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Model for evaluation of less-matured digital business ecosystems

Dissertação para obtenção do Grau de Mestre em
Engenharia e Gestão Industrial

Orientador: Professor António Grilo, Professor Auxiliar com
Habilitação, FCT-UNL

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Março de 2018

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"Without any deviation from the norm, progress is not possible"

Frank Zappa

Acknowledgments

This masters dissertation results from the contribution of several persons who, one way or another, helped me through the whole process and deserve a special acknowledgment.

First of all, I would like to thank my supervisor and professor at several subjects for the guidance and advices in this very important and decisive stage of my academic course. I would like to extend this appreciation to all the professors at Faculdade de Ciências e Tecnologias da Universidade Nova de Lisboa with whom I crossed paths with until this stage

To my colleagues during my academic course who also helped me reach my goals and taught me so much.

Sometimes, life has its own peculiar ways of telling us where to look, especially when it seems that it is going off the rail, leaving us with feelings of fear, doubt, anxiety, and anguish. With attitude, focus, hope and sense of humour everything becomes lighter, easier to deal with and obstacles are surpassed, learning and making fun of them. Because of that, my deepest appreciation goes to my parents, sister and grandparents who are always nearby, and to my dear friends who, in some way gave me a huge support and contribution: André Fernandes, Dora Fernandes, Mariana Vicente, Rogério Gomes (those last days were painful), Mariana Gomes, Tomás Lopes, Filipa Capela, Gonçalo Nalha, Sara Costa, João Gouveia and Frederico Costa. Without them this paragraph would not be written and I would not have learned anything.

Finally, I would like to dedicate this dissertation to my parents for all their support, trust, patience and helping me to realize that when things seem to be going off the rail I can always walk along that rail laughing at the derailed train.

Abstract

The entrepreneurship philosophy assimilated shaped perfectly to the new reality provided by the emergence of the new technologies of information and communication, connecting people and organizations and narrowing the distance between them. With this distance shortage, entrepreneurship assumed a more local dimension than ever, promoting the emergence of smaller entrepreneurial ecosystems at a city-level, ceasing to be exclusive to big cities: the digital business ecosystems. These smaller communities are, therefore, unique and, due to the intrinsic factors of its location (society, culture, finance, politics, demography, etc.), validate the premise of placing the city as the center of the study of entrepreneurship. Recently, academical studies have been using this approach to analyze the entrepreneurial activity in cities, with the help of composite indexes which provide numerical comparisons between the cities. However, these studies tend to be focused on matured digital business ecosystems.

As such, this dissertation is motivated by such lack of knowledge and analysis of less-matured digital business ecosystems. The aim of this study is to develop a model of comparison of less-matured digital business ecosystem to be applied in the southern and eastern European region and, with its results, analyze the patterns of such region.

This dissertation is settled on a solid literature review followed by a study of the region selected to validate the conditions previously established. With this knowledge base, the model is developed following a strategy fitted with the characteristics of less-matured entrepreneurial ecosystems (configuration, themes, variables, weights, data processing and display). The final results are analyzed and used a base to conjecture about the region's entrepreneurial activity.

With this study, it was concluded that the strategy defined cannot be the same as the other more general models, and is crucial to attaining reliable results through this model with these particularities. Concerning with the final results, it was concluded that this region has potential to evolve its stage of entrepreneurial maturity, however, it currently lacks entrepreneurial culture and experience to fully enable input conditions to generate outputs aspired.

Keywords: Entrepreneurship, Entrepreneurial Ecosystems, Digital Business, Startups, Composite Index

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Resumo

O fenómeno do empreendedorismo assimilou e adaptou-se perfeitamente à nova realidade provocada pela emergência das novas tecnologias de informação e comunicação, conectando pessoas e organizações e encurtando a distância entre elas. Com este encurtamento de distâncias, o empreendedorismo assumiu uma dimensão mais local do que em qualquer outra ocasião, promovendo o aparecimento de ecossistemas de empreendedorismo mais pequenos ao nível de cidades, deixando de ser apenas um fenómeno de grandes cidades: os ecossistemas de negócios digitais. Estas comunidades menores são únicas e, devido aos fatores intrínsecos das suas localizações (sociedade, cultura, finanças, política, demografia, etc.) validam a premissa de colocar a cidade enquanto centro do estudo do empreendedorismo. Recentemente, os estudos académicos têm utilizado esta abordagem para analisar a atividade empreendedora nas cidades, com o auxílio de índices compósitos que mostram comparações numéricas entre as cidades. No entanto, estes estudos tendem a focar-se em ecossistemas de negócios digitais mais maduros.

Como tal, esta dissertação é motivada por esta ausência de conhecimento e análise de ecossistemas de negócios digitais imaturos. O objetivo deste estudo passa por desenvolver um modelo de comparação de ecossistemas de negócios digitais imaturos a ser aplicado nas regiões sul e leste da Europa e, com os seus resultados, analisar os padrões verificados nesta região.

Esta dissertação está assente numa sólida revisão da literatura seguida de um estudo sobre a região selecionada para validar as condições previamente estabelecidas. Com esta base de conhecimento, o modelo é desenvolvido seguindo uma estratégia que se enquadra com as características de um ecossistema de empreendedorismo imaturo (configuração, temas, variáveis, pesos, processamento e exibição de dados). Os resultados finais são analisados e utilizados como base para conjeturar sobre a atividade empreendedora da região.

Com este estudo, concluiu-se que a estratégia definida não pode ser a mesma a ser utilizada com outros modelos mais gerais, e é crucial para atingir resultados fidedignos através de um modelo com estas particularidades. Em relação aos resultados finais, concluiu-se que esta região tem o potencial de evoluir o seu estado de maturidade empreendedora, no entanto, neste momento ainda carece de cultura e experiência empreendedora para possibilitar que as condições de input possam gerar integralmente os outputs desejados.

Palavras-chave: Empreendedorismo, Ecossistema de Empreendedorismo, Negócios Digitais, Startups, Índices compósitos

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List of Acronyms

BA   Business Angel

DBE   Digital Business Ecosystem

EDCI   European Digital Cities Index

EU   European Union

GDP   Gross Domestic Product

ICT   Information and Communication Technologies

IoT   Internet of Things

IT   Innovation Technologies

NUTS Nomenclature of Territorial Unites for Statistics

S&EE Southern and Eastern European

VC   Venture Capital

VCS   Venture Capitalists

1. Introduction

The purpose of this chapter is to present the context this document and to further explain the reasons and motivations that led to this research. It provides a description regarding the objectives proposed to be achieved, the methodology used throughout its development and the strategy and premises defined. Moreover, it presents the research questions chosen to be analyzed as well as how the document is organized with a brief preview of each chapter.

1.1. Context

"We are living in the global era" is a common buzzword, not only on the business and corporate environment, but also in a regular day-to-day. It is not a coincidence that such expression usually goes hand-to-hand with "we are living in the digital era". Anyone can guess that the new technologies of information and communication revolution are the links to both expressions. When transposing these ideas to the corporate and business context, the first point of contact is inevitably the entrepreneurship. Regarding this, it is reached the very first struggle with definitions: several different researchers have concluded that the field of entrepreneurship does not have a well-accepted, unified and consistent definition. It is widely acknowledged that the field of entrepreneurship lacks a single unified and accepted definition for the term "entrepreneurship" (Gedeon, 2010).

Entrepreneurship's definition is not fully accepted by the academic community. The earliest historical references to entrepreneurship come from the field of economics and the nature of sources of profit. All economic value was thought by the classical economists to come from some combination of land, labor and capital. Profits were obtained if a good was purchased at a market value that exceeded the intrinsic value of the land labor and capital that went into producing it (Gedeon, 2010). This wideness of a consensual definition even led Gartner (1985) to state that "entrepreneurship has become a label of convenience with little inherent meaning". For the purpose of contextualization, in this chapter, it will be used the Bygrave & Hofer's (1991) definition which is associated to the risk theory school of theoretical view, which is going to be developed later: "entrepreneurship is the process of perceiving an opportunity and creating an organization to pursue it".

Still this idea is going to be further developed, it is safe to admit that the new information and communication technologies (ICT) are the main reasons for this new business trend called the digital business. According to Abbie Lundberg (2015), a digital business compels the transformation of business models, products and/or operations from the use of ICT. Digital business is a different approach of those new technologies in which they are not only a mean to achieve higher operational efficiency, but also the purpose of the existence of a new business concept and the core business itself. The tech-mindset has permeated even the most traditional of industries, with almost all

businesses finding that information technologies (IT) are becoming an increasingly important pivotal part of their organization (Lonergan, 2014).

Since this revolution of communication and information had a great acceptance worldwide, it has brought new ways of people and companies to relate with each other, the market itself changed so dramatically that the demand for digital solutions to provide a better service from companies emerged. Such emergence, consequently, and since the digital era is also contemporary with the global era as mentioned before, gave tools to the market newcomers, and it is at this stage that entrepreneurship culture also changed.

During the last decade, the business infrastructure has become digital with increased interconnections among products, processes, and services. Across many firms spanning different industries and sectors, digital technologies (viewed as combinations of information, computing, communication, and connectivity technologies) are fundamentally transforming business strategies, business processes, firm capabilities, products and services, and key interfirm relationships in extended business networks (Bharadwaj *et al.,*2013).

The distance shortage between entrepreneurs, major companies and deeper knowledge about the demand caused by the emergence of this new era also boosted the startup culture, specifically technology startups. Therefore, the concept of startup is inevitably associated with this contextualization. A startup is not a smaller version of a large company. In that way, a startup is a temporary organization that looks for a scalable, repeatable and profitable business model. Basically, the startup business model is a canvas covered with ideas and guesses, but it has no customers and minimal customer knowledge (Blank & Dorf, 2012). Those younger companies, usually with disruptive ideas and original ways to apply their know-how, after giving the first steps towards a promising success, are commonly associated with bigger companies who are looking for talent attainment, technology alienation, or just for doing business, building partnership relations. Meaning that startups are nowadays propelling development, whether each entrepreneur motivation is being associated with a bigger player or to lead their business to higher stages of development.

The capacity of growth, processes behind the concept operationalization and quick scalability are the key factors to create profit and are correlated with the business model originality and adequacy. However, this may not be enough to speed up the business growth, the evolution of the startup ecosystem brought new actors such as the accelerators, incubators and capital ventures, each one playing a different role and with different features. When confronting these actors with the characteristics of the place they established in, such as lifestyle, geography, culture, financial and economic aspects, infrastructures and politics, they naturally tend to adopt corporatist behaviors, and this is nothing less than how a local Digital business ecosystem (DBE) grows and establishes.

Because the intrinsic factors of any given location are unique with their pros and cons, when concerning to entrepreneurship development and culture favorable conditions, this geographical point of analysis is relevant. It is not unexpected that cities known for having good quality of life, a friendly and easily adaptable culture, financially and politically stable, with wide centers of knowledge creation

(universities for example) are usually associated to attractive places to start companies. Though those factors mentioned before are considered ideal regardless the type of business to be launched, there are also others that are more subjective, harder to measure and specific to certain type of business. Moreover, other factors such as market size and potential market size, entrepreneurial culture and funding availability are considered nuclear and are related to how mature certain ecosystem is. Besides, the location is even a key factor that determines the entrepreneur mindset and proclivity to a certain field of business. Entrepreneurial environment can either provide an atmosphere conducive or corrosive to entrepreneurial success (Shaver, 2010). Considering such diversity of business success factors that are highly correlated with location, legitimizes then placing the city as the center of studying and research. Such assumption has already been studied before by several academics such as Richard Florida (2016), who stated that place has replaced the industrial corporation as the key economic and social organizing unit of our time. The assumption that the region is an important factor that, not only shapes the entrepreneur's mindset, but affects the odds of success or failure of a startup depending its business activity is taken in account through this document

Another example that shows how academics and other entities concern with this assumption, is the variety of comparison indexes and rankings developed about it. One of the most reputed indexes is the *European Digital City Index* (*EDCI*) ran by *Nesta*, an innovation foundation, on an annual basis. The *EDCI* goal is to describe and measure how European cities have been supportive of digital entrepreneurship, which is considered as the basis and starting point for this study. It is not necessary to take a deep look at most of the indexes and rankings about this subject to realize that there are discrepancies in terms of ecosystem maturity between south and north Europe. For instance, looking at the *EDCI*, it is easy to notice that the top half of the ranking is predominantly composed f cities from north and center of Europe.

1.2.   Research objectives

The main objective of this research is to develop a model that compares, evaluates and categorizes different DBE's, intended to be applied to less mature DBE's. This model is aimed to be tested on southern eastern European (S&EE) countries DBE to acquire knowledge about its tendencies and patterns.

There are two important premises behind the main objective presented:

➢ The S&EE DBEs deserve a deeper study of its characteristics and what makes them so distinct than the others. There are several aspects considered to be relevant when evaluating a DBE, that are specific pros of this regions' DBEs. For this reason, several emergent DBEs are in the S&EE countries;

➢ The second premise follows up the first one. The great majority of the indexes referred previously are not specifically aimed to evaluate a certain stage of DBE maturity and, as such, not all the variables considered are always as sensible and appropriate as they should be

when it concerns with this matter. This is understandable because it is complex to build an index that makes a fair comparison between two different regions in terms of ecosystem maturity. Thus, most of those indexes tend to create such a big gap between those two realities that, the pros inherent in the less matured ecosystems may become dissolved and not highlighted enough.

The model resulting from research should be intended as a different proposal of an approach to this subject. Not only the aim of the application of the model but also the structure and its conception follows a different approach comparing to the existing models. This proposal should not be considered worse or better than the existing ones but different, more intuitive and, most important, intended to be applied to a specific target. The S&EE DBEs target is an ideal match to test this model.

This dissertation includes a literature review in order to cover the existing studies about the subject, and have a solid base of knowledge developed so far. To have a precise idea of the target aimed to achieve, a geographical coverage study is necessary. Such study is also useful to determine the region selection for the model application, and to be used as a proof of concept. The model itself is built considering the target aimed. All the variable, themes and respective weightings should be chosen and measured concerning the particularities and specifications of this type of DBEs.

Finally, the conclusions reached with this research are presented as well as the answers of the research questions, limitations to the study and advising for future research recommendations regarding the subject in matter.

1.3.   Methodology

Since the main objective of this dissertation is to build a model for comparison and evaluation of less-matured DBE and, besides the research process and the analysis, evaluations and conclusions, the methodology is composed in two core parts: the DBE study and the model configuration and application. The criteria inherent to this division is the type of tasks performed, the research process is more related with the study of the DBE, and the model configuration consists on practical tasks to build the model itself and test it. Despite existing two different core parts, they are inter-dependent of each other and share inputs and outputs. In this chapter those two sections and its approaches are broke down and it is shown how they connect with the common steps to overview the process that leads the research objectives to the final conclusions.

I.   Research process:

- The research process is common to both core parts. Its result is the Literature Review that sums up a theoretical background to the subject and to identify the current state situation. This part of the research process is also important to identify the initial steps and lines of thinking to be taken in order to fulfill the scope of the study. The Literature Review not only covers

general concepts concerning the entrepreneurship subject but also other more specific theories that are cornerstones of this dissertation;

- In the research process, several academic reports, articles, papers, books and websites were consulted. For reasons of knowledge and quality-control, the most remarkable authors and institutions were privileged;

II.   The DBE study:

- This section of the methodology consists of studying the geographical situation concerning the entrepreneurship scene in S&EE countries. This is the first point to apply the first premise previously announced, and, for that, a suitable overview of the current European situation is necessary as a background for the whole study. This stage is crucial to identify the patterns between the DBEs inside a specific region, this is how the region selection is justified;

- To select the region the *EDCI* is considered the base. This index is highly credited and such choice is justified on the proper chapter of the dissertations. Besides being annually developed by a reputed and credible institution, this index covers all capital cities in European Union (EU) plus other cities considered relevant in the European entrepreneurship scene;

- With the common patterns identified in the region selected, the DBEs list is gathered. Once again, this task is performed with the support of the *EDCI* results.

- Moreover, the pattern identification between the region's DBEs selected leads to the model's themes, variables and indicators proposition and criteria selection. This selection is intimately correlated with the typical stage of maturity in this region.

III.   Model configuration:

- Since an enriching knowledge about the geographical coverage was acquired, it is possible to match the theoretical needs, assumptions and restrictions intended for the model with the structure to be defined. The Model Configuration corresponds to tasks between the identification of the special features that this model should have for its configuration, until the application;

- The beginning of the Model Configuration part comes from the end of the research process, after defining the specific theories and general concepts about the subject. The definition of the literature review leads to a learning stage to settle the assumptions and restrictions that the model configuration follows;

- The first connection points between the two methodology core parts begin after the geographic coverage pattern identification to select the model's themes, variables and indicators criteria. This selection is based on both patterns identification and assumptions and restrictions settlement. The two core parts reconnect after defining the list of DBEs for the purpose of gathering data to apply the model. Once again, the data gathering process is also dependent on the indicators criteria;

- The indicators selected represent the meaning of the variables to assume numeric and tangible values. Those variables have the respective weightings in the model, and, with this,

all the inputs are ready to be filled with the data gathered after being statistically processed and turned into scores. The scoring system is developed regarding the weighing of the indicators and data normalization. This is a nuclear stage because its output is the main subject to be analyzed and discussed in latter;

- The output of this part are the results of the application stage, meaning, the rankings obtained after the imputation of the processed data in the model;

- An important source used to help to build this model, aside from the learning process with other documents, was a publication developed by the Organization for Economic Co-operation and Development (*OECD*) called The Handbook on Constructing Composite Indicators (2008). This handbook aims to provide guidance to the construction and use of composite indicators, for policy-makers, academics, the media and other interested parties. While there are several types of composite indicators, this handbook is concerned with those which compare and rank country performance in areas such as industrial competitiveness, sustainable development, globalization and innovation (*OECD*, 2008).

IV. Analysis, evaluation and conclusions:

- The final part of the methodology is the analysis of the model's outputs concerning not only addressing the research questions proposed at the beginning, but also any result that may evidence prominent reason for deeper analysis;

- The output analysis also has a theoretical background besides the statically analysis, those two components are nuclear to properly address the research questions.

The methodology scheme (figure 1.1) was designed to emphasize de outputs and inputs transition from each task.
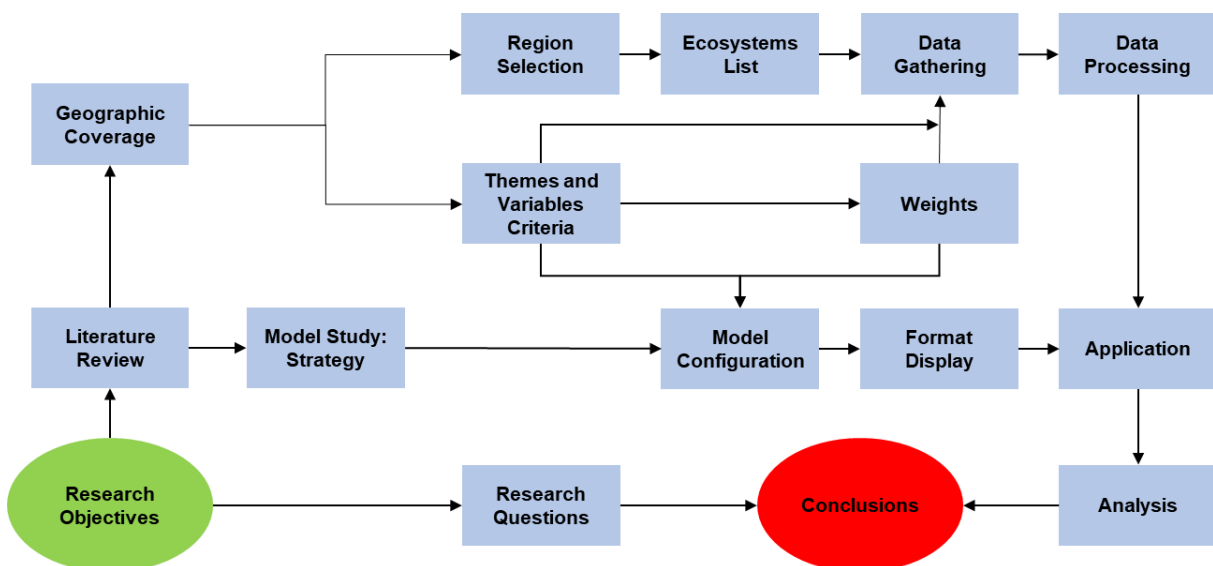
Figure 1.1 – Dissertation methodology scheme.

1.4.   Research questions

Since there are already several researches and indexes/models developed with the purpose of evaluating DBEs, with a background of years of studying and in with are involved technicians and academics with extensive experience in this area, the urge of developing research in a gap emerges. The research questions are the result of the philosophy used to develop this dissertation: developing a different approach and specifying the research on a particular stage of maturity of the ecosystem

As introduced before, this dissertation follows two nuclear premises that leads to the final objective of building a model of comparison and evaluation of less-matured DBEs. Taking in consideration the previous, this dissertation aims to address the following research questions:

➤ How to build a composite index model to be applied to less matured digital business ecosystems?
➤ What are the most relevant characteristics of the southern and eastern European digital business ecosystems?

1.5.   Structure of the dissertation

This dissertation is divided into seven chapters, each chapter is broken down into smaller sub-chapters. The chapter division and sequencing criteria is similar to the methodology structure shown before.

The first chapter is an introduction section. It contains a contextualization of the subject, definition of the research objectives, methodology description that guide the research and execution of the dissertation and the identification of the research questions to be addressed at the end.

The second chapter refers to the literature review. The literature review contains definitions from the more general subjects related the topic of entrepreneurship, to more specific theories and schools of thinking related to the scope of this dissertations.

The third chapter is a study over the geographic coverage to be included in the model. This study begins with a deep study over the region selected to identify what are the patterns inherent to it. With the patterns identification it is possible to suitably justify and confirm the selection of this region to apply the model. Knowing the general patterns of this region, the list of the DBEs (cities) can be selected to be applied in the model. With the knowledge about the selected region learned, it is possible to propose criteria for the model's indicators selection. This is the first chapter with practical outputs: the DBEs list and the criteria of indicators selection proposition.

In the fourth chapter, it is shown how the model is built. This chapter covers the assumptions and restrictions for the configuration itself concerning the practical aspects, the definition of indicators and their respective variables, variables and themes weightings and a comparison with the *EDCI* to show the differences between. By the end of this chapter the model is ready to be applied.

The fifth chapter shows application of the model, beginning with the data gathering process. These data are processed from raw data to values to be applied in the model. The first validation test is made right before the results presentation with a correlation analysis between the themes. After all the statistic processes and data treatment, the outputs are the scores for each city testes and the respective rankings.

The results of the model are than analyzed in the sixth chapter with the aim of providing technical resources to address the research questions.

Finally, on the seventh and last chapter, the research questions are addressed as well as the presentations of the conclusions of this study, limitations of this dissertation and recommendations for further studies.

2. Literature review

The aim of this chapter is to present the literature review considered relevant regarding the scope of this document. The purpose of the literature review is to develop a solid base of knowledge about the theme, from the general concepts to the more specific ones.

2.1. Entrepreneurs and entrepreneurship

There is no doubt that, of late, entrepreneurship in general has gained its status as a legitimate scholarly research subject, enjoying in addition much public interest (Vesper, 1990),a good indicator of this is that as of today, there is practically no business school without at least one course on entrepreneurship (Porter & McKibben, 1988) even so, according to Berea (2013) different researchers have concluded that the field of entrepreneurship does not have a well-accepted, unified and consistent definition. Even in the academic literature, there are some inconsistencies regarding the definitions of "entrepreneurship" and "entrepreneur", which reveals some barriers in understanding this phenomenon and the related actors (Berea, 2013). This is one of the biggest issues that academics struggle when it comes to defining entrepreneurship: its definition itself.

