex temporal dynamics underpinning EEs (e.g., Alaassar et al., 2022).

That said, going forward greater methodological pluralism is strongly required to examine the inherent complexity of different EEs (Wurth et al., 2021). Multiple cases enrich our understanding of the different dynamics at play across different EEs. For example, in their comparative analysis of two different EEs Belitski and Büyükbacı (2021) claim 'that complex interrelationship between EE actors and the EE contextual factors matter ... and these differences can be traced between different institutional contexts' (p. 745). We also see considerable merit in using these tools and newer forms of real-time data and social media metrics, such as Meet-Up (Rocha et al., 2021) and Twitter data (Hannigan et al., 2021), to help capture and map the temporal evolution of social capital, entrepreneurial networks, and cultural possibilities across EEs.

5. CONCLUSIONS

In this paper we have outlined the fundamental tension between the theoretical and conceptual underpinnings of anthropomorphized life-cycle models and the inherent complexity and dynamism of different spatial EEs. Initially, many scholars adopted a life-cycle framework to depict the temporal evolution of EEs, however over time research has called into question the veracity of this approach (Cho et al., 2022). Just as spatial scholars saw the inherent limitations of this conceptual framing in the context of clusters (Martin & Sunley, 2011), we urge EE scholars to question the utility of this framing in the domain of ecosystems research. Indeed, the foundational principles of life cycles are in many ways diametrically opposed to how EEs operate and function in reality. EEs are messy and complex entanglements replete with discontinuous junctures, disequilibria and ruptures where temporal development is definitely not on some pre-ordained sequential trajectory. To reiterate, *places are not like people*.

From our examination of recent literature, we have also identified a number of other emerging novel systemic theoretical framings, such as CAS, and associated forms of data which may better comprehend and convey the true non-linear dynamics of EEs. Like others (Fredin &

Lidén, 2020; Roundy et al., 2018), we feel EEs exhibit the properties of a complex systems (Figure 1). However, it is not our intention to identify or argue for a single conceptual alternative to life cycles, but rather to stimulate a critical debate on how to best conceptualize the temporal development and continual reconfiguration of EE. As we have argued, anthropomorphized models built on human lived experience are quite simply an inappropriate way in which to explore and build our understanding EEs. We have also argued that the uncritical adoption of simplistic life-cycle models could potentially misinform policymakers by suggesting that all locations undergo the same developmental phases, as is increasingly evidenced in replicative policy approaches (Brown & Mawson, 2019) rather than the creation of bespoke policies best suited to the specificities of different locations. Embracing the complexity of EEs and their associated multifaceted network governance structures that cut across multiple levels is one such example of how complex systems can potentially be coordinated via policymakers (Feldman & Lowe, 2018; Knox & Arshed, 2022).

Blindly applying standard methods and their underlying assumptions falls short in explaining the non-linear dynamics and evolutionary nature of EEs (Abootorabi et al., 2021). If we are to take the EE metaphor seriously (Kuckertz, 2019), greater consideration and reflection of how we conceptualize and theorize this complex spatial phenomenon is urgently required. Inevitably, this will mean exploring and embracing a wider and more heterogeneous range of transdisciplinary research fields, methodological techniques and data sources. A fertile and vibrant research agenda awaits scholars of these highly complex and variegated 'tangled banks'.

ACKNOWLEDGEMENTS

The authors are grateful for the comments by Dan Isenberg and the three anonymous reviewers for their constructive and helpful feedback on various iterations of the manuscript. They are also very grateful to John Harrison, Editor of the Urban and Regional Horizons section of *Regional Studies*, for his very helpful comments. The usual disclaimer applies.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

FUNDING

The authors acknowledge InGAME: Innovation for Games and Media Enterprise, part of the Arts and Humanities Research Council (AHRC) Creative Industries Clusters Programme [grant number AH/S002871/10], for funding the time of one of the co-authors.

NOTES

1. Levie and Lichtenstein (2010) identified 104 papers using linear life-cycle models of business growth during this 45-year period examined (i.e., 1962–2006).
2. These terms are far from universal: there is surprising diversity in the labels applied to each phase within the literature and it is beyond the scope of this paper to discuss this issue robustly. The key consideration here is that despite the terminology used, the stages (and the nature of the stages) are largely consistent.
3. Roundy et al. (2018), however, do advocate mixed methods such as the use of three methods: qualitative comparative analysis (QCA), agent-based modelling and interpretivist qualitative research.

