

Capturing conversations in entrepreneurial ecosystems

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Capturing Conversations in Entrepreneurial Ecosystems

Abstract

This paper examines a novel and innovative methodological approach and dataset for measuring the complex relational dynamics underpinning entrepreneurial ecosystems (EEs). Existing measurement techniques have largely failed to yield sufficiently nuanced data or insights to inform robust policy recommendations within this research field. To rectify this situation, this paper sets out a novel approach to assessing the relational connectivity within EEs by capturing entrepreneurial "conversations". Drawing on real-time data extracted from an event-based social media platform, in combination with social network analysis and qualitative interview data, we provide an in-depth assessment of the relational connections within the city of Edinburgh at three analytical levels. Overall, the paper demonstrates that the analysis of conversations and conversational spaces is an important mechanism for exploring and mapping the relational connectivity within EEs. As well as producing novel empirical insights, this approach provides policy makers with vital strategic policy intelligence to help better inform public policy frameworks and associated interventions.

Keywords:

Entrepreneurship

Entrepreneurial Ecosystems

Networks

Conversations

Real-Time Data

Public Policy

1.Introduction

Despite the importance attributed to strategic policy intelligence¹ within innovation policy frameworks in recent years (Flanagan et al, 2011, p. 711), limited empirical attention has been devoted to the methodological processes applicable to enhance policy learning in the sphere of entrepreneurship. Therefore, this paper sets out a novel data-driven technique for capturing the relational, spatial and temporal dynamics underpinning entrepreneurial ecosystems (henceforth EEs). Admittedly, this is a somewhat unconventional paper. It does not provide a detailed set of empirical findings followed by a somewhat sparse discussion of their policy relevance. Instead, its core aim is to provide a detailed picture of how scholars and policy makers can deploy this novel methodological approach to help yield practicable and actionable insights to inform policy making.

The main empirical focus of this paper is to measure spatial network "connectivity" within EEs. It does so by developing an innovative technique to track the entrepreneurial "conversations" taking place. Following others, we explore conversations in order to examine the social and spatial interactions underpinning entrepreneurship within ecosystems (Lowe and Feldman, 2008; Uyarra et al, 2017). While the term 'conversations' is often invoked rather loosely, in this paper, we define conversations to be *impromptu informational exchanges between like-minded individuals and groups of people, usually in informal settings and spaces*. This term implicitly conveys knowledge creation and idea formation within specialist communities of practice in particular geographic places. In other words, conversations are a "socially embedded" concept arising when like-minded people

¹ Strategic Policy intelligence is defined as "a set of actions to search, process, diffuse and protect information" (Tübke et al, 2001, p.5). Essentially, it offers a variety of methodologies, such as foresight exercises, to meet the demands of policy-making.

congregate and communicate (Uyarra et al, 2017, p. 833). These conversations and their associated conversational spaces are recognised as crucial for enhancing place-specific knowledge creation advantages in regions (Lowe and Feldman, 2008).

So why do conversations matter for entrepreneurs? Critically, they enable entrepreneurs to make sense of their ventures and their own entrepreneurial experiences through narratives and storytelling (Lounsbury and Glynn, 2001; Garud, and Giuliani, 2013), which is often crucial for resource acquisition and vicarious learning, not least because many of the best ideas "originate outside the walls of a company" (Malecki, 2011, p. 42). However, it remains unclear how these narrative processes operate within and shape various communities across EEs (Roundy, 2016). While the critical importance of conversations has been strongly demonstrated in the context of innovative processes (Lester and Piore, 2004; Lowe and Feldman, 2008; Uyarra et al, 2017), we wish to argue this concept has equal resonance for aiding our understanding of the social structures and relational dynamics underpinning EEs.

Recent years have witnessed a burgeoning research output exploring EEs (Mason and Brown, 2014; Alvedalen and Boschma, 2017; Malecki, 2018; van Rijnsoever, 2020). Consequently, the main empirical unit of analysis has changed from a dominant focus on individual entrepreneurs, towards a much stronger focus on the contextual, institutional and relational factors mediating entrepreneurial behaviour (Autio et al, 2014). This shift is in line with scholars who advocate the need for greater pro-social research, which conceives of entrepreneurial opportunities as a "*process of social interaction* (between a community and the entrepreneur) rather than solely as an *outcome of thinking*" by entrepreneurs themselves (Shepherd, 2015, p. 491). In many respects, this re-orientation mirrors the

manner in which the innovation process is now widely conceived as a systemic process involving a variety of different interconnected actors, institutions and iterative processes (Lundvall et al, 2002; Acs et al, 2014). Consequently, it is increasingly recognised that entrepreneurship (like innovation) is most likely to occur within EEs where there are a set of inter-related actors, institutions and processes, bound together by a supportive culture with strong levels of social capital (Neck et al, 2004; Feldman et al, 2019; Spigel and Harrison, 2018; Audretsch et al, 2019).

Such has been the rapid upsurge of interest in the EE concept during the last decade it has quickly assumed the mantle of "word du jour" within entrepreneurship research (Lowe and Feldman, 2017 p.2)². Given the scale of research interest on this topic, several reviews of the literature have been undertaken despite its relatively nascent status as a field of enquiry (Alvedalen and Boschma, 2017; Cavallo et al, 2018; Malecki, 2018). Importantly, the concept has also been widely propagated by an array of important supranational organisations, such as the EU, OECD and World Bank, marking it out as the latest industrial policy "blockbuster" (Brown and Mawson, 2019)³ or "fad" (Brown and Mason, 2017) within regional policy making (Stam, 2015). The strong resonance with policy makers possibly stems from the fact that the practitioner community initially developed and disseminated the concept (see Feld, 2012; Isenberg, 2010; Napier and Hansen, 2011).

Despite this widespread appeal, the manifest problems associated with operationally deploying the EEs metaphor have prevented policy makers from maximising the concept's

² A search of the term "entrepreneurial ecosystems" in August 2020 using Google Scholar produced 55,100 results, with 12,800 results published in the last 2 years.

³ Indeed, the EE concept seems to be joining a list of recent academic concepts which have managed to bridge the gap between academia and public policy. Other notable academic concepts entering the policy lexicon over the last 20 years include, *inter alia*: clusters, open innovation, innovation systems, smart specialisation and related variety.

utility. This largely stems from a lack of clarity about the concept (Isenberg, 2016), with many policy makers crudely equating the concept with start-ups (Brown and Mawson, 2019; Muñoz et al, 2020). By the same token, research has found that a strong commonality across many ecosystems is a focus on narrow measurement issues, with key metrics typically focusing on the *volume of entrepreneurship* in terms of measuring start-up numbers, peoples' propensity and intention towards engaging in entrepreneurial activities or the measuring the outputs from universities, incubators and accelerators. These rather crude approaches to empirical measurement focus on the things that are easy to find (e.g. start-ups, scale-ups, unicorns) and easy to measure (e.g. levels of VC funding, attitudinal perceptions) (see Nylund and Cohen, 2017; Stam, 2018; Szerb et al, 2019; Vedula and Kim, 2019). Much of this owes to an over-reliance on traditional off-the-shelf sources of available data such as governmental surveys and Global Entrepreneurship Monitor (GEM) data (Credit et al, 2017).

