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How Technology Evolution and Disruption are Defining the World's Entrepreneurial Ecosystems: The Case of Barcelona's Startup Ecosystem

Abstract

This article provides a critical overview of the development process of entrepreneurial ecosystems and the role played by technology and startups within such process. The analysis focus on the characteristics and components of entrepreneurial ecosystems with special attention to startups, as they are the main actors of these ecosystems. The objectives are reached through a critical literature review. Results show the evolution of these ecosystems, and an in-deep analysis of the role played by startups, big companies and governments in such evolution. The knowledge paradox between universities and startups is also taken into account together with the importance of cities in the development of successful entrepreneurial ecosystems. We apply the result of our critical review to the analysis of the case of the Barcelona Ecosystem. Last section is devoted to policy implications for the strengthening of entrepreneurial ecosystems with special reference to the universities and the need for a redesign of technology transfer strategies. Success factors analysis and specific policy recommendations can help to a better understanding and policy planning of entrepreneurial ecosystems.

Keywords: Startups; Entrepreneurial Ecosystems; Innovation Ecosystems; Barcelona

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Received 07 Oct 2019 - Accepted 10 January 2020

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Introduction

Technological change is the most important factor driving economic growth. Technological changes in key sectors of the economy are like a series of explosions that give impetus to future prosperity. These lead sectors guide the economy and provide economic growth. Technology as the engine of economic development has been studied from various points of view. One group of economic theories takes an evolutionary perspective of technological change and economic growth, its main characteristics being neatly summed up as follows: Technology is dynamic, constantly changing, continually improving. New varieties and new options appear relentlessly. Technological change is also considered to be systemic, which means that technology does not appear without provoking change in its environment. New technologies appear in conjunction with the infrastructure required to produce and distribute them: The car needs roads and service stations; Internet has evolved alongside fibre infrastructure. This technological interdependence means that major changes are slow and costly (Archibugi and Simonetti 1998). On the other hand, technological change is also cumulative. What we can do today depends on the actions and decisions taken in the past. Finally, technology, by definition, is synonymous with uncertainty and insecurity.

But there are huge expectations invested in technology, above all in the initial stages of technology, that is, in the so-called emerging technologies. Indeed, expectations are the driving force behind the evolution of current systems. Expectations move the respective actors of technology change, forcing them to act and to attract investors and other economic agents. Such expectations are, in short, “executive” by nature and define the dynamics of the production of technology.

It has been well documented that user adoption of technology traditionally followed an S-shaped curve, as first defined by Rogers (1962). Yet, today, the adoption of certain new technologies evolves practically along a vertical line. Innovative technologies are quickly introduced to the market and are accepted, almost without hesitation, by society. The S-curve today is virtually non-existent (Downes and Nunes 2014). Another way for us to consider it is to time how long it takes for an innovation to be adopted by one hundred million users – and we would find that today it is a mere fraction of the time that was required in the past. The current age is characterised by “big bang” disruptions and by the very rapid pace of innovation adoption and both factors present traditional companies with major challenges (Schmidt and Druehl 2008). It should not be forgotten that the introduction of a new technology in many cases spells the disappearance of existing companies and, sometimes, of entire sectors.

Technology and innovation have tended to concentrate geographically. This spatial component of technology and innovation has been studied from different points of view: Alfred Marshall’s industrial districts, the Italian industrial districts, the French innovative milieu, Porter’s clusters, and local, regional and national innovation systems. The industrial district (Marshall 1920) placed the emphasis on the local division of labour within a sector and on the interaction between the community of workers and a group of firms in the same territorial entity, in order to achieve success in international markets. Porter’s clusters focused on “geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in a particular field that compete but also cooperate” (Porter 1998). Most studies of clusters focus on firms and sectors, including their dynamics. Finally, regional innovation systems (RIS) refer to the

networks and institutions that link together the knowledge-producing centres of a given region, that is, its universities and public research centres, and the innovative firms operating in the same area. These links ensure that knowledge circulates between the different organizations, increasing the region's overall innovation and competitive capacity (Cooke et al. 1997).

The technological characteristics of current times are transforming the dynamics and the focus of the analysis of technology and innovation concentrations. Earlier models of innovation systems are no longer so effective. Today, we need to speak in terms of ecosystems of entrepreneurs or entrepreneurial ecosystems. This is the latest concept to emerge from academia.

Stam and Spigel provided us with a description of the concept of Entrepreneurial Ecosystem. They claim that the approach of the entrepreneurial ecosystem differs from that of the industrial district, the cluster and the innovation system insofar as it is the entrepreneur, rather than the firm, that is at the heart of analysis (Stam and Spigel 2016). Most cluster studies focus on firms and sectors and are concerned with their dynamics. Yet, startups – geared towards high and rapid growth – are not usually included in models of clusters and industrial districts. And although these earlier conceptual frameworks include the role of entrepreneurs, they do not place a specific emphasis on them. Unlike clusters, industrial districts and the literature on innovation systems, entrepreneurial ecosystems place their focus of research very much on the entrepreneur, and not on large, traditional companies or on SMEs. Entrepreneurial ecosystems also concern themselves with the economic and social conditions in which the entrepreneurial process is played out.

In such a framework, the aim of this article is to provide, through a critical literature review, an overview of the development process of entrepreneurial ecosystems and the role played by technology and startups within such process. Firstly, we review the definition of startup, the main economic agent of the entrepreneurial ecosystems. In section two, the concept of individual entrepreneur is broadened in the framework of the development of the ecosystems. Section three deals with the useful indicators to analyse an ecosystem. After that, we discuss the role of traditional firms in this new setting and the new instruments for innovation activities within the startup economy. We conclude our theoretical work with the knowledge paradox and the role played by cities in the development of successful entrepreneurial ecosystems. We apply the result of our critical review to the analysis of the Barcelona Ecosystem. Last section is devoted to policy implications for the strengthening of entrepreneurial ecosystems with special reference to the role played by universities and the need for a redesign of technology transfer strategies.

