This paper explores how to measure entrepreneurial ecosystems with an urban-rural mix by using Ewing Marion Kauffman Foundation's four indicators framework and while accounting for the needs of different types of entrepreneurs from main street to high growth firms.

Same Ecosystem, Different Entrepreneurs

An assessment model for measuring diverse entrepreneurial ecosystems

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EXECUTIVE SUMMARY

Development practitioners, policy-makers, and researchers continue to use an ecosystem approach to understand regional entrepreneurship dynamics. Entrepreneurial ecosystem studies include analyses of system components and efforts to measure, benchmark and better understand how businesses form and grow within a connected system. Our research explored three specific and under-researched aspects of entrepreneurial ecosystems:

1. The varied system requirements of differing types of entrepreneurs, specifically innovation-driven (IDE) or high growth firms versus small to medium (SME) or main street firms.
2. The dynamics of regional networks containing a mix of both urban and rural features.
3. The identification of useful and practical metrics to assess the success of ecosystem functioning for differing enterprise types. We build on the Ewing Marion Kauffman Foundation's four ecosystem indicators—density, fluidity, connectivity and diversity—outlined in the 2015 article, *Measuring an Entrepreneurial Ecosystem*.

To explore these aspects, we selected the Roanoke-Blacksburg region, a relatively nascent urban-rural entrepreneurial area in southwest Virginia, as a study location. We conducted quantitative analyses of ecosystem metrics and network relationships, as well as a qualitative analysis using stakeholder interviews and entrepreneur surveys. Data results included strengths and weaknesses of the Roanoke-Blacksburg entrepreneurial ecosystem, identification of key actors, and information on how entrepreneurs accessed and utilized connections and resources, or failed to do so.

The research team used study findings to construct a set of recommended metrics, including those indicators aligning with specific interests of SME or IDE entrepreneurs. We found that IDEs have numerous growth-related resource needs including angel, venture and scale-up funding; prototyping equipment and facilities; and translational research by local universities. SMEs required more entrepreneurial education programming, subsidized main street office space, and clearer pathways through the government regulatory system. The differing entrepreneurial needs require regular asset inventories, as an ongoing assessment. Resource provider or entrepreneur surveys also may serve as useful data gathering tools for longitudinal monitoring of ecosystems, particularly for understanding the quality of ecosystem components and their connectedness. Secondary metrics data is valuable for benchmarking outputs and outcomes of the system with peer regions, using data points such as startup density, business churn, and employment share of locally owned businesses. We argue that many common secondary data measures are innovation-focused and may address IDE interests more, so some consideration and active collection of ongoing SME-focused or all-inclusive measures are also needed to fully apprehend and monitor ecosystem functioning over time.

Finally, we offer a set of policy recommendations, drawing from the study's conclusions:

- Ecosystem resources and access points are not always open, shared, or known, to people interested in starting a business. Resources are also regularly changing, and comprehensive

inventories or asset maps of larger, more diffuse regional ecosystems may appear time and resource-prohibitive. Feedback in this study suggests that providers, practitioners, and policymakers should collectively invest time and resources to gather data from entrepreneurs and resource providers to construct and update regional inventories, while also exploring ways to maximize their resources and returns for these activities.

- In many ways, there is not one ecosystem in a region, but a collection of linked systems. For entrepreneurial growth, regions need to recognize and support a spectrum of diverse entrepreneurial activities, types and stages, recognizing different entrepreneur resource, development, and access needs. Healthy ecosystems develop and promote entrepreneurial resources appropriate for different types and stages of entrepreneurs, including small-scale main street retail, restaurant, and similar businesses.
- Some individuals, such as those from under-resourced geographies or under-represented populations, require more substantive attention within a system. Resource organizations may not be actively seeking to engage and support those audiences. Regions need to create and nurture an entrepreneurial climate of encouragement and inclusion. Our study found a significant knowledge and service gap among some populations. In general, main street and minority business starters were less likely to access resources, and had fewer resources with which they were familiar.

GLOSSARY

Entrepreneurial Ecosystem – A set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organizations (e.g. firms, venture capitalists, business angels, banks), institutions (universities, public sector agencies, financial bodies) and entrepreneurial processes (e.g. the business birth rate, numbers of high growth firms, levels of 'blockbuster entrepreneurship', number of serial entrepreneurs, degree of sellout mentality within firms and levels of entrepreneurial ambition) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment (OECD 2014).

Innovation-driven Enterprise (IDE) – Sometimes used interchangeably with gazelle entrepreneurs and high growth firms. IDE entrepreneurs aspire to function in global markets and base their enterprise on new technology, processes or business models. They do not have to work in a fixed location and often start by losing money before growing exponentially.

Small and Medium Enterprise (SME) – Sometimes used interchangeably with main street, lifestyle or small business entrepreneurs. SME entrepreneurs focus on more local markets but can expand regionally. They rely on jobs performed locally and experience linear growth as they succeed. SME entrepreneurs do not build their enterprises around innovation, even if they embrace aspects of innovation.

Metrics – Quantifiable measures used to assess and track the status of an entrepreneurial ecosystem over time. Unlike individual measures, a metric often combines or compares measures to illustrate a trend over time, compare regions, or provide greater context.

Indicators – Often used interchangeably with metrics. An indicator is a qualitative or quantitative factor or variable that provides a simple and reliable mean to express achievement, the attainment of a goal, or the results stemming from a specific change. It often aggregates or combines multiple measures in an explicit formula. For our purposes, we frame indicators as higher-level phenomena that can be measured through an aggregation metrics.

<u>Kauffman Foundation's Four Entrepreneurial Ecosystem Indicators</u>

Density – Relative density of entrepreneurship and resources

Fluidity – The accessibility and easy flow of assets

Connectivity – Connections among elements: programs, companies, individuals

Diversity – An assortment of economic specializations, people and opportunities

INTRODUCTION

Small businesses form and grow within complex, interconnected networks. The research literature on entrepreneurial ecosystems supports this notion, contributing to a better understanding of how small businesses, resource providers, and other elements intersect and function in support of business startup within a particular geography. The Organization of Economic Co-operation and Development (OECD) states this more comprehensively, defining an entrepreneurial ecosystem as:

> [...] a set of interconnected entrepreneurial actors (both potential and existing), entrepreneurial organizations (e.g. firms, venture capitalists), institutions (universities, public sector, financial bodies) and entrepreneurial processes (e.g. the business birth rate, numbers of high growth firms, number of serial entrepreneurs, degree of sellout mentality within firms) which formally and informally coalesce to connect, mediate and govern the performance within the local entrepreneurial environment.[1]

Our research explored three aspects of entrepreneurial ecosystems that remain areas in need of additional research and better understanding:

1. the varied requirements of differing types of entrepreneurs within an ecosystem;
2. the dynamics of ecosystems with a mix of both urban and rural features; and
3. the identification of useful and practical indicators and metrics to assess the success of ecosystem functioning for differing enterprise types.

The first element concerns the presence of two or more types of entrepreneurs within a given ecosystem, and the differing ecosystem requirements of entrepreneurs of vastly different market and growth aspirations. Aulet and Murray differentiate between two types of entrepreneurship: the innovation-driven "gazelle" enterprises (IDE) looking to function in global markets; and the small and medium-sized enterprises (SME) focused on addressing local and regional needs. IDE entrepreneurs base their enterprise on new technology, processes or business models. They do not have to work in a fixed location and often start by losing money before growing exponentially, if successful. Alternatively, SME entrepreneurs often rely on jobs performed locally and experience linear growth as they succeed.[2] SME entrepreneurs do not build their enterprises around innovation, even if they embrace aspects of innovation. IDEs and SMEs do not necessarily function within the same spaces or rely on the same networks.

Second, our study focused on the dynamics of a regional ecosystem with urban and rural features. While there have been a number of studies of entrepreneurial ecosystems focused on a city, and a rising number of studies discussing rural entrepreneurship, fewer studies focus on the aspects and challenges of a decidedly mixed urban/rural geography.

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[1] Mason, C., & Brown, R. (2014). Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship. Retrieved from Netherlands: http://www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf

[2] Aulet, B. and F. Murray (2013), *A Tale of Two Entrepreneurs: Understanding Differences in the Types of Entrepreneurship in the Economy*, Ewing Marion Kauffman Foundation.

Third, a number of metrics have been developed to measure an entrepreneurial ecosystem. By metric, we refer to quantifiable measures used to assess and track the status of an entrepreneurial ecosystem over time. Indicators are the measures or metrics we combine and use to illustrate a broader trend or idea. The Council on Competitiveness (CoC), the Aspen Network of Development Entrepreneurs, the Center for Rural Entrepreneurship, U.S. SourceLink, the International Economic Development Council, the Ewing Marion Kauffman Foundation and others have each developed comprehensive diagnostic tools for assessing and tracking ecosystem development. For instance, the Kauffman Foundation proposed four indicators: density, fluidity, connectivity and diversity.[3] Despite the plethora of models, and burgeoning literature on ecosystem metrics, there continues to be a need to identify field-tested assessment models that are practical and implementable at the regional scale, and include means and methods for assessing the success of an ecosystem in supporting different types of entrepreneurs.

METHODOLOGY

We conducted a pilot study focusing on one regional entrepreneurial ecosystem: the Roanoke and Blacksburg Metropolitan Statistical Areas (MSAs) in Virginia. In line with the aforementioned gaps in our understanding, the study explored three key questions:

1. What are the differing requirements of each type of entrepreneur within an ecosystem?
2. What are the dynamics of ecosystems with a mix of both urban and rural features?
3. How can we identify useful and practical metrics to assess how well ecosystems function to support different types of entrepreneurs?

We selected Roanoke-Blacksburg opportunistically and due to its likelihood of being an information-rich data source on mixed urban-rural ecosystems. The two MSAs in southwest Virginia are composed of eight counties and three cities.[4] These localities are interconnected socially and economically, as evidenced by the high rate of daily commuter traffic, particularly between Blacksburg and the City of Roanoke. The region is almost 3,300 square miles with a population of approximately 495,000, or about 150 people per square mile.[5] While this large geography encompasses multiple MSAs and significant rural lands, regional organizations have increasingly nurtured a distinct region-wide identity and concerted business development activities at the regional scale. The Roanoke-Blacksburg region is a particularly good single-case study due to ongoing initiatives that support both IDE and SME entrepreneurs. We believe the region offers great potential to contribute to the theoretical understandings of the overlapping and differing ecosystem requirements of IDEs and SMEs in urban and rural locales.

To study this case, our team identified and convened a regional advisory group consisting of key entrepreneur advocates and stakeholders to help guide the process, review findings, and provide input to

[3] Stangler D. and J. Bell-Masterson (2015). "Measuring an entrepreneurial ecosystem." Kauffman Foundation Research Series on City, Metro and Regional Entrepreneurship. Ewing Marion Kauffman Foundation: Kansas City, MO.

[4] Botetourt, Craig, Franklin, Giles, Montgomery, Pulaski and Roanoke counties; independent cities of Radford, Roanoke and Salem

[5] Virginia Tourism Corporation (2013). Community Profile. http://virginiascan.yesvirginia.org/communityprofiles/; American Factfinder. PEPANNRES 2014 Population Estimates. http://www.census.gov.

the study. The group also served as a gateway to other ecosystem stakeholders. The study consisted of four key approaches, each yielding data of relevance for the project:

1. Review of the literature on entrepreneurial ecosystems, particularly focused on metrics. We gathered recommended metrics and categorized them according to the Kauffman Foundation's four indicators: density, fluidity, connectivity and diversity.[6]
2. Survey of entrepreneurs to gather data on ecosystem features and information on where and how IDE and SME entrepreneurs interact and access regional resources.
3. Interviews of entrepreneurs and resource providers to initially map the ecosystem—its players, assets, and characteristics. Interviews allowed entrepreneurs and resource providers to suggest appropriate metrics and give feedback on measures that seem suitable to the region.
4. Social network analysis of the entrepreneurial ecosystem to explore social networking approaches to the Kauffman Foundation's connectivity indicator. Using data from identified Twitter Feeds and the entrepreneur survey, the visual analysis further mapped the region's assets, communities, and connections (nodes and edges).

Through these approaches, we identified desired metrics, some of which align with specific interests of SME or IDE entrepreneurs. In the sections below, we discuss these approaches and our findings resulting in a proposed assessment framework as well as policy implications for similar regions wishing to understand their own entrepreneurial ecosystems. We also included appendices that provide more details on ecosystem metrics and data collection methods.

ENTREPRENEURIAL ECOSYSTEMS AND METRICS

Entrepreneurial Ecosystems (EE) have long been a subject of inquiry by scholars from economic geography, economics, and other disciplines, who have sought to explain why and how certain regions experience greater startup growth than others. The term 'Entrepreneurial Ecosystem' dates back more than two decades[7] but gained mainstream popularity with works such as Dan Isenberg's 2010 article, "How to Start an Entrepreneurial Revolution" and Brad Feld's 2012 book, *Startup Communities*.[8]

Many organizations and researchers have contributed to the understanding of an EE and its components. Auerswald (2015) defines a vibrant ecosystem as a "flow of people and ideas between entrepreneurial organizations, starting new ventures, joining existing ones, and linking innovations together."[9] Ahmad & Hoffman (2008) describes an EE as the combination of three factors: opportunities, skilled people and resources.[10] Isenberg (2010) expands on this definition by including leadership, culture, capital markets,

[6] Stangler D. and J. Bell-Masterson (2015).
[7] Dubini, P. (1989). The influence of motivations and environment on business startups: Some hints for public policies. Journal of Business Venturing, 4, 11-26. doi: 10.1016/0883-9026(89)90031-1
[8] Spigel, B. (2016). Resource acquisition and co-production in entrepreneurial ecosystems. Paper presented at the Babson College Entrepreneurship Research Conference, Bodo, Norway. http://www.research.ed.ac.uk/portal/en/publications/resource-acquisition-and-coproduction-in-entrepreneurial-ecosystems(ba948a74-435a-4c9d-8bfa-350ff5bd6581).html
[9] Auerswald, P. E. (2015). Enabling Entrepreneurial Ecosystems, Ewing Marion Kauffman Foundation.
[10] Ahmad, N.; Hoffman, A. (2008). A framework for addressing and measuring entrepreneurship. OECD Statistics Working Paper No. 2.

and open-minded customers.[11] He highlights that in every entrepreneurial hotspot resides important connectors and influencers who may not be entrepreneurs themselves.[12] The Center for Rural Entrepreneurship sums up an ecosystem using five C's: Capital (financial resource), Capability (entrepreneur and owner skillset), Connection (resource and relationship network), Culture (the local communities' perception and support of entrepreneurship) and Climate (regulatory, economic development and policy environment).[13] Some other elements that enrich an EE include presence of large firms, universities[14] and service providers.[15] The presence or absence of these ingredients and the degree to which they mix differentiates ecosystems.[16]

For policymakers and EE actors, the focus on entrepreneurial ecosystems shifts the unit of analysis away from a firm's internal operations to the entirety of the environment where the firm is situated, offering a holistic understanding of how clusters of economic activity come into being and strongly mediate firm performance. This broad perspective highlights a dynamic and evolving community rather than a static phenomenon, suggesting the importance of adaptation to social and economic changes among EE actors. Traditionally, actors have recognized that high growth firms make a disproportionate contribution to economic growth and should be actively fostered to generate more activity. Government, non-government organizations and other actors therefore frame policies and programs to support these firms. An EE perspective encourages these policies to be not only transactional in nature—providing financing or building knowledge capacity—but also relational in their forms of assistance; for example, network building, developing connections among entrepreneurial actors, institutional alignment of priorities and fostering peer-based interactions.[17] An entrepreneurial ecosystem framing further enables more entrepreneurship-related interventions at the local or regional scale in addition to one-on-one support to entrepreneurs.[18] For instance improving healthcare or regulatory measures for businesses, or supporting other forms of entrepreneurship that support the overall quality of life and business for high growth firms.