Even though entrepreneurship may seem to be a trend in this days, the first mention to this theme was made by Richard Cantillon (1755) with his *Essay on the Nature of Commerce in General* in 1755. Richard Cantillon (1755) considered a division in society based on the income earning source: fixed (wage earners) or non-fixed. According to Cantillon (1755) the lack of certainty in the received income is the result of the investment on production costs, so that, the speculative fluctuation of the demand takes an important role. Cantillon (1755) considered the attitude of bearing the risk of the uncertainty of prices typical of an entrepreneur. This approximation of a definition is purely focused on economics and not so much on the social aspects.

Because one of the biggest struggles trying to reach a consensual definition of entrepreneurship is the broadness of the concept, Gedeon (2010) suggested that, as some scholars have made before, the appliance of an adjectives to the word "entrepreneurship", creating a "subdomain" of the term, is a good strategy to refine the definition. This is why, in the literature, terms such as "corporate entrepreneurship" or "social entrepreneurship" are quite common. According to Gedeon (2010), the variety of sub-domains created in the literature comes from the origin of the different theories and schools of thought of the authors.

Stevenson, & Jarillo (1990), suggested that the plethora of studies on entrepreneurship can be divided in three main categories: what happens when entrepreneurs act; why they act; and how they act

What happens when entrepreneurs act:

- This category concerns with economical point of view of the matter since the entrepreneur as an individual, its motivations and actions are not the focus but the results. Bearing in mind this idea, Casson (2003) defined and entrepreneur as "someone who specializes in taking judgmental decisions about the coordination of scarce resources."

Why entrepreneurs act:

- Focusing on the motivations and the entrepreneur itself. This category also relates the entrepreneur with its environment. The causes of individual entrepreneurial action constitute the primary interest of the researcher. Both the individual entrepreneur and the environment as it relates to the motives of individual entrepreneurial behavior are considered. It is the why of the entrepreneur's actions that becomes the center of attention (Stevenson & Jarillo, 1990). Describing the entrepreneurial activity, McClelland (1987) suggested that they involve: (a) risk-taking, (b) energetic activity, (c) individual responsibility, (d) money as a measure of results, (e) anticipation of future possibilities, and (f) organizational skills (McClelland, 1987)

How entrepreneurs act:

- In this case, researchers analyze the characteristics of entrepreneurial management, how entrepreneurs are able to achieve their aims, irrespective of the personal reasons to pursue those aims and oblivious to the environmental inducements and effects of such actions. (Stevenson & Jarillo, 1990)

Based on his researches on past relevant studies on entrepreneurship, Gedeon (2010) suggested a classification of the definitions of entrepreneurship based on its origin, creating two dimensions: The Risk Theory of Profit and the Dynamic Theory of Profit. Those dimensions are theoretically opposite and its cornerstone is how entrepreneurs seek the profit.

➢ Risk Theory of Profit

This dimension includes the Cantillon's approach mentioned before. Hawley (1907) is the first to articulate vigorously that the assumption of risk is the most essential function of the entrepreneur and that the rewards of enterprise primarily accrue to the owner due to the assumption of responsibility and risk (Gedeon, 2010). This dimension relates the success of the entrepreneur with its willingness of assuming risks managing its business. Gedeon (2010) emphasis a few definitions related with this dimension:

- An entrepreneur is defined as a major owner and manager of a business venture not employed elsewhere. (Brockhaus,1980);
- The entrepreneurial function involves primarily risk measurement and risk taking within a business organization (Palmer,1971).

➢ Dynamic Theory of Profit

The dynamic theory of profit, in contrast, starts with neoclassical economic theory which proposes that profits arise as a result of dynamic change from the static equilibrium state of perfect competition

(Hayek, 1937). According to Gedeon (2010), this dimension is also a prolific source of other subdomains of entrepreneurship. The dynamic theory of profit relates the success of the entrepreneur with strategic changes in strategic moments that it may provide to the business

- The carrying out of new combinations we call 'enterprise'; the individuals whose function it is to carry them out we call 'entrepreneurs' (Schumpeter, 1934).
- This defines entrepreneur and entrepreneurship - the entrepreneur always searches for change, responds to it, and exploits it as an opportunity (Drucker, 1985).

According to Gedeon (2010), after analyzing both risk and dynamic theories of profit and adding the inputs of other complementary theories with different knowledge backgrounds (subdomains) through history, concludes that most of those are not contradictory but may be complementary. Entrepreneurship is a multi-dimensional concept that includes owning a small business (Risk Theory), being innovative (Dynamic Theory).

As a combination of multiple theories, Herbert & Link (1988), proposed a group of roles of the entrepreneurs: 1) assumes risk associated with uncertainty, 2) supplies capital, 3) innovator, 4) decision maker, 5) leader, 6) manager, 7) organizer and coordinator, 8) owner, 9) employer of factors of production, 10) contractor, 11) arbitrager, 12) allocator of resources.

2.2. Digital business

According to Accenture consultant (2014), a digital business is "An organization that incorporates digital technology to create revenue and results via innovative strategies, products, processes and experiences.". Jorge Lopez (2014) describes a digital business as a brand-new business design concerning both physical and digital worlds. It promises to usher in an unprecedented convergence of people, business and things that disrupts existing business models - even those born of the Internet and e-business eras (Lopez, 2014). Lopez (2014) also predicts that by 2020, there will be more than seven billion people and businesses and at least thirty billion devices connected to internet. This connection between people and businesses generates permanent communication and information transaction, which is the most relevant part of the establishment of a DBE.

The concept of DBE was first introduced in 2002 in the Unit ICT for Business of the Directorate General Information Society of the European Commission (Nachira, 2002). This concept definition evolves from the entrepreneurial ecosystem of James F. Moore (1996) previously presented, which is combined with "digital". A DBE is a technical infrastructure supported by networking software applications (such as peer-to-peer), with the purpose of connecting services and information, enabling network transactions over Internet. (Nachira *et al.,* 2007). The emergence of DBEs was made possible with the raise of the digital era, when the information and communication technologies (ICT) networks, social networks and knowledge networks converged. The faster and more pervasive communications enabled by the technology reinforced the already existing trend from a material economy based on

manufacturing toward a service economy based on knowledge production and distributed value chains (Nachira *et al.,* 2007). With the help of an effective application of technologies (which, naturally, will keep evolving and interacting themselves), DBEs will tend to create unprecedented convergence of people and business, promoting new revenue opportunities (McGee *et al.*, 2014).

It is important to make the distinction between the internet of things (IoT) and digital business. According to the International Telecommunication Union, IoT is a "global infrastructure for the Information Society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies (Wortmann & Flüchter, 2015). The IoT plays a crucial role in a digital business due to its functionality of enabling communication and interaction between objects (physical or virtual) and with its internal states or external environment (Lopez, 2014). Most will see digital business as a simple extension of an enterprise technology or e-business past. Digital business disrupts existing business models - even those that were born of the Internet and e-business eras (McGee *et al.,* 2014).

The digital business emergence can be considered as the result of the symbiosis of the entrepreneurial ecosystem and mindset with technology advances, specifically in ICT. There is little doubt that digital tools and technologies are profoundly affecting the way business is being conducted today. They have already disrupted many industries and are threatening to disrupt others (Nachira *et al*., 2007). Despite the digital business being highly correlated with the use of technology, this concept should have a broader definition, as it should also be considered as an enterprise approach. Digital business should not be considered an IT program and should instead become an enterprise mindset and lingua franca, with digital expertise spread across the enterprise and value ecosystem (McGee *et al.,* 2014).

McGee (2014) developed a research in which it is suggested a methodology composed of six sequential steps to help build and establish a sustainable and successful approach for a digital business in an enterprise:

- Step 1: The first step concerns with developing and spread the digital business philosophy among the enterprise's decision makers. The first step is also important to identify the opportunities where this approach should be taken. The practical result of this step should be creating the basic standards and rules to promote the new approach.
- Step 2: After having made sure that the digital business is a valid approach to increase better results, it is necessary to form the core leadership team responsible to drive and monitor the transformation. This team is supposed to be composed by interim positions, because, over time, this approach will be fully established and accepted all over the hierarchy.
- Step 3: With a responsible team formed, a digital business center of excellence should be launched. The purpose is to assess business capabilities, and to develop solutions for possible opportunities and threats. This center should provide inputs for collaborative formation of a digital strategy, innovations, response to challenges and advices for practical

execution. At this step, is imperative to have a precise notion of at which stage of technology base is the enterprise now.

- Step 4: Once the team and structure is established, it can be developed the strategy to provide guidance on priorities and investments, to response the opportunities and threats previously identified.

- Step 5: The fifth step concerns with making sure that the enterprise has the necessary tools to execute the digital business strategy developed, meaning acquiring or developing knowledge, competencies and skills.

- Step 6: The final step of this methodology is to create the business capabilities so assure that the enterprise is fully prepared to deal with the digital age. Even though the philosophy of digital business should be present in the whole enterprise, the technical workforce may not yet be prepared. This publication suggests than the best practices for the final step should be a mix of business-oriented disciplines with their underlying knowledge required (McGee *et al.,* 2014).

Digital business represents an important part of the entrepreneurship subject due to their relation of proximity. This is because the principles and goals of both concepts are similar, for this reason, with a healthy ecosystem, this relation of proximity may become a relation of interdependence.

2.3.   Entrepreneurial ecosystems

The first author to define the concept of "ecosystem" was the English botanist and ecologist Sir Arthur Tansley in the around 1930. Sir Arthur Tansley defined and ecosystem as a localized community of living organisms interacting with each other and their specific environment. The organisms described influence each other, collaborate, coevolve, share and create resources. This definition of ecosystem is also applicable for this subject. James F. Moore (1996) makes this transition between those two different universes considering this as a biological metaphor of interaction and interdependence of the actors involved regarding their roles, needs and capabilities (Moore, 1996). An entrepreneurship ecosystem represents the combination of conditions that shape the context in which entrepreneurial activities take place (Kelley *et al*., 2015)

The ecosystem consists of a set of factors linked together in a specific location, including universities, research institutions and development of human resources and formal networks unofficially, governments, investors, professional service providers and cultural in an open and dynamic environment in which all these elements are connected (Yaribeigi *et al*., 2014). Gnyawali & Fogel (1994) considers that for the success and development of the ecosystem it is important to gather a combination of factors that are important. Entrepreneurship, to be self-sustaining, requires an ecosystem, and an ecosystem requires proximity so the different domains can evolve together and become mutually reinforcing.

Part of what the entrepreneurial ecosystems are able to offer to its actors is dependent of what those actors also have to give and how they interact with each other and outside. Entrepreneurial ecosystems are very much a dynamic rather than a static phenomenon (Mayer, 2013) and they provide businesses access to sharp minds and smart resources, which may be located with suppliers, customers, research organizations or independently.

An entrepreneurial ecosystem may also be compared as a network composed by several actors with the entrepreneur taking the central role when influencing the ecosystem itself concerning its geographical region. Vogel (2013) describes it as a "dynamic interactive community within a geographic region, composed of a varied inter- dependent actors and factors, which evolves over time and whose actor and factors coexist and interact to promote new venture creation".

Geographical location influence over the characteristics of the ecosystem is a premise also supported by Daniel Insenberg (2011) who states that "Even in regions not particularly known for their entrepreneurship, it is still possible to find hotbeds of entrepreneurship". Isenberg (2011) justifies it with the tendency of local resources centralization provides attraction for other such as human, capital and information which may enhance the richness of the ecosystem. A successful entrepreneurship environment needs a strong and dynamic community and, therefore, a self-sustaining and attractive ecosystem. To promote this self-sustainability, proximity and access to different domains is important. The shortest path to creating this virtuous cycle is to directly create, enhance, cultivate, evolve a geographically concentrated ecosystem that is conducive to entrepreneurship and its success (Isenberg, 2011).

Through all the entrepreneurial ecosystems models developed so far, one stands out for its influence, broadness and usefulness: The "Entrepreneurship ecosystem strategy for economic development" developed by Daniel Isenberg in 2011. This approach privileges the symbiosis of several aspects that should be taken in account as pre-conditions to success, its relationship with the ecosystem and how they cultivate it. Isenberg states that, although entrepreneurship is not a direct and immediate solution to economic issues of society, its spillovers justify being a public priority such as education, security, welfare, energy and heath as a basic social good (Isenberg, 2011). As a matter of fact, according to Isenberg, there is already enough dispersed research theory and practice in the world about entrepreneurship develops in society to create strategies for its better cultural implementation for a given region, to promote its self-sustainability. This approach has the entrepreneurship ecosystems inter and intra developments and share as a cornerstone, the need for an ecosystem strategy comes from the observation that when we look at societies where entrepreneurship occurs with any regularity or is self-sustaining, we realize that a unique, complex environment or ecosystem has evolved (Carvalho, 2016). Isenberg (2011) states that "entrepreneurship is an idea whose time has come to all regions of the world".

Isenberg (2011) proposed his approach in the form of a diagram meant to explain and demonstrate the influence and impacts of the ecosystem over the entrepreneur in its own perspective. Isenberg consolidated the ecosystem activity in six domains to show how they interact and influence the entrepreneur's activity, despite that, according to Isenberg, the various combinations of those domains

always result in unique circumstances. The diagram in figure 2.1 is composed of the several domains each one plays a role influencing the entrepreneur's conditions for decision taking, and even possibilities of success. At each domain, several elements are associated, which some of them have been omitted in previous studies.
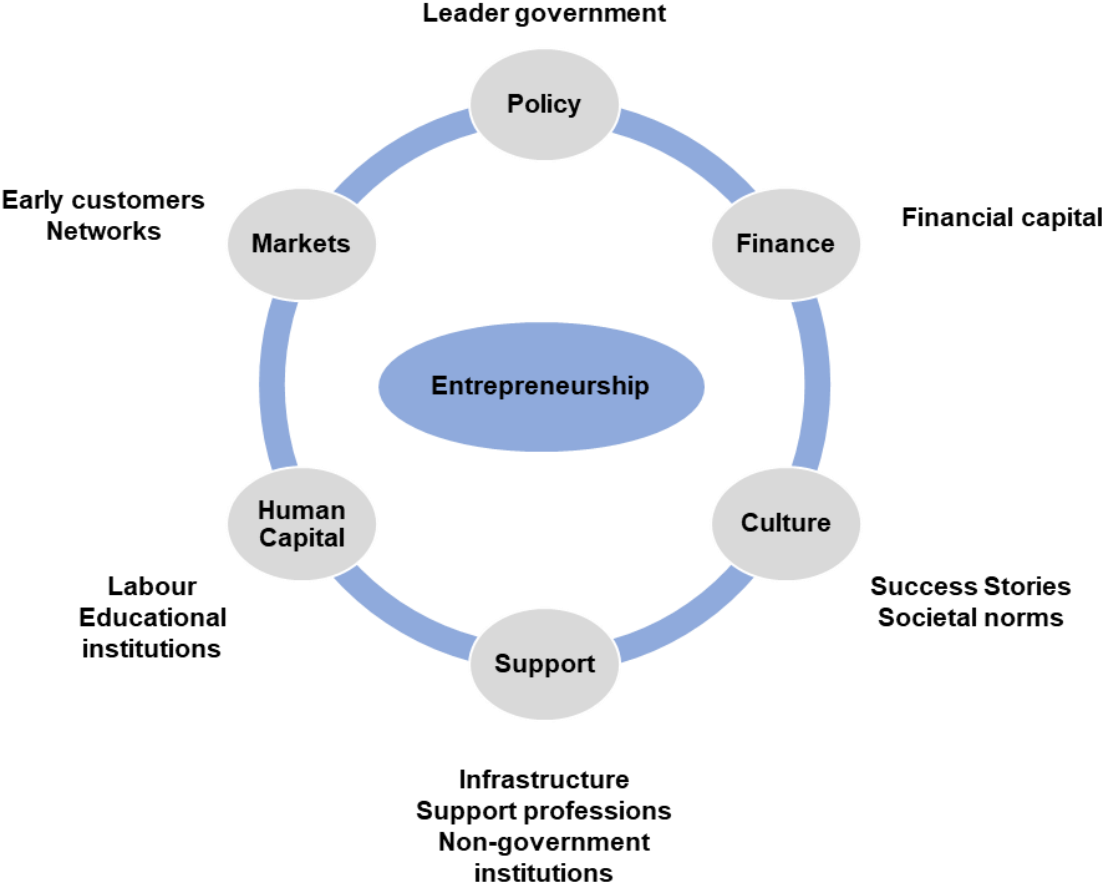
Figure 2.1 – Domains of the entrepreneurial ecosystem (adapted from Isenberg, 2011).

However, Isenberg points that this diagram have some flaws: although the crucial elements of the domains are fully designated, casual paths and interactions between them are not considered, there are not arrows pointing what causes what. The justification for this, is that there are innumerous and complex interactions between the elements of the domains, which, themselves are even highly dependent of the local conjectures. According to Isenberg since each ecosystem emerges under a distinctive set of surroundings and circumstances, because no one can replicate someone else's ecosystem (Isenberg, 2011), therefore, the process of pinpointing in such diagram would inflict with the framework.

Fang (2015) also have developed literature concerning the most important aspects of the entrepreneurial ecosystem. These researches conducted to a model which the authors named the *"Power of 5"* (figure 2.2) referring to the five entities in every ecosystem that the authors claim to be strategically needed to implement a sustainable flow of business creation and information in the ecosystem.
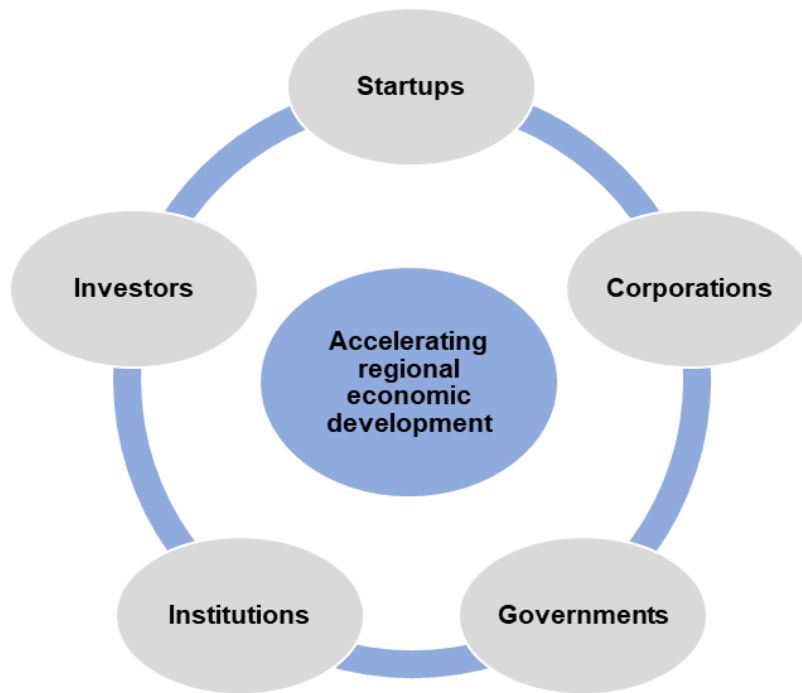
Figure 2.2 – The power of five, innovation ecosystem (adapted from Fang, 2015).

1. Startups: spur job creation in the local community as startup founders transform ideas into concrete businesses;

2. Corporations: provide entrepreneurs an outlet to solve industry and specific company problems, as well as connections to new talent;

3. Governments: implement policies to attract startups through taxes, incentives, grants and funding;

4. Educational institutions: infuse young talent with significant skill sets and provide educational mentorship;

5. Investors (e.g., accelerators, incubators and venture capitalists (VCS): fund early-stage startups and connect portfolio companies to potential customers and mentors in their network.

Healthy ecosystems require that each of these five entities works in conjunction with, and mutually supports, each other because their needs are interdependent and success is co-created. Maximizing the role of these actors is essential to create and maintain a vibrant start-up ecosystem (Fang et al., 2015). According to the authors, the theory behind the "*Power of 5*" is that, the economic actors should mutually support each other gathering resources and efforts to attain talent and funding to the "*Power of 5*" region.

Apart from the five elements, the authors also emphasize three essential roles that work as enablers to maximize the ecosystem creation, strengthening the connections between the five entities, and promoting the conditions for changes necessary to develop solutions to attain talent and capital: the

ignitor to spur ecosystem creation, the connector to maximize the connections between the five entities and the lever to differentiate it from other ecosystems.

The five elements do not always demand the same resources nor the same investment, most of all, they need the minimum constraints to access to each other's information and resources, in order to maximize the outburst of quality of opportunities that such entrepreneurial ecosystem may have to offer to new players.

2.4. Entrepreneurial ecosystem actors

As referred before about the entrepreneurial ecosystem, it is composed by its actors who shape the inner ecosystems characteristics into a better environment to create new ventures, prosper the established ones and create opportunities and attractiveness for new-comers. To describe the entrepreneurial ecosystem actor's roles and features, it is taken as a base the *"Power of 5"* research of Fang (2015). Bearing it in mind, for this document, the six actors are considered instead of five due to considering that the "corporation" entity should be divided into accelerators and incubators. This option is justified to adapt the study of the entrepreneurial ecosystem over the region to be studied in this document.

2.4.1. Startup

It is common for startups to be called small companies, which is not completely true. A startup can be considered as a temporary stage for an organization contemplated in an approach set in a business model. Startups are visionaries who passionately believe in their product or service and have a plan to scale up fast and grow to achieve the vision (Lewandowski, 2015). Startups gain notoriety due to the role of ICT's evolution. This evolution enabled startups to reach global markets and customers rapidly, such factor is determinant for them to take bigger steps in their growth. This approach taken by startups promptly drawn the attention of bigger and matured corporates to the imminent disruption in several sectors, considering them both as potential partners, customers or even threats

The online version of the *Oxford dictionary* (2017) defines the term "startup" as "a newly established business". According to literature, this definition is vague and half true. Firstly, besides being quite reductive to call a company a "startup" only based on how long it is operating, even though, and taking in consideration the longevity criterion, the literature is not conclusive and unanimous about from when does a company changes from being a startup to something else. As seen, there are some gray zones when defining what a startup really is, commonly, besides the longevity, the most common criteria used in the literature to define startups are the scope, their ambitions of growth or growth potential, and the recognition requirements. In India, recently, the *Department of Industrial Policy and Promotion in collaboration with the Startup India Initiative* stipulated boundaries to define the concept of startup. Those boundaries were stipulated to enlarge and set straight this vague concept. Such modifications concern mainly with from how long should a company be called "startup" (longevity); what business

area should the company be working on and what kind of working (innovation, development or improvement on services or processes); potential and intentions of scalability, employment generation and wealth creation; recognition processes such as need of recommendation, support or funding letter from certain entities (Nasscom, 2017). Still, this does not necessarily mean that such classification method is unquestionable nor even definite, however, it may definitely be taken as a sample of which criteria is usually used to classify companies as startups, and, more important, describe the typical startups characteristics.

