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# Mapping Entrepreneurial Ecosystems: Evidence from Italy

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# Executive summary

This thesis aims to map and identify the Italian entrepreneurial ecosystems. Starting from E. Stam's work "Measuring EE" (2018), where he defines the key elements that help the born and evolution of this kind of systems, we have created a database including these factors and the respective measures that help characterize an entrepreneurial and innovative ecosystem.

After a deep exploration of the literature on entrepreneurial ecosystems and of research based on the development of economic value and growth from the generation of startups, we chose to focus the analysis on the potential presence of these ecosystems in the Italian area.

Important is to say that the analysis that we would carry on is at a provincial level, that means that we follow the Nuts3 codification of the provinces in all the Italian regions. It begins with the analysis the variables, associated to each element, and the evaluation of their influence on the birth rate of technological start-ups in the national territory.

The main purpose was then represented by the search of all the EE and the identification of the characteristics of the relative clusters. Indeed, these can bring together different provinces. So, find how these clusters are composed and what characterize them in relation with the key dimension previously analyzed.

Nowadays there is no literature about the actual presence and number of entrepreneurial ecosystems born in the Italian territory, neither about where did they developed, their characterizing models and how they can be grouped.

The idea is to find where and which extent these ecosystems have; make a ranking of them and, at the end, evaluate the effect of new and high technology on the generation and emergence of startups. To narrow the field of innovations the focus was given on new technology relevant to Artificial Intelligence.

Therefore, we have started from the provinces each region to find entrepreneurial models. That is to say, where did they emerge and what influences their growth and functioning.

Empirically we have tried to determine which dimensions, with their respective measuring variables, impact on the generation and development of entrepreneurial ecosystems' models.

To follow, the steps that have been done to exploit this thesis. Firstly, research has been focused on literature and previous studies on the field of EE, then both qualitative and quantitative analysis methods were applied to achieve the prefixed goal.

In detail, the quantitative analysis was carried out in two subsequent phases: the first phase was mainly based on the search of data from official channels, basically Istat and Eurostat, in order to create the most complete database to work on; while, the second phase was a statistical analysis of the data contained in the aforementioned database.

This analysis was made through the use of one of the most common software used by researchers: STATA, for the execution of a Confirmatory Factor Analysis and Cluster Analysis.

The Factor Analysis was determinant for the evaluation of the best variables to use to explain the main elements (chosen from the literature) that affect entrepreneurial ecosystems. Results confirmed the linkage between the variables and the relative dimension. Indeed, they collapse in one unique factor.

The last step was a Cluster Analysis in order to determine how the different provinces are influenced by each factor, how they can be grouped, and which are the characteristics that had generated this aggregation,

The results obtained show the presence of 7 clusters distributed in the Italian territory. Each of these have different numerosity in terms of number of provinces that constitute them, and specific characteristics that are based on the territorial differences between the respective provinces.

# Index

Acknowledgements ........ 2

Executive summary ........ 3

Introduction ........ 7

1. Entrepreneurial Ecosystems ........ 10

1.1 Birth and Definition of the Entrepreneurial Ecosystem concept ........ 10

1.2 Literature on systems related to innovation and entrepreneurship ........ 13

1.3 Previous Theories: links and differences ........ 14

1.4 What's new about Entrepreneurial Ecosystems? ........ 16

1.5 Characterizing elements and development drivers ........ 18

1.6 Importance of well-functioning and sustainable EE ........ 20

1.7 Generation of an entrepreneurial Ecosystem ........ 24

A. Importance of interactions ........ 24

B. How to build an EE ........ 26

1.8 Technology in Entrepreneurial ecosystems ........ 30

A. New technologies: how do they impact on the generation of entrepreneurial ecosystem 30

B. Born of new types of ecosystems ........ 38

1.9 Research Questions: Trying to cover a literature gap ........ 43

2 Italian ecosystems: Research setting and method ........ 45

Database creation ........ 46

Method and statistic tools ........ 47

2.1 Database creation and data description ........ 48

2.2 Statistic Method and Tools ........ 50

Factor Analysis: Method ........ 50

2.3 Implementation of the Factor Analysis ........ 56

Demand ........ 57

Entrepreneurial Culture ........ 57

Formal Institutions ........ 57

Physical Infrastructure ........ 57

Talent & Human Capital ........ 58

Networks ........ 58

New Knowledge ........ 58

Finance ........ 58

Leadership ........ 58

Support services & intermediaries ........ 59

2.4 Cluster Analysis and Results ........ 62

Conclusion................................................................................................................................ 67
References ................................................................................................................................ 68

# Introduction

This work can be considered as a reading tool that allows to establish a new point of view regarding the link between newborn startups and entrepreneurship culture; with a focus on digital and high technologies. Nowadays, these topics are in fact strictly connected.

Starting from the current state of art and by relying on international scholars' research, the early stages in developing the study has been concentrating on the definition of the concept and of the environment typical of entrepreneurial ecosystems. As well as what is entrepreneurship and the relation that this have with a territory.

The initial effort was made on defining the main elements that effectively impact on the creation of an entrepreneurial ecosystem, as well as on the role of technology in the generation and development of innovative and high-tech startups.

According to this purpose, essential is the understanding of the concepts of *Entrepreneur* and *Entrepreneurial Ecosystem*. These, with support of a strong entrepreneurial culture, are strictly connected.

One of the most common definitions of Entrepreneurial Ecosystem is "a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory" (Stam, 2018).

Its characterizing elements are based on the presence of key dimensions that impact at a local level on the generation and development of an interconnected system; in this system all elements and actors involved share knowledge, culture and influence each other.

A focus, during literature research on the field, was also made on the policy implications and reforms that, if put in place, can actively favour the development of a local ecosystem, conducive to entrepreneurship and to the spread of an entrepreneurial culture. So, on the practices that is better avoid if you want to foster the generation of ecosystems that are well-functioning and that will have a sustainable growth.

Furthermore, in this work was useful to incorporate a brief exploration of the role of digitalization in the development of new ideas and innovative startups. As well as, of the trends of the digital transformation processes on organizations, economy in general and everyday life (think about people, institutions, policy).

As a result of this transformation we had the born of the concept of *Digital Ecosystem*, an ecosystem that is not limited to a territory, a defined area, but that can be considered "without boundaries", allowing connection between people and objects everywhere in the world.

Here comes the fusion of two concepts, Entrepreneurial and Digital ecosystems, in one unique one: Digital Entrepreneurial Ecosystem. An innovative model that renew the way of doing business thanks to the use of cutting-edge technology.

Noteworthy is the impact of high technology, such as Artificial intelligence, on the emergence and development of entrepreneurial ecosystems. How this fast-evolving innovation affects the born of startups and enable the creation of system strictly interconnected and self-sustaining.

Having has fundamentals the previous analysis of the national and international literature and by taking Stam's studies as a model for the further empirical work on Italian territory, this thesis wants to try to fill the gap that we have about the presence of Entrepreneurial Ecosystems in Italy.

So, the main goal is to identify and map the clusters and describe the models that characterize each of them.

Firstly, this paperwork has been focused on the main elements characterizing an ecosystem and on which measures can better explain and represent these key dimensions – with regard to the chosen area.

The essential, elements distinctive of the presence of an Entrepreneurial Ecosystem, are the following 10: Demand, Entrepreneurial culture, Formal Institutions, Physical Infrastructures, Talent, Networks, Leadership, New Knowledge, Support services/Intermediaries and Finance.

Research has helped to identify which variables can show and describe the effect of these dimensions on the born of startups and, consequently, on the emergence of ecosystems in an entrepreneurial context.

Data were mainly got from well-known public databases: Istat, Eurostat and Crunchbase, as well as on the Register of companies (for all information about active and newborn enterprises), and the MIUR database (for achieving all data inherent to the educational field).

The dataset was structured following the main dimensions, and for each of these the creation of a specific paper including all the variables chosen to explain and show the effect of those factors on the Italian provinces. So, the analysis has been done at the Nuts3 level.

After the long organization and cleaning of data in the dataset, two statistical analysis have been done: Factor and Cluster Analysis.

The first analysis enabled to confirm the relationship between the above said elements and the development of entrepreneurial ecosystems. Therefore, it was possible to qualitatively identify the environmental characteristics of an ecosystem and fix which are some of the best measures for monitoring the generation and presence of entrepreneurial ecosystems at the city level.

From these results, we have been able to cluster the models of entrepreneurial ecosystems in the Italian territory. Through a Cluster Analysis find the number of EE present on the area of search and describe the characterizing models of each of the cluster identified.

Furthermore, the final goal of the research work was to try to understand the role of AI in new entrepreneurial ecosystems; in particular, how can this influence the creation and growth of new startups.

This work wants to give a contribute to the studies done by the other authors of the considered literature stream; obtaining a result that confirms the previous theories on the dimensions that characterize an Entrepreneurial Ecosystem, with a particular focus on the cluster models developed in the different Italian provinces, so where do these ecosystems spread and what influence their born. Trying to explain why are clustered in a certain way and what elements are typical of each cluster model.

# 1. Entrepreneurial Ecosystems

## 1.1 Birth and Definition of the Entrepreneurial Ecosystem concept

To better understand and study the rise of the EE's literature, we should consider the concepts of *system* and *ecosystem*. From a business prospective, a system is a set of interacting and interdependent organizations that function together as a whole entity to achieve a purpose.

An ecosystem is a purposeful collaborating network of dynamic interacting systems that have an ever-changing set of dependencies within a given context (Mathews & Brueggemann, 2015). This term comes from the biological sciences.
In fact, biological ecosystems "are thought to be robust, scalable architectures that can automatically solve complex dynamic problems" (Li, 2012).

These two concepts work together. Indeed, the modeling of systems' properties is a complex process that involves assumptions of the biological definition.
The aim is not only to identify the components of the ecosystem, but to understand how this complex socio-economic community functions and produces system performances.

From the biological origins of the ecosystem metaphor as an emergent, self-organizing, and self-sustaining system (Isenberg, 2016; Thompson, Purdy, Ventresca 2017; Tansley, 1987), scholars have linked entrepreneurship with the concept of ecosystem.

The EE concept emerged during debates about entrepreneurship in the 1980s and 1990s. Thanks to the early works of Dubini (1989), Van de Ven (1993), and Spilling (1996).

The focus of investigations shifted from individual features of entrepreneurs, to the social and economic structures in which entrepreneurship is included.
Exploring the influence of cultural, political, and economic context supporting and influencing entrepreneurs, authors like Daniel Isenberg (2010) and Brad Feld (2012) highlighted the importance of the actors in the playground, which create a network providing resources and financial support to new ventures.

This new stream has been followed by academic research whose purpose is to determine the main elements of a successful ecosystem and how they support its growth (Acs, Autio & Szerb, 2014; Alvedalen & Boschma, 2017; Audretsch & Belitski, 2016; Auerswald, 2015; Autio, Kenney, Mustar, Siegel & Wright, 2014; Mack & Mayer, 2015; Motoyama & Knowlton, 2016; Qian, 2016; Spigel, 2017; Stam & Bosma, 2015; Stam & Spigel, 2016).

These characterizing elements enable new ventures to become competitive firms by identifying market niches, acquiring resources and funding. Therefore, the aim is not to increase the start-up rate, but to facilitate high-growth entrepreneurship.

This focus avoids the strategy of giving inefficient economical support to many new firms, but "picking winners" (Spigel & Harrison, 2017) and laying the groundwork for creating the social and economic condition to build strong and durable entrepreneurial ecosystems.

There is not a single agreed **definition** of the concept of entrepreneurial ecosystem:

- "An entrepreneurial ecosystem can be defined as a set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship within a particular territory" (Stam, 2015; Stam & Spiegel, 2018).
- "Entrepreneurial Ecosystems are complex socioeconomic structures that are brought to life by individual-level-action" (Spigel, 2015)
- "The entrepreneurship ecosystem consists of a set of individual elements—such as leadership, culture, capital markets, and openminded customers—that combine in complex ways. In isolation, each is conducive to entrepreneurship but insufficient to sustain it. That's where many governmental efforts go wrong—they address only one or two elements. Together, however, these elements turbocharge venture creation and growth" (Isenberg, 2010).
- Entrepreneurial ecosystems at the socioeconomic level having properties of self-organization, scalability, and sustainability, composed of sub-systems and systems, are seen as "…dynamic institutionally embedded interaction between entrepreneurial attitudes, abilities and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures." (Acs, 2014)
- Ecosystems are defined as "systems of co-located elements where a variety of actors, functions, and institutions interact to support the creation and growth of new ventures" (Isenberg, 2010; Thomas, 2013).
- "Entrepreneurship ecosystems consist of a dozen elements (consolidate into six domains: Policy, Finance, Culture, Supports, Human Capital, Markets). They are idiosyncratic because they interact in very complex ways and are always present if entrepreneurship is self-sustaining" (Isenberg 2011).

With respect to the key determinates of ecosystems: Spigel (2017) suggests that, despite the variance of the relevant elements constituting an entrepreneurial ecosystem, these can be categorized as Cultural, Social or Material.

Cultural elements represent the attitudes toward entrepreneurship. A positive perception can encourage new ventures creation and normalize the risk of becoming an entrepreneur, as well as the existence of success cases of other local entrepreneurs.
How I will expose below, in this context, it is crucial the contribute of government and leaders in spreading information on these successful stories and promoting entrepreneurship practice.

However, a supportive culture is not enough to sustain long-term entrepreneurial growth. Entrepreneurs need to draw on resources such as risk capital, talented workers, and mentorship from experienced entrepreneurs as they start and scale new ventures (Spigel &

Harrison, 2017). The second category is, in fact, Social and it deals with the social networks within regions.

This net of connections is essential to disseminate knowledge about new technology and opportunities, and, in this way, develop the entrepreneurship process.
A solid network allows entrepreneurs to reach key resources for venture growth: talented workers and investments; as well as to share experiences, learn from each other's mistakes avoiding common missteps.

At last, Material attributes are institutions present in a certain place. These can be physical- such as incubators, accelerators, universities, office infrastructure- or related to public policies, government projects and direct financing.

Going back to the definition of EE. According to Stam (2015) the entrepreneurial ecosystem construct has some characteristics of a "chaotic conception". The definition presents a list of elements with no reasoning of their congruence and there is doubt over the appropriate level of analysis (national, regional, city level, etc.).

For this reason, the EE approach should go beyond a metaphorical approach by constructing a complex analytical one. Looking at ecosystems as processes emerging and transforming over time, by which entrepreneurs gain resources and support increasing their competitive ability to scale up.

Indeed, scholars have argued that entrepreneurial ecosystems are best conceptualized as complex systems. In other words, systems in which the macro-level behaviors of the system both influence and emerge from interactions among the agents comprising the system (Levin, 2002; Roundy, 2016).

Providing a global view, the economic system is constantly changing; every actor at the micro-level interact with the others and experiment, so try to become an entrepreneur. Many of this fail, but some succeed developing innovation and value for society (Beinhocker, 2006).

Today, an important role is given to innovation and technology. Scholars have started debates on what now are called innovation ecosystems, a new form of ecosystem.

An innovation ecosystem in terms of economic value contains economic decision makers, such as government, businesses (producers) and consumers, as well as non-economic factors, such as culture, knowledge, organizations, and social interactions. These non-economic factors play important roles in helping and fostering idea creation and in the initiating and distributing of innovation among all the actors (Munigala, Oinonen & Ekman, 2018).