A new actor: the startup

An entrepreneurial ecosystem can be defined as a set of actors and factors coordinated in such a way that they facilitate “productive entrepreneurship” in a specific territory, where “productive entrepreneurship” is considered as that which results from the success of “ambitious” entrepreneurship (Audretsch 2009). Ambitious entrepreneurs are individuals that seek opportunities by discovering and evaluating new products and services and who exploit them by adding as much value as possible. This type of entrepreneurship has absolutely nothing to do with self-employment nor with those entrepreneurs who simply want to be their own bosses. Ambitious entrepreneurs achieve stronger rates of growth and greater innovation

or internationalization than the average entrepreneur. Ambitious entrepreneurs focus on the performance and success of their businesses and seek rapid growth.

Traditionally, technology has been created in two places: in well-established companies and in public and private research centres (universities, etc.). But, in the last few years, due to the phenomena we have just described – the acceleration of technology change and the expectations placed in technology – a new actor has emerged: the startup. The characteristics of startups are radically different from those of traditional companies. They are linked to high expectations and have specific characteristics. Also, they constitute an explicit value chain, with their own support entities (accelerators, for example), public policies and investors. In each territory, and always centred on a big city, this value chain has generated the entrepreneurial ecosystems.

Startups are firms oriented towards rapid growth. They achieve the velocity with money provided by forms of financing that have no place in traditional companies (business angels, seed capital companies, crowdsourcing platforms, etc.). Entrepreneurs are actively and constantly seeking changes, or making the most appropriate strategic choices as a means of overcoming problems and influences that the ventures face, leading to business success (Hormiga et al. 2018). Startups represent a high-risk model with considerable turbulence and volatility. Many firms are created but a high percentage perish. They are created by talented individuals that are willing to take risks, an entrepreneurial talent that originates in the main within our universities. And this is a relevant characteristic since the commitment of territories (countries and regions) to promote education and research acquires now sense. The knowledge or innovation paradox that has worried Western societies for three decades has partly been overcome by “ambitious” entrepreneurship (Kijek and Kijek 2019).

Literature review shows that there is no one correct definition of a startup. Each actor in the entrepreneurial system will define a startup in their own way. Yet, at the same time, the concept is perfectly clear and well-defined in the minds of everyone. One of the research results of the seminal Startup genome report (Marmer et al. 2011) was that startups are temporary organizations designed to scale into large companies. This report defends that:

- Startups evolve through discrete stages of development. Each stage can be measured with specific milestones and thresholds.
- There are different types of startups. Each type evolves through the developmental stages differently.
- Learning is a fundamental unit of progress for startups. More learning should increase chances of success.

Blank and Dorf (2012) believe that a startup is essentially an organization built to search for a repeatable and scalable business model. Graham (2012) argues a startup is a company designed to grow fast but stresses that being newly founded does not make it a startup. It does not have to engage with technology or take venture funding or achieve an exit of some sort. Its essential element is growth. Damodaran (2012) says that the value of a startup lies entirely in its future potential. Cheung (2015) claims that a startup is a state of mind. Neil Blumenthal, founder of Warby Parker, notes that a startup is a company that works to solve a problem that does not have an obvious solution and where success is not guaranteed. Dave McClure, founder of the well-known 500 Startups Accelerator, says that it is a company that is confused about what its product is, who its customers are and how to make money. From this approach, when the startup has answers to all three questions, it ceases to be a startup and becomes a traditional business. Eric Ries defines a startup as a human institution designed to deliver a

new product or service under conditions of extreme uncertainty. According to Rahaman (2015) the most important part of Eric Ries' definition is what it omits. It has nothing to do with the size of the company or the sector in which it operates. The objective of a startup is to figure out the right thing to build (as quickly as possible) that customers want and are willing to pay for. People often tend to lose sight of the fact that a startup is not just about a product, a technological breakthrough, or even a brilliant idea. A startup is greater than the sum of its parts and the learning process is an essential unit of progress (Ries 2011).

In short, the fundamental differences between a startup and a traditional company can be summed up as follows: Speed of growth, investment, expectations, exit, disruption, global market, risk, talent, growth process, management techniques and culture. We address each of them in greater detail below.

- The growth of a startup is much faster than that of a traditional firm, which may need decades – generations even – to achieve global leadership.
- To inject this greater speed, startups concentrate their targets in a period of just a few years. This can only be done with money, provided by investors, who acquire shares or equity in the startup. In general, traditional companies do not transfer part of their equity in exchange for the financing of new developments. Projects of this type in traditional companies are financed by “other kinds of money”.
- Investors, in exchange for their funding, want to see evidence of future potential. They have high expectations and faith in a profitable end result.
- This means an exit is the primary focus of investors. This can be achieved by the acquisition of the startup by a large corporation or by being listed on an equity market.

These are the two ways in which investors can get rid of their holdings in the company and obtain a return on their investment.

- To uphold expectations of future growth and attract the interest of corporations, startup products or services (or their proposals for a new business model) must be characterised by elements of disruption.
- Investors also seek a great potential impact. Thus, the market must be the largest possible: global is desirable
- The risk run is much greater in a startup. Traditional, consolidated companies have to be conservative. They can run risks in some projects but, unlike startups, they cannot put the whole company at risk.
- Startups have very different human resource requirements to those of traditional companies. In general, startups are promoted by highly trained people, with a certain personality. Often, all founders and employees share this profile.
- The growth process is different: there are incubators, accelerators, venture builders, etc. that provide startups with support and a specific and almost universal roadmap to growth.
- Startups adopt innovative management practices: Lean Startup, Agile, Design Thinking, etc. Some of these practices are now being exported to traditional companies.
- The different culture is palpable: In startups there are no fixed work schedules, the offices have a characteristic design¹, key personnel receive equity in the company, the entrepreneurs organize and attend events that are very different in format to those of traditional firms.

¹ The unicorn Wework has spread the concept globally.

