

Promoting the Assessment of University's Innovation and Entrepreneurship Ecosystems

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Abstract

With the aim to empower the market economy, university's Innovation and Entrepreneurship (I&E) Ecosystems setup the first spark for many disrupt innovations to become a reality. To study this interesting phenomenon, standardized metrics are needed to study the growth and impact of university's I&E ecosystems. Metrics can be translated into the university's strengths, weaknesses, opportunities and threats (SWOT) in order to motivate resource distribution and increase intervention impact. Considering a diverse range of publications on this topic, stakeholders have designed a set of metrics which adequately implemented would at least provide a general idea. Although some of the works already done on I&E metrics do provide an effective layout, we recognize the degree of undefined metrics present in most of the literature and the fact that many are case sensitive. With the aim to create a consensus; this work augments on the definition of metrics to enhance standardization and fulfill general needs.

Keywords

Innovation, Entrepreneurship, Ecosystem, Assessment

1. Introduction

Entrepreneurship is an important aspect of most cultures; it is what keeps us relevant in an ever expanding array of technological and economic advances, like the ones we witness today. It has been adopted globally as an economic development strategy. By 2013, over 50% of the working population (120 million individuals) in the U.S. worked in small business, and more than 65% of net new jobs since 1995 were generated by small startup business [1]. It is then no surprise that universities, commonly the centers of development, would take part in such an aspect, particularly due to its potential to increase revenue and help the regional economy grow [2].

Each entrepreneurial ecosystem is unique due to the fact that they all have hundreds of elements interacting in highly complex and peculiar ways [3]. Different metrics to measure the output of these elements come into play at different levels of a university's entrepreneurial development [4]. Measuring where a university does stands as an entrepreneurial institution implies looking at: the institutional and cultural approach to determine if entrepreneurship is at the roots of the university and its community; innovation capacity within the framework to understand the potential of resources and areas for improvement; and finally, the ecosystem impact [2]. With all the effort that is put into the development of an institutions ecosystem this could be considered the most important due that it compiles a list of outputs. Through these, we are able to determine the effectiveness of the university entrepreneurial ecosystem, strengthen the identified areas of opportunity, and explore its impact both within itself and beyond.

Considering a diverse range of publications on this topic, this paper defines a set of metrics that adequately implemented should at least provide a general idea of how efficiently they are achieving their desired result.

2. Metrics on the University I&E Ecosystem

There are over 200 metric definitions to look at for performance indicators that will, in a measurable way, show how entrepreneurship is being driven within the university ecosystem. These metrics are parameters of quantitative assessment aimed at determining whether entrepreneurship is at the core of the university and the variety of resources allocated for it to spread. Metric elements taken for account vary equal in quantity as in content. There is a relatively large spectrum as from where these metrics can be assessed. However, these quantitative assessments must be done all over the ecosystem in order to understand the entrepreneurship uptrend in it. For ease of discussion, the metrics (Figure 1) have been doled out in three main sections outlined below.