## 1.2 Literature on systems related to innovation and entrepreneurship

The analysis can be based on three approaches:

- System of Innovation (Nelson, 1994);
- The Competitive Advantage of Nations (Porter, 1990);
- Systems of Entrepreneurship (Acs, 2014).

The broadest approach to economic performance at the economy level is the concept of National Systems of Innovation (NSI) (Edquist, 1997; Lundvall, 1992; Nelson, 1994). Knowledge is considered as a fundamental resource in the economy; it generates through an interactive and cumulative process of innovation. The term “system” identifies a set of institutions whose interactions determine the innovative performance of national firms.

According to Rosenberg and Nelson (1993) the system concept “...is that of a set of institutional actors that, together, plays the major role in influencing innovative performance.”
In the SI literature, systems are not created. They are evolving structures that have to be studied in order to actively improve their performances. In particular, the NSI concept is about how institutions lead to knowledge production and application within a nation (Acs, 2014).

The second approach to systems is connected to Porter’ work (1990, 1998) on clusters and the economics of competition. The central question to answer according to Porter is: “Why do firms in some industries achieve international success and others do not?”.
To understand the environment Porter introduced the “Diamond” model: a concept that tied together factor conditions, demand conditions, related and supplier industries, firm strategy, structure, and rivalry.

Porter introduced the concept of cluster: “A cluster, or group of interconnected firms, suppliers, related industries, and specialized institutions in particular fields that are present in particular locations.” Focusing on clusters he offers an economic view on competition and strategy.

The third approach to systems is associated with Acs’ studies (2014). The concept of system related with entrepreneurship is based on three important preconditions that provide an appropriate platform for analyzing entrepreneurial ecosystems. First, entrepreneurship is an action undertaken and driven by agents on the basis of incentives. Second, the individual action is affected by an institutional framework for entrepreneurship. Third, entrepreneurship ecosystems are complex structures in which many elements interact to produce systems performance.
This concept has also been applied at the regional level (Szerb, 2014).

## 1.3 Previous Theories: links and differences

The main actor in this contest is the entrepreneur. The entrepreneur is a person who is continually pursuing economic value through growth. Entrepreneurship is aspirational and risk-taking. "Self-employment per se, is not entrepreneurship: self-employment-plus-aspiration, usually is; aspiration, not business ownership per se, is the continental divide between the entrepreneur and the non-entrepreneur" (Isenberg 2011).

Scholars have noted that entrepreneurial activities tend to cluster in specific locations in particular ways (Kenney & Von Burg, 1999; Spigel, 2017). Works in economics has often focused on entrepreneurial ecosystems as one type of "innovation cluster" or "regional system of innovation (RIS)" (e.g. Cooke, 1996; Morgan, 2004; Niosi & Banik, 2005). These studies emphasize the agglomeration, spillover, and knowledge transfer effects that are produced where there is a high concentration of innovation-creating firms (e.g. Audretsch, 1998; Gordan & McCann, 2005).

Several studies have devoted attention to the relationship between entrepreneurship and regional development, and this can be synthetized in the entrepreneurial ecosystem approach (Stam, 2015; Spigel, 2017; Stam & Spigel 2018). To explore and fully understand the importance and implications of EE, it is necessary to consider other existing theories.
In particular, we can start to focus on literature of Clusters and RIS.

Starting with industrial clusters, Porter's work (1998) is always cited. Both literatures, of ecosystems and clusters, are built on Marshall's (1920) core idea: "there are forces outside an organization but within a region that contribute to firms' competitive advantage. Firms' productivity and competitiveness are enhanced by the presence of multiple competing and cooperating firms that are in the same industry or share a common technological base".

Clusters increase the competitiveness of new ventures: firstly, the presence of many firms in the same industry or supply chain attracts skilled workers enhancing innovative potential; secondly, knowledge built up in a cluster through spillovers from existent firms and universities help to access new technology and market information. Clusters, in short, create a supportive environment providing opportunities (e.g. find new niches) and resources required by entrepreneurs and enable "a better access to a more diverse range of inputs and complementary products" (Delgado, Porter & Stern, 2010).

What links EE with the cluster theory is:

- The presence of other firms is a source of competitive advantage for new ventures. Using their network connections, they can find first adopters, and insert themselves into existing supply chains;
- The importance of achieving information and knowledge outside the firm;
- The acknowledge knowledge processing and creation is a key element for success, and this is aided by physical proximity between firms (local bias).

Another recognized stream, which deals with innovation systems, is about: Regional innovation systems (RIS).

This concept may be drawn conceptually around economic, social, political and institutional relationship that supports knowledge producers and collective learning process between firms within regions; encouraging the rapid diffusion of knowledge, skills and best practice.

Cooke, G. Uranga, and Etxebarria (1997) divide RIS into its three basic components: region, innovation, and system.

Region is the housing of the innovative activity because of the “stickiness” of knowledge, the generation of networks, and the presence of workers. Innovation spreads from different sources of knowledge: firms, universities, incubators. Thus, RIS develops around a university, a research lab or a big firm. The term “System” refers to the elements of RIS that working together create cycles of innovation and economic growth.

As for clusters, social networks are critical elements to let access to the most important resources for innovation: unique knowledge, better positioning in the marketplace and risk capital.

The frequent interactions, encouraged by geographic proximity, allow entrepreneurs and other actors to build up strong local networks that contain numerous ties that provide access to unique resources (Westlund & Bolton, 2003).

Cooke (2007) developed the notion of entrepreneurial regional innovation systems (ERIS). ERIS is differentiated from traditional RIS by the presence of pools of venture capital, market-focused serial entrepreneurs, and disruptive innovation driven by strong internal networks rather than external supply chains.

Links between EE and the concepts of RIS and ERIS:

- The role of networks: entrepreneurs need to be able to gather a variety of sources to acquire knowledge and resources. The interactive learning and innovation in EE depend on the cultural outlooks within their regional context;

- The importance of universities and the other entities that push innovation as places of knowledge production and reservoirs of talents, training ground for future entrepreneurs and magnets to attract high educated workers;

- The role of policy: create a supportive environment and the preconditions for the occurrence of innovation. It is possible to use policies to provide for funding and training, but these cannot alone generate a self-supportive ecosystem. (McQuaid, 2002; Isenberg, 2011).

## 1.4 What's new about Entrepreneurial Ecosystems?

Cluster and RIS concepts provide frameworks that help understand why some areas have higher rates of entrepreneurship growth than others and how to support this growth within a specific region.

What is new in EE concept is the focus on the unique needs of innovative ventures rather than of all firms in a region. From an ecosystem prospective it is important to consider the ability of entrepreneurs to access resources, this reduces the importance of the universities or firms in supporting the competitive advantage of local firms and as source of innovation.

Additionally, it is correct to highlight the role of social networks but new entrepreneurs my lack to integrate into them (McAdam et al., forthcoming; Jack, 2005).

Finally, innovative start-ups require skilled workers, but these, furthermore, must be able to work in a unique environment characterized by more onerous conditions of employment. This capacity is strictly linked with the cultural mindset of that region.

Knowledge, according to scholars, con be expressed in three ways: market, technical and of the entrepreneurial process. Focusing on the last, it involves skills of identifying opportunities, business planning, getting investments and fit into the entrepreneurial network.

Entrepreneurship knowledge is acquired through training and learning from books/websites, but mostly by interacting with more experienced entrepreneurs and business mentors. This may help entrepreneurs anticipate and overcome challenges in the new venture creation process.

One important characteristic of entrepreneurial ecosystems is that the ecosystem ought to be led by entrepreneurs themselves (Stam, 2015; Feld, 2012).

One main argument relative to this literature stream is also the policy role.
Lerner's (2009) believes that policy makers' lack of knowledge about entrepreneurship is a major barrier to effective state support of its creation.
Following this view entrepreneurs should identify the issues that must be addressed to public intervention, such as local investments and talent development. The EE approach suggest the State to adopt a more facilitate role rather that coordinating entrepreneurial networks and directly supporting activities.

A final difference between cluster and RIS research and EE is the role of Industrial sectors. Cluster and RIS frameworks are primarily concerned with the flows of technical knowledge within a particular industrial sector. While EE does not focus on a specific sector, but on technology and innovative ventures.
In this way the emergent benefits do not occur to firms in the same market or supply chain, but to a great variety of high-growth ventures due to the importance of entrepreneurial knowledge within an ecosystem. This enables a cooperation and mutual learning exchange within different firms in different sectors.

This view is supported by research on existent ecosystems, that have not identified high level of competition between local start-ups (e.g., Mack & Mayer, 2015; Motoyama & Knowlton, 2016). It is more common for these firms to share technology rather than clients. This idea creates a tension with Porter's (1998) emphasis on competition as a leading driver of competitiveness within regional clusters, but only if not considering global competition which is faced by the start-ups included in an ecosystem. Global competition is handles with the benefit of having a supportive environment.

There is a need for understanding the processes through which ecosystems support high-growth start-ups and by which ecosystems build and change over time. The processes driving clusters and regional innovation systems—economies of scale, economies of scope, and knowledge spillovers—do not adequately explain the functionality of ecosystems.

Spigel & Harrison (2017) suggest a set of key prepositions to establish the role of ecosystems in supporting high-growth star-ups, and highlight the contribute of entrepreneurs in the ecosystem:

**Proposition 1.**

**1a.** Firms that are better able to access the resources of the ecosystem will be more competitive than those that are not.

**1b.** Entrepreneurs' ability to access the flow of resources within an ecosystem depends on their perceived legitimacy as high-growth entrepreneurs within the community.

**1c.** Entrepreneurs will display a continuum of ability and willingness to engage with their ecosystem, which will affect their ability to benefit from the resources in the ecosystem.

**1d.** The extent to which the public sector creates opportunities for entrepreneurs to come together will be reflected in the level of development of an entrepreneurial ecosystem.

**Proposition 2.**

Entrepreneurs in successful ecosystems will be able to take advantage of the knowledge, talent, and other resources produced by previous rounds of successful and failed entrepreneurship.

**Proposition 3**

**3a.** Barring exogenous or endogenous shocks, more of the resources produced by or attracted to well-functioning ecosystems will tend to stay there than will be the case for poorly functioning ecosystems.

**3b.** Well-functioning entrepreneurial ecosystems will be characterized by stronger positive imprinting effects on entrepreneurs and new ventures of their technology and institutional infrastructures.

**3c.** The recycling of entrepreneurial resources in less developed ecosystems will be hampered by the loss of firms, entrepreneurs, capital, and other resources to stronger entrepreneurial communities.

## 1.5 Characterizing elements and development drivers

Leaving aside the field-based theories, Entrepreneurial Ecosystems have been studied by scholars in entrepreneurship and organization theory. This by focusing on identifying and isolating the key components, such as large pools of investment capital, support organizations, as well as venture incubators and accelerators, labor forces with sufficient human capital, and cultures that encourage risk taking, innovation, and are accepting of failure (e.g. Arruda et al., 2014; Bahrami and Evans, 1995; Neck, 2004).

The EE approach has gained relevance among entrepreneurs, entrepreneurship supporters (Feld 2012), and in public policy (Isenberg 2010), but it was not yet fully determined how to be measured.

Now we can benefit from Stam's work "Measuring Entrepreneurial Ecostystems" (2018) where he offers methods and measures for analysing EE as complex systems, composed by many elements and agents which interact with each other.

Complexity economics (Arthur 2013) provides the conceptual basis for analysing the relation of entrepreneurial ecosystems with outputs (entrepreneurship) and outcomes (value creation and structural change).

The model provides framework conditions, systemic conditions, outputs and outcomes, as well as upward and downward causation, and intra-layer causal relations (see also Stam 2015).

To explain these elements: the framework conditions include the physical and the social ones (formal institutions and culture), which generate interaction between the actors and get access to the demand for new goods and services that is notably linked with the relative position of the ecosystem; the systemic conditions include the core aspects that lead to the entrepreneurial activity and drive its success: leadership, talent, finance, networks, knowledge, and support services; upward causation shows that the causes of the value creation go through intermediate causes, while downward causation reveals how outputs and outcome of the system over time log back to the systemic conditions.
Finally, the intra-layer causal relations refer to the interactions between the elements forming the ecosystem and between the outputs.

The emergent key elements and their relative measures are:

- **Formal Institutions:** reflect the playground where new ventures start their entrepreneurial activity. Relevant is the quality and efficiency of institutions. These are measurable considering the regulatory framework and the perceived quality of government.
- **Entrepreneurial Culture:** how is entrepreneurship seen in the society, which value is given to someone who decide to build its own business to become an entrepreneur and how this is seen as a career choice. It is measurable indirectly with the number of newborn firms in a region, which indicates how "common" it is.

- **Physical Infrastructure:** the measure considers different indicators of the potential accessibility (roadway, railway, number of passengers and flights) in terms of time, effort, distance and cost.
- **Demand:** through an estimate of the GDP, population and income per capita we obtain the potential market demand.
- **Networks:** to indicate the connectedness of businesses for new value creation, enabling diffusion of information and knowledge, as well as labour and capital. It is measured as the percentage of businesses in a region that collaborate for innovation, and in this thesis, the element of new technology and artificial intelligence, its generation and exploit.
- **Leadership:** provides role models and guidance for collective action in developing an entrepreneurial ecosystem. The leader's involvement is crucial in building and supporting a "well-functioning" ecosystem. Leadership is measured with the prevalence of innovation project leaders.
- **Talent:** For an entrepreneurial ecosystem to be effective there is the need of skilled workers, so it can be measured with the share of the population with a higher education degree.
- **Finance:** The supply and accessibility to financing for new and small firms is an important condition for their growth and survival, preferably if provided by investors (venture capitalists and angel investors) with entrepreneurial knowledge.
- **New Knowledge:** Investments in new knowledge are an important source of entrepreneurial opportunities and prosperity. It can be measured as percentage of GDP invested in R&D.
- **Intermediate services:** The supply of support intermediate business services by intermediaries can lower entry barriers, enhance the diffusion and generation of innovation.

In this thesis the analysis of the Italian environment and the presence of ecosystems include an additional element whose goal is to value the impact of new and high technology on the generation of startups and so entrepreneurial ecosystems. In particular, the focus is on Artificial Intelligence and its applications.

The challenge is to select the correct empirical indicators, comparable in time and space, of these elements to determine and point out the different models of entrepreneurial ecosystem considering the Italian dimension.

The focus of the research has been on the provinces in each Italian region, to explore the presence of Entrepreneurial Ecosystems modelling and mapping them. After this ranking, the target is to analyze each cluster, show the relation between the different ecosystem models and how technologies influence the born of starups.

## 1.6 Importance of well-functioning and sustainable EE

Economic development is possible when entrepreneurs create new value, it does not emerge spontaneously (Fayolle, 2007; Schumpeter, 1934). The new value creation derives from the presence of a complex system of economic agents and their interactions: the entrepreneurial ecosystem.

Entrepreneurship is considered both the result and the channel of evolution (Day, 1987). “Entrepreneurial behaviour as an output is enabled by the system, while the new value created, and potential structural change as an outcome of the system is mediated by entrepreneurship” (Stam, 2018). Therefore, the nature of the system can be explained by feedback effects.

Considering Stam and Spigel’s (2015, 2018) view, to capture the value created by both output and outcome we can use the concept of “Productive entrepreneurship” that refers to “any entrepreneurial activity that contributes directly or indirectly to net output of the economy or to the capacity to produce additional output” (Baumol, 1993). The entrepreneurial activity is what creates aggregate welfare.