The academic literature on EEs has compounded this problem by often using static (predominantly backward-looking) methodologies for examining these complex structures. Brown and Mason (2017, p. 22) hold that most measurement approaches to date have been rudimentary, with many ignoring the relational underpinnings of the metaphor. Arguably, it is "the interactions and connectedness" between different component parts of EEs that "create and sustain entrepreneurial ventures and a culture of entrepreneurship over time" (Credit et al, 2017, p. 5). Despite the growing scholarly research interest, to date there has been a dearth of nuanced studies using innovative methods for studying relational dynamics within ecosystems in a holistic way (Stangler and Bell-Masterson, 2015), with little use made of novel and real-time data to capture nebulous facets of ecosystems such as relational connectivity, culture and social infrastructure (Credit et al, 2017; Roundy et al, 2017).

This paper attempts to address these shortcomings by delineating a novel methodological approach for capturing conversations that could potentially provide policy makers with more dynamic real-time "relational metrics" to inform public policy and support interventions for EEs. It does so by using a novel source of relational metrics by using an online events booking platform, Meetup.com, to observe these entrepreneurial interactions and exchanges. Such relational metrics differ markedly from the traditional quantitative metrics for measuring entrepreneurial activity, such as increases in start-ups or patents. Our goal here is not to provide a single one-size-fits-all "quantitative measure", "statistic" or "count metric" to assess an EE, but rather we focus on the concept of a "relational metrics" to provide insights into the relational connections formed by human interactions to help inform policy decision making. Crucially, the types of relational metrics examined enable us to map and track the evolutionary changes of the entrepreneurial conversations taking place spatially within an EE. Therefore, the paper fulfills an essential role in contributing to the nascent literature surrounding measurement techniques and EEs by addressing the following key research question: *how and where do entrepreneurial conversations take place in EEs and how do they evolve over time?*

In addition to a comprehensive review of the EE literature, the paper draws upon a novel form of social network analysis (SNA). This analysis was undertaken utilising a data-driven approach to track and examine the conversations amongst entrepreneurial "meetup" events in the city of Edinburgh, triangulated with 23 in-depth interviews of participants at various Meetup events. Edinburgh provides an excellent contextual backdrop for examining EEs as it ranks as one of the most dynamic cities for technology entrepreneurship in the UK (Sheppard, 2016; Spigel, 2016) and disproportionately contributes to the country's stock of

high growth firms deemed crucial for productivity growth (Mason and Brown, 2013)⁴.

Together these sources of data and empirical context provide a strong vantage point for reviewing the rapidly developing landscape surrounding the issue of measurement approaches and EEs.

The remainder of the paper is set out as follows. First, we briefly consider the definitional ambiguities plaguing the EE research field before interrogating the empirical literature on EEs. We then examine a new and innovative methodological approach for empirically measuring the relational connections within an EE. The penultimate section discusses some of the empirical evidence generated, focusing specifically on how these insights can be used to help inform policy makers in local EEs. The final section then draws some conclusions and policy recommendations from the study.

2. Definitional Ambiguities

A key criticism of the EE concept is lack of definitional transparency. This, coupled with its strong propensity for interpretive flexibility, has led to a number of recurring ambiguities within both the academic literature as well as policy development. This situation begs the fundamentally important question: if you cannot be sure of what something is, how can you establish its parameters and measure it effectively? Indeed, a cursory look at the long list of competing definitions reveals that considerable heterogeneity exists in terms of how scholars perceive, and importantly define, EEs (see Table 1 below). While some definitions emphasize the importance of interconnectedness and "interacting components" between different actors and processes (Mason and Brown, 2014; Mack and

⁴ Between 2013 and 2017, the number of high-growth enterprises in Edinburgh (i.e. firms expanding turnover by over 20% per annum over three years) increased by 115% (ONS, 2019).

Meyer, 2016; Audretsch and Belitski, 2017; Bruns et al, 2017), others stress the importance of key EE components (Roundy et al, 2017) such as infrastructure (Rijnsoever, 2020), entrepreneurial agents such as VCs, universities, accelerators (Wright et al, 2017; Cohen et al, 2019) and start-ups (Auerswald and Dani, 2017; Spigel, 2017).

[Insert Table 1 about here]

Crucially, many definitions fail to properly encapsulate the *systemic nature* of the original concept, often ignoring somewhat hidden relational aspects such as networks, social capital, culture and "buzz" (Storper and Venables, 2004). Within EEs, entrepreneurs often need to seek out other actors "who can supply them with resources and with whom they can interact" (Rijnsoever, 2020, p. 2). Entrepreneurs frequently use events such as hackathons, conferences, meetups and informal drinks as a means of building their social networks and social capital. It is often the informal impromptu relationships, networks and conversations between different entrepreneurial actors which are crucial for the performance of EEs (NESTA, 2015), with well-functioning ecosystems often conceived as being more than the sum of their parts (Brown and Mason, 2017). However, while social capital within an ecosystem powerfully shapes the performance of the entrepreneurial actors within a region, it remains somewhat neglected by scholars (Kemeny et al, 2015).

Cumulatively, these problems clearly highlight the urgent need for greater specification of what EEs are so that scholars can adopt a more homogenous and uniform view of the parameters encompassing this phenomenon. As many definitions of EEs can appear "vague and opaque" (Kuckertz, 2019), we take the view that there is a need for detailed and highly specified definitions (Cavallo et al, 2018). Whereas some of the expansive definitions outlined in Table 1 (see Acs et al, 2014; Spigel, 2017) perhaps strongly

equate the concept primarily with start-ups, others specifically frame the concept as a dynamic one entailing a series of entrepreneurial processes such the propensity for new firm formation, numbers of high growth firms and levels of "blockbuster entrepreneurship" (Mason and Brown, 2014). Arguably, this more finely tuned delineation of the concept is better equipped to capture the whole gamut of processes and factors shaping regional entrepreneurship.

While Mason and Brown's (2014) definition provides a good terminological starting point, it fails to explicitly mark out two further aspects of these complex organisms. First, it pays insufficient attention to relational connectivity. Social capital and networks effectively act as the arteries circulating the lifeblood of information, ideas and tacit knowledge enabling ecosystems to function appropriately (Malecki, 2011; Spigel, 2017; Neumeier et al, 2019). Definitions of EEs which ignore or downplay these relational connections misconstrue the true systemic nature of the concept. Second, while acknowledging the spatial nature of EEs, the definition fails to elaborate on their "geographically bounded" nature (Audretsch and Belitski, 2017, p. 1031)⁵. Unfixed boundaries make it difficult, if not impossible, to assess and measure EEs effectively (Brown and Mason, 2017). While the optimal spatial scale for examining EEs is yet to be determined (Stam, 2015), as a broad heuristic, we would suggest that most ecosystems are spatially localised (van Rijnsoever, 2020). In line with other scholars, this would suggest that the most appropriate spatial demarcations are the immediate urban or city-region context (Audretsch and Belitski, 2017),

⁵ Interestingly, Malecki (2018) notes that only a handful of empirical studies include spatial parameters (such as a 30-60 mile radius) whilst delineating ecosystems.

although spatial heuristics are likely to be more expansive for more remote locations where EEs are more diffuse and less concentrated (Miles and Morrison, 2018).