ORCID

Ross Brown  <http://orcid.org/0000-0002-6164-7639>

Suzanne Mawson  <http://orcid.org/0000-0003-1983-514X>

Augusto Rocha  <http://orcid.org/0000-0001-8419-476X>

REFERENCES

- Abootorabi, H., Wiklund, J., Johnson, A. R., & Miller, C. D. (2021). A holistic approach to the evolution of an entrepreneurial ecosystem: An exploratory study of academic spin-offs. *Journal of Business Venturing*, 36(5), 106143. <https://doi.org/10.1016/j.jbusvent.2021.106143>
- Acs, Z. J., Stam, E., Audretsch, D. B., & O'Connor, A. (2017). The lineages of the entrepreneurial ecosystem approach. *Small Business Economics*, 49(1), 1–10. <https://doi.org/10.1007/s11187-017-9864-8>
- Alaassar, A., Mention, A. L., & Aas, T. H. (2022). Ecosystem dynamics: Exploring the interplay within fintech entrepreneurial ecosystems. *Small Business Economics*, 58(4), 2157–2182. <https://doi.org/10.1007/s11187-021-00505-5>
- Alvedalen, J., & Boschma, R. (2017). A critical review of entrepreneurial ecosystems research: Towards a future research agenda. *European Planning Studies*, 25(6), 887–903. <https://doi.org/10.1080/09654313.2017.1299694>
- Audretsch, D. B., & Belitski, M. (2017). Entrepreneurial ecosystems in cities: Establishing the framework conditions. *The Journal of Technology Transfer*, 42(5), 1030–1051. <https://doi.org/10.1007/s10961-016-9473-8>
- Audretsch, D. B., & Belitski, M. (2021). Towards an entrepreneurial ecosystem typology for regional economic development: The role of creative class and entrepreneurship. *Regional Studies*, 55(4), 735–756. <https://doi.org/10.1080/00343404.2020.1854711>
- Audretsch, D. B., Falck, O., Feldman, M. P., & Heblich, S. (2008). The lifecycle of regions. SSRN 1141662.
- Audretsch, D., Mason, C., Miles, M. P., & O'Connor, A. (2021). Time and the dynamics of entrepreneurial ecosystems. *Entrepreneurship and Regional Development*, 33(1–2), 1–14. <https://doi.org/10.1080/08985626.2020.1734257>
- Auerswald, P. E., & Dani, L. (2017). The adaptive lifecycle of entrepreneurial ecosystems: The biotechnology cluster. *Small Business Economics*, 49(1), 97–117. <https://doi.org/10.1007/s11187-017-9869-3>
- Belitski, M., & Büyükbacı, P. (2021). Uncharted waters of the entrepreneurial ecosystems research: Comparing Greater Istanbul and reading ecosystems. *Growth and Change*, 52(2), 727–750. <https://doi.org/10.1111/grow.12457>
- Bergek, A., & Onufrey, K. (2014). Is one path enough? Multiple paths and path interaction as an extension of path dependency theory. *Industrial and Corporate Change*, 23(5), 1261–1297. <https://doi.org/10.1093/icc/dtt040>
- Bergman, E. M. (2007). *Cluster life-cycles: An emerging synthesis* (SRE – Discussion Papers No. 2007/04). Institut für Regional- und Umweltwirtschaft, WU Vienna University of Economics and Business.
- Birch, D. G. (1987). *Job creation in America: How our smallest companies put the most people to work*. University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership, Historical Research Reference in Entrepreneurship.