We can pay now attention on what can maintain an ecosystem functional, strong and able to self-sustaining.
Key elements that have already been highlighted are: resources and network.

It is important, for supporting high-growth entrepreneurship, to have access to the resources within the ecosystem and this became possible due to the network, through which these resources flow.
Talking about resources likely to gain competitive advantage and growth means: financing, skilled and talented workers, leaders and experienced mentors, knowledge (technical, and entrepreneurial).

It is to be considered that some ecosystems have a major amount of resources available within it beyond others. These are in literature called “munificent ecosystems”, in the better case, and “sparser ecosystems”, when there is a lack of resources (Spigel, 2017).

Therefore, firms in sparser ecosystems find harder to scale up and survive in a long time period. The ability of entrepreneurs to get access to the resource they need determinates the functionality of an ecosystem.

Spigel (2017) distinguish: *well-functioning* and *poorly functioning* ecosystems.

Well-functioning ecosystems have a dense network of investors, entrepreneurs, innovators, and helpful leaders surrounded by a strong entrepreneurial culture that facilitates the resource flow. While, Poorly functioning ecosystems lack in building a strong network, giving information on market opportunities and entrepreneurial knowledge, and this influence the ability of reaching critical resources.

This is to highlight the importance for success of having resources that flow within an ecosystem through an extended entrepreneurial network.

Looking at the representative schematic view of ecosystem types by Spigel and Harrison:

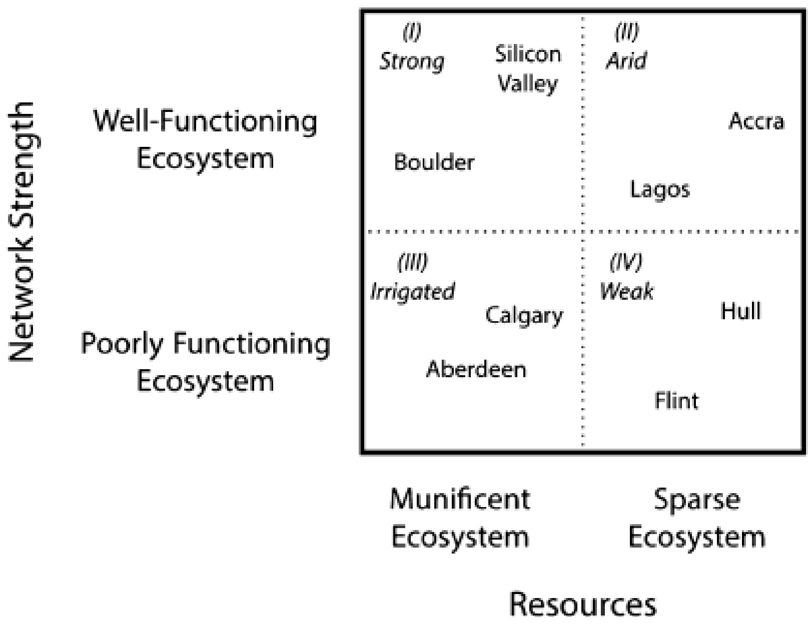


*Figure 1 - Ecosystems types*

We find, along with "strong" (such as Silicon Valley, I) and "weak" ecosystems (regions that have suffered economic shocks, IV), ecosystems that are resource poor but with dense networks, called "*arid*" (II).

These types of ecosystems create the opportunity to generate new capital and resources through successful entrepreneurship that can consolidate over time.

Similarly, ecosystems that are munificent but poorly functioning are called "*irrigated*" (III); these have high rates of entrepreneurship because of the multitude of opportunities, but the strong competition make it difficult to collaborate and learn from each other.

The model predicts that well-functioning and resources full ecosystems will have higher growth and innovative activity that will contribute to sustain the economic development.

EE can be seen as ongoing processes trough which resources develop and flow within the ecosystem and its actors changing the actual structure of the ecosystem. Therefore, it is limiting to define them only considering the rate of start-ups formation or the entrepreneurial activity in that area.

From studies of different scholars has emerged the importance of a successful and various network, and the presence of crucial resources to develop and support an EE.

Additionally, we mustn't neglect the impact of the entrepreneurial local culture that encourages risk taking, network developing and learning (Argote & Miron-Spektor, 2011).

We know the relevance of these elements, but it is not that easy to put them into practice getting results. Extremely difficult is to build an entrepreneurial culture, commonly the need of intervention by policymakers has emerged.

The role of the State is to cultivate the entrepreneurial community and resources that already exist rather than trying to create new ones through top-down intervention and by emulating other ecosystems.

Some aspects, like risk taking and innovation, can't be created, but can develop over time through entrepreneurial activity and stories of success. Others must be cultivated, such as the network of entrepreneurs, in order to build strong basis for the ecosystem creation and sustainable running.

Successful entrepreneurship has spillover effects by reinforcing all its components. Training and experience upgrade the human capital level, new generations are inspired by successful stories and society became more tolerant of risk, and failure is seen as a growth process. This positive influence stimulates new ventures creation and greater numbers of entrepreneurs become influential mentors and informal advisors to public leaders.

Successful entrepreneurship enhances the development of formal capital markets encouraging better governance and regulation policies, particularly addressed to entrepreneurship. As well as making regions more competitive and more likely to attract resources. So, the beneficial impact can be on all the political-economic structure.

From a policy view has emerged that, instead of continuing to focus on increasing the number of new firms providing public investments, it is better to leave the direct and decisional role to entrepreneurs, supported by the network.
The state should put its effort in stimulating the creation of dense networks, promoting events with leaders and mentor of the entrepreneurial field, helping the ecosystems' actors to identify opportunities and building a culture of consensus.

Besides cultivating the existent resources, required in supporting the ongoing entrepreneurial activities, innovation and success will help attract other resources and, in this way, strengthen the entrepreneurial culture in the region. This is essential for creating strong well-functioning ecosystems.

These elements allow the generation of value for societies (mainly for the ecosystem region) and this is the hearth of the entrepreneurial ecosystem concept (Stam, 2015). This value is created by high-growth entrepreneurs who attract capital to the region and create jobs.

The ecosystem's sustainability through problem solving is essential; in fact, an ecosystem can thrive, but also die. Silicon Valley and venture capital represent an entrepreneurial ecosystem that produces both routine and high-growth entrepreneurship, which are manifestations of an EE.
Sustainability is therefore the key outcome of the ecosystem process (Acs, 2017).

Over time studies of entrepreneurial ecosystems have focused on identifying and understanding the role of several categories of ecosystem participants.

For example, in a case study of the Silicon Valley (California ecosystem), Bahrami and Evans (1995) highlight the importance of a highly skilled labor pool, venture capital, a well-organized services infrastructure, universities and research institutions, and the entrepreneurial culture of the ecosystem.

Similarly, Neck (2004), in a study of the Boulder (Colorado) entrepreneurial ecosystem, focused on factors such as the existence of large established corporations that can spinoff new ventures; as well as the informal and formal networks among entrepreneurs, the physical infrastructure of the ecosystem, and the ecosystem's culture.

More recently, Isenberg (2011), with the Babson College Entrepreneurship Ecosystem Project, argues that entrepreneurial ecosystems can be conceptualized as consisting of six key domains: "a conducive culture, enabling policies and leadership, availability of appropriate finance, quality human capital, venture-friendly markets for products, and a range of institutional and infrastructural support."
According to Isenberg, every entrepreneurial ecosystem is unique and consists of a myriad of specific elements, an although ecosystem is comprised of general factors that span socio-cultural (e.g. institutional support) and economic forces (e.g. venture-friendly markets; also cf. Isenberg, 2010).

Current research also investigates entrepreneurial ecosystems located in market-based capitalist systems (Boltanski & Thevenot, 2006; Friedland & Alford, 1991).

# 1.7 Generation of an entrepreneurial Ecosystem

## A. Importance of interactions

To study the creation and evolution of an entrepreneurial ecosystem we should focus on its early moments and the everyday interactions within it; how durable activity patterns and common shared culture become structured and solid over time (Thompson, Purdy & Ventresca, 2018).

Already Becker (1986) and Hughes (1971), have highlighted that daily interactions among actors are the starting point of the generation of conventions, that enable activities that have common focus.

Thompson (2018) describes a two-period model based on the concept of "conventions", seen as the result of successful coordination between actors operating under conditions of uncertainty (Storper & Salais, 1997). According to this view, ecosystems generates from continuous and practical interactions.

This study provides evidence for the formation of EE through endogenous, bottom-up, and time-patterned processes – a prospective in contrast to another current of thought that the development comes primarily from exogenous top-down factors such as government action with no attention to process.

The early moments of ecosystem formation are characterized by fragile and unstable experimental activities. Thompson, Purdy and Ventresca (2018) have indicated four categories that reflect the cultural-cognitive elements typical of the early moments of ecosystems creation: selecting language, creating community, developing legal infrastructure, and providing financial support.

How is the *two-period model* designed?

In the *I Period* efforts are put in building a shared culture and language with common cognitive and material foundations. In this phase social interactions begin slowly; the need is to identify actors to develop a shared sense of purpose and differentiate their activities from existing conventions. Indeed, it is focused on the categories of selecting language (establishing shared meanings and consolidate the group) and creating community (concrete activities that generates opportunities for interaction).

While, in the *II Period* the number of interactions increase, strengthening connections, and establishing the ecosystem boundaries. This facilitates the sustained and mutually reinforced efforts to develop the ecosystem and permit to consolidate it over time through durable patterns. Now the cultural-cognitive and material elements are organized to achieve a common goal. Activities related to obtaining financial support and developing legal infrastructure are dominant. The language evolves but it is formalized, and the boundaries of the ecosystem are sufficiently established. Also true is that this phase involves boundary testing and expanding which generates social power for the ecosystem, gaining legitimacy and recognition from other institutional fields.

Fundamental is the role of customers and networks. Entrepreneurship need early adopters, customers that help to define the level of services and product features.

Of interest is that these kinds of dynamics are not only related to ecosystems formation, they are also connected to the emergence of new technologies. In this sense entrepreneurs must face, adapting to or changing, all the established conventions connected to the existing technologies, as well as actual policies and employment conditions.

## B. How to build an EE

As mentioned above the entrepreneurial ecosystem consists in a set of single elements that interact and combine in a complex system. Each element, alone, favours the entrepreneurship activity, but is insufficient to sustain it. While, together foster venture creation, innovation and growth (Isenberg, 2010; Stam, 2015).

Different scholars over time have studied the EE and have proposed prescriptions about the "best practices" for creating an EE, as well as what are the strategies that the government should apply in order to achieve that goal.

I'll take Isenberg (2010, 2011) as baseline; he presents nine well-defined points:

1. *Do not emulate Silicon Valley or other established ecosystems*:
   The Valley has a mixture of elements, resources and culture that are unique. Even replicating itself today wouldn't be possible; it evolved under specific historical and economic circumstances. Traying to reproduce this ideal model is a waste of efforts and easily leads to failure. Each region is different and has its peculiar features. Leaders cannot copy anyone else's model because no one can replicate someone else's ecosystem.

2. *Shape the ecosystem around local conditions:*
   Government, with support of entrepreneurship leaders, should foster the development of new solutions; but this by leveraging on local resources, culture and circumstances.

3. *Engage the private sector:*
   Policymakers cannot built an ecosystem without the endorsement of the private sector, who has the right motivation and prospective to develop a successful and self-sustaining ecosystem.
   This, It will be possible through "entrepreneurship-friendly" projects and policies, already in the early stages of creation.

4. *Favor the "high potentials":*
   this is to say that, due to the scarcity of resources it is better to promote programs that focus on ambitious and growth-oriented entrepreneurs, and not on many small-scale firms. But, to keep in mind is that the role of government is not to fill the "money-gap" of entrepreneurs that haven't been able to obtain investments from venture capitalists or loans from banks. Otherwise, the policy intervention would distort the equity markets by not allowing any sustainable pricing mechanism to take place. The only way is through stimulation of virtuous circles among the ecosystems' elements.

5. *Overcelebrate success:*
   Even one success, also if modest, has an impressive stimulating and encouraging effect on the entrepreneurs in an ecosystem. Isenberg call this effect: “law of small numbers”.
   Visible success help reduce the perception of entrepreneurial risk, so it’s important that governments promote events and put the media attention on celebrating it ventures.

6. *Changing a deep-rooted culture is difficult, but not impossible* (see Ireland and Chile cases).

7. *“It’s a mistake to flood even high-potential entrepreneurs with easy money”*:
   There is little evidence that generous financial help and expensive programs contribute proportionately with entrepreneurship growth.

8. *Don’t Overengineer Clusters*:
   It is important to help them grow “organically”.
   Porter, as well as Isenberg, has pointed out that government should reinforce and cultivate existent and emergent clusters rather than building new ones, because they generate where there are some local circumstances that guarantee an advantage.
   It’s also preferable for governments to remain sector neutral, observe which direction entrepreneurs in that region take and economically support their activity.

9. *Reform legal, bureaucratic, and regulatory frameworks*:
   often entrepreneurship occurs in their absence. It’s not obvious to have effective reforms unless accompanied by aimed actions to support and develop the entrepreneurship culture, promote success stories and change the way of thinking entrepreneurial failures. But, simplifying tax regimes and removing administrative barriers to venture formation will create positive incentives.

In conclusion, government leaders can help to build EE and sustain entrepreneurship. This not just following, but refining the cited prescriptions, improving the economy of emerging and developing countries. Best practices are arising from very different sides of the world, mostly by trial and error.

This action is much easier and more effective with the support of private and nonprofit sectors, as well as entrepreneurs themselves that have initiate and financed entrepreneurship education, research and conferences. Operating according to interrelated objectives this is what seems to actually work for stimulating EE.

Ecosystems must exist for entrepreneurship to be *sustainable* (Isenberg, 2011), this sustainability exists without much central control, but It is necessary to monitor its evolution.

Governance has the power to intervene holistically, but not the competences, and for this reason the private sector should be put in the condition to cooperate with the policy leaders. The private sectors, indeed, have the right competences and profit generation perspective.

Thanks to research and studies on EE development, Isenberg (2011) proposes the idea of starting to "deliberately create the conditions so that there will be measurably more of it and do so in a relatively short period of time".

This is to say that the knowledge we have achieved on the theme can be used to support entrepreneurship in being self-sustaining, generating social and economic benefits.

This is what they have tried to do in practice in the Babson Entrepreneurship Ecosystem Project, by following the "entrepreneurship ecosystem strategy", a cost-effective strategy for stimulating economic wealth. This is seen as a precondition or a complement to cluster strategies and innovation systems.

The need of an ecosystem strategy comes from the observation of the evolution of a unique system where all the constituent elements combine in different and complex ways. But, in order to became self-sustaining what is needed, while talking about entrepreneurship, is a supportive environment. Different dimensions have to be taken into account: market, policy, skilled workers, culture.

Other key principles to follow:

- *Allocate high public priority to entrepreneurship.*
  Profit and its distribution generate tax revenues; this both impact government revenues and entrepreneurship. A well-organized tax mechanism facilitates entrepreneurship, consequently it challenges successful stories, and this generate a positive cycle for other entrepreneurs.
  This, as well, incentives advisors, angel investors, venture capitalist to feed back their experience and generate more entrepreneurship.