A Metrics Framework for Assessing Entrepreneurial Ecosystems

Ecosystem actors often employ metrics to assess the impacts of interventions, benchmark growth, and compare regions.[19] Although organizations recommend a number of useful indicators, effective metrics

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[11] Isenberg, D. (2010). How to start an entrepreneurial revolution. Harvard Business Review.
[12] Isenberg, D. (2014). What an Entrepreneurship Ecosystem Actually Is. *Harvard Business Review*.
[13] Macke, D., Markley, D., & Fulwider, J. (2014). Energizing Entrepreneurial Communities: A Pathway to Prosperity. Lincoln: Center for Rural Entrepreneurship.
[14] Gertler, M. (2010) Rules of the Game: The Place of Institutions in Regional Economic Change, Regional Studies, 44, 1-15, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.735.2411&rep=rep1&type=pdf
[15] Colin Mason, R. B. (2014). *Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship*. Retrieved from Netherlands: http://www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf
[16] Colin, N. (2015). What makes an Entrepreneurial Ecosystem? Retrieved from https://salon.thefamily.co/what-makes-an-entrepreneurial-ecosystem-815f4e049804#.gij6oqmum
[17] Colin Mason, R. B. (2014). *Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship*. Retrieved from Netherlands: http://www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf
[18] Auerswald, P. E. (2015). *Enabling Entrepreneurial Ecosystems*. Retrieved from http://www.kauffman.org/~/media/kauffman_org/research%20reports%20and%20covers/2015/10/enabling_entrepreneurial_ecosystems.pdf
[19] Colin Mason, R. B. (2014). *Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship*. Retrieved from Netherlands: http://www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf; Federal Reserve Bank of Kansas City. Grow your own entrepreneurship-based economic development for local communities. Retrieved from https://www.kansascityfed.org/~/media/files/publicat/community/gyo/entrepreneurship-econ-dev-local-communities.pdf

collection can prove challenging. Defining what a region should measure is difficult in complex systems. Research on EEs emphasizes multidimensional approaches to measurement. For instance, the Kauffman Foundation proposes four ecosystem indicators: 1) Density, measured in terms of density of new and young firms, share of employment in new and young firms, and high-tech density; 2) Fluidity, measured by population flux, labor market reallocation, and number of high-growth firms; 3) Connectivity, based on data related to program connectivity, spinoff rates, and dealmaker networks; and 4) Diversity, determined using metrics such as economic diversification, immigration, and income mobility. The authors cautioned that communities should not interpret these indicators in a vacuum—they should track indicators across time and compare them with state, national or peer region indicators.[20]

When measuring ecosystem components, understanding the role of those components, how they relate to others and the diversity of components is important to assessing the whole. Isolated metrics like R&D funding, investment capital, engineering degrees, university patents or licenses provide incomplete glimpses. Many of these measures are inputs and do not illustrate the resulting outputs or necessary vibrancy of an ecosystem. OECD's Entrepreneurship Measurement Framework, and later the Aspen Network of Development Entrepreneurs (ANDE), differentiated input, output and outcome metrics to provide a better assessment of policy initiatives (inputs) and what they produce on the regional scale (outputs and outcomes):

1. Entrepreneurial Determinants (inputs): Various factors that affect entrepreneurship. Example of determinants of entrepreneurship includes specific policies, amount of venture capital financing deployed, and the availability of business development services.
2. Entrepreneurial Performance (outputs): Specific activities that entrepreneurs perform that will ultimately deliver the impacts. Outputs include total number of businesses, the number of high-growth firms (gazelles), employment figures, and enterprise survival and death rates.
3. Impact (outcomes): Value created by entrepreneurial performance, which may be measured in terms of macroeconomic variables, such as GDP growth, employment, Gini coefficients (to measure income distributions), or the size of the formal sector vs. the informal sector.[21]

Identifying appropriate data is another challenge. Certain secondary data may not be available at the necessary geography, i.e. county-level data. Other data may be difficult to capture, requiring the use of proxy measures. Primary data collection requires effective collaboration among regional stakeholders. Finally, researchers must engage ecosystem actors and entrepreneurial stakeholders to identify the metrics that may best serve as reliable measures and be most useful and appropriate to collect.

For the purposes of this study, we used the Kauffman Foundation typology and combined it with the OECD/ANDE's input-output framework. Kauffman's typology emphasizes the holistic and interconnected

[20] Auerswald, P. E. (2015). *Enabling Entrepreneurial Ecosystems*. Retrieved from http://www.kauffman.org/~/media/kauffman_org/research%20reports%20and%20covers/2015/10/enabling_entrepreneurial_ecosystems.pdf
[21] Colin Mason, R. B. (2014). *Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship*. Retrieved from Netherlands: http://www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf

perspective of entrepreneurial ecosystems that lead to vibrancy while remaining inclusive of the many components that may exist in the system. Meanwhile the OECD/ANDE framework provides an analytical structure for assessing impact by differentiating the resources present and their possible results. A full list of the metrics explored, their definitions, and their data sources can be found in Appendix B and C.

Table 1. Combined Kauffman Foundation-OECD/ADNE Metrics Framework

	Density	**Fluidity**	**Connectivity**	**Diversity**
Definition	*Relative density of entrepreneurship and resources*	*The accessibility and easy flow of assets*	*Connections among elements: programs, companies, individuals*	*An assortment of economic specializations, people and opportunities*
Inputs	Resources contributing to firm growth: Finance, Support, Policy, Markets, Human Capital, Infrastructure, Research & Development, and Culture			
	Density of resources (often % or per # of people)	*# and movement of resources available and used*	*Resource and information sharing*	*Diversity of resources or all types of entrepreneur*
Outputs	Growth and development of the ecosystem: Businesses, Employment, Increased interactions among EE actors			
	Density of firms and employment	*# of firms and employment*	*Change in program connectivity, company interactions or memberships*	*Company and employment diversity*
Outcomes	Macroeconomic indicators illustrating overall regional prosperity: Unemployment Rate, GDP, Income Inequality, Median Household Income, Job Growth, Cost of Living			

CASE STUDY: THE ROANOKE-BLACKSBURG ENTREPRENEURIAL ECOSYSTEM

The Roanoke-Blacksburg Entrepreneurial Ecosystem is comprised of two metropolitan areas, as seen in Figure 1. The Blacksburg-Christiansburg-Radford MSA is in orange and the Roanoke MSA is in maroon. The region has eight counties and three independent cities.

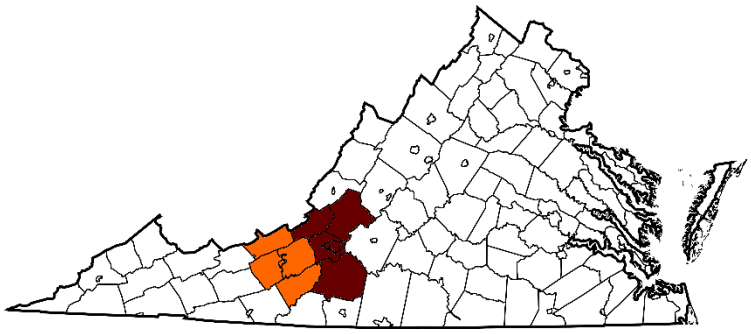

Figure 1. Study Area: New River and Roanoke Valley MSAs

The area is large and encompasses the Roanoke Valley to the east, and the New River Valley to the west. Roanoke has an urban core of just over 100,000 residents, with nearly 316,000 in the larger MSA. The city is the largest in western Virginia and serves as an economic, cultural, and social hub within the larger region. The New River Valley consists of the Blacksburg-Christiansburg-Radford MSA, with over 185,000 residents. The regions are connected in many ways, including by commuting patterns, a shared health care system, a regional airport and other transportation hubs. Interstate 81, the Appalachian Mountains and the Appalachian Trail stretch across both regions. The region retains a strong rural and agriculture presence, particularly in the non-urban core localities such as Floyd and Franklin Counties. As a whole, the region is almost 3,300 square miles with a population of about 150 people per square mile.[22]

With the second largest technology council in the Commonwealth of Virginia, this region works to foster and support innovation-driven entrepreneurs or "gazelles" as described by Aulet and Murray (2013). The Roanoke-Blacksburg Technology Council (RBTC) – a non-profit, member-driven association of businesses and organizations – promotes the growth of the region's technology sector. The RBTC has become an essential resource for entrepreneurs and technology companies and has spearheaded the creation of a *Regional Innovation Blueprint*, a strategic plan to develop the innovation ecosystem of the region.

A strong economic driver for IDEs in the region is Virginia Tech in Blacksburg, currently ranked No. 44 in the National Science Foundation's most recent annual survey of higher education research expenditures. In the 2015 fiscal year, the university generated $504 million in R&D activity. U.S. News has consistently ranked Virginia Tech as one of the nation's top ten public engineering programs. The university hosts an internationally recognized research park, the Virginia Tech Corporate Research Center (VTCRC), which is home to over 130 private companies, ranging from larger corporations to smaller startups. The Virginia Tech Carilion Research Institute is a recent collaboration between Virginia Tech, based in Blacksburg, and

[22] Virginia Tourism Corporation (2013). Community Profile. http://virginiascan.yesvirginia.org/communityprofiles/; American Factfinder. PEPANNRES 2014 Population Estimates. http://www.census.gov.

Carilion Clinic, a regional non-profit healthcare system based in Roanoke. The new research institute spurs medical research and the growth of businesses in the medical field.

Recent and ongoing development efforts support IDEs in the region. The RBTC is partnering with Virginia Western Community College and the City of Roanoke to develop a new business accelerator, focused on high-growth companies. Also in Roanoke, Virginia Tech's partnership with the city and Carilion Clinic is growing through an expansion of the Virginia Tech Carilion Research Institute and associated development of an Innovation District around health, life sciences, and biotechnology. Existing coworking and incubator spaces also support technology-based entrepreneurs, such as the CoLab in Roanoke, the New River Valley Business Center in Radford, and TechPad and Studio 2.0 in Blacksburg. A number of efforts are ongoing to expand venture and investment funding around high-potential entrepreneurs in the region.

While technology-based economic development and aspiring high growth enterprises are a presence within the region, the entrepreneurial landscape, like the physical landscape, is much more textured. Agriculture and main street businesses remain a stable presence. Regional asset-based initiatives seek to support small businesses related to the outdoors, agriculture, the arts, and other regionally significant strengths. For example, the Roanoke Regional Partnership has developed an economic strategy around the outdoors industry and related businesses, many of which are SMEs. These businesses include outfitters, other retail, restaurants, manufacturers, and enterprises supporting outdoor recreation.

A number of ecosystem assets also support SME enterprises. The region has a Small Business Development Center, which is based in Roanoke but serves the larger region. Some incubator/coworking spaces also support smaller, more locally oriented enterprises in addition to tech entrepreneurs; for example, the Floyd Innovation Center in rural Floyd County and the HIVE Business Incubation Center just outside of the City of Roanoke. There are also multiple business associations and chambers of commerce which are oriented towards main street enterprises.

Other colleges and universities also contribute to the entrepreneur ecosystem in the region, through support for student startups, coursework, training, networking and learning opportunities and more. These include Radford University, Roanoke College, Hollins University, New River Community College, and Virginia Western Community College. Radford University offers Design-Think coursework for entrepreneurs, social entrepreneurs and researchers alike. Virginia Western Community College has developed a makerspace that they have opened for public use.

To explore these IDE and SME-related initiatives and the resulting state of the ecosystem, the research team disseminated surveys to entrepreneurs, engaged entrepreneurs and resource providers in interviews and focus groups, and conducted preliminary social network analyses using Twitter and survey responses from entrepreneurs regarding their memberships to EE organizations.

Survey Results

The research team disseminated the online survey through regional resource providers: chambers of commerce, business associations, service organizations and interview contacts. At least 20 providers distributed the survey link through their contact lists one or more times between April and July 2016. We also reached out to minority businesses using intercept and phone surveys.

Of the 94 completed surveys, 82 surveys were completed by entrepreneurs. Only 51 respondents considered themselves an "entrepreneur", while 31 respondents cited maybe, primarily because they questioned the term "entrepreneur". Figure 2 shows how respondents described their businesses.

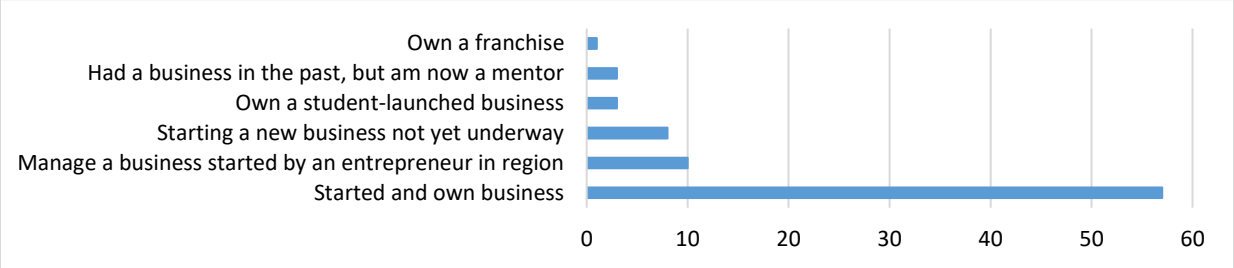

Figure 2. Which of the statements best describes your business?

We classified 51 out of 82 entrepreneur respondents as SME entrepreneurs and 31 as IDE entrepreneurs. Using Aulet and Murray's definition, we categorized responses based on their primary market locations, employee locations, whether their businesses rely on an innovative technology, process or business model, the funding structure of their business, and each respondent's product description.

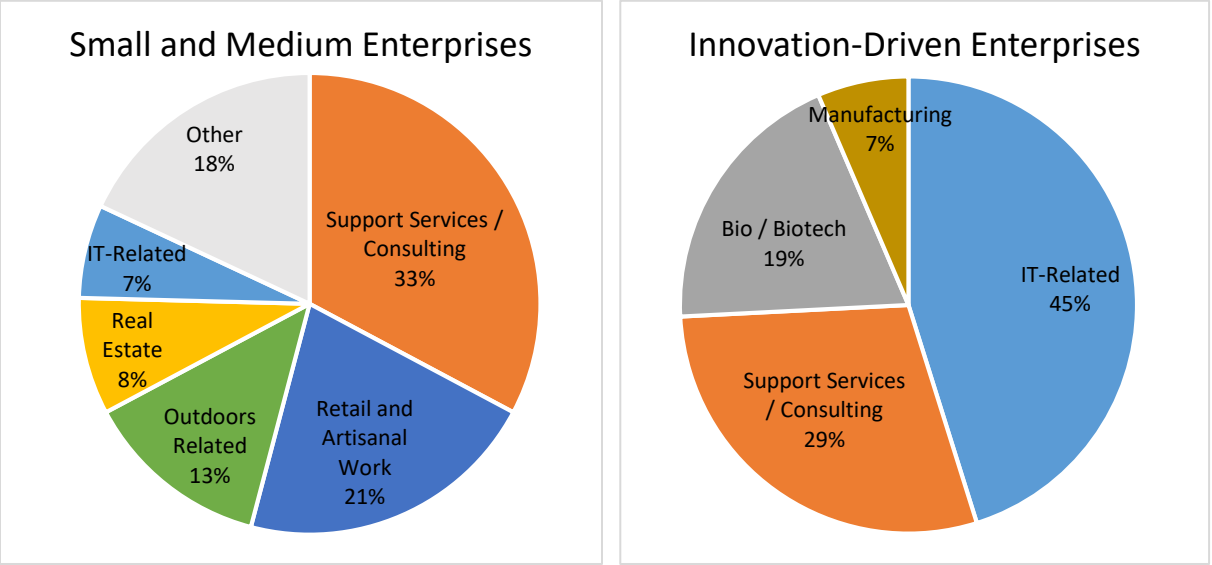

Figure 3. Industry breakdown of SME and IDE business survey respondents in the Roanoke-Blacksburg entrepreneurial ecosystem

General strengths within the ecosystem

"Friendly and Supportive. Lots of open doors."

Entrepreneurs praised this region foremost for its quality of life and low cost of living. They mentioned the growing number of entrepreneurial resources, particularly organizations providing office and coworking spaces like CoLab, TechPad and the Virginia Tech Corporate Research Center. Other strengths included the networking events, legal and tax services, and the education institutions training the region's workforce. Both types of entrepreneurs highlighted the same mentors who helped them navigate the informal entrepreneurial network. Additionally, respondents described individuals and groups that support the ecosystem including attorneys, CPAs, banks, Rotary Club and young/women's professional groups. When asked where and how they networked with other entrepreneurs, both IDEs and SMEs tended to meet fellow businesses formally as much as informally, 1-3 times a month. They most frequently connect at coffee shops and restaurants, places of business, coworking spaces, and professional events.