One of the main goals for a typical technology company in this shape is to achieve scalability in their businesses. Is the belief that, the entrepreneur's idea will be disruptive enough to encourage the market to absorb it and make the business profitable, that drives them to invest or seek for investment on it, and, hopefully, turn the initial idealized business into a replicable one that would fit into a different, and more appropriate, business model to scale it. These scalable startups tend to cluster in technology hotspots such as Silicon Valley, Israel or New York and make up a small percentage of entrepreneurs, but their outsize return potential attracts almost all the risk capital (Carvalho, 2016). Since, according to the literature, the objective of reaching scalability seems to be an important and common for the classification of startup, it is important to define such concept: a scalable startup are the traditional technology startups aiming to search for a repeatable and scalable business model. Scale requires external venture-capital investment in the tens of millions to fuel rapid expansion (Blank & Dorf, 2012). Another point that reinforces this argument is that some authors state that the health and wealth of an entrepreneurial ecosystem is more dependent of the number of scale ups than startups. According to the *Organization for Economic Co-operation and Development (OECD),* it is considered a scale up a company with an average annual return of at least 20% in the past three years, employing more than ten people (*OECD*, 2007). Fabre (2014) states that the premise of the more new businesses created the better for society is not accurate, arguing that a well-regulated market is friendlier for newcomers. Therefore, the evaluation of the condition and potential of the market and ecosystem is highly dependent of companies at this stage. The quantity and success of local scale-up entrepreneurs increases the quantity and success of other manifestations of entrepreneurship, including start-ups, small business, and family business (Fabre, 2014)

The objective of reaching scalability, as a dominant point for startups, and, consequently, directly interferes with the growth stages of the company- the startup lifecycle. Marmer & Bjoern (2011) assigns a relevant role to identify at which stage the startup is for better assessment of progress and to monitor it properly. The authors state that the startup lifecycle is composed of six stages in a tree structure with substages. From those six stages, the first four are based on Steve Blank's *4 Steps to the Epiphany* of 2006 but one key difference is that the Marmer Stages are product centric rather than company centric. The six stages contemplated are:

1- Discovery;

In the first stage, the company is working on finding out which problem should their solution solve, or which solution should their new approach improve. In this stage, the founding team is formed and the value proposition is defined alongside the first drafts of their product/service is created.

Usually startups at this stage tend be keen on attending into incubation and acceleration programs, seeking for primary support and mentoring. It is common that the main source of external financial investment comes from family or friends. This stage usually takes from 5 to 7 months (Marmer & Bjoern, 2011).

2- Validation;

The Validation stage concerns with letting people get to know the aim of the startup and evaluate their reaction for validation. The main point is to look forward if the idea arouses interest through the exchange of money or attention. During this stage, startups experience other events such as refinement of core features, registration in initial user growth platforms, obtaining the first important customers, pivot of their business model (if needed), getting the first paying customers and working on product market fit. The Validation stage lasts between 3 and 5 months (Marmer & Bjoern, 2011).

3- Efficiency;

Now the startup is running for close to one year, proceeding to the Efficiency stage, startups reshape their business model and, consequently, optimizing the customer acquisition process. By this time startups redefine and update their value proposition, overhaul user experience and improve the conversion funnel. The result should be viral growth achievement and repeatable sales process and/or scalable customer acquisition channels found. This stage should be anticipating the scale stage, so that, no fund-raising round should be taken place before. This stage lasts on average 5 to 6 months (Marmer & Bjoern, 2011).

4- Scale;

This stage symbolizes the next and probably and biggest step on the growth development of the company. The company usually experiments massive customer acquisition, back-end scalability improvements, first executive hires, process implementations and establishment of departments. This stage is usually follows rounds of fund-raising. This stage lasts on average 7 to 9 months (Marmer & Bjoern, 2011).

5- Profit Maximization;

This stage concerns with the balance between profit maximization and customer happiness. The procedure of profit optimization begins with diagnosing the business for operational insufficiencies, internally as well as externally and providing efficient and effective solutions to improve profitability through operational optimization (removal of redundant costs, optimum utilization of resources and improving the gross profit margin) (Carvalho, 2016). The customer acquisition process and fund-raising rounds continues.

6- Renewal.

The last stage of the startup lifecycle is the reinventing of the company itself. The company should identify and explore new markets or new solutions in the same market.

The reasons that may lead startups to progress and stablish are correlated with the reasons that trigger entrepreneurship. When dealing with the venture creation, Vesper (1990) considers four important elements: a profitable business opportunity, technical know-how, business know-how and the entrepreneurial initiative. Regarding this research, Gnyawali & Fogel (1994), reduces to three elements:

- Propensity to Enterprise- People that have an urge for brilliance, willingness to take reasonable risk, and wish to be independent are very likely to become entrepreneurs (McClelland, 1961).
- Opportunity- Opportunity refers to the extent to which possibilities and prospects for new ventures exist and the extent to which entrepreneurs may influence their chances for success through their own actions (Gnyawali & Fogel, 1994).
- Ability to Enterprise- Ability to enterprise refers to the sum of technical and business capabilities necessary to start and manage a business (Vesper, 1990).

Gnyawali & Fogel (1994) also proposed a model (figure 2.3 below) to represent the relationships between the three elements referred until the new venture creation. The importance of each dimension of the environmental factors is variable, according to the availability of opportunities for business startup and the general level of propensity and ability of people to start an enterprise.
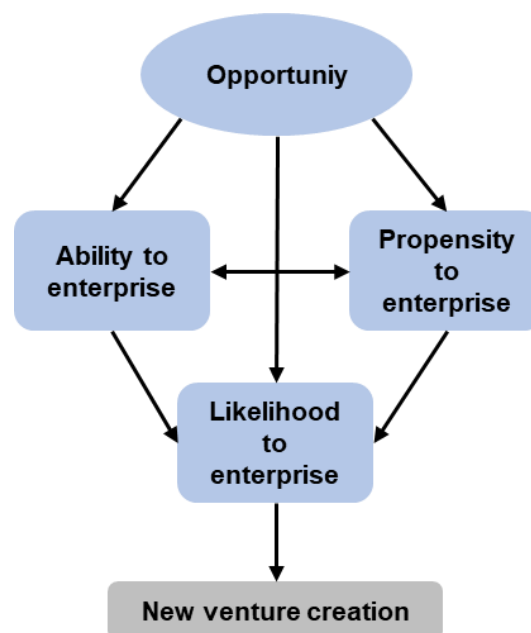
Figure 2.3 – Interactions between opportunity, ability and propensity to enterprise (adapted from Gnyawali & Fogel, 1994).

According to the author, the probability of creating a new venture successfully is dependent of the likelihood to enterprise, pursuant to, this dimension is highly affect by the other two dimensions inherent to the entrepreneurs, which of them may be lined up with the opportunity of entrepreneurship

2.4.2. Accelerators

The startup accelerators can be considered a recent trend, the first clear example is *Y Combinator* founded by Paul Graham in 2005. Accelerators are programs that help entrepreneurs bring their products into the marketplace. They typically operate by inviting a cohort of startup companies to work intensively on their technologies for a period of time (Dempwolf *et al*, 2014). Acceleration programs can be considered as a combination of other services that already existed, in fact, the comparison with incubators is common. Those institutions are aimed to support ventures providing almost everything one needs to boost its growth. The main objective of accelerators is to condense several services consolidating activities and, consequently, easing pain points in obtaining services and opportunities and decreasing costs for entrepreneurs. Usually the resources and services an accelerator provide are: seed investment, value-added mentorship and advisement, co-working/co-location with other startup companies, capital introductions and exposure, network building, and the opportunity to pitch to multiple investors (Hochberg, 2015). Indeed, accelerators often attempt to be an organized version of the "dealmakers" (Feldman & Zoller, 2012).

Usually accelerators organize cohort-based programs and boot camps for startups instruction and mentorship providence, getting them to interact with a broad range of mentors, which includes former entrepreneurs, venture capitalists, angel investors and corporate executives (Carvalho, 2016). Accelerators usually help ventures define and build their initial products, identify promising customer segments and secure resources, including capital and employees (Cohen & Hochberg, 2014). The acceleration programs end with a public pitch event called "Demo Day", in which graduated startups pitch their ideas, business models and value propositions to potential investors present in the audience. Taking this in consideration, accelerators serve three distinct markets during then product development stage: potential startup business with rapid growth potential; investors in early stage businesses; firms interested in acquiring those business to be part of their own business strategies (Dempwolf et al, 2014). Usually, startups working with web mobile related products are particularly suitable for the accelerator model, since their development costs are relatively low (Barrehag, et al. ,2012). Such fact ended accelerators to direct their business to business specialization, recent years have seen the emergence of accelerators that focus on a specific industry (vertical accelerators) (Cohen & Hochberg, 2014).

According to Hochberg's, (2015) research, accelerators typically small seed investment around $26thousand in a range from $0 to $150 thousand, such investment is meant to cover living expenses during the program. In return, they receive an equity stake in the portfolio company between 5 and 7%. The programs are usually limited to about three months and this is believed to create a sense of urgency that encourages intense work and rapid progress (Barrehag et al. ,2012). The evaluation of the success of the accelerator must be measured both sides, whether with accelerator's metrics and startups attending to programs. Baird, Ross, Bowles, and Suaraph Lall. (2013) in their publication for *Aspen Institute* proposed to organize those metrics for both accelerators and startups based on time horizon (short and long). According to the authors, accelerators should measure their performance

based on the acceptance rate and frequency with which graduate startups are acquired, as well as, in the long run, the internal rate of return and sources of funding, as shown in table 2.1.

Table 2.1 – Evaluation metrics for accelerators and startups based on time horizon (adapted from Baird, et al., 2013).

Time Horizon	Accelerator Metrics	Startup Metrics
Short-term (program duration plus 6 months)	Number of applicants Number of investors at demo day Percentage receiving next-stage funding Percentage acquired Percentage failed	Operational status (operating, closed, acquired) Number of financial investments or number of investors Size of financial investments Number of customers gained
Long-term (expected cash-out in 3-7 years)	Sources of funding (series or portfolio) Performance distribution Internal rate of return Network metrics (partnerships, etc.)	Sales or revenue Number of employees Rate of return to investors Stock prices (if applicable)

The comparisons between incubators and accelerators are inevitable since the second concept was originated from the first. The similar and sometimes overlapping characteristics of accelerators and incubators have led to some inconsistency in classification (Dempwolf et al, 2014). The concept of incubation is important for the study of the accelerator since they appear to share common features. Both accept early startups that have a potential commercial viability and they both provide an environment that is meant to serve the needs of a startup (Barrehag, *et al.* ,2012). The differences between both sometimes lie in the nature, intensity, and duration of characteristics, rather and its presence or absence in a program (Dempwolf *et al*, 2014). The investment strategy is not also the same, since accelerators provide direct investment unlike incubators which rarely do it directly.

Once again, just like incubators, the relationship with universities, creating university-affiliated accelerators, is an emerging trend. These programs tend to focus more on educational opportunities and entrepreneurship culture spread more than potential profit. Therefore, the accelerators contribution to the ecosystem growth is similar to incubators. Accelerators benefit on carefully understanding the current situation and dynamics of the region's ecosystem and capacity for innovation. Accelerators, by design, likely lower the search costs for both entrepreneurs and investors seeking early stage investments. As such, startup accelerators are predicted to stimulate an increase in the level of seed stage investment activity in a region. At the same time, accelerators may be more likely to be founded in regions that have higher levels of startup investment activity or have experienced swift growth in that activity (Hochberg, 2015).

2.4.3. Incubators

The first U.S. business incubator opened in 1959, when Joseph Mancuso started the *Batavia Industrial Center* in Batavia, New York. Since that time, business incubation programs have emerged as successful economic development tools throughout the country and around the world (Harper-Anderson, *et al.,* 2011). The word "incubator" has been widely used in the press to broadly refer to an organization that helps facilitate the creation of a new enterprise. Other terms that are often used interchangeably are "catalyst," "facilitator," "accelerator" and arguably "venture capitalist" and "angel investor." It's all a matter of definition, and that seems to vary greatly (Chinsonboon, 2000). As a matter of fact, all these terms are not misused. Chinsonboon (2000) describes incubators as "a controlled environment that fosters the care, growth, and protection of a new venture at an early stage before it is ready for traditional means of self-sustaining operation. In today's world, where information technology and the Internet are normal parts of the business environment, the term "controlled environment" could be either physical (real estate and office facilities) or virtual (networks)". According to Smilor (1987), incubators are known for providing benefits for their tenants in four broad dimensions: credibility development, shortening of the entrepreneurial learning curve, faster solution of problems and access to a valuable network of entrepreneurs. Business incubation programs are designed to accelerate the successful development of entrepreneurial companies through an array of business support resources and services, developed or orchestrated by the incubation program manager, and offered both in the incubator and through its network of contacts. (Harper-Anderson, *et al*., 2011). Today's new class of incubators aspires to help entrepreneurs by providing pre-seed, seed, and other early investments that have been traditionally offered by angel and early stage venture capitalists. They offer seasoned business guidance, connection to their coveted network of contacts, and the ability to take on the more mundane tasks of managing an office, acquiring computers, hiring, and payroll (Chinsonboon, 2000). The most valuable aspects for entrepreneurs are the providence of assistance in developing and refining ideas and concepts (brainstorming for instance), how to better apply new technology or other resources, developing an adequate business plan and value proposition, and provide access to experts, mentors and advisors. With the help of targeted business assistance, entrepreneurs are better prepared to turn business ideas into successful new ventures that have a greater-than-average chance of success (Harper-Anderson, *et al*., 2011). According to a study developed by Sherman (1999) about the effectiveness of interventions within incubation programs, incubated startups are more likely to thrive than others.

Harper-Anderson, et al. (2011) proposed that the incubator should be divided in categories and emphasize two:

- With walls: Incubation programs with a multitenant business incubator facility and on-site management, the focus of the program remains on the business assistance services provided to the start-ups, not on the building itself;
- Virtua: incubation programs without on-site spaces for clients, although they may have a central office to coordinate services, house the management staff, meet with clients, and perhaps even provide conference rooms for clients. Some entrepreneurs prefer not to locate

in an incubator facility because they already have established offices elsewhere or need access to specialized equipment or facilities not present in the incubator. For those, this solution seems better than an in walls incubator.

The usual equity agreed between ventures and incubator varies and it is not usually settled previously, it depends case by case. However, Chinsonboon (2000) claims that the equity breakdowns from no equity to a range between 5% to 60% maximum, dependent on the stage of maturity, type o help needed and finance health.

Chinsonboon (2000) also analyzed the typical time that the incubation programs last. Once again, this matter is a case by case decision but, in this case, the duration breakdowns have stronger correlation with the type of startup. For instance, for a high-technology software firm the program would have a range from 6 to 18 months, as for a bio-tech lasts as long as 5 years. Usually the duration stipulated is dependent on the milestone that is proposed and agreed. The usual milestones to exit the program tend to be: first round of institutional funding; space constrains within the physical incubator; failure of the venture to meet agreed upon milestones; trade-sale/merger to/with another firm.

Concerning with the investment size, according to Chinsonboon (2000), incubators often have a minimal capital investment size always depending of the amount of effort necessary to be dispended. This minimum can range anywhere from $50,000 to $500,000. Maximums are typically true for seed rounds and only apply to those co-investment funds that are large enough to take the hit without too large a percentage devoted to the one investment. For a seed round, this is typically about $2 million (Chinsonboon, 2000).

Incubators tend to have a strong and fruitful relationship. Most university technologies are embryonic and development on them is necessary before they can be sold in the market place. Incubators allow entrepreneurs to "ripen" technologies in close proximity to inventors whose inputs are useful for further development (Di Gregorio & Shane, 2003). Incubators that have some relationship with a university are often there to help commercialize strategic technologies that were developed in a research laboratory or to help business minded students bring their own ideas to market (Chinsonboon, 2000). Analogously, incubators inflict with the economic development fostering job creation. Once ventures become successful and grow business, new jobs are necessarily created

The same way incubators contribute to the entrepreneurial ecosystem, they are also highly dependent on it, especially concerning the community. Much of the success can be directly linked to public support that enables incubation programs to develop new services, enhance entrepreneurial training programs, and increase their visibility in their host communities (Harper-Anderson, et al., 2011). Collaborating with local entrepreneurs works in all interests of incubators to refine the process of targeting new individuals to connect with, and to better understand the needs and strengths of the ecosystem in matter. Being socially embedded allows entrepreneurs to understand the local structure and become part of it. It also helps small business owners draw upon local resources and obtain a unique competitive advantage (Harper-Anderson, et al., 2011).

2.4.4. Universities

The role of universities on the entrepreneurial ecosystem goes way beyond its common definition. According to the *Oxford Dictionary (2017),* the university is a high-level educational institution in which students study for degrees and academic research is done. Considering its impact on the entrepreneurial ecosystem, the role of universities cannot be simply summed up into educating new professionals to the job market, or generating research literature. Neck et all (2004) states that the university is amongst the most commonly mentioned reasons for the development of the entrepreneurial ecosystem. The university may support the ecosystem in different ways, such as contributing to the development of capable graduates, creating leading-edge technology, and providing faculty as consultants (Carvalho, 2016). University inventions are an important source of knowledge spillovers (Jaffe, 1989), which may eventually become very important inputs to enrich the ecosystem. However, the contribution of universities is highly dependent of its investment on the entrepreneurial education and culture implementation. The university creates the proper environment for valuable ideas to emerge. Students are continuously stimulated and often feel motivated to be the best that they can be in order to contribute to their field of study (Carvalho, 2016). Universities contribute more than funding and often provide infrastructure, business plan assistance, support staff, and other resources to enable research faculty to start firms. These efforts coincide with increasing pressure on modern public universities to promote, measure, and report on their contributions to economic development in their region (Lowe & Quick, 2004).

According to the literature, the importance of universities in the ecosystem may be translated in three main domains: Generate knowledge to the ecosystem; spread the culture and mindset of entrepreneurship between students; and incubation of university startups. Knowledge generation is the basic function of this actor to contribute to the ecosystem since is part of the genesis of concept of university. Traditionally, universities have been viewed as the wellspring of new knowledge that is published openly and drives the creation of new technologies. Although there are limitations to measuring the contribution of basic science to economic growth, multiple studies demonstrate a positive rate of return for the economy as a whole. (Lowe & Gonzalez-Brambila, 2007). The massification of the trend of entrepreneurship is helpful to spread the rear the will of entrepreneurship, universities have been playing a core role encouraging students to adopt this mindset. Although a substantial amount of research and early-stage technological innovation comes out of universities and from their students, many schools were slow to adapt their curriculums or support students who opted for the entrepreneurial track. This has changed significantly in recent years. Many universities now incorporate courses around entrepreneurship and innovation into their curriculum or, even degrees. In addition, several universities, whether at the undergraduate or masters levels, have as a first step, moved to launch their own incubators, and, more recently accelerators (*NUMA*, 2014). The ultimate stage of the process of spreading the entrepreneurship culture by universities is the creation of university startups and the development of incubation processes. *NUMA'*s report of 2014 notices that plenty universities such as Standford's, Cambridge, Waterloo launched successful acceleration and incubation programs for startups. These initiatives were erstwhile faced by other accelerators and

incubators as competition, however, nowadays they are perceived as potential partners since universities are the first filter to identify talent.

After an investment and training years for projects of entrepreneurship development and support over students, an effective way of measuring success is the number of patents and licenses registered and startup successfully generated. According to the publication of 2007 by Lowe & Gonzalez-Brambila, surveying the impact of such numbers in the US, in 1965, less than 100 U.S. patents were granted to 28 U.S. universities, by 1992, more than 1,500 patents were granted to 150 universities, and by 1998, more than 3,000 patents were issued to academic institutions. Such increase in those numbers is, not only related with the direct influence of universities over students to promote entrepreneurship activities and mindset (entrepreneurship courses for instance), but also with the flexibility to adapt to this reality and ease the generation of new business opportunities and, ultimately, new startups. In short, significant differences exist across universities in their generation of new firms to exploit university inventions. Both university policies and intellectual eminence influence this variation, generating important implications for research on and policy towards university technology transfer (Di Gregorio & Shane, 2003)

Ultimately, universities are one of the most active and determinant actors of the ecosystem because of their role of conditioning the occurrence of talent or even opportunity, and promotion of the culture. Promoting university start-ups is worthwhile to promote commercialization of a technology, and the potential cost of sacrificing academic research is not significant if even existent (Lowe & Gonzalez-Brambila, 2007).

2.4.5.   Investors

In 1874 when Alexander Graham Bell came up with the idea of the telephone, banks did not want to give him financing (Sohl, 1999). They did not believe in the idea and turned him away, even so, Bell did not give up and ended up getting his financing from the lawyer Gardiner Green Hubbard and the merchant Thomas Sanders. Looking back in history there are several stories like the one behind the invention of the telephone. Unlike large business finance, the high risk of startups is unbearable for banks and certain investment firms (Provatas & Barry, 2013). Financing early stage businesses involves special problems and is fundamentally different from financing mature and well-established companies. (Keuschnigg & Nielsen, 2003). Funding is critical to the success of a startup firm, yet the earlier the stage, the harder it tends to be for the entrepreneur to acquire funding due to the high risks involved (Rodriguez, 2011). Those risks are not only financial, but also time consumption and hard work.

As a startup proceeds through several stages and its business model becomes more concrete, different funding options are available (Davila, *et al.*, 2003). Usually, the first funding source for entrepreneurs tends to be financial help from family and closest friends, as well as self-funding (bootstrapping), this means that the entrepreneur will need to invest private funds which include savings, credit cards, second mortgages, and personal loans (Preston, 2007). While bootstrapping is a very effective resource of financing, it cannot be the only source of financing as the start-up continues

to grow. When a company grows it will tend to have more revenues which will lead to higher costs. These costs will require more money for the company to be able to run efficiently. As a result, eventually the entrepreneur will need to turn to external sources for financing (Rodriguez, 2011). The reason why the external financing is inevitable with the venture growth is because sales generation are rarely enough to offset the costs that come along with the development and growth of venture growth. Although, if the venture grows, entrepreneurs will eventually need external financing, this may be postponed by adopting strategies such as using second hand equipment instead of new, leasing contracts, consignment supplying, trade credit obtainment with suppliers or even deliberate delaying in payments (Rodriguez, 2011). In fact, entrepreneurs have interest in delaying the external financing, since the later startups resort this option the less control will have to surrender. The reasoning behind this is that the riskiness of the venture decreases dramatically as it develops (Rodriguez, 2011). Despite being plausible to delay the external influence over the venture, it will necessary become an inevitable scenario, which may not be fatefully just a sunken cost. The availability of funding in the ecosystem and the existence of a network of investors are also determinant to attract new entrepreneurs to the ecosystem and keep the local ones.

a) Business angels

The influence of an adequate investor at the right stage of maturity of the startup is determinant to achieve success sustainably. Bearing this idea in mind, and considering that sooner or later a venture will eventually need external financing, common bank funding is not always the only option, and most of the times is not even an option. The initial capital required for a startup is called seed capital. Seed capital, also known as seed money, is usually limited because the startup is still in a conceptual stage. Seed money is used for market research and product development until the company can start generating income (Provatas & Barry, 2013) Until it proves successful, however, it will be hard to receive funding from banks and venture capitalists (Rodriguez, 2011). Such situation naturally generates a void in the financing business which is usually filled by business angels (BA). According to Shane (2009), a business angel is "is a person who provides capital, in the form of debt or equity, from his own funds to a private business, which is often an early-stage company but not exclusively, owned and operated by someone else, who is neither a friend nor family member" Over the last decade angels have become a more important source of early stage funding for entrepreneurs. (Hellmann & Thiele, 2015).