3. Relevant Empirical Literature

In order to interrogate the methods and metrics used within the empirical evidence base surrounding EEs, the authors conducted a comprehensive meta-review of the published literature on this topic. Our aim was not to provide a thematically based or fully systematic review of the literature, but rather to unpack the nature of the methodological approaches and analytical techniques used to explore EEs empirically. Recognising that the EE literature permeates several research fields, our evaluation collected publications from a number of different databases⁶. We used the search term "entrepreneur* ecosystem*" and looked at works published between 2001 and 2018⁷. In total, this search identified 101 papers. While not exhaustive, we are confident this encompasses the vast majority of rigorous published research on the EE concept during this timeframe.

3.1 Analysing the Literature

Our review of the literature revealed a number of discernible trends. Entrepreneurship was by far the single largest disciplinary field contributing to this evidence base, with almost half of all the papers emanating from entrepreneurship and small business journals. The other two major disciplinary contributors to the literature were innovation and regional studies. While we examined a sizable timespan, it is only recently that the field has really taken-off, with almost a third of papers published in 2017 and

⁶ These included EBSCO (Business Source Complete and EconLit), Emerald, ProQuest Business Premium Collection, ScienceDirect, and Web of Science (Social Sciences Citation Index and Emerging Sources Citation Index).

⁷ As a measure of quality control, we excluded publications that did not explicitly address the EE concept and those published in outlets not included in the CABS Academic Journal Guide 2015.

almost half published in 2018 (see Table 2 below). This temporal bias was accompanied by a notable spatial bias, with the US and the UK being the two most prominent locations contributing to this rapidly developing research field. Nevertheless, contributors are now emerging from a wide range of developed and developing economies alike.

[Insert Table 2 about here]

Importantly, our review also yielded insights about the literature from a methodological perspective (see Table 2 above). A quarter of papers examined EEs from a conceptual perspective, which is perhaps unsurprising given the field's nascent status. Qualitative research approaches have been by far the most popular, constituting around 40% of the total papers with just under one-third (27) applying quantitative research methods. The use of mixed methods approaches was quite rare, with just around 10% of studies adopting this approach. Overall, this suggests that much of the literature to date has adopted an inductive approach towards examining EEs (Colombelli et al, 2019; Miles and Morrison, 2018), with many studies adopting a case study approach to describe either a "particular place" or "particular features" of EEs (Alvedalen and Boschma, 2017, p. 894). Some of these are highly nuanced case histories such as Feldman and Lowe's (2018) detailed study on North Carolina's Research Triangle.

In contrast, much of the quantitative empirical literature has tended to focus on historical GEM data on entrepreneurial intentions (Bruns et al, 2017; Hechavarría and Ingram, 2019; Simmons et al, 2019), national governmental data (Auerswald and Dani, 2017; Ghio et al, 2019; Vedula and Kim, 2019), Eurostat data (Audretsch and Belitsky, 2017; Bruns et al, 2017) and bespoke datasets such as Crunchbase (Nylund and Cohen, 2017). A common feature of these quantitative approaches is the use of static cross-sectional data

and methods. This precludes examining EEs from an evolutionary perspective, despite this being crucial when looking at an inherently changing phenomenon (Mack and Meyer, 2016; Schäfer and Henn, 2018).

Given the empirical focus of this paper, of significant interest is the nature and types of measurement techniques and metrics adopted by scholars when examining EEs. Overall, what we see is that the field of EE scholarship is characterised by a distinct lack of methodological pluralism, which has arguably hindered our comprehension of this complex empirical phenomenon. As we shall see, this is particularly important from a policy perspective. While traditional metrics used to measure entrepreneurial activity such as the number of jobs created, levels of new firm creation and levels of equity investment provide a baseline, they do not fully capture the intrinsic nature or health of EEs (Roundy et al, 2017). Indeed, due to their inherent complexity EEs they "cannot be effectively assessed using such simple 'count-based metrics'" such as the number of start-ups (Roundy et al, 2017, p. 103). Critically, these metrics fail to inform public policy makers about how best to intervene to make ecosystems function *more effectively*. Furthermore, traditional datasets and industrial classification schemes rarely consider the full complexities of the "relationships among diverse organizations across space" (Feldman and Lowe, 2015, p. 1793) or over time.

Recently, two main forms of measurement techniques have been advanced within the literature. One top down approach is the "entrepreneurial ecosystem index" (Stam, 2018). This approach rather crudely appraises a range of different metrics using a set of proxies to assess the vibrancy of localised EEs and is very similar to the approach adopted by scholars examining national systems of entrepreneurship using the Global Entrepreneurship

Index (Acs et al, 2014)⁸. Vedula and Kim (2019) propose a similar composite index of ecosystem quality which assesses EEs based on five key variables: supportive entrepreneurial culture, access to finance, availability of human capital, innovative capacity and support organisations. Again, this is a composite index based on various proxies for each of these key variables. While clearly issue could be taken with the validity of the proxies used, they do enable EEs to be compared to other spatial areas on a broad range of ecosystem performance indicators. These approaches will probably hold traction with national policy makers, who often like to monitor regional differentials across their respective economies. However, by the authors' own admission, they do not offer local policy makers much that is particularly meaningful in terms of how they could influence or change specific components of the EE (Vedula and Kim, 2019). Overall, these types of aggregate approaches examining different regions do not yield much in the way of practicable policy insights.

Alternative bottom-up approaches towards measurement techniques using different tools to assess the nature of networks and social capital within EEs are now beginning to emerge. While these types of studies are a relatively novel addition to the EE literature, as a methodological technique they feature widely across a range of social sciences (Payne et al, 2011). Adopting a social network lens, research is starting to yield interesting and important insights into the nature of intra-ecosystem connectivity within different EEs. Examining the nature of networks within Chicago and Orlando, Neumeyer et al (2019) found stark differences between male and female high growth entrepreneurs, with the latter exhibiting a much lower degree of bridging social capital than their male entrepreneurs. Similarly,

⁸ This comprises formal institutions, entrepreneurship culture, physical infrastructure, market demand, networks, leadership, talent, finance, new knowledge, and intermediate services.

Motoyama and Knowlton (2017) discovered that the way in which entrepreneurs interact and form relationships is substantially influenced by the way support organizations have interacted with them. Utilising novel mapping software, Pittz et al (2019) found that the relational connections of "dealmakers" are configured very differently across EEs, displaying strong connectivity within dynamic EEs such as Seattle and weaker connectivity in less dynamic EEs such as Tampa. Dealmakers are former entrepreneurs and serial entrepreneurs who "glue" EEs together (Napier and Hansen, 2011) by connecting people throughout their network (Feldman and Zoller, 2012).