- Boschma, R. (2015). Towards an evolutionary perspective on regional resilience. *Regional Studies*, 49(5), 733–751. <https://doi.org/10.1080/00343404.2014.959481>
- Boschma, R., & Martin, R. (2007). Constructing an evolutionary economic geography. *Journal of Economic Geography*, 7(5), 537–548. <https://doi.org/10.1093/jeg/lbm021>
- Brenner, T., & Schlump, C. (2011). Policy measures and their effects in the different phases of the cluster life cycle. *Regional Studies*, 45(10), 1363–1386. <https://doi.org/10.1080/00343404.2010.529116>
- Brown, R., & Mawson, S. (2013). Trigger points and high-growth firms: A conceptualisation and review of public policy implications. *Journal of Small Business and Enterprise Development*, 20(2), 279–295. <https://doi.org/10.1108/14626001311326734>
- Brown, R., & Mason, C. (2017). Looking inside the spiky bits: A critical review and conceptualisation of entrepreneurial ecosystems. *Small Business Economics*, 49(1), 11–30. <https://doi.org/10.1007/s11187-017-9865-7>
- Brown, R., & Mawson, S. (2019). Entrepreneurial ecosystems and public policy in action: A critique of the latest industrial policy blockbuster. *Cambridge Journal of Regions, Economy and Society*, 12(3), 347–368. <https://doi.org/10.1093/cjres/rsz011>
- Cantner, U., Cunningham, J. A., Lehmann, E. E., & Menter, M. (2021). Entrepreneurial ecosystems: A dynamic lifecycle model. *Small Business Economics*, 57(1), 407–423. <https://doi.org/10.1007/s11187-020-00316-0>
- Cho, D. S., Ryan, P., & Buciuini, G. (2022). Evolutionary entrepreneurial ecosystems: A research pathway. *Small Business Economics*, 58(4), 1865–1883. <https://doi.org/10.1007/s11187-021-00487-4>
- Cloutier, L., & Messeghem, K. (2021). Whirlwind model of entrepreneurial ecosystem path dependence. *Small Business Economics*, <https://doi.org/10.1007/s11187-021-00553-x>
- Colombelli, A., Paolucci, E., & Ughetto, E. (2019). Hierarchical and relational governance and the lifecycle of entrepreneurial ecosystems. *Small Business Economics*, 52(2), 505–521. <https://doi.org/10.1007/s11187-017-9957-4>
- Daniel, L. J., de Villiers Scheepers, M. J., Miles, M. P., & de Klerk, S. (2022). Understanding entrepreneurial ecosystems using complex adaptive systems theory: Getting the big picture for economic development, practice, and policy. *Entrepreneurship & Regional Development*, 1–24. <https://doi.org/10.1080/08985626.2022.2083691>
- Darwin, C. R. (1872). *The origin of species by means of natural selection, or the preservation of favoured races in the struggle for life*, 6th edn, with additions and corrections. John Murray.
- Essletzbichler, J., & Rigby, D. L. (2007). Exploring evolutionary economic geographies. *Journal of Economic Geography*, 7(5), 549–571. <https://doi.org/10.1093/jeg/lbm022>
- Feldman, M., & Lowe, N. (2018). Policy and collective action in place. *Cambridge Journal of Regions, Economy and Society*, 11(2), 335–351. <https://doi.org/10.1093/cjres/rsy011>