BAs are often experts in entrepreneurship and have experience in running businesses. Entrepreneurs can take advantage of this and benefit by using the expertise of their angel investor's business insight to help in areas in which they may not be as familiar (Rodriguez, 2011). However, angels typically invest in industries they are familiar with and understand, which commonly means investing in the same field as their earlier successful endeavors (Carvalho, 2016). Financial angels have earned their wings through prior business success, accumulating wealth and wisdom that they re-deploy in ventures founded by the next generation of entrepreneurs. They willingly, even cheerfully, assume financial risks that would frighten off even some of the most experienced venture capital firms (Hill & Power, 2002). Alongside providing entrepreneurs the needed funding, BAs also tend to share their

business knowledge and give any other kind of support. The relationship between entrepreneur and business angel is supposed to be, above all, mentorship. BA investors expect to realize a significant return on their investment. This usually occurs when the venture is sold, goes public, or merges with another company. Since angel investors usually provide capital in the form of equity rather than debt, if the company fails the entrepreneur does not need to repay the money. This is one of the greatest advantages of having angel investors (Rodriguez, 2011). The criteria for BAs to invest in ventures, as opposed to other investors, is mainly based on the entrepreneur's profile and willing to work hard with passion, determination, commitment and enthusiasm. Angel investors weigh heavily into the man behind the idea. Beyond having a good idea and investment preferences that match up well with the company, angel investors are also very concerned about the entrepreneur. "Based on evidence from focus groups with angel investors, people in the project are the most critical factor in an angel investor's decision to invest" (Mason & Stark 2004).

The growth of new ventures also leads to a growth in the number of entrepreneurs who are potential future angel investors, because if their venture proves successful they reap the rewards and have the potential to accumulate enough wealth to invest in other early-stage ventures (Rodriguez, 2011). And this is active part of the entrepreneurial ecosystem growth. In a 2011 report of the *OECD*, the size of the angel market was estimated to be roughly comparable to the venture capital market (Hellmann & Thiele, 2015).

b) Venture capitalists

Venture capitalists (VCs) are other funding solution for ventures who need to step up with their growth and path to success. Unlike angel investors, Venture Capital (VC) firms do not invest their money but act as intermediaries between startups and funds raised from institutional investors, referred to as limited partners. (Provatas & Barry, 2013) Angels have limited funds and typically need VCs to provide follow-on funding for their companies. At the same time VCs rely on angels for their own deal flow. (Hellmann & Thiele, 2015). VCs are long-term investors, which means they expect return from their investment after 5 to 10 years. Their goal is a profitable exit from the company and therefore they are not interested in running the company for a very long time. VCs typically hold the strongest rights regarding the choice and timing of exit (Provatas & Barry, 2013). VC has come to specialize in financing early stage investment. VCs finance the investment cost but also provide valuable business advice to enhance survival chances of start-up firms (Keuschnigg & Nielsen, 2003).

VC has a similar target to BAs, with small particularities and with different kind of support and resources. VCs use their experience as well as their contacts to reduce many of the information and opportunity costs related to new business formation (Florida & Kenney, 1988). Many business failures, however, result from avoidable management mistakes that originate in the commercial inexperience of entrepreneurs in the early stages of their career. An active role of VCs in providing valuable business advice might be an important factor in raising survival rates of start-up firms. (Keuschnigg & Nielsen, 2003). VC provide a different kind of support at a cost of lower investment risks for themselves. This type of investment is destined to entrepreneurs of new ventures, particularly those with intangible, mostly intellectual property-based resources, VC is an important source of funding for the ongoing

operations of the venture (Hsu, 2007). VCs are interested in companies that have potentials for high growth. VCs do not only provide companies with money, but they also support them with their experience and coach them in their first stages (Provatas & Barry, 2013).

VC may be comparable in some way with public equity funds supported by governments. The establishment of public equity funds is problematic since political imperatives may impede decisions best made on the basis of market and technological criteria. In addition, the expansion of public capital may simply mean another round of interlocally competition pitting jurisdiction against jurisdiction in another mad scramble for high tech businesses and jobs (Hellmann & Thiele, 2015). Furthermore, public funds do not have the capacity of providing all the other resources and support that ventures in such stages require, this is the strongest advantage that VC have over public funding.

c) Crowd funding

During the last few years a new way of financing called crowdfunding has been developed. Crowdfunding is a collective effort by consumers who network and pool their money together in order to invest in and support efforts initiated by other people or organizations (Ordanini, *et al*., 2011).

Most crowdfunding platforms operate online and they are an interesting alternative to traditional financing opportunities because in most cases they allow entrepreneurs to receive funding without the need to sell equity (Provatas & Barry, 2013).

Another advantage of crowdfunding is that it's simplified and more standardized than contractual agreements with BAs, which makes it more appealing to inexperienced entrepreneurs. Due to the smaller capital one can raise, crowdfunding can be used primarily for projects in early stage startups.

2.4.6. Government

The government is one of the actors that most conditionate the entrepreneurial ecosystem. Its interference is highly correlated with the model proposed by Gnyawali & Fogel (1994) showing the relationships between the three elements that may lead to the creation of a new venture (showed before on figure 2.3): The government policies and procedures have an effect on the business opportunity and it is the set of policies, actions and the set of programs of the business development organizations that have an influence on the opportunity, propensity to enterprise and ability to enterprise (Gnyawali & Fogel, 1994).

The government may intervene to create conditions for the opportunity to arise, and conditionate the levels of propensity and ability to enterprise. Such interventions may be related to the provision of laws and regulation to protect entrepreneurial innovation such as patents and copyrights, liberal economic policy to allow the community to freely exercise their entrepreneurial talents and minimum rules and regulations for entrepreneurs to follow so that the costs of doing business can be minimized (Gnyawali & Fogel, 1994). Even though, it is safe to consider that the most important influence that the government may exert is in the opportunity element, Usually, the main goal of the government and other agencies is to increase opportunities, to develop the motivation of potential entrepreneurs to get

involved in the business and to improve potential entrepreneurs' ability to start a business (Carvalho, 2016). Governments both directly and indirectly affect the development of an environment that could support entrepreneurship (Gnyawali & Fogel, 1994). The government can play many other roles, in either fostering or hampering entrepreneurship in their regions through tax rates and incentives, in providing other forms of financial support, and in eliminating the bureaucratic "red tape" often associated with applying for permits and licenses (Neck. *et al.*, 2004). Efficient government increases demand and supply for private and public services which may result in higher growth rate in the entire economy. The positive outcomes of efficient administrative services and resource allocation will create stability and make place more attractive to live, work and invest (Audretsch & Belitski, 2016).

The strategical approach taken by the government cannot be linear nor 100% replicable, each case has its own singularities, therefore, the strategy should be a result of deep analysis of the ecosystem. Nevertheless, theoretically, is consensual that the more (and more affectively) the government participate, the more the ecosystem can provide better conditions to newcomers. While there can be deficiencies in the institutional framework anywhere, it is normally argued that problems are especially serious in less developed economies (Aidis & Estrin, 2010). As such, an "healthier" government participation tends to be associated with an healthier economy and, consequently, the entrepreneurial ecosystem tends to be more inviting to the other actors. More extensive government spending may create a basis for stronger institutions, funding law and order enforcement systems that protect contracts and supporting infrastructure that may enhance entrepreneurship. Conversely, lower government spending might weaken the business environment (Aidis & Estrin, 2010).

Bearing in mind the premise that there are no formulas for a government to operate positively over the entrepreneurial ecosystem, some authors suggested general measures and guides lines. Gnyawali & Fogel (1994) prosed general guide lines based on three aspects that the authors consider that the government can exert influence in: Opportunity, propensity and ability to enterprise. The authors sum up its suggestions in four points:

1- Governments can influence the market mechanisms and make them function efficiently by removing conditions that create market imperfections and administrative rigidities. They can also create an "enterprise culture" that enables firms to take reasonable risks and seek profits (Gnyawali & Fogel, 1994).
2- Governments whose countries have low propensity to enterprise but high ability to enterprise could design policies and programs aimed to improving the socioeconomic dimension of the environment (Gnyawali & Fogel, 1994).
3- Governments whose countries have a low level of ability to enterprise but high propensity to enterprise could try to develop policies and programs that enhance the entrepreneurial and business skills of potential entrepreneurs. Example: Technical and vocational training, and short-term entrepreneurship development courses and workshops aimed at enhancing specific business skills (Gnyawali & Fogel, 1994).
4- Some caution is needed in offering broad-based financial assistance to potential entrepreneurs in countries where propensity and ability to enterprise are low. If the propensity

and ability to enterprise are low, policies and programs should also be directed to developing the propensity and ability to enterprise. This is because despite the financial assistance, people with low propensity and ability to enterprise may not venture into business or, even if they did, they may not be able to manage the enterprise. The greater the likelihood to enterprise, the greater the role of financial and non-financial assistance in creating new ventures (Gnyawali & Fogel, 1994).

Generally, the primary role of the governments and other agencies is to increase opportunities, to develop the motivation of the potential entrepreneurs to go into business, and to enhance potential entrepreneur's ability to start a business (Gnyawali & Fogel, 1994). The impact of the government on the ecosystem is ultimately decisive for those who already established there, attract newcomers and provide conditions to interact with other ecosystems. Public policies allowing faster access to information and internet may further lead to a more entrepreneurial activity and more innovation (Audretsch & Belitski, 2016). Government is indeed critical in many ways, but in creating the framework conditions: there is a big difference between building a highway system and telling people where to drive (Isenberg, 2011).

2.5.   The city as the center of entrepreneurship

An ecosystem is vital for the entrepreneurship self-sustainability, moreover, ecosystems proximity is one of the most prolific aspects that benefits a local entrepreneurship community (meaning an ecosystem). Bearing this statement in mind, it is easy to relate the entrepreneurship ecosystem with geography, Daniel Isenberg (2011) reinforced this stating that "as we look around the world, entrepreneurship tends to be geographically concentrated in specific regions, cities, neighborhoods, and even buildings". According to the ecosystem description and definition previously shown, an urban region, such as a city, fits as a suitable habitat for an entrepreneurial ecosystem, considering that, on a general base, it is a typical capitalism driven community that converges several actors, promoters of creativity and talent, which may conduct to an innovation cluster emergence. Richard Florida (2016) is one of the authors that defends that theory of pointing the city as the center of entrepreneurship. Florida (2016) considers that the region is the level at which the demand for entrepreneurial activity is articulate. Jane Jacobs (1969) had already given the basis for this theory considering the city as a key organizing unit for innovation, entrepreneurship and economic growth.

From the earliest records of ancient civilizations to present-day accounts of the knowledge-economy, the geographic concentration of people and their activity has been and always will be a constant feature of human existence (Rutgers, 2010). Although this statement may seem obvious, there are still points for and against. In fairness, declaring the irrelevance of geography and location is not entirely unreasonable given modern-day trends (Rutgers, 2010). The end of the twentieth century brought transportations and communication technological revolutions that promoted globalization of economy. Globalization has also heavily contributed to the remote work approach, which should be considered

as a point against the premise of the city as the center of the entrepreneurial activity. Such fact, seemed to narrow the importance of location in business activity matter.

However, Hoover & Giarratani (1999) brings up an interesting premise that the geographic distribution of economic activity is itself a product of entrepreneurial process, which means that it is the entrepreneurial activity itself that enlights the economical privileges of a certain region. This argument represents the opposite point of view of the previous, putting the entrepreneurial activity before the emergence of the region as a proper host for an entrepreneurial ecosystem. Apparently, if geography importance is diminished, the interaction of ecosystems would not promote the occurrence of knowledge and creativity to the entrepreneurs. Such consequence would antagonize the theory of Burt (2009), an American sociologist who focused his researches on the importance of social networks and social capitals, who defends that different networks offer entrepreneurs different access to information and capital.

Even though, with years past from the beginning of globalization, it does not seem to be confirmed that globalization is contributing to devalue the importance of geography over the entrepreneurial activity. Despite such claims, geography's demise has been more apparent than real (Rutgers, 2010). In fact, internet and technological improvements over transportation and communication brought people together, but, instead, while transportation and communication advances diminish the role of geography in some ways, for most economic activities, such advances reaffirm the relevance of geography in new and compelling ways (Morgan, 2004). This does not mean that globalization has not brought people and places closer, it just did not have enough impact on geography in economic matters. Cheaper means of transportation and communication have changed the economic landscape but not by making geography irrelevant (Rietveld & Vickerman, 2004). In other words, geography still matters and influences entrepreneurial activity in ways that are both puzzling and fascinating (Rutgers, 2010). Isenberg (2011) reaffirms that, not only geography still matters in spreading and growing an entrepreneurial ecosystem, but also is a key factor to ease the process. The shortest path to creating this virtuous cycle is to directly create, enhance, cultivate, evolve—a geographically concentrated ecosystem that is conducive to entrepreneurship and its success (Isenberg, 2011). Summing up, if globalization could represent a threat to diminish the influence of geography in entrepreneurial ecosystems development, the latest years technological advances consequences seem to match with the statements of the several authors mentioned, claiming that geography still matters and that the thesis of pointing the city as the center of entrepreneurship is valid. In short, entrepreneurship is, and always has been, both a cause and an outcome of the geographic distribution of economic activity (Rutgers, 2010)

According to Florida (2016) this relationship dates back through history, there were always certain cities known for being fonts of innovative, creative and entrepreneurial activity. Cities like those would be attractive for migrants with creative inclinations, making them hotbeds of creativity used, not only to promote collaboration between individuals to develop new innovative ideas, but also to be used as arenas for presenting findings from elsewhere.

As mentioned before, Jacobs (1969) developed knowledge about this approach, coming close expressing how cities actively spur innovation and entrepreneurship. Jacobs (1969) countered the mainstream economical approach of setting developments course at the scale of the firm, entrepreneur and national economy, pointing the whole process centered in cities. According to the author, this rescaling involved a move away from specialization and cost reduction as mechanisms for development. The key argument of this approach is that, in an optimized urban economy cannot be driven by a single major production function, instead, this economy benefits with margin growth of firms, collecting skills, capital, physical platforms, knowledge attained and the firms themselves to recombine into new productive forms. Such approach configures a modern, replicable and effective urban model of growth.

A city dimension is itself suitable to host an entrepreneurial ecosystem. Such localized knowledge creation, of course, translates into a range of opportunities including the potential for new products and processes, the use of specialized (shared) resources, and new organizational knowledge about effective routines and competencies (Rutgers, 2010). Florida (2016) considers that cities are suitable to host an entrepreneurial ecosystem, not only as containers for innovation and entrepreneurship emergence, but also as mechanisms to enable it. Florida (2016) describes cities as the entities that bring together all the actors that make part of the entrepreneurial ecosystem, which means that innovation and entrepreneurship are more urban processes than firm or individual level ones. According to the author, cities do not only represent catchment areas for common set of rules and other institutions, because of the frequent dynamic interaction of skilled workers and creatives, the growth process of the ecosystem occurs more naturally.

Since the margin of growth of the urban model seems to be a key factor to host an entrepreneurial ecosystem, cities, usually and more than any other, have the characteristic of privileging the diversity of cultures, knowledge and experience, and, naturally, making it beneficial for the emergence of sets of functions that contribute to the self-sustainability of the process. One of this process concerns with cyclicality of the market itself. This constant change is actually a key factor. Jacobs (1969) states that "when a place gets boring even the rich people leave", the ecosystem needs constant dynamic of actors coming and going, changing its stages of growth (or even failing in its activity) and tendencies appearing and disappearing to guarantee that the ecosystem keeps competitive enough to be interesting to newcomers (who may be considered as bringers of knowledge), and healthy to keep providing ultimate technology and infrastructure, and, consequently, the best opportunities to those who established in such city for its entrepreneurial activity (whatever it may be). Cities have always been important engines of economic growth, but they are assuming an even greater importance in today's knowledge-driven, innovation economy, where place-based ecosystems are critical to economic growth (Florida *et al*, 2016).

Cities are, most of all, an influence on the mind set of creative entrepreneurs. According to the psychologist Dean K. Simonton (2011) this usually happens two ways: They assemble personal role models, who can influence the development of the young, higher plasticity mind. They also provide the diverse ideational milieu that will allow the creative mind to better overcome blocks in the creative

process (Florida *et al.*, 2016). Using this argument, such influence that cities take over entrepreneurs is evidenced with competitiveness, resources availability and selection and, most of all, to help developing the correct attitude and mind-set to be a part of such ecosystem positively.

Nevertheless, the previous arguments presented, do not necessarily mean that only cities with high technological assets and hosts of very matured DBEs are suitable for a community of entrepreneurship. According to the literature, typically there are two different common points of view for the entrepreneurs to deal with this: On one hand, the "perfect" environment for entrepreneurship, with conditions and high levels of entrepreneurial activity, human capital and investment availability, may seem the preferable place for entrepreneurs to embrace their activity. On the other hand, the emergence of local opportunities, such as those arising from local market imperfections or new additions to local stocks of knowledge, as being the incentives for entrepreneurs to emerge (Rutgers, 2010). Although the second option may seem riskier, since the ecosystem is not matured, and the market, at first sight, do not seem to be prepared to absorb new business, this combination of factors may represent a profitable opportunity emergence.

Summing up, pointing the city as the center of entrepreneurial activity means focusing and understanding the entrepreneurial activity as an important part of an urban model of growth. The dynamism that it is brought to the host city is a two-way beneficial relationship for the reasons presented, the entrepreneurial community benefits from what the city (and the ecosystem) has to offer, and the city benefits with all the physical and knowledge infrastructure installed. Finally, it is expected that the geographic distribution of people, resources, and businesses are both a cause and a consequence of the entrepreneurship process (Rutgers, 2010).

2.6. Composite indexes

The configuration chosen to present the results of such study must be part of a careful decision. Since the final result is the presentation of data to be analyzed and to make conclusions about, the shape of it should be a tool to provide friendly-user comparisons and highlighted scores. Considering the majority of the similar studies, the "composite index format", as being the most used, is considered to be the most effective, useful and easier and most appealing to interpret and consult. The literature on composite indicators is vast and almost every month new proposals are published on specific methodological aspects potentially relevant for the development of composite indicators (*OECD*, 2008). It often seems easier for the general public to interpret composite indicators than to identify common trends across many separate indicators, and they have also proven useful in benchmarking country performance (Saltelli, 2007).

A composite index is an index based on standardized statistical factors in columns (usually). Each factor (numerical values) represents a variable which is respective to an indicator. In general terms, an indicator is a quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions (e.g. of a country) in a given area (*OECD*, 2008). A composite indicator is

formed when individual indicators are compiled into a single index on the basis of an underlying model. The composite indicator should ideally measure multidimensional concepts which cannot be captured by a single indicator (*OECD*, 2008). On the table 2.2 are presented the pros and cons about the use of composite indicators for this type of researches proposed by Saisana & Tarantola (2002).

Table 2.2 – Pros and cons about using a composite index (adapted from Saisana & Tarantola, 2002).

Pros	Cons
• Can summarize complex, multi-dimensional realities with a view to supporting decisionmakers	• May send misleading policy messages if poorly constructed or misinterpreted
• Are easier to interpret than a battery of many separate indicators	• May invite simplistic policy conclusions
• Can assess progress of countries over time	• May be misused, e.g.to support a desired policy, if the construction process is not transparent and/or lacks sound statistical or conceptual principles
• Reduce the visible size of a set of indicators without dropping the underlying information base	
• Thus, make it possible to include more information within the existing size limit	• The selection of indicators and weights could be the subject of political dispute
• Place issues of country performance and progress at the center of the policy arena	• May disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action, if the construction process is not transparent
• Facilitate communication with general public (i.e. Citizens, media, etc.) and promote accountability	
• Help to construct/underpin narratives for lay and literate audiences	• May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored
• Enable users to compare complex dimensions effectively	

OECD (2008) developed the Composite Indicators Handbook where a set of recommendations on how to design composite indicators alongside an appropriate methodology to approach on:

- Theoretical framework: A theoretical framework should be developed to provide the basis for the selection and combination of single indicators into a meaningful composite indicator under a fitness-for-purpose principle.

- Data selection: Indicators should be selected on the basis of their analytical soundness, measurability, country coverage, relevance to the phenomenon being measured and relationship to each other.

- Imputation of missing data: Consideration should be given to different approaches for imputing missing values. Extreme values should be examined as they can become unintended benchmarks.

- Multivariate analysis: An exploratory analysis should investigate the overall structure of the indicators, assess the suitability of the data set and explain the methodological choices, e.g. weighting, aggregation.

- Normalization: Indicators should be normalized to render them comparable. Attention needs to be paid to extreme values as they may influence subsequent steps in the process of building a composite indicator. Skewed data should also be identified and accounted for.

- Weighting and aggregation. Indicators should be aggregated and weighted according to the underlying theoretical framework. Correlation and compensability issues among indicators need to be considered and either be corrected for or treated as features of the phenomenon that need to retain in the analysis.

- Robustness and sensitivity. Analysis should be undertaken to assess the robustness of the composite indicator in terms of, e.g., the mechanism for including or excluding single indicators, the normalization scheme, the imputation of missing data, the choice of weights and the aggregation method.

- Back to the real data. Composite indicators should be transparent and fit to be decomposed into their underlying indicators or values.

- Links to other variables. Attempts should be made to correlate the composite indicator with other published indicators, as well as to identify linkages through regressions.

- Presentation and Visualization. Composite indicators can be visualized or presented in a number of different ways, which can influence their interpretation.

One of the key composite indexes in which this study is based on is the *EDCI* of 2016. This index is annually developed by *Nesta*, an organization that helps entrepreneurs to achieve their potential and success, as stated in *Nesta's* mission declaration: "We are dedicated to supporting ideas that can help improve all our lives, with activities ranging from early-stage investment to in-depth research and practical programs" (Bannerjee, *et al*., 2016). The purpose of this composite Index is to provide entrepreneurs, policymakers and researchers a tool for measuring the readiness or receptiveness of city-level ecosystems for both digital startups, as well as scale-ups (Bannerjee, et al., 2016). The structure of this index is with a ranking of 60 European cities, including all the European Union capitals, composed by ten themes: Access to Capital, Business, Environment, Digital Infrastructure, Entrepreneurial Culture, Knowledge Spillovers, Lifestyle, Market, Mentoring, Nondigital Infrastructure and Skills. Each of them with between two and eight variables and a set of indicators. The ultimate purpose of *EDCI* is to support digital entrepreneurship by providing a holistic and local view across Europe by describing what ecosystem factors are most conducive to digital startups (Bannerjee,. et al., 2016).

Apart from the *EDCI*, there are other examples of good-practices for indexes like this, although not all being so similar to this one in matter, they still are credible and respect the fundamentals, so that, and for being considered references in the subject, should be taken in account when developing a study like this, such as the Global Entrepreneurship Monitor and the Kaufman Index Startup.

3. Geographical coverage

In this chapter, it is analyzed what is the situation of the S&EE countries concerning the entrepreneurial practices and the conditions that influence it. The main point is to legitimize the match of the characteristics of this region with the less-matured DBE classification. The final section of the chapter is the process of choice of the DBE applied in the model.

3.1. Region overview and selection justification

The second premise inducted on the Research Objectives section of the Introduction chapter is determinant for the first one. Studying such a specific ecosystem with such characteristics needs a model with particular specifications.

According to the *EDCI* rankings, most of the S&EE cities are at the last third of the ranking. From all the twenty cities that integrate the S&EE regions taking part in *EDCI*, only seven are not at the last third of the list and only three are part of the top 20 (first third). Moreover, calculating the average position of those twenty-two cities the result is 48. Strengthening this apparently obvious conclusion, resorting on the *EDCI* data collection, when considering the hard skills themes (access to capital, market, infrastructure), once again, the S&EE cities are the ones with lower scores for each indicator. According to the *EDCI* report over the index, there is a "significant divide between North-West and South-East Europe, which is particularly visible when it comes to different cultural attitudes towards entrepreneurship, the availability of capital, and mentoring or managerial assistance" (Bannerjee, *et al*., 2016).