Beyond the individual entrepreneur: the broadening of the concept

The empowerment of the individual creator has been extended to other areas of economic and social activity, not just that of entrepreneurship, in a process that is completely redefining the shape and organisation of ecosystems as understood until now (Audretsch et al. 2019). From our literature survey, a range of distinct characteristics, as listed below, have their basis in this new perception of the ability of individual entrepreneurs to be disruptive:

- The global circulation of talent, a permanent circulation that opts to wash ashore in the world's most attractive ecosystems and cities.
- Part of this talent is made up of digital nomads, who have created a new way of life, at least at certain moments in their lives.
- It is a talent with a desire to address the great challenges faced by society.
- 'Crowd' concepts – that is, crowdsourcing, crowdsolving, crowdfunding, etc. – originate precisely from this desire to use intelligence and collective resources to address these challenges.
- Social entrepreneurship identifies new channels (the so-called impact entrepreneurship) for solving major challenges.
- Entrepreneurs and ecosystems alike are keenly motivated to address these challenges, be it to fulfil social or economic goals or for market purposes. Thus, we have witnessed a proliferation of such events as hackathons and the like: ideathons, cybathlons, codeathons, startup challenges, etc.
- The challenges have entered the education system, in both schools and universities. These challenges, along with Massive Online Open Courses or MOOCs and other platforms

(that are turning training into a commodity) point to an overhaul of the traditional education system.

- Business schools have also been shaken up by the new context. New talent is not interested in receiving long periods of training. It wants information and immediate training. They seek other forms of the added value that business schools can offer.
- Consultants are also seeking their space in the ecosystems and are beginning to act as a link between traditional companies and startups, as major sources of disruption.
- Entrepreneurship has flattened the world's playing field. Startups can originate anywhere, providing opportunities in environments previously considered complex. Accelerators have been set up to promote such activities².
- Young people in the ecosystem want to be active and to construct. They are more concerned with what they can contribute than with their education. 'Makers' have become key actors of ecosystems.
- Fab labs, coders and co-working and co-living are all expressions of the new context. As is the collaborative economy – sharing – and the emergence of many SaaS business systems and models that supply traditional assets: including, cars, housing, workspaces, etc.
- Highly informal presentation and networking events have little in common with traditional events and conferences. They are programmed as parties; but it is evident that they are effective.
- New management techniques are emerging from startups and are being taken up by traditional companies.

² As an example, many young Africans today have the chance to access this global entrepreneurial dynamic. As an example, the accelerator Fledge invites entrepreneurs from Africa to the Barcelona ecosystem in order to facilitate the growth of its startups.

- And, today, certain technologies of great disruptive potential, such as blockchain, point the way forward and identify the next major opportunities for startup ecosystems.

But the new context also has its perverse effects, generating new types of inequality. Richard Florida (2017) claims that this “new activity”, so highly concentrated in big cities, is leaving other smaller cities behind. At the same time, inequalities are emerging between two “social classes”: those that participate in this phenomenon and those that do not. These are the challenges that the big cities will have to face.

Entrepreneurial ecosystems and startups: towards a definition

Entrepreneurial ecosystems integrate all the actors described above as well as all the phenomena outlined. Arguably, the work of Stam and Spigel (2016; 2018) clearly illustrates these ecosystems from the perspective of startups. They introduce the idea of productive entrepreneurship and relate it to an ambitious, growth-oriented entrepreneurship. From its side the entrepreneurial ecosystems report of the World Economic Forum considers that an entrepreneurial ecosystem can be said to comprise the following eight components (WEF 2013, WEF 2014):

- Accessible markets, both domestic and foreign, with large companies, SMEs and governments as customers.
- Talent and human capital: management talent, technical talent, entrepreneurial company experience, territorial capacity to assume the outsourcing of services, access to immigrant talent.
- Funding: Availability of three Fs (family, friends and fools), angel investors, seed capital, venture capital, access to debt.

- Support system: mentors and advisors, professional services, incubators and accelerators, networks of entrepreneurial peers.
- Regulatory and legal framework and institutional backdrop: ease of creating a business, tax incentives, business-friendly regulations, access to basic infrastructure, access to broadband and telecommunications, access to transport.
- Education and training: available workforce with pre-university and university education, entrepreneur-specific training.
- Major universities of the territory as catalysts promoting a culture of respect for entrepreneurship, playing a key role in idea-formation for new companies and providing graduates for new companies.
- Cultural support: tolerance of risk and failure, social preference for entrepreneurship, success stories, research and technology culture, positive image of entrepreneurship and celebration of innovation.

From a purely economic viewpoint, there are three essential elements making up a startup ecosystem: talent, money and the possibility of achieving an exit, a return on the investment.

Talent is crucial. It is what nurtures the entrepreneurial flow, giving rise to proposals for new initiatives, as well as the necessary scientific and technical personnel to implement them and ensure their growth. In other words, an entrepreneurial ecosystem can be illustrated simply as a box containing entrepreneurial initiatives or startups in different stages of evolution. The box has two main inputs: 1) New ideas, opportunities, business proposals generated by entrepreneurs. These entrepreneurs are willing to dedicate their time to these ideas and proposals; and 2) Money, contributed by investors, who also -like entrepreneurs- assume risk. The box's outputs comprise both the successful and unsuccessful proposals. The unsuccessful

proposals are those that fail to survive and achieve success. But the key to an entrepreneurial ecosystem is to ensure that the entrepreneurs who fail do not give up but try again. Next time round, they do so with more experience and self-confidence, and with more likelihood of achieving success. Repetition is a key element in the ecosystem, both for entrepreneurs and investors. The successful proposals are those that manage to achieve a specific exit, that is, an outcome thanks to which the entrepreneurs and investors monetize the time and money they devoted to the project. The exit can be achieved basically by the acquisition of the startup by a large corporation or by going public on a stock exchange – one, that is, that can guarantee adequate volume and liquidity, which is not currently the case of Spain's Alternative Equity Market. Successful actors (entrepreneurs and investors), in the same way as their unsuccessful counterparts, then reinitiate the whole entrepreneurial process.

From this approach ideas and incipient proposals are converted, with time and money, into economic returns for that city or region. But we are dealing with a high-risk economic process, one of great uncertainty, because the proposals developed by startups are by definition highly innovative and disruptive. But when successful, they can result in rapid change and have the potential for a high return.

Society's acceptance of failure is a result, another output of this process, not an input. Failure analysis has to go beyond the traditional interpretation of entrepreneurial failure (Khelil 2016). When the city or region and its corresponding society understand what this economic process means, they learn to accept that failure is a likely outcome for the entrepreneurs and investors who decide to participate in this ecosystem. Failure is not an input. An ecosystem is not built when society has culturally learnt to accept failure. Rather it is just the reverse. Once an ecosystem is up and running, society gains an awareness of failure. Obviously, this means

the pioneering work involved in the construction of ecosystems (entrepreneurs, investors, etc.) is a thankless task.