SMEs: In open-ended responses, about half of SME respondents described the ecosystem positively, referring to a friendly, supportive and upbeat atmosphere that is great for networking. Others said there were opportunities for future growth. When describing quality of life, SMEs referred to the region as a desirable place to live with its outdoor recreational assets, its small town amenities, and its desirability as a place to raise a family and retire. A handful of SME entrepreneurs actually mentioned not wanting to leave the region as a reason for starting their companies.

IDEs: A handful of IDE entrepreneurs cited recent positive changes and the potential for more improvement. While quality of life was referenced often, one entrepreneur explained "Quality of life is a plus, but without capital, I can't attract well-qualified, experienced mid-level and senior executives from other areas." A third of IDEs described the benefits of having access to higher education—its research, resources and talent. Several expressed a desire to connect more with the graduates of these institutions to keep them in the region rather than trying to attract outside talent. Almost all IDE respondents participate in the RBTC, but few other business associations. Entrepreneurs appreciate the RBTC most for its networking opportunities, its celebrations of entrepreneurial success in the region, informational events and peer forums, and its efforts to market the region.

General weaknesses within the ecosystem

"Much rah-rah, very few successes - i.e. companies created that can supply living wages for their founders and create and fund new jobs for new employees."

Consensus among entrepreneur respondents was that the hype surrounding the notion of startups and entrepreneurship in the region is not matched by actions and outcomes. Many noted the region's resource providers and localities needed to better coordinate and address various types of small business, from micro to second stage companies. Several respondents observed little to no concerted effort to provide resources to help scalable businesses grow and employ more people.

SMEs: SMEs expressed the difficulty they had opening their businesses. Seven explicitly stated the challenges of working with local government (specifically Blacksburg and Christiansburg), and the lack of interagency collaboration and information sharing to facilitate startup growth. SMEs utilized more entrepreneurial education programming than IDEs with 49% of respondents participating in courses.

Fittingly, SME businesses cited the need for more business education programs; for instance, budgeting, advanced building and managing websites, best practices in supervision/staffing/hiring, reality-based initial screening to identify demand and markets, and hands-on technical courses. Less than half of SME respondents cited being part of a membership organization, such as a chamber of commerce or business associations. These organizations serve smaller geographies, so there is no one organization or advocate on which SME entrepreneurs can rely, in contrast to the RBTC for IDEs.

IDEs: Most IDEs described the region as stagnant, backwards and slow to adopt new ideas. One entrepreneur explained, "The regional political climate is not particularly startup friendly. Very little creativity or long term interest in making this area anything more than what it is now." The region seems to suffer from a dearth of early stage funding and growth capital. Although several entrepreneurs cautioned against thinking of the region as the next Silicon Valley, they explained that investors needed to be less risk-averse if companies are going to stay and thrive in the region. Those closer to Blacksburg, in particular, have found that the focus on student entrepreneurship has inadvertently masked the accomplishments of those startups outside the university and prevented entrepreneurs who are not "22 year olds eating pizza and drinking Red Bull" from getting support.

SME and IDE businesses cited several of the same resource needs, though the degree to which they emphasized specific needs differed across groups. In general, respondents indicated the need for:

1. More collaboration among resource providers to create a unified front and facilitate easier access for businesses. SME businesses emphasized a need for a hub, similar to the RBTC for IDEs, which would serve microenterprises and sole-proprietors.
2. More financial resources. IDEs emphasized the need to attract and raise more venture capital in the region. Both SMEs and IDEs wished for advocacy efforts to elected officials concerning taxes on small and medium businesses that inhibit their growth.
3. More openness from higher education institutions, particularly Virginia Tech. Both business types are aware of the resources that the universities have to offer—through research, IP, space, faculty and student expertise, workforce potential. Entrepreneurs, however, are under the impression that these institutions may not want to help. More regional programs like NSF Innovation Corps, a program in which groups of faculty and students team up to translate research into market technologies, could encourage more business growth.
4. Better internet service throughout the region. While broadband is available in certain areas, some areas lack adequate internet service options.
5. More meetups or forums designed for industry-specific businesses/entrepreneurs. These meetings need to be for actual businesses and aspiring entrepreneurs. Several of the existing meetings in the region are overly populated by service providers rather than businesses.

Metrics

Based on feedback from entrepreneur, several metrics emerged that could help to monitor the strengths and weaknesses of the region over time, or through comparison with peer regions. We identified the

metrics that could feasibly be collected through secondary or primary sources, and arranged recommended measures according to the Kauffman Foundation's indicator typology.

Table 2. Survey Results – Identified Metrics Contributing to Kauffman Framework

Density
Density metrics illustrate the relative density of entrepreneurship and resources. This indicator is useful for understanding resources, businesses and employment in terms of percentages and proportions, and for comparing a region to peer regions. SME entrepreneurs emphasized the need for more broadband internet, particularly in more rural communities. Mapping out and measuring **broadband density** over time will help to monitor the continued need for this resource across the region. Both entrepreneur types desired more support for businesses that employ workers. In this case, SMEs responses indicated a desire to show the **employment share of locally-owned businesses**, or percent of total employment due to entrepreneurs in the region. Another metric more apt for IDEs because of their high growth potential would be **employment share of new and young firms**.
Fluidity
Fluidity metrics describe the easy flow of assets or their accessibility either through number of assets present or evidence of resource or business flow. IDEs described a need for more funding dollars and options. Metrics for monitoring this aspect of the ecosystem are the **number of angel networks, venture capital networks and funding organizations** and the **number of deals made annually** in the region. These metrics require primary data collection and communication with resource providers and entrepreneurs to gauge new activity. While some secondary sources exist, they are not adequate for this more rural regions. Even primary data collection would only provide an approximation. Because many of the survey responses indicated lack of knowledge of resources, **a regular survey of entrepreneur perceptions** would help to gauge ease of accessing and quality of resources.
Connectivity
Connectivity metrics gauge opportunities and instances of connection within the ecosystem that may facilitate the easy flow of information and resources. Entrepreneurs emphasized the **number of networking events** as a strength in the region. They also mentioned the need for more **partnerships with university entities** and greater **resource provider program connectivity**, both in terms of communication and programs. These metrics would need primary data collection: interviews with resource providers, including universities, to tally networking events and partnerships; a network analysis with data gathered from a resource provider survey to visualize ecosystem connectivity.
Diversity
The diversity indicator emphasizes the need for an assortment of resources, people, businesses and opportunities. Survey responses revealed limited understanding among entrepreneurs, particularly SMEs, of the diverse resources the region has to offer. They also asked for more resources by business stage. These responses indicate a need for **a resource inventory** broken down by business types--micro, small business and second-third stage businesses. This inventory could monitor the number and capacity of education programming for SMEs and funding sources for different stages of IDE.

Interview Results

The interviews collected personal accounts of the challenges that entrepreneurs face in the region and identified key strengths and opportunities that already exist or are emerging within the ecosystem. Understanding these strengths and challenges can help to identify areas to monitor and measure moving forward. Perhaps more importantly, the findings from the interviews provide alternative perspectives, complementary data, and qualitative stories to be utilized alongside secondary metrics and the survey of entrepreneurs.

Our interviewee pool included a mix of representatives from IDE or "gazelle" enterprises, local and regional SME enterprises, as well as providers and educational leadership institutions. We conducted a total of 22 interviews and four focus groups between April and June, 2016. Of the 44 total participants, 27 were entrepreneurial resource providers and 17 were entrepreneurs working within the region.

General strengths within the ecosystem

"The region is hungry for anything. We've gotten a lot of attention and praise."

Resource Providers: Recent years have brought a plethora of new resources and hype about entrepreneurship to the region. There are more organizations focused on supporting entrepreneurs, more business plan and pitch competitions, more education programs meant to train entrepreneurs, and more spaces to network, ideate and develop the entrepreneurial culture. Interviewees also highlighted the existing soft and hard infrastructure within some areas of the region, including human capital and expanding broadband.

SMEs: Interviewees heralded a community of supportive individuals from local business owners and elected officials to bank officials and heads of specific industry organizations. They commented that the local Chambers of Commerce were making strides to be better conveners for non-tech companies, lowering financial barriers for individual entrepreneurs and startups to be members and offering education and networking programming to inform businesses of the resources to help them grow and thrive in the region. SMEs stated the time when Chambers hold these events, however, sometimes conflict with regular business hours for SME businesses.

IDEs: Interviewees noted that, when compared to 15 years ago, the region has a lot more mentors and serial entrepreneurs, including "cashed out" entrepreneurs who stayed in or returned to the region because of its human capital and quality of life. Almost all interviewees mentioned the presence of a strong research university with strengths in hard sciences and engineering, as well as an abundance of entry-level developers as assets for IDE entrepreneurs, though many noted the challenges associated with keeping these actors and entities within the region.

General weaknesses within the ecosystem

"Ecosystem flaws add up."

Resource Providers: Service providers identified a lack of mentors within the region, specifically from people who have "done it recently." Respondents observed that existing programs seem geared

towards traditional industries and that early stage funding is lacking, especially with Angel investors and Venture Capital. They also noted a lack of a regional media and communications strategy, which would ideally help with regional branding, publicizing success stories and helping to shape the entrepreneurial culture of the region.

SMEs: SME entrepreneurs and related service providers noted the low density of people and businesses within the region as a weakness within the ecosystem. Ecosystem resource knowledge and information sharing have long suffered from intra-regional competition and lack of coordination. As one SME noted, "Entrepreneurs go to the municipal building and are sent around everywhere like yoyos." Other interviewees noted the limited market research available and a lack of social media training/workshops targeted toward SMEs. In Roanoke specifically, minorities and international residents, including immigrants, have greater difficulties accessing resources. The residual impacts of historical racial segregation in the city, the suspicion among these groups of government aid, and the low levels of cultural competency/diversity in resource provider organizations contribute to this gap.

IDEs: Although there are many 'spaces of collision' for entrepreneurs, translating these interactions into coordinated resources for emerging entrepreneurs, especially in "hard science spinoffs", remains a challenge. Numerous interviewees mentioned that a culture of risk does not exist within the region and others noted that the Regional Fund should be retooled to focus on deals other than late-stage, low risk investments. While IDEs also described universities as an important asset, they urged regional schools such as Virginia Tech to incentivize more translational research to support the entrepreneurial ecosystem. Others cautioned that the university should not be the face of the region, referencing lack of trust among some entrepreneurs due to past IP legal complications.

Both SMEs and IDEs described common elements of the ecosystem to consider moving forward.

1. Interviews highlighted a tension in the ecosystem between emerging entrepreneurs seeking flexibility and innovative approaches to commercialization and more established institutions and actors more focused on the development of physical products. For IDE entrepreneurs, this tension is manifest through the discourse on lean startups versus brick and mortar investment. More traditional IDE stakeholders noted that regional entrepreneurs are not building as many companies as before. Instead, they build an application and then sell it to a company. Meanwhile, SME stakeholders wish to explore more innovative means of brick and mortar investments that lower barriers for SME entrepreneurs to acquire their own space, e.g. subsidized rents.
2. Many interviewees had suggestions about what the region could do to improve the health of its entrepreneurial ecosystem. Some noted the importance of harnessing the power of successful entrepreneurs who have ties to the region. 'Cashed out' entrepreneurs filter resources into the region and some have gradually returned to the region. Many noted the need for regional leadership to build on quality of life components to attract returning entrepreneurs and retain students, thus cultivating a stronger entrepreneurial community.
3. Fragmentation within the ecosystem was another identified barrier. Specifically, a divide exists between Roanoke and Blacksburg that is both physical and symbolic. A history of competition as well as a mountain range have resulted in an ecosystem that operates as two semi-linked systems.

Even the Roanoke-Blacksburg Tech Council (RBTC) has reportedly struggled to unite leaders in the two locations. For IDE entrepreneurs, the region may be less fragmented as IDEs turn to the regionally-focused RBTC as a hub for its community. IDEs also utilize more geographically diverse resources than their SME counterparts. The region may be even more fragmented than just the two regions for SME entrepreneurs. Many of these main street businesses operate in small locales within the larger ecosystem, implying that their resource needs are much more place-based and that SMEs may have less political clout than IDEs due to so much fragmentation.

Metrics

Each interview ended with a question about what measures or metrics are worthwhile to track if we wanted to understand how well the region is supporting entrepreneurship. Responses varied widely, and for some, we could not find adequate ways of collecting data. One broadly stated point was to have more qualitative stories of experience to complement the more quantitative metrics. Others could be framed in terms of Kauffman Foundation indicators.

Table 3. Interview Results – Identified Metrics Contributing to Kauffman Indicator Framework

Density
Similar to entrepreneur survey responses, interviewees want to know the number of people employed by entrepreneur-owned businesses and startups. Framing these metrics in terms of density or a proportion of total employment helps provide a context and a comprehensive scale. Moreover, these two metrics—**employment share of locally-owned businesses and startups**—are then good measures of comparison with peer regions.
Fluidity
IDE entrepreneurs and resource providers found the need to benchmark and observe the potential growth of the **annual number of companies licensing IP** from local universities, **money raised annually by tech companies** through different funding channels (angel, VC, etc.), and the **number of startup companies sold** in the area over time and their revenue. They were also interested in the **annual number of students involved in entrepreneurship**, a metric that many universities across the U.S. also wish monitor.
Connectivity
Stakeholders questioned the level of coordination between regional resources providers, with SMEs particularly feeling bounced around between government offices. A network analysis using data from a resource provider survey illustrates the presence and strength of EE **program connectivity**, highlighting where communication or resource gaps may occur. Entrepreneurs also emphasized that the hype around entrepreneurship and increased resources does not translate into actual resources and business success. To address this, the following metrics when gathered collectively across the region may reveal this connection: **number of startups coming out of entrepreneurial programs**, **rate of university startups** annually or every five years, **spinoff rate** from existing companies in the region.

Diversity
Similar to the coordination challenge was the expressed need to market the region's existing resources and **map the entrepreneurial ecosystem (resource inventory)** for new entrepreneurs. This map would need to show the diversity of resources present as well as the geographic span of the resources considering this region is 3,300 square miles.

Exploring Kauffman's Connectivity Indicator: Social Network Analyses

When describing ways of measuring an entrepreneurial ecosystem, stakeholder discussions in the Roanoke-Blacksburg region have mirrored national interests in mapping the connectivity among EE actors. One metric recommended for the Kauffman Foundation's connectivity indicator, for instance, is program connectivity. Traditional secondary metrics do not necessarily capture the connectivity indicator well. Many have proposed social network analyses as an approach to measurement.

A social network is formed by nodes and edges. Nodes can represent a resource organization, a business or an individual. In many visualizations, the size of the node symbolizes its centrality or importance to the network, such as its number of connections in the network. Edges are the lines connecting the nodes, representing a relationship between the resource provider, business or individual. Depending on the analysis, edges are weighted, showing thicker or thinner lines to illustrate the quality of the relationship.

The purpose of a social network analysis when examining entrepreneurial ecosystems is to visualize an ecosystem, identify its more prominent players, and illustrate how or with whom they interact. Identifying the more prominent players in an ecosystem can help to understand where to reach the greatest amount of stakeholders; for example, if a researcher wishes to collect data via a survey or an organization wishes to advertise a new entrepreneurial resource, the most central nodes would be the logical places to start.[23] The visualization can help organizations within the network identify other organizations with whom they should interact in the future, increasing their network connectivity; for instance, if an organization is not connected to another node or the connection is weak (a thin edge). In addition, a network analysis can identify different communities existing within a network based on their more densely connected nodes. In other words, the EE actors in these communities interact more closely than with the rest of the network.[24] Knowing the different communities helps researchers identify what nodes (i.e. organizations or individuals) to connect with in order to increase the likelihood of reaching as many entrepreneurs as possible across the network. For organizations operating within the networking, understanding the different communities can help them to strategize their market reach, whether they want to strengthen relationships within their community or expand to other communities within the network.

[23] We used Gephi, free network visualization software, which allows the user to statistically analyze relationships between different nodes, or in this case relationships among entrepreneurial ecosystem organizations, businesses, and individuals. For instance, different centrality analyses can distinguish nodes (EE actors) that are most vital to the network; either they have the most connections with other nodes (*degree centrality*), they serve as an important bridge among different EE actors in the network (*betweenness centrality*), or their connection with other well-connected EE actors amplifies their essential role in the network (*eigenvector centrality or PageRank)*.