Some of the newer bottom-up approaches outlined above appear to be of strong potential for policy makers; the use of SNA, in particular, seems a valuable technique for analysing and dissecting the complex relational dynamics underpinning EEs. That said, the EE literature has not produced a comprehensive network approach. A key research challenge facing EE scholars is how to best explore how different networks and "subnetworks" connect to each other and to what extent overlap exists between networks (Alvedalen and Boschma, 2017, p. 894-896). For example, the nature of the underlying data in some studies (i.e. one-off interviews) means that these studies can only provide static snapshots about the functioning of social capital within EEs (Neumeyer et al., 2019). While of academic interest, this information is less relevant for EE policy makers charged with the responsibility of better understanding, improving and tracking connectivity within their respective jurisdictional boundaries. For these types of observers, capturing "real-time" data (Brundin, 2007) about the changing nature of social capital within ecosystems would potentially be of much greater value. In order to provide information on the temporal dynamics of these social structures, much more in-depth and temporally sensitive data is

required, especially those that can capture conversations made by a wider array of actors across an EE.

Another limitation of these approaches is a lack of detail about the nature of relationships. While these techniques can shed light on the ties between different actors within different EEs at a given point in time, they cannot specify the nature of the connections or "topics of conversations" taking place. Conversations are intentional ongoing forms of knowledge creation between individuals, which are crucial for helping entrepreneurs source and develop new ideas (Lester and Piore, 2004; Rutten, 2017). Research shows that tacit knowledge sharing and a deepening of social relations also emanates from a shared conversational space (Lowe and Feldman, 2008). It is through such interactions that "problems are framed, choices get made and the rationales underpinning them developed" (Uyarra et al, 2017, p. 833). Whilst conversations appear crucial for the promotion of entrepreneurship, it is of critical importance to unravel the socio-spatial nature of the conversations taking place within EEs. In other words, gaining a greater understanding of the nature of these localised interactions taking place is needed if policy makers are to better comprehend the relational and spatial dynamics and interconnections underpinning EEs. However, the methodological tools (and associated datasets) utilised by EE scholars have to date not been able to adequately capture these relational processes.

4. Data and Methods

To empirically examine the nature and the locations of conversations, and thus the relational connectivity in the city of Edinburgh's EE, a multi-method research approach was developed to assess these conversations at three levels: macro level (i.e. meetups across the Edinburgh EE), meso level (i.e. specific Meetup groups) and micro level (i.e. individual

ecosystem actors). In order to measure the connections at the macro and meso levels, we utilised data capturing the existence of "Meetup" events organised via an online event website (see below). In order to explore connectivity at the micro level, specifically how individual actors within the Edinburgh EE identify events, exchange knowledge and develop their own network connectivity through the use of Meetups, we collected qualitative data via in-depth interviews. This mixed-methods research design not only enabled us to develop a picture of conversations at three different levels, it also ensured important data triangulation (Molina-Azorín et al, 2012).

4.1 Why Meetup.com data

Undoubtedly, new social media and networking platforms offer "promising avenues" for deriving and assessing new metrics within EEs (Credit et al, 2017, p.11). Utilising these online sources of data on entrepreneurial events also plays to those who suggest that the rapid evolution of digital infrastructures is creating "digital affordances" that innately affect the organisation of economic activity within EEs (Autio et al, 2018). With this in mind, there are a number of compelling reasons for specifically utilising data from Meetup.com rather than the other event booking platforms (e.g. Eventbrite), networking platforms (e.g. LinkedIn) or social media platforms (e.g. Twitter) used in other studies.

First, the digital platform Meetup.com is the world's largest platform for finding and building local communities and related offline events. The Meetup.com platform has more than 40 million members, 330k+ active Meetup groups and 84k+ Meetup events happening every week⁹. Meetups events have become an important part of the digital innovation landscape in recent years in Edinburgh and are recognised to be important for the

⁹ As of September 2020: <https://www.meetup.com/media>

development on entrepreneurial networks (Scottish Government, 2020). Indeed, a recent survey of high-tech Meetup group attendees in the UK found that two-thirds of respondents considered these face-to-face conversations an important mechanism for obtaining information and "allowing gaps in knowledge to be filled" (Ingram and Drachen, 2020, p. 15). The scale of Meetup.com allows the platform to capture a significant volume of event information that would otherwise be distributed (and perhaps inaccessible) across a range of other platforms.

Second, from a policy perspective Meetup data is "live", spatially located and accessible. The Meetup data set is continually updating and therefore provides real-time information on what is happening on any given day. Real time information entails the collection of data and/or empirical material instantaneously as events are unfolding (Brundin, 2007). Such sources of data are rare, yet of significant value when tracking activity and interactions over time. Additionally, unlike some other forms of social media, Meetup.com supports online and spatial interactions, bringing benefits which enhance knowledge flows within an EE. Indeed, the innovation agency NESTA when examining the UK's digital tech landscape identified the potential usefulness of Meetup data from a policy perspective (NESTA, 2015) to identify tech "hotspots". This combination of real-time and spatial data allows not only for analysis of current activity, but also for longitudinal analysis and tracking of event volumes and locations over time.

And thirdly, in certain respects, Meetup.com provides more robust data than other types of social media sources (e.g. Twitter, Instagram) for analysing EE interactions. While previous research has used these data sources to examine entrepreneurial behaviours in cities (Casadei and Lee, 2020), these users tend to be predominantly younger and wealthier

which potentially skews results (Blank and Lutz, 2017). By contrast, Meetup events tend to attract a wide spectrum of people from varying backgrounds and age ranges, as corroborated by our interviewee cohort.

4.2 Data collection and analysis

This data was analysed using different techniques to dissect the nature of the networks identified at their relevant scale (macro, meso and micro). At a macro level, the Meetup data was analysed to enable geolocation tagging while at the meso level SNA software was used to undertake modularity tests and network density calculations. At a micro level, we collected data from in-depth interviews from individual ecosystem actors involved with networking events in Edinburgh. More detail on the different data and different analytical techniques adopted within the study are provided in Table 3 below.

[Insert Table 3 about here]

The Meetup data was collected for Edinburgh between October 2007 and October 2018. The use of Meetup.com has risen exponentially over the last decade within the Edinburgh EE, from a figure of 41 Meetup events in 2008 to 593 in 2018. In 2018, Edinburgh had around 148 Meetup groupings categorized as Tech (103) and Career & Business (45) with 313 members on average in each type of group. Groups have different "join modes", with 126 being open to all and 22 requiring approval (prospective members need to request approval for group membership). Edinburgh's Meetup groups have 21,612 unique members (note that one member can be part of more than one Meetup group) and each member has joined on average 2.139 groups. There were 2,232 Meetup events organised between October 2007 and October 2018 with 20.73 members on average confirming attendance and lasting 2.69 hours on average (based on 1,217 Meetups that provided specific duration).