An ecosystem learns from experience. When it learns to accept failure and recognises failure as a likely outcome, then failed startups can generate entrepreneurs with more experience, with the desire to try again, but this time with stronger guarantees of success.

The box described above (the ecosystem) is as such an artefact (we should stress, an economic process) that converts ideas, time and money into solid businesses that are sold to other firms (which preferably should be located in the same territory) or which are listed in the equity markets. This artefact, the ecosystem, is made up of various component parts and is responsible for a variety of processes. From our literature review, an entrepreneurial ecosystem can be simplified and broken down into ten components or indicators (Table 1). Those indicators facilitate the comparison of ecosystems.

Table 1. Ten key indicators of an entrepreneurial ecosystem

1. Number of startups in the ecosystem
2. Number of new startups entering the ecosystem each year
3. Volume of investment, from pre-seed to advanced rounds of funding
4. List of the main investment operations
5. Entities that educate entrepreneurs
6. Accelerators, incubators, venture builders, mentors, etc.
7. Specialist consultancy services: patent agents, lawyers specialized in technology, stockbrokers, etc.
8. Actions, events, investment forums
9. Corporate venturing programs
10. Number and volume of Exits (acquisitions or IPOs)

Source: Self elaboration

A global movement

This phenomenon has already become a global movement. These entrepreneurship ecosystems are created from colonies of talent and creativity, from research and innovation. Such a huge number of startups has emerged on the world stage that this boom has been compared to the boom to the “explosion” of biological life that occurred in the Cambrian Period (The Economist 2014). Companies with a high growth potential have penetrated almost every corner of society and for each company from the Industrial Era that has gone into decline or has had to transform itself, we can find one or several emerging businesses to replace them from the new Information Age. Some companies analyse and compare startups ecosystems around the globe. Startup Genome produces a key reference report: “The Global Startup Ecosystem” where they identify the world’s top 30 entrepreneurial ecosystems. But Startup Genome has identified up to 60 highly active startup ecosystems around the world. The movement is well and truly global, and no continent has been left out³. These are today the main places in the world that produce technology through startups.

The traditional firm in this new setting

As the new ecosystems are characterised by technology, disruption and rapid growth, it is not surprising that traditional businesses see startups as an opportunity – yet, at times, also as a threat that must be closely monitored. Indeed, startups have begun to impact these longstanding “traditional businesses”, who have begun to enter into commercial relations with startups, to invest in them and to acquire them.

³ The cities included in the top 30 of the 2019-list of Startup Genome are: New York City, London, Beijing, Boston, Tel Aviv, Los Angeles, Shanghai, Paris, Berlin, Stockholm, Seattle, Toronto-Waterloo, Singapore, Amsterdam, Austin, Chicago, Bangalore, Washington, D.C., San Diego, Denver-Boulder, Lausanne-Bern-Geneva, Sydney, Vancouver, Hong Kong, Atlanta, Barcelona, Dublin, Miami, Munich.

Today, traditional businesses can innovate by taking two paths: The one that has always been distinctive of them, the path that has typically characterised each company and sector, a path that includes the subject of much debate in recent decades: technology transfer and the University-Business relationship; and the path of startups, which is useful for all businesses and sectors (Schaeffer 2015).

In most of the value chains, the customer is not usually the motor of radical technological change. Customers are not usually aware of the potential of a better option; they cannot imagine it. And for reasons of pragmatism, customers do not seek major changes. They value improvements in quality and price. The value chains of many sectors are based precisely on this, improving performance and price of the existing products and services. At the other end of the value chain, the suppliers, although they are often major contributors to incremental innovation, have, in many sectors, only a limited capacity to make radical technology changes. For this reason, it is often the new, small, dynamic firms (the startups, rather than universities or technology centres) that supply the disruptive technologies, generating huge improvements in competitive capacity. These new, small, dynamic firms are created in a quite unplanned mode, from other companies in the sector or alternatively -and mainly- from outside it.

Cooperation between traditional businesses and startups might also be seen from a different perspective: traditional businesses delegate part of the risk of the development of new innovations to startups in open innovation contexts (Huizingh 2011). Biotechnology is the best example here, and one that is now followed and copied in other sectors, resulting in this explosion of startups around the world. Today, most of the new products in the world's pharmaceutical sector originate from biotech companies. As an example, 63% of all new

prescription drugs approved by FDA in the period 2013-2017 are the results of research that stems from biotech start-ups (Geilinger 2018). Pharmaceutical companies seek above all the flexibility and creativity afforded by startups and more and more renounce the risk of developing new products themselves, something they entrust to entrepreneurs and startup investors. Pharmaceutical companies are prepared to pay high prices for biotech and biomed firms. But what they purchase are the successful businesses, those that have successfully passed the development risk filter. Washed up along the way lie the best years of the professional life of many entrepreneurs as well as huge investments in unsuccessful startups. Corporate venturing activities have traditionally been cyclical. For example, in 2004 Dell offloaded their investment portfolio. Other large corporations did the same at that time. But in recent years, the investment activity of large companies has picked up and not just that of the major technology corporations. There are more and more examples of global companies that have adopted this method as they seek to monitor the future – that is, forging relationships with startups through their own incubation and acceleration programs. As we have seen, the pharmaceutical and biotechnology sectors were the ones to initiate these mechanisms. Today we see companies in all sectors that are highly active in Corporate Venturing activities. The investment arms of large corporations do not want to be seen simply as another investor; their goals are quite distinct. Indeed, entrepreneurs know that these “investors” are not the same: Entrepreneurs know that it is not the same to approach a traditional investment company that contributes money to keep the business growing (and which expects an exit in the next years) as it is to approach a corporate fund, which will be less interested in profitability and an exit than in the technological capabilities of the startup.

Corporate funds set themselves various objectives, but their primary concern is identifying and monitoring disruptive innovations and, if considered appropriate, integrating them within the corporation. It is this objective that has led to the massive convergence of these corporate funds with global startups. Many corporations begin as minority investors in the startup, monitoring the small company from within, and then later opt to acquire it. This is the case, for example, of MedImmune and its acquisition of Collective Therapeutics in 2005, as well as Intel and its purchase of Indisys, partly owned by Catalan investors. Lisa Lambert, head of Intel Capital, said that Intel first opted to invest in the startup but after a short time acquired the company. Intel was seeking to cultivate new technologies and plant the seed of new markets that could serve as the destination for Intel's core products. She stressed that the idea was not to control the company, but if it was to Intel's liking then they would buy it.