In this dissertation, the division criterium of Europe is purely geographical, disregarding other criteria usually mentioned in the literature, such as historical, political, economic or religious divisions. Nevertheless, dividing by compass directions is never easy since the midpoint calculations of the continent are hard to find, so that, applying this method, it is common to mix the real criterium used. In this study, S&EE region covers countries of eastern-central Europe (except the old Russian republics) and the southern (Mediterranean) Europe.

It is common sense that, in Europe, northern and western economies are more prolific than southern and eastern'. The great majority of these countries have been (or are still) surpassing dictatorial regimes and social crisis which have, in one way or another, delayed and caused friction to the introduction of new technologies and infrastructures which, consequently, slowed economic growth. Such factors were determinant to delay the emergence of entrepreneurship and the basic conditions to build an entrepreneurial ecosystem. Fortunately, and perhaps due to the actual paradigm, mindsets are changing and entrepreneurship, self-employment, and the "do by yourself" approach are becoming more consensual, success cases become more common, which automatically tend to favor the urge of conditions for others to pursue the same path. The graphic on figure 3.1 shows the ranking points of

political stability index of *The World Bank*. The majority of SEE countries are in the second half of the ranking while the northern and western countries place the top positions
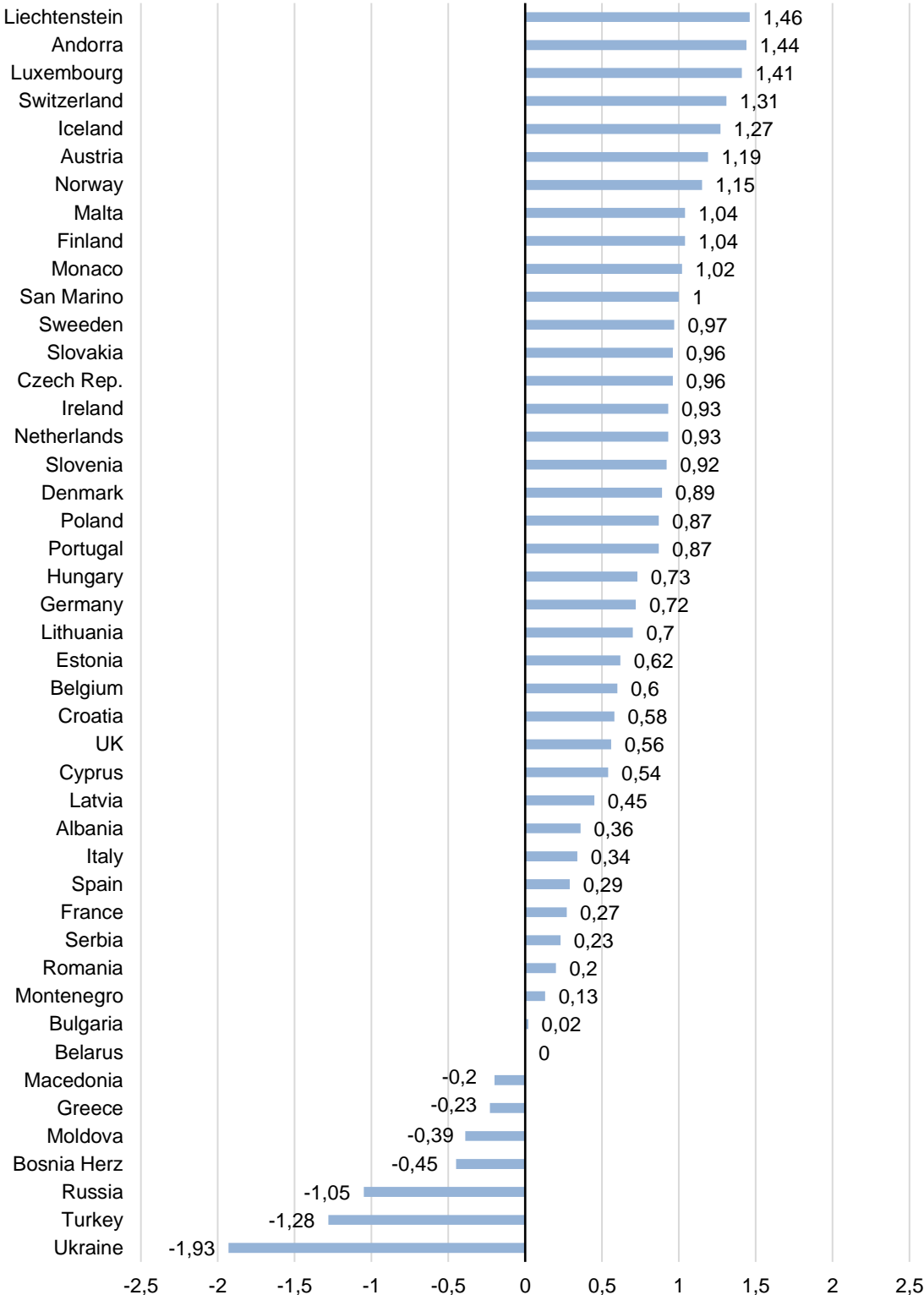
Figure 3.1 – Ranking points of political stability (-2,5 weak; 2,5 strong) (adapted from The World Bank, 2015).

Analyzing the literature, it is easy to find connections with the *EDCI* conclusions. S&EE countries (still southern European countries and eastern European countries do not have exactly the same characteristics) tend to share the same or similar pain points when it comes to developing an entrepreneurial ecosystem, especially considering a DBE, which requires technical infrastructure and know-how. Commonly, and for reasons mentioned before, S&EE countries are facing financial crisis or complications, typically with the intervention of external help. This environment allied to high unemployment rates are usually prone to generate social consternation.

With the unfavorable political and financial situation, access to funding becomes harder to get for smaller business to grow, plus, facing these conditions, governments do not always consider priority to take political measures to help entrepreneurs or attract new ventures. With limited funds to invest, governments tend to neglect the essentials to promote entrepreneurship since they do not consider it as a possible solution or contribution to easing the instability issues. So that, S&EE entrepreneurs usually struggle with poor digital infrastructure, lack, underuse or misuse of it, and even lack of public transportations quality or connections. The government's neglection over entrepreneurship not only tend to skip the essentials to build and feed an entrepreneurial ecosystem, but also do to invest in cultivating it over new generations and students, consequently, the basic entrepreneurial formation and education is a deficit. Figure 3.2 shows the unemployment rates of European countries are compared. From the nine countries with a higher unemployment rate than the average of the EU, six are in the SEE region.

On the other hand, entrepreneurship is much more concerned with the mentality and attitude over business. A good entrepreneur learns how to take advantage of what the ecosystem in which it is inserted has to offer and to find opportunities where other see struggles. As a matter of fact, S&EE have characteristics which other countries hardly have or will ever have. S&EE countries (particularly those in eastern Europe) have a low cost of living, and southern European is worldwide known for having tempting weather. In other words, S&EE countries have a good quality of life. The tourism growth in this region (for different reasons between southern regions and eastern regions) contributes to the economic growth of these countries (in some cases being cornerstone for economic development), and is also an attractive factor for new entrepreneurs and other actors of the entrepreneurial ecosystem. One big and evident advantage that S&EE countries usually have are the easy access to frontier countries and, therefore, international markets. While S&EE countries' governments struggle to ease the access of credit, other institutions, recognizing the abundance of emerging talent in, are starting to seed investing in ventures in these regions and, most of all, promoting programs of incubation and acceleration for them. Such actions contribute to boost the entrepreneurial culture and, eventually, inspirit governments in investing in entrepreneurial culture spread.
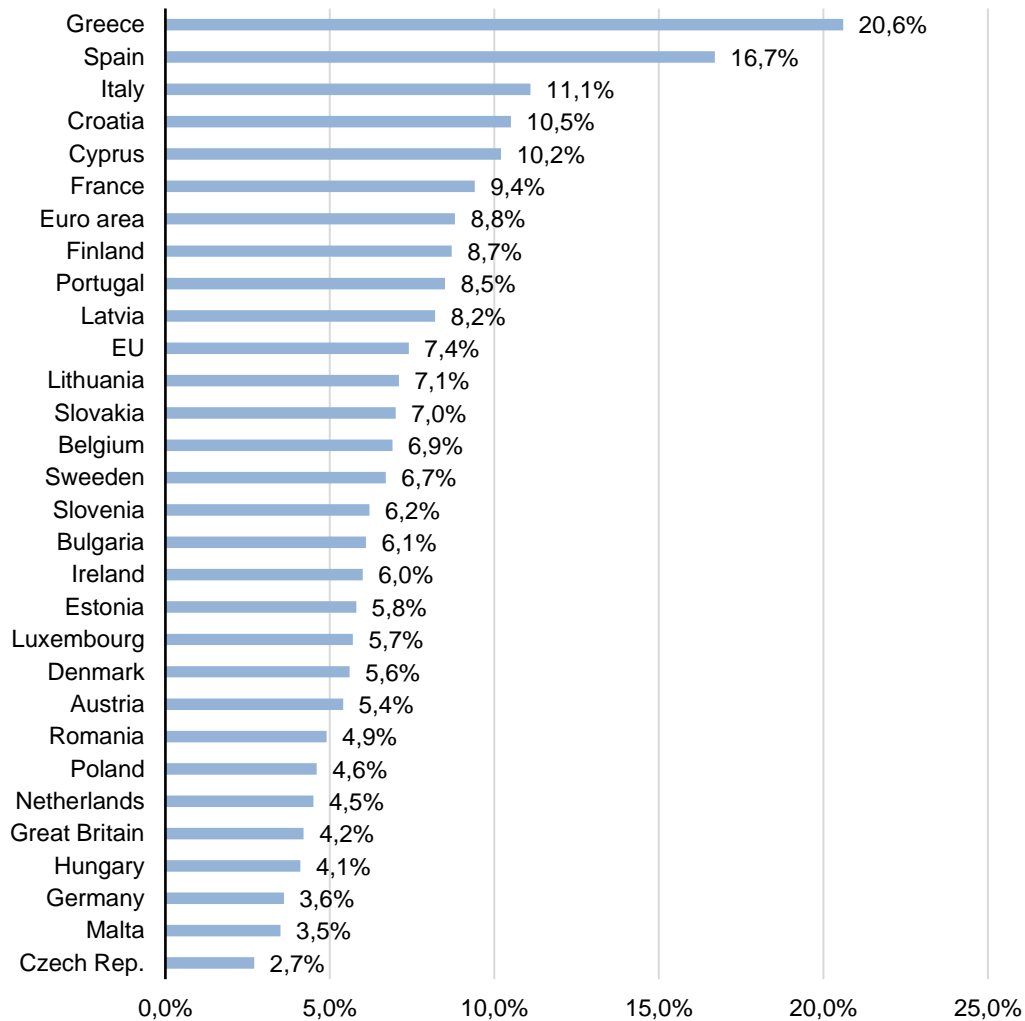
Figure 3.2 – Unemployment rates between European countries (adapted from Statista, 2017).

As a result, nowadays a considering number of important entrepreneurship and technology events are being hosted in S&EE cities. The most powerful evidence that may convince investment over the entrepreneurial ecosystem is ultimately the occurrence of cases of success. Although it is not expected for every ecosystem in every city to have a unicorn (over one million dollars evaluated technological startup), it is unquestionable that the first cases of success are emerging and a few unicorns are even appearing in the bigger hubs. As expected, considering all the reason mentioned on the last paragraph, the most consistent entrepreneurial ecosystems in S&EE countries tend to be centralized in one particular city, most of the times the capital or a particular city with high development in a specific area of business. This is actually an attractive point for external entrepreneurship actors specialized in that particular business area. This originates a common phenom in entrepreneurship that usually attracts newcomers: the business clustering. In addition to this, there is a high concentration of university students in S&EE main cities. Also for this reason, the percentage of English fluent speakers in S&EE regions is very acceptable. On table 3.1 shown next, it is concluded that most of the bottom table's positions are occupied by SEE countries, in contrast, the top table's position is mostly occupied by northern and western countries.

Rank	Country	Cost of living index
1	Switzerland	131.39
2	Iceland	123.96
3	Norway	113.70
4	Luxembourg	96.56
5	Denmark	93.30
6	Ireland	85.45
7	France	83.66
8	Sweden	83.70
9	Belgium	83.35
10	Netherlands	82.69
11	Finland	81.70
12	Austria	81.47
13	Italy	79.06
14	UK	75.85
15	Germany	74.35
16	Malta	70.92
17	Greece	63.15
18	Spain	61.75
19	Slovenia	59.65
20	Estonia	57.65
21	Portugal	55.86
22	Croatia	55.06
23	Latvia	53.42
24	Lithuania	50.51
25	Slovakia	50.41
26	Czech Rep.	50.09
27	Hungary	48.60
28	Poland	45.20
29	Montenegro	44.41
30	Russia	43.89
31	Bulgaria	41.21
32	Romania	39.71
33	Serbia	39.59
34	Bosnia Herz	39.26
35	Albania	37.88
36	Macedonia	34.84
37	Belarus	34.06
38	Moldova	33.10
39	Kosovo	29.44
40	Ukraine	25.98

Table 3.1 – Cost of living ranking relatively to New York city (which would score 100) (adapted from Numbeo, 2018).

As observed in figure 3.3, the contribution of tourism to the GDP (Gross Domestic Product) in SEE countries tend to be high, showing that tourism is a nuclear source of national income.

Country	Contribution
Iceland	33,9%
Georgia	27,1%
Malta	26,7%
Croatia	24,7%
Montenegro	22,1%
Cyprus	21,4%
Greece	18,6%
Portugal	16,6%
Estonia	16,1%
Azerbaijan	14,6%
Spain	14,2%
Armenia	14,0%
Bulgaria	12,8%
Slovenia	12,6%
Italy	11,1%
Albania	11,1%
Germany	10,8%
Hungary	10,5%
Sweden	9,6%
Bosnia-Herzgovina	9,2%
Switzerland	9,1%
Norway	9,1%
Latvia	9,0%
France	8,9%
Finland	8,8%
Czech Republic	7,8%
Denmark	7,7%
Macedonia	6,7%
Serbia	6,7%
Ireland	5,8%
Ukraine	5,6%
Belgium	5,6%
Lithuania	5,3%
Romania	5,2%
Netherlands	5,2%
Luxembourg	5,1%
Poland	4,5%
Moldova	3,4%
Austria	3,0%
United Kingdom	2,8%

Figure 3.3 –Contribution of tourism to GDP (Gross Domestic Product) (adapted Knoema,2016).

Once again, invoking the second premise on the Research Objectives section, and since the research interest over S&EE region has been demonstrated, a suitable and specific model is required for a deeper study of it. Due to the unique characteristics of this European region with such evident differences comparing with the north and west of the continent, the S&EE region seems to be a perfect

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match for the implementation of this model. One of the main purposes of this combination of premises (model and region) is to highlight the crucial factor that may determine if such ecosystem will evolve sooner or later in its stage of maturity: Potential.

3.1. Digital business ecosystem list selection

Once the region of study is selected it remains about thirty countries. Considering the cities contemplated in the *EDCI* index, there are twenty cities (DBEs) belonging in the region selected. From the twenty-two cities left, there were excluded the third least ranked cities in every country (Valencia and Turin). To hone the precision and sensibility of the index it is good practice to homogenize the cities chosen to apply the index. So that, since, as said before, the eastern European countries and southern European countries still have differences between, it was opted to exclude the northern cities of the region remaining (Warsaw, Krakow, Prague, Riga, Vilnius, Bratislava, Tallin and Budapest). At the end, it remains four eastern European countries with four different cities (Ljubljana, Sofia, Bucharest and Zagreb) and six southern European countries with eight cities (Barcelona, Madrid, Lisbon, Milan, Rome, Athens, Valletta and Nicosia). Such group of cities should cover the great majority of characteristics that prevail in the DBEs in this southern and eastern region of Europe. This selection (table 3.2) ranks on average the position 44 on the *EDCI* index and nine out of the twelve cities is part of the last third of the *EDCI* index.

Table 3.2 – Final list of selected cities with their EDCI Rankings.

Ranking *EDCI*	City	Country	Zone
9	Barcelona	Spain	South
14	Madrid	Spain	South
24	Lisbon	Portugal	South
46	Milan	Italy	South
47	Ljubljana	Slovenia	East
50	Sofia	Bulgaria	East
52	Bucharest	Romania	East
54	Rome	Italy	South
56	Athens	Greece	South
67	Zagreb	Croatia	East
59	Valletta	Malta	South
60	Nicosia	Cyprus	South

This selection, apart from covering the region proposed to analyze, it also fulfils the purpose of developing and implementing an index that tests less-matured DBEs.

4. The model

In this chapter is shown how the defined strategy is translated into the practical configuration of the model: Its features, results display, themes and variables definition and themes and variables weights. The last section concerns with a comparison between this model and the *EDCI*.

4.1. Model configuration

As mentioned in the first chapter, the structure of this model is a proposal not ought to be judged as better or worse, but different and more intended to be applied to a certain target. The format used is the composite index. This format, based in standardized and normalized statistical factors disposed of in columns representing each indicator, is better suited to measure multidimensional concepts and for intuitive comparison. The configuration of the model follows the assumptions and restriction taken earlier to simulate as much as possible the entrepreneurial scene in the less-matured DBEs. This approximation is reached with a careful selection of the themes, variables and indicators and with a reasonable ponderation of the weights of each one regarding the region in study. In the table 4.1 is represented the common display of the index showing the score of the variables for each ecosystem.

Table 4.1 – Display of the composite index.

	Variable score X	Variable score […]
Ecosystem A		
Ecosystem […]		

This model, unlike the majority of the literature, is divided into two parts: the first part concerns with the inputs and the second with the outputs. The input section refers to what the ecosystem may provide (or potentially provide), the output section regards with the practical results of the entrepreneurial culture in the ecosystem. Once again, the logic behind each section is the same, the indexes are broken down into themes represented by variables and the respective indicators with numerical standardized values. Each variable and theme is pondered by a range between [0;1], these weights are used to aggregate variables into theme scores and theme scores into final scores.

The reason for having two different "sub-indexes" leads to another feature of this model. The final display of the results is a vector with one row and two columns, each column representing the input and output final result (from zero to one). The first column (input) represents the potential of the ecosystem and the direction that it is potentially coming (short/mid-term), zero as potentially remaining a less-matured ecosystem, and one for high perspectives of evolving to a more developed stage of maturity. The second column (output) represents an actual situation bearing in mind the results that

such ecosystem is producing at the moment, zero as currently very less-matured ecosystem and one for an ecosystem that is currently close to reaching a more matured situation.

Bearing the previous in mind, the final result of the vector is in the mid-way of one of the four scenarios represented in the Matrix of maturity stages evolution represented on the table below. The scenarios represented on the Matrix of maturity stages evolution (table 4.2 above) are the limit situations (zeros and ones), so that, for instance, an ecosystem with input score between zero and 0,5 and output score between zero and 0,5 is encompassed in the first scenario.

Table 4.2 – The four scenarios of the matrix of maturity stages evolutions.

Scenario 1		Scenario 2		Scenario 3		Scenario 4	
Input	Output	Input	Output	Input	Output	Input	Output
0 - 0,5	0 - 0,5	0 - 0,5	0,5 - 1	0,5 - 1	0 - 0,5	0,5 - 1	0,5 – 1
Worst Case Situation: this ecosystem does not show evidences of reaching a higher stage of maturity and currently it is apparently not an interesting ecosystem		**Stagnancy**: this ecosystem still is currently interesting for a venture in digital business but not for a long term stay or starting a new one due to not showing evidences of evolution		**Prospect**: Although not currently being the being the best ecosystem to start or have a venture, it is creating the basis to change the actual situation in the best way possible		**Best Case Situation**: this ecosystem is a reference in the region, ideal for ventures based in and appealing for new comers, this ecosystem apparently has everything needed to consistently become a more matured ecosystem	

When ranking all the ecosystems selected, each one has a score represented by a single value (one entry vector), such value is the result of the ponderation of both columns of the initial vector. The ponderation of the input and output is the determinant of the vector. With this final score for each ecosystem it is possible to build the final ranking.

As seen, this index has three-way display formats:

➢ Composite indexes where all the standardized values for all the indicators are shown for comparison with other ecosystems represented (table 4.1);

➢ The Matrix of maturity stage evolution showing which direction of development is a certain ecosystem taking according to the scenarios proposed in table 4.2;

➢ Ranking with final scores with all ecosystems listed.

4.2. Themes, variables and indicators selection

4.2.1. Themes selection proposition and criteria

The selection of the themes is based on the analysis of other indexes considered as "best in class" combined with the particular characteristics of the ecosystem in matter, for the purpose of fulfilling the aim of the model. Because the index is meant to analyze the typical characteristics of less-matured ecosystems emphasizing on growth potential, the selection of the themes is directed to highlight the characteristics that may be considered reachable for smaller economies with less infrastructure and ecosystems with lower entrepreneurial culture, such as the talent produced, the inner characteristics that may attract newcomers or the potential market.

One of the features of this model is having the input themes separated from the outputs and they evaluated separately, so that, the respective themes and variables are analyzed here separately. Breaking down the points to be evaluated, the composition of the index is hierarchically dived into seven themes with three to five variables described by the respective indicators for the inputs, and one theme with five variables for the outputs.

The selection of the themes has two aspects in consideration: first, they are meant to encompass the role of the entrepreneurial ecosystem's actors. Secondly, the themes should represent the *Startup Manifesto* conclusions. *Startup Manifesto* is a movement composed by *The Startup Europe Leaders Club* – an independent group of founders in the field of tech entrepreneurship who provide guidance on strengthening the business environment for web entrepreneurs in Europe, founded by Neelie Kroes, vice-president of the European Commission. This manifesto is intended to develop policies and practices to stimulate the economic growth, based on the perspective of web entrepreneurs instead of typical policies applied when in possession of sophisticated infrastructure and strong investment power. According to the Startup Manifesto the main domains in which is nuclear to intervene are: Education & skills; access to talent; access to capital; data police, protection & privacy; thought leadership. Bearing this in mind the themes selected are presented in the tables 4.3 and 4.4:

Table 4.3 – Selected input themes description and reason of selection.

Inputs

Themes	Description	Reason of selection
Market	Evaluation of the potential market size in the perspective of the digital business. Propensity to start entrepreneurial activity and openness to discuss business	Considering that such region may be particularly attractive for foreign entrepreneurs, the market panorama is an important aspect considered mostly by potential newcomers
Talent	Availability of qualified and skilled people to potentially be part of the ecosystem. Importance given to ICT sector	Being a key point for Startup Manifesto, the availability of talent in a region is crucial not only for early stage ventures, but for others in need of special skilled people
Infrastructure	Quality of the digital and non-digital infrastructure and accessibility available in the ecosystem	Digital and non-digital infrastructure are determinant both for practical activities and to help highlighting, inspiring and spotting talent
Mentoring & Support	Influence of corporations and other actors supporting ventures in early stages of maturity	This theme measures how the ecosystem experienced actors can influence and entrepreneurs, so that, early stage assistance is determinant for less-matured ecosystem
Entrepreneurial Culture	Attitude towards the entrepreneurial mindset and how external factors influence it positively	Since the region is a less-matured ecosystem, the entrepreneurial culture may be a factor that may enable the others to progress
Lifestyle	Factors that influence the receptiveness for new comers to the ecosystem and keep the locals	The friendly and inviting lifestyle is, for this region, a key factor to attract newcomers to consider starting business and explore other factors more related to business and entrepreneurship

Table 4.4 – Selected output themes description and reason of selection.

