

## **THREE PERSPECTIVES ON REGIONAL ECONOMIES: A CONVERGENCE ON ECOSYSTEMS AND PLATFORMS**

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**ABSTRACT** Globalisation has given rise to a resurgence of regional economies. Scholars trying to understand this emergence have explored the phenomenon from different perspectives. It only makes sense that scholars write for different audiences. This preliminary systematic review examines the rise of the regional economy literature by examining different research streams. These streams are directed toward three different audiences: business managers, regional policy makers and university leaders. The review suggests that these three streams are beginning to converge on two key concepts: ecosystems and platforms. By pursuing this convergence, scholars can benefit from the different perspectives and develop tighter integration across these research streams. This integration will likely yield more valuable insights.

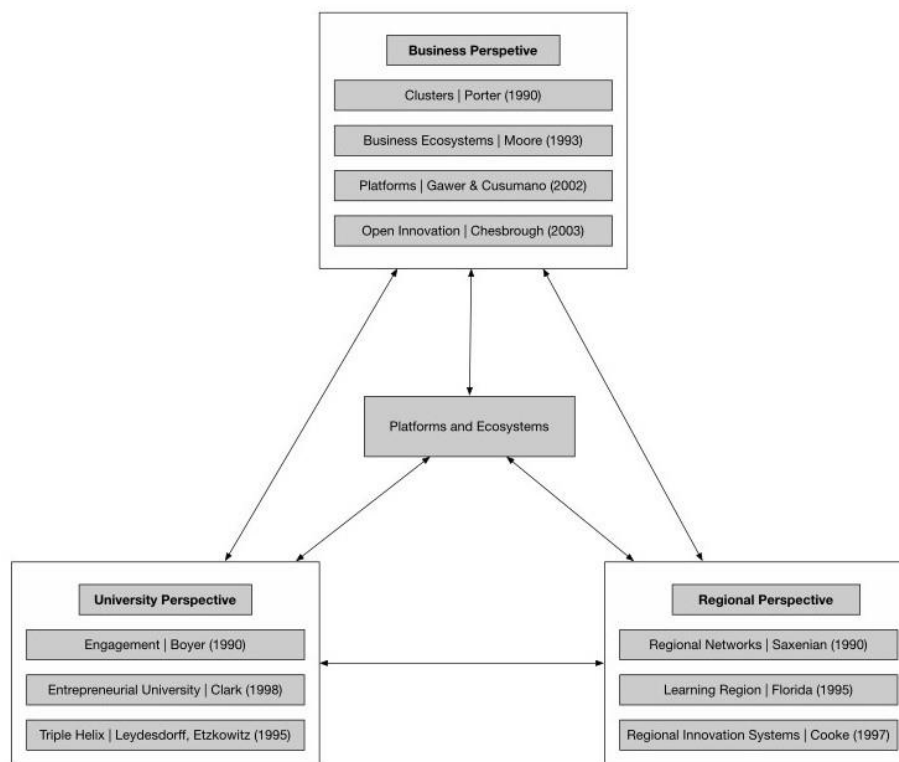
**KEY WORDS:** innovation ecosystem; entrepreneurial ecosystem; platforms; regional innovation system; university engagement.

### **1. INTRODUCTION**

Globalisation has given rise to the resurgence of regional economies (Storper, 1997). This systematic review examines the emergence of regions from multiple perspectives. The purpose is to explore whether scholars from different disciplines, writing for different audiences, intersect around any central concepts. Indeed, this approach suggests that various streams of research are beginning to converge on two connected concepts: ecosystems and platforms. This conclusion is preliminary and requires further development. However, the systematic review does indicate a promising path forward. If this emerging alignment is confirmed with further analysis, the implications could be significant along three dimensions: research agendas, theory development and policy.

Scholars write for different audiences. The review is organized around three key audiences: business managers, regional policymakers, and university

administrators. The literatures within each of these streams is vast. Each perspective reveals three to four critical concepts scholars have developed to describe the growing importance of dynamic regional economies. Within each section, the review begins with leading authors and then traces the research flow. Figure 1 provides a map for the analysis that follows.



**Figure 1.** Key Concepts from Different Research Perspectives. Source: the Author.

The analysis starts with the business perspective, led largely by management scholars. The scholarship in this section is primarily directed to business managers to guide them in building more competitive and innovative companies. Within the business perspective four key concepts have emerged.

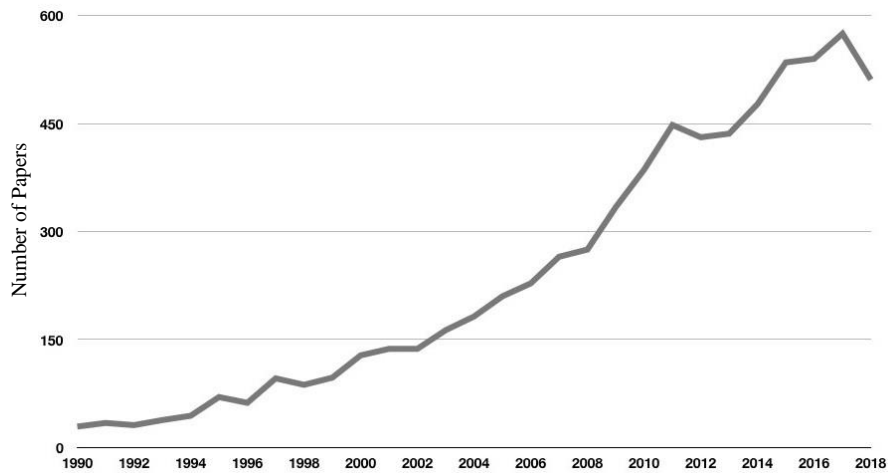
These key concepts are clusters, business ecosystems, open innovation, and platforms.

The review next moves to the regional policy perspective. Scholarship in this area is primarily led by regional economists and geographers. The primary audience is regional policymakers. This perspective includes three important concepts: regional networks; learning regions and regional innovation systems. The review then moves to scholarship that is primarily directed toward university leadership. These scholars are focused primarily on the developing role of the university within the emerging knowledge economy. Three key concepts dominate this research: the “engaged university”; entrepreneurial universities; and the Triple Helix and its derivatives. The review concludes by suggesting that all three streams are beginning to converge on the two central and related concepts of ecosystems and platforms.

## **2. METHODOLOGY**

The literature exploring the impact of globalisation on the emergence of regional economies is vast. A SCOPUS review with the search term “regional AND economy AND global\*” returned over 7 083 articles. As Figure 2 demonstrates, the literature begins to gain momentum in the 1990’s and has continued to accelerate. A systemic review should follow a replicable methodology (Smart *et al.*, 2003). This review followed these steps:

- Step 1: Define the corpus of literature using a broad SCOPUS search term: “globalization AND region”;
- Step 2: Identify highly cited articles in the early period of literature development: 1990-2000 and designate “lead authors”;
- Step 3: Evaluate the external audiences that the lead authors are seeking to influence to identify different research streams within the corpus;
- Step 4: Follow the citation stream of the lead authors to identify key concepts within each research stream;
- Step 5: Identify any emerging concepts that may be common across research streams.



**Figure 2.** Number of Papers Retrieved from SCOPUS with Search Term “Regional AND Economy AND Global”. Source: SCOPUS search performed November 18, 2018; n=7083.

Based on this methodology, lead authors within three research streams were identified: (1) a business perspective directed toward management scholars and organizational managers; (2) a regional policy perspective directed toward regional policy makers; and (3) a university perspective directed toward university administrators. The citation stream for each lead author within these streams revealed the core concepts within each stream. In addition, some common concepts appear to be emerging across research streams. The balance of this paper proceeds as follows. Each research stream will be characterised in turn. The next section will explore two emerging concepts – ecosystems and platforms -- that appear across research streams. The conclusion will draw implications of these preliminary findings and suggestions for future research.

### 3. THE BUSINESS PERSPECTIVE ON REGIONAL ECONOMIES

This section explores how business leaders increasingly see geographic proximity—the regional economy—as a resource for accelerating

innovation. Four key concepts emerge from this perspective: clusters, business ecosystems, open innovation and platforms.