But how exactly can Corporations benefit from taking this second path to innovation, the path of startups? They can:

- Complement their own products with external innovations from startups.
- Use startups to diversify into areas in which the company does not have great knowledge, with base technologies and markets that differ from those the company is used to.
- Improve their organization.
- Use them as mechanisms for attracting talent.
- Gain contact with specific business opportunities.
- Become immersed in a global ecosystem.
- Have a window and springboard into the future.

Blank (2013), says that large companies once again face the need to make strategic changes – as important as those that 50 years ago saw these companies become multi-divisional, with the aim of meeting the challenges of multiple customer segments, diversified product lines, expanded markets, as well as those of vast geographic distances. Corporations today are obliged to adjust themselves to a new context, characterised by a world that is completely flat and instantaneous, in which both consumers and entrepreneurs are connected. Moreover, the cost of market entry for new companies has plummeted and the speed at which new users and customers can be reached is accelerating. Competition is no longer found solely in local, regional and national markets but it has gone global. Innovation now comes from every corner of the earth and many markets have been completely reimaged. There is a relentless wave of disruptive innovation that not only affects the technology industries. At the same time, disruption is also changing – and destroying – sectors we thought would last forever: energy, healthcare, education, construction, transportation, finance, newspapers, entertainment, etc. Most of the innovation and disruption today are coming from new entrants – young, fearless, and quite unafraid to take on the status quo. The democratisation of entrepreneurship from Silicon Valley and from startup ecosystems around the world is creating new strategies for that disruption and innovation. Following Blank (2013), it is the strategy lessons taught by startups that will light the way for the massive restructuring of corporate structures in the short term. It is becoming increasingly clear that technology entrepreneurship will be the main driver of growth in this new economic era. In short, to date technology has given birth to traditional companies and public research centres, but from here on in startups are being shaped as the third great source of disruption generation.

Years ago, when we spoke of company innovation, a distinction was drawn between the following sources of innovation: Customers, suppliers, specialized company personnel, company executives, fairs and exhibitions, R&D, the firm's production department, its marketing department, the firm's other departments, outside experts and consultants, competition analysis, universities and research centres, patent analysis, congresses and scientific publications, technology centres and laboratories – all of these were the source of ideas for innovation. We have learned that, while everything has its importance, in relation to the above, each sector and each company has sources that predominate over others. To exploit all these sources of innovation, firms have many tools at their disposal, which they have used for years and which they continue to employ: R&D projects, benchmarking studies, quality circles, publication databases, technology consultants, R&D agreements with universities, etc. But things have changed within the so-called “open innovation” strategies (Chesbrough and Bogers 2014). Sources of innovation have expanded, albeit that the previous sources have been maintained. In this new context, companies need to be aware of the new sources of innovation and they must be prepared to use new instruments in their innovation activities. Table 2 sums up a list of main instruments now being widely used.

Startups, universities and the knowledge paradox

If we review the economic growth policies of the western countries in the middle and second half of the last century, we see that the biggest companies occupied a central role: Famously “What's good for General Motors is good for America”. Countries that did not have big companies of their own went to great lengths to attract foreign investment (Atkinson and Lind 2018). Later, the West would commit itself to the so-called knowledge economy, to R&D, universities, and research centres, etc. Europe was to clearly back this model.

Table 2. New instruments for innovation activities within the startup economy

- Setting challenges for schools and universities, using management networks that are already operative on the market. For example, Telanto, a platform created for the Barcelona ecosystem.
- Creating a Corporate Mentoring Program so that a company's management personnel can mentor the young talent of university students. Large technology companies have been using these mechanisms for some time. But it is not restricted to the technology sector, today almost all the big world companies run programs of this type, oriented both to the outside world and their own employees.
- Networks of innovators, including external agents. These networks can be either open or closed and typically target a specific challenge. When open, they can include a wide variety of businesses and institutions.
- Crowdsourcing platforms for open innovation. InnoCentive is a global reference in this field. But today there are an enormous number of proposals on the market that facilitate this activity for businesses.
- Technology transfer platforms, which facilitate access to proprietary technology, frequently from universities and research centres. For example, the Association of University Technology Managers (AUTM) Global Technology Portal, which provides information about the inventions made by the major American universities.
- Use of technology intermediaries, such as Advanced Technology Innovations, Inc.
- Creating your own Open Innovation Portal for soliciting external ideas and proposals. Yet2 promotes and manages initiatives of this type. Examples include the Philip Morris International Idea Submission Portal and the Dupont Technology Bank.
- Running a dedicated Corporate Venturing program.
- Setting challenges for entrepreneurs all over the world.
- Operating one's own incubator-accelerator.
- Using global startup databases to identify initiatives of potential interest.
- Attending some of the world's largest startup fairs.
- Participating in both real and virtual innovation bridges.
- Acting as an investor in crowdfunding platforms.
- Creating one's own startup investment fund.
- Locating some of the business's units in environments (buildings, science parks, co-working places, etc.) where disruption concentrates.
- Using tools such as trend extrapolation and scenario creation to identify alternative future models, exploring their possible threats and opportunities.
- Building – using different techniques and methods – mental bridges in company leaders (board of directors, executives, etc.) between the present and the future.

Source: self-elaboration.

At the same time, globalization shifted the West's manufacturing units to other places around the world, resulting in the loss of jobs. The claim was made that the world's competitive capacity was no longer based on capital but on knowledge. However, Europe and the United States were to encounter unforeseen results from their policies as the following paradox emerged. First Sweden, then the United States and, finally, Europe realised that while they

invested heavily in knowledge, these investments were not being transferred to society. Many scientific publications were being generated but few patents, few products, and little technology. During many years, western societies have sought (and continue to seek) solutions to this paradox. Many resources have been invested in order to create and operate technology transfer structures (offices, science parks, etc.) and the cultural and organizational characteristics of universities have been analysed to detect where the problem lies.