Outputs

Themes	Description	Reason of selection
Startup Scene	Dynamism of the entrepreneurial scene in the form of new ventures creations	The number cases of success are, for less-matured ecosystems, the ultimate objective, since it may influence all the input themes to grow and the actors to invest in such ecosystem
Finance	Availability of funding and ease of getting it to support ventures 'growth	The finance theme is a distinguish factor to assess the maturity increasing potential in the city. Although the local finance matter may be overcame in some way, it is still convenience for entrepreneurs to be aware of funding solutions and support nearby

Concerning the criterium of classification of "input" and "output" for the themes, it is considered that the input themes comprise the conditions that the ecosystem can by itself provide (or may potentially provide) to the entrepreneurial actors. As for the output theme, it regards to the cases of success in the ecosystem to make the contrast with the conditions that the ecosystem can provide. In this case, it was opted to ignore other possible themes such as the occurrence of scaleups or unicorns because of the rarity of it in this kind of ecosystems.

4.2.1. Variables and indicators selection proposition and criteria

Each theme is characterized by a number of indicators with the respective variable. Once again, the selection of indicators is based on what would best describe the respective themes in such specific ecosystem, for this reason, it is expected that the indicators selected would not always be the same as the ones selected for other more general indexes. The indicators selected regard to the same reasons as the themes selection, they tend to highlight potential and are adapted to the entrepreneurial stage of maturity of the region. The indicators selection should also be based on the reason for the theme selection, translating them into numeric values.

In what concerns with the coverage of the indicators and variables it depends on the universe to be analyzed. Whenever possible the data is reduced as much as the citizen domain as the smallest universe, however, in some cases it is not possible to collect data at such small level or it is irrelevant to distinguish national coverage from a city. In other cases, it is needed to apply a different level of coverage: The Nomenclature of Territorial Units for Statistics (NUTS). The NUTS was drawn to provide a single uniform breakdown of territorial units for the production of regional statistics for the European Union (*EUROSTAT*, 2011). For each EU member there are between three and one levels of NUTS, each subdivision corresponds to administrative divisions within the country. For each level there is a maximum and a minimum number of population, for this reason, some countries do not have the three levels of NUTS. As an example, in Italy the NUTS1 correspond to the whole group of regions, the NUTS2 to the regions themselves and the NUTS3 the provinces inside each region, on the other hand for Malta there is only NUTS3 corresponding for each island of the country. The tables 4.5 and 4.6 show the indicators for each variable.

Table 4.5 – Selected input variables and respective indicators and coverage.

Inputs			
Theme	**Variable**	**Indicator**	**Coverage**
Market	Ease of Doing Business	Score based on Time and cost associated with doing business (from 1 to 190) distance to frontier score	National
	Potential Business Market Size	% of internet users on the last 12 months	National
	Ease of Starting Business	Score based on time, access to connections, infrastructure and cost associated with starting a new business (from 1 to 190) distance to frontier score	National
Talent	Importance of ICT	% of GDP contribution by ICT	National
	Access to Graduates	% of population aged 25-64 with tertiary (level 5 - 8) education attainment	NUTS2
	English Use	% of population who can communicate in English	NUTS2
Infrastructure	Mobile Internet Speed	Speed of mobile internet (MB/Sec)	City
	Availability of 3g 4g	% population with availability of 3g/4g signal	National
	Airport Connectivity	Score based on number of flights from local airports (from 0 to 1)	City
	Commute	Average travel time and distance to work	City
Mentoring & Support	Networking and Mentoring events	Number of meetups events in the last year	City
	Access to Accelerators	Number of accelerators	City
	Access to Business Angels	Number of business angels	National
Entrepreneurial Culture	Government Policies	Average score from 1 (highly insufficient) to 9 (highly sufficient) attributed from people about the support and relevance of government's entrepreneurial policies	National
	Entrepreneurial Education at School Stage	Average score from 1 (highly insufficient) to 9 (highly sufficient) attributed from people about the entrepreneurial education	National
	Willingness to Take on Risk	Percentage of people who disagreed with the statement: "One should not start a business if there is a risk it might fail"	NUTS2
	Multicultural Diversity	Percentage of population that are foreign born	NUTS2
	Engagement with Digital Startup Ecosystem	Number of tweets with selected entrepreneurship related hashtags in the last year.	City
Lifestyle	Standard of Living	Quality of life index score (from 0 to 221.36)	City
	Tolerance	Openness to diversity (ranking from 1 to 136)	National
	Political Stability	Score based on the political stability in the national government from -2,5 (weak) to 2,5 (strong)	National
	Employment	Unemployment rates	National

Table 4.6 – Selected output variables and respective indicators and coverage.

Outputs			
Theme	**Variable**	**Indicator**	**Coverage**
Startup Scene	Dynamism of Startups per Capita	Number of active startups/population (number of startups / Million inhabitants)	City
	Dynamism of Startups Nationwide per Capita	Number of active startups in the country/population (number of startups / Million inhabitants)	National
	Contribution to the National Startup Scene	% of national startups established in the city (number of startups in the city / number of startups in the country)	National and City
Finance	Availability of Early-stage Funding	Amount of seed and startup funding raised (€ thousands)	National
	Availability of Late-stage Funding	Amount of later-stage funding raised (€ thousands)	National
	Ease of Getting Credit	Score based on the number of credits given by governmental and non-governmental institutions (from 1 to 186) distance to frontier score	National

4.2.2. Weightings

The weighting process is crucial to correctly determine the final scores, so that, it is important to bear in mind the aim of the index. There are several methods for variables and themes weighting described in entrepreneurship literature, most of them consider indicators as equally influential to the final score, suggesting the use of equal weighting techniques for variables and themes. However, according to *EDCI* methodology and considering the aim of the index (as well as all the considerations taken from the study over the region selected), it was decided that the weighting should not be equal for all variables. The reason for this is that, considering that this model should highlight specific characteristics of the ecosystem, certain variables and themes should have heavier ponderations than others, otherwise, even though the variables and themes selection criteria already makes the separation from more matured ecosystems main characteristics, this model would be evaluating over similar parameters as the more general ones. Such approach should help users to view the index from the perspective of less-matured ecosystems and its own specific characteristics.

Therefore, it was decided to individually weight the variables and the themes regarding the research made as well as the opinion of experts who developed similar indexes. One of the most used methods is the budget allocation. This approach implicates that a limited number of points would be allocated between variables. Although the approach was considered, it revealed to be too limited for the number of variables of each theme, besides, it would not describe properly the importance of variables when they belonged to different themes. Instead, a level based ponderation was used. It was considered five levels of discrete weighting points: Low (L)= 0,2; Medium Low (ML)= 0,4; Medium (M)= 0,6; Medium High (MH)= 0,8 and High (H)= 1. This approach was used the same way for variables and themes for both input and outputs indexes.

Table 4.7 – Input themes and variables' weights.

		Inputs	
Themes	**Weights**	**Variables**	**Weights**
Market	M	Ease of Doing Business	H
		Potential Digital Market Size	ML
		Ease of Starting Business	MH
Talent	M	Importance of ICT	M
		Access to Graduates	H
		English Use	ML
Infrastructure	ML	Mobile Internet Speed	M
		Availability of 3g 4g	L
		Airport Connectivity	M
		Commute	ML
Mentoring & Support	H	Networking and Mentoring Events	H
		Access to Accelerators	MH
		Access to Business Angels	M
Entrepreneurial Culture	H	Government Policies	ML
		Entrepreneurial Education at School Stage	MH
		Willingness to Take on Risks	MH
		Engagement with Digital Startup Ecosystem	ML
		Multicultural Diversity	L
Lifestyle	MH	Standard of Living	MH
		Tolerance	L
		Political Stability	M
		Employment	ML

Table 4.8 – Input themes and variables' weights.

		Outputs	
Themes	**Weights**	**Variables**	**Weights**
Startup Scene	H	Dynamism of Startups per Capita	H
		Dynamism of Startup Nationwide per Capita	MH
		Contribution to the National Startup Scene	M
Finance	MH	Availability of Early-stage Funding	H
		Availability of Late-stage Funding	M
		Ease of Getting Credit	MH

Concerning with the inputs index, themes such as the Entrepreneurial Culture, Lifestyle or Mentoring & Supporting have a heavier weight than Infrastructure and Market for instance, as for the outputs index the Startup Scene themes weighs more than the Finance. This is an evidence that the potential factor is being valorized over the economic situation, investment availability and market actual situation. The same happens with the variables' weighting ponderation in both indexes.

4.3. Comparisons with the European Digital City Index

The *EDCI* is an important base for this study with direct influence in three aspects:

- Region selection validation: The DBE list was gathered taking the full *EDCI* ranking as a base of study. The main objective of the study is centered on the less-matured ecosystems, the SEE countries were a hypothesis tested to verify it would fit in the premise. The DBE list selection section shows that the region fits;

- Composite index important learnings: Although several documents were consulted to learn the theoretical aspects of a composite index, the *EDCI* methodology report was crucial to operationalize concepts and build the model;

- The years of experience of *NESTA* and the vast multidisciplinary team of specialists in entrepreneurship conducted to two editions of the *EDCI* (so far). Learning from the beginning, some concepts and configuration practices were adapted into this different reality studied in this document.

The comparisons between the EDCI and this index are undeniable and, as such, needed. However, a premise of this document is that an ecosystem with different stages of maturity deserves an individual and deeper study. This model is intended to differentiate from more general ones (such as the *EDCI*) focusing on a specific target: an entrepreneurial stage of maturity. With the support of the literature review and geographical coverage learnings the configuration of this model differs from the *EDCI* into three key aspects:

- The division between inputs and outputs: instead of having a single composite index (and overall ranking) it was opted to make this division to verify correlations between inputs and outputs, with the final objectives of highlighting the potential of certain ecosystems, and predict the direction of maturity stage evolution;

- Themes and variables selection and respective weights ponderation: for both indexes, the configuration of the model is adapted to evaluate this certain type of DBE, instead of a broader approach that may compromise too many ecosystems with less entrepreneurial maturity;

- Results display: the final results display is, once again, more focused in predicting a future situation evaluating the key aspects that may be translated into the potential of entrepreneurial

maturity evolution. This is the reason why the results are presented using the composite indexes, rankings and Matrix of maturity stage evolution, instead of just the overall ranking.

An important point to, once again, refer is that this model should not be considered better or worse than others but different, and the reason for this is the specific target covered. While general indexes are able to evaluate any city with a slight evidence of entrepreneurial activity, this model focus on the specificity of this entrepreneurial maturity, so that, if a city that does not belong to the aim of this study (less-matured DBE) is tested in this model, the final result would be very likely coming up biased.

5. Application

Having the model fully defined, the Application chapter shows the inner process of transforming raw gathered data into final scores, regarding the mathematical methods used, practical restrictions and assumptions. This chapter ends with a sensitivity analysis

5.1. Data gathering

Besides all the knowledge acquired to develop the literature review, the basis for all the research, the second phase of information gathering concerns with the filling of the fields of the model: the data to be inserted for the numerical values of the variables.

The sources used for the data gathering process are mainly based on the recommendations that digital experts left at the crowdsourcing platform developed by Nesta for the construction of the *EDCI*. The sources used are highly varied including hard sources such as: *Eurostat, Eban, World Bank, OECD* and *ITU*; innovatively sourced soft data: *Teleport, Ookla, Numbeo, Funderbeam, Doingbusiness* and *Meetup;* as well as other notable publications about the theme: *General Entrepreneurship Monitor, Global Creative Index, Global Innovation Scoreboard, Global Competitiveness Report*. Moreover, the *EDCI* data was also used in some cases.

Even so, in specific cases, it was not possible to find easily compiled or available data, so that, proxy measures were used as indirect data. For example, in the "Entrepreneurial Culture theme", the variable "Engagement with digital startup ecosystem" is measured with (the respective indicator) the number of tweets using hashtags with keywords related to entrepreneurship in the ecosystem.

Concerning the thirty variables and indicators in the index, the focus was to use data as close as possible to the city (smallest universe of measuring), however, in some cases, the use of wider coverage was needed to gauge certain indicators, such as national coverage and NUTS2 level, to make fair and reasonable comparisons across the different ecosystems. This, would allow comparing small cities with bigger ones without jeopardizing the coherence of the index. The raw data gathered, as well as the sources used for research are shown in the appendix chapter at the end of the document.

5.2. Data processing

5.2.1. Standardization and normalization

The first stage of the data processing is to enable data to be comparable between cities. Normalization is a transformation process to obtain numerical and comparable input data by using a

common scale (Vafaei, *et al*, 2015). To do so it is necessary to turn absolute terms into relative, for instance: using relative terms instead of absolute is the only way to compare cities with a different population. The comparison must always be based on the same scale so that all needed data must be standardized first according to the correct level. On the tables 5.1 and 5.2, it is presented the standardization base of each variable which absolute terms needed standardization.

Table 5.1 – Standardization bases of input variables.

Inputs	
Variable	**Standardization base**
Networking and Mentoring Events	City population
Access to Accelerators	City population
Access to Business Angels	Country population
Engagement with Digital Startup Ecosystem	Country population

Table 5.2 – Standardization bases of output variables.

Outputs	
Variable	**Standardization base**
Availability of Early-stage Funding	GDP
Availability of Late-stage Funding	GDP

Concerning with normalization method, it was used the Min-max normalization technique. This consists on normalize values into the range of [0;1] by subtracting the minimum or maximum value (depending of the criterion used) and then dividing by the entire range of values for that variable. Min-max normalization purpose is to provide either the distance from the maximum value using the benefit criterion (equation 1) or from the minimum candidate using the cost criterion (equation 2)

- Benefit criterion normalization equation:

$$n_{ij} = \frac{r_{ij} - r_{min}}{r_{max} - r_{min}} \qquad\qquad (1)$$

where n_{ij} is the normalized value for city i and variable j; r_{ij} is the original value for city i and variable j; r_{max} is the maximum value for variable j; r_{min} is the minimum value for variable j.

- Cost criterion normalization equation:

$$n_{ij} = \frac{r_{max} - r_{ij}}{r_{max} - r_{min}}$$

<div align="right">(2)</div>

where n_{ij} is the normalized value for city i and variable j; r_{ij} is the original value for city i and variable j; r_{max} is the maximum value for variable j; r_{min} is the minimum value for variable j.

Since the index comparison method is based on vectors comparison, this method appears to be suitable because all the values will already be turned into the range of [0,1] easing the rest of the process.

Even though the Min-max technique seems to be the most appropriated another two methods were considered: The first one was the ranking normalization method, still the easier to operationalize it would not show properly the information on the absolute performance of cities. The second method was the distance to reference point normalization method which involves dividing each value by a reference level. Although this method may be applicable, because the range in which the values are is [-1,1], it was opted the Min-max technique instead.

The advantages of the Min-max method are that it is sensible to the benefit and cost criteria, and increases the differences between values considering minimal deviations allowing to differentiate the cities while analyzing their scores.

5.2.2. Missing data imputation

For the input's index almost 98% of the data is complete from the initial data gathering process, as for the output's this percentage is close to 94%. From all the 28 variables analyzed (from both indexes), 4 of them have 2 values missing (close 17% of the data for the respective variable). The city with more missing values is Valletta with 21,4% of incomplete data. Such fact may be justified because Malta is the smallest country of the index, with small population, recently independent from the United Kingdom, and only entered in the EU in 2004.

To replace the missing data, the method used was Mean of overall theme. This method consists on calculating the mean of the remaining variables (normalized values) of the theme and replace the missing data by the mean. Using this approach, the themes scores obtained through imputed data do not differ from those that would have been obtained had the variables containing missing values been excluded from the index.

5.2.3. Aggregation

Having all the variables normalized and with the missing data filled, the last stage is to generate scores for each city regarding their normalized values for each variable, and weights for each variable and theme.

The variables and themes were aggregated using the weighted arithmetic mean (linear aggregation). This method consists of adding the terms, each multiplied by the ponderation and dividing it by the ponderation given. Using the linear aggregation allows compensability to be assured, this means that a city with a lower score for a certain theme would not need such higher score on others to improve its final score. With this method it is assured that all the themes and variables have an important effect even if they have lower ponderations. Such assumption fits it the model configuration's premises because it is believed and assumed that all the themes are important for the entrepreneurial ecosystem, for this reason the linear aggregation method was applied for both input and output's indexes. The equations below show how variables generate themes scores (equation 3) and theme scores final scores (equation 4)

- Linear aggregation for theme scores equation:

$$TS_{i,k} = \frac{\sum_{j=1}^{J} w_j z_{i,j}}{\sum_{j=1}^{J} w_j} \qquad (3)$$

where $TS_{i,k}$ is the aggregated theme score for city i and theme k; w_j is the weight given to variable $j = [1, ..., J]$; $z_{i,j}$ is the normalised value for city i and variable $j = [1, ..., J]$.

- Linear aggregation for index scores equation:

$$IS_i = \frac{\sum_{k=1}^{K} w_k TS_{i,j}}{\sum_{k=1}^{K} w_k} \qquad (4)$$

where IS_i is the aggregated index score for city i; w_k is the weight given to theme $k = [1, ..., K]$; $TS_{i,k}$ is the aggregated theme score for city i and theme $k = [1 ..., K]$.

Besides the linear aggregation method, the geometric aggregation method was also considered both for variables and themes aggregation. Geometric aggregation although applicable lacks compensability when multiplying terms. Another disadvantage of geometric aggregation is that this method is not so sensible when using the normalization min-max technique because of the unavoidable presence of zeros (minimum values of the normalized terms). Even though, the combinations with linear and geometric aggregations were tested both for variables and themes aggregation (geometric-geometric, linear-geometric, geometric-linear) producing, in some combinations, similar results as the linear-linear approach used. All combinations are analyzed on the Sensitivity analysis chapter.

5.2.4. Correlations

The correlations show how variables and themes have influence with each other whether negatively or positively. The correlation values are in the range of [-1;1] where -1 means the opposition, 1 direct influence and 0 no influence. The correlations reflect the effectiveness of the variables and themes in the index which is not necessarily related with their weights, no connection between variables/theme's weights and a number of strong or weak correlations were found neither on input or outputs indexes. The reason for this is that the weighting criteria is based on the literature review rather than statistical

analysis. Nevertheless, any variable or theme was discarded (even those with lower influence over the remaining) since in a previous evaluation all variables and themes were justified so as their weights. Another aspect worth to refer is the interpretation of the negative correlations, in some instances, variables/themes negatively correlated reflect "real world trade-offs". These negative correlations mean that for the benefit of one variable/theme there is other which must decrease, among all the nine correlation diagrams studied for both indexes, several examples of real-world trade-offs occur.

A secondary but meaningful analysis of the correlations is to corroborate and legitimate the development process of the index, concerning the assumptions and restrictions assumed earlier. While developing the principles in which the model would settle, and building the structure and algorithms that generated to the final scores, the assumptions and restrictions lead to certain expectations for variables and themes correlative behavior with each other. With this analysis, such correlative behavior between variables and themes is tested, in cases of anomalous correlative behavior, justifications are suggested. Summarizing, an expectable correlative behavior between variables and themes validates the strategy predefined as well as the whole methodological process was taken by so far.

To have a deeper perception of the subject, for each index, the variable-variables, theme-theme and variable-theme correlations were analyzed. Because, unlike most of the other indexes, outputs and inputs are analyzed in separate indexes, the output and input variable-variable, theme-theme and variable-theme correlations were analyzed as well to determine how different indexes' variables and themes influence each other. The range of correlations is divided into five sub-ranges: [-1; -0,4], [-0,4; -0,3], [-0,3; 0,3]; [0,3; 0,8]; [0,8;1]

- Inputs variable-variable correlations

As expected, in the inputs variable-variable correlations there are not many correlations in the range of [0,8;1], there are twenty-two variables corresponding 231 correlations and the range [0,8;1] is supposed to distinguish special cases. The only combination of variables with such strong correlation is Commute with Multicultural Diversity, one possible reason for this is that commute strongly encourages foreigners to choose such city to live and start a venture.

The variables with more strong correlations [0,3; 0,8] are Potential Digital Market Size, Access to Business Angels, Government Policies, Standard of Living and Political Stability, all of them highly correlated with each other. The Potential Digital Market Size variable highly correlates with several other variables for being a point of starting for others to develop themselves and is an appeal for investment. Access to Business Angels high correlation with other variables is explained by the influence that this DBE has over a less-matured ecosystem. Government Policies have a direct influence on several aspects of the ecosystem has showed on the literature review, easing the presence of more DBE actors. Standard of living and Political Stability both belong to the Lifestyle theme and, because of the aim of this index, are, as expected, highly correlated with several other variables.

The variables present in the Infrastructure and Entrepreneurial Culture themes are the ones with less high correlations and more negative correlations. Concerning with variables of the Infrastructure theme, particularly Mobile Internet Speed, Availability of 3g and 4g and Airport Connectivity are the most negatively correlated. The reason for this is, as explained earlier, less-matured ecosystems tend to be deficit in supporting infrastructure due to the lack of investment for the effect. However, the presence of such variables is important for this index to differentiate smaller degrees of maturity between the cities analyzed. Such reason also suggests the occurrence of real-world trade-offs.

As for variables present on the Entrepreneurial Culture, specifically Entrepreneurial Education at School Stage and Engagement with Digital Startup Ecosystem, they represent the corner stone for the development of the entrepreneurship mindset and, for this reason their relationship with other variables connected with hard skills tend to be weak since its influence over them is not direct.

- Inputs theme-theme correlations

Because themes encompass more than one variable, and so that a broader dimension, the correlations with other themes tend to be closer to zero, meaning that there are less interdependence and trade-offs between the six themes. The themes with more strong correlations [0,3; 0,8] are Lifestyle and Mentoring & Support.

Besides strongly correlating with each other, Lifestyle has a strong correlation with the Infrastructure an Entrepreneurial Culture. The Lifestyle and Entrepreneurial Culture correlation were expected since there are a few variables which could be shared between the two themes, whereas the correlation with Infrastructure reflects not only the entrepreneurial infrastructure investments, but also general infrastructure investments across the city causing positive effects over society and lifestyle improvement.

Mentoring & Support strongly correlate with Market and Talent themes, the reasons for this is that the Mentoring & Support theme encompasses the learning of nuclear skills to ease the emergence of talent and eventually feeding the market improving its characteristics.

- Inputs variable-theme correlations

The variable-theme correlations' main purpose is to check if the correlation between variables and the respective theme is as strong as expected. An alternative use for this analysis is to confirm the conclusions taken with the previous correlations analyzed, verifying how variables affect different themes. Concerning the main purpose, almost every variable does correlate with its respective theme.

The point that stands out the most is the correlations between the variable Engagement with Digital Startup Ecosystem and most of the themes. This variable is the only that does not have a strong correlation [0,3; 0,8] with any theme, not even its own theme, and has a very weak correlation [-1; -0,4] with the Lifestyle theme. However, it was decided to keep this variable in the index for being considered relevant for the growth of the entrepreneurial culture.

From the 132 correlations between the twenty-two variables and the six themes, there are six very weak correlations [-1; -0,4], 3 of them between the variables Importance of ICT, English Use, Availability of 3g 4g and the Market theme. The Importance of ICT weak correlation with the Market theme may be considered as a sign of ecosystem immaturity and, considering the nature of this index, a long-term investment trade-off result, as such, it is expected that in the future, this correlation approximates to zero. On the other hand, the weak correlation between the variable English Use and Market theme can hardly be explained as a trade-off, so that, a plausible explanation may be related with the quality and size of the sample (after further analysis this was the only case detected in the inputs index).