### **Clusters**

As the latest wave of globalization began to take hold after 1980, academics began pointing out the globalization paradox. On the one hand, telecommunications costs have declined so much that productive activities can be carried on anywhere in the world. On the other hand, local markets have become even more critical to competitive advantage. Resolving the paradox depends on an understanding of how information and knowledge networks have become integral to defining the competitive position of companies competing in the global market.

The roots of why information is important to competition lie in an article by Porter and Millar in 1985 (Porter and Millar, 1985). The authors explored how information technology can create competitive advantage. In particular, they point out that a firm's value chain is embedded in a broader "value system" that is defined by linkages with outside firms. These connections create interdependencies that can give rise to competitive advantages. Five years later, Porter introduced the concept of clusters to explain this dynamic (Porter, 1990). He demonstrated how information, integrated with physical production flows, can create a value system or value chain with competitive advantages.

Writing in 1998, Porter continued to develop his theory of clusters. Moving forward, he defined clusters as "geographic concentrations of interconnected companies and institutions in a particular field" (Porter, 1998a; 1998b). His primary research focus involved explaining how clusters improve productivity within an economy. He suggested three important ways: 1) increasing the productivity of a company; 2) driving the direction and pace of innovation; and 3) stimulating the formation of new businesses. In this way, Porter used his theory of clusters to explain the paradox emerging in the global economy: why regional economies are increasingly important in an interconnected world.

### ***Business Ecosystems***

The concept of business ecosystems entered the literature in 1993 (Moore, 1993). Moore started with a basic proposition: in a dynamic global economy, sustainable competitive advantage emerges from a company's ability to innovate. To explain the nature of this challenge, Moore used a biological metaphor of evolution and ecosystems. Each company has an ecosystem within which it evolves. This ecosystem extends beyond traditional industry boundaries. The ecosystem involves the continuous interaction and interdependencies that develop, as entities pursue their own goals in relationships with each other. Companies and organizations within the ecosystem co-evolve new capabilities, as they innovate to support new products and satisfy customer needs. In other words, ecosystems are dynamic.

Five years later, Moore amplified his argument (Moore, 1998). It is the combination of assets and the ability to link these assets together, that defines the competitive trajectory for firms. Networks and relationships become core attributes of competitiveness. The biggest challenge for company executives involves shifting their mindset from stand-alone hierarchical companies to seeing themselves as participants in continuously evolving complex systems. The development of business ecosystems is closely aligned to the concept of open innovation and platforms, to which the literature review now turns.

### ***Open Innovation***

Open innovation is a process that describes the way in which companies innovate. In the past, companies relied on internal research and development resources to set their innovation agenda. With closed innovation, the company generates, develops and commercializes its own ideas. In 2003, Chesbrough introduced an alternative approach to innovation, the concept of open innovation (Chesbrough, 2003). Through this process, companies rely on relationships with outside partners to accelerate innovation. Company boundaries become more porous. The company commercialises its own ideas with partners, as well as incorporating outside technologies into internal projects. More formally, Chesbrough and his co-authors have defined open innovation as "the use

of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand markets for external use of innovation, respectively” (Chesbrough *et al.*, 2006). In another iteration of the concept, Curley proposes the idea of Open Innovation 2.0, in which open innovation takes place within an ecosystem (Curley, 2015; 2016).

### ***Platforms***

The exploration of business ecosystems and open innovation has led scholars to explore the concept of platforms. The concept can be difficult to understand. The development of platforms as a separate concept for study emerged with research pioneered by Gawer and Cusumano (Gawer and Cusumano, 2002; Cusumano, 2010). Initially, the concept applied to product platforms. Companies develop a product platform on which different variations of a product can be built. The initial meaning of product platform applied only to a company’s product development strategies. Gawer and Cusumano extended the idea of product platform to define industry platforms on which ecosystems can grow. In essence, the distinction is between platforms that are internal to the firm and platforms that are external to the firm. Ecosystems grow on external platforms (Cusumano, 2010; Gawer and Cusumano, 2014).

Hagel and Brown amplified this concept of platforms by demonstrating the fundamental dynamic of a “pull platform” to mobilize resources within a collaborative innovation project (Brown and Hagel, 2005; Hagel *et al.*, 2012). These platforms provide resources that participants on the platform can use to innovate through networks. Participants “pull” resources from the platform when the need arises. These pull models of innovation enable participants to manage growing uncertainty. They can access specialized and distributed resources without controlling them.

Increasingly, scholars are making the link between platforms and ecosystems (Gawer and Cusumano, 2014; Gawer, 2014; Isckia and Lescop, 2015; Altman and Tushman, 2017). Businesses can guide the formation of ecosystems by designing the platforms on which they emerge. The design of platforms includes issues of governance, participation, openness, and protocols. The term ecosystem describes the community of interacting organisations that co-evolve their capabilities and roles as participants on

the platform. Network effects, or increasing returns, emerge as participants continuously create value on the platform; the platform becomes more valuable the more people use it (McIntyre and Srinivasan, 2017). The review reveals that this metaphor of ‘platforms’—and its connection to ecosystems—is being adopted by scholars focused on other perspectives on the regional economy.

#### **4. THE REGIONAL POLICY PERSPECTIVE ON REGIONAL ECONOMIES**

The literature review now moves from scholarship that is focused on a business perspective, or the viewpoint of the firm, to scholarship that is directed toward regional policymakers. In this section of the literature review, three key concepts emerge from the scholarship: regional networks; regional innovation systems; and innovation and entrepreneurial ecosystems.

##### ***Regional Networks and Learning Regions***

The emergence of regional networks can be traced to the major work completed in the early 1990s by Saxenian (Saxenian, 1990; 1991; 1994; 1996). This line of research began with an investigation of how Silicon Valley recovered high technology employment in the semiconductor industry in the 1980s. In the 1970s, Silicon Valley had captured the attention of scholars and policymakers with its high technology growth in the semiconductor industry. By the mid-1980s, however, Japanese competition depressed semiconductor employment in the Valley. Then, a new wave of semiconductor investment expanded employment. Saxenian found that the flexible production networks and informal networks within the Valley enabled the regional economy to respond quickly to intensify Japanese competition (Saxenian, 1990). Saxenian pointed to these regional networks as critical to the regional economy’s resilience.

Saxenian subsequently explored networks operating in the Valley beyond the semiconductor industry (Saxenian, 1991). She also compared the regional economies of Silicon Valley and Route 128 in Boston (Saxenian, 1994, 1996). She used the comparison to point to the weakness of cluster analysis. Cluster analysis, she maintained, creates an invisible



boundary between an atomistic firm and an external economy. In other words, standing alone, cluster analysis does not recognize that networks that are critical to understanding the dynamics of knowledge flows within a regional economy. She proposed a network approach to regions to explain the relationships among the internal organization of firms, their connections to each other, and to the social structures within the region (Saxenian, 1994).

Florida and Morgan amplified Saxenian by introducing and exploring the concept of “learning regions” (Florida, 1995; Morgan 1997). Florida maintained that learning regions will become increasingly important as the global economy moves into a more knowledge intensive period of development. Echoing Saxenian’s work, Florida argued that within these regions, hierarchically organized firms will be replaced by firms that rely more heavily on networks and teams.

In exploring the concept of learning regions, Morgan looked more deeply at a convergence of innovation studies and economic geography. Focusing on regional policy within the European Union, Morgan drew the implications of learning regions for regional policymakers. He drew together the threads of a wide range of research in both innovation studies in economic geography to illustrate a potentially deep research agenda. More important, for the purposes of this review, he suggested that the emergence of a network paradigm helps policymakers overcome the rigidities of ideological thinking that create deep tensions between the state and the market. The growing importance of networks within regional economies is also reflected in a 1996 publication by the Organization for Economic Cooperation and Development, “The Knowledge-based Economy” (OECD, 1996). The publication underscored that networks are critical to understanding the diffusion of information, knowledge and technology.