Yet, today there is a strong consensus among academics and politicians alike that entrepreneurship and startups are the very tools that make it possible to exploit this commitment to knowledge. The great investment made in knowledge and in R&D over all these years by western societies (and in recent years, by countries all round the world) has created individuals that are highly versed in science, innovation and technology. But not only that, they are also open, creative, tolerant, well-travelled and experienced. Society has generated people who in turn can generate or recognize ideas and, with entrepreneurship, put them into practice. Ideas are the driving force behind economic activity and in order that people can derive profit from these ideas, they must become entrepreneurs. And as the knowledge resulting from this commitment to universities and research centres is geographically concentrated, entrepreneurship also concentrates geographically in local ecosystems. In other words, when investment is made in knowledge, in R&D, in science, in human capital, etc., its commercialisation tends to occur in fairly close geographical proximity to the sources of knowledge. Entrepreneurship is responsible for knowledge spillovers. When people have access to ideas, they are likely to create businesses near the sources of these ideas. This concept underpins entrepreneurial ecosystems – and it is typical

to speak of entrepreneurial ecosystems being based on powerful ecosystems of talent and creativity, and of research and innovation (Audretsch 2009; Audretsch et al. 2019).

There are two main reasons why universities, research centres and technology hubs play a critical role in the establishment of entrepreneurial ecosystems: First, they provide the foundations on which opportunities can be generated and, second, they afford the appropriate environment and education so that entrepreneurs are motivated to set up their own businesses. Today the role of the University can no longer be limited to the transfer of research results. The mandate of the University in this new *Entrepreneurial Society* is to provide leadership in the creation of entrepreneurial thinking, to motivate actions and consolidate institutions that strengthen entrepreneurial capital. Universities need to inculcate their students in science, innovation and technology and motivate them to identify disruptive opportunities that they can put at society's disposal.

The concept of the *Entrepreneurial University* has been spoken of for years. It was Henry Etzkowitz who perhaps best defined the idea (Etzkowitz 2003). He talked in terms of a revolution of the universities that included fostering the economic development of the territory as its third mission, in addition to teaching and research. For Etzkowitz it was a university that was very much involved with its industrial setting and with the commercialisation of its research results. Audretsch (2014) took the concept and developed it further, stating that Universities should be doing more than transferring patents or creating businesses. What distinguishes an Entrepreneurial University from a University in an Entrepreneurial Society is the scope of its mission. In an Entrepreneurial University, the core competences are not changed. In contrast, in a University in an Entrepreneurial Society, the whole institution has to contribute to the generation of entrepreneurial capital. The distinction

drawn by Audretsch is critical since it places the university system under even greater pressure and justifies the changes that certain institutions will have to make.

Therefore, as we have seen, the regions' commitment to R&D, to their universities and to knowledge, now makes sense. Technology transfer has become of lesser importance. But students must be inculcated in science and technology at these universities so that they can create disruptive startups.

Cities centred on the production of knowledge and the circulation of talent.

Gradually, therefore, we have witnessed the mutation of the idea of the “innovation ecosystem” to that of the “entrepreneurial ecosystem”. Moreover, this change has been accompanied by others that have derived from it. For example, the entrepreneurial ecosystems – much more than was the case of the “former” innovation ecosystems – vie with each other to obtain a good ranking on the global list. Today's rankings – such as that published by Startup Genome – employ a range of metrics to periodically compare entrepreneurial ecosystems, the results of which are then published and disseminated globally. And because these ecosystems are centred on the big cities, reports and classifications of technological and entrepreneurial cities are being produced. As we will see below, in recent years, Barcelona's ecosystem has been recognised as one of the world's most active. This has served to reaffirm the idea expressed by more than one scholar about the relevance of cities, based on the ideas set out by Richard Florida (Florida 2002). Cities are being shaped as the sites of globalization, the points of origin and destination of massive international interconnections. The evolution of these places, the changing nature of our cities, also affects the surrounding territory (Vidaechea and Pareja 2017). The new entrepreneurial classes – the creative classes – that live in the city are increasingly seen as citizens of the world capable of living first in Barcelona

and later in Berlin, New York or Shanghai. Entrepreneurial and creative citizens want to move between the world's cities. Digital nomadism, which has attracted much attention of late, is the extreme case of this willingness to shift location. As a result of this phenomenon – and of the economic wealth that entrepreneurship generates – cities want to take on an increasingly more prominent role in public policies, they want to be able to participate more in the definition of regional and national policies. For example, they want greater autonomy and power in policies governing immigration. The attraction of talent is essential for an ecosystem and each ecosystem needs the necessary leverage to manage and attract this talent. But – as seen – these phenomena also have their negative effects. Cities end up polarizing their citizens, between those who can and those who cannot. Obviously, life in the city is very different for the two groups. The effects of Airbnb, for example, are the same in most big cities around the world. These global cities, with their respective ecosystems, will be, in the words of Thomas Kösters (2017), like popular night clubs: crowded and very expensive. We must be willing to pay a premium to live in a place where things happen, where opportunities are generated. This author also says that smaller cities and towns from the metropolitan areas or the surrounding region need to stay connected and seek to absorb the dynamics of some of these big cities.

The case of Barcelona and the Catalan ecosystem

In 2014, Barcelona received *The European Capital of Innovation Award - iCapital*, in recognition of the healthy position it has carved out for itself within the phenomenon described in this article. Barcelona was ranked eighth among *The World's Best Cities 2018*. The ranking considers 23 factors, in six categories – the '6 Ps': Place, Product, Programming, People, Prosperity and Promotion. In mid-2017, the World Economic Forum listed *The 25*

most high-tech cities in the world, in which Barcelona was ranked 24th, the only city on the European continent located south of Amsterdam to appear on the list. The *Startup Heatmap Europe* asks European entrepreneurs if they had to create their startup afresh where they would go and which ecosystem they consider best to startup in. In the survey for 2017, Barcelona is the third favourite hub in Europe, behind only London and Berlin. Digital nomads, too, express a preference for Barcelona. In January 2018, in a list of 978 dynamic cities around the world published by NomadList, Barcelona was ranked number one by digital nomads. The 2017 edition of the *State of European Tech Report* places Barcelona fourth in terms of the volume of investment received and the fifth in number of operations. In the report *10 things you did not know about Europe's tech scene* focused on the analysis of European businesses that had attracted a minimum investment of 1 million euros that same year (Mohout 2016). The author wielded data of 1,100 operations in 30 countries. On the basis of this, he ranked Barcelona fifth behind London, Berlin, Paris and Stockholm. Milan was ranked tenth. Neither Rome nor Madrid appeared among the top 10 and were left trailing some distance behind (for example, in Barcelona there had been 28 operations of more than 1 million euros while in Madrid just 8). Finally, in the report *Which European cities generate the largest VC returns?* Barcelona's ecosystem occupied top spot (Putz 2016).