- Outputs variable-variable correlations

The fifteen correlations between the six variables of the outputs index show that the variables belonging to the same theme are well correlated, however, when confronting variables from different themes the same does not always happen.

As expected the variables Availability of Early-stage Funding and Availability of Late-stage Funding (both from the Finance theme) are strongly correlated with Dynamism of Startups per Capita (Startup Scene theme) in the rages of [0,8;1] and [0,3; 0,8] respectively. Those two variables are considered nuclear for the emergence of new ventures and, on the other hand, the emergence of new ventures attract new investors to the city.

Because the data gathered about the Finance theme variables cover the city domain, the correlation with Dynamism of Startup Nationwide per Capita and Contribution to the National Startup Scene is weaker.

- Outputs theme-theme correlations

The two themes present in the outputs index have an almost null correlation due to the fact of the different coverages of the variables, and due to the categorization of outputs: While Startup Scene theme may be considered as an output in the entrepreneurs (as founders and employees of startups), the finance theme is considered an output for investors, representing the ease of practicing business in this field and the availability of funding achieved. Those two different dimensions of outputs.

- Outputs variable-theme correlations

In the outputs variable-theme correlations analysis, the conclusions are taken are similar to the previous. Variables belonging to the same theme strongly correlate with the respective theme while variables belonging to a different theme have null or weak correlation with it. The reason for it is, once again, the indirect cause-effect connection between the two themes that are reflected in the variable-theme correlation without any trade-off between.

- Outputs/inputs variable-variable correlations

The output/input variable-variable correlations analysis confronts the influence that variables from different indexes have on each other, the twenty-two input variables with the six output variables generate 132 correlations.

Concerning with the correlations between input and output variables, Ease of Doing Business, Access to Graduates, Access to Business Angels, Government Policies, Standard of Living, Political Stability and Tolerance are the ones with more strong correlations. Ease of Doing Business has strong correlations with all output variables except the nationally covered ones. Access to Graduates strongly correlates [0,3; 0,8] with all the variables in the Finance theme, which is a positive conclusion to take, since such correlations prove that availability of funding and ease of doing business is also connected with the increasing of the literacy level. Access to Business Angels, as expect, has very strong correlation [0,8; 1] with the Dynamism of Startups per Capita and the availability of both late and early stage funding. Government Policies, for being a national covered variable, strongly correlates with Dynamism of Startups per Capita and also with Dynamism of Startup Nationwide per Capita. The strong correlation with Availability of Early Stage funding indicates the direction which typically less-matured DBEs' governments are taking towards the spreading of entrepreneurial culture, which, regarding the nature of this index, is considered correct. Standard of Living, Political Stability and Tolerance have almost the same strong correlations even at rather close levels, not only because of the strong correlation [0,3; 0,8] between them but also for having similar relation with all the variables, both variables took a similar behavior at the input variable-variable correlation, although not as evident.

Proceeding this analysis, English Use, Willingness to Take on Risks and Ease of Doing Business again, are the variables with more weak correlations. English Use has weak correlations with two of the three variables of the Finance theme possibly for the same reason it weakly correlates with the theme Market. Willingness to Take on Risks has weak correlations with all variables of the Finance theme, representing a real-world trade-off. Besides being part of the variables with more strong correlations, Ease of Doing Business is also one of the variables with more weak correlations. This variable is very weakly correlated [-1; -0,4] with Dynamism of Startup Nationwide per Capita and Contribution to the National Startup Scene. Despite the three variables having national coverage, perhaps, the fact that the majority of the cities in this index are undoubtedly the main hub of entrepreneurship nationwide, may be affecting this correlations effects.

- Outputs/inputs theme-theme correlations

Analyzing the twelve correlations between the eight themes of both indexes, one conclusion may be easily taken: Since more than a half of the correlations are strong [0,3; 0,8], it is clear that the majority of the input themes are in fact producing the outputs, confirming that the index is correctly describing an "input/output" typical process.

- Outputs/inputs variable-theme correlations

The final correlations analysis is composed by 224 correlations between the twenty-eight variables and eight themes, and is actually a combination of two diagrams: input variables with output themes and input themes with output variables, as such, the analysis is made separately

Considering the input variables correlations with output themes, it is verified that list of strong and weak correlations identified on the variable-variable correlations analysis shorten. Access to Business Angels, Standard of Living and Tolerance are the variables with more strong correlations, while English Use and Willingness to Take on Risks the ones with more weak correlations. This means that, this group of variables are the one with more influence over the output themes. Output themes have thereabout the same number of strong correlations, as verified previously, the Startup Scene strongly [0,3; 0,8] correlates with all variable of the Lifestyle theme and most of the Infrastructure theme, while the Finance theme strongly correlates with most of the variables of Market and Mentoring & Support themes. The Finance theme is also the one which very strongly correlates [-1; 0,4] the English Use and Willingness to Take on Risks for reasons explained before.

In the output variables correlations with input themes diagram it is also observed that the majority of the correlations are mostly strong [0,3; 0,8] or null. Ease of Getting Credit is the output variable with more weak correlations, one [-0,4; -0,3] with Lifestyle theme and another [-1; 0,4] with Entrepreneurial Culture. Such correlation weakness may have a number of possible explanations, though the most plausible justification may be a problem of mentality and unwell adjustment with the entrepreneurial mindset typical from less-matured entrepreneurial ecosystems. In addition to this, the Ease of Getting Credit variable, as opposed to the other output variables, barely have strong correlations with other input themes. Summing up, it is safe to state that, this index shows that, in this group of less-matured DBEs, inputs are effectively generating outputs and outputs are simultaneously showing evidence of retroactively benefiting the inputs.

5.3. Scores

The final scores of the index are shown in three different configurations and with different purposes of analysis. It is believed such format may be not enough to best portray the reality of the entrepreneurial scene in the SE&E DBEs. So that, it is recommended to consult the Composite Index to show the variables scores that produced the ranking, and the Matrix of maturity of stage of evolution to analyze the tendency of maturity stage evolution.

5.3.1. Composite indexes

The Composite Index form shows the final scores of the twelve cities for each variable for both indexes. Those scores are the result of the normalization, standardization and data imputation processes that lead the gathered raw data to final values. The purpose of this display is to allow comparisons between variables of each city. Tables 5.3, 5.4, 5.5 and 5.6 show the inputs and outputs final composite indexes.

Table 5.3 – Inputs index.

	Market			Talent		
	Ease of Doing Business	Potential Digital Market Size	Ease of Starting Business	Importance of ICT	Access to Graduates	English Use
Athens	0,304	0,211	1,000	0,000	0,641	0,481
Barcelona	1,000	1,000	0,246	0,250	0,659	0,101
Bucharest	0,696	0,211	0,585	0,256	0,518	0,496
Lisbon	0,982	0,474	0,831	0,215	0,478	0,235
Ljubljana	0,839	0,737	0,862	0,332	0,569	0,562
Madrid	1,000	1,000	0,246	0,250	1,000	0,000
Milan	0,679	0,368	0,554	0,259	0,000	0,087
Nicosia	0,554	0,789	0,800	0,549	0,772	0,668
Rome	0,679	0,368	0,554	0,259	0,145	0,235
Sofia	0,607	0,000	0,108	0,571	0,699	0,192
Valletta	0,000	0,789	0,000	1,000	0,011	1,000
Zagreb	0,589	0,158	0,231	0,422	0,091	0,350

Table 5.4 – Inputs index.

	Infrastructure				Mentoring & Support		
	Mobile Internet Speed	Availability of 3g 4g	Airport Connectivity	Commute	Networking and Mentoring Events	Access to Accelerators	Access to Busines Angels
Athens	0,385	0,000	0,518	0,549	0,187	0,041	0,000
Barcelona	0,428	0,612	0,159	0,695	0,927	0,457	0,976
Bucharest	1,000	0,448	0,750	0,000	0,474	0,204	0,339
Lisbon	0,518	0,382	0,524	0,567	0,357	0,331	1,000
Ljubljana	0,372	0,008	1,000	0,850	1,000	0,581	0,597
Madrid	0,453	0,612	0,189	0,823	0,864	0,219	0,976
Milan	0,452	0,443	0,152	0,496	0,207	0,108	0,159
Nicosia	0,000	0,556	0,781	1,000	0,000	1,000	0,916
Rome	0,322	0,443	0,000	0,717	0,110	0,071	0,159
Sofia	0,307	0,561	0,902	0,207	0,231	0,185	0,136
Valletta	0,484	1,000	0,689	0,724	0,100	0,000	0,050
Zagreb	0,432	0,415	0,988	0,423	0,871	0,124	0,035

Table 5.5 – Inputs index.

	Entrepreneurial Culture					Lifestyle			
	Ggovernment policies	Entrepreneurial Education at School Stage	Willingness to Take on Risks	Engagement with Digital Startup Ecosystem	Multicultural Diversity	Standard of Living	Tolerance	Political Stability	Employment
Athens	0,095	0,400	0,298	1,000	0,589	0,171	0,000	0,000	0,000
Barcelona	0,190	0,200	0,000	0,375	0,633	0,621	1,000	0,409	0,228
Bucharest	0,260	0,260	0,716	0,048	0,016	0,077	0,281	0,339	0,918
Lisbon	1,000	1,000	0,840	0,160	0,567	1,000	0,888	0,866	0,708
Ljubljana	0,714	0,200	0,686	0,187	0,553	0,976	0,742	0,906	0,842
Madrid	0,190	0,200	0,436	0,415	0,659	0,894	1,000	0,409	0,228
Milan	0,333	0,600	0,734	0,221	0,397	0,300	0,708	0,449	0,556
Nicosia	0,571	0,400	0,257	0,258	1,000	0,671	0,629	0,606	0,608
Rome	0,333	0,600	0,779	0,000	0,352	0,000	0,708	0,449	0,556
Sofia	0,000	0,000	0,433	0,009	0,000	0,302	0,607	0,197	0,848
Valletta	0,498	0,498	1,000	0,177	0,318	0,573	0,854	1,000	1,000
Zagreb	0,095	0,000	0,406	0,056	0,544	0,867	0,225	0,638	0,591

Table 5.6 – Outputs index.

	Startup Scene			Finance		
	Dynamism of Startups per Capita	Dynamism of Startup Nationwide per Capita	Contribution to the National Startup Scene	Availability of Early-stage Funding	Availability of Late-stage Funding	Ease of getting Credit
Athens	0,016	0,076	0,470	0,000	0,082	0,426
Barcelona	0,167	0,250	0,160	0,242	1,000	0,607
Bucharest	0,128	0,034	0,460	0,018	0,211	1,000
Lisbon	1,000	0,237	0,516	1,000	0,656	0,303
Ljubljana	0,299	0,353	0,724	0,141	0,227	0,303
Madrid	0,191	0,250	0,257	0,242	1,000	0,607
Milan	0,082	0,000	0,204	0,072	0,123	0,303
Nicosia	0,140	0,631	0,282	0,607	0,607	0,607
Rome	0,000	0,000	0,000	0,072	0,123	0,303
Sofia	0,192	0,143	0,840	0,236	0,000	0,820
Valletta	0,248	1,000	1,000	0,000	0,000	0,000
Zagreb	0,112	0,167	0,640	0,107	0,145	0,533

5.3.2. Matrix of maturity stage evolution

The Matrix of maturity stage of evolution confronts the input final scores with the output final scores, showing which direction is certain DBE going to in terms of maturity evolution. In the figure 5.1 is shown the disposition of the twelve cities on the final Matrix of maturity stage evolution.
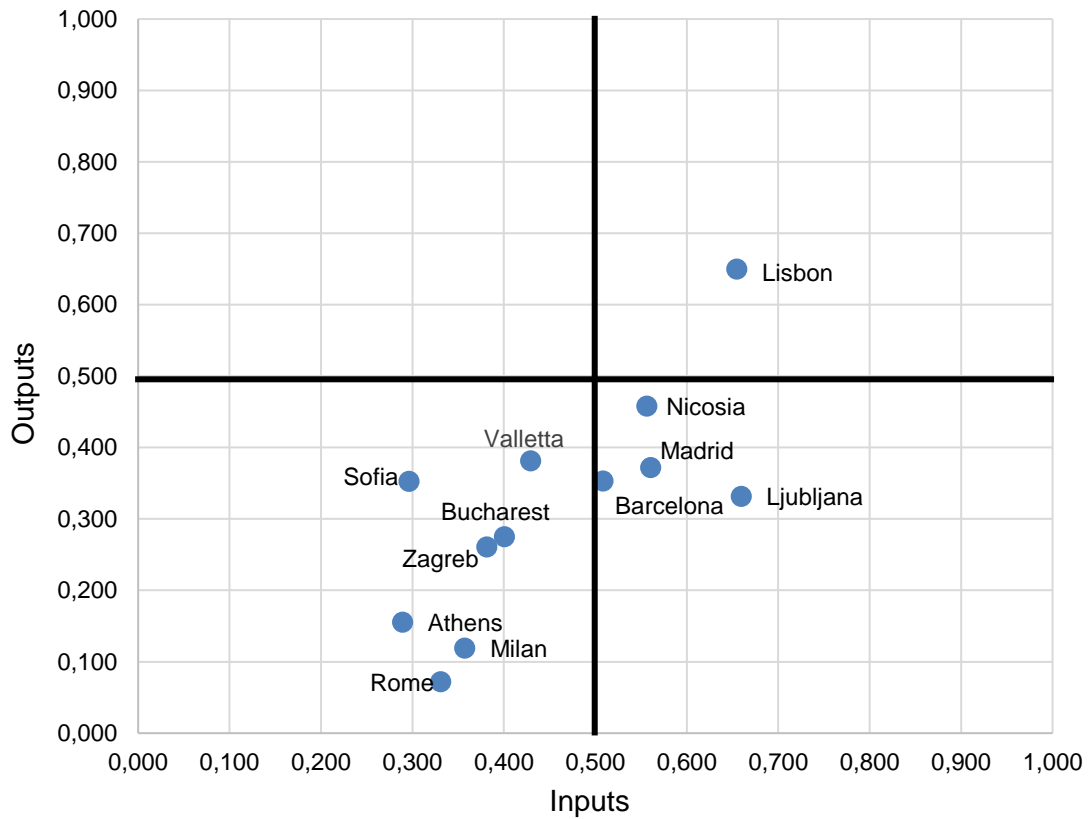
Figure 5.1 – Matrix of maturity stage evolution.

5.3.3. Ranking

The Ranking is the ultimate form of final results display, ordering the twelve cities from the best scored city to the least. The Ranking also shows the combination of inputs and outputs scores (final ranking). The tables 5.7, 5.8 and 5.9 show the final scores for inputs, outputs and final raking respectively.

Table 5.7 – Input index ranking.

Inputs		
City	**Score**	**Ranking**
Ljubljana	0,660	1
Lisbon	0,655	2
Madrid	0,561	3
Nicosia	0,556	4
Barcelona	0,508	5
Valletta	0,429	6
Bucharest	0,400	7
Zagreb	0,381	8
Milan	0,357	9
Rome	0,331	10
Sofia	0,296	11
Athens	0,289	12

Table 5.8 – Outputs index ranking.

Outputs		
City	**Score**	**Ranking**
Lisbon	0,650	1
Nicosia	0,458	2
Valletta	0,381	3
Madrid	0,372	4
Barcelona	0,353	5
Sofia	0,353	6
Ljubljana	0,332	7
Bucharest	0,275	8
Zagreb	0,261	9
Athens	0,155	10
Milan	0,119	11
Rome	0,072	12

Table 5.9 – Final ranking.

City	Final Score	Ranking
Lisbon	0,652	1
Nicosia	0,507	2
Ljubljana	0,496	3
Madrid	0,466	4
Barcelona	0,431	5
Valletta	0,405	6
Bucharest	0,338	7
Sofia	0,324	8
Zagreb	0,321	9
Milan	0,238	10
Athens	0,222	11
Rome	0,201	12

5.4. Sensitivity analysis

The sensitivity analysis tested the result that alternative decisions would produce on the overall score, and the impact of the decisions made. The effects tested were:

- Finance theme: Whether this theme should be considered an input or an output

- Aggregation methods: The effect of using different aggregation methods to produce the final scores.

5.4.1. Finance theme

Using all the same methodological assumptions and restrictions, gathered data and data processing methods, it was conjectured the hypothesis of considering the Finance theme as an input instead of an output.

The Finance theme encompasses variables which indicators relate to funding raised amount from ventures and the ease of getting funding. From the point of view of a startup, such should undoubtedly be considered an input since financial aspects are a point of interest of whom is starting a business. Bearing this in mind, the whole index was simulated using the Finance theme as part of the inputs index. On the tables below are shown the input and output scores and the final rankings if Finance was considered an input theme, it is discussed the influence of that decision and the comparison with the final index.

Table 5.10 – Input scores with Finance theme as input comparison.

City	Aggregated score (Finance input)	Ranking (Finance input)	Original ranking	% difference of aggregated score
Lisbon	0,659	1	2	0,640%
Ljubljana	0,591	2	1	-10,334%
Nicosia	0,564	3	4	1,456%
Madrid	0,559	4	3	-0,210%
Barcelona	0,515	5	5	1,350%
Bucharest	0,399	6	7	-0,258%
Valletta	0,363	7	6	-15,385%
Zagreb	0,362	8	8	-4,962%
Milan	0,327	9	9	-8,414%
Sofia	0,308	10	11	3,910%
Rome	0,305	11	10	-7,861%
Athens	0,270	12	12	-6,738%

Adding the Finance theme on the inputs index would decrease the aggregated scores in 3,9% on average. This happens because the Finance theme's variables are rather highly weighted (one high, one medium high and another medium weighted variables), and the theme itself is highly weighted (medium high). Such modification would induce several but slight fluctuations in the input rankings.

Table 5.11 – Output scores with Finance theme as input comparison.

City	Aggregated score (Finance input)	Ranking (Finance input)	Original ranking	% difference of aggregated score
Valletta	0,687	1	3	80,000%
Lisbon	0,625	2	1	-3,920%
Ljubljana	0,424	3	7	27,754%
Nicosia	0,339	4	2	-25,970%
Sofia	0,338	5	6	-4,294%
Zagreb	0,262	6	9	0,718%
Madrid	0,227	7	4	-38,954%
Barcelona	0,193	8	5	-45,317%
Bucharest	0,180	9	8	-34,593%
Athens	0,149	10	10	-3,739%
Milan	0,085	11	11	-28,608%
Rome	0,000	12	12	N/A

Withdrawing the Finance theme on the outputs index, even though three cities would have higher aggregated scores, decreases the aggregated scores on 6,9% on average. This happens because of some weak correlation between the Finance theme and its variables with other themes and variables. In the case of Rome, its score would be zero because this city is the last of all the Startup Scene's variables (the remaining theme of the outputs index). Comparing with the original ranking, there would occur ranking modifications in all cities until the bottom three, particularly for Valletta, Ljubljana, Madrid, Barcelona and Zagreb. The final ranking on the table 5.12 reveals that the aggregated scores would decrease 6,3% with the change of the Finance theme from output to input.

Table 5.12 – Final scores with Finance theme as input comparison.

City	Aggregated score (Finance input)	Ranking (Finance input)	Original ranking	% difference of aggregated score
Lisbon	0,642	1	1	-1,632%
Valletta	0,525	2	6	29,499%
Ljubljana	0,508	3	3	2,407%
Nicosia	0,452	4	2	-10,928%
Madrid	0,393	5	4	-15,661%
Barcelona	0,354	6	5	-17,775%
Sofia	0,323	7	8	-0,549%
Zagreb	0,312	8	9	-2,655%
Bucharest	0,290	9	7	-14,233%
Athens	0,209	10	11	-5,690%
Milan	0,206	11	10	-13,467%
Rome	0,152	12	12	-24,312%

The cities of Valletta and Rome stand out because of its percentage of difference of the aggregated score: Valletta would increase nearly 30%, because of its rather high scores on the Startup Scene theme (the best in two of the three theme's variables and third best on the remaining) and rather lows on the Finance theme (last on the three variables of the theme) such fact keeps both themes on balance so Valletta gets positively affected by the modification concerning its aggregated scores. On the other hand, the same does not happen with Rome since it has very low scores on the Startup Scene theme (the last on the three variables of the theme) and not much higher scores on the Finance theme, in this case the themes scores are not balanced and its aggregated scores for final rankings decreases 24,3%. For this reason, the major ranking position's shift is to Valletta moving from the sixth position to the second, and Rome remains in the last position with a larger distance from the eleventh position, being the most impaired city with this modification.

Apart from the two cities which the Finance theme modification would have more impact in, there are nine cities which would have their ranking position shifted. This means that the modification of the Finance theme from one index to the other would have a rather large impact on the final ranking.

However, although it would be a valid assumption to consider the Finance theme as an input, because this index is aimed to cover as much as possible the whole DBE's dynamic and growth potential, it was decided that Finance should be considered and output. This decision allows to encompassing investors and organizations (as potential investors or investment seekers) active parts of the ecosystem, broadening target of the index.

5.4.2. Aggregation method

In the Data processing section, it was explained the advantages and disadvantages of using linear or geometric aggregations for variable and theme levels, and the reason why it was decided to use the linear aggregation to combine both variables into theme scores and theme scores into final scores. Nevertheless, it was tested the effect of using the remaining possible combinations between the two

methods. Since there the index is divided into two indexes separating the outputs and inputs, each one would have four different possibilities of aggregation methods, in this section it is tested the effects of using for both input and outputs indexes the following aggregation methods: Geometric-geometric, linear-geometric and geometric-linear.

- Geometric-geometric

As said before, the geometric aggregation approach is not so sensible using the normalization min-max technique because of the presence of zeros (minimum values of the normalized terms). As such, aggregating both variables into themes and themes into final scores using the geometric approach would produce several values as final scores for both indexes. For this reason, the geometric-geometric possibility was excluded.

- Geometric-linear

Once again, because of the lower compensability of geometric aggregation, using this method to aggregate variables into themes, a city with a low score for one variable would need a much higher score on other to improve its final score in the theme. In addition to this, because it is not possible to guarantee the robustness of all variables, using the method to generate themes scores would lessen sensibility of the variables, meaning that, for each index, the distance between scores with be larger and the scores themselves would be lower as verified on the table 5.13.

Table 5.13 – Comparison with geo-lin aggregation method.

City	Input scores (geo-lin)	Output scores (geo-lin)	Final scores (geo-lin)	% difference final scores	Final ranking (geo-lin)	Final ranking
Lisbon	0,620	0,560	0,590	-9,554%	1	1
Ljubljana	0,633	0,310	0,471	-4,865%	2	3
Nicosia	0,384	0,422	0,403	-20,503%	3	2
Madrid	0,416	0,333	0,374	-19,705%	4	4
Barcelona	0,415	0,313	0,364	-15,483%	5	5
Valletta	0,332	0,311	0,321	-20,747%	6	6
Zagreb	0,285	0,197	0,241	-24,906%	7	9
Bucharest	0,294	0,120	0,207	-38,718%	8	7
Milan	0,327	0,059	0,193	-18,850%	9	10
Sofia	0,215	0,140	0,177	-45,371%	10	8
Rome	0,127	0,059	0,093	-53,915%	11	12
Athens	0,139	0,034	0,087	-61,037%	12	11

Using this method, not only would not correctly reflect the distances between city scores (decrease their aggregated final score in 27,8% on average), but also, as verified, would make quite a large difference on the ranking cities with nine cities shifting its position in the ranking.