- *Focus on very specific, concentrated geographies.*
  Entrepreneurship tends to be geographically concentrated in specific cities, regions or even buildings. Because resources tend to attract each other and be localized. Well-known is that the positive effects are powerful when there is a physical proximity.
  Governments, looking at the whole nation, distribute resources as evenly as possible. But to have a reasonable impact the greatest efforts should be concentrated in small areas and regions.
  "Entrepreneurship, to be self-sustaining, requires an ecosystem, and an ecosystem requires proximity so the different domains can evolve together and become mutually reinforcing. Entrepreneurship education can support capital formation, and capital formation can support government reform." (Isenberg, 2011)

- *Set a target of one new high potential venture entering the system every year: Rule of Thumb*
  If you adopt an entrepreneurship ecosystem strategy you want to know what it takes to create a tipping point of sustainability, so "how much entrepreneurship is enough".
  Reasonably, 1000 micro-enterprises employing one person do not morph naturally into 10 high growth ventures employing 100 people each. And, the effort and process of getting to 10 high growth ventures spins off a lot of other consequences, such as smaller suppliers who naturally sprout up around growing ventures. Successful entrepreneurship draws in professional support services such as venture-friendly lawyers, accountants, consultants, investment bankers, caterers, facilities managers, etc.
  In other words, is better focusing on getting to one high potential venture, because the mix of small and "small but growing" will tend to generate the equilibrium wanted.

- *Have an environment that does not over-penalize failure*
  Failure, especially if is quick, does not mean of course something completely negative. The factor inputs to entrepreneurial ventures are recycled. Many of the failed entrepreneurs try again, exploiting their experience, or at least remain engaged in related activities. In fact, looking at entrepreneurial societies, you can see that they tend to have high venture failure rates.
  The policy objective should not be to have a high venture survival rate, but to have high potential ventures survive, and low potential ventures to fail, the sooner the better.

## 1.8 Technology in Entrepreneurial ecosystems

### A. New technologies: how do they impact on the generation of entrepreneurial ecosystem

Focusing on the role played by technology in the generation or development of new startups and the creation of structured and sustainable ecosystems, the first analysis will be on the phenomenon of digitalization. This has had an important effect on the economic system, everyday life, and on the way of exploiting entrepreneurship. And, in particular, on how innovation and new ideas generate.

F. Sussan and Acs (2017) established a conceptual framework for studying the impact of digitalization on entrepreneurship. This by integrating two concepts and literatures: the digital ecosystem and the entrepreneurial ecosystem.

The Digital Entrepreneurial Ecosystem is made up of entrepreneurs creating innovative products/services and digital companies. The key concepts of this framework are: digital infrastructure governance, digital user citizenship, digital entrepreneurship, and digital marketplace.

Integrating the role of agents and users it is possible to capture the entrepreneurship thinking in the digital economy, as well as consumers' individual and social behaviour in multisided platforms.

Whether talking about biological, technical or entrepreneurial ecosystems, they all have outcomes and they all have to deal with the problem of sustainability; which is at the center of the ecosystem process.

Describing and defining the main concepts of the framework, a Digital ecosystem (DE) is defined as "a self-organizing, scalable and sustainable system composed of heterogeneous digital entities and their interrelations focusing on interactions among entities to increase system utility, gain benefits, and promote information sharing, inner and inter cooperation and system innovation" (Li, 2012).

Despite the presence of various discussion on the concept, scholars and experts commonly agree on two foundation elements: People and Digital Technologies.

The assumptions of such ecosystem are being — user-driven, bottom-up and open-source oriented (Dini, 2011). In this type of ecosystem digital technologies are used by people, and the interactions between them create dynamic continuous changes which form the "nature" of the ecosystem.

To explain digital ecosystems in relation with entrepreneurship ecosystems we have to consider a much more complex system that have as a basis: digital infrastructure and users.

Digital infrastructure (DI) is a socially embedded mechanical system that includes technological and human components, network, systems, and processes which generate feedback loops that are self-reinforcing (Henfridsson and Bygstad, 2013; Tilson, 2010).

DI links systems and networks at different levels and it is constantly changing due to the advancement of digital technologies and the contribute of users who are as well designers.

DI generates through the simultaneously work of multiple actors within the system. It is a system of itself (Hussain 2010); it should be considered as an open and interconnecting element of the digital ecosystem.

The peculiarity of the DI is that allows users to contribute, becoming an enabler for innovation for individual entrepreneurs. This creates new paths for innovation and intensively promote the innovative activity (Henfridsson and Bygstad, 2013).

*Users* are anyone who has access to digital technologies. The increase in use of devices has led to a user-centered innovation pattern. Users can contribute in developing new products and services for themselves and other users (Von Hippel, 2006).

The consequence of digitalization is a pro-social behaviour in which user provide free labor in time and effort and together they co-generate value. This is seen as a digital ecosystem. Some of these users in the process of intense interactions with their community accidentally develop new products or services and become accidental entrepreneurs (Shah and Tripsas, 2007).

*How can we connect this concept with the one of entrepreneurial ecosystems?*

EE are, as well, a way to conceptualize complex and interdependent social systems. Acs (2014) defines EE at the socioeconomic level having properties of self-organization, scalability, and sustainability, composed of sub-systems and systems, a "dynamic institutionally embedded interaction between entrepreneurial attitudes, abilities and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures."

It is possible to compare this definition to Spigel's one (2015): "Entrepreneurial Ecosystems are complex socioeconomic structures that are brought to life by individual-level-action". Much of the knowledge relevant for entrepreneurial action is embedded in ecosystem structures and requires individual-level-action to extract it (Autio & Levie, 2015).

Connected to this concept the two fundamental strongholds are: *Institutions* and *Agents.* Looking at entrepreneurship, importance is given to economic institutions, because they influence the structure of financial incentives and assist the more efficient allocation of resources.

While exploring the entrepreneurial context, we have to talk about "entrepreneurs", and it is necessary to know the definition of this term. Considering Casson's definition (1982): The entrepreneur is someone who is specialized in taking judgmental decisions about coordinating scarce resources.

The term “judgmental” is used to highlight that entrepreneurs do not applicate routinely standard procedures.

Acs and Sussan (2017) distinguish between routine entrepreneurship and high-impact entrepreneurship. The first definition includes all the activities involved in coordinating and executing a well-established production function, that operates in a defined way. The latter refers to the activities necessary to create innovative high-growth ventures, where not all the parts of the production function are totally known. Innovative entrepreneurs, with their capacity, contribute to increase productivity and facilitates economic growth.

After describing and exploring both definitions of digital and entrepreneurial ecosystem, it emerges that the digital entrepreneurial ecosystem (DEE) integrates these two existing ecosystem literatures.

The size of DEE depends on, and is dependent on, the adoption, absorption, and diffusion of digital technologies. The DEE is defined as “the matching of digital customers (users and agents) on platforms in digital space through the creative use of digital ecosystem governance and business ecosystem management to create matchmaker value and social utility by reducing transactions cost” (Acs & Sussan, 2017).

Through the presence and integration between users (people using technologies and internet) and agents (entrepreneurs) the digital business emerges.

The continuous birth of new digital entrepreneurs who substitute the “old” ones is essential for the sustainability of the ecosystem; the digital marketplace have not to be monopolized, it must be open road for new disruptive digital entrepreneurs.

In order to function and sustain DEE are constituted of interrelated elements: digital infrastructure governance, digital user citizenship, digital marketplace and digital entrepreneurship.

- *Digital infrastructure governance*
The coordination and governance needed in order to establish a set of shared technological standards that are related to entrepreneurial activities.

- *Digital user citizenship*
The legal and social contract users formally and informally agree to in their participation in digital environment that is related to the entrepreneurial ecosystems.

- *Digital marketplace*
Value creation in the form of a new product or service or new knowledge that are the results of entrepreneurial activities and users’ participation.

- *Digital entrepreneurship*
Entrepreneurial activities that optimize the utilization and reconfiguration of digital infrastructure in the form of new systems, new platforms, and new networks.

We have seen what a Digital Entrepreneurial Ecosystem is and so, the role of digitalization in the new venture creation and innovation process. But nowadays, new and advanced technologies have taken hold and influence the emergence of high-tech stat-ups. One of these is Artificial Intelligence.

Artificial intelligence (A.I.) can be considered the latest form of automation, from driving cars to medical diagnosis
Interesting is to study how this technology affects economic growth, how this growth is considered by different firms in their organization, as well as the influence on the market structure.

A.I. can be defined as "the capability of a machine to imitate intelligent human behavior" (dictionary) or also "an agent's ability to achieve goals in a wide range of environments" (Legg & Hutter, 2007). These definitions evoke economic issues (e.g. how is human labor affected by the introduction of A.I. in an ever-increasing number of tasks?).

A.I. may implement ordinary production processes, but also change the way we solve complex problems and create new ideas. Someone (Good, 1965; Vinge, 1993; Kurzweil, 2005; Nordhaus, 2015) believe that A.I. will become rapidly self-improving leading to unbounded machine intelligence and economic growth.

*What's the impact on the production process? And what about the creativity path?*

P. Aghion, B. Jones & C. I. Jones (2017) introduced A.I. in the production function of goods and services, and tried to combine the evolution of automation with the stability in the capital share and per capita GDP growth.

The model they proposed shows the possibility of generating a prolonged period with high capital share with overall balanced economic growth, while automation keeps moving forward.

Furthermore, they focus on the effects of the introduction of A.I. in the process of generating new technology ideas. A.I. can potentially increase temporarily or permanently growth depending on how it is introduced, managing to replace the role of humans in generating ideas.

They also demonstrate that "if some steps in the innovation process require human R&D, then super A.I. may end up slowing or even ending growth by exacerbating business-stealing which in turn discourages human investments in innovation".

Looking at how firms influence and are influenced by the advance of A.I. the focus could be on their organizational structure, market structure and sectoral reallocation.

A.I. can also cause issues, such as speeding up imitation, and with the increase of creative destruction innovations will come limited returns to the introduction of new technology imposing, in this way, a boundary to the growth process.

In fact, A.I. intensive firms are likely to: outsource a higher fraction of low-occupation tasks to other firms and pay a higher premium to the low-occupation workers they keep inside the firm (Jones, 2017).

Another research stream (AV. Lavrentyeva, AA Dzikia, AE Kalinina, DP Frolov, EA Akhverdiev and AS Barakova 2019) has focused on the global trends in the digital economy development. In particular, these scholars highlighted the role of A.I. on the formation of the institutional environment of ecosystems and on the formation of organizations' management methods to build strategies in the digital setting.

Nowadays, due to digitalization and globalization, firms must deal with high-speed environmental changes that are transforming traditional ways of life.

The digital economy process has developed since the Industrial Revolution in the $17^{th}$ century, arriving at the big boost of robotization of the $21^{th}$ century, and this developing process is accelerating every year. There is an exponential growth of the innovation progress and of new technologies (e.g. IoT, A.I., and other digital technologies).
As these technologies are spreading efficiency in production and performance will no longer be a key difference for enterprises.

*How is now A.I. applied in management?*

Information and communication technologies (ICT) are making it possible for more and more people to access knowledge. Firms are integrating digital platforms, services and technologies for data collection and control. These changes in technology are modifying the way societies are structured and how interactions take place. Every moment massive amounts of data are created, and these are used by all the companies to try to gain a competitive advantage, and this is possible by embracing the technological innovations above.

In the last decade, competition has increased; and with this all the methods and managerial systems to build strategies by analysing large amounts of data, and by using business analytics and smart environments have changed.

With the introduction of A.I. and advanced IT systems of data analysis, organizations can effectively collect data and information: users' needs, competition trends, prices, costs, and other business indicators, as well as forecasting the demand of products and services reducing production costs and becoming more efficient.

Nowadays, big data technology allows us to consider the preferences and interests of Internet users, build individual behaviour through complex digital stages and without the efforts of people, offer and independently orient them in the digital space. These processes are one of the determinants of the development of artificial intelligence.

When talking about AI and process automation (the latter has already been implemented in many industries) it is necessary to understand all the complex algorithmic methods that allow computer, robots and machines in general to simulate human actions. These technologies substitute human labor or help to simplify a large number of tasks in the process of creating new products.

In this context, there is a significant facilitating role of big data for artificial intelligence, the work of which is provided by information about interactions, preferences of people, and the history of cyclical actions.

Today, it is predicted that the stimulation of AI growth will be carried out in three ways:

1. Creating a virtual workforce;
2. Increasing existing skills and workforce in the digital economy;
3. Innovations used in AI work.

Getting the access to big data and creating a network that permits to continuously acquire them, ensure the capacity of generating innovative ideas based on real needs. And, notably, having technologies that permit to analyze them can be the starting point for the born of an ecosystem.

Overall many industries, as well as the public sector, are coping with change. Even the way knowledge and labor's generation is changing; new types of collaborative organizational forms are emerging, such as I-form, virtual organisation (Newman, 2017), community (Heckscher & Adler, 2006), meta-organisation (Lakhani, Iansiti, 2017), and actor-oriented organisations (Fjeldstad, Snow, Miles & Lettl, 2012).

These pave the way for the theory of adaptive, self-organizing and innovative organisations (Child & McGrath, 2001).

To analyze and conceptualize organisational forms of cooperation and how they relate to conventional projects, most studies in the literature of economic organization were based on two ideal forms: *markets and hierarchies*. But these, with the born of the networked economy, where cooperation is essential, are becoming inefficient.

**Adler** (2008) proposed a third type that has at its center the co-production of knowledge and trust as coordination mechanism.

We can say that this is at the basis of the concept of ecosystem, where the presence of a strong network and a collaborative environment ensure the possibility of high growth and sustainability.

Considering the strong impact of this technology, easily emerges the question:

W*hich are the direct consequences of A.I. on policy and the regulation system?*

Focusing on regulation of digital economy, there are two lines of thoughts: the first one proposes a free market; the latter believes in the need of controlling data and information with regulation of digital legal relations.

The collection and use of big data let emerge some issues. These are linked with all investments in infrastructures that allow innovation and digitalization; necessary to meet the growing need for networked ecosystems and data management standard that provide greater access to information.
Such infrastructures stimulate the introduction of a wide range of technological ecosystems.

Participants in ecosystems actively interact and cooperate building a network and creating knowledge, innovation, technology. The nature of AI con be a driving force that will improve the relationship between bug data and stakeholders.

It is necessary, in order to accelerate the creation of sustainable societies, the move towards new digital business models and digitalization of services.
A key role in this digital transformation is given to big data.

The access to and analysis of a large amount of data and their relationships allow the development of new business models. This will generate innovative solutions, providing benefits for all the ecosystem.

The legal disputes on the actual "nonlegal existence" of digital economy on the international platforms give rise to risks, such as the abuse of intellectual properties, digital fraud and hackers capable of attacking public institutions.

The digital economy has developed rapidly and in a short time, inserting in all public life's fields. Policymakers understand that new technologies could have unpredictable growths that under free regulation can undermine the legal system (Gulati, Puranam, Tushman, 2012). So, many nations have adopted programs to cover all the faces of Digital Economy.

In particular, the focus is on: legal regulation, education, internet accessibility, information infrastructure and security.

Some problems arising in the digital economy:

1. Development of basic digital legal concepts to ensure the functioning of the entire regulatory system.

2. Traditional norms and approaches are not enough; there is the need of setting new economic mechanism.

3. Preservation of the existing order of labour relations. At the foundation of the digital economy there are the creative and intellectual work; this implies not normal conditions for the organization of work.