Scholars have worked to distinguish different types of networks within regional economies. Bathelt, Malmberg and Maskell explored knowledge flows within a cluster (Bathelt *et al.*, 2004). The authors argued that clusters need both local networks, which they called “buzz” and global networks which they called “pipelines”. Clusters need both types of networks to funnel different types of knowledge into the regional economy. Ostergaard took an even more granular look and explores how knowledge

flows through social networks (Ostergaard, 2009). Those findings underscore the inadequacy of the concepts of “knowledge spill-overs”, a concept on which many economists rely. He demonstrated how knowledge is diffused through informal contacts.

Huggins and his colleagues (Huggins *et al.*, 2008; 2012; Huggins, 2016) moved to the level of the university to explore the role of universities in regional knowledge flows and networks. Huggins, Johnston and Steffson cautioned regional policymakers about expecting too much from policies designed to accelerate university knowledge transfer through networks (Huggins *et al.*, 2008). Huggins, Johnston and Stride took a closer look at these networks within the UK higher education system (Huggins *et al.*, 2012). Through more empirical work, the team presented a more nuanced look at how knowledge transfer takes place within regional economies. They find that more established universities are likely to have a wider range of organizations involved in knowledge transfer. Equally important, the authors point out that in lagging regions, universities can still play an important role. The nature of their networks is different. In lagging regions, networks are more locally focused than in leading regions. Huggins, writing in 2016, returned to themes first introduced by Saxenian. In exploring regional development in Silicon Valley, Taiwan, and Finland, Huggins concluded that regional policies should focus on the development of “open search networks” that are both local and global (Huggins, 2016). Designing these networks calls for experimentation, a region’s existing clusters can renew themselves through more open and connected networks, a point first emphasized by Saxenian (Huggins, 2016).

### ***Regional Innovation Systems***

Regional innovation systems represent a model initially designed to guide regional policy in the European Union. Scholarship by Cooke represents a direct path to the development of the concept (Cooke, 2008). Regional innovation systems are deeply grounded in network theory (Cooke and Morgan, 1993), and Cooke more formally explores the concept in a 1997 paper (Cooke, 1997). In that paper, he advocated that regional innovation systems make an appropriate and helpful connection between innovation systems and regional science.

In a review of the concept delivered in 2015, Asheim, Grillitsch and Trippel echoed and amplified Cooke's 2008 review (Asheim *et al.*, 2015). The concept of regional innovation systems integrates research on innovation systems with territorial innovation models developed by geographers and regional scientists. The following presents a brief summary.

Research on innovation systems was built on the premise that pathways to economic prosperity would be found by exploring the role innovation plays in a knowledge economy. Researchers wanted to overcome the limited insights into innovation provided by economists. This work provides a new tool to policymakers who are in charge of science and technology policy (Lundvall, 2007). This work represented a rejection of the simple linear model of innovation which had dominated most of the thinking in post-World War II economies (Narayanamurti, 2016). The linear model portrays innovation as a straightforward process moving from basic research to applied research to commercialisation and the market. In place of this linear model, innovation systems research focuses on interactions and learning processes among multiple parties in a system. Innovation results from multiple parties interacting with a complex system that is characterized by co-evolution and self-organisation (Lundvall, 2007).

In regional innovation systems, the "soft infrastructure" of networks plays an important role in the performance of regional innovation systems (Cooke *et al.*, 1998). The regional innovation system literature is beginning to incorporate the platform metaphor, a concept that is more advanced in the strategy management literature. The concept enters the regional innovation system literature initially as a reference to "policy platforms" (Cooke, 2007; Cooke *et al.*, 2010; Asheim *et al.*, 2011). More recently Acs, Stam, Audretsch and O'Connor connect the regional innovation system literature to the strategy management literature of platforms (Acs *et al.*, 2017). Walshok, Shapiro and Owens, after investigating the regional innovation systems in San Diego, Philadelphia and St. Louis, conclude that intermediary organisations can serve as platforms to support regional innovation systems. The effectiveness of these intermediary organisations, however, are shaped by the distinctive characteristics of place (Walshok *et al.*, 2013).

## 5. THE UNIVERSITY PERSPECTIVE ON REGIONAL ECONOMIES

Universities are experiencing more demands based on the shifting character of the regional economy. This section explores how scholars have characterized these shifts with three key concepts: entrepreneurial universities, the Triple Helix model, and university engagement.

### *University Engagement*

The concept of “university engagement” emerged in the wake of the publication by Ernest Boyer of a 1990 report for the Carnegie Foundation for the Advancement of Teaching. The vocabulary of university outreach and engagement, which now has taken root among major universities in the United States, began with his initial report (Boyer, 1990). In it, Boyer introduced the “scholarship of application”. In a subsequent paper, published posthumously, Boyer substituted the term “engagement” for the term “application” (Boyer, 1997). The Kellogg Commission on the Future of State and Land-grant Universities further developed Boyer’s work (Kellogg Commission, 1999).

Boyer, president of the foundation, initially defined the “scholarship of application” as the application of knowledge to practical challenges or social problems. This type of knowledge arises when academic research asks, “How can knowledge be applied to consequential problems?” Further, “Can social problems themselves define an agenda for scholarly investigation?” (Boyer, 1990). Boyer’s work led directly to the mobilisation of the Kellogg Commission. The Commission made the case for change by putting forth the proposition that the public view universities as out of touch and out of date (Kellogg Commission, 2001). The Commission called on universities to “renew the covenant” between universities and the American people by focusing on the institutional engagement. The concept of university engagement involves a new way of thinking about the relationship of the university to its community and regional economy. The Kellogg Commission outlined the meaning of the engagement by emphasizing that the concept goes well beyond conventional conceptions of outreach and public service. It is “embedded” in a “commitment to sharing and reciprocity”. “By engagement, the Commission envisioned partnerships, two-way streets defined by mutual respect among the partners for what each brings to the table”:

*“Such partnerships are likely to be characterised by problems defined together, goals and agendas that are shared, and definitions of success that are meaningful to both university and community and developed together, and some pooling or leveraging of University in public and private funds. The collaboration arising out of this process is likely to be mutually beneficial and to build the capacity and competence of all parties.” (Kellogg Commission, 1999).*

Following the work of the Commission, McLean, Thompson and Jonker proposed that engaged institutions have two key characteristics (McLean *et al.*, 2006):

- A significant portion of the University’s activities are oriented toward the needs of the communities it serves, and
- The university’s faculty staff and students are involved in a broad range of collaborations with the community that the university serves.

To these two characteristics, Fitzgerald and his co-authors add a third: An engaged university recognizes that “not all knowledge and expertise resides in the academy... expertise and great learning opportunities in teaching and scholarship also reside in non-academic settings” (Fitzgerald *et al.*, 2016). In other words, the university is involved in an ecosystem. The university actively participates in the design of this ecosystem by participating in collaborative initiatives.

Walshok’s work, which pre-dates the Kellogg Commission, nevertheless explored the practical implications of an engaged university. Exploring the evolving role of the research university in the United States, Walshok argued that to meet the needs of society, research universities must reframe their traditional approaches to teaching and learning. At the same time, they must develop new institutional mechanisms for connecting new knowledge that they develop “to the increasingly large and diverse publics who can use and contribute to that knowledge” (Walshok, 1995). In other words, moving toward an engaged university involves designing collaborations across the traditional boundaries both inside and outside the university. A core activity involves spanning traditional boundaries (Weerts and Sandmann, 2010). This argument is similar to Clark’s proposal for the entrepreneurial university discussed below (Clark, 1998).

Walshok, Furtek, Lee and Windham explain in practical terms how the University of California, San Diego worked to transform itself into an engaged university and built regional innovation capacity (Walshok *et al.*, 2002). The authors highlighted three important “hooks” to the engaged university. Within each step, the authors demonstrated some practical steps.