These 2,232 Meetups generated 53,820 RSVPs (confirmation of attendance). While the level of demographic data on Meetup is limited, we were able to tease out some basic information (e.g., age, gender, location). Using, for example, the name-based gender assigned API "NamSor" (Carsenat, 2019), we selected a sample of 16,334 meetup profiles (from members located in Edinburgh) containing both first and last names. Results suggested an overall gender balance of 4,580 females and 10,120 males (10% of results with the lowest score were excluded). In other words, approximately a third of participants at these Meetup events were female.

The data gathered provided an exploratory dataset for the analysis of network structures among thematic groups and their relationships. The network data was extracted through Meetup REST API and manipulated using the programming language Python.¹⁰ We used the software tools Gephi and UCINET for the SNA. SNA software is designed for qualitative and quantitative analysis of social networks, where information about network structure (including network statistics) and visualisation can be used to examine social connections. Data extracted was composed of affiliation information for each Meetup group from our sample (2-mode network with groups and members). Co-affiliation provided the conditions for the development of social ties of various kinds and information about flow of knowledge (Parker et al, 2016).

The qualitative data analysis examined the micro-level aspects of networks from the perspective of individual ecosystem actors and comprised 23 semi-structured interviews

¹⁰ Web scraping/harvesting is a well-known practice to digitally extract data from websites, retrieving data using REST API. Several platforms have their own REST API methods, including Meetup.com, LinkedIn, Twitter, etc.

with attendees of the Meetup events. To avoid biases associated with specific types of events, interviewees were randomly selected from different groups and events. The sample of interviewees comprised 6 females and 17 males, a gender split in line with the overall demographic composition of the groups. The average age of the respondents was between 35-40. Interestingly, only 6 were native Scots, with the remainder coming from a variety of countries such as Germany, Italy, Chile, Singapore and the US, emphasising the strong role of transnational entrepreneurs for many EEs (Schäfer and Henn, 2018; Brown et al, 2019).

The interviews were designed to inquire about their rationale for interaction with networking events, the kind of knowledge and information sought, use of digital platforms and general interaction within the ecosystem. Questions were crafted in a way to extract information about how people use the Meetup.com platform to seek out relationships, knowledge, information and also to ascertain the key benefits individuals derive from these relational connections. They also probed the factors determining their attendance at events. The interviewee sample was targeted towards active and/or prospective entrepreneurs and other actors engaged in the Edinburgh EE. The interviews were approximately one hour in length, tape recorded and transcribed verbatim enabling the use of direct quotations within the paper.

5. Identifying Ecosystem Conversations: Insights and Implications for Policy Makers

We now present some of the empirical evidence emanating from this novel data collection approach by examining conversations at the three different analytical levels explained in the methodology. As noted at the outset of this paper, our express intention is not to provide an exhaustive empirical treatment of the relational connections within this specific ecosystem, nor to present a one-sized fits all "statistic" or "quantitative metric" to

objectively assess EEs. Instead we seek to demonstrate how this unconventional methodological approach can yield operational insights for local policy makers and other ecosystem actors. For this reason, interwoven within these findings are key messages for policy makers emerging from the findings at each of the analytical levels examined.

5.1 Macro-Level Conversational Analysis

The nature of the Meetup data enables us to graphically portray the spatial and institutional nature of the relational connections and landscape underpinning the Edinburgh EE and (perhaps most crucially) how this has evolved over time. The events organised, promoted and hosted take a variety of forms but are all located within the city's spatial boundaries. It should be noted however that around a third of Meetup participants reside outwith the city of Edinburgh. The heat maps produced are based on the density of meeting events (based on a total of 2,232 Meetup events), with the light green and red elements depicting areas of high activity. In contrast, the dark green areas denote lower levels of event activity (see Figures 1, Figure 2 and Video 1). We can see in 2011 that the main spatial focal point of these relational connections centred on two main geographical nodes, one within the heart of the city centre and one within close proximity to the city's main research-intensive university.

[Insert Figure 1 about here]

[Insert Figure 2 about here]

[Insert Video 1 about here]

Part of the geographic concentration in the central business district of the city possibly owes to the establishment of an important catalytical co-working and incubator

organisation, the "Melting Pot", which was originally established in 2007 and received support from the Scottish Government and the City of Edinburgh with the specific focus to help promote entrepreneurship within the city (Scottish Government, 2018a). Since its inception its remit has expanded considerably and is now a core geographic node for hosting entrepreneurial networking conversations within the Edinburgh EE. As Claire Carpenter, founder of The Melting Pot, noted:

"I wanted to bring together interesting people who do interesting things, and to develop a dynamic and diverse community that shared a sense of collective purpose and reach. Ultimately, it's all about a place where the sum of the parts was greater than the whole."

The other main node hosting conversations was the University of Edinburgh, which likewise acts as an important fulcrum for academic and entrepreneurial communities in the city.

Looking back, it becomes vividly apparent that the conversational geography within Edinburgh's EE has evolved remarkably during the intervening ten-year period examined (see Figure 1 and Figure 2). Two main issues become immediately apparent from the data. First, the volume and density of conversations taking place within the EE has become much thicker over this ten-year time period. The volume of entrepreneurship events rose fourfold (See Figure 3 below) between 2014 and 2018 and the average size of participation in these Meetup events (see Table 4) also increased considerably over the same time period¹¹. The increase in entrepreneurship Meetup event volume is somewhat larger than the scaling of other professional thematic Meetups in Edinburgh generally during the 2014-2018 period,

¹¹ We use the number of people who sent a positive RSVP divided by the number of events to calculate the average size of these Meetup events during the period, 2008-2018.

indicating that there is more substance behind this trend than simply additional uptake or use of the Meetup.com platform¹².

[Insert Figure 3 about here]

[Insert Table 4 about here]

In brief, this means that conversations and connectivity appear to have increased markedly during this time, representing a sign the ecosystem is becoming denser and better developed. Part of this upsurge of interest in entrepreneurship possibly owes to the booming interest in entrepreneurship, perhaps linked to the "demonstration effects" from the success achieved by two local companies (Skyscanner and Fan Duel) which achieved the holy grail of unicorn status. This type of blockbuster entrepreneurship has very important catalytical effects and offers strong opportunities for entrepreneurial spin-offs and entrepreneurial re-cycling. As research strongly shows (Clayton et al, 2019), new ventures rarely start from scratch, but instead often emerge from other pre-existing local unicorns or anchor firms such as Skyscanner and Fan Duel. It appears that in Edinburgh these success stories have simultaneously inspired and helped mentor numerous new ventures (Sheppard, 2016).

Second, while conversations have become much denser, critically the geographic centre of gravity of events across the city has also undergone significant transformation during this period. This reconfiguration owed to a major westward expansion of these networking events across Edinburgh. This was caused in part by anchor institutions, such as the new incubator (Codebase) becoming an important generator of conversations by

¹² Interestingly, there seems to be a correlation between the numbers of entrepreneurship events and the economic cycle (e.g. with a post financial crisis dip between 2009-2012).

providing free meeting space to host Meetup group events on their premise. While the existing hot spots or nodes highlighted above are still central points in the ecosystem, there appears to be a much richer and denser geographical composition of events across a wider spatial area in the city. The benefits of this data enables us to explore how this growth connects to other component parts of the EE, which may explain this changing conversational landscape. For example, in 2015 an important entrepreneurial initiative was instigated to improve networking and mentoring within the Edinburgh called the Business Improvement Districts (BID), West End (Business Support and the Entrepreneurial Ecosystem, 2017). We can see from Figure 2 that this then became a dense focal point for conversations within the local EE.