[24] GrandJean, Martin (2015). Gephi -- Introduction to Network Analysis and Visualization. http://www.martingrandjean.ch/gephi-introduction/

The research team identified three relatively feasible types of social network analyses that a region might conduct to understand better its ecosystem:

1) A Twitter analysis where nodes are connected based on number of followers;
2) An analysis of entrepreneur surveys illustrating entrepreneur's use of different resource providers and how these providers are connected through entrepreneurs; and
3) An analysis of EE program connectivity based on a resource provider survey asking entrepreneurial resource providers how they interact with one another.

We conducted initial analyses using the first two of these approaches to assess the effectiveness in capturing connectivity within the ecosystem. We recommend the third analysis in the future for a more in-depth measure of program connectivity.

Twitter Analysis

Using different social networking sites, a researcher can "scrape" data to see who is connecting with whom through online networks. Although Facebook and LinkedIn would have been the logical choices, both sites have restricted APIs (application programming interfaces), which means one would need permission to access and scrape their data. Twitter has an open API, allowing a computer scientist or engineer to gather the data needed to map a network.

A Twitter analysis can highlight EE actors that maintain a strong presence in the ecosystem and connect virtually with others, as well as identify communities that exist within the network. A Twitter analysis can also help characterize the different communities in terms of SME and IDE entrepreneurship. Compared to the other social network analyses described, it can more easily visualize prominent main street and high growth firms, and the individuals and organizations supporting these firms. Based on interview and survey responses, the research team identified a seed set of 48 Twitter feeds, split equally among Blacksburg and Roanoke geographies, SMEs and IDEs, and businesses and service providers. Including followers of that seed set, the analysis revealed a network of over 10,000 Twitter feeds.

Figure 4 shows the visualization of the Twitter feed analysis. Because the network includes so many actors, only the most central nodes are labeled. These nodes are the resource providers, individuals and businesses that may have more influence in the Twitter network in terms of information sharing. When reaching out to entrepreneurs to share or gather information on the ecosystem, these are physical and virtual entities that could be most influential. These nodes include business associations, coworking and incubation spaces, as well as individuals who support entrepreneurs. Also represented are businesses ranging from SMEs such as breweries, coffee shops, restaurants, and food coops, to IDEs like engineering or manufacturing firms and software development/platform businesses.

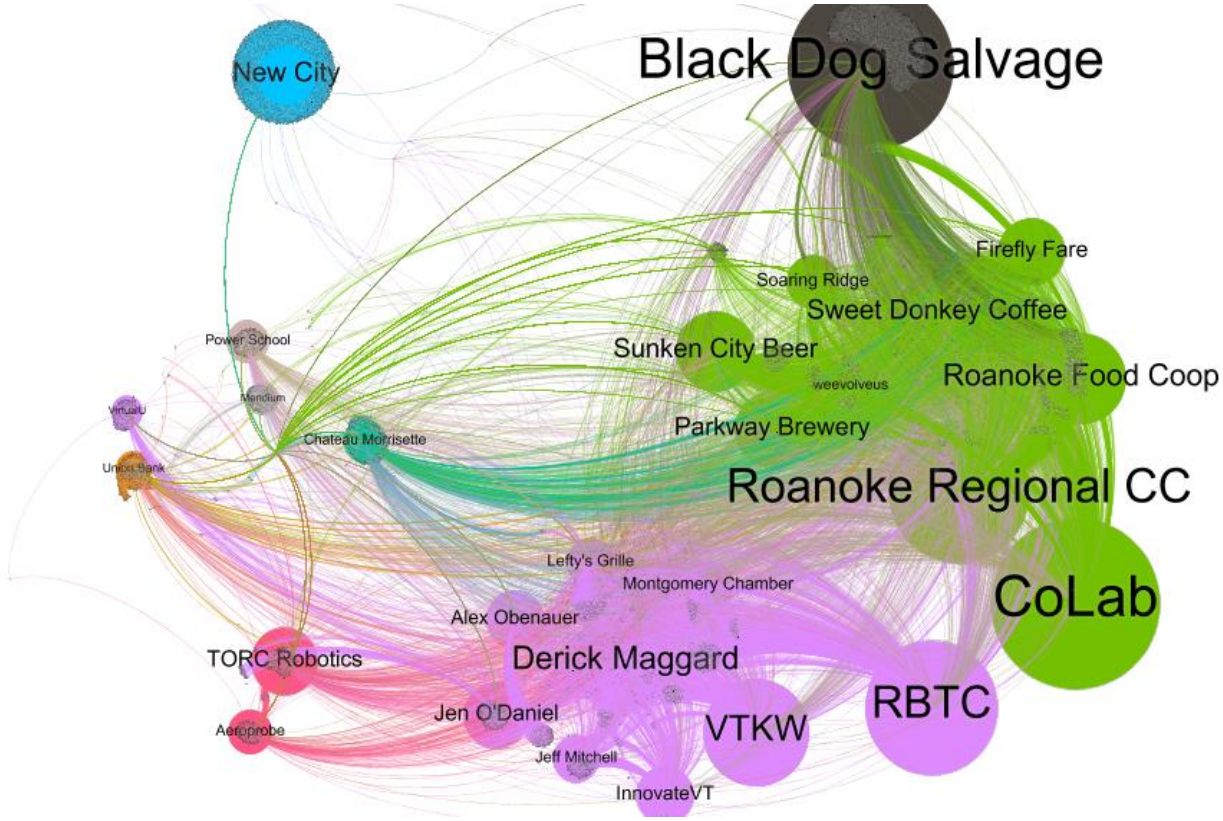

Figure 4. Twitter Network of Roanoke-Blacksburg Entrepreneurial Ecosystem

This analysis effectively identifies communities within the network. In order to analyze this network, however, other forms of research are necessary to understand the ecosystem. We use insights gathered from surveys and interviews. Mirroring interview comments that Roanoke and Blacksburg are still fragmented, this visualization shows Roanoke EE players in green and Blacksburg resource providers in purple. The regional IDE business association, RBTC is purple, most likely because the other nodes labeled in purple are more closely related to IDE entrepreneurship than the SME nodes in Roanoke (green). However, RBTC still has many connections to Roanoke and thus serves as an ideal bridge between to two communities. Several IDEs are in their own communities. See TORC Robotics and Aeroprobe, in pink, located in the Blacksburg region. The four single nodes—New City, Black Dog Salvage, Chateau Morrisette, and Union Bank—are part of this ecosystem, but also exist within other, potentially larger networks that distance them from other EE actors in the ecosystem and establish them as separate communities.

Entrepreneurial Survey Network Analysis

By asking entrepreneurs about the resources they use, one can create a network showing the most utilized resources according to respondents. This analysis also shows how those resources are connected through individual entrepreneurs. For instance, if an entrepreneur is a member of the RBTC and two local chambers of commerce, these organizations connect through the activities of this entrepreneur. Hypothetically, information could flow from one organization to others through word of mouth of entrepreneurs utilizing these services. As surveys and interviews show, word of mouth is the most

common form of information sharing. This analysis, therefore, may provide an approximation of that informal network.

Figure 5 is an illustration of the network created through the entrepreneur survey responses. The RBTC, the Montgomery Chamber of Commerce, the Roanoke Regional Chamber, and the Salem-Roanoke Chamber of Commerce stood out in terms of the number of entrepreneurs citing membership to these organizations and their connections with other organizations through these memberships. The edges connecting theses nodes are thicker, connoting the number of membership connections between nodes. For instance, many entrepreneurs are members of both the RBTC and the Roanoke Regional Chamber. Practically speaking, these larger nodes are places to reach entrepreneurs through emails and events.

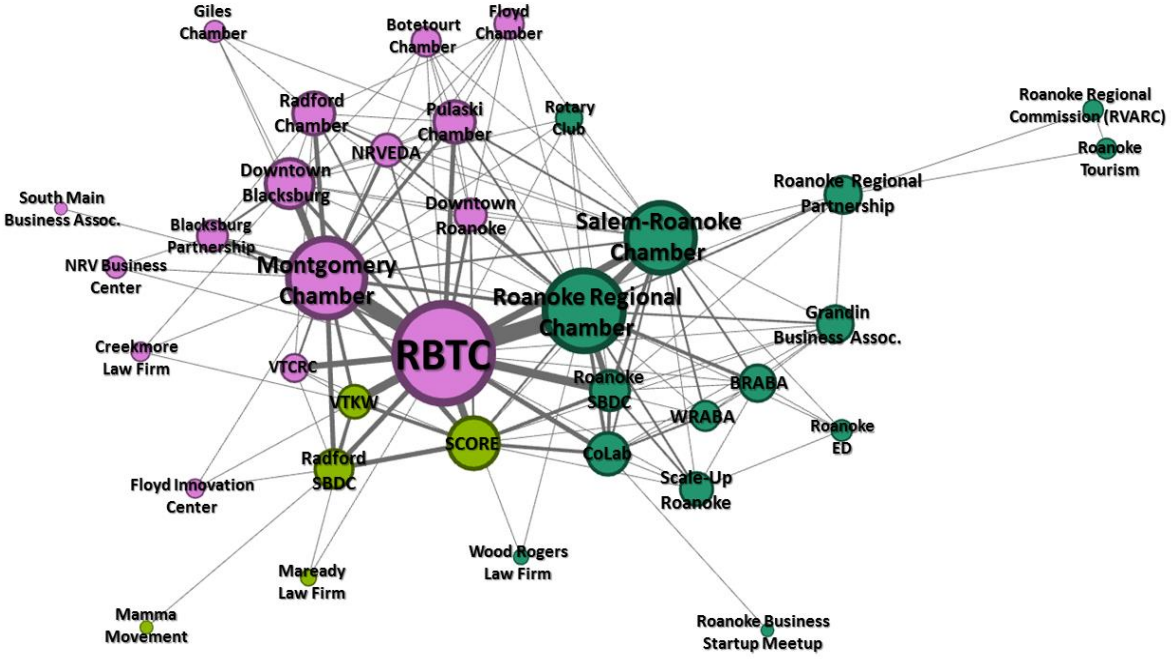

Figure 5. Ecosystem according to entrepreneur survey responses of their resource use

Similar to the Twitter Analysis, this analysis also identifies the two separate Roanoke and Blacksburg MSAs, although the limited amount of data (82 surveys) results in a weaker, less reliable analysis of communities compared to the Twitter Analysis. The social network mirrors the physical reality of the region as well, with more rural agencies less connected and on the outskirts of the ecosystem.

This type of social network analysis is one that improves over time. The research team's initial survey listed most of the resource providers shown in Figure 5, but left open-ended questions for entrepreneurs to write in additional resource providers. Figure 5 shows these additional resource providers, but they are most likely less prominent in this network than they are in the actual ecosystem. Every respondent would have needed to take the time to adequately fill in the open-ended questions thoroughly for this network to be perfect. Thus, future surveys can add to the existing list and capture a more accurate portrayal of the ecosystem and resources.

DISCUSSION

An Approach for Identifying and Collecting a Diverse, Holistic Set of Metrics

The purpose of this research was to explore how best to measure an entrepreneurial ecosystem in light of a region's urban-rural nature and the diversity of its entrepreneurs. Traditionally, regions view innovation-driven enterprises (IDEs) or high growth firms as the drivers of economic growth. More recently, the role of small and medium enterprises (SMEs) or main street and lifestyle businesses have entered the entrepreneurial ecosystem conversation as they are seen as contributing to the quality of life and ecosystem vibrancy that nurture entrepreneurs of all sorts. Both entrepreneurial types are needed in an ecosystem, and thus a region should utilize metrics that take into account the needs and realities of the entrepreneurial spectrum.

Through surveys and interviews, the research team identified metrics that matched the concerns of stakeholders in the Roanoke-Blacksburg region and that future researchers could collect either through secondary sources or through regular primary data gathering. We collected survey responses of 82 entrepreneurs and interviewed 44 resource providers and entrepreneurs. Both methods highlight ecosystem strengths and weaknesses for all entrepreneurs including IDEs and SMEs. Assuming these strengths and weaknesses should be monitored over time to assess change, the research team identified aligned metrics that would be feasible to collect. Metrics requiring primary data collection should be used for the purposes of longitudinal analyses and for mapping and marketing the ecosystem. Primary data collection is most successful when ecosystem resource providers agree on collective metrics and methods to gather and aggregate those metrics on a regional scale. For metrics collected through secondary sources, feasibility in smaller regions with an urban-rural mix often means access to county-level data. We identified county level data that would result in metrics, allowing for comparisons with peer regions.

Table 4 revisits the Kauffman Foundation framework while differentiating between resource inputs and entrepreneurial business outputs. Included in the framework are the metrics found most suitable for the Roanoke-Blacksburg region.[25] Some metrics are more relevant to SMEs or IDEs. For instance, SME firms described a greater gap in internet service provision than IDE firms, primarily due to financial concerns or more SMEs operating in rural counties. On the IDE side, indicators like net knowledge worker migration, number of high growth firms and number of university startups might be more important. Additional researchers and regional groups should collect metrics more broadly to account for different firm types, firm stages, and the resources needed by each. Industry diversification can help to understand the region's economic diversity and to a lesser extent the SME and IDE make-up of the region. Other metrics are all-inclusive, such as program connectivity, labor market reallocation, entrepreneur perception survey for access and quality of resources, startup density, and business churn.

[25] Note that some of the Kauffman Foundation's original metrics are present in this framework, while others are not. The research team found that some of Kauffman's recommended metrics were too difficult to collect for more rural regions.

While the table below highlights metrics that were identified specifically using SME or IDE feedback, the measure may still have relevance to other entrepreneurial types. Moreover, the table highlights many more IDE specific metrics than SME, mostly because IDEs cited using a more diverse set of entrepreneurial ecosystem resources and they more readily articulated their need for specific metrics. Go to Appendix B and C for definitions of these metrics, whether they might pertain more to certain entrepreneurial or business types, and where to collect them.

Table 4. Identified Ecosystem Metrics for Roanoke-Blacksburg Region

	Density	**Fluidity**	**Connectivity**	**Diversity**
Definition	*Relative density of entrepreneurship and resources*	*The accessibility and easy flow of assets*	*Connections among elements: programs, companies, individuals*	*An assortment of economic specializations, people and opportunities*
Inputs	Resources contributing to firm growth: Finance, Support, Policy, Markets, Human Capital, Infrastructure, Research & Development, and Culture			
	- *Workforce education levels* - *Incubator, accelerator, and coworking spaces per 100,000 people** ***Identified by SMEs*** - *Broadband density*	- *Labor market reallocation* - *Net migration* - *Entrepreneur perception survey – access and quality of resources** ***Identified by IDEs*** - *Funding availability and # of deals** - *University licensing to regional companies**	- *Transportation infrastructure* - *Program connectivity** - *Number of networking events in area annually** ***Identified by IDEs*** - *Net knowledge worker migration or brain drain*	- *Inventory of resources (map showing geographic diversity)** - *# of new migrants and immigrants* - *Racial make-up*
Outputs	Development of the ecosystem: Businesses, Employment, Increased interactions among EE actors			
	- *Startup density* ***Identified by SMEs*** - *Employment share of locally-owned businesses* ***Identified by IDEs*** - *Employment share of new and young firms*	- *Business churn (births/deaths)* ***Identified by IDEs*** - *# and $ or regional exits** - *Number of students involved in regional startups** - *Number of high growth firms (HGF)*	- *# of startups coming out of entrepreneurial programs** ***Identified by IDEs*** - *Rate of university startups** - *Spinoff rate**	- *Industry diversity and specialization*
Outcomes	Macroeconomic indicators illustrating overall regional prosperity and quality of life: GDP, Unemployment Rate, Income Inequality, Median Household Income, Job Growth, Cost of Living			

* Indicates metrics that would require primary data collection

Of course, our identified metrics focus on one case study, and additional metrics may be added over time to address other regional interests as they arise. Other regions may identify other metrics with which stakeholders are more concerned. This case, however, illustrates an approach for identifying those metrics and offers tools for collecting those metrics moving forward. A proposed survey for entrepreneurs with questions to capture metrics is in Appendix D. Metrics that can be collected through resource providers and approaches to collecting those metrics is in Appendix E.