- Build a research base with world-class scientists and engineers—this step involves developing research clusters of “geographically concentrated groups of non-profit research institutions or groups within research institutions that have an expertise in specific fields of science and technology”. These research clusters must be connected to the regional economy through continuous interaction with local business leaders.
- Develop social networks to support new and growing companies—this step involves both creating quality places, “amenities of place”, as well as continuously forming teams of researchers, innovators and entrepreneurs. This step reinforces a culture open to entrepreneurs.
- Develop responsive education and training initiatives—this step involves developing both “breadth and depth of the advanced skills and knowledge” of the residents in the region.

Subsequent research into San Diego’s health and life sciences ecosystem have reinforced these findings (Majava *et al.*, 2016). Other research into San Diego’s innovation economy is also supportive of these three thrusts (Walshok and Shragge, 2013).

Scholars have continued to advance the concept of university engagement. McNall and his co-authors propose that the concept of systemic engagement to suggest that universities can be effective partners in systemic approaches to complex community change (McNall *et al.*, 2015). The authors argued that the most challenging problems facing humanity in the 21<sup>st</sup> century involve complex dynamic systems. A new, more sophisticated form of engagement, systemic engagement, is needed to meet the call of Boyer and the Kellogg Commission. The approach follows six key principles:

- Systems thinking—designing inquiries that embrace a systems perspective.
- Collaborative inquiry—using participatory approaches to research and evaluation that solicit multiple perspectives on problems.
- Support for ongoing learning—incorporating flexible, continuous evaluation that supports ongoing cycles of inquiry and action.
- Emergent design—embracing the uncertainty of any solution with the recognition that more effective solutions will emerge based on what is being learned.
- Multiple strands of inquiry in action—organizing multiple teams to pursue different dimensions of a complex challenge.
- Transdisciplinary—integrating the perspectives of multiple academic disciplines.

Systemic engagement sets forth potentially important design principles for how universities address increasingly complex social and economic challenges. This notion of systemic engagement tries to capture how universities can effectively engage within dynamic ecosystems. The framework embraces the complexity science used by economists to interpret the emerging knowledge economy (Arthur, 1996; 1999; Beinhocker, 2006). As such, the proposed framework begins to align the concept of university engagement with the underlying complexity of social and economic systems embraced in the concept of ecosystems.

### ***Entrepreneurial Universities***

The concept of entrepreneurial universities initially emerged from the work of Burton Clark, a professor of higher education and sociology at the University of California, Los Angeles. Clark is interested in exploring how universities are transforming themselves in the wake of the dramatic emerging trends of the knowledge economy (Clark, 1998). His research, which began in 1994, explored the transformation that took place in five exemplary European universities from 1980 to 1995. The universities included the University of Warwick (England), the University of Twente

(The Netherlands), the University of Strathclyde (Scotland), Chalmers University (Sweden), and the University of Joensuu (Finland). From these case studies, Clark identified five pathways of transformation to a new model of what he called the entrepreneurial university (Clark, 1998). These pathways can be also viewed as characteristics of Clarke's definition of how an entrepreneurial university can contribute effectively to a dynamic regional economy:

- A strengthened steering core—entrepreneurial universities have a systematic capability to steer themselves. There is an alignment between the managerial centre and what Clark termed the “academic heartland”.
- An enhanced development periphery—entrepreneurial universities design units that make the boundaries of the university more porous.
- A diversified funding base—entrepreneurial universities nurture and grow new sources of revenue.
- A stimulated academic heartland—in an entrepreneurial university academic units within the university become more entrepreneurial by reaching out beyond the boundaries of the university and promoting new sources of income from engagement.
- An integrated entrepreneurial culture—entrepreneurial universities develop a culture that embraces change. Strong practices that embrace change cultivate a new identity and a distinctive reputation.



In subsequent research, Clark identified three additional characteristics of entrepreneurial universities capable of sustaining transformation (Clark, 2004).

- Reinforcing interactions—there must be continuous interactions that create sufficient mutual value to sustain these interactions.
- Perpetual momentum—there must be a continuous commitment to building perpetual momentum by taking small steps: “momentum is acquired from the cumulative thrust of small steps”.
- Ambitious collegial volition—there must be continuous expressions of the collective will to transform. Within entrepreneurial universities, Clark finds a volition to take risks, to move ideas into action: “entrepreneurial universities accumulate small connected volitions—acts of will—that adapt their character”.

According to Shattock, Clark’s research generated a significant impact among universities in Europe (Shattock, 2010). Clark’s work also triggered an interest among scholars to conduct case studies in order to gather a more holistic view of the complex changes taking place in universities operating within dynamic regional economies (Rhoades and Stensaker, 2017). For example, Bramwell and Wolfe explore the impact of the University of Waterloo on the regional economy by identifying the “virtuous cycle of deep and interactive links with the local industrial community” (Bramwell and Wolfe, 2008). The authors conclude that by nurturing and “entrepreneurial attitude of mind” among faculty and students, the University of Waterloo stands out as a particularly exemplary example of an entrepreneurial university. In particular, they point to the following activities:

- Generating, attracting and retaining talent;
- Providing critical research support to industry;
- Global linkages; and
- Building “civic capital.

Wolfe and Bramwell provide a useful model for how the framework of entrepreneurial universities, as originally envisioned by Clark, can be applied to define a university's role in a regional economy.

### ***The Triple Helix Model***

The Triple Helix model of university transformation is rooted in technology commercialisation. The work originated in a series of academic conferences held in the 1990s. In the call for the first conference, the sponsors indicated that they wished to explore the “university's position in the newly emerging knowledge infrastructure” (Etzkowitz and Leydesdorff, 1995).

The Triple Helix model represents one of the first efforts to define an alternative approach to the linear model of commercialisation that emerged after World War II with the publication of Vannevar Bush's “Science: The Endless Frontier” (Bush, 1945). Scholars have concluded that this model is inadequate to describe technology commercialisation. The process is more subtle, sophisticated and complex (Narayanamurti, 2016; Shneiderman, 2016). With the Triple Helix, scholars use an organic metaphor based in molecular biology, in contrast with the ecosystem metaphor that is grounded in ecosystem science. As Figure 4 demonstrates, the model continues to attract scholarly interest.

The Triple Helix model encourages scholars to explore the interactions among business, government and universities in order to capture the reciprocal linkages taking place. This line of inquiry, according to the Triple Helix thesis, illustrates the enhanced role in innovation played by universities (Etzkowitz and Leydesdorff, 2000). Scholars engaged in the development of the concept continue to articulate the model (Etzkowitz and Ranga, 2013; Leydesdorff and Meyer, 2003). The boundaries of the model are not tightly drawn. Scholars have added helices to the model with quadruple and quintuple helix models being proposed (McAdam *et al.*, 2016; Baccarne *et al.*, 2016; Miller *et al.*, 2016).

Cooke, a proponent of regional innovation systems, critiques the Triple Helix model as an inadequate approach to providing policy guidance, especially in less advantaged regions without strong research universities: “Triple Helix thinking draws attention only to possible but weakly generalisable broad outlines of important contemporary innovation interactions” (Cooke, 2005). In

response, scholars who focus on the development of the Triple Helix model argue that the Triple Helix model provides more flexibility and granularity to enable scholars to understand the complex flows within the knowledge economy (Ranga and Etzkowitz, 2013).