4. The novelties of the institutional and legal system of economic relations determine the need to change the principles of state systems. There is talk about the possibility of using blockchain technology for state information bases: tax, property, car owners, etc.

The results of the digital economy development, as we can see, greatly improve the political, social and legal life of society.

Not to forget is the impact on the creative process of generating innovative ideas and on the strategic methods to help organizations to make decisions. Here comes the concept of innovation ecosystem.

## B. Born of new types of ecosystems

### *Innovation Ecosystems*

The innovation ecosystem construct has emerged in literature linked to themes as strategy, entrepreneurship and innovation, but also linked to competition.

The business ecosystem construct, followed by the innovation ecosystem construct, emerged as one of most promising approaches in the literature on innovation, strategic management, and entrepreneurship.

Using social network analysis, literature remains concentrated on a small number of authors, notably Moore (1993), Iansiti and Levien (2004a), Adner (2006), and Adner and Kapoor (2010). Many authors use these terms indistinctively. Oh (2016) and L.A. de Vasconcelos Gomes, A.L. Figueiredo Facin, M.S. Salerno, R. Ikenami (2016) have highlighted the need of formalizing these concepts to consolidate the knowledge. The business ecosystem construct, which relate mainly to value capture (Moore, 1993), and innovation ecosystems, having value co-creation as focus.

Today, scholars' attention has been attracted on the developing and activities of the network of actors involved in an organization in the innovative process.
Open innovation (e.g., Chesbrough, 2003) or innovation networks (Lee, 2015) are becoming more and more common.

Adner and Kapoor (2010) argue that complex innovations tend to involve a series of actors, demanding changes not confined to the supply networks (other actors may be impacted, such as regulators). Innovation ecosystems are the answer to address this process of joint venture creation.

Scholars have developed a set of definitions and concepts in a variety of contexts and, in some cases, with different meanings and purposes: digital innovation ecosystem (e.g. Rao & Jimenez, 2011), hub ecosystems (e.g. Nambisan & Baron, 2013), open innovation ecosystem (e.g. Chesbrough, 2014), platform-based ecosystem (e.g. Gawer, 2014).

*Innovation ecosystem* is defined with respect of the features of co-creation of value. It is constituted of interconnected and interdependent networked actors, including firms, customers, suppliers, innovators and agents as regulators. Members face cooperation and competition in the ecosystem, and for this reason this evolves.

The innovation ecosystem construct brings value creation to the center stage and offers a new lens for modeling the collective dimension of value creation.

Innovation ecosystem constructs have been used in the context of entrepreneurship. Some authors, such as Nambisan and Baron (2013), discussed how entrepreneurs participated in a large innovation ecosystem, led by a well-established firm (leader).

Another stream, instead, employed the innovation ecosystem construct as the context in which entrepreneurs obtain important resources for creating value for customers. In this stream, the authors considered that entrepreneurs might build an innovation ecosystem rather than follow the leadership of a firm.

Innovation ecosystem building is a key research area, including decision, pivot implications, and the management of collective uncertainty, those that affect more than one actor in the ecosystem.

An important trend is to employ the innovation ecosystem construct to address radical innovation, new markets, or emerging industries. In these situations, value creation predominates over value capture. Also, in these cases, the relationships among actors are unstable and unclear, co-evolving in unforeseen ways, which may be changing from cooperation to competition.

To consider now the implication of the fast-technologic development, trends such as personal robots, artificial intelligence (AI), synthetic biology, drones, self-driving cars and globalization are influencing the changes that are taking part in our lifestyle. These changes also pose a challenge to innovation ecosystems to go on supporting the needs of the change makers of the future.

To continue to drive change in a profitable direction, it is necessary for innovation ecosystems to focus on the new needs that will develop. For this aim infrastructures achieve an important role, for example University should educate students with a new foresight approach (Munigala, Oinonen & Ekman, 2017).

Innovation ecosystems naturally spread around universities, but this method, the foresight approach, should be used as well by organizations to assist them in decision-making and future preparedness.

The *foresight approach* is defined as a process by which an organization can satisfactorily identify and understand the drivers that impact their long-term futures and that must be considered when making decisions and planning strategies.

This approach consists in qualitative and quantitative ways for discovering forthcoming trends and opportunities. The use of foresight or the strategic foresight approach has been increasing in large companies to increase the innovation competence of organizations (Rohrbeck, Mahdjour, Knab & Frese, 2009).

Innovation ecosystems are characterized by economic as well as non-economic factors. The least play an important role in fostering ideas creation and spilling innovation among all other actors in the ecosystem. These ecosystems facilitate cooperation between members and generation of knowledge for innovation. Indeed, innovations continue to be achieved through the convergence of different technologies.

Nowadays the environment is increasingly digital and connected; this makes riskier innovations due to uncertain business models, high costs, and greater fluidity in the emergence of competitors. These risks can be mitigated in innovation ecosystems. Indeed, these will lead to more effective implementation and profitable innovation.

## *Social Ecosystems*

The formation of entrepreneurial ecosystems is recognized as an activity that can produce economic development and community revitalization. Social entrepreneurship is also an activity related to social and economic problems.

We have until now focused on the role of investors and supporting organization.

*Which could be the role of social entrepreneurs and how can influence the ecosystems functioning?*

Roundy (2016) have found and interrelationship between entrepreneurial ecosystems and social entrepreneurship.

Entrepreneurship is increasingly seen as a driver of economic growth, development, and prosperity (e.g. Acs, 2008). The main actor is the entrepreneur who takes risks (Cantillon, 1931; Knight, 1957), coordinates resources (Say, 1964), and creates opportunities through innovation (Kirzner, 1979; Schumpeter, 1942). Entrepreneurship in modern economies is essential because stimulates wealth creation, influences institutions and develops innovation.

Economic and social policymakers try to push the development of EE because of their capacity of attracting resources as skilled workers from other regions, creating job positions, stimulating innovation and promoting economic growth (Audretsch, 2006).

Efforts in creating and developing EE often are led by the attempt to replicate the economic and social value created by high-profile ecosystems, such as Silicon Valley, Singapore and Tel Aviv (Roundy 2016, Feldman and Francis, 2002).

As an attempt to spur entrepreneurship, economic and social policymakers at all levels have sought to create and strengthen entrepreneurial ecosystems: inter-connected collections of actors, institutions, social structures, and cultural values that produce entrepreneurial activity (e.g. Breznitz and Taylor, 2014; Feld, 2012; Mason and Brown, 2014; Neck et al., 2004; Roundy, 2016; Spigel, 2017; Spilling, 1996; Van de Ven, 1993).

**Social entrepreneurs** create innovative organizations which aim is to resolve social problems using business models and methods. In doing so they use multiple logics: a market logic, which overstate the generation of profits; and a social welfare logic, which goal is the creation of value for public benefit. And this is obtained by solving social problems.

Social entrepreneurs are becoming market actors (e.g. Rymsza, 2015), what it is interesting is which role they can play in shaping entrepreneurial ecosystems. Social entrepreneurs are conceived as those market actors whose “distinctive domain of action […] is addressing neglected problems in society involving positive externalities” (Santos, 2012).

EE will impact social entrepreneurship through activities like supporting organizations, resource diversity, culture, recognizing and creating business opportunities; while social entrepreneurs can draw attention to ecosystems by increasing their attractiveness to internal and external stakeholders.

To give some *definitions*: social entrepreneurship attempts to create business ventures that address societal problems (profit, nonprofit and hybrid forms) and in this way generate positive externalities. Social entrepreneurs often interact with other members of entrepreneurial ecosystems, such as angel investors, incubators, venture capitalists, while managing their ventures.

To make an entrepreneurial ecosystem "hospitable" for the generation and development of social ventures some key factors are needed: diversity resource providers, support organizations, the culture of the ecosystem, and opportunities for vicarious entrepreneurial learning.

The diversity of an entrepreneurial ecosystems in considered in terms of differences in firm types, industries, demographic characteristics and motivations of the actors involved; this property determines the resilience of these complex systems (Roundy, 2016; Adger, 2000) and the ease with which social entrepreneurs scale social ventures. It will benefit social entrepreneurs having a wide array of investors and philanthropists with different tolerance for risk and return, and motivations.

Support infrastructures, as incubators and accelerators, provide entrepreneurs with mentorship, a community of entrepreneurs, office space, capital providers, legal and administrative support (Peters, 2004; Isenberg, 2011). Social entrepreneurs can leverage the resources and network provided by these organizations. But often, they lack in skills necessary to develop a business model.

The **ecosystem culture** consists in values and knowledge shared among the ecosystem's actors. This culture emerges from the repeated interactions between individuals; it reflects and can, as well, influence entrepreneurs.

The importance given to social values creation encourages social activities (Zahra, 2009), influences the perception of risk and failure, as well as the incentive to innovate and experiment (Isenberg, 2011).

Social entrepreneurs can benefit from vicarious learning by observing the outcomes of other successful firms (Baum and Ingram, 1998; Lévesque, 2009). It is in fact very common to enter social entrepreneurship from non-business backgrounds.

In conclusion, the system of actors, institutions, and culture in which social entrepreneurs are situated can influence the founding of such ventures and their success. But also, the activities of social entrepreneurs can influence the formation and functioning of entrepreneurial ecosystems.

Indeed, in entrepreneurial ecosystems the diversity of system components increases its resilience (Limburg, 2002) and this diversity is fostered by the presence of social entrepreneurs, that usually have nontraditional backgrounds and motivations

This provides a variety of opportunities, sources of founding (e.g. impact investors, which pursue social investments because they are seeking both financial return and social value creation (Brest & Born, 2013)) and additional participants into the network of the ecosystem.

Growth in the number of entrepreneurs and investors can strengthen the overall entrepreneurial ecosystem by increasing the amount of entrepreneurial activity taking place in the system. The presence of social entrepreneurs can also enhance the entrepreneurial ecosystem attractiveness thanks to the reduction of social problems; in fact, doing so, there is an improvement of the quality in the ecosystem. As well as, capturing stakeholders' attention and involving the local community.

In conclusion, in addition to the value social entrepreneurs generate for the groups they directly intend to serve, their activities can also produce other benefits which serve to strengthen an entrepreneurial ecosystem and benefit its participants.

## 1.9 Research Questions: Trying to cover a literature gap

The analysis of the common knowledge and literature over the topic of entrepreneurial ecosystems has been carried out in both Italian and International field.

As I presented above, scholars from different countries have studied existing ecosystems, like Silicon Valley (one of the most mentioned) or Tel Aviv, trying to capture the essence of their creation and development. They also have tried to determine what are the key elements which favour this emergence, and the main actors that interact within it.

Some started their studies looking at Universities or Research Labs to explore how these entities enable the spread of innovation, entrepreneurial culture and new technology; indeed, these are the basis for building a strong, well-functioning and time sustaining entrepreneurial ecosystem.

Others put their focus on cities or delimited territorial areas (e.g. clusters) and looking to their inherent characteristics tried to explain the reason of phenomenon of marked technological growth or economic development in general encountered in that restricted area.

Our focus, in this thesis, have in particular been on one of the most recent Erik Stam's work "Measuring Entrepreneurial Ecosystems" (2018) which, by the use of the twelve provinces of the Netherlands as a test case, aimed to measure the characterizing elements of an entrepreneurial ecosystem by composing an index.

Drawing inspiration from his study, we have taken the key elements defined by Stam as impactive on the emergence of entrepreneurial ecosystems as a base and adapted them to the Italian case. The research was carried out at the provincial level, that means following the Nuts3 identifying code.

So, the research goals are the following:

1. Identification and mapping of the Italian Entrepreneurial Ecosystems;
2. Find and describe the cluster models that gather together the varied provinces; detect and compare the clustering models to highlight affinities and differences.

At present there is no literature or analysis that give a complete and detailed insight on the presence of entrepreneurial ecosystems in Italy. And completely none done at the provinces level.

To fill this gap, we want to identify the EE present on the Italian territory, where are located and how they generate and evolve;

After the identification of the clusters that show the presence of EE, determine how these different EE are modelled and describe their characteristics – which are the primary elements and internal dynamics that distingue them.

To conclude, considering the intrusive presence of digitalization and high technology in everyday life, we explored the latest innovations and tried to apprehend the effect that these have on the emergence and development of entrepreneurial ecosystems. In particular, the impact of Artificial Intelligence on the generation of high-tech startups that put this innovation at foundation of their businesses.

# 2 Italian ecosystems: Research setting and method

After analyzing the entrepreneurial ecosystem concept and its expression in different and varied areas of the world, I want to focus on the Italian context, and explore the presence of such ecosystems in this territorial area. Where are located and which kind of models have emerged.

Unlike other regions, Italy is not very extensive on the surface, but it is rich of provinces that are very different from each other due to the territorial structure or the economical and innovative pattern. In order to analyze and find where and which entrepreneurial ecosystems have emerged in the area, I started the research relying on Stam's work: "Measuring Entrepreneurial Ecosystems" (2018).

In this paper, he uses the twelve provinces of the Netherlands as a test case for measuring the entrepreneurial ecosystems elements, composing an index and, at the end, relating this index to the entrepreneurial outputs.

The Netherlands' provinces are in some way comparable to the Italian ones, so it was possible to use the study as baseline for further research on entrepreneurial ecosystems in the Italian setting. As well as, to determine and define their centers of growth, and finding entrepreneurial models in the Italian field.

Considering the main scholars and international papers on the topic, and by comparing the different dimensions that are thought to impact on the creation of entrepreneurial ecosystems, Stam's work has emerged to be complete and schematic. Therefore, we have chosen this structure, that is easier to follow and has specific measurable variables to take inspiration from.

Therefore, following Stam's model and starting from the elements he has identified as impactive for the entrepreneurial ecosystems, we have applied this research pattern to the 109 main Italian provinces. So, the analysis has been done at a provincial level, considering all the provinces of the regions in which the territory is divided; this in order to find the different models of ecosystems existing in the considered area.

The focus of the research has been on the single provinces and not on regions, because we believe that ecosystems have their center in specific cities, and they spread from them.

Therefore, our data setting follows the Nuts3 scheme, in which each province city has an identification code with respect of the position in the Italian territory (north, east, etc.) and the region of belonging.

## Database creation

After having established the scale level for the analysis, I focused on each of the elements find in literature as impactive in the process of the generation of an Entrepreneurial Ecosystem.

The dimensions considered are: Demand, Entrepreneurial Culture, Formal Institutions, Physical Infrastructures, Talent, Networks, New Knowledge, Finance, Leadership and Support services/ Intermediaries.

The analysis has begun with the identification of indicators to describe each element. So, for each dimension, I have found some measurable variable to outline which of these better express and explain the abovesaid key elements for the generation of entrepreneurial ecosystems.

Subsequently, in relation with each of the defined variables, I started the search of data using mainly Italian, European and university studies-based datasets. The creation of the dataset for the analysis was complex and long, also because of the different nature of the data (e.g. different time range and scale).

All the data found were based on observations in different years and ranges of time. For this reason, the first thing to do was making them comparable by defining a smaller and common range.

According to the available data the time-range selected is: 2012-2018. But the statistical analysis needed a unique value for each variable; It was then necessary to apply a cross-section analysis to extract a single value for each variable referred to each city at the Nuts3 level. Because each factor has been composed by two or more variables that would explain its effect on the province and so on the emergence of an EE.