The prestigious business incubator Codebase also opened up in the western part of the city centre in 2014. This place is now one of the largest technology incubators in the UK, hosting around 80 start-ups and acts as a host for a number of networking events within the city. Since new entrepreneurs lack credibility and a track record, incubators allow them to overcome this liability of newness by providing a crucial networking infrastructure (van Rijnsoever, 2020). This demonstrates the pivotal role played by network anchors for aiding relational connectivity within EEs (see Figure 2).

So how can this evidence be interpreted by public policy makers? *Prima facie*, it appears governmental bodies may be able to initiate and foster conversations by providing support for the types of conversational spaces (e.g. Melting Pot and BID) identified above. Within the Edinburgh context, the state already plays a strong and highly proactive role within the local EE (Spigel, 2016). However, the mere presence of networking organisations and incubators alone is insufficient for EEs to work effectively (van Weele et al, 2018). What

is crucially important for policy makers is that they carefully select where publicly-funded organisations are located. Close proximity to other entrepreneurs is often a key motivator to attract individuals motivated to contribute to the ecosystem and co-working spaces physically drive these connections impacting entrepreneurial activities (Thompson et al, 2018). Therefore, by examining the spatial nature of these conversational spaces within an ecosystem, policy makers can build upon existing relational connectivity when deploying new actors such as co-working spaces, incubators, accelerators and so on, to ensure that they are appropriately spatially targeted.

The importance of the choice of geographic location was reiterated during our interviews, with some participants stating that they avoided attending events more than a 10 to 15 minutes walk from their regular working location. Therefore, staging events or deciding on where to locate a new institutional actor, such as an incubator or co-working space, could have vital ramifications for the success of these activities. Often the public sector is guilty of using existing property assets when designing such interventions. Our work suggests the success or failure of such initiatives hinges on their spatial location in relation to other parts of the ecosystem. This aligns with other recent work examining the nature of the built environment and how this impacts the connectedness to other parts of EEs (Johnson et al, 2019). The Meetup data provides policy makers with key insights into changing spatial patterns and micro-geographies of conversations and network activity within the local EE. It also enables insight into where business activity and regeneration is needed (or working) and where policy intervention may benefit specific locations and communities.

Another valuable lesson for local policy makers is the need to adopt a systems-wide perspective when designing initiatives. The important role identified by the universities, incubators and local unicorns in shaping the geography of conversations in Edinburgh demonstrates the importance of existing actors within the ecosystem who act as important conversational spaces. This shows the "boundary spanning" nature of key entrepreneurial actors such as large existing firms and universities, which often act as important relational bridge builders within EEs (Heaton et al, 2019). This is especially important as one of the most common features hard-wired into most EE policy frameworks is the lack of genuinely systemic policy initiatives spanning multiple parts or various actors across EEs (Brown and Mawson, 2019).

5.2 Meso-Level Conversational Analysis

We now turn our attention to the "meso-level" to examine the dynamics and composition of the Meetup groups themselves and their associated topics of conversation. Although the data was officially restricted to two broad topic categories under Meetup.com typology (*Tech* and *Career & Business*), our analysis detected that a wider range of thematic groups existed within the ecosystem. The data analysis pointed out the existence of hidden topical categories that re-organise and create new categories based on different structures and sub-networks which are more densely connected. When communities are visible and identifiable within a broader network, members of those communities have a better chance of identifying and conversing with each other, exchanging knowledge and/or developing their activities.

In the case of Edinburgh's Meetup groups, modularity tests indicated the presence of different sets of topic groups clustered together¹³. These tests showed that the network taxonomy had a partition with optimized modularity score ($Q=.173$) which re-divided the network into three main clusters. To understand the underlying meaning of why groups were clustered in three sub-networks, further analysis was undertaken on each group description using word frequency and critical analysis. The first community (*Tech*) was formed by groups with a high focus on technology related terms (e.g. data, code, programming). The second community (*Business*) gathered mainly groups covering subjects closer to business discussions (e.g. finance, start-up). And finally, the third community (*Hybrid*) concentrated groups dealing with a mix of business and technology themes. Interestingly, this third community organised several events dealing with entrepreneurial activities. This hybrid grouping proved very interesting because our interview data detected that these individuals were often the most focused on new venture formation and those most likely to be seeking information, resources and assistance. In identifying the different nature and structures of these networking events, policy makers may be able to identify clues as to how they can better tailor their communications and their interventions.

To be more specific about the implications for policy makers, this type of thematic analysis means that conversations can also be captured in different stages such as topic formation, transformation or even when topics are in decline. Often a clear problem facing entrepreneurs is informational asymmetries and the need for advice rather than the desire for transactional forms of support. In other words, business support organisations may wish

¹³ Modularity tests performed used the algorithm for community detection based on modularity optimization (Blondel et al, 2008). This test allows detection of compartmentalized sub-networks that might underlie real-life meaning of why some nodes are more attracted to each other.

to attend these events so they can showcase the types of support they can offer nascent entrepreneurs/start-ups. Furthermore, given the thematic and topic-based nature of some conversations, policy makers can offer bespoke forms of advice and support to target these specific audiences and communities of practice. For example, if an event is discussing Artificial Intelligence, local policy makers may wish to engage with other ecosystem actors such as local universities, potentially enabling other parts of the ecosystem to directly feed into the conversations based around these thematic topics. Plus, if there is a concentration of conversations happening in a specific area about a specific technology like Fintech, policy makers can help build connections between different players within those communities.

A key issue for policy makers to consider when exploring the relational connections within EEs, is to identify the areas where networks are strongest and where they are more nascent. Structural knowledge about networks allows further analysis on knowledge flows, both in terms of direction and intensity. Analysis of our data enables us to interpret network density results and to compare different networks both as a whole, or by each thematic sub-category identified above. The concept of density refers to possible ties within a network reached when dividing the number of existing ties by the total number of potential ties (Borgatti et al, 2013). A network with high density suggests an elevated number of connections and hence indicates higher potential for conversations and knowledge exchange enabling information flows. Data analysis on co-affiliation networks (such as Meetup groups membership) also allows us to capture insights about levels of information flow, thereby potentially signalling groups at different stages of knowledge exchange.

Measuring the distinctive density allows comparability across different networks and importantly this kind of information may indicate communities in need of some sort of intervention. Our data on Meetup communities shows small differences on levels of cohesion amongst the three identified sub-networks ($TECH_{density} = 0.883$; $BUSINESS_{density} = 0.863$; $HYBRID_{density} = 0.857$)¹⁴. Even though these densities imply only a marginal variation, the *Tech* community reveals greater connectivity levels amongst its members than the other two.