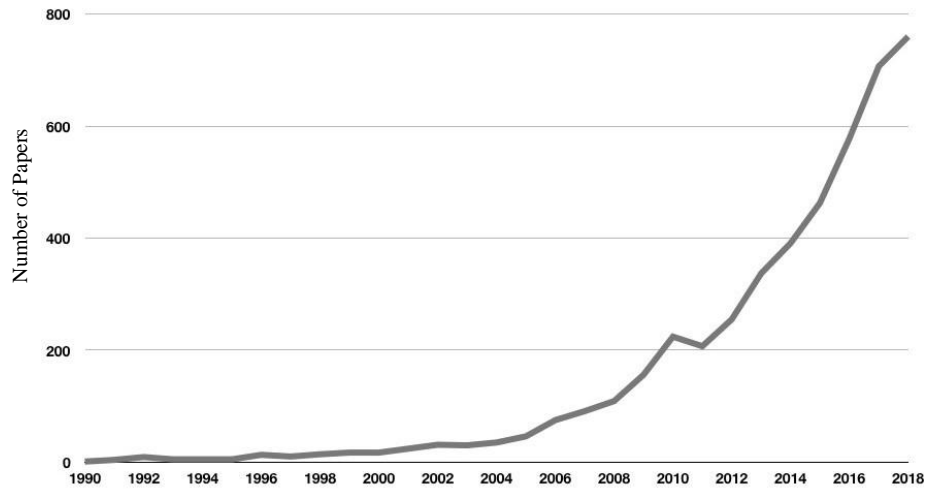
The value of the Triple Helix model for practitioners may not be rooted in its analytic power. Rather, the Triple Helix model may provide a helpful narrative structure to guide the complex interactions among multiple parties within a region. This insight comes from applying the Triple Helix model to the evolution of the Research Triangle in North Carolina (Morgan, 2016). Morgan found that the Triple Helix model provided a useful metaphor to explain the collaborative innovation that emerged in the region. Participants in the region describe these interactions as highly organic with no formal agreements or contracts. In a similar way, Rodrigues and Melo researched the application of the model in a lagging region of Portugal. They found that a primary benefit comes in inspiring people to think differently about collaboration. The model may give rise to new perceptions of value and improve the capacity to act (Rodrigues and Melo, 2013).

## **6. CONVERGENCE ON ECOSYSTEMS AND PLATFORMS?**

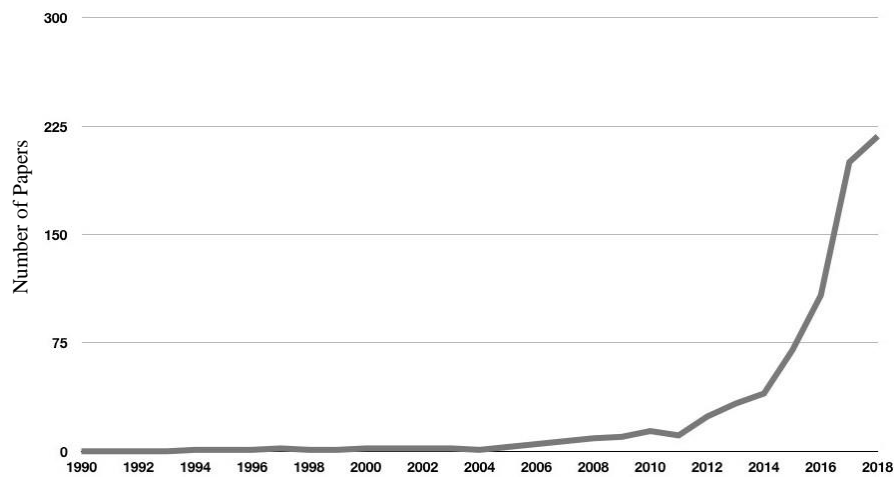
More recently, the concepts of innovation ecosystems, entrepreneurial ecosystems, and platforms are appearing across all three research streams.

### ***Innovation Ecosystems and Entrepreneurial Ecosystems***

The concepts “innovation ecosystem” and “entrepreneurial ecosystem” have attracted growing interest among scholars focused on business management, regional policy and universities. Both concepts have a relatively new lineage. Figure 3 illustrates the growth in scholarship for the “innovation ecosystem” literature. Figure 4 illustrates the growth in scholarship for the “entrepreneurial ecosystem” literature. Whereas the innovation ecosystem research stream began accelerating after 2009, the entrepreneurial ecosystem stream began its rapid growth in 2014.



**Figure 3.** Number of Papers Retrieved from SCOPUS with Search Term: “innovation ecosystem”. Source: SCOPUS search performed November 18, 2018; n = 4 656



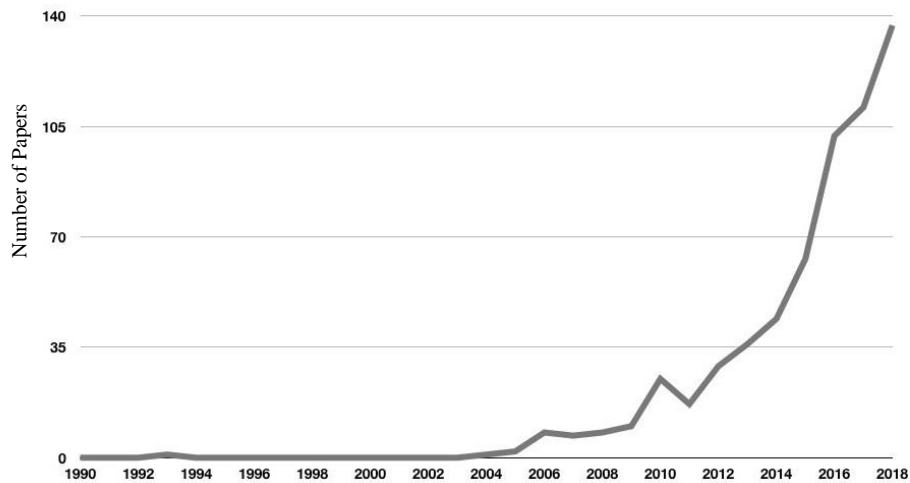
**Figure 4.** Number of Papers Retrieved from SCOPUS with Search Term: “(entrepreneurial OR startup) AND ecosystem”. Source: SCOPUS search performed November 18, 2018; n = 623.

The literature on innovation ecosystems is grounded in both the business perspective stream and the regional policy stream. It appears to be an outgrowth from scholars developing the concept of “regional innovation systems”. Strategic management scholars are focused primarily on how firms can develop their own innovation ecosystem (Adner, 2006). In contrast, scholars exploring regional innovation systems are primarily focused on the challenges facing regional policymakers in shaping technology and innovation policy in an era of increasingly open innovation. The innovation ecosystem literature introduces the potentially useful concept of orchestration (Dhanaraj and Parkhe, 2006). Within ecosystems, the creation of value involves collaboration across firms and organisations. The concept of orchestration suggests that leading firms within an innovation ecosystem can play a central role in aligning interests to achieve desired business objectives. Dhanaraj and Parkhe define orchestration as a set of deliberate actions to create an extract value from an innovation ecosystem. Gastaldi and Corso go on to suggest that in innovation ecosystems, academics can play an important role as orchestrators in ecosystems of continuous innovation (Gastaldi and Corso, 2016).

The entrepreneurial ecosystem literature, which is rooted more directly in the U.S. context, is largely focused on policies directed to the formation of entrepreneurial ecosystems. Theory development in entrepreneurial ecosystems is in its infancy (Roundy *et al.*, 2016). However, there is growing interest in entrepreneurial ecosystems, since there is growing evidence that entrepreneurship plays an important role in economic growth and development (Baumol and Strom, 2007). Scholars recognise that the research literature on entrepreneurial ecosystems is underdeveloped (Spigel, 2017; Roundy *et al.*, 2018).

### ***Platforms***

The concept of platforms, often tied to the concept of ecosystem, is also appearing across all three streams of literature. Figure 5 demonstrates that the connection of platforms with both innovation and entrepreneurial ecosystems is growing in momentum. This graph indicates that a growing number of papers are connecting the concepts of ecosystems and platforms together.



**Figure 5.** Number of Papers Retrieved from SCOPUS with Search Term: “(((entrepreneurial OR startup OR innovation) ecosystem) AND platform)”. Source: SCOPUS search performed November 18, 2018; n = 603.

As explored above, the relationship between the concepts of platforms and ecosystems is most thoroughly developed among management scholars considering the business perspective. We see the growing adoption of this perspective among scholars focused on both a regional perspective and a university perspective. Within the regional perspective, Asheim and his co-authors provide a highly cited article focused on the concept of “platform policies” to develop regional advantage (Asheim *et al.*, 2011). Since its publication, this paper has been gaining momentum among scholars. Within the university perspective, Whitmer and his co-authors find the concept of platform useful for explaining the emerging university role in engagement (Whitmer *et al.*, 2010). Other scholars see the university as a platform or hub for the development of ecosystems (Walshok *et al.*, 2002; Walshok and Shragge, 2013; Majava, *et al.*, 2016; Gastaldi and Corso, 2016; Malecki, 2018; McNall *et al.*, 2015).