- Fredin, S., & Lidén, A. (2020). Entrepreneurial ecosystems: Towards a systemic approach to entrepreneurship? *Geografisk Tidsskrift – Danish Journal of Geography*, 120(2), 87–97. <https://doi.org/10.1080/00167223.2020.1769491>
- Freitas, C., & Kitson, M. (2018). Perceptions of entrepreneurial ecosystems in remote islands and core regions. *Island Studies Journal*, 13(1), 267–284. <https://doi.org/10.24043/isj.44>
- Gherhes, C., Vorley, T., & Williams, N. (2018). Entrepreneurship and local economic resilience: The impact of institutional hysteresis in peripheral places. *Small Business Economics*, 51(3), 577–590. <https://doi.org/10.1007/s11187-017-9946-7>
- Haarhaus, T., Strunk, G., & Liening, A. (2020). Assessing the complex dynamics of entrepreneurial ecosystems: A nonstationary approach. *Journal of Business Venturing Insights*, 14, e00194. <https://doi.org/10.1016/j.jbvi.2020.e00194>
- Han, J., Ruan, Y., Wang, Y., & Zhou, H. (2021). Toward a complex adaptive system: The case of the Zhongguancun entrepreneurial ecosystem. *Journal of Business Research*, 128, 537–550. <https://doi.org/10.1016/j.jbusres.2019.11.077>
- Hannigan, T. R., Briggs, A. R., Valadao, R., Seidel, M.-D. L., & Jennings, P. D. (2021). A new tool for policymakers: Mapping cultural possibilities in an emerging AI entrepreneurial ecosystem. *Research Policy*, 104315. <https://doi.org/10.1016/j.respol.2021.104315>
- Harima, A., Harima, J., & Freiling, J. (2021). The injection of resources by transnational entrepreneurs: Towards a model of the early evolution of an entrepreneurial ecosystem. *Entrepreneurship & Regional Development*, 33(1–2), 80–107. <https://doi.org/10.1080/08985626.2020.1734265>
- Harris, J. L. (2021a). Rethinking cluster evolution: Actors, institutional configurations, and new path development. *Progress in Human Geography*, 45(3), 436–454. <https://doi.org/10.1177/0309132520926587>
- Harris, J. L. (2021b). Bridging the gap between ‘Fin’ and ‘Tech’: The role of accelerator networks in emerging FinTech entrepreneurial ecosystems. *Geoforum; Journal of Physical, Human, and Regional Geosciences*, 122, 174–182. <https://doi.org/10.1016/j.geoforum.2021.04.010>
- Hassink, R., Klaerding, C., & Marques, P. (2014). Advancing evolutionary economic geography by engaged pluralism. *Regional Studies*, 48(7), 1295–1307. <https://doi.org/10.1080/00343404.2014.889815>
- Iammarino, S., & McCann, P. (2006). The structure and evolution of industrial clusters: Transactions, technology and knowledge spillovers. *Research Policy*, 35(7), 1018–1036. <https://doi.org/10.1016/j.respol.2006.05.004>
- Isenberg, D. J. (2016). Applying the ecosystem metaphor to entrepreneurship: Uses and abuses. *The Antitrust Bulletin*, 61(4), 564–573. <https://doi.org/10.1177/0003603X16676162>
- Kapturkiewicz, A. (2021). Varieties of entrepreneurial ecosystems: A comparative study of Tokyo and Bangalore. *Research Policy*, 104377. <https://doi.org/10.1016/j.respol.2021.104377>
- Kibler, E., Kautonen, T., & Fink, M. (2014). Regional social legitimacy of entrepreneurship: Implications for entrepreneurial intention and start-up behaviour. *Regional Studies*, 48(6), 995–1015. <https://doi.org/10.1080/00343404.2013.851373>
- Kim, M. J., Shaver, J. M., & Funk, R. J. (2021). From mass to motion: Conceptualizing and measuring the dynamics of industry clusters. *Strategic Management Journal*, 43(4), 822–846. <https://doi.org/10.1002/smj.3354>
- Knight, F. (1921). *Risk, uncertainty and profit*. Hart, Schaffner & Marx; Houghton Mifflin.
- Knox, S., & Arshed, N. (2022). Network governance and coordination of a regional entrepreneurial ecosystem. *Regional Studies*, 56(7), 1161–1175. <https://doi.org/10.1080/00343404.2021.1988067>