In short, Barcelona and Catalonia have succeeded in creating a hub of entrepreneurship, a concentration of technology startups of significant global importance. Some sources report that there are more than 2000 technology startups in the Barcelona and some 30 private accelerators. At the same time, the seed capital invested in 2017 exceeded 600 million euros while the ecosystem's acquisitions and equity market listings (exits) are beginning to be significant, exceeding 500 million euros a year. However, the most remarkable aspect of the

Barcelona hub has been its relatively rapid evolution and its growth dynamics. Catalonia in the nineties, in common with many other Western countries, committed itself to R&D and knowledge. In keeping with the European goal of defeating the productivity paradox and impacting society, the region strove hard to forge the University–Business link: First with R&D contracts, later – at the end of the 90s – with patents and, after 2000, with the so-called spinoffs. Fractus, Oryzon and ScytI, today major global businesses, are the direct result of that period. In parallel with these public actions, Catalan entrepreneurs (with weaker links to the universities) riding the Internet wave originating from Silicon Valley during the 1990s, created numerous startups and have continued to do so over the last few years 25 years. These were the years of companies such as Intercom, which until recently was a leading incubator. Against this backdrop, and complementing the work of Intercom, *Barcelona Activa*, the Barcelona city council incubator, was created in the late 80s and has played a key role as one of Europe’s first incubators. The current ecosystem, therefore, results from two movements: one, a public movement, underpinning Catalonia’s potent biomedical and biotechnology sector and, the other, primarily a private movement, and which enjoys continuity today with the promotion, in general, of ecommerce and the Internet in our ecosystem.

The *Generalitat* manages the Barcelona Catalonia Startup Hub, the map of Catalan startups. This tool has already identified 1,300 startups and continues to grow (ACCIO 2018). The map highlights the enormous weight of ecommerce and the Internet in general, mobile technology, the IoT and big data (Barcelona Catalonia Startup Hub 2018). Other key fields are biotechnology, engineering and energy. Money is fundamental for guaranteeing the growth of those startups. In 2017, 140 investment operations were completed in startups and spinoffs to

the tune of more than 620 million euros, that is, an increase of more than 50% on 2016's figures. In 2018, the amount was close to 1000 million euros.

Two key agents in the process of the creation and growth of startups are the accelerators and venture builders. There are more than thirty in the ecosystem of Barcelona. Also, among other key agents we should mention lawyers, coders and fab labs. Specialized lawyers are crucial players in the ecosystem, given their role in managing investments in startups, mergers and acquisitions and helping companies go public. The leading law firm in this field in Catalonia, and across the whole of Spain for that matter, is Rousaud Costas Duran (RCD). They have been involved in the creation of startups and spinoffs from the very outset of the movement and have an excellent understanding of the processes involved. Subsequently, other firms have joined the field: for example, Metricson, Legal & Tax Meeting, Fornesa, Delvy, Across Legal, Roca Junyent, Emindsetlaw, Bellavista, Cirial180, etc. In short, this is another area in which the ecosystem is now well consolidated. The so-called coder academies supplement the need for programmers. Here, we might highlight Ubiquim, Skylab Coders Academy, Barcelona Code School, Codeworks - Code Cafe, IronhackCoding Academy by Epitech and @scratch_school. Finally, another key element in the ecosystem are the fab labs, makers and co-working spaces, which are now well into their hundreds (Capdevila 2017). Barcelona's ecosystem comprises six initiatives created within the framework of the global network of MIT's Fab Labs: Fab Lab Barcelona, MADE, TestLab21, Green Fab Lab, Tinkerers Fab Lab and Beach Lab Sitges.

Corporate initiatives

We should note that the two paths open to businesses for innovating (the traditional path and the path associated with the new context that we have analysed in previous sections) oblige

the public sector to modify and adapt its innovation policies. Thus, technology transfer between the public research sector and business continues to be an essential area requiring stimulation. But governments must be aware of this second path for innovating, that of startups. The Catalan government – the *Generalitat* – leads the way in Spain and has already adopted clear policies for promoting Corporate Venturing. The *Generalitat* has initiated various programs aimed at fostering this second path of innovation, including, for example, funding that helps traditional firms implement methods for forging relations with startups, and projects that help identify companies that implement these programs in international startups. The agreement signed between the *Generalitat* and the Chamber of Commerce has resulted in various events promoting this concept. As for Corporate Venturing initiatives, in Catalonia today there are more than 30 traditional corporations that work systematically with startups: including, Bayer, Seat, Telefónica, Banco Sabadell, Agbar, Hotusa, Ogilvy, Ficosa, Fluidra, Promaut, Sorigué, Torras, Grupo Z, Open Trends, Suara, Casa Ametller, Grupo Sifu, Zobebe, Vallformosa, Port de Barcelona, CELSA and Sanofi. This number is growing rapidly, given awareness that companies have developed regarding the potential of startups.

Concluding remarks: how can the Catalan ecosystem be strengthened?

An entrepreneurial society is one in which knowledge-based entrepreneurship has been established as a driving force for economic growth and as a generator of employment and competitiveness in global markets. An entrepreneurial society is one that facilitates entrepreneurial economic growth by promoting an institutional context that is favourable to, and which fosters, entrepreneurial activity (Audretsch 2009 and 2014). The example of the Barcelona case analysed with the theoretical framework of this article has been used in order to illustrate the characteristics and the relevance of the entrepreneurial ecosystems and the

role played by technology disruption in the so-called startup economy. Once reached a recognition within the international rankings of an entrepreneurial ecosystem the challenge is how the ecosystem can be nurtured and how it can be strengthened.

The entrepreneurial capital of an economy or a society refers to the institutions, culture and historical context that are conducive to the creation of new businesses. This implies a series of characteristics including society's acceptance of entrepreneurs, that is, of those who are willing to take the risk of creating new companies and of individuals, banks and venture capital firms that are willing to share the associated risks and profits. For this reason, entrepreneurial capital is made up of a set of different legal, institutional and social factors and forces, which when brought together constitute an economy's entrepreneurial capital, which underpins its capacity for entrepreneurial activity.