Despite its early stage of development, the entrepreneurial ecosystem literature introduces another set of potentially useful concepts that echo the concept of platform. These concepts are “place” and “narrative”. The concept

of place and its connection to entrepreneurial ecosystems emerges from several papers. Ecosystems involve continuous knowledge flows that take place within a geographic location (Spigel, 2017; Malecki, 2018). The concept of place is, however, more than a geographic location; it is deeply connected to identity. Gill and Larson, incorporating Gieryn, explain the concept in these terms:

*“[A] place is a specific spot in the world, embodied in built and natural things and infused with meaning. Places are distinct from space in that place is space filled by people, practices, objects and representations”* (Gill and Larson, 2014; Gieryn, 2000).

The notion that the university can provide a place (or platform) for entrepreneurial ecosystems to develop is presented by Miller and Acs in their exploration of the University of Chicago (Miller and Acs, 2017).

In his exploration of entrepreneurial ecosystems, Roundy introduces “narratives”, another potentially valuable concept to explain the concept of platforms (Roundy, 2016). He emphasizes that entrepreneurial ecosystems do not just have physical characteristics. They are also social constructions. In particular, the narratives that develop during the creation of these ecosystems, may be critical to their continued development and sustainability.

Roundy structures his argument by initially pointing to the importance of narrative at the individual level of entrepreneurship. Narratives play an important role in developing the entrepreneur’s individual understanding of events, experiences and opportunities. The narratives that entrepreneurs construct about their venture can accelerate the flow of resources to the new firm. Roundy proposes that narrative can play an equally important role in the development of entrepreneurial ecosystems. In particular, narratives can serve important functions such as transmitting the ecosystem’s culture, making sense of the ecosystem, and constructing the ecosystem’s identity. In other words, narratives can explain the special value of a platform or place.

## **7. CONCLUSION**

The three research perspectives on the emerging regional economy that are considered in this systematic survey of literature are business strategy, regional

policy and university administration. These research streams, which serve different audiences, appear to be converging around concepts of platforms and ecosystems. If this preliminary conclusion is sustained through further analysis, the convergence holds important implications for research agendas, theory development, policy and practice. As scholars design their research strategies, the development of more multi-disciplinary teams appears promising. The phenomena under review involve multiple complexities—relationships, connections, and patterns of interactions—that are difficult to visualise. Quantitative data and analysis will likely be inadequate to capture and explain constantly changing systems. A multi-disciplinary team, focused on developing a visual language centred on platforms and ecosystems appears to be a promising approach. The research challenge is not too dissimilar to the challenge of developing a visual language to explain phenomena in systems biology (Novere *et al.*, 2009). From a policy perspective, the convergence on the concepts of ecosystems and platforms suggests that policy making to develop regional prosperity should focus on more adaptive and experimental approaches (Swanson and Bhadwal, 2009). Ecosystems and platforms are inherently dynamic. Fixed approaches to policy, animated by simple “if/then” logic are not likely to be successful. Instead, multiple policy experiments are likely to yield better results. Finally, practitioners should be aware of the complexity of ecosystems and platforms. While ecosystems, as complex adaptive systems, are inherently unpredictable, the platforms on which they form can be designed and guided. Here, research in strategic management appears to provide the most promising path forward. What would it look like if business managers, regional policy makers and university administrators all aligned their actions to strengthen a regional economy? How could they develop a more inclusive and dynamic process for sharing assets and making collaborative investments? If the convergence around ecosystems and platforms is, in fact, really taking place, the development opens an exciting new frontier for research, policy and practice.



## REFERENCES

- Acs, Z. J., Stam, E., Audretsch, D. B. and O'Connor, A. (2017). The Lineages of the Entrepreneurial Ecosystem Approach. *Small Business Economics*, 49(1), pp. 1-10.
- Adner, R. (2006). Match Your Innovation Strategy to Your Innovation Ecosystem. *Harvard business review*. doi: [http://doi.org/10.1007/978-1-4614-3858-8\\_100487](http://doi.org/10.1007/978-1-4614-3858-8_100487).
- Altman, E. J., and Tushman, M. L. (2017). Platforms, Open / User Innovation, and Ecosystems: a Strategic Leadership Perspective. Working paper 17-076. Retrieved from [http://www.hbs.edu/faculty/Publication Files/17-076\\_89f9f387-6692-41ca-a744-3528dc569c23.pdf](http://www.hbs.edu/faculty/Publication%20Files/17-076_89f9f387-6692-41ca-a744-3528dc569c23.pdf).
- Arthur, W. B. (1996). Increasing Returns and the New World of Business. *Harvard Business Review*, 74(4), pp. 100-109.
- Arthur, W. B. (1999). Complexity and the Economy. *Science*, 284(5411), pp. 107-109.
- Asheim, B. T., Boschma, R. and Cooke, P. (2011). Constructing Regional Advantage: Platform Policies Based on Related Variety and Differentiated Knowledge Bases. *Regional studies*, 45(7), pp. 893-904. doi: <http://doi.org/10.1080/00343404.2010.543126>.
- Asheim, B., Grillitsch, M. and Trippel, M. (2015). Regional Innovation Systems : Past - Presence - Future. *Papers in innovation studies*. No 2015/36. Lund.
- Baccarne, B., Logghe, S., Schuurman, D. and Marez, L. De. (2016). Governing Quintuple Helix Innovation: Urban Living Labs and Socio-Ecological Entrepreneurship. *Technology Innovation Management Review*, 6(3), pp. 22-30. doi: <http://doi.org/http://timreview.ca/article/972>.
- Bathelt, H., Malmberg, A. and Maskell, P. (2004). Clusters and Knowledge: Local Buzz, Global Pipelines and the Process of Knowledge Creation. *Progress in human geography*, 28(1), pp. 31-56. <http://doi.org/10.1191/0309132504ph469oa>
- Baumol, W. J. and Strom, R. J. (2007). Entrepreneurship and economic growth. *Strategic entrepreneurship journal*, 1(3-4), 233-237. doi: <http://doi.org/10.1002/sej.26>.

- Beinhocker, E. D. (2006). *The Origin of Wealth: Evolution, Complexity, and the Radical Remaking of Economics*. Harvard Business Press, Boston.
- Boyer, E. L. (1990). *Scholarship Reconsidered: Priorities of the Professoriate*. Princeton University Press, Lawrenceville, NJ 08648.
- Boyer, E. L. (1997). Ernest L. Boyer: Selected Speeches, 1979-1995. Jossey-Bass Inc., San Francisco.
- Bramwell, A. and Wolfe, D. A. (2008). Universities and Regional Economic Development: The Entrepreneurial University of Waterloo. *Research policy*, 37(8), pp. 1175–1187. doi: <http://doi.org/10.1016/j.respol.2008.04.016>.
- Brown, J. and Hagel, J. (2005). The Next Frontier of Innovation. *The McKinsey quarterly*, 3(3), pp. 82–91. Retrieved from <http://johnseelybrown.com/pushpull.pdf>.
- Bush, V. (1945). Science: The Endless Frontier. *Transactions of the Kansas Academy of Science*, 48(3), pp. 231-264.
- Chesbrough, H. W. (2003). *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Publishing, Cambridge, MA.
- Chesbrough, H. W., West, J. and Vanhaverbeke, W. (2006). *Open Innovation: Researching a New Paradigm*. Oxford University Press, Oxford.
- Clark, B. R. (1998). *Creating Entrepreneurial Universities: Organizational Pathways of Transformation (1st ed.)*. Elsevier Science, Ltd., Guildford.
- Clark, B. R. (2004). Delineating the Character of the Entrepreneurial University. *Higher Education Policy*, 17(4), pp. 355-370. doi: <http://doi.org/10.1057/palgrave.hep.8300062>.
- Cooke, P. (1997). Regions in a Global Market: the Experiences of Wales and Baden-Wuerttemberg. *Review of international political economy*, 4(2), pp. 349-381.
- Cooke, P. (2005). Regionally Asymmetric Knowledge Capabilities and Open Innovation: Exploring “Globalisation 2” - A New Model of Industry Organisation. *Research policy*. doi: <http://doi.org/10.1016/j.respol.2004.12.005>.
- Cooke, P. (2007). To Construct Regional Advantage from Innovation Systems First Build Policy Platforms. *European planning studies*, 15(2), pp. 179-194.
- Cooke, P. (2008). Regional Innovation Systems: Origin of the Species. *International Journal of Technological Learning Innovation and Development*, 1(3), p. 39.
- Cooke, P. and Morgan, K. (1993). The Network Paradigm: New Departures in Corporate and Regional Development. *Environment and Planning D: Society and Space*, 11(5), pp. 543-564.