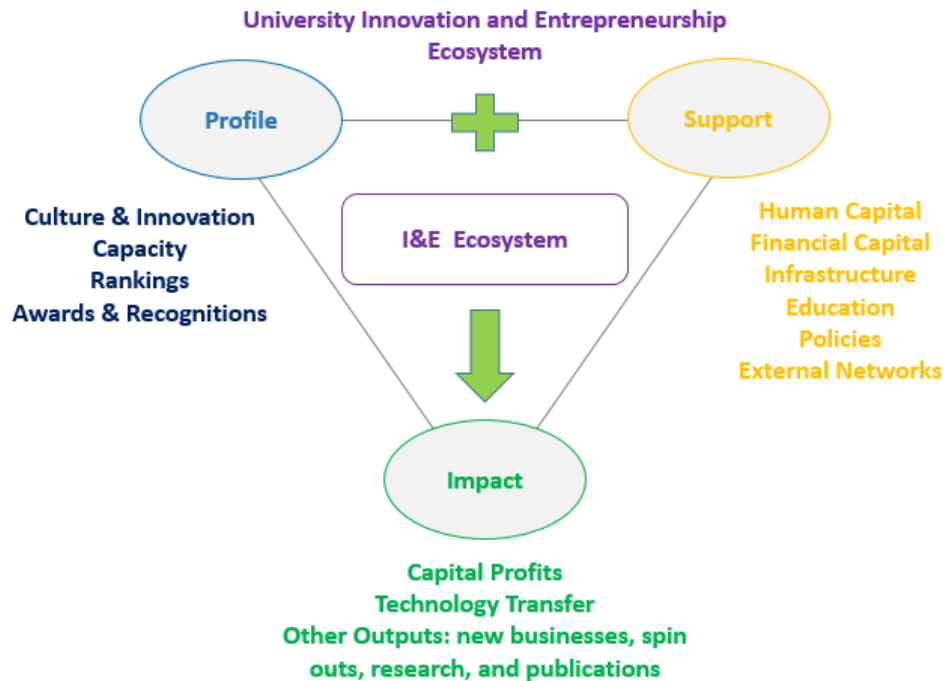


Figure 1: Visual representation of the I&E Ecosystem breakdown

2.1 Support

The student community is supported with a variety of resources and services provided by the University. The development of academic services and programs in universities which strengthen student skills and sense of commitment to the community, while providing valuable knowledge is vital for an I&E institutional support sector [5]. These supports encircles most, if not all, of the I&E courses, seminars, workshops and other types of academic support the institution offers to its community to provide knowledge, skill and motivation to encourage entrepreneurial success in a variety of settings and more challenging educational experiences that will enable them to develop the insight needed to discover and create entrepreneurial ideas [5]. The institutional support, as a whole, can act as an effective institutional strategy. Some effective strategies appeared to be relatively independent of the university size, location and profile. Some examples are approaches where the institutional focus for I&E did not reside within a single group, but was allowed to emerge as multiple, and often unconnected, activities operating across and beyond the campus [2]. The amount of courses and curricular time devoted to I&E and continuous professional development in all disciplines are key input indicators for the efficiency of education and development opportunities in the ecosystem as well as for the quality and awareness of these in the community.

2.1.1 Human Capital

Capital is a type of asset that allows a business to produce revenue or otherwise further its goals, and according to entrepreneurs, one of the most important factors for enabling a company's growth is Human Capital. Human capital is the sum total of a person's knowledge and skills that a company can use to further its goals [6]. It can also referred to talent and employees like experts, leaders, champions, management, etc. Most of the metrics infer probing the degree of management I&E support and the amount of students/alumni exploiting that support. Hence, there are metrics to consider different types of human capital – senior management, students and alumni and organizations.

2.1.2 Financial Capital

Entrepreneurial Finance is such an important aspect of I&E ecosystems that is actually a subject of study in most institutions. It is impossible to achieve long-term and short-term goals without effectively managing finances. Funds are needed for business growth and market competition. Access to finance is a critical factor in the creation and growth of new enterprises at large, which is the main goal of a university entrepreneurial ecosystem. The lack of appropriate funding sources can be a significant challenge for early-stage innovative ventures, like those that are university-based [7]. However, universities have considerably developed and professionalized their support services to staff and students through financial support. This enables the university with hiring workforce, management, produce product, and create infrastructure facilities for I&E. The financial support and investment of the university I&E ecosystem is mainly reflected upon the creation of infrastructure, services, training, and education which are discussed more in depth later on. However, the university sometimes in collaboration with external entities, mostly from the industry, offers to the university's I&E community (alumni, faculties, employees, organizations, etc.) a series of funding opportunities like grants, loans, and endowments that enables the launching of new technology-based ventures within and beyond the university, which will further on, enhance the market economy.

2.1.3 Education

Another way of promoting entrepreneurship and creating the possibility of producing it is through an inevitable certain degree of education and development opportunities offered by the university. These metrics are a framework for the university to use in building objectives, learning activities, and assessments for the targeted audience which are the students, alumni and sometimes even the employee and senior management. These opportunities seek to provide knowledge, skill and motivation to encourage entrepreneurial success in a variety of settings and provide students more challenging educational experiences that will enable them to develop the insight needed to discover and create entrepreneurial ideas [5]. Even some universities are offering majors in entrepreneurship combining management, marketing, finance and accounting with emphasis on business ownership, either of a startup or an existing business. Entrepreneurship education can positively impact a learner at all levels in a wide number of contexts. Hence, whether it is the amount of courses and curricular time dedicated to I&E in all disciplines or the amount of students that combine their degree with work experience (COOP/Internships) in high-tech companies, these metrics are aimed at defining and measuring any effort put on by the university to promote I&E within its educational frame.