Innovation and entrepreneurship policies have no political colour. All modern societies, via their states and governments, are committed to strengthening a whole range of areas that make these societies and their corresponding territories competitive in the face of other societies and territories.

A state committed to science, technology, innovation and entrepreneurship as essential factors of economic growth is an Entrepreneurial State. If we take Israel as an example, we can see that in that country startups are part of a powerful economic process. The number of startups (with around 6,000) is three times higher than that in Catalonia and each year the Israelis are creating three times as many startups as the Catalans (c. 1,000 new startups per annum in Israel). The seed and venture capital that these startups receive is also much higher – somewhere in the order of seven times more. There is still a more marked difference in exits with Israel selling technology “encapsulated” in the form of startups for an annual figure of

between 10 and 15 billion dollars, which is somewhere between 10 and 20 times more than the exits produced in the Catalan ecosystem.

Based on the foregoing description of the global context and the current state of the ecosystem, let's assume that Catalonia has set itself the target of becoming one of the world's leaders of disruptive production, based on its emerging technology firms. What can we do to achieve this? What are the policy implications in such scenario?

Investment in Universities and Science

First and foremost, the system needs to be scaled to generate more projects, projects that must be disruptive and have growth potential. Young talent should be in front of new projects. This means this young talent must be inculcated in science, innovation and technology, by targeting students at university, high school and those on vocational training programs, consolidating STEM education, on the understanding that teachers are drivers of change. We also need to consider, from the other end of the entrepreneurial value chain, how investors and entrepreneurs "monetize" their effort and how an exit can be facilitated. But other measures will be necessary, including, the challenges of the so-called "new university" and the ones related to the redesign of technology transfer strategies.

The New University

It has become clear in this analysis that entrepreneurial ecosystems are entirely underpinned by education and research. As such, no country can hope to create a global startup ecosystem without a potent public research system formed by universities, research centres, research hospitals and technology centres fed by the state's corresponding R&D plans and with the capacity to attract international financing for its research.

In 1999, it was said that the universities were having to face a second revolution, one that meant them taking on a new role: namely, that of promoting the economic development of their immediate territory by way of technology transfer and the forging of university-business ties. Over the last 20 years, efforts have been made to construct universities of this type and, overall, the goal has been achieved: our universities have successfully taken on board their three missions. So, how should we now define the University of the future? Universities today face several different challenges. Broadly speaking, two major changes are occurring:

The first is the evolution undertaken by the Universities' third mission. Technology transfer, university science parks, and cooperation with the wider society have led to a model in which—as this article has stressed—individuals have become key elements in innovation disruption and creativity. Students are aware that they are the ones that have to contribute this innovation and disruption and, as such, they demand the means to develop their potential in this regard.

The second change calls into question the Universities' first mission: namely, that of teaching. Global innovative companies no longer place any great value on the certificates issued by universities, accrediting a person's knowledge. Rapid technological and scientific change means that that some University courses are obsolete before the first students enrolled on them graduate. Training today has been universalized via platforms such as *Coursera* that allow access to courses taught by some of the most prestigious universities without having to leave the comfort of your own home. The Khan Academy which began by offering video lectures is today a global platform. Various specialized agents have likewise committed themselves to online training. For example, Barcelona Football Club has set up its *Barça* Innovation Hub, where *Barça Universitas* offers 12 courses in sport: including, a Certificate in Technology and Sciences Applied to Sport, a Certificate of Sports Nutrition and a Master's

in Football Business. Chris Weller (2017) cites the futuristic vision of Thomas Frey who reckons that by 2030 there will be a much more sophisticated and massive version of the present-day MOOCs in operation. But, what's more, the teachers will be robots that personalize the training to meet the needs of each individual student. The current role played by the universities in the dissemination of knowledge hangs very much in the balance.

The University basically comprises spaces, scientists and students. What will happen if students no longer have a need to go to universities to train? Teaching spaces lose any sense they might once have had. What will happen to the University of the future? A possible vision may be the following: Training will be shifted away from the University. Yet, the spaces operated by the University will serve to further the training of these students, allowing them to perfect their knowledge and to specialise in science and technology. How will it achieve this? By making them participants in the University's second mission: namely, that of research. The Universities will be distinguished by the quality and interest of the research projects in which their students participate. The Universities will also have to channel and facilitate the employability and creativity of their students by making them participants of their third mission: namely, the economic development of their immediate territory, by accepting the challenges set by both businesses and institutions. Universities will be distinguished by their ability to develop creativity, innovation and the disruptive capacity of their students. They will also be distinguished by their ability to find suitable companies and institutions in which their students can work and/or their ability to help them create and grow businesses. Therefore, a university, instead of classrooms, should be equipped with laboratories, workshops, co-working spaces, spaces for advanced creation, fab labs, companies and projects in which students (all students) can put into practice what they learn

from the corresponding MOOCs or training pills. At the same time, the University will have to help find work for (all) these students or help them create their own firms based on their creative skills. This type of University will contribute to accelerating the pace of technology.

New technology transfer strategies

When speaking of the two paths followed by traditional businesses, an assertion was made that certainly would not have gone unnoticed. It was claimed that typically it is the new, small, dynamic businesses – the startups – that develop disruptive technologies, “more so than the universities or technology centres”. This is perhaps too bold a claim. But, at the same time, this statement means that the two paths open to traditional firms as they seek to innovate cannot be entirely hermetic and must be linked in some way. In other words, it raises a question of pressing interest for universities and technology centres: how can startups help in the mission of technology transfer? Despite the enormous differences between traditional businesses and startups, the former are better able to forge relations with the latter than they are with a University. The distance between what companies do and what research groups do is so great that some kind of adapter is needed: and this is precisely the role startups can play. Startups allow knowledge to flow and to be channelled along the value chain of public R&D, bringing it into the arena of the market. And this is not solely the case of spin-offs (research-based startups), but all firms created by students. Therefore, in the short term, we shall see actions aimed at strengthening the role of startups as adapters in this process of public transfer. As stressed above, to achieve this inculcating all university students in science and technology is the path that has to be taken.

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