The time period wasn't the only difficulty: also, the unit of measure had to be considered to confront the variables referred to a single entrepreneurial dimension. Some, in fact, were expressed in 'number of', while others in percentages or rates.
After different attempts, to overcome the hump we decided to normalize the data and then start with the real analysis phase.

## Method and statistic tools

Using STATA as statistic software, I have been able to reshape data (panel structure), choose the range, and do a cross-section analysis based on the average value of the considered period.

Furthermore, to have all the data comparable these were normalized, and the first analysis has been set: a confirmatory factor analysis, to define if each variable found was really linked with the referential dimension.

After finding the variables that better describe and help determine to effect of each element on the emergence of EE, and this because they correlate to one single factor, a Cluster analysis has been set.

The cluster analysis permit to find where, at the considered Nuts level, entrepreneurial ecosystems are present, and which kind of models lead their born and development.

The same model structure can exist in different areas of the Italian territory, so entrepreneurial ecosystems can have similar characteristics despite the distance. Or have a strong singular identity because of a factor that has a marked influence on that ecosystem.

The principal steps of the analysis con be synthetized as follows:

1. Cross-section analysis and normalization of the data – structure and organize the database to be complete and clean for the analysis;

2. Confirmatory factor analysis – define the variables related to each of the Stam's elements;

3. Cluster Analysis – identify and map EE in Italy.

## 2.1 Database creation and data description

Below you can see the description of each element considered in the analysis as fundamental for the generation and development of entrepreneurial ecosystems, as well as the relative chosen variables.

The variables were chosen in order to try to better measure and describe each dimension. Sometimes it has been difficult to find specific datasets linked with the key elements, so we have done a selection taking account of the available data.

All these variables where then tested to confirm their relationship with the referential dimension.

The following table, used to structure the database, is designed and organized in 5 columns:

- Elements: dimensions affecting the entrepreneurial ecosystem creation and development;
- Description: at what, in words, that element refers to;
- Indicators: the main areas/topics covered by the relative element;
- Variables: the name of each single variable that was included in the test. Variables that were thought in order to measure and explain the effect of the reference element on the growth and evolution of EE.

| Elements | Description by E. Stam | Indicators | Variables | Variable_name |
|---|---|---|---|---|
| Demand | Measured as a composite composing of disposable income per capital and two measures of potential market demand (estimation of GDP and population) | GDP | Gross Domestic Product | gdp_ |
| | | Population per Prov | Population qty | pop_ |
| | | Employment (Number) | Employment (Number) | employment_ |
| | | Foreigners | Foreign population | foreign_ |
| | | Economic welfare | Average annual remuneration | remun_ |
| Entrepreneurial Culture | Reflects the degree to which entrepreneurship is valued in society. Measured with the prevalence of new firms (how common starting up a business is in a particular region) | Business economics | Births of enterprises | birthenterprice_ |
| | | | Active companies | actcompanies_ |
| | | | Discontinued businesses | inactcompanies_ |
| | | | Startups | Startups_ |
| | | | Startups AI | AI_ |
| Finance | Supply and accessibility of finance for new and small firms is an important condition for their growth. Measured with the success rate in acquiring banck finances. | | Investors | investors_ |
| | | | Banks | banks_ |
| | | | Decay rate | decayrate_avg |
| Leadership | Provide guidance for and direction of collective action. Measured with the prevalence of innovation projects leaders. | | Partecipanti | pertecip_ |
| | | | Coordinatori | coordin_ |
| Support services/Intermediaries | The supply and accessibility of intermediate business services | | Acceleratori e Incubatori | incubators_ |
| Generation of AI | | Startups | Number of AI startups | AI_ |

| | | | | |
|---|---|---|---|---|
| **Formal institutions** | Quality & efficiency of institutions: education, healthcare, law enforcement, government effectiveness…etc. | Health | Mortality rate (per ten thousand val | mortrate_ |
| | | | Number of total deaths | deaths_ |
| | | | Public & Privat Hospitals | hosp_ |
| | | | Infant mortality rate | infmortrate_ |
| | | | Infant mortality deaths | infdeaths_ |
| | | Politics&Institutions | Municipal women administration | admwomen_ |
| | | | Election participation | electpart_ |
| | | Safety | Road accidents rates | rateroadacc_ |
| | | | Number road accidents | nroadacc_ |
| | | | Road mortality | roadmort_ |
| | | | Number of robberies | nrobb_ |
| | | | Number of pickpoketings | pick_ |
| | | | Number of House robberies | houserob_ |
| | | | Thefts rate | ratethefts_ |
| | | | Number of thefts | nthefts_ |
| | | | Number of homicides | nhomic_ |
| | | | Intentional homicides rate | homicrate_ |
| | | Services | Density of cycle paths | cycle_ |
| | | | Pedestrian area | ped_ |
| | | | Social services | socserv_ |
| | | | Children services | infserv_ |
| | | | Participation in kindergarden | infpart_ |
| | | | Pollution level | pollutionlev_ |
| | | | Transfer urban waste | transpwaste_ |
| | | | Municipal waste | waste_ |
| | | | Recycling waste | diffwaste_ |
| | | | Motorization rate | motorate_ |
| | | | Density undeground network | undergtrans_ |
| | | | Density bus transport | bustrans_ |
| | | | Demand for public transport | dempubtrans_ |
| | | | Annual number passengers on put | pubpasseng_ |
| | | Education | Participation in kindergarden | infpart_ |
| | | | Numero/Elenco scuole per prov | nschool_ |
| | | | Number of Univeristies | nuniversities_ |
| | | | Total number of full professors | prof_ |
| **Physical Infrastructure** | Composite measure including indicators of motorway and railway potential accessibility and the number of passenger flights | Air Transport | Movements | airtrans_ |
| | | | Passengers | airpassenger_ |
| | | Underground | Density undeground network | undergtrans_ |
| | | Bus transport | Density bus transport | bustrans_ |
| | | Demand for public transport | Demand for public transport | dempubtrans_ |
| | | l number passengers on public tr | Annual number passengers on put | pubpasseng_ |
| **Talent (Human capital)** | Indicated by the prevalence of individuals with high levels of human capital. Measured with the share of population with a higher education degree. | Graduate students | Mobility of italian graduates | mobilgrad_ |
| | | Graduated students ISCED 6 | Number of graduated students ISC | gradisced6_ |
| | | Graduated students ISCED 7 | Number of graduated students ISC | gradisced7_ |
| | | Graduated students ISCED 8 | Number of graduated students ISC | gradisced8_ |
| **Netwoks** | Connectedness of businesses for new value creation. Measured as the percentage of businesses in a region that | | Depositi | depisiti |
| | | | Brevetti concessi | concessioni |
| | | | Coassegnazioni | coassegnazioni |
| **New Knowledge** | Investments in new knowledge | Innovation | Patent Intensity | patentintensity_ |
| | | | Patent applications | npatent_ |
| | | | High-tech Patent applications | hightechpatent_ |
| | | | Patents without assigned technolo | domande_mancante_tecnologia |
| | | | Low technology patents | depositi_bassa_tecnologia |
| | | | Medium-low technology patents | depositi_medio_bassa_tecnologia |
| | | | Medium-high technology patents | depositi_medio_alta_tecnologia |
| | | | High-tech patent | depositi_alta_tecnologia |

*Figure 2 - Database table structure*

## 2.2 Statistic Method and Tools

STATA has been used as software of statistics for making the analysis. This software has been chosen because It is well-rounded and commonly used by researchers to meet their data science needs. With STATA you can obtain and manipulate data, explore, visualize, model, make inferences and collect results into reproducible reports.

### Factor Analysis: Method

Following the decision of the tool to use and the data collection, the central and most time-consuming part of the work was the execution of statistical analysis.

A Confirmatory factor analysis have been done according to each identified element to test if the set of variables identified (since are assumed) truly fit in the correspondent dimension; below the description of the method.

The *Factor Analysis* is used for data reduction purposes:

• To get a small set of variables (preferably uncorrelated) from a large set of variables (most of which are correlated to each other);

• To create indexes with variables that measure similar things (conceptually).

Instead, in the Confirmatory Analysis you want to test specific hypothesis about the structure or the number of dimensions underlying a set of variables (i.e. in your data you may think there are two dimensions and you want to verify that). This is what we wanted to do and test in connection with our dataset.

To be more specific about the method to exploit the analysis: firstly, to start the analysis on STATA, is good to check on the dataset imported; the one that we want to test.
The command *describe* depicts the data in memory and the variables composing it (their type and format); *summarize* calculates and displays a variety of univariate summary statistics. If no *varlist* is specified, summary statistics are calculated for all the variables in the dataset.

The variables need to exhibit a certain degree of correlation. We use the command *pwcorr* to display all pairwise correlation coefficients.

In STATA we use the command *factor (followed by all the variables we want to consider)* to run the Factor Analysis.

Follows an example of the output you get:
this is the result we get from the *Demand* dimension

```
8 . factor $xlist
  (obs=103)

  Factor analysis/correlation                  Number of obs    =        103
      Method: principal factors                Retained factors =          3
      Rotation: (unrotated)                    Number of params =         10

      Beware: solution is a Heywood case

              (i.e., invalid or boundary values of uniqueness)
```

| Factor | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| Factor1 | 4.03463 | 3.68894 | 0.9203 | 0.9203 |
| Factor2 | 0.34569 | 0.32841 | 0.0789 | 0.9991 |
| Factor3 | 0.01728 | 0.02198 | 0.0039 | 1.0031 |
| Factor4 | -0.00470 | 0.00414 | -0.0011 | 1.0020 |
| Factor5 | -0.00884 | . | -0.0020 | 1.0000 |

```
    LR test: independent vs. saturated:  chi2(10) = 1105.93 Prob>chi2 = 0.0000

  Factor loadings (pattern matrix) and unique variances
```

| Variable | Factor1 | Factor2 | Factor3 | Uniqueness |
|---|---|---|---|---|
| gdp_avg | 0.9866 | 0.0182 | -0.0520 | 0.0237 |
| pop_avg | 0.9487 | -0.2895 | 0.0568 | 0.0129 |
| empl_avg | 0.9967 | -0.0656 | 0.0474 | -0.0001 |
| foreign_avg | 0.9846 | 0.1025 | -0.0765 | 0.0142 |
| remun_avg | 0.4453 | 0.4967 | 0.0571 | 0.5517 |

*Figure 3 - Demand: CFA output*

The first column shows the number of factors. Using only a few factors instead of many items reduces its precision, because the factors cannot represent all the information included in the items.

Consequently, there is a trade-off between simplicity and accuracy. In order to make the analysis as simple as possible, we want to extract only a few factors. At the same time, we do not want to lose too much information by having too few factors. This trade-off must be addressed in any PCA and factor analysis when deciding how many factors to extract from the data.

The second column display the eigenvalues, which means the total variance accounted by each factor. To remember is that the sum of all eigenvalues is equal to the total number of variables. When negative, the sum of eigenvalues is equal to the total number of factors (variables) with positive eigenvalues. The Kaiser criterion suggests retaining those factors with eigenvalues equal or higher than 1.

The third column shows the difference between one eigenvalue and the next. Then, “Proportion” indicate the relative weight of each factor in the total variance (this since the sum of total variance=total number of variables).

Lastly, “Cumulative” shows the amount of variance explained by n+(n-1) factors.

We have than the output of *Factor loadings*, that represent the weights and correlations between each variable and the factor. The higher the load the more relevant in defining the factors’ dimensionality. A negative value indicates an inverse impact on the factor.

To interpret the solution, we have to determine which variables relate to each of the factors extracted. We do this by examining the factor loadings, which represent the correlations between the factors and the variables and can take values ranging from -1 to +1. A high factor loading indicates that a certain factor represents a variable well.

Subsequently, we look for high absolute values, because the correlation between a variable and a factor can also be negative. Using the highest absolute factor loadings, we “assign” each variable to a certain factor and then produce a label for each factor that best characterizes the joint meaning of all the variables associated with it.

We can make use of factor rotation to facilitate the factors’ interpretation. We do not have to rotate the factor solution, but it will facilitate interpreting the findings, particularly if we have a reasonably large number of items.

So, to get final solution is better to rotate the factor loads and, in this way, get a “cleaner” pattern. Various orthogonal rotation methods exist, all of which differ with regard to their treatment of the loading structure.

The varimax rotation (the default option for orthogonal rotation in Stata) is the best-known one; this procedure aims at maximizing the dispersion of loadings within factors, which means a few variables will have high loadings, while the remaining variables’ loadings will be considerably smaller (Kaiser 1958).

Alternatively, we can choose between several oblique rotation techniques. In oblique rotation, the 90° angle between the factors is not maintained during rotation, and the resulting factors are therefore correlated. Promax rotation (the default option for oblique rotation in Stata) is a commonly used oblique rotation technique. The Promax rotation allows for setting an exponent (referred to as Promax power in Stata) that needs to be greater than 1. Higher values make the loadings even more extreme (i.e., high loadings are amplified, and weak loadings are reduced even further), which is at the cost of stronger correlations between the factors and less total variance explained (Hamilton 2013).

The command to use in STATA to implement this rotation is *rotate,* and the most common type of rotation used is VARIMAX which produces orthogonal factors. This means that factors are not correlated to each other.

This setting is recommended when you want to identify variables to create indexes or new variables without inter-correlated components. The varimax rotation (the default option for orthogonal rotation in Stata) is the best-known one; this procedure aims at maximizing the dispersion of loadings within factors, which means a few variables will have high loadings, while the remaining variables' loadings will be considerably smaller (Kaiser 1958).

Below the example of output after implementing the factor analysis and the rotation command:

```
17 . factor $xlist
   (obs=103)

   Factor analysis/correlation                        Number of obs    =        103
       Method: principal factors                      Retained factors =          3
       Rotation: (unrotated)                          Number of params =         10

       Beware: solution is a Heywood case
               (i.e., invalid or boundary values of uniqueness)
```

| Factor | Eigenvalue | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| Factor1 | 4.03463 | 3.68894 | 0.9203 | 0.9203 |
| Factor2 | 0.34569 | 0.32841 | 0.0789 | 0.9991 |
| Factor3 | 0.01728 | 0.02198 | 0.0039 | 1.0031 |
| Factor4 | -0.00470 | 0.00414 | -0.0011 | 1.0020 |
| Factor5 | -0.00884 | . | -0.0020 | 1.0000 |

```
       LR test: independent vs. saturated:  chi2(10) = 1105.93 Prob>chi2 = 0.0000

   Factor loadings (pattern matrix) and unique variances
```

| Variable | Factor1 | Factor2 | Factor3 | Uniqueness |
|---|---|---|---|---|
| zgdp | 0.9866 | 0.0182 | -0.0520 | 0.0237 |
| zpop | 0.9487 | -0.2895 | 0.0568 | 0.0129 |
| zempl | 0.9967 | -0.0656 | 0.0474 | -0.0001 |
| zforeign | 0.9846 | 0.1025 | -0.0765 | 0.0142 |
| zremun | 0.4453 | 0.4967 | 0.0571 | 0.5517 |

*Figure 4 – Demand: Factor Analysis*

```
9 . rotate, varimax  blanks(0.30)

  Factor analysis/correlation                        Number of obs    =        103
      Method: principal factors                      Retained factors =          3
      Rotation: orthogonal varimax (Kaiser off)      Number of params =         10

      Beware: solution is a Heywood case
              (i.e., invalid or boundary values of uniqueness)
```

| Factor | Variance | Difference | Proportion | Cumulative |
|---|---|---|---|---|
| Factor1 | 3.68423 | 2.99455 | 0.8404 | 0.8404 |
| Factor2 | 0.68968 | 0.66598 | 0.1573 | 0.9977 |
| Factor3 | 0.02370 | . | 0.0054 | 1.0031 |

```
LR test: independent vs. saturated:  chi2(10) = 1105.93 Prob>chi2 = 0.0000
```

Rotated factor loadings (pattern matrix) and unique variances

| Variable | Factor1 | Factor2 | Factor3 | Uniqueness |
|---|---|---|---|---|
| gdp_avg | 0.9328 | 0.3149 | | 0.0237 |
| pop_avg | 0.9918 | | | 0.0129 |
| empl_avg | 0.9685 | | | -0.0001 |
| foreign_avg | 0.9050 | 0.3918 | | 0.0142 |
| remun_avg | | 0.6124 | | 0.5517 |

Factor rotation matrix

| | Factor1 | Factor2 | Factor3 |
|---|---|---|---|
| Factor1 | 0.9513 | 0.3067 | 0.0307 |
| Factor2 | -0.3082 | 0.9471 | 0.0897 |
| Factor3 | 0.0015 | 0.0947 | -0.9955 |

*Figure 5 - Demand: orthogonal rotation of factors*

It shows only the factors with eigenvalues ≥ 1. The pattern matrix offers a clearer picture of the relevance of each variable in the factor. So, we can see that is we got 2 factors one con be defined better by some variables, while the other by different variables. The Factor rotation matrix is a conversion matrix to estimate the rotated factor loadings (RFL)

RFL= Factor loadings * Factor rotation

After rotating the factors, we need to interpret them and give each factor a name, which has some descriptive value. Interpreting factors involves assigning each variable to a specific factor based on the highest absolute loading.