Commonly, universities hosts a variety of events; lectures, performances, exhibitions, concerts, readings, film screenings and more, many of which are student planned and handled. These activities are also part of the array of efforts from the university to cultivate an entrepreneurial vibe or atmosphere within its ecosystem and it is important to keep track of all daily entrepreneurial happenings on and around campus and make sure these events are somehow inciting the I&E culture in the students. Definitions under this metric suggest measuring how much exposition, students and management have, to entrepreneurial activity within the ecosystem. Some of these include the percentage of students and employees involved in volunteer I&E activities, or the amount of workshops offered related to I&E. These events are good opportunities to show off talent, enable networking, develop skills, and have professional growth. Hence, it is definitely something to look at when measuring entrepreneurial mindset emergence.

2.1.4 Infrastructure

Entrepreneurial infrastructure includes the facilities and services present within a geographic area which encourage the birth of new ventures and the growth and development of small and medium size enterprises. Well-funded and structured programs that provides capital, markets, support network and business advisory service are part of a robust entrepreneurial infrastructure. This infrastructure helps to develop strong tradition of self-reliance and entrepreneurship which is critical in starting up new ventures which create employment and deliver superior services and products [8]. The entrepreneurial infrastructure of the university should offer every tool and opportunity necessary for students to try their hand at business. Therefore the creation of essential structure that support I&E is needed to train professionals in innovative business management, to give students the opportunity to build teams for specific projects, undergo seminars and trainings, and graduate as owners of private science-intensive companies. Metrics on this type of support aim to measure the dedicated facilities and space for entrepreneurship and even also those that in some way or another enables entrepreneurship among the college community.

2.1.5 Policy

In order to measure the effectiveness of the university regulatory framework is necessary to understand the beliefs and behaviors that determine how the university employees and management interact and handle outside business affairs. Often, this term is implied, not explicitly outlined, and develops naturally over time from the cumulative traits of the people the company hires. Moreover, the same goes as to taking into consideration the rules, terms, and regulations by which the institution, the university in this case, governs itself. Some of the definitions within *Policy* suggest looking at number of institutional policies that support I&E, the strategic vision and mission of the school including entrepreneurship, symbols, norms and traditions that support entrepreneurship and so on. A strand of policy is also a focus on organizations within ecosystems which provide resources to entrepreneurs. This includes finance providers such as banks, angel groups and venture capital firms and also service providers [9]. A key focus is enhancing 'access to finance' by increasing the supply of risk finance [9]. Basically, it comprises every standardize regimentation within the university that supports and promotes entrepreneurship and innovation (I&E).

2.1.6 External Network

This networks represent robust relationships built on trust and mutual benefit between the university and the regional/national I&E community, with a platform for these individuals to play a visible and influential role in university life [2]. As a community begins building a resource network, more support becomes available to starting and growing businesses [4]. Thus, collaboration between academia and industry is increasingly a critical component of efficient, in this case, university innovation systems [10]. Partnerships between universities and industries usually involves financial support for I&E that along the way will enable: other types of support and services (education and training), the generation, acquisition, and adoption of knowledge (innovation and technology transfer), and the promotion of entrepreneurship (start-ups and spin-offs). University and industry collaboration can also expand the relevance of research carried out in public institutions, foster the commercialization of public R&D outcomes, and increase the mobility of labor between public and private sectors [10]. These metrics seek to oversee the growth of external supports like professional service providers, industries, and investors.

In addition, many universities benefit from significant external support for ecosystem development in the form of generous government subsidies and advantageous regional policies [2]. In some cases, it has been observed that these interventions allowed universities to present a highly successful façade that masked an ineffective or very limited I&E contribution by the institution itself. However, experts also highlighted a significant number of cases where regional or government interventions had achieved much more positive and sustainable results [2].

2.2 Profile

A considerable part of metrics seek to have a better understanding of the university's current state and capability to produce entrepreneurship and to enhance an entrepreneurial mindset throughout the whole ecosystem. Thus, is necessary to measure how does the university incites and rewards entrepreneurship. This usually involves measuring what percent of the university community that actually takes advantage of the I&E Support offered university, the level of transfer knowledge and access to resources, the degree in which the university holds award ceremonies for those entrepreneurial-minded, the raking of the university among other of its type, etc. Hence, most of these metric definitions fit under what is define as the university I&E *Culture*. Others are viewed as the *University Rankings, Awards and Recognitions*.