- Cooke, P., De Laurentis, C., MacNeill, S. and Collinge, C. (2010). *Platforms of Innovation: Dynamics of New Industrial Knowledge Flows*. Edward Elgar Publishing, Cheltenham, UK.
- Cooke, P., Uranga, M. G. and Etxebarria, G. (1998). Regional Systems of Innovation: an Evolutionary Perspective. *Environment and planning A*, 30(9), pp. 1563-1584.
- Curley, M. (2015). The Evolution of Open Innovation. *Journal of innovation Management*, 3(2), pp. 9-16. Retrieved from <http://hdl.handle.net/10216/79104%5Cnhttp://www.open-jim.org%5Cnhttp://creativecommons.org/licenses/by/3.0>.
- Curley, M. (2016). Twelve Principles for Open Innovation 2.0: Evolve Governance Structures, Practices, and Metrics to Accelerate Innovation in an Era of Digital Connectivity. *Nature*, 533(7603), pp. 314-317. doi: <http://doi.org/10.1038/533314a>.
- Cusumano, M. (2010). Technology Strategy and Management: The Evolution of Platform Thinking. *Communications of the ACM*, 53(1), p. 32. doi: <http://doi.org/10.1145/1629175.1629189>.
- Dhanaraj, C. and Parkhe, A. (2006). Orchestrating Innovation Networks. *Academy of Management Review*, 31, 3, pp. 659–669.
- Etzkowitz, H. and Leydesdorff, L. (1995). The Triple Helix-University-Industry-Government Relations: A Laboratory for Knowledge Based Economic Development. *EASST Review*, 14(1), pp. 14-19. Retrieved from <http://ssrn.com/abstract=2480085>.
- Etzkowitz, H. and Leydesdorff, L. (2000). The Dynamics of Innovation: from National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations. *Research Policy*, 29(2), pp. 109.
- Etzkowitz, H. and Ranga, M. (2013). Triple Helix Systems: an Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Industry and Higher Education*, 27(4), pp. 237-262. doi: <http://doi.org/10.5367/ihe.2013.0165>.
- Fitzgerald, H. E., Bruns, K., Sonka, S. T., Furco, A. and Swanson, L. (2016). The Centrality of Engagement in Higher Education. *Journal of Higher Education Outreach and Engagement*, 20(1), pp. 223-244
- Florida, R. (1995). Toward the Learning Region. *Futures*, 27(5), pp. 527-536.

- Gastaldi, L. and Corso, M. (2016). Academics as Orchestrators of Innovation Ecosystems: The Role of Knowledge Management. *International journal of innovation and technology management*, 13(05), 1640009.
- Gawer, A. (2014). Bridging Differing Perspectives on Technological Platforms: Toward an Integrative Framework. *Research Policy*, 43(7), pp. 1239-1249. doi: <http://doi.org/10.1016/j.respol.2014.03.006>.
- Gawer, A. and Cusumano, M.A. (2002). Platform Leadership: How Intel, Microsoft, and Cisco Drive Industry Innovation. Harvard Business School Press, Boston, MA.
- Gawer, A. and Cusumano, M. A. (2014). Industry Platforms and Ecosystem Innovation. *Journal of Product Innovation Management*, 31(3), pp. 417-433. doi: <http://doi.org/10.1111/jpim.12105>.
- Gieryn, T. F. (2000). A Space for Place in Sociology. *Annual review of sociology*, 26(1), pp. 463-496.
- Gill, R. and Larson, G. S. (2014). Making the Ideal (Local) Entrepreneur: Place and the Regional Development of High-Tech Entrepreneurial Identity. *Human Relations*. 67(5), pp. 519-542. doi: <http://doi.org/10.1177/0018726713496829>.
- Hagel, J., Brown, J. S. and Davison, L. (2012). The Power of Pull: How Small Moves, Smartly Made, Can Set Big things in Motion. Basic Books (AZ).
- Huggins, R., Johnston, A. and Steffenson, R. (2008). Universities, Knowledge Networks and Regional Policy. *Cambridge Journal of Regions, Economy and Society*, 1(2), pp. 321-340.
- Huggins, R., Johnston, A. and Stride, C. (2012). Knowledge Networks and Universities: Locational and Organisational Aspects of Knowledge Transfer Interactions. *Entrepreneurship and regional development*, 24(7-8), pp. 475-502.
- Huggins, R. (2016). Entrepreneurship, Innovation and Networks: Lessons for Regional Development Policy. *Welsh economic review*, 24, pp. 18-22.
- Isckia, T. and Lescop, D. (2015). Strategizing in Platform-Based Ecosystems: Leveraging Core Processes for Continuous Innovation. *Communications and Strategies*, (99), pp. 91-112.

- Kellogg Commission (1999). Returning to Our Roots: the Engaged Institution. Kellogg Commission on the Future of State and Land-Grant Universities. Washington, DC: Association of Public and Land-grant Universities. Online version accessed November 11 2018, <http://www.aplu.org/projects-and-initiatives/economic-development-and-community-engagement/Kellogg%20Commission%20on%20the%20Future%20of%20State%20and%20Land-Grant%20Universities/index.html>.
- Kellogg Commission. (2001). Returning to Our Roots: Executive Summaries of the Reports of the Kellogg Commission on the Future of State and Land-Grant Universities. Washington, DC: Association of Public and Land-grant Universities. Online version accessed November 11 2018, <http://www.aplu.org/projects-and-initiatives/economic-development-and-community-engagement/Kellogg%20Commission%20on%20the%20Future%20of%20State%20and%20Land-Grant%20Universities/index.html>.
- Leysdesdorff, L. and Meyer, M. (2003). The Triple Helix of University - Industry - Government Relations. *Scientometrics*, 58(2), 191-203. <http://doi.org/10.1023/A:1026276308287>.
- Lundvall, B. Å. (2007). National Innovation Systems—Analytical Concept and Development Tool. *Industry and innovation*, 14(1), pp. 95-119.
- Malecki, E. J. (2018). Entrepreneurship and Entrepreneurial Ecosystems. *Geography Compass*, 12(3), e12359.
- Majava, J., Leviäkangas, P., Kinnunen, T., Kess, P. and Foit, D. (2016). Spatial Health and Life Sciences Business Ecosystem: a Case Study of San Diego. *European Journal of Innovation Management*, 19(1), pp. 26-46. doi: <http://doi.org/10.1108/EJIM-01-2015-0003>.
- McAdam, M., Miller, K. and McAdam, R. (2016). Understanding Quadruple Helix Relationships of University Technology Commercialisation: a Micro-Level Approach. *Studies in Higher Education*, 5079(November), pp. 1-16. doi: <http://doi.org/10.1080/03075079.2016.1212328>.
- McIntyre, D. P. and Srinivasan, A. (2017). Networks, Platforms, and Strategy: Emerging Views and Next Steps. *Strategic management journal*, 38(1), pp. 141-160. doi: <http://doi.org/10.1002/smj.2596>.
- McLean, S., Thompson, G. and Jonker, P. (2006). The Rising Tide of Outreach and Engagement in State and Land-Grant Universities in the United States: What are the Implications for University Continuing Education Units in Canada?. *Canadian journal of university continuing education*, 32(1), p. 83.