In particular, our case is a C*onfirmatory Factor Analysis* that allows for testing hypothesized structures underlying a set of variables. In a confirmatory factor analysis, the researcher needs to first specify the constructs and their associations with variables, which should be based on previous measurements or theoretical considerations.

Instead of allowing the procedure to determine the number of factors, as is done in an exploratory factor analysis, a confirmatory factor analysis tells us how well the actual data fit the pre-specified structure.

In a confirmatory factor analysis, we set up a theoretical model linking the items with the respective construct (researchers generally use the term construct rather than factor). This process is also called operationalization and usually involves drawing a visual representation (called a path diagram) indicating the expected relationships.

Reliability analysis is an important element of a confirmatory factor analysis and essential when working with measurement scales. The preferred way to evaluate reliability is by taking two independent measurements (using the same subjects) and comparing these by means of correlations. This is also called test-retest reliability.

However, with many indicators, there are many different ways to split the variables into two groups. Cronbach (1951) proposed calculating the average of all possible split-half coefficients resulting from different ways of splitting the scale items.

The *Cronbach's Alpha coefficient* has become by far the most popular measure of internal consistency. It varies from 0 to 1, whereas a generally agreed lower limit for the coefficient is 0.70. It is also noteworthy, when calculating Cronbach's Alpha, to ensure that all items are formulated in the same direction (positively or negatively worded).

The next step in reaching results and findings according to the aim of the paperwork is a *Cluster analysis.*

This is to finally define where we can see the presence of an entrepreneurial ecosystem in the Italian area, and which model characterize each of them.

After finding the n clusters it is possible to describe and name them; value and explore in each of these the presence of start-ups based on high technology, and specifically on Artificial Intelligence. So, how these concentrates and force the emergence of ecosystems.

## 2.3 Implementation of the Factor Analysis

The database has been divided into the main elements of research. To describe and measure each dimension we found different variables; after naming and commenting them, I have chosen a time range as a base for making the analysis the more similar as possible for all the considered elements. And make sure that the data were at the provinces level, so follow the Nuts3 structure.

Mainly, the research for data to populate the database has been run on the Istat and Eurostat public data, Register of companies, Crunchbase and on the MIUR data source.

After reshaping the data, putting them in panel, the cross-section analysis has allowed to converge them into a unique value based on the average of the selected time range.

Firstly, the FA have been run with the data in their original scale/measure type, so not always effectively comparable. But results weren't good enough to get a robust analysis.

The Cronbach' alpha was often lower than 0.7; being this is a test that express the consistency of the analysis the results weren't good enough.

Furthermore, we decided to normalize the data, that means scale them to a [0,1] range. In this way, repeating the factor analysis results were more consistent and robust.

The table below shows the ultimate values of the test, all above the minimum level of acceptance 0.7.

| Dimension | Cronbach's Alpha |
|---|---|
| Demand | 0.98 |
| Entrepreneurial culture | 0.74 |
| Formal Institutions | 0.98 |
| Physical Infrastructures | 0.95 |
| Talent | 0.82 |
| Networks | 0.98 |
| New Knowledge | 0.97 |
| Finance | 0.91 |
| Leadership | 0.99 |

*Figure 6 - Detail on Cronbach's alpha values*

To explain the analysis' process, I start with the description of the dimensions:

## Demand

To measure the element "Demand" we have used: GDP, the Gross Domestic Product; population in number, split into total and share of foreign residents; economic welfare, so the average annual remuneration; and the number of workers employed.

## Entrepreneurial Culture

Reflecting the value of entrepreneurship in society, it has been measured using the number of actual active companies, how many enterprises arise every year, and the number of new startups every year. Notably, we have considered the total number of births of startups, but the ones related to Artificial Intelligence were also accounted singularly.

## Formal Institutions

To simplify this important and complex element, we have divided the variables into five subgroups: Health, Safety, Politics & Government bodies, Public Services, and Education.

Health includes – number of deaths, total number and the proportion of childhood deaths; the number of private and public hospitals in the province.

Safety, in terms of city life – traffic safety, road mortality and road accidents rate/number; number of thefts, robberies, pickpocketing, and number of homicides.

Politics & Government bodies means the participation of population during elections, this is to say how many people go to the polls and vote; and the number of women employed in municipal administration.

Public services are all the services that a citizen have in place. The density of cycle paths and pedestrian area; social services, for adults, family, children, people with disabilities and elderly persons; the pollution level and the quantity of municipal waste (recycling and not); and the motorization rate, so the use of cars in that area.

Education is the expression of the possibility given by the state or private institution of acquiring knowledge and so get different education levels. It is measured with the presence of schools, from kindergarten to universities, and the number of full professors employed.

## Physical Infrastructure

It deals with the various types of transports, that permit a better accessibility to the area. Air transport, considering movements and number of passengers; presence of underground lines; density of bus transport; demand for public transport and the annual number of passengers on public transport.
We didn't manage to find usable data on the roadway or railway paths.

## Talent & Human Capital

Focus on people with a high education level, so the measurements used are based on the number of graduated students in the ISCED classification (International Standard Classification of Education). We used data on ISCED 6 graduates, bachelor's degree, ISCED 7, Master's or equivalent level, and ISCED 8 correspondent to the doctoral.

## Networks

Networks are fundamental for value creation. In the technology field, to measure this dimension, we considered the number of filing patents, shared allocations and patents that are effectively granted. Innovation means doing something new that improves a product, process or service. Many innovations can be protected through intellectual property rights (IP), and patenting in this field is often crucial. Patents protect the interests of inventors whose technologies are truly groundbreaking and commercially successful, by ensuring that an inventor can control the commercial use of their invention. Talking about start-ups, holding a patent makes a small business more attractive to investors who play a key role in enabling the commercialization of a technology. The patenting process can spark new ideas and promote new inventions from which we can all benefit and which may, in turn, qualify for patent protection.

## New Knowledge

For New knowledge we mean all investments done with the aim of generating ideas, innovation, and knowledge that is new and even disruptive. So, we consider the number of patens application, in general and specific for the high-tech ones, and the intensity of patenting. IT is strictly connected with innovation and newness.

## Finance

Not so many data were available, but it was possible to find data of the number of Italian investors (in the startup field) and banks that make loans. As well as the cash loan decay rate. Without funding it is impossible for entrepreneurs to develop their business idea and enter in the market.

## Leadership

The development of an entrepreneurial culture is forced by the presence of mentors and successful entrepreneurs. In order to provide guidance and direction for collective action, leadership is measured with the prevalence of innovation projects leaders, so with the number of coordinators and participants in innovative and high-technology projects.

## Support services & intermediaries

They supply and support the development of innovation and the birth of new start-ups. They are mainly accelerators, incubators, linked to a university, innovation labs or spin offs of leader firms.

For each of these elements we performed a specific confirmatory factor analysis.

Here follows one output as an example of the work done:

The *Networks* element, considered one of the most important for the generation of a strong and well-functioning ecosystem, has been measured with three variables linked to patent filing – deposits, concessions and co-allocation.

The first part of the analysis is used to verify the correctness of data in storage and format, and their correlation level.

Then, the implementation of the *factor* command for the analysis.

```
3 . describe $xlist

                 storage   display    value
 variable name    type     format     label      variable label
 ---------------------------------------------------------------------------------
 zdepositi        float    %9.0g                 Standardized values of (depositi_agv)
 zconcessioni     float    %9.0g                 Standardized values of (concessioni agv)
 zcoassegnazioni  float    %9.0g                 Standardized values of (coassegnazioni_agv)

4 . summarize $xlist

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+---------------------------------------------------------
   zdepositi |        108    5.86e-10           1  -.6175832   6.793345
zconcessioni |        108    7.63e-10           1  -.5854484   6.850431
zcoassegna~i |        108    4.25e-09           1  -.6491613    6.71741

5 . pwcorr $xlist, star (.01)

             | zdepos~i zconce~i zcoass~i
-------------+---------------------------
   zdepositi |   1.0000
zconcessioni |   0.9975*  1.0000
zcoassegna~i |   0.9306*  0.9181*  1.0000

6 . factor $xlist
(obs=108)

Factor analysis/correlation                      Number of obs    =        108
    Method: principal factors                    Retained factors =          2
    Rotation: (unrotated)                        Number of params =          3

    --------------------------------------------------------------------------
         Factor  |   Eigenvalue   Difference        Proportion   Cumulative
    -------------+------------------------------------------------------------
        Factor1  |      2.85977      2.83703            0.9933       0.9933
        Factor2  |      0.02274      0.02627            0.0079       1.0012
        Factor3  |     -0.00353            .           -0.0012       1.0000
    --------------------------------------------------------------------------
    LR test: independent vs. saturated:  chi2(3)  =  794.87 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances
```

```
Networks_norm  Friday February 14 14:33:47 2020   Page 2

    Variable |  Factor1   Factor2 |   Uniqueness
-------------+--------------------+--------------
   zdepositi |   0.9990   -0.0262 |      0.0014
zconcessioni |   0.9947   -0.0868 |      0.0030
zcoassegna~i |   0.9340    0.1205 |      0.1131
----------------------------------------------

7 . rotate, varimax blanks (0.3)

Factor analysis/correlation                  Number of obs    =        108
    Method: principal factors                Retained factors =          2
    Rotation: orthogonal varimax (Kaiser off)  Number of params =          3

      Factor |     Variance   Difference        Proportion   Cumulative
-------------+-----------------------------------------------------------
     Factor1 |      1.91179      0.94107            0.6641       0.6641
     Factor2 |      0.97072            .            0.3372       1.0012
-------------------------------------------------------------------------
    LR test: independent vs. saturated:  chi2(3)  =  794.87 Prob>chi2 = 0.0000

Rotated factor loadings (pattern matrix) and unique variances

    Variable |  Factor1   Factor2 |   Uniqueness
-------------+--------------------+--------------
   zdepositi |   0.8303    0.5561 |      0.0014
zconcessioni |   0.8619    0.5041 |      0.0030
zcoassegna~i |   0.6925    0.6382 |      0.1131
----------------------------------------------
    (blanks represent abs(loading)<.3)

Factor rotation matrix

             |  Factor1  Factor2
-------------+-------------------
     Factor1 |   0.8160   0.5781
     Factor2 |  -0.5781   0.8160
---------------------------------
```

*Figure 7 - Factor Analysis Output*

As we can see all the variables converge to one unique factor, named Network. To test the reliability of the analysis it is good to look at the Cronbach's Alpha coefficient. We got a value of 0.98 that is > 0.7, so the analysis can be considered consistent.

```
8 . alpha zdepositi zconcessioni zcoassegnazioni

  Test scale = mean(unstandardized items)

  Average interitem covariance:     .9487439
  Number of items in the scale:            3
  Scale reliability coefficient:      0.9823
```

*Figure 8 - Cronbach's Alpha Test*

```
9 . estat kmo

  Kaiser-Meyer-Olkin measure of sampling adequacy
```

| Variable | kmo |
|---|---|
| zdepositi | 0.5978 |
| zconcessioni | 0.6196 |
| zcoassegna~i | 0.7977 |
| Overall | 0.6578 |

*Figure 9 - KMO measure*

The analysis has confirmed the linkage between the dimension and the relative variables. Some of them were excluded because not really correlated to the others or not explicative of the element considered. But in general, we have received confirmation of the correctness of the analysis' method and have determined which variables have to be included in the analysis for the search of EE.

## 2.4 Cluster Analysis and Results

The Cluster Analysis concerns a set of procedures and methodologies useful to derive from one data population a group structure. In particular, clustering techniques point to bundle the considered statistical units (objects) into groups (clusters), with the aim of creating groups that are maximally homogeneous within them and maximally heterogeneous among them.

Running the analysis, we obtained **seven** different **clusters** in which the Italian provinces were divided, as the figure 8 below shows.

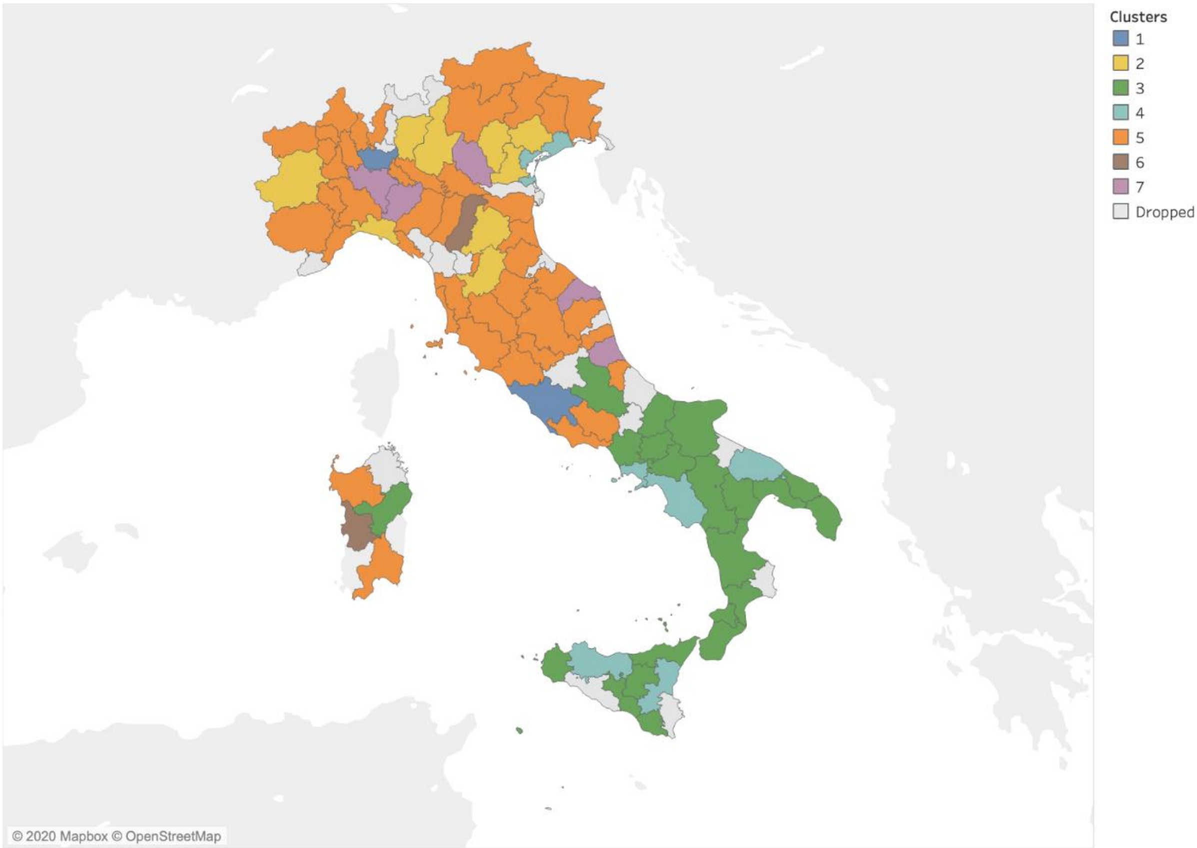


*Figure 10 - Cluster Analysis Output*

Figure 8 shows the different Italian provinces grouped in clusters, which are identified with specific colors. Some of them have been dropped, so they have been left out from the analysis because there were too many missing data and information on these provinces.