While the causal reasons for these variations cannot be detected from the data, they do nonetheless present policy makers with valuable insights. Being able to identify networks with higher or lower levels of density might lead to interventions to exploit advantages or develop initiatives to enhance knowledge exchange. In an ecosystem with a community with higher density levels initiatives, aiming to increase linkages between entrepreneurs with potential sources of capital (e.g., business angels, venture capitalists) might perform better in these groups compared with communities with lower levels of connectivity. Additionally, policy makers may wish to invite key dealmakers to these events to help bolster their nuanced networking capabilities. On the other hand, communities with lower connectivity levels might need interventions concentrated in developing their networking events. In this case, policy makers should identify constraints preventing these groups from thriving. As an example, these groups might be struggling with physical space for meetings, so interventions could be aimed at helping with the provision of facilities

¹⁴ The network's density is the number of connections divided by the number of possible connections. A completely linked network has a density of one, while other networks will have a decimal value representing the percentage of possible links that are actually present.

where these meetings could occur. In both scenarios, interventions are deployed in a bespoke and temporally changing fashion as the nature of network density alters over time.

5.3: Micro-Level Conversational Analysis

Ultimately, individuals are the "micro-level" actors who engage in network-related conversations. It quickly became apparent from the interviews that there were a range of perceived benefits from these relational interactions and conversations. It was also evident that the respondents themselves displayed strong levels of "self-efficacy" demonstrated by their innate belief they could achieve the desired outcomes through their relational interactions. What was interesting was that some of them noted how their perceptions of the whole ecosystem in Edinburgh had evolved over the years owing to the growing role of the Meetup community. This indicates that the relational connections between different entrepreneurial actors are now perceived as being of great strategic importance especially as this adds to the sense of "community building" within the EE. As one attendee noted:

"20 years ago or so they [networking events] didn't seem to be the same level of kind of venues like the Meetup community. But I still see people that I've known for 20 or 30 years sometimes at some of these events. So I think that the Meetups are valuable in the sense of providing the opportunity to kind of engage and meet with people in a way that was perhaps not so obvious in the past."

More specifically for policy makers, Meetup events enable and facilitate the ability of individuals to undertake tacit knowledge sharing. As numerous studies have evidenced, "face to face" interactions allow quicker access to local knowledge and opportunities which are crucial for alleviating informational asymmetries confronting nascent entrepreneurs:

"I'm an entrepreneur, I'm looking for opportunities and the only way that I can get access to local data and information is through meeting and speaking to people, you know, face-to-face. You can't get that through social media, through primary sources of data and market reports, articles, and so on and so forth."

Importantly, these connections enable individuals to undertake "vicarious learning" opportunities which is often crucially important for developing new ideas. This is vital for EEs because it helps to inculcate and instil a culture of experimentation within the entrepreneurial community, a critical facet for promoting a culture conducive to the creation of new ideas and *de novo* ventures. As one participant noted:

"It's really nice to just test an idea... someone trying something out and it might work, it might fail completely, but it's a very safe environment just to try something new instead of, you know, starting your project that might cost you thousands".

Plus, fostering such a safe environment can also help overcome feelings of stress and alienation within prospective entrepreneurs:

"The most intense resource or the resource that I was using was probably my emotions... it's quite draining to put yourself out there and have all those conversations and make sure that you are making progress. Maybe learning to be more self-confident and talk to people and representing myself and defending myself and engaging with colleagues and superiors became easier."

A final issue which was strongly detected within the local entrepreneurial community was the more practical benefits from attending Meetup events. Indeed, quite a number of attendees were quite instrumental in their rationale for attending, which often

hinged on their desire to acquire "fresh talent". This illustrates the fact that participants in Meetup events are not just budding entrepreneurs: many attendees are employed within various actors across the EE such as anchor firms. This is very important for the local Edinburgh ecosystem, given the nature of the local labour market which is very tight, especially for skills software engineers and coding skills.

"The market for software developers is quite difficult. So when you're a product manager you want to have a really good team of developers. Sometimes it's challenging because, you know, there's only that many developers on the market and companies fighting for them. So sometimes you can learn about some those developers, thinking about changing the company. So you just need to jump and try to innovate there."

This clearly demonstrates the need for policy makers to help foster such conversations within their respective jurisdictions to help tacit knowledge sharing, peer-based learning and opportunities for "vicarious learning". This can be done by launching networking events, the provision of accommodation and connecting up different actors within their respective EEs. The attraction of these types of policy initiatives is their relative simplicity to enact and limited expenditure incurred.

By being aware of (and listening into) these conversations, policy makers are also able to better understand some of the potential "pinch points" within their respective EEs. This information can then be translated into strategic policy intelligence to help shape interventions. For instance, close relational integration with entrepreneurs within these conversational spaces enables policy makers to become aware of emergent growth bottlenecks such as skills gaps and skills shortages long before official evidence such as

government surveys capture these trends. If there is, for example, a shortage of certain types of computer software coding skills, policy makers can work with local universities to help develop and deliver appropriate provision in a timely fashion. Likewise, if there are discernible funding gaps for new ventures, policy makers may seek to better connect these entrepreneurial communities with sources of entrepreneurial finance such as business angels. This could be particularly salient for start-ups, who often face the greatest problems securing finance due to their opaque nature and weak financial support networks (van Rijnsoever, 2020).

6. Conclusions and Recommendations

6.1 Key Contribution

Arguably traditional measurement tools and approaches dominating the EE literature have, by and large, been limited in providing satisfactory (or actionable) insights for policy makers. We sought to rectify this omission by undertaking a novel form of empirical analysis using a multi-method research approach and unique dataset. The key contribution of this paper is the novel methodological approach deployed, which generated rich empirical insights into the social networks and connections within Edinburgh's ecosystem. By "capturing conversations" at different analytical levels (macro, meso and micro) taking place within this ecosystem we are able to offer policy makers a novel new set of "relational metrics" with which to assess and measure the relational connectivity and social infrastructure within their local EEs. In turn, this provides vital insights with which to help guide and inform policy. While this research does not address causal relationships, it does provide strong suggestive evidence of the powerful role networks play in shaping (and re-shaping) the nature and structures of EEs. Importantly, it also provides indicative

evidence of how certain institutional actors within EEs disproportionately contribute to the formation of networks and where weaknesses occur within entrepreneurial networks.

6.1 Theoretical Implications

Whilst this is a methodologically driven paper, our work also has clear theoretical implications. A common and recurring lament made by numerous scholars examining EEs is the lack of theoretical development related to the concept (Alvedalen and Boschma, 2017). Despite this, social network theories have been heavily invoked recently by researchers examining the relational dynamics underpinning EEs (Motoyama and Knowlton, 2017; Spigel, 2017; Neumeier et al, 2019). Entrepreneurship scholars have long recognised the crucial role and value that social networks and social capital have in stimulating the entrepreneurial process (Stuart and Sorenson, 2005; Kemeny et al, 2015), especially at times of uncertainty (Engel et al, 2017). A crucial, but sometimes overlooked, element underpinning social networks is the medium of conversational narratives. What this paper has sought to explicate is the crucial role that face-to-face conversations play in developing EEs. While we have not – and do not intend to – empirically prove a relationship between conversations and entrepreneurial activity, the evidence provided indicates that conversations may act as a crucial catalyst (and in some cases a necessary pre-condition) for nurturing entrepreneurial activity within EEs. Further evidence is of course needed to assess this causal relationship.