Implications for Policy and Practice

While our study focused on one case, a number of the findings and questions raised suggest implications for policy and practice related to understanding and strengthening a region's entrepreneurial climate and context more broadly. For policy makers and development practitioners interested in advancing regional entrepreneurship, we identify three core possible lessons or takeaways, described below in more detail: adopt indicators or inventories; develop and promote entrepreneurial resources appropriate for different types and stages of entrepreneur; and create and nurture an entrepreneurial climate of encouragement and inclusion.

1. Adopt indicators and inventories

Perceptions of a region's entrepreneurial climate will vary. Those perceptions will differ depending on individual conceptions of entrepreneurship, of a region or of success. Our respondents described the same ecosystem in widely varying ways. While the region has an overall context or climate, how an entrepreneur views the ecosystem differed based on their geography (city, county, town, or even neighborhood where their enterprise is located) and/or their business type (technology entrepreneur versus retail store, for instance).

Region wide efforts to strengthen entrepreneurship benefit from the collection and monitoring of specific measures, or indicators, which can help track and improve outcomes over time. These types of metrics help shift the perspective from anecdotal to analytical. Maps, and visual data tools, to depict connections among a region's entrepreneurs and resource entities can also help illuminate and communicate the nature of relationships and interactions.

Some data is readily available through existing sources, but other types of valuable information may only be gleaned from primary data collection such as entrepreneur surveys. However, such surveys may be resource intensive and somewhat costly. Our own experiences with surveying for this project suggest the difficulty of this task but also emphasize for us how important that data can be. Providers, practitioners, and policymakers should consider investing time and resources in annual or biannual data collection from entrepreneurs and resource providers, and explore ways to maximize resources, data tools, and returns for these activities.

In addition, a common refrain from respondents in our study concerned the low levels of awareness concerning available resources and the need for an inventory of ecosystem resources. Some regions have done this well, and SBDCs or other entities develop resource guides that may be helpful to aspiring entrepreneurs. Too often, however, these types of resource inventories are incomplete, sporadically updated, or not widely distributed and available across the region. Developing a comprehensive regional inventory of entrepreneurial support resources is an important step to understanding a region's ecosystem, sharing resources, and identifying potential gaps and overlaps.

2. Develop and promote entrepreneurial resources appropriate for different types and stages of entrepreneurs

Entrepreneurs in a particular region, or ecosystem, have different needs and different access to resource and support. While some efforts focus on a particular type of firm, or startup, such as high growth or technology entrepreneurs; there appears to be less focus on maximizing support across the full spectrum of entrepreneurial activities, types, and stages in a location.

As one example, our interviews suggest that the Roanoke-Blacksburg region has established a fairly strong supportive environment for technology-related early-stage startups as well as a good environment for mid-size, established technology companies that are not in a high-growth stage. As a number of our respondents suggested, networking and investment resources are present for those with the ability and initiative to seek out and participate in networking opportunities or core "nodes" or access points for resources such as a coworking space. Beyond the physical space provided, locations such as Grandin CoLab or the HIVE, or RBTC membership and event participation, serve as gateways to locating and accessing the wider range of ecosystem resources ranging from knowledgeable patent attorneys to experienced business mentors. The RBTC, for instance, actively promotes and communicates programs and events throughout the Roanoke-Blacksburg region. Technology-related entrepreneurs seem to be very aware of those opportunities.

Yet, many respondents in the region, indicated that SMEs had fewer such "gateways" and networking opportunities. Main street oriented businesses and startups lack the same type of region-wide awareness regarding opportunities and resources. Small to mid-sized enterprises (SMEs), or "main street" businesses, sometimes use a coworking space as a gateway, or access the Small Business Development Center as their entry point into ecosystem resources, but several small business owners we spoke with in the New River Valley were unaware of the Small Business Development Center and its functions. While there are a number of business associations and chambers of commerce, the events and programs are more limited and uneven across the region, and often most promoted to and attended by only their members.

In some cases, the focus of resources and economic development strategy on high-growth potential entrepreneurs is intentional (see the literature on economic gardening, for instance). Regardless of the validity of that approach, a robust ecosystem contains a range of business types and ongoing startup activities across varied kinds of enterprises. In regions with a large presence of rural locations that are

actively adopting asset-based development approaches, as well as in more urban locations that are cultivating neighborhood-focused development, there is a critical need to better support SMEs. SMEs contribute to the amenities and quality of life characteristics that undergird other development activities (company and talent attraction and retention, for instance).

An over-focus on IDEs, then, can be detrimental if it results in a lack of resources and attention to other businesses, such as restaurants, retail, food-based business, and services. SMEs often benefit from the same networking opportunities, access to experienced mentors, and other resources that IDEs more readily enjoy. The same can be said about an overemphasis on one particular entrepreneurial stage (i.e. early or late) or one particular type of business (i.e. food-based or artisan businesses) within a given ecosystem. Therefore, it is important that ecosystem inventories or resource maps, described above, should intentionally include resources of relevance to entrepreneurs at different stages and levels, as well as specialized resources for specific kinds of businesses

Respondents in the Roanoke MSA also referenced a relatively low level of support for scaling up ventures, particularly high potential IDEs. The business accelerator project in Roanoke, the recent development of multiple regional venture and investment funds, and expansion of the Virginia Tech Corporate Research Center and VT-Carilion Research Institute are all, in part, efforts that respond to this need. Respondents also suggested the importance of identifying and making more widely available a larger pool of experienced IDE mentors. There are a number of IDE success-stories in the region, but the tendency is to focus mentoring efforts on the few most successful, or most engaged, entrepreneurs. This creates a challenge in terms of the talent or resource pool. Our interviewees suggested documenting more success stories, and engaging a deeper pool of possible mentors, as their assistance to IDE scale-up has been repeatedly cited as among the most valuable and useful resources.

3. Create and nurture an entrepreneurial climate of encouragement and inclusion

A recurring theme in our study concerned whether or not entrepreneurs perceived the region as a great place to start and grow a business. Both entrepreneurs and resource providers referred to an aspirational goal of making the region the best possible place for entrepreneurs.

In general, this study illuminated a perceptions gap: entrepreneurs who accessed resources through the SBDC or coworking space, or who participated in RBTC or other networking activities, tended to describe the region's resources as more robust and accessible than those entrepreneurs who did not avail themselves of these resources and opportunities. While this perception gap is not necessarily surprising, what was more surprising were the many entrepreneurs who simply were unaware of services, or even more concerning, felt that the resources were less accessible to certain populations.

As one example, the city of Roanoke has a sizable minority population and growing international population who have not yet connected to many of the formal services and opportunities available within the ecosystem. While these immigrants and minority-owned small businesses have been on the rise in

recent years, they are often congregated in a small number of neighborhoods within the city and do not as frequently connect with other entrepreneurs outside of their community. One limitation of our study was the low level of responsiveness from these entrepreneurs in our survey. We did speak with several respondents who work with minority-owned enterprises, and as reported to us, the outreach efforts to engage those business owners and to support their startup and growth was very minimal. This is not necessarily an indictment of the support organizations, and their personnel. Indeed, the SBDC in Roanoke is very active as is the Roanoke Chamber, which has established a committee to support international small-business owners.

Instead, the critique suggests an opportunity in Roanoke: entrepreneurship represents a job creation opportunity, one that resonates with many newer regional residents who have an entrepreneurial mindset. Some of these residents are able to start and operate businesses with a nominal amount of support from resource entities, but others may struggle, perhaps unnecessarily, as resources and opportunities remain unknown or inaccessible to them. The potential here is for stronger growth, enhanced profits, better likelihood of longer-term viability, and even more startups if a more intentional set of diverse resources were available. Many resource organizations are either membership-driven or reactionary, in that they serve members or they serve those who actively seek them out. A strong entrepreneurial climate requires a more extensive portfolio of proactive approaches to engagement, development, and inclusion.

This is also true for existing SME businesses across the board. There is little concentrated focus on small business retention, expansion, and transition. Many established small businesses close, simply due to owner retirement, declining interest, or the owner's pursuit of alternative opportunities. If a portion of those businesses could be successfully transferred to new owners, with supports in place to encourage knowledge-sharing and even financial incentives or support for new owners, then the result would be job retention, business retention, and support for newer cadres of entrepreneurs.

An entrepreneurial climate of encouragement and inclusion also requires better alignment across local governments and agencies in order to alleviate barriers to small business startups and growth. More than one small business owner described local government officials as unhelpful. Often these descriptions were of encounters with specific officials in a regulatory or zoning capacity. The descriptions also suggested the lack of a central point of contact, or even of a lack of a welcoming and helpful environment, for small business owners in search of assistance or attempting to navigate requirements. Local and regional economic development officials and others are advocates for business, but the need appears to exist to improve the experiences of small business owners in their interactions with local government officials. It should be noted that we did not speak with business owners in every locality and some of the comments were specific to a town or municipality where that owner was located as opposed to the region as a whole. Still, some local governments have identified small business liaisons to help business owners or have provided training or other efforts to improve the local entrepreneurial climate. This appears to be a need and an area of opportunity for more focus.

APPENDICES

Appendix A: Case Study Methods

Surveys. The research team disseminated the online survey through regional resource providers: chambers of commerce, business associations, service organizations and those we interviewed. At least 20 providers confirmed that they distributed the survey link to their partners or contact lists one or more times between April and July 2016. Through intercept and phone surveys, we also reached out to minority businesses.

We received 146 survey responses. Of the 94 completed surveys, we classified 82 surveys as completed by entrepreneurs. Only 51 respondents considered themselves an "entrepreneur", while 31 respondents were classified as maybe. Those classified as "maybe" either argued the term is overused, indicated that they have not created any new technological product but provide a service or product with a twist, or identify more with "small business owner". They may have also left the question blank, but could be considered an entrepreneur based on their product description and type of business.

To explore the difference between entrepreneurs and their respective needs, the research team distinguished between the small and medium enterprise (SME) and the innovation-driven "gazelle" (IDE) entrepreneurs. Respondents in the survey and in the interviews often framed this difference as main street versus high growth businesses. The survey asked the following questions to distinguish between these groups:

- Are your customers mostly local/region, or are they from outside the region?
- Are your employees mostly local or within the region? Or is geographic proximity not an issue and employees can operate anywhere?
- Does your business rely on an innovative technology, process or business model?
- What is your business' ownership and funding structure?
- Does surplus revenue go into business operations or into additional R&D?; and
- Describe the product or service of your business.

Of the determined 82 entrepreneurs who filled out the survey, we classified 51 as SME entrepreneurs and 31 as IDE entrepreneurs. Responses varied, however. Several SMEs claimed an innovative twist on their products or services that made them successful, or were IT-related and so did not need their employees to be geographically based; they did, however, mostly serve this region in a supportive services capacity. Still others sell outside the region, but they did not claim any innovative product or service. They saw themselves as more traditional small- to medium-sized businesses. IDE entrepreneurs differed on funding. Only four of the 31 IDE entrepreneurs cited receiving angel or venture capital funding. The rest had not received funding, with half conveying their inability to reinvest any money into R&D as a result.

Interviews. Our preliminary list of interviewees was culled from members of the Roanoke-Blacksburg Tech Council (RBTC), local and county governments, Regional Commissions such as the Roanoke Regional

Partnership, Chambers of Commerce and the Virginia Tech Corporate Research Center. Additional interview subjects were identified through snowball sampling. We conducted a total of 22 interviews and four focus groups between April and June, 2016. Of the 44 respondents interviewed, 27 were entrepreneurial resource providers and 17 were entrepreneurs working within the region. All interviews followed a standardized protocol that allowed for interviewer flexibility in pursuing follow-up queries or unexpected directions.

The interview protocol varied by group. *Resource providers* were asked about what it means to be an entrepreneur, the state of the region's entrepreneurial ecosystem (including its strengths and weaknesses), the nature of entrepreneurs within the region and if that has changed over time, whether there is an entrepreneurial network within the region and what it might look like, and the degree to which there are services available for entrepreneurs of all types within the region. *Entrepreneur*s were asked about their own enterprise and how it started, what it is like to be an entrepreneur within the region (including available resources, challenges, and day-to-day operations), if and how they network with other regional entrepreneurs, and the extent to which they utilize technology to innovate their business. All interviews ended with a discussion of metrics and recommendations for other actors to interview.

While the interviews themselves provided basic information about ecosystem stakeholders, interview coding allowed us to obtain a more detailed understanding of the entrepreneurial environment, including local perceptions of vibrancy and measurement methodology. The personal accounts undoubtedly vary, but common themes emerged across interviews and across team members' axial memos.

Social Network Analysis. To visualize this analysis, we used Gephi, free network visualization software.[26] This software allows the user to statistically analyze relationships between different nodes, or in this case relationships among entrepreneurial ecosystem organizations, businesses, and individuals. For instance, different centrality analyses can distinguish nodes (EE actors) that are most vital to the network; either they have the most connections with other nodes (*degree centrality*), they serve as an important bridge among different EE actors in the network (*betweenness centrality*), or their connection with other well-connected EE actors amplifies their essential role in the network (*eigenvector centrality or PageRank)*. Another type of analysis, modularity, identifies communities within the network based on their more densely connected nodes. In other words, the EE actors in these communities interact more closely than with the rest of the network.[27]

The research team identified three relatively feasible types of social network analyses that a region might conduct to understand better its ecosystem. Each has its own data source:

1) A Twitter analysis where nodes are connected based on number of followers. Data is "scraped" from the Twitter API;

[26] Gephi (2016). Gephi: the open graph viz platform [computer software]. https://gephi.org/
[27] GrandJean, Martin (2015). Gephi -- Introduction to Network Analysis and Visualization. http://www.martingrandjean.ch/gephi-introduction/

2) An analysis of entrepreneur surveys illustrating entrepreneur's use of different resource providers and how these providers are connected through entrepreneurs. The entrepreneur survey is found in Appendix D. Surveys can be set out through service provider listservs, collected during networking events or collected in-person or over the phone if time and resources permit.
3) An analysis of EE program connectivity based on a resource provider survey asking entrepreneurial resource providers how they interact with one another. The resource provider survey is found in Appendix E. One should create an initial resource provider inventory and perhaps add to that inventory through interviews to create a survey pool.

Appendix B: Metrics Descriptions

Below is a list a metrics, their descriptions and possible places to find them. We organize them according to the Kauffman Foundation's four indicators and how they pertain more to the regional population, businesses and particular resources. We recommend secondary sources and primary data gathering techniques. Those metrics in **Bold** were originally recommended by Kauffman.