Indeed, a cluster analysis is robust and well explaining of the phenomena when data are the most complete as possible.

The overall picture is that clusters are localized in precise territorial areas. *Cluster 5,* in orange, covers the northern and central provinces of Italy; while *Cluster 3* (green) and *4* (light blue) the southern area, Sicilia island, and part of the center.

We can see that Sardegna island has an abnormal situation - various cluster models are present on its surface. It is possible that this anomaly is due to the geographic distance from the other provinces on the peninsula.

So, clusters are very explicative of the territorial characteristic of the provinces are made up of.

In detail we can see how the different provinces are subdivided in each cluster:

- Cluster 1 (in blue) is composed only by the provinces of Milano and Roma;
- Cluster 2 (in yellow) include Torino, Genova, Bergamo, Brescia, Vicenza, Treviso, Padova, Bologna, Firenze;
- Cluster 3 (in green) is constitute of the provinces of L'Aquila, Campobasso, Caserta, Benevento, Avellino, Taranto, Brindisi, Lecce, Foggia, Potenza, Matera, Cosenza, Catanzaro, Vibo Valentia, Reggio di Calabria, Trapani, Messina, Caltanissetta, Enna, Ragusa, Nuoro;
- Cluster 4 (in light blue): Napoli, Salerno, Bari, Palermo, Catania, Venezia;
- Cluster 5 (in orange): Vercelli, Biella, Verbano, Novara, Cuneo, Asti, Alessandria, Aosta, Savona, La Spezia, Varese, Como, Lodi, Cremona, Mantova, Pescara, Sassari, Cagliari, Bolzano, Trento, Belluno, Pordenone, Udine, Gorizia, Parma, Reggio nell'Emilia, Ferrara, Ravenna, Forlì-Cesena, Prato, Livorno, Pisa, Arezzo, Siena, Grosseto, Perugia, Terni, Pesaro e Urbino, Macerata, Ascoli Piceno, Viterbo, Latina, Frosinone;
- Cluster 6 (in brown): Oristano e Modena;
  Cluster 7 (in purple): Pavia, Teramo, Verona, Piacenza, Ancona.

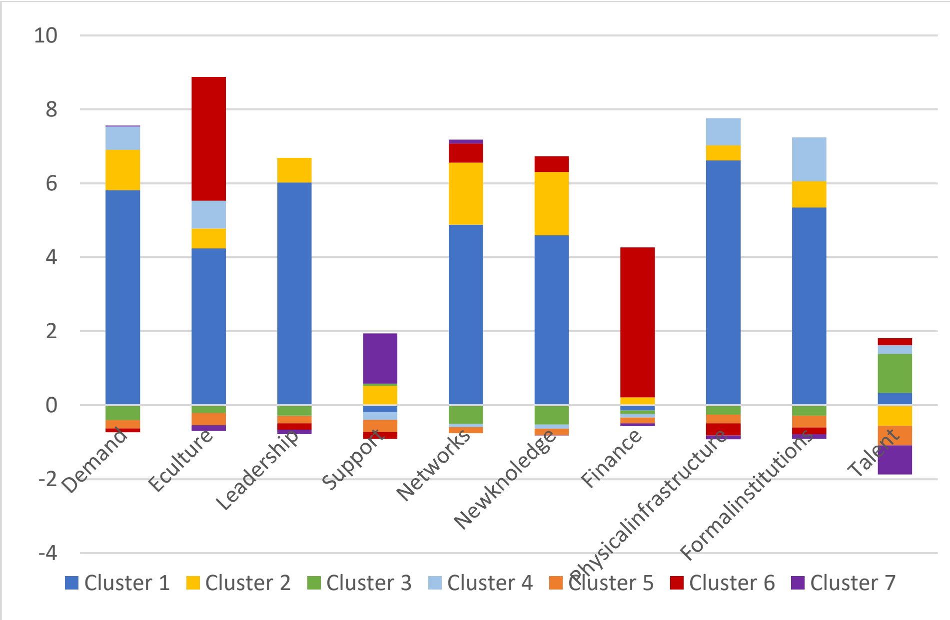


*Figure 11 - Impact of each factor on the 7 clusters found*

Focusing our attention on *Cluster 1* that is made up of only 2 provinces -Milano and Roma- the most extensive provinces in Italy. So, it is notable that the analysis shows them together anole in one unique cluster. Indeed, these have a very high population number – 3,26M Milano and 4,6M Roma- and a significant GDP level – Milano, where the major foreign investments are located, has a per capita value above the mean of the other Italian provinces. These variables affect the Demand factor.

Additionally, the Entrepreneurial culture is widespread and nowadays it can be seen as a pervasive way of thinking – being an entrepreneur is considered a valuable choice thanks to the opportunities given by investors that believe in new startups projects.

Particularly, in *Cluster 1*, Roma has the largest number of births of new companies followed by Milan. And these have as well the major number of universities and schools, where this culture is emerging and growing.

Patenting activities, that affects both "New Knowledge" and "Networks" elements are fully developed in the province of Milano. A large number of patent applications are done every year, and many of them are related with high technology innovations – for this reason we can notice the highest number of startups present and born in the area.

Above a picture focused on Cluster 1

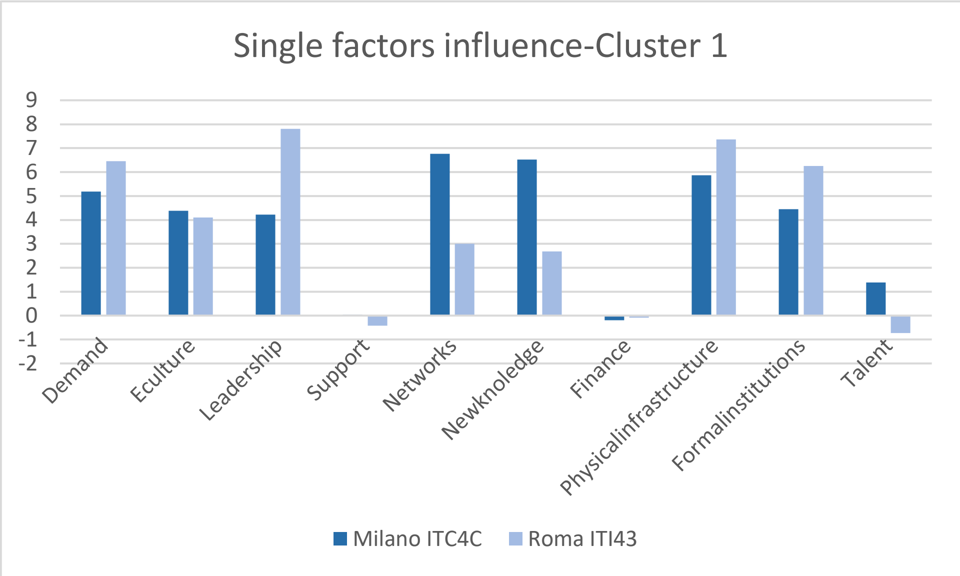


*Figure 12 - Single factors influencing Cluster 1*

Instead, *Cluster 3* is positively influenced by the variables linked to the factors: Support services and Talent. The presence of new incubators and startups accelerators is gradually affecting the entrepreneurial activities and the development of a culture that encourage starting a new business. Furthermore, in the last years, the effect of a growing percentage of people studying and so raising the mean education level is having a very positive influence in the development of networks that foster the development of entrepreneurial ecosystems.

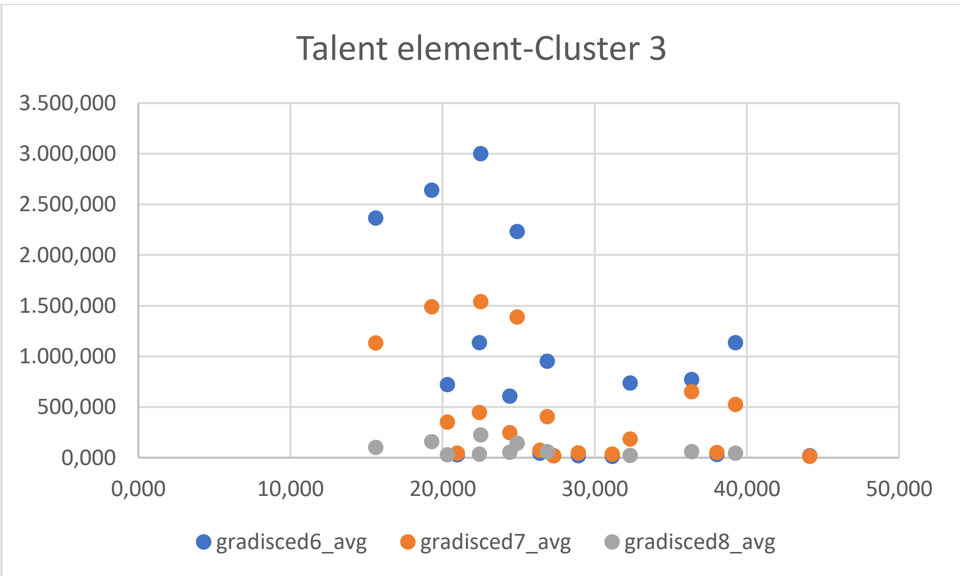


*Figure 13 - Impact of Talent dimension on provinces of Cluster 3*

Instead, the demand factor- made up of - GDP level, population, employment, foreign population and average annual remuneration- doesn't emerge as a leading element in the process of developing an entrepreneurial ecosystem.

Provinces of *Cluster 3* have a developed Network. But, as we can see, Physical infrastructures are best-functioning and their presence is more developed in the provinces that make up *Cluster 5*.

*Cluster 5* have a strong concentration of high educated people. Thanks to the presence of research labs and well-known universities, the presence of students with a considerable degree level is relevant.

As well as, these provinces are characterized by a high level of patent intensity. This enables the development a significant level of new knowledge generation in terms of innovation and new startups. The entrepreneurial network is growing stronger and this promote the embedding of an entrepreneurial culture and the activities of leadership mentors.

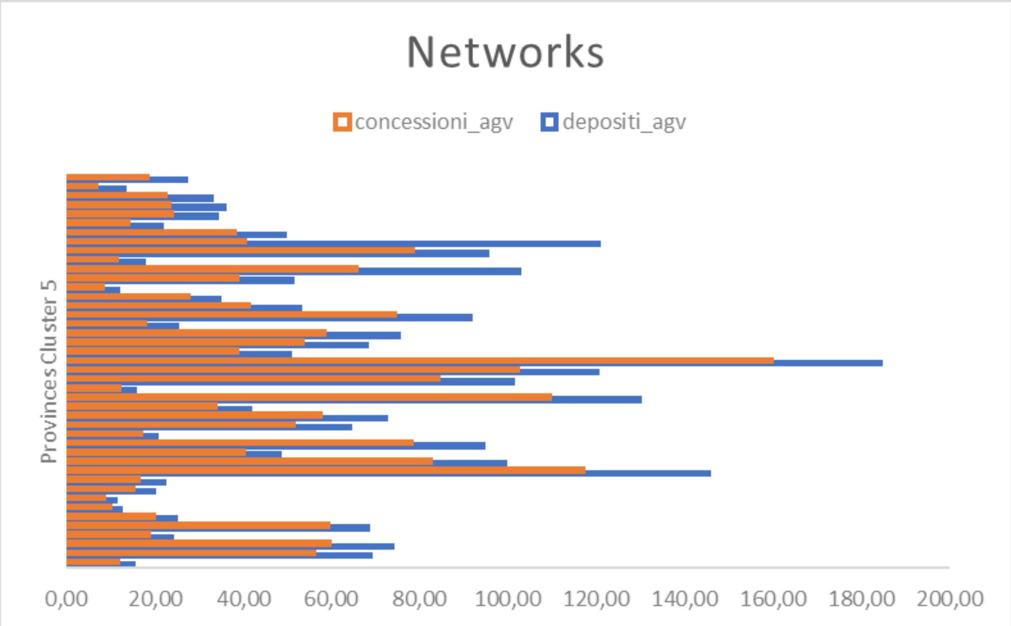


*Figure 14 - Networks Cluster 5*

Interesting is also the analysis of *Cluster 2* (in yellow), which is particularly influenced by the "Support service/ Intermediaries" factor. This because of the large presence of incubators, accelerators and labs that sustain the born and development of new startups. Fostering new knowledge generation and innovation.

Furthermore, as I have previously explained, by relying on data and present entrepreneurial literature, nowadays the development of new technologies and the great diffusion of digitalization in every area of our life is faster and all-pervading.

This implies that the born and development of new startups and innovative businesses is strongly determinate by the evolution in the high technology field.

In particular, using some data I have been able to get, little analysis can be done on the provinces having the highest presence of AI startups. Indeed, AI is one of the most recent innovation that is starting to be heavily applied in different industries. We talk about it in machine learning processes, so manufacturing, for applications in the healthcare, automotive and finance, as well as in the energy or agrifood fields.

So, continuing our analysis specifically in the Italian territory we have, in order- Milano, Roma, Torino, Bologna, Firenze, Trento e Bergamo. These are provinces with a great development of innovative applications and where there is a strong entrepreneurial culture. Indeed, the number of incubators and newborn startups is very high.

# Conclusion

The analysis has given results that can contribute in adding knowledge about Entrepreneurial Ecosystems. In particular, basing the study on the Italian provinces has expanded the research on ecosystems spreading from specifically localized areas.

Indeed, the territorial location element is fundamental. The unique features that characterize each province in an economic and cultural way are reflected in the clusters structure.

Every Cluster has a specific model in relation with the dimensions that influence the entrepreneurial activity.

There is space for further research in particular on the influence of high technology in the emergence of new startups. Testing the influence of innovation and technology evolution in the development of entrepreneurial ecosystems can explain the fast evolution we have nowadays in technology and how this affect economical changes.

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