2.2.1 Culture & Innovation Capacity

By definition, an entrepreneurial culture is an environment where someone is motivated to innovate, create and take risks [11]. For a university institution, an entrepreneurial culture is an environment where students are encouraged to come up with new ideas or products. When work and time is dedicated to these activities, it is called entrepreneurship. Institutional I&E culture was almost universally described by experts as an "essential" ingredient of a successful ecosystem [2]. Metrics on *Culture & Innovation Capacity* seek to have an understanding of the current entrepreneurial mindset in the students, management, and even employees, and how often they take part or make use of any I&E support or service offered by the university. That is, attitudes to and participation in entrepreneurial activities by staff and students [2]. Knowing this is important for determining the effectiveness of the university entrepreneurial ecosystem in order to then strengthen the identified areas of opportunity. As one of the experts in MIT Skoltech Initiative stated: "*it is important to measure the climate, the entrepreneurial behavior or intention to do something – how many people inside and outside of the university are capable of working together, how many students are interested in joining entrepreneurship classes – all of these things will tell you where the university is and where they will be going in the future*".

2.2.2 Awards and Recognition

It is essential for universities to recognize the importance of honoring accomplished faculty, staff, students, and community leaders and organizations for significant contributions and achievements in I&E. Appreciation and recognition are major factors that motivate students and employees to work harder and aim higher. Recognition is priceless. It enhances performance and generates greater success [12]. Thus, the I&E ecosystem output will be directly proportional. Few but vital metrics on *Awards and Recognition* seek to quantify the awards given to the I&E community by the university and the rate at which these are given.

2.3 Impact

These metrics are concerned with the impact of the university on the ecosystem. They seek to measure the results of the role played by the university in building external network/relations and capacity (Education and Infrastructure) dedicated to I&E; the key performance metrics used to evaluate the university's entrepreneurial success and the extent to which these are being/will be met; the role played by university vision, policy and senior management in the university's I&E performance; and finally, key functions/individuals/groups (Human Capital) underpinning the university's I&E strengths [2]. In short, it involves every outcome from the I&E support efforts. Through these, we are able to determine the effectiveness of the university entrepreneurial ecosystem and strengthen the identified areas of opportunity. The metrics are divided in three types: *Capital Profits*, *Technology Transfer*, and *Other Outputs*.

2.3.1 Capital Profits

Revenue growth is an evident result of a successful I&E ecosystem. Whether is the financial value of the total sum of new businesses created or simply the annual income of the university itself, there is always an added financial value that comes along with the enhancement of entrepreneurship and innovation in the university. Thus, these metrics seek to quantify the financial profits and/or the revenue growth of the university, new businesses, individual alumni entrepreneurs, and even those of the community.

2.3.2 Technology Transfer

In the academic sector, the process of commercialization — or of bringing technologies to the marketplace — is known as “technology transfer” [13]. It is accomplished by way of licensing intellectual property (IP) to companies that have the resources and ambition to develop and produce the technology for specific applications. In return, universities receive payments (in the form of cash fees and/or equity and/or royalties on earned revenues) for the products or services that were licensed [13]. That is, *technology is typically transferred through a license agreement* in which the university retains ownership of the intellectual property, while the industrial partner obtains conditional rights to use and develop a technology [14]. The income to the university is distributed according to each university's policy, but it includes compensation to inventors and a mechanism for channeling income back into the research programs of the university. The income generated through the licensing of technologies provides an added incentive for universities to carry out technology transfer. The primary motivation, however, has been — and continues to be — the advancement of knowledge and the improvement of the human condition [13]. Moreover, the university obtains recognition and increases its reputation for their research and innovation potential. Industry partners can also reduce the costs incurred during their research and development stage by licensing technology from a university. Another benefit for the university involves using the licensing revenue to support further research and education at the institution [14]. Hence, *Technology Transfer* has directly proportional relation with the I&E support put on the ecosystem. Thus, these metrics seek to measure the degree of *Technology Transfer* generated in the ecosystem; from number of licenses or licensing success rates (number of licenses per year/number of invention disclosures) to the amount of pre-transactional interaction with industry (i.e. engagement that it not directed at securing a contract or license).

2.3.3 Other Outcomes

In addition to the financial profits and the technology transfer that an I&E ecosystem may produce if well-implemented, there are other several highly-important outputs that come along with it like: the creation of new student-led businesses, research technology-based projects, publications, and university spin-out companies. The assessment of measuring these outcomes are of much importance since they form part of the primary goal by large of setting up and supporting a university I&E ecosystem, which is empowering the market economy while improving the society's standard of living.