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
DIVERSITY			
Inventory of types of funding		To show diversity of funding types available to entrepreneurs, develop a list of available funding and amount of funding available if possible	Requires primary data collection; Monitor business journals and newspapers; Compile list of funding entities and do annual check in of funding in region with government and resource providers
Population			
# of New Migrants/Immigrants		How many new migrants and immigrants have been attracted to the area?	Census American Community Survey (ACS) Resident Population Change; County and MSA level data
Racial Make-Up	SMEs	Breakdown of population by race and ethnicity	Census American Community Survey (ACS)
Income Mobility	Quality of Life	The difference in incomes between a child raised in a low income family vs. a high income family in a given area	Can use the Equality of Opportunity Project (http://www.equality-of-opportunity.org/), but there doesn't seem to be any longitudinal data at this time.
Business			
Industry diversity or specialization	IDEs and SMEs	Identify existing and emerging target industries by total employment, location quotient, competitive effect and overall change over time.	Method 1: Bureau of Labor Statistics QCEW database; Method 2: County Business Patterns; Method 3: EMSI Analyst, JobsEQ or other private labor force analyst tools
Startups by age of entrepreneur	Startups	Number of startups in region and a breakdown of that number by age: 18-24; 25-30; 31-40; 41-50; 51-60; 61-70; 71+	No feasible secondary method found for county or metropolitan areas. IPUMS-CPS may work for larger areas, identifying the metropolitan region and then records where respondents are self-employed under Class of Worker. Otherwise, primary data gathering would be required. Entrepreneur survey

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
DENSITY			
Programs and Infrastructure			
Broadband Density	SMEs	Number of high speed connections per 1,000 households	American Community Survey S2801 and S2802; County-level data
# of mobile networks	SMEs	Number of companies offering cell phone services in region; the quality of the network could be accounted for as well, e.g. signal strength, dropped calls, etc.	National Broadband Map (http://www.broadbandmap.gov)
# of Incubators, Accelerators and Coworking Spaces	IDEs and SMEs	# of spaces for every 100,000 people	Asset Inventory – input from online, government and resource providers
R&D Resources			
Academic R&D Intensity	IDEs	Dollars spent on R&D as percent of total academic expenditures annually	University Outreach
Corporate R&D Intensity	IDEs	Percent of Private Industry Output devoted to Corporate R&D Expenses	Official sources such as Bureau of Economic Analysis and National Science Foundation provide state and national-level data. One county or regional proxy to show levels of R&D occuring in a region could be total economic output by NAICS 5417, Scientific Research and Development Services. The economic census provides "Receipts" by industry. Showing this number as a proportion of regional GDP or total industry "Receipts" could provided a partial sense of total R&D in a region. This would not account for businesses, particularly medium-size businesses, that do R&D internally and do not use the NAICS 5417 code for any of their operations. Proprietary databases such as EMSI ANALYST or JobsEQ may also show from what industries R&D funding are coming.
R&D Intensity	IDEs	Gross expenditure on R&D (private and public) compared to GDP	

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
DENSITY			
Workforce			
STEM Graduates/Population	IDEs	Number of STEM Degrees issued in region as percent of regional population or total graduates	University Outreach
Workforce Education Levels		Breakdown of workforce education levels; Percentage of Workforce (25+ Years Old) with Bachelor's Degree or Higher	Census ACS S2301 Employment Status; MSA and County-level data
High Tech Payroll Share	IDEs	Percent total payroll devoted to high tech employment	Create "High Tech" occupation cluster. One example is COMPTIA's typology of high tech occupations (https://www.comptia.org/resources/it-industry-outlook-2016-final). Then use an LMI database (e.g. state database, EMSI ANALYST, Jobs EQ) to obtain payroll of the high tech industries. Then divide high tech payroll by total industry payroll.
High Tech Export Share	IDEs	High Tech Exports as a percentage of total exports or State GDP (Regional GDP)	Create "High Tech" industry cluster. One example is COMPTIA's typology of high tech industries (https://www.comptia.org/resources/it-industry-outlook-2016-final). Then use an LMI database (e.g. state database, EMSI Analyst, Jobs EQ) to obtain total exports of the high tech industries. Then divide total high tech exports by total regional exports or regional GDP. GDP is only accessible for MSAs, states, etc. (not county-level GDP)
High Tech Employment	IDEs	High Tech Employment as a percentage of total employment	Create "High Tech" occupation cluster. One example is COMPTIA's typology of high tech occupations (https://www.comptia.org/resources/it-industry-outlook-2016-final). Then use an LMI database (e.g. state database, EMSI ANALYST, Jobs EQ) to obtain employment of the high tech industries. Then divide high tech industry employment by total employment.

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
DENSITY			
Workforce			
STEM Workforce Density	IDEs	Science and engineering employment as percent of total employment	Create STEM occupation cluster. Then use an LMI database (e.g. state database, EMSI ANALYST, Jobs EQ) to obtain total STEM occupation employment. Then divide total STEM occupations by total employment.
Employees of Locally-Owned Businesses	Stages 2-3	Because locally owned businesses are often more influential and have stronger connections to the welfare of their localities, show the percent of locally-owned business employees or percent contribution to overall employment.	Youreconomy.org provides the number of people employed by resident businesses, by size of business. "Resident" business is defined as "companies that are either a stand-alone or report to a headquarters in the same state." Go to the Indicator Details under the Resident Businesses tab.
Employment share of new and young firms	Startups	Startups can be considered 5 years old or less. Startup employment as percent of total employment in region.	Method 1: Youreconomy.org shows total number of jobs created by startups and expansion startups (new establishments) over a time period. You can use the startup number to show the annual number of jobs existing due to firms one year old by total employment. Method 2: Census' Business Dynamics Statistics provides longitudinal firm employment data for MSAs, but not counties. You can see employment for firms 0, 1, 2, 3, 4 and 5 years old.
Entrepreneurs			
Rate of New Entrepreneurs		Number of new entrepreneurs in a given month divided by every 100,000 people living in the area. Includes entrepreneurs with incorporated and unincorporated businesses, with or without employees. They should have worked 15 hours or more on their business.	No feasible or statistically significant, secondary method found for data at the county or metropolitan level. IPUMS-CPS may work for larger areas, identifying the metropolitan region and then records where respondents are self-employed under Class of Worker. Otherwise, primary data gathering would be required. Entrepreneur survey or number of participants in programs

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
DENSITY			
Entrepreneurs			
Opportunity Share of Entrepreneurs		Percent of new entrepreneurs coming out of a wage/salaried position (i.e. not unemployed). This can serve as a proxy for higher growth potential as entrepreneurs coming out of unemployment may see entrepreneurship as a necessity and not necessarily focus on the growth potential of the business.	No feasible or statistically significant, secondary method found for data at the county or metropolitan level. IPUMS-CPS may work for larger areas, identifying the metropolitan region and then records where respondents are self-employed under Class of Worker. Otherwise, primary data gathering would be required. Entrepreneur survey
Percent of Business Owners in the Population		The percentage of the U.S. adult population that owns a business as their main job	Method 1: Youreconomy.com provides the raw numbers of locally-owned businesses or ones that report to another business in the same region. As a proxy, take this number of "Resident Businesses" as a percent of all businesses, as a percent of the population, or for every 100,000 people. Method 2: Use County Business Patterns. As a proxy, you could do number of firms in a county as percent of adult population or for every 100,000 people.
Businesses			
# New Establishment/All establishment	Startups	New establishments as a percentage of all establishments	Statistics of U.S. Businesses (SUSB), Employment Change Data tables can provide county-level data on establishment births (# new establishments) and total # of establishments. It also breaks this down by industry. Provides historic data up to 2013 for county- and MSA-level data.
Density of Scale-Ups	Stage 2-3	Number of firms that have successfully scaled up in the last # years by total number of firms. Scaling up can include expanding markets, increasing revenue and adding to existing employment	Entrepreneur survey.

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
DENSITY			
Businesses			
Startup Density	Startups	Number of new firms in the region divided by every # people living in the area. Kauffman defines startups as 5 years old or less and are employing at least one person other than the owner	Method 1: Statistics of U.S. Businesses: Employment Change Data Tables (County and MSA data available for 2013). These tables provide number of establishment births. Take this number and ACS data on total population for the corresponding year to determine Startup Density (# of Startups for every 1,000 people). Method 2: Census' Business Dynamics Statistics provides longitudinal firm data for MSAs, but not counties. You can see number of firms or establishments ages 0, 1, 2, 3, 4 and 5 years. Method 3 (State Level Data): State Labor Market Information may provide quarterly and annual startups, deaths and/or number of establishments on the county level to determine business churn. Virginia, for instance, provides number of startup firms and total firms for 2015 and previous years.
Established Small Business Density	Stage 2-3	Number of established small businesses by every 100,000 people living in the area. Established small businesses are defined as employer firms over the age of five years employing at least one, but less than fifty, employees.	No county level data found. MSA level data can be found through US Census Bureau Business Dynamic Statistics, "Firm Age by Firm Size by MSA Data Tables". Annual data with 2014 being the most recent year. Use corresponding ACS data to determine number of establish small businesses for every 100,000 people.
Survival Rates		Number of firms lasting an n number of years, as a percentage of total firms started in a given year. For example, percent of firms existing after 1 and 5 years.	For MSAs only, Business Dynamics Statistics provides longitudinal data and firm exits data, where a cohort of firms can be followed to see how many last after a certain period of time

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
DENSITY			
Businesses			
Sector Density (new and young firms)	IDEs, Startups	Number of new or young firms within a specific target industry sector as percent of total new or young firms. Alternatively percent of establishments in a certain sector.	Secondary sources either don't provide industry and firm age cross sections of data, or sources (e.g. NETS) are too expensive and/or unreliable to use regularly. Change in number of establishments by industry sector can be measured however, with the caveat that it would be roughly measured according to one or multiple NAICS codes. Method 1: Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) provides quarterly/annual number of establishments by high level industry clusters to 6-digit NAICS codes industries. See QCEW Data Viewer at http://www.bls.gov/cew/. Method 2: Labor market analyst tools such as EMSI ANALYST or JobsEQ provide number of establishments by industry sector.
CONNECTIVITY			
Population and Workforce			
Commuting Data	SMEs	Flow of commuters between regions, commuting time to work, labor shed	American Community Survey provides commuting data such as means of transportation, time travel to work, and place of work. LEHD On-the-map provides visualizations of laborshed, and shows where residents of a certain geography work or where workers of a certain geography live.
Transportation Infrastructure	Quality of Life	Descriptive: Inventory and quality of main transportation infrastructure including airport(s), roads, proximity to other larger regions, connectivity among regional entrepreneur hubs/node (e.g. downtowns)	LEHD On-the-Map, online, government, etc.

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
CONNECTIVITY			
Population and Workforce			
Dealmaker Network	IDEs	Number of connections per dealmaker "node," as well as the links between dealmakers. "Dealmaker" network: Ted Zoller and Maryann Feldman have looked at the role of these "individuals with valuable social capital, who have deep fiduciary ties within regional economies and act in the role of mediating relationships, making connections and facilitating new firm formation."	Can attempt to pull from private databases including Capital IQ. May need primary data collection to create an inventory. Entrepreneur survey and engagement with resource providers
Net Knowledge Worker Migration/Brain Drain	IDEs	Number of people with a Bachelor's Degree or higher migrating into and out of the region	Census ACS S0701 Geographic Mobility by Selected Characteristics in the United State; County-level data
# of student entrepreneurs staying in region		Student entrepreneurs staying in the region may be evidence of connections made in the region and their integration into the entrepreneurial network	University Outreach
# of students involved in startups	IDEs, Startups	Number of students participating in product or business development, internships/externships, or programs partnered with regional startups. Evidence of education institution connectivity with the larger ecosystem	University Outreach
Programs and Infrastructure			
Number of networking events and activities in the area		An inventory or count of number of different networking events held across the region.	Primary data collection either through inventory and/or resource provider survey. Mapping this number geographically can also show where these events are most prominent

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
CONNECTIVITY			
Programs and Infrastructure			
Program Connectivity	SMEs and IDEs	The connectivity between programs and resources for entrepreneurs. One way to approach this metric is through a survey of entrepreneurial resource organizations in the ecosystem. The survey to ask about the organization's engagement with other organizations and the nature of that engagement: e.g. occasional discussions, information sharing, resource sharing, shared programming, etc. To analyze the survey, use social network visualization software such as Gephi to illustrating the strengths, weakness, and gap in connectivity among program and/or organizations. Go to Appendix E	Method 1: Resource Provider Survey to collect data for a social network analysis, illustrating directionality of connections between programs, nature of connections and intensity of connections. Method 2: Entrepreneur Survey to collect data on Entrepreneurs' perceptions of resource and program connectivity. One such analysis could illustrate how programs and resources are connected through entrepreneur participation. Method 3: Social network analysis of Twitter feeds as proxy.
Businesses			
# of startups coming out of entrepreneurial programs	SMEs and IDEs	Individual programs would monitor program participants and their progress, accounting for participants that successfully start a business within the first year. This metric can be modified depending on whether stakeholder wish to see if these businesses succeed beyond the first year or if they begin to employ workers within a designated time period.	Resource Provider Survey/Interviews
University Startups (rate of university start-ups)	Startups	Number of Startups for Regional Universities; Number of University Startups per # residents.	University Outreach

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
CONNECTIVITY			
Businesses			
Spinoff Rate		Genealogy of company creations as new startups relate to existing businesses or institutions.	Primary data collection is most reliable here: entrepreneurial surveys and stakeholder interviews including successful entrepreneurs to understand business' relationship with others. LinkedIn and Twitter can provide an initial scan of these relationships.
# and $ of regional exits	IDEs	Number of regional exits annually, the dollar gains as a result and where those companies go indicates connectivity outside the ecosystem.	Primary data collection through interviews, media and other ecosystem sources
Out-of-Region Markets			
Top Tourism Markets	SMEs	Top origins of visitors from outside the ecosystem. Particularly relevant to service oriented SMEs, identifying regions to mass market products and encourage more visitation	Government input and entrepreneur survey
# of tourists annually	SMEs	Indication of small business reliance on tourism economy	State and regional tourism offices may be able to provide estimates
# of companies selling products online	SMEs, IDEs	Proxy for understanding out-of-region market growth of SME and IDE businesses. Particularly, how many SME entrepreneurs are expanding their markets through online sales?	Entrepreneur survey
% businesses selling products outside the state	IDEs	Proxy to understand out-of-region market growth of SME, but more likely IDE businesses.	Entrepreneur survey

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
FLUIDITY			
Programs and Infrastructure			
Effective Tax Rates in Region	SMEs	What are the tax rates in the region compared to other competitor regions?	Go to state Departments of Taxation for respective peer regions to compare. Entrepreneur survey.
# and types of tax incentives/credits for small businesses	SMEs	Part of asset inventory	State Department of Taxation, Local and regional government
Program participation		# of people in project-based learning, internships/externships and training programs	Resource Provider Survey
# of entrepreneurial events annually	IDEs	Inventory and # of pitch competitions, shark tank style events, startup weekends, hackathons, etc.	Resource Provider Survey
Quality of Program Outcomes	SMEs and IDEs	# of people learning from these programs, # of business plans created, and descriptive characteristics	Pre- and post-tests from programs; Entrepreneurial survey
R&D Resources			
Inventory of Faculty Interested in tech transfer or entrepreneurship	IDEs	Descriptive	University Outreach
SBIR/STTR Grants	IDEs	Number of SBIR and STTR grants issued in the region over the past five years; SBIR/STTR Award Amounts Per Capita	Can use SBIR.gov site -- "Awards Information". Download excel files by state and year. City and zip code data are available for each awardee.
University Licensing	IDEs	Number of University Agreements issued per year and the gross license income in millions; Gross Income per Capita	University Outreach
University Licensing to Regional Companies	IDEs and Stages 2-3	Number of companies licensing research and tech out of university	University Outreach

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
FLUIDITY			
R&D Resources			
Patents	IDEs	Number of patents issued in the region over the past # years	US Patent and Trademark Office, "US State Patenting Breakdown by Regional Component" 2000-2015
R&D Expenditures	IDEs	Amount of expenditures devoted to research and development	Official sources such as BEA and NSF provide state and national-level data. One county or regional proxy to show levels of R&D occurring in a region could be total economic output by NAICS 5417, Scientific Research and Development Services. The economic census provides "Receipts" by industry. Showing this number as a proportion of regional GDP or total industry "Receipts" could provide a partial sense of total R&D in a region. This would not account for businesses, particularly medium-size businesses that do R&D internally and do not use the NAICS 5417 code for any of their operations. Proprietary databases such as EMSI Analyst or JobsEQ may also show from what industries R&D funding are coming.
R&D Expenditures - private	IDEs	How much money does private industry devote to research and development?	
R&D Expenditures-Research Labs	IDEs	How much money do research laboratories devote to R&D Expenditures	
R&D Tax Credits	IDEs	How many approved R&D Tax credits are there in the region over time? What is the amount of R&D expenditure in the region?	Government info
Financial Resources			
Funding availability by stage (research, proof of concept, startup, second stage/scale up)		What kinds and how much funding is available in the region?	Resource provider interviews/survey; Entrepreneur survey
# Venture Capital and Angel Networks (broken down by type)	IDEs	How many venture capital groups or angel groups are there in the region?	Requires primary data collection; Monitor business journals and newspapers; Compile list of funding entities and do annual check in of funding in region; Resource providers and Entrepreneur survey