- Kuckertz, A. (2019). Let’s take the entrepreneurial ecosystem metaphor seriously! *Journal of Business Venturing Insights*, 11, e00124. <https://doi.org/10.1016/j.jbvi.2019.e00124>
- Kuechle, G. (2011). Persistence and heterogeneity in entrepreneurship: An evolutionary game theoretic analysis. *Journal of Business Venturing*, 26(4), 458–471. <https://doi.org/10.1016/j.jbusvent.2009.12.001>
- Levie, J., & Lichtenstein, B. B. (2010). A terminal assessment of stages theory: Introducing a dynamic states approach to entrepreneurship. *Entrepreneurship Theory and Practice*, 34(2), 317–350. <https://doi.org/10.1111/j.1540-6520.2010.00377.x>
- Li, Y., Kenney, M., Patton, D., & Song, A. (2022). Entrepreneurial ecosystems and industry knowledge: Does the winning region take all? *Small Business Economics*. <https://doi.org/10.1007/s11187-022-00681-y>
- Loots, E., Neiva, M., Carvalho, L., & Lavanga, M. (2021). The entrepreneurial ecosystem of cultural and creative industries in Porto: A sub-ecosystem approach. *Growth and Change*, 52(2), 641–662. <https://doi.org/10.1111/grow.12434>
- Lowe, N. J., & Feldman, M. P. (2017). Institutional life within an entrepreneurial region. *Geography Compass*, 11(3), e12306. <https://doi.org/10.1111/gec3.12306>
- Mack, E., & Mayer, H. (2016). The evolutionary dynamics of entrepreneurial ecosystems. *Urban Studies*, 53(10), 2118–2133. <https://doi.org/10.1177/0042098015586547>
- Malecki, E. J. (2018). Entrepreneurship and entrepreneurial ecosystems. *Geography Compass*, 12(3), e12359. <https://doi.org/10.1111/gec3.12359>
- Martin, R. (2010). Roepke Lecture in Economic Geography – Rethinking regional path dependence: Beyond lock-in to evolution. *Economic Geography*, 86(1), 1–27. <https://doi.org/10.1111/j.1944-8287.2009.01056.x>
- Martin, R., & Sunley, P. (2011). Conceptualizing cluster evolution: Beyond the lifecycle model? *Regional Studies*, 45(10), 1299–1318. <https://doi.org/10.1080/00343404.2011.622263>
- Maskell, P., & Malmberg, A. (2007). Myopia, knowledge development and cluster evolution. *Journal of Economic Geography*, 7(5), 603–618. <https://doi.org/10.1093/jeg/ibm020>
- Mason, C., & Brown, R. (2014). Entrepreneurial ecosystems and growth oriented entrepreneurship. *Final Report to OECD, Paris*, 30(1), 77–102.
- Menzel, M. P., & Fornahl, D. (2010). Cluster life cycles – dimensions and rationales of cluster evolution. *Industrial and Corporate Change*, 19(1), 205–238. <https://doi.org/10.1093/icc/dtp036>
- Miles, M. P., & Morrison, M. (2020). An effectual leadership perspective for developing rural entrepreneurial ecosystems. *Small Business Economics*, 54(4), 933–949. <https://doi.org/10.1007/s11187-018-0128-z>
- Moore, J. F. (1993). Predators and prey: A new ecology of competition. *Harvard Business Review*, 71(3), 75–86.
- Motoyama, Y., & Knowlton, K. (2016). From resource munificence to ecosystem integration: The case of government sponsorship in St. Louis. *Entrepreneurship & Regional Development*, 28(5–6), 448–470. <https://doi.org/10.1080/08985626.2016.1186749>
- Muñoz, P., Kibler, E., Mandakovic, V., & Amorós, J. E. (2020). Local entrepreneurial ecosystems as configurational narratives: A new way of seeing and evaluating antecedents and outcomes. *Research Policy*, 104065. <https://doi.org/10.1016/j.respol.2020.104065>
- Nicholls-Nixon, C. L., Valliere, D., Gedeon, S. A., & Wise, S. (2020). Entrepreneurial ecosystems and the lifecycle of university business incubators: An integrative case study. *International Entrepreneurship and Management Journal*, 17(2), 809–837. <https://doi.org/10.1007/s11365-019-00622-4>
- O’Shea, G., Farny, S., & Hakala, H. (2021). The buzz before business: A design science study of a sustainable entrepreneurial