- McNall, M. A., Barnes-Najor, J. V., Brown, R. E., Doberneck, D. and Fitzgerald, H. E. (2015). Systemic Engagement: Universities as Partners in Systemic Approaches to Community Change. *Journal of Higher Education Outreach and Engagement*, 19(1).
- Miller, D. J. and Acs, Z. J. (2017). The Campus as Entrepreneurial Ecosystem: the University of Chicago. *Small business Economics*, 49(1), pp. 75–95. doi: <http://doi.org/10.1007/s11187-017-9868-4>.
- Miller, K., McAdam, R. and McAdam, M. (2016). A Systematic Literature Review of University Technology Transfer from a Quadruple Helix Perspective: Toward a Research Agenda. *R & D Management*. doi: <http://doi.org/10.1111/radm.12228>.
- Moore, J. F. (1993). Predators and Prey: A New Ecology of Competition. *Harvard Business Review*, 71(3), pp. 75-86.
- Moore, J. F. (1998). The Rise of a New Corporate Form. *Washington quarterly*, 21(1), 167-181. doi: <http://doi.org/10.1080/01636609809550301>
- Morgan, J. Q. (2016). A Collaborative Approach to Innovation-Based Economic Development: the Triple Helix In D. Bromberd (Ed) Problem Solving with the Private Sector: a Public Solutions Handbook. Routledge, London pp. 103-125.
- Morgan, K. (1997). The Learning Region: Institutions, Innovation and Regional Renewal. *Regional studies*, 31(5), pp. 491-503.
- Narayanamurti, V. (2016). *Cycles of Invention and Discovery*. Harvard University Press, Boston.
- Novère, N. L., Hucka, M., Mi, H., Moodie, S., Schreiber, F., Sorokin, A., Demir, E., Wegner, K., Aladjem, M. I., Wimalaratne, S. M., Bergman, F. T., Gauges, R., Ghazal, P., Kawaji, H., Li, L., Matsuoka, Y., Villéger, A., Boyd, S. E., Calzone, L., Courtot, M., Dogrusoz, U., Freeman, T. C., Funahashi, A., Ghosh, S., Jouraku, A., Kim, S., Kolpakov, F., Luna, A., Sahle, S., Schmidt, E., Watterson, S., Wu, G., Goryanin, I., Kell, D. B., Sander, C., Sauro, H., Snoep, J. L., Kohn, K. and Kitano, H., (2009). The Systems Biology Graphical Notation. *Nature biotechnology*, 27, 735. doi: <https://doi.org/10.1038/nbt.1558>.
- Organisation for Economic Co-operation and Development (OECD) (1996). *The Knowledge-Based Economy*. Organisation for Economic Co-operation and Development.
- Ostergaard, C. R. (2009). Knowledge Flows Through Social Networks in a Cluster: Comparing University and Industry Links. *Structural Change and Economic Dynamics*, 20(3), pp. 196-210. doi: <http://doi.org/10.1016/j.strueco.2008.10.003>.

- Porter, M. E. (1990). The Competitive Advantage of Nations. *Harvard Business Review*, 68(2), pp. 73-93.
- Porter, M. E. (1998a). Clusters and the New Economics of Competition. *Harvard Business Review*, 76(6), pp. 77-90.
- Porter, M. (1998b). The Adam Smith Address: Location, Clusters, and the “New” Microeconomics of Competition. *Business Economics*, 33(1), pp. 7-11.
- Porter, M. E. and Millar, V. (1985). How Information Gives You Competitive Advantage. *Harvard Business Review*. 63(4), pp. 149-160.
- Ranga, M., and Etzkowitz, H. (2013). Triple Helix Systems: an Analytical Framework for Innovation Policy and Practice in the Knowledge Society. *Industry and Higher Education*. doi: <http://doi.org/10.5367/ihe.2013.0165>.
- Rhoades, G. and Stensaker, B. (2017). Bringing Organisations and Systems Back Together: Extending Clark’s Entrepreneurial University. *Higher education quarterly*, 71(2), pp. 129-140. doi: <http://doi.org/10.1111/hequ.12118>.
- Rodrigues, C. and Melo, A. I. (2013). The Triple Helix Model as Inspiration for Local Development Policies: An Experience-Based Perspective. *International Journal of Urban and Regional Research*, 37(5), pp. 1675-1687. doi: <http://doi.org/10.1111/j.1468-2427.2012.01117.x>.
- Roundy, P. T. (2016). Start-Up Community Narratives: The Discursive Construction of Entrepreneurial Ecosystems. *Journal of Entrepreneurship*, 25(2), pp. 232-248. doi: <http://doi.org/10.1177/0971355716650373>.
- Roundy, P., Bradshaw, M. and Brockman, B. (2018). The Emergence of Entrepreneurial Ecosystems: A Complex Adaptive Systems Approach. *Journal of Business Research*, 86(10). doi: <https://doi.org/10.1016/j.jbusres.2018.01.032>.
- Saxenian, A. (1990). Regional Networks and the Resurgence of Silicon Valley. *California Management Review*, 33(1), pp. 89-112. doi: <http://doi.org/10.2307/41166640>.
- Saxenian, A. (1991). The Origins and Dynamics of Production Networks in Silicon Valley. *Research Policy*, 20(5), pp. 423-437. Doi: [http://doi.org/10.1016/0048-7333\(91\)90067-Z](http://doi.org/10.1016/0048-7333(91)90067-Z).
- Saxenian, A. (1994). Inside-Out: Regional Networks and Industrial Adaptation in Silicon Valley and Route 128. *Cityscape*, 2(2), pp. 41-60. doi: <http://doi.org/10.2307/3158435>.
- Saxenian, A. (1996). *Regional Advantage*. Harvard University Press, Boston.

- Shattock, M. (2010). The Entrepreneurial University: an Idea for its Time. *London Review of Education*, 8(3), pp. 263-271.
- Shneiderman, B. (2016). *The New ABCs of Research: Achieving Breakthrough Collaborations*. Oxford University Press, Oxford.
- Smart, P., Tranfield, D. and Denyer, D. (2003). Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review. *British Journal of Management*, 14(3), pp. 207-222. doi: <http://doi.org/10.1111/1467-8551.00375>.
- Spigel, B. (2017). The Relational Organization of Entrepreneurial Ecosystems. *Entrepreneurship: Theory and Practice*, 41(1), pp. 49-72. doi: <http://doi.org/10.1111/etap.12167>
- Storper, M. (1997). *The Regional World: Territorial Development in a Global Economy*. Guilford Press, New York.
- Swanson, D. and Bhadwal, S. (2009). *Creating Adaptive Policies: A guide for Policymaking in an Uncertain World*. International Development Research Centre.
- Walshok, M. L. (1995). *Knowledge Without Boundaries: What America's research Universities Can do for the Economy, the Workplace, and the Community*. The Jossey-Bass Higher and Adult Education Series. Jossey-Bass, San Francisco.
- Walshok, M. L., Furtek, E., Lee, C. W. and Windham, P. H. (2002). Building Regional Innovation Capacity: The San Diego Experience. *Industry and higher education*, 16(1), pp. 27-42.
- Walshok, M. L. and Shragge, A. J. (2013). *Invention and Reinvention: The Evolution of San Diego's Innovation Economy*. Stanford University Press, Stanford.
- Weerts, D. J. and Sandmann, L. R. (2010). Community Engagement and Boundary-Spanning Roles at Research Universities. *The Journal of higher education*, 81(6), pp. 632-657.
- Whitmer, A., Ogden, L., Lawton, J., Sturmer, P., Groffman, P. M., Schneider, L., Hart, D., Halpern, B., Schlesinger, W., Raciti, S., Bettez, N., Ortega, S., Rustad, L., Pickett, S. and Killilea, M. (2010). The Engaged University: Providing a Platform for Research that Rransforms Society. *Frontiers in Ecology and the Environment*, 8(6), pp. 314-321.