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
FLUIDITY			
Financial Resources			
$ Investment (Venture, Angel, etc. by Stage); # of deals	IDEs	How much venture capital is available or has been given in the region? Amount of angel investment, venture capital invested by stage of development, and number of venture capital deals by stage	Requires primary data collection; Monitor business journals and newspapers; Compile list of funding entities and do annual check in of funding in region For MSAs and #/$ of Venture Capital: PricewaterhouseCoopers and National Venture Capital Association MoneyTree™ Report, Data: Thomson Reuters & US Census Bureau. http://nvca.org
Venture Growth ($ and #)	IDEs	Has the amount of venture capital data changed in the past few years?	For MSAs and #/$ of Venture Capital: PricewaterhouseCoopers and National Venture Capital Association MoneyTree™ Report, Data: Thomson Reuters & US Census Bureau. http://nvca.org
$ Debt Equity Financing	Stages 2-3	How many companies have engaged in debt equity financing (raising capital by selling bonds, bills or notes)? How much?	Entrepreneur survey
$ Capital Attraction from outside region	IDEs		Entrepreneur survey
Public Sector Investment ($)	SMEs	Amount of public funds invested each year. In VA, those funds could be CIT Gap Funds or Virginia Tobacco Commission R&D Grants	Requires primary data collection; Monitor business journals and newspapers; Check with government entities
$ provided in tax incentive programs	SMEs	How many tax dollars or credits were provided in the region that were devoted to entrepreneurship, R&D, and innovation.	Collect data from local, county and regional government.
Philanthropic Grants in the region (#/$)	SMEs	How much money in grants have philanthropic organizations provided in the region?	Requires primary data collection; Monitor business journals and newspapers; Compile list of funding entities and do annual check in of funding in region
Foundations/Philanthropic orgs. (#)	SMEs	How many foundations and philanthropic organizations that provide support and resources to entrepreneurs are there in the region?	Requires primary data collection; Monitor business journals and newspapers; Compile list of funding entities and do annual check in of funding in region

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
FLUIDITY			
Workforce			
Population Flux; Net Migration		Measure of out-migration and in-migration into the region; Number of People Migrating into region minus those migrating out of the region	Method 1: Internal Revenue Service has county-by-county inflow-outflow migration records by year. Method 2: Census American Community Survey (ACS) Resident Population Change; Community and MSA level data
Labor Market Reallocation		Job reallocation rates (sum of creation and destructions rates/sum of hires and separations)	Method 1: Quarterly Workforce Indicators (QWI) LED Extraction Tool - http://ledextract.ces.census.gov/ - can give you quarterly job creation and destruction or worker hires and separations at the county level; you can show them as percent of employment on a line chart. Method 2: Business Dynamic Statistics provides Reallocation Rate by MSA
PhD Graduates/Earned Doctorates	IDEs	Number of students enrolled in doctorate programs in regional universities	University Outreach
Community College Certificates	Stages 2-3	Number of Community College Certificates awarded by year in the region	Contact Community College System. Most have online databases with certifications offers and number of certificates awarded annually.
# of jobs created annually by startups	Startups		Youreconomy.org provides the number of jobs created annuallly by startups. By clicking "Indicator Details" in the Gained and Lost Dashboards, you'll find numbers for New Startups, Expansions, Closings, Move Outs and more.
R&D Employment/Employment - Private	IDEs	How many R&D workers does private industry employ?	Create R&D occupation cluster then use state LMI data from the state or private databases such as EMSI ANALYST or Jobs EQ

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
FLUIDITY			
Workforce			
R&D Personnel/Employment - Universities	IDEs	Number of R&D Personnel employed by universities in the region	University Outreach; State LMI; EMSI ANALYST/JobsEQ Data
Businesses			
Time to Start a Business	Startups	According to the World Bank: "Time required to start a business is the number of calendar days needed to complete the procedures to legally operate a business. If a procedure can be speeded up at additional cost, the fastest procedure, independent of cost, is chosen." In 2016, the average time to start a business in the U.S. was 5.6 days.	Entrepreneur Survey
Cost of Doing Business		How much does it cost to do business in the region? Can include tax burdens, labor cost, energy costs etc.	Entrepreneur Survey
Business or establishment Churn		Total establishment births and deaths, and expansions and contractions, relative to the total number of firms in a county for all years available; The rate of firm entry and exit relative to the total number of businesses in the state or peer regions	Method 1: Statistics of U.S. Businesses: Employment Change Data Tables (County and MSA data available for 2013, http://www.census.gov). Method 2: Other sources: Small Business Development Center; NETS. Method 3 (State Level Data): State Labor Market Information may provide quarterly and annual startups, deaths and/or number of establishments on the county level to determine business churn. Virginia, for instance, provides number of startup firms and total firms annually (https://data.virginialmi.com)
High Growth Firms: Inc. 5000 Companies	IDEs	Number of Inc. 5000 Fast Growing Firms in the region as proxy for high growth firms	Explore Inc. 5000 site link and apply filter for cities in region: http://www.inc.com/
Inc. 5000 Firm's Revenue growth	IDEs	How much has the Inc. 5000 firm's revenue grown over the past three years?	Explore Inc. 5000 site link and apply filter for cities in region: http://www.inc.com/

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
FLUIDITY			
Businesses			
# of Startups landing in a space	SMEs, Startups	Number of startups who participated in an entrepreneurial program and who rented/bought their own business space in past year	Resource Provider Surveys
# of Startups receiving third party funding	Startups	Number of startups who participated in an entrepreneurial program and who received third party funding (angel, venture, bank, etc.)	Resource Provider Surveys; Entrepreneur survey
# and characteristics of serial entrepreneurs		To better identify and understand serial entrepreneurs in the region, how they have been successful, the resources they've used. This metric is recommended both to understand success of entrepreneurs and to identify mentors in the region.	Entrepreneur Survey
OUTCOMES - Economic Environment			
Unemployment Rate	Quality of Life	Average Unemployment Rate Over the Past Three Years	1) American Community Survey (ACS); 2) Social Explorer (analyzes census data, www.socialexplorer.com); County level data
Gross Domestic Product		The total value of goods produced and services provided in a country during one year	No county-level data. GDP by Metropolitan Area, US Department of Commerce
Growth in Per Capita Personal Income; Per Capita Income	Quality of Life		1) American Community Survey (ACS); 2) Social Explorer (analyzes census data, www.socialexplorer.com); County level data

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
OUTCOMES - Economic Environment			
Income Inequality	Quality of Life	Measure modified in 2015: Income Inequality is the ratio of household income at the 80th percentile to that at the 20th percentile. I other words, when the incomes of all households in a county are listed from highest to lowest, the 80th percentile is the level of income at which only 20% of households have higher incomes, and the 20th percentile is the level of income at which only 20% of households have lower incomes. A higher inequality ratio indicates greater division between the top and bottom ends of the income spectrum.	Method 1: http://www.countyhealthrankings.org/measure/income-inequality. County Health Rankings and Roadmaps provides county income inequality measures based on household income. Using those income numbers and ACS Total Household #s, you may calculated the weighted average and determine an income inequality measure. ACS 2014 5-Year Estimates. Method 2: Using ACS data, calculate the ratio between average and median household income. ACS 2014 5-Year Estimates and 2015 1-Year Estimates. Method 3: Gini Coeffient by County or Metro, ACS Data and SocialExplorer.com
Average Wage	SMEs	Average or median wage in the region	1) American Community Survey; 2) Social Explorer (analyzes census data, www.socialexplorer.com); County level data
Median Household Income	Quality of Life	Median household income in the region	1) American Community Survey; 2) Social Explorer (analyzes census data, www.socialexplorer.com); County level data
Poverty Rate	Quality of Life	Percent of those living below the poverty line	1) American Community Survey; 2) Social Explorer (analyzes census data, www.socialexplorer.com); County level data
Job Growth		The difference or percent change in total number of jobs between two points in time (e.g. 2005-2015). Can also be expressed in a graph showing total jobs over a period of time (annually or quarterly).	1) American Community Survey; 2) Social Explorer (analyzes census data, www.socialexplorer.com); County level data

METRIC	TAGS: Relevance to SMEs, IDEs, etc.	DESCRIPTION OF METRIC	WHERE TO FIND THE METRIC
OUTCOMES - Economic Environment			
Job Growth to Population Growth		The rate of employment growth compared to the rate of population growth. Best presented in a line graph.	Population Growth: Can be found at American Community Survey or Social Explorer. Job Growth: Can be found on Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) or on a state labor market information website.
Cost of Living Index	Quality of Life	Provides the relative cost to the average household within a particular MSA or urban place. More rural places or towns may not participate as the index was designed to embody a more urban lifestyle. Regional participants are expected to provide raw data to C2ER. Those wishing to access the data pay a subscription.	Most cost of living indices are targeted toward urban areas. Rural regions may pull different cost of living measures cited in the C2ER Cost of Living Index to gauge cost of living. Some workforce and economic development tools have their own COL indexes (e.g. EMSI ANALYST and JobsEQ), but at a cost.
StatsAmerica Innovation Index	IDEs	The Innovation Index compares a region or county of your choice to the U.S. for assessing innovation capacity. Use the options below to select by county (or multiple counties that comprise your region), by established region (such as a metropolitan area or Economic Development District), or by state to get all the counties in a state.	StatsAmerica.com - County and MSA level data (YEAR). However, since it is an index, you cannot combine geographies. For example, if you are looking a region made up of several counties, but it is not an MSA, you will have to settle for index numbers for each county or an average.

Appendix C: Metrics Source Locations

The following is a quick reference guide to a set of possible metrics sources reviewed during this research. They are organized in terms of the Kauffman Foundation's four ecosystem indicators – Diversity, Density, Fluidity and Connectivity. Metrics are also organized by inputs, outputs and outcomes of the entrepreneurial ecosystem. Unless stated otherwise, these sources provide county-level data, which allows for metrics collection for more rural regions.

METRICS		Primary Data				Federal Government Websites												Third Party Websites												State Data	
Bold = Kauffman Recommended ( ) = Pertinent to a particular type of entrepreneur or business (IDEs, SMEs, Stages 2-3, Startups)		Entrepreneur Survey	Resource Provider Interviews/Surveys	University Outreach	State/Local Government Data	American Community Survey	County Business Patterns	Business Dynamics Statistics (MSA only)	Statistics of U.S. Businesses	LEHD On-the-map	SBIR.gov	US Patent and Trademark Office	Bureau of Economic Analysis	Bureau of Labor Stats (QCEW)	Quarterly Workforce Indicators	Internal Revenue Services	Community College Database	IPUMS America and CPS	Your Economy	STATS America	EMSI ANALYST Analyst Tool ($)	Social Explorer	County Health Rankings	Inc. 5000	C2ER coli.org	Equality of Opportunity Project	National Venture Capital Assoc.	National Broadband Map	Twitter	Linked In	State LMI Website	Department of Taxation
DIVERSITY – an assortment of economic specializations, people and opportunities																															
Inputs	**# of New Migrants/Immigrants (SMEs)**					X															X										
	Racial Make-Up (SMEs)					X																									
	Income Mobility (Quality of Life)					X																				X					
	Inventory of types of funding		X	X	X																										
	Industry diversification or specialization						X																								
Outp	Startups by age of entrepreneur (Startups)	X																													
	Ratio of high growth to lifestyle businesses	X					X																								
DENSITY – relative density of entrepreneurship and resource																															
Inputs	Broadband Density (SMEs)					X																									
	# of mobile networks (SMEs)																											X			
	# of Incubator, Accelerator, Coworking Spaces		X		X																										
	Academic R&D/GDP (IDEs)			X																											
	Corporate R&D Intensity (IDEs)												X								X										
	R&D Intensity (IDEs)												X								X										
	STEM Graduates/Population (IDEs)			X																											
	Workforce Education Level (Quality of Life)					X																									

METRICS		Primary Data				Federal Government Websites												Third Party Websites												State Data	
Bold = Kauffman Recommended ( ) = Pertinent to a particular type of entrepreneur or business (IDEs, SMEs, Stages 2-3, Startups)		Entrepreneur Survey	Resource Provider Interviews/Surveys	University Outreach	State/Local Government Data	American Community Survey	County Business Patterns	Business Dynamics Statistics (MSA only)	Statistics of U.S. Businesses	LEHD On-the-map	SBIR.gov	US Patent and Trademark Office	Bureau of Economic Analysis	Bureau of Labor Stats (QCEW)	Quarterly Workforce Indicators	Internal Revenue Services	Community College Database	IPUMS America and CPS	Your Economy	STATS America	EMSI ANALYST Analyst Tool ($)	Social Explorer	County Health Rankings	Inc. 5000	C2ER coli.org	Equality of Opportunity Project	National Venture Capital Assoc.	National Broadband Map	Twitter	Linked In	State LMI Website	Department of Taxation
DENSITY (continued) – relative density of entrepreneurship and resource																															
	High Tech Payroll Share (IDEs)																			X										X	
Outputs	High Tech Export Share (IDEs)																			X										X	
	High Tech Employment (IDEs)																			X										X	
	STEM Workforce Density (IDEs)																			X										X	
	Employees of Locally-Owned Businesses (Stages2-3)																		X												
	Employment share of new and young firms (Startups)							X						X					X												
	Rate of New Entrepreneurs	X																													
	Opportunity Share of Entrepreneurs	X																													
	% Business Owners in the Population						X												X												
	# New Establishment/All establishment (Startups)								X																						
	Startup Density (Startups)							X	X																					X	
	Established Small Business Density (Stage 2-3)							X																							
	Density of Scale-Ups (Stage 2-3)	X																													
	Sector Density (Startups, IDEs)													X						X											
	Survival Rates							X																							
CONNECTIVITY – connections among elements: programs, companies, individuals																															
Inputs	Commuting Data (SMEs)					X				X																					
	Transportation Infrastructure (Quality of Life)					X				X																					
	Dealmaker Network (IDEs)	X	X																									X	X		
	Net Knowledge Worker Migration/Brain Drain (IDEs)			X		X																									
	# of student entrepreneurs staying in region			X																											

METRICS		Primary Data				Federal Government Websites												Third Party Websites											State Data	
Bold = Kauffman Recommended ( ) = Pertinent to a particular type of entrepreneur or business (IDEs, SMEs, Stages 2-3, Startups)		Entrepreneur Survey	Resource Provider Interviews/Surveys	University Outreach	State/Local Government Data	American Community Survey	County Business Patterns	Business Dynamics Statistics (MSA only)	Statistics of U.S. Businesses	LEHD On-the-map	SBIR.gov	US Patent and Trademark Office	Bureau of Economic Analysis	Bureau of Labor Stats (QCEW)	Quarterly Workforce Indicators	Internal Revenue Services	Community College Database	IPUMS America and CPS	Your Economy	STATS America	EMSI ANALYST Analyst Tool ($)	Social Explorer	County Health Rankings	Inc. 5000	C2ER coli.org	Equality of Opportunity Project	National Venture Capital Assoc.	National Broadband Map	Twitter	Linked In	State LMI Website	Department of Taxation
CONNECTIVITY (continued) – connections among elements: programs, companies, individuals																														
Inputs	# of students involved in startups (IDEs, Startups)			X																										
	Program Connectivity	X	X																									X	X		
	# of networking events and activities in the area		X		X																										
Outputs	# of startups coming from entrepreneurial programs		X																												
	University Startups (Startups)			X																											
	Spinoff Rate	X	X	X																								X	X		
	# and $ of regional exits (IDEs)	X	X																									X	X		
	Top Tourism Markets (SMEs)	X	X		X																										
	# of tourists annually (SMEs)				X																										
	# of companies selling products online (SMEs, IDEs)	X																													
	% businesses selling products outside the state (IDEs)	X																													
FLUIDITY – the accessibility and easy flow of assets																															
Inputs	Effective Tax Rates compared to peer regions (SMEs)	X																													X
	# and types of tax incentives for businesses (SMEs)	X			X																										X
	Program participation		X																												
	# of entrepreneurial events annually (IDEs)	X	X																												
	Quality of Program Outcomes	X	X																												
	Inventory of faculty interested in tech transfer (IDEs)			X																											
	SBIR/STTR Grants (IDEs)										X																				
	University Licensing (IDEs)			X																											
	University Licensing to Regional Companies (IDEs and Stages 2-3)			X																											