3. Conclusion

This study has pointed to a simplified and fairly general structure of a university's ecosystem and its areas to be measured seeking the ease of approach from stakeholders to develop, assess, and study the growth and impact of the ecosystem through a standardized index of metrics in a way that is flexible to use as a guide for almost any institution with similar resources. Its aim has been to highlight key performance indicators within the ecosystem associated with I&E and give a strong statement on why they should be measured, in order to provide guidance and support to other universities wishing to make a change towards Entrepreneurship and Innovation.

Acknowledgements

This material is based upon work supported by the Chancellor's Office at the University of Puerto Rico at Mayagüez and the National Science Foundation Pathways to Innovation Program directed by Stanford University and VentureWell. We also recognize Elisha C. Franqui, Paulina T. Jiménez, Marivette Rullán, Nestor Delíz and Diana Torres for their collaboration at early stages of this work.

References

- [1]. Nazar, J. (2013, September). *16 Surprising Statistics about Small Businesses*. Retrieved from <http://www.forbes.com/sites/jasonnazar/2013/09/09/16-surprising-statistics-about-small-businesses/#13e3e8cd3078>
- [2]. Graham, R., Dr. (2014, June). *Creating University-based Entrepreneurial Ecosystems Evidence from Emerging World Leaders*. MIT.
- [3]. Isenberg, D. (2011, May). *Introducing the Entrepreneurship Ecosystem: Four Defining Characteristics*. Retrieved from <http://www.forbes.com/sites/danisenberg/2011/05/25/introducing-the-entrepreneurship-ecosystem-four-defining-characteristics/#4c5e4c5438c4>
- [4]. Meyers, M. (2015, June & July). *Making (and Measuring) an Entrepreneurial Ecosystem*. Retrieved from [http://www.joinsourcelink.com/docs/default-source/research-reports/making-\(and-measuring\)-an-entrepreneurial-ecosystem.pdf?sfvrsn=0](http://www.joinsourcelink.com/docs/default-source/research-reports/making-(and-measuring)-an-entrepreneurial-ecosystem.pdf?sfvrsn=0)
- [5]. Whitton, D., Prof. (2011, May). *The Importance of Academic Service Learning in Universities*. Retrieved from <https://learning21c.wordpress.com/2011/05/01/the-importance-of-academic-service-learning-in-universities/>
- [6]. Grimsley, S. (2016). *What Is Human Capital? - Importance to an Organization*. Retrieved from <http://study.com/academy/lesson/what-is-human-capital-importance-to-an-organization.html>
- [7]. Euro Tech. *Nurturing the Entrepreneurs of Tomorrow - A Contribution of the EuroTech Universities Alliance*. (2015, June). Retrieved from <http://eurotech-universities.eu/wp-content/uploads/2015/06/EuroTechPolicyPaperfinal.pdf>
- [8]. GMRI Capital. (2013, November). *The Importance of Entrepreneurial Infrastructure*. Retrieved from <http://www.herald.co.zw/importance-of-modern-entrepreneurial-infrastructure>
- [9]. Mason, C., Prof., & Brown, R., Dr. (2014, January). *Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship*. Retrieved from <https://www.oecd.org/cfe/leed/Entrepreneurial-ecosystems.pdf>
- [10]. Guimón, J. (2013). *Promoting University-Industry Collaboration in Developing Countries*. Retrieved from http://innovationpolicyplatform.org/sites/default/files/rdf_imported_documents/PromotingUniversityIndustryCollaborationInDevelopingCountries.pdf
- [11]. Reference. *What is an Entrepreneurial Culture?* (2016). Retrieved from <https://www.reference.com/world-view/entrepreneurial-culture-296add28c78989e2>
- [12]. Capobianco, E. (2014, October 9). *Rewards and recognition: two highly effective ways to motivate your employees*. Retrieved from <http://thenextweb.com/entrepreneur/2014/10/09/recognizing-your-employees/>
- [13]. UR Ventures. (2016). *What is Technology Transfer?* Retrieved from <http://www.rochester.edu/ventures/about/what-is-technology-transfer/>
- [14]. Lenagh, A. (2012, December 18). *The Importance of Technology Transfer*. Retrieved from <http://www.unemed.com/blog/the-importance-of-technology-transfer>

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