Capturing conversations at different structural levels (macro, meso and micro) provides scholars with unique insights into the evolutionary nature of how ecosystems adapt, change and re-configure over time. New digital sources of data such as the novel Meetup data utilised within this paper enable scholars to further unpack the role of these

conversations and conversational spaces within ecosystems. By mapping conversations we can visualize and join the invisible dots together which bond different entrepreneurial actors together within EEs across time and space. While the analysis of conversations and conversational spaces was initially deployed to examine tacit knowledge sharing around innovation (Feldman and Lowe, 2008; Uyarra et al, 2017), this paper demonstrates the concept has equal applicability for exploring the locally embedded nature of entrepreneurship within EEs.

6.2 Practical Recommendations

Throughout the paper we have drawn important messages for local policy makers from our approach, however we wish to augment this with a wider set of generic policy recommendations arising from this study. This is crucial because research on EEs strongly suggests that when insufficient meetings and networking (either random or formal) take place so-called "network failures" occur (van Rijnsver, 2020). Network failures are ubiquitous and persistent and often arise when a more or less idealised set of relational-network institutions fail to sustain desirable activities or to impede undesirable activities (Schrank and Whitford, 2011). Eradicating network failures and "promoting inter-actor relational connections" should be given a much stronger prominence within policy frameworks (Brown and Mawson, 2019, p. 361), especially as this can help build community logic and resiliency within an ecosystem (Roundy et al, 2017). This is important as a number of scholars note that policy frameworks within EEs are often far too focused on financial instruments rather than these types of crucial relational support activities (Brown and Mason, 2017; Muñoz et al, 2020).

Another overarching message from this study is the strong value in using publicly available, user-generated real-time datasets such as the Meetup data examined herein. The primary benefit of this specific data source is its international relevance and scale - policy makers nearly everywhere can access this dataset to examine the relational connectivity via Meetups within their own EEs. Importantly, this can enable cross-city or cross-country comparisons. Additionally, since data is generated in real time by Meetup users of their own volition, the data presents a more accurate account of user interests and activity than other datasets which may either be outdated or potentially biased in terms of data inclusion. Whilst Meetups occur in many locations, this methodological approach may be best suited to urban EEs, where Meetups are most prevalent and have become a vital part of the entrepreneurial social infrastructure.

We acknowledge that in some rural and embryonic EEs, Meetup.com data may not yield as many insights owing to a reduced critical mass of such events. In these types of locations we would urge policy makers to seek out contextually meaningful sources of data drawing on the principles of "capturing conversations" for assessing the connectivity of their local EEs as discussed in this paper. For example, in a predominantly rural context a lot of relational connectivity may occur informally (but just as effectively) through farming associations, Chambers of Commerce, Rotary clubs, community councils, and so on. By working with these types of networking actors, policy makers could gather data similar to Meetup data to map the interconnections across the local EE. In such contexts, in the absence of universities and other anchor bodies, local economic development bodies could use centrally located public buildings such as libraries or local schools to host meetup events run by these organisations. Within these contexts, policy makers may need to seek recourse to more bespoke measurement techniques for measuring relational connectivity such as the use

of SNA software. This is crucially important, as high levels of social capital are often intrinsic within small town EEs (Roundy, 2017), which in turn can help build relational connectivity.

So how can this data and associated "relational metrics" be operationalised to examine the changes occurring within EEs and what kind of benefits can they confer for policy makers? One of the key advantages of this form of data analysis is the granular way it captures the changing micro-geographies of entrepreneurial activity over time. To properly understand entrepreneurial activity, policy makers and scholars are increasingly keen to look at how issues unfold at a very localised spatial scale (Rammer et al, 2020)¹⁵. Therefore, a key benefit of the Meetup data is the ability to track changes over time and space which, crucially, enables the potential to evaluate policy interventions. It may be particularly beneficial to identify network failures and then design initiatives accordingly to redress these problems, such as the provision of new incubators, co-working spaces or more prosaic initiatives to help increase networking within a specific local context. For example, it can also help monitor and evaluate the effectiveness of policy initiatives specifically designed to stimulate networking such as the Melting Pot initiative in Edinburgh. These steps are important because policy makers acknowledge that the frequency and scale of Meetup events is currently hampered by a lack of "meeting space and basic hosting expenses in places" (Scottish Government, 2020, p 76). Therefore, a crucial benefit of this particular data source is its ability to probe temporal aspects within EEs and map how networks change and unfold over time.

Another important benefit of this kind of real-time data is that it enables policy makers the opportunity to examine diversity levels within EEs which is crucial for fostering a dynamic

¹⁵ Rammer et al (2020) found micro-geographies vary significantly over very small distances (less than 250 metres) which fundamentally shape innovation outcomes.

and inclusive entrepreneurial environment. For example, our research found that only around a third of participants in meetup events in Edinburgh were women. This is very useful information for policy makers as they can encourage higher female participation in the local ecosystem by, for example, setting up bespoke events specifically targeting female entrepreneurs in locations that align to work and family life patterns. Policy makers can then track and evaluate how successful these initiatives are at developing a better gender balance and greater inclusivity. Similar principles apply for encouraging other underrepresented groups such as entrepreneurs from ethnic minority backgrounds.

We do however acknowledge that as well as upsides, there are potential challenges with these form of data and associated relational metrics. In addition to the complex nature of the data analysis¹⁶, Meetup data can only trace entrepreneurial conversations rather than capturing actual entrepreneurial activity such as firm incorporations and/or new process/product development. Oftentimes, involvement in such entrepreneurial conversations will not induce or foster new venture formation. We would argue that this is not in itself a problem; conversations, whether or not they result in quantifiable outputs, are critical in terms of building an entrepreneurial culture, intentions and dynamism within EEs. However, we fully recognise that policy makers may wish to identify the more common measure of entrepreneurial activity in addition to tracking these relational connections.

To date, sophisticated analysis of socio-economic and spatial processes has arguably been impeded by the lack of meaningful and accessible data (Feldman and Lowe, 2015). However, a growing number of real-time data sources such as Meetup.com data potentially

¹⁶ Whilst the ability to webscrape and access and interrogate platform APIs is still a specialist skill set, it is now becoming more commonplace across different range of policy organisations (Nesta, 2015; Casadei and Lee, 2020).

offer valuable clues for policy makers as to how their ecosystems operate and how policy can help them function more effectively. We have shown that by capturing and dissecting entrepreneurial conversations we can generate important strategic policy intelligence to help inform future public policy. Inevitably, by focusing on one particular location, one limitation of this work is that we restrict the generalisability of this empirical analysis. Given the replicable nature of this exercise, however, it is our hope other scholars and policy makers begin examining conversations in other spatial environments. Ultimately, we hope this paper can start a conversation regarding the veracity and utility of these new types of data sources and uncommon "relational metrics".

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