METRICS		Primary Data				Federal Government Websites												Third Party Websites												State Data	
Bold = Kauffman Recommended ( ) = Pertinent to a particular type of entrepreneur or business (IDEs, SMEs, Stages 2-3, Startups)		Entrepreneur Survey	Resource Provider Interviews/Surveys	University Outreach	State/Local Government Data	American Community Survey	County Business Patterns	Business Dynamics Statistics (MSA only)	Statistics of U.S. Businesses	LEHD On-the-map	SBIR.gov	US Patent and Trademark Office	Bureau of Economic Analysis	Bureau of Labor Stats (QCEW)	Quarterly Workforce Indicators	Internal Revenue Services	Community College Database	IPUMS America and CPS	Your Economy	STATS America	EMSI ANALYST Analyst Tool ($)	Social Explorer	County Health Rankings	Inc. 5000	C2ER coli.org	Equality of Opportunity Project	National Venture Capital Assoc.	National Broadband Map	Twitter	Linked In	State LMI Website	Department of Taxation
FLUIDITY (continued) – the accessibility and easy flow of assets																															
Inputs	Patents (IDEs)			X								X																			
	R&D Expenditures (IDEs)												X								X										
	R&D Expenditures - private (IDEs)												X								X										
	R&D Expenditures-Research Labs (IDEs)												X								X										
	R&D Tax Credits (IDEs)				X																										
	Funding availability by stage		X																												
	# Venture Capital and Angel Networks (IDEs)		X																												
	$ Investment; # of deals (IDEs)	X	X																							X					
	Public Sector Investment $ (SMEs)				X																										
	# of foundations and philanthropic orgs		X		X																										
	$ provided in tax incentive programs (SMEs)				X																										
	Venture Growth $/# (IDEs)		X																												
	$ Debt Equity Financing (Stages 2-3)		X																												
	$ Capital Attraction from outside the region (IDEs)	X	X																												
	Population Flux; Net Migration					X										X															
	Labor Market Reallocation							X							X																
	PhD Graduates/Earned Doctorates (IDEs)			X																											
	Community College Certificates (Stages 2-3)			X													X														
Outputs	# of jobs created annually by startups (Startups)																		X												
	R&D Employment/Employment - Private (IDEs)																				X									X	
	R&D Personnel/Employment - Universities (IDEs)			X																	X									X	
	Time to Start a Business (Startups)	X																													

METRICS		Primary Data				Federal Government Websites													Third Party Websites												State Data	
Bold = Kauffman Recommended ( ) = Pertinent to a particular type of entrepreneur or business (IDEs, SMEs, Stages 2-3, Startups)		Entrepreneur Survey	Resource Provider Interviews/Surveys	University Outreach	State/Local Government Data	American Community Survey	County Business Patterns	Business Dynamics Statistics (MSA only)	Statistics of U.S. Businesses	LEHD On-the-map	SBIR.gov	US Patent and Trademark Office	Bureau of Economic Analysis	Bureau of Labor Stats (QCEW)	Quarterly Workforce Indicators	Internal Revenue Services	Community College Database	IPUMS America and CPS	Your Economy	STATS America	EMSI ANALYST Analyst Tool ($)	Social Explorer	County Health Rankings	Inc. 5000	C2ER coli.org	Equality of Opportunity Project	National Venture Capital Assoc.	National Broadband Map	Twitter	Linked In	State LMI Website	Department of Taxation
FLUIDITY (continued) – the accessibility and easy flow of assets																															
Outputs	Cost of Doing Business	X																													
	Business or establishment Churn					X		X	X																					X	
	High Growth Firms: Inc. 5000 Companies (IDEs)																							X							
	# of Startups landing in a space (SMEs, Startups)		X																												
	# of Startups receiving third party funding (Startups)		X																												
	# and characteristics of serial entrepreneurs	X																													
OUTCOMES – macroeconomic statistics related to the success of an ecosystem																															
Outcomes	Unemployment Rate (Quality of Life)					X								X								X									
	Gross Domestic Product												X																		
	Per Capita Income (Quality of Life)					X																X									
	Income Inequality (Quality of Life)					X																X	X								
	Average Wage (SMEs)					X																X									
	Median Household Income (Quality of Life)					X																X									
	Poverty Rate (Quality of Life)					X																X									
	Job Growth					X																X								X	
	Job Growth to Population Growth					X								X								X								X	
	Cost of Living Index (Quality of Life)																				X				X						
	StatsAmerica Innovation Index (IDEs)																			X											
	Violent and Property Crimes																					X									

Appendix D: Entrepreneur Survey Tool

As we discuss in the report and show in the previous appendices, an entrepreneur survey may help to collect and elaborate on certain entrepreneurial ecosystem metrics. Below are a set of survey questions that ecosystem researchers may add, remove or alter in their own entrepreneur survey, depending on the needs of their specific ecosystem. The more you can hone your survey and provide fewer questions, the better.

METRICS/PURPOSE	**SURVEY QUESTIONS**
FIRST, PLEASE TELL US ABOUT YOUR BUSINESS	
Mapping local firms	Where is your business located? What zip code:
Rate of new entrepreneurs. Also whether to classify as "startup"	When did you legally start your business? ❍ Underway ❍ Within the last year ❍ Within the last five years ❍ Other. Please provide year: _____
Understanding the nature of the firm, its industry and product(s). This can help to understand if a firm is more of an IDE or SME.	Which of the statements best describes your business? (Please Select One) ❍ I am working to start a new business that is not yet underway ❍ I own a franchise ❍ I am a student entrepreneur ❍ I own a student-launched business ❍ I own an existing business that I started ❍ I manage a business that was started by an entrepreneur in the region ❍ I do not own or plan to own a business ❍ Other: _____ ❍ I provide services to entrepreneurs/small businesses
	Your business most fits into which industry sector? ❍ Agriculture or Forestry ❍ Manufacturing ❍ Professional and Business Services ❍ Education and Health Services, including healthcare ❍ Leisure and Hospitality ❍ Accommodation and Food Services ❍ Information Services and Telecommunications ❍ Retail ❍ Other Services ❍ Construction ❍ Transportation and Warehousing ❍ Wholesale Trade ❍ Finance, Insurance or Real Estate ❍ Nonprofit and Social Enterprise

	What is your firm's main activity, product or service? (describe)
# of companies selling products online	Do you sell your product or service online? ❍ Yes ❍ No
% businesses selling products outside the state	What percent of your product or service do you sell outside the state/region? ❍ Zero ❍ 0-24% ❍ 25-49% ❍ 50-74% ❍ 75-100%
Top tourism markets	Does your business cater to tourists? ❍ Yes ❍ No If so, these tourists come from what localities/regions? *(provide multiple choice response)*
Ratio of high growth to lifestyle businesses *[IDE: High growth, Startup, Second Stage and Innovative; SME: Main Street, Lifestyle, Startup, Second Stage]*	Which best describes your business (select all that apply): ❍ High growth firm ❍ Main Street firm ❍ Lifestyle firm ❍ Startup firm ❍ Second Stage firm ❍ Reliant on an innovative technology, process or business
To understand size of business, particularly those that are identified as startups	Number of employees of your current business (including yourself) ❍ 1 (1) ❍ 2 (2) ❍ 3 (3) ❍ 4 (4) ❍ 5 (5) ❍ 6-10 (6) ❍ 10-15 (7) ❍ 16-25 (8) ❍ 26-50 (9) ❍ 51-100 (10) ❍ 101-200 (11) ❍ 201+ (12)

Density of Scale-Ups	Has your business "scaled-up" in the past five years? ❍ Yes, we've increased our number of employees ❍ Yes, we've increased our revenue ❍ Yes, we've expanded our market reach ❍ No Would you explain further?
Spinoff Rate	Is your business a spinoff of another business? ❍ Yes ❍ No Has your business resulted in one or more spinoff firms? ❍ Yes ❍ No Explain:
$ Capital Attraction from outside the region	Have you received capital for your business from outside the region? ❍ Yes, Angel Investment(s) ❍ Yes, Venture Capital ❍ Yes, other:_____ ❍ No FOLLOW-UP: How much?
$ Investment and # of deals	Have you received capital for your business from groups in the region? ❍ Yes, Angel Investment(s) ❍ Yes, Venture Capital ❍ Yes, other:_____ ❍ No FOLLOW-UP: How much?
TELL US ABOUT YOUR EXPERIENCE IN THE REGION *(make sure you've specified "region")*	
Time to start a business	On average in the US, it takes 6 days to complete legal procedures to operate a business. In this region, how many days did it take to legally start your business?
Program Connectivity and Quality of Program Outcomes	Within this past year, you have belonged to or used the services of which of the following organizations? How would you rate their quality in terms of usefulness to your business? *Create a matrix that lists the organizations within your entrepreneurial ecosystem you wish to include. Create the following columns:* - *I am a member or have used services* - *Not at all helpful* - *Somewhat helpful* - *Helpful* - *Very helpful*

Quality of Program Outcomes	Would you provide examples of how organizations have been *very helpful* to your business in the past year?
Quality of regional services as perceived by entrepreneurs	Based on your experience in the region, please rate the following entrepreneurial resources (Check all boxes that apply): *Create a matrix that lists all types of service; for example, funding/financing, legal/tax services, incubator/accelerator services, entrepreneurial education programs, business consulting, mentors, technical/subject matter experts, or affordable office space. Create the following columns:* - *Is NOT available* - *Is available, but I have not used* - *Is available, but was NOT USEFUL to my business* - *Is available and was USEFUL to my business* - *I don't know*
# of entrepreneurial events annually – to understand if and what types of entrepreneurs attend these events	In the past year, have you attended any of the following entrepreneurial events? (check all that apply) ❍ Pitch Competition ❍ Shark Tank-style of event ❍ Business Plan Competition ❍ Startup Weekend ❍ A Design-Think Challenge ❍ Entrepreneur Meetups *Choices depend on what is offered in the region and can specifically name events taking place regionally*
# and types of tax incentives for businesses	Has your business used any of the following tax incentives? *From your asset inventory, list state and local tax incentives for business*
Effective tax rates compared to peer regions – a perception metric	Based on your experience and discussions with other entrepreneurs, how do this region's tax rates compare to other regions in the U.S.? ❍ Tax rates are less ❍ Tax rates are greater ❍ Tax rates are similar to other regions Explain:_____
Cost of doing business – this provides a perception metric	Based on your experience and discussions with other entrepreneurs, how does the cost of doing business compare to other regions in the U.S.? ❍ Cost of doing business is less ❍ Cost of doing business is greater ❍ Cost of doing business is similar to other regions Explain:_____

# and $ of regional exits	Within the past year, how many regional exits are you aware of and which companies?
# of Dealmaker Networks	"Dealmakers" are the individuals who mediate relationships, make financial and relationship connections, and serve as mentors in the region. Who are the "Dealmakers" in the region you have met and worked with during the past year?
FINALLY TELL US ABOUT YOURSELF	
Opportunity share of entrepreneurs (Also, take into account previous question asking when did they legally start their business, which will tell you if they are "new entrepreneurs"	What statement(s) best describe you before becoming an entrepreneur or small business owner? ❍ I was a student ❍ I worked full-time at another company ❍ I worked part-time at another company ❍ I was unemployed
# and characteristics of serial entrepreneurs	Number of ventures (if any) you started previously: ❍ None ❍ 1 ❍ 2 ❍ 3-5 ❍ 6 or more
Startups by age of entrepreneur (Also, take into account previous questions identifying respondent as a startup)	Your age: ❍ Less than 18 years ❍ 19-22 years ❍ 22-29 years ❍ 30-40 years ❍ 41-50 years ❍ 51-65 years ❍ 66-75 years ❍ 76+ years
To understand diversity amongst startups and entrepreneurs	Your gender: ❍ Male ❍ Female ❍ Other

	Your race/ethnicity: ❍ Black or African American ❍ White ❍ Hispanic, Latino, or Spanish Origin ❍ Asian ❍ Middle Eastern or North Africa ❍ American Indian or Alaskan Native ❍ Other ❍ Do not wish to respond
	Country of Birth: ❍ United States ❍ Other: (Please Specify) _____

Appendix E: Resource Provider Metrics and Data Collection Methods

Resource providers can contribute to metrics collection in three ways. **First**, resource providers are in regular contact with entrepreneurs and have their ears to the ground of the entrepreneurial ecosystem. As such, they can contribute to a regular inventory of the region's assets. These metrics include:

- # of incubators, accelerators and coworking spaces
- # of Dealmaker Networks
- Spinoff rate
- # and $ of regional exits
- Inventory of type of funds
- Funding availability by stage
- # Venture Capital and Angel Networks
- # of foundations and philanthropic orgs
- Venture Growth $/#
- $ Debt Equity Financing

Interviews with resource providers may help to build the inventory and understand moving forward how the inventory has changed from year to year. This is also a good time to ask where resource providers see strengths and gaps in the ecosystem, particularly as they pertain to different entrepreneur types.

Second, resource providers can coordinate amongst each other to collect similar metrics that they can then aggregate to the regional level. Collective metrics gathering can help resource providers to systematize their own internal evaluation of their programs as well as understand how they function within the whole of the ecosystem. Below are a set of possible program measures that resource providers could collect and aggregate to create a larger ecosystem metric.

Metric	***Possible ways to implement…***
# of networking events and activities in the area	How many networking events and activities does your organizations host annually?
# of entrepreneurial events annually	How many of the following entrepreneurial events does your organization hold annually? ___ Pitch Competitions ___ Startup Weekends ___ Design-Think Challenges ___ Business Plan Competitions ___ Shark Tank Style Events *Etc….*
Quality of program outcomes	Resource providers should decide collectively on a small set of evaluation questions to provide program participants at the end of any activity or program. For instance, how satisfied were you with the content of this program/event?

Program participation	How many people have you served annually (including members)? *With collective metrics gathering, online programs allow resource providers to enter individuals served anonymously and then aggregates for the region so no individual will be double counted across programs. This possible metric gathering technique would work for the following metrics as well.*
# of startups landing in a space	How many of the individuals your program has served, landed an office/work space in the past year?
# of startups receiving third party funding/# of deals	How many of the individuals your program has served, received third party funding in the past year? What type of funding? ❍ Angel ❍ Venture Capital ❍ Bank Loan Etc….
$ Capital Attraction from outside the region/$ Investment	How many of the individuals your program has served, received capital from outside the region? How much?

Several regions are beginning to develop a system of collective metrics gathering. The process is slow. Many organizations have proprietary data concerns and need to see success before buying into such a program. Regions may need to start small, with a handful of resource providers, and grow from there.

Third, a resource provider survey can help to illustrate the ecosystem's network of service providers, for instance, how they interact and opportunities to strengthen network connectivity. The findings from this survey will contribute to the program connectivity metric recommended by the Kauffman Foundation and supported by the many entrepreneur and resource provider interviews done during this research. Components of the survey include:

- A list of resource providers in the region: resource provider respondents would indicate with which organizations they have an established relationship
- A characterization of their relationship with the other organizations: respondents would indicate what kind of relationship they have. In other words, what activities do they engage in with other organizations:
    1) *Information sharing* – regarding programs, upcoming events, organizational changes, best practices, administration, etc.
    2) *Resource sharing* – funding, sponsorship of events, materials, shared staff or volunteers, space, technology, etc.
    3) *Service delivery coordination* – client referrals, outreach, service coordination, case management
    4) *Joint planning* – joint strategic planning, planning of services and activities, programming and events planning

- The degree to which they engage: of the activities they indicate, to what degree of intensity do they engage with these partners:
    1) Low intensity involvement (not an especially important or frequent link)
    2) Moderate intensity involvement (a moderately important or moderately frequent link)
    3) High intensity involvement (on-going interactions or a link that is very important to the respondent's organization)

With an online tool, this survey could have two parts: 1) the first question in which respondents check the organizations with whom they have established relationships and 2) a matrix showing the list of checked organizations, columns showing the four activity types, and drop down menus for each response to indicate the intensity level of the activity. Another paper format could be:

Possible Resource Provider Partners	**Check if you have a relationship**	**If you have a relationship, how would you characterize the intensity of your relationship based on the following activities?** *(1=infrequent link, 2=moderately frequent and important link, 3=on-going interactions where link is important to your organization)*			
		Information Sharing	**Resource Sharing**	**Service Delivery Coordination**	**Joint Planning**
Tech Council	X	3	2	2	
Roanoke Chamber of Commerce	X	1			
Blacksburg Business Incubator	X	3	2	2	2
Wood Rogers Law Firm	X	2			
Radford University					
Grandin Coworking Space	X	3	2	3	3
Pulaski Credit Union					

Using this information and network visualization software (e.g. Gephi), you can create a visualization of the resource provider social network where:

- Nodes are the resource providers and their size indicates their prominence in the network, their number of connections in the network
- Edges are the connections or relationships between the resource providers. Edges are thicker depending on the strength of the relationship, i.e. how they characterized the intensity of their relationship. (See Appendix A)

Your list of resource providers may not be complete considering the amount of organizations at play and in development. Make sure to have a few follow-up questions where respondents can add to the list.