- ecosystem. *Small Business Economics*, 56(3), 1097–1120. <https://doi.org/10.1007/s11187-019-00256-4>
- Page, S. E. (2010). *Diversity and complexity* (Vol. 2). Princeton University Press.
- Perugini, F. (2022). Space–time analysis of entrepreneurial ecosystems. *The Journal of Technology Transfer*, 1–52.
- Phelps, R., Adams, R., & Bessant, J. (2007). Life cycles of growing organizations: A review with implications for knowledge and learning. *International Journal of Management Reviews*, 9(1), 1–30. <https://doi.org/10.1111/j.1468-2370.2007.00200.x>
- Pickernell, D., Battisti, M., Dann, Z., & Ekinsmyth, C. (2022). Disadvantaged entrepreneurship and the entrepreneurial ecosystem: Conclusions and areas for future research. In Pickernell, D., Battisti, M., Dann, Z., & Ekinsmyth, C. (Eds.), *Disadvantaged entrepreneurship and the entrepreneurial ecosystem* (pp. 219–223). Emerald. <https://doi.org/10.1108/S2040-724620220000014010>
- Radinger-Peer, V., Sedlacek, S., & Goldstein, H. (2018). The path-dependent evolution of the entrepreneurial ecosystem (EE) – Dynamics and region-specific assets of the case of Vienna (Austria). *European Planning Studies*, 26(8), 1499–1518. <https://doi.org/10.1080/09654313.2018.1494136>
- Roca, C. P., Cuesta, J. A., & Sánchez, A. (2009). Evolutionary game theory: Temporal and spatial effects beyond replicator dynamics. *Physics of Life Reviews*, 6(4), 208–249. <https://doi.org/10.1016/j.plrev.2009.08.001>
- Rocha, A., Brown, R., & Mawson, S. (2021). Capturing conversations in entrepreneurial ecosystems. *Research Policy*, 50(9), 104317. <https://doi.org/10.1016/j.respol.2021.104317>
- Rocha, H., & Audretsch, D. B. (2022). Entrepreneurial ecosystems, regional clusters, and industrial districts: Historical transformations or rhetorical devices? *Journal of Technology Transfer*. <https://doi.org/10.1007/s10961-022-09920-6>
- Roundy, P. T. (2019). Back from the brink: The revitalization of inactive entrepreneurial ecosystems. *Journal of Business Venturing Insights*, 12, e00140. <https://doi.org/10.1016/j.jbvi.2019.e00140>
- Roundy, P. T., Bradshaw, M., & Brockman, B. K. (2018). The emergence of entrepreneurial ecosystems: A complex adaptive systems approach. *Journal of Business Research*, 86, 1–10. <https://doi.org/10.1016/j.jbusres.2018.01.032>
- Roundy, P. T., Brockman, B. K., & Bradshaw, M. (2017). The resilience of entrepreneurial ecosystems. *Journal of Business Venturing Insights*, 8, 99–104. <https://doi.org/10.1016/j.jbvi.2017.08.002>
- Schäfer, S., & Henn, S. (2018). The evolution of entrepreneurial ecosystems and the critical role of migrants. A phase-model based on a study of IT startups in the greater Tel Aviv area. *Cambridge Journal of Regions, Economy and Society*, 11(2), 317–333. <https://doi.org/10.1093/cjres/rsy013>
- Scott, S., Hughes, M., & Ribeiro-Soriano, D. (2022). Towards a network-based view of effective entrepreneurial ecosystems. *Review of Managerial Science*, 16(1), 157–187. <https://doi.org/10.1007/s11846-021-00440-5>
- Sohns, F., & Wójcik, D. (2020). The impact of Brexit on London's entrepreneurial ecosystem: The case of the FinTech industry. *Environment and Planning A: Economy and Space*, 52(8), 1539–1559. <https://doi.org/10.1177/0308518X20925820>
- Spigel, B. (2017). The relational organization of entrepreneurial ecosystems. *Entrepreneurship Theory and Practice*, 41(1), 49–72. <https://doi.org/10.1111/etap.12167>
- Spigel, B. (2020). *Entrepreneurial ecosystems: Theory, practice and futures*. Edward Elgar.
- Spigel, B. (2022). Examining the cohesiveness and nestedness entrepreneurial ecosystems: Evidence from British FinTechs. *Small Business Economics*. <https://doi.org/10.1007/s11187-021-00589-z>
- Spigel, B., & Harrison, R. (2018). Toward a process theory of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12(1), 151–168. <https://doi.org/10.1002/sej.1268>
- Spigel, B., & Vinodrai, T. (2020). Meeting its Waterloo? Recycling in entrepreneurial ecosystems after anchor firm collapse. *Entrepreneurship & Regional Development*, 33(7–8), 599–620. <https://doi.org/10.1080/08985626.2020.1734262>
- Stam, E. (2015). Entrepreneurial ecosystems and regional policy: A sympathetic critique. *European Planning Studies*, 23(9), 1759–1769. <https://doi.org/10.1080/09654313.2015.1061484>
- Suire, R., & Vicente, J. (2014). Clusters for life or life cycles of clusters: In search of the critical factors of clusters' resilience. *Entrepreneurship & Regional Development*, 26(1–2), 142–164. <https://doi.org/10.1080/08985626.2013.877985>
- Vedula, S., & Kim, P. H. (2019). Gimme shelter or fade away: The impact of regional entrepreneurial ecosystem quality on venture survival. *Industrial and Corporate Change*, 28(4), 827–854. <https://doi.org/10.1093/icc/dtz032>
- Wurth, B., Stam, E., & Spigel, B. (2021). Toward an entrepreneurial ecosystem research program. *Entrepreneurship Theory & Practice*. <https://doi.org/10.1177/1042258721998948>
- Xu, Z., & Dobson, S. (2019). Challenges of building entrepreneurial ecosystems in peripheral places. *Journal of Entrepreneurship and Public Policy*, 8(3), 408–430. <https://doi.org/10.1108/JEPP-03-2019-0023>