- Linear-geometric

The linear-geometric method is the one which comes closer to the final one used. Since the geometric aggregation method was only used when generating final scores from the linear aggregated themes, the effect of lower compensability is diminished.

Table 5.14 – Comparison with lin-geo aggregation method.

City	Input scores (lin-geo)	Output scores (lin-geo)	Final scores (lin-geo)	% difference final scores	Final ranking (lin-geo)	Final ranking
Lisbon	0,619	0,649	0,634	-2,779%	1	1
Nicosia	0,543	0,439	0,491	-3,196%	2	2
Ljubljana	0,632	0,314	0,473	-4,540%	3	3
Madrid	0,540	0,337	0,438	-5,968%	4	4
Barcelona	0,453	0,308	0,380	-11,659%	5	5
Bucharest	0,394	0,255	0,324	-3,981%	6	7
Sofia	0,263	0,352	0,308	-5,200%	7	8
Zagreb	0,347	0,261	0,304	-5,343%	8	9
Milan	0,299	0,113	0,206	-13,474%	9	10
Athens	0,216	0,155	0,185	-16,583%	10	11
Valletta	0,290	0,000	0,145	-64,276%	11	6
Rome	0,281	0,000	0,140	-30,263%	12	12

Using this method, the differences between final scores come closer (13,9% on average), and the ranking's position shifting is lower than using the previously presented method (six cities shifting ranking positions) and the top five cities remain the same. Even so, a smaller issue of process sensibility was detected when using the geometric aggregation method to aggregate output scores: For reasons explained before, Valletta and Rome would score zero points which could have compromised the sensitivity of the index when calculating the final score (average between input and output scores). So that, though valid, this method was discarded in favor of the linear-linear

6. Analysis

In this chapter is discussed what are the aspects that stand out from the results and what are key points to retain from the study of the index results after a technical analyzed. It is aimed to match and relate the different relevant elements collected from the model to generate knowledge.

6.1. Aggregated scores and indexes rankings

Concerning with the inputs and outputs indexes' aggregated scores, it is verified that the average aggregated score of the inputs index (average score of 0,452) is higher than the output's (average score of 0,315). This is evident in the case of Ljubljana (input scores: 0,660; output scores: 0,332), and the only exception is Sofia with higher output score (0,353) than input's (0,296). Combining these two points and bearing in mind the correlations identified between both indexes analyzed, it is safe to admit that the outputs index reflects a not yet concretized entrepreneurial potential of the cities.

Analyzing the differences between the input and output aggregated scores for each city, it is verified that the most consistent city is Lisbon. One of the reasons that put Lisbon in the first place of the ranking is the consistency between high input and output aggregated scores (0,005). On the other hand, Ljubljana is the city with the largest difference between input and output aggregated scores (0,328). In this case, the aggregated scores difference is the result of rather high input scores and a low output scores, for this reason Ljubljana occupies the third position of the ranking with 0,496 overall score. If a large difference of input and output scores benefits Ljubljana's final ranking position, the same does not happen with Rome. Occupying the last position of the overall ranking, the difference of 0,259 is the result of a low input aggregated score (0,331) and even lower output (0,072) aggregated scores.

With the differences between the input and output aggregated scores for each city another pattern is identified: The average difference between input and output aggregated score is 0,137, and excepting Ljubljana (0,328), the remaining cities that have a larger difference than the average are Madrid (0,189), Barcelona (0,155), Rome (0,259) and Milan (0,238), all these four cities are the double representations of a same country (Spain and Italy respectively). It is believed that such fact is not a matter of a coincidence but, instead, an effect caused by the dimension of the country being enough to host more than one entrepreneurial hub city. In practical terms, concerning with the algorithms used, this is a reflex of national covered data used and standardization bases used. An example of this is the Finance theme, in which two variables are standardized using the GDP as a base. Although it would have been possible to consider removing the double representation of the same country cases of the model, it is believed that, ignoring that some countries of the S&EE region actually have conditions to

host more than one major entrepreneurial hub, it would compromise the integrity of the final objective. So that, it was decided to keep them and acknowledge the possible consequences of that.

The eastern cities, which are in minor representation in this index (four eastern countries and six southern countries), although two of the southern countries are represented by two cities), tend to occupy mid positions of the overall ranking (7th, 8th and 9th), with the exception of Ljubljana (3rd in the overall ranking). This is related to the also mid positions at both input and output rankings. Eastern cities have an average aggregated score of 0,370 (0,367 input and 0,256 output), which is 0,014 points below the average, and southern cities score 0,390 (0,494 input and 0,345 output), which is 0,06 above the average.

6.2.   Input composite index

Taking a deeper look at the inputs composite index's variables, there are a few contrasts between the input's rankings and the individual variables' rankings:

- Even though it occupies the last position of the input ranking, Athens is the top ranked city on the Ease of Doing Business and Engagement with Digital Startup ecosystem.
- Sofia, on the eleventh position of the ranking also has high ranks on the Importance of ICT (2nd), Access to Graduates (3rd), Airport Connectivity (3rd) and Employment (3rd) variables.
- Ljubljana, the first ranked city of the inputs index, has rather lower ranks at Mobile Internet Speed (9th), Entrepreneurial Education at School Stage (9th) variables.
- The third ranked city, Madrid, also has low ranking positions at several variables: Importance of ICT (10th), English Use (12th), Entrepreneurial Education at School Stage (10th) and Employment (11th).

Expanding this analysis at the theme level, there are also contrasts verified:

- Lisbon, the second on the input ranking, is the penultimate at Talent theme;
- Even do it does not rank the first position in any theme, Ljubljana is still the first city of the input ranking;
- Sofia is the fourth best city at the Talent theme, however it is still the penultimate city at the input ranking;
- Southern cities tend to lead the top three positions on every theme, Ljubljana is the only eastern city that interferes in the top three of Market (2nd), Talent (3rd), Mentoring & Support (2nd), and Lifestyle (2nd) themes.
- Southern cities are also the ones who tend to occupy the bottom three positions of every theme, the exceptions are for the Market theme in which Valetta and Sofia are at the bottom, and Entrepreneurial Culture with Bucharest, Zagreb and Sofia at the bottom three.
- Considering the previous two points, bearing in mind the exceptions mentioned, eastern cities tend to occupy mid positions on the input themes rankings.

6.3. Output composite index

The same analysis is made of the outputs composite index:

- The third position of the output ranking, though it highly scores in every variable of the Startup scene theme (3rd at Dynamism of Startups per Capita and 1st at Dynamism of Startup Nationwide per capita and Contribution to the National Startup Scene), it is the last at every variable of the Finance theme. The high scores at the Startup Scene variables are related to the standardization bases used and the demographic dimension comparing to the country. As for the Finance theme, the last position at all variables is explained by the missing data imputation method used: Valletta's data for Availability of Early and Late-stage Funding were not found, so that, it was imputed using the Ease of Getting Credit variable, in which Valletta has the lowest score.
- With the opposite effect the same happens with Nicosia: The Availability of Early and Late-stage Funding were imputed using the Ease of Getting Credit variable, in this case, ranking fifth at this variable, benefits the rankings of the imputed variables (2nd at Availability of Early-stage Funding, and 4th at Availability of Late-stage Funding).

The variable level composite index analysis reflects at the theme level

- Valletta is the first at Startup scene theme and the last at Finance theme, however, because the Startup Scene theme weights more than the Finance's, this contrast between themes did not prevent Valletta to occupy the third position of the ranking.
- Once again, eastern cities tend to occupy mid positions at the output theme rankings. Southern cities tend to occupy the top three and bottom three positions of both Startup Scene and Finance themes. Ljubljana is the exception being the second city on the Startup Scene theme.

6.4. Matrix of maturity stage evolution

The average aggregated score of the twelve cities is 0,384 (input: 0,452; output: 0,315) as shown in figure 6.1, somewhere between Valletta and Bucharest. This mid-point lies in the scenario 1 of the Matrix of maturity stages evolution, the Worst-case scenario. However, the input average score is higher than the output's and both relatively close 0,5, meaning close to the scenario 3, the Prospect.
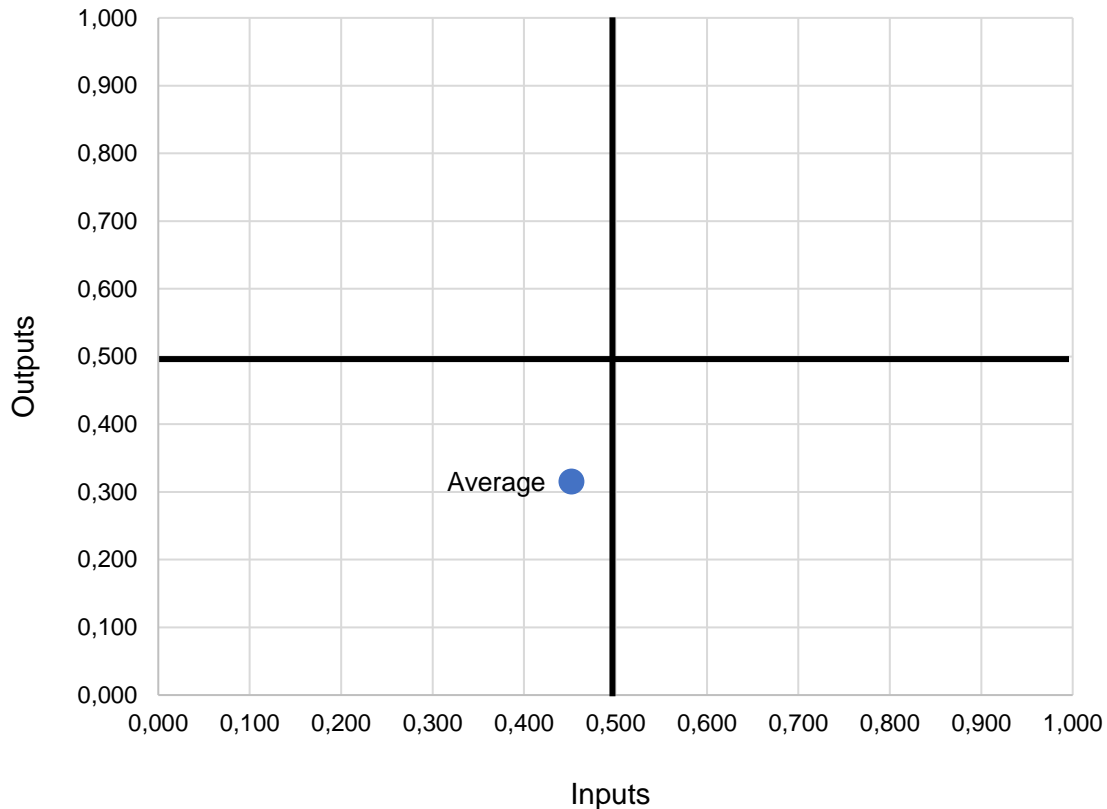
Figure 6.1 – Average score in the matrix of maturity stage evolution.

All the cities on the scenario 1 are at bottom half of the final ranking and with lower aggregated final score than the average, with the exception of Valletta (0,405) being the closest city to the scenario 3. From this group, Valletta is also the closest city from the scenario 2.

The cities of Barcelona, Madrid, Ljubljana and Nicosia are part of the scenario 3 all of them with an aggregated overall score above the average, Nicosia is the closest to the scenario 1. The top ranked city in the overall index, Lisbon, is located in the scenario 4. Lisbon is also one of the cities with the largest differences between overall aggregated scores (0,145 from the Nicosia the second of the ranking).

Analyzing the cases of Barcelona, Madrid, Nicosia and Ljubljana it is visible that the only thing that is holding these cities from shifting to the scenario 4 (a better position) is their lower output aggregated scores. This is especially evident in the case of Ljubljana with an aggregated input score of 0,332 (0,017 higher than the average input aggregate score).

Grouping the analyzed cities into eastern and southern regions, and calculating their average points for input and output scores, the two points on the Matrix of maturity stage evolution have the following coordinates: input= 0,461 and output= 0,320 for southern cities; input= 4,434, output= 0,305 for eastern cities. They are both located in the scenario 1, although relatively close to each other, southern cities tend to be very close to the scenario 3. The figure 6.2 shows the position of both regions is the Matrix of maturity stage evolution.
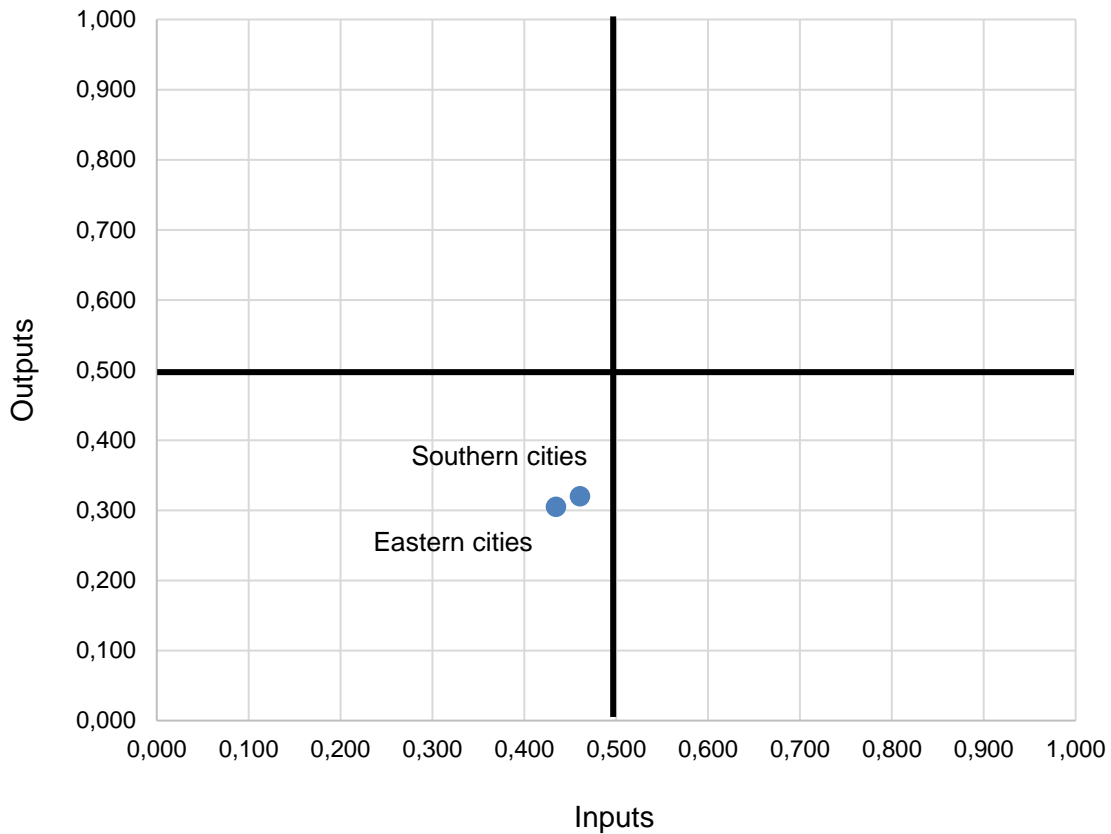
Figure 6.2 – Eastern and southern cities score in the Matrix of maturity stage evolution.

6.5.   Individual city rankings

➢   Lisbon (Input: 2nd - 0,655; Output: 1st - 0,650; Overall:1st - 0,652)

The first city on the overall ranking is the only one located in the scenario 4 of the Matrix of maturity stage evolution, being the second on the inputs index and first on the outputs index. The aspect that stands out is the consistency between input scores and output scores and this is the main reason why Lisbon leaders the ranking.

At the inputs index, Lisbon leads in the Lifestyle and Entrepreneurial culture themes with good ranks on variables such as Standard of living(1st), Tolerance(3rd) and Political stability(3rd) (Lifestyle), Government policies(1st), Entrepreneurial education(1st) and Willingness to take risks (2nd) (Entrepreneurial culture), and being top three at Market and Mentoring support themes. The worst theme ranking is Talent with lower ranks on the three variables such as Importance of ICT (11th)

The consistency of Lisbon's scores is again proven on the outputs index, being the first with leading any output theme. Lisbon leads at the Dynamism of startups per capita and has average ranks on the remaining variables of the Startup Scene theme moving to the top three of this theme. A similar situation happens with the Finance theme ranking, being the first on the Availability of early-stage funding variable and the third on the Availability of late-stage funding.

➢ Nicosia (Input: 4th - 0,556; Output 2nd - 0,458; Overall: 2nd - 0,507)

Nicosia is also one of the most consistent cities of the overall ranking standing on the fourth position on the input ranking and second on the output ranking.

Despite its better position on the output ranking, Nicosia does not have any lower rank on any input theme, leading the Talent theme, being top three in every variable of the theme. Besides not making part of the input top three ranking, Nicosia is one of the most regular cities on the input theme rankings, with its lower ranks at the Market theme due to the tenth position at the Ease of doing business variable, and Mentoring and support theme being at the bottom of Networking and mentoring events variable.

Regularity once again rewards Nicosia at the outputs index, with its lowest rank at the Startup scene theme, ranking eighth at Contribution to the national startup scene variable, but second on the Dynamism of startup nationwide per capita variable. This may be a consequence of having such a concentrated entrepreneurial activity in the city.

➢ Ljubljana (Input: 1st - 0,660; Output: 7th - 0,332; Overall: 3rd - 0,496)

If Lisbon and Nicosia benefit from their consistency between input and output scores, the same does not happen with Ljubljana being the most inconsistent city of the ranking with the largest difference between input and output aggregated score. Ljubljana is also the best ranked of the eastern cities, being the only on the scenario 3 of the Matrix of maturity stage of evolution.

One of the reasons why Ljubljana reaches the top three of the overall ranking is its good performance at in input ranking bringing it to the top of it. One curious fact is that despite Ljubljana leading the input ranking, it does not lead any input theme ranking. Ljubljana benefits for being top three in four (2nd Market, 3rd Talent, 2nd Mentoring & Support and 3rd Lifestyle) out of six of the input themes. Concerning with the input variables, Ljubljana's best ranks are Ease of Doing Business (2nd), Airport Connectivity (1st), Commute (2nd), Networking and Mentoring events, Access to accelerators (2nd), Government policies (2nd), Standard of living (2nd) and Political Stability (2nd). On the other hand, the few variables in which Ljubljana does not so well are Entrepreneurial Education (9th) and Mobile Internet Speed (9th).

Concerning with the output ranking, Ljubljana follows the eastern cities trend standing in the middle of the ranking (7th). Nevertheless, Ljubljana is still the second on the Startup Scene theme being at the top three of all its variables. On the Finance theme Ljubljana has average scores with its lowest at Ease of getting credit (9th).

➢ Madrid (Input: 3rd - 0,561; Output: 4th - 0,372; Overall: 4th - 0,466)

Madrid has decent aggregated scores for both indexes and it is part of the scenario 3 at the Matrix of maturity stage evolution.

The third position at the input ranking is justified by its regularity at most of the themes, being the second at Infrastructure with its best results at Commute (3rd) in this theme, but also doing well at Ease of Doing Business (2nd), Potential Digital Market Size (2nd), Access to Graduates (1st), Access to

Business Angels (2nd), Engagement with Digital Startup Ecosystem (2nd), Multicultural Diversity (2nd), Standard of Living (3rd) and Tolerance (3rd). This is a result of being a developed country. Madrid's lowest theme score is Talent (9th), besides being the first at the Access to Graduates variable, it is tenth and twelfth ate Importance of ICT and English Use variables respectively. The remaining input variables in which Madrid does not so well are Entrepreneurial Education (10th) and Employment (11th).

Madrid is also impaired by a discrepancy between the two themes of the outputs index. Being the second on the Finance theme, Madrid is fourth at Availability of Early-stage Funding and Ease of Getting Credit and second at Availability of Late-stage Funding, however Madrid struggles at the Startup Scene theme with its lowest rank at Contribution to the National Startup Scene (9th) and being fifth at Dynamism of Startups per Capita and Dynamism of Startup Nationwide per Capita. This might be a sign of the capacity of Spain to host more than one DBE hub.

➢ Barcelona (Input: 5th - 0,508; Output: 5th - 0,353; Overall: 5th - 0,431)

Has expected, Barcelona has similar scores as Madrid, being right behind the capital city in several categories.

Barcelona best results at the inputs index are for the Market and Mentoring & Support themes being the first at both. At the Market theme, Barcelona is the first at Ease of Doing Business and Potential Digital Market Size, right after Madrid in both variables. At Mentoring & Support, Barcelona ranks second at Networking and Mentoring Events and Access to Business Angels variables, and third at Access to Accelerators. Concerning with the other inputs index themes, Barcelona remarkable ranks are at Tolerance (1st), Multicultural Diversity (3rd) and Engagement with Digital Startup Ecosystem (3rd). Contrary to Madrid, Barcelona weakest input theme is the Entrepreneurial Culture, with generally lower ranks than Madrid, mainly for the Willingness to Take on Risks variable (12th), as for the remaining variables, Barcelona has similar scores to Madrid but slightly lower in most cases.

If for Madrid the discrepancies at output themes were large, for Barcelona they are even larger. Barcelona is the first on the Finance theme, being the third at Availability of Early-stage Funding and Ease of Getting Credit, and first at Availability of Late-stage Funding, but the eighth at the Startup Scene theme, with similar ranks as Madrid but slightly lower, such as Contribution to the National Startup Scene (11th). Once again, this is an evidence that proves the capacity of Spain to host more than one ecosystem hub, and, according to this model's results, Barcelona is second to Madrid nationwide.

➢ Valletta (Input: 6th - 0,429; Output: 3rd -0,381; Overall: 6th -0,405)

At the first mid position of the overall ranking comes up Valletta, the first and best ranked city in the scenario 1 of the Matrix of maturity stage evolution.

Even though Valletta belongs to the smallest country analyzed, it is the first at Infrastructure theme and second at Talent and Lifestyle. In the Infrastructure theme, Valletta has regular ranks with highlights for Mobile Internet Speed (3rd), in the Talent theme variables is the first on every variable

except Access to graduates (11th). Being the first on Importance of ICT may be related to the good ranks at Infrastructure theme due to its strong correlation, and its first position at English Use variable is a result of remarkably having almost 100% of the population able to communicate in English. On the Lifestyle theme, being the first at Political Stability variable may be a large contribute of the high rates of employment (1st). The small dimension of Malta may otherwise impair its Market theme score (10th) with the lowest ranks for Ease of Doing Business and Ease of Starting Business variables. The Mentoring & Support theme (11th) also has low scored variables being bottom three at all of them.

Valletta is the city with the largest discrepancy between output themes. The small dimension of Malta brings Valletta to the top of the Startup Scene theme, ranking first at every variable of the theme except for Dynamism of Startup per Capita, this is the most notable consequence of being the entrepreneurial hub of a small country. The Finance theme bottom position on every variable of the theme may be a consequence of the missing data imputation.

➢ Bucharest (Input: 7th - 0,400; Output: 8th - 0,275; Overall: 7th - 0,338)

The first city with an aggregated score below the average is the overall ranking seventh positioned Bucharest.

Bucharest ranks in mid positions of most of the input themes, except of Entrepreneurial Culture and Lifestyle (10th at both themes). The best ranks of Bucharest are being the first at the Mobile Internet Speed and second on the Employment variable (even though this variable belongs to the Lifestyle theme). The Entrepreneurial Culture theme lower score is due to lower ranks at Multicultural Diversity (11th) and Engagement with Digital Startup Ecosystem (10th) variables). Regarding the tenth position of the Lifestyle theme, Bucharest seems to be part of a tendency of the Eastern cities analyzed (except Ljubljana), ranking bottom three at Political Stability (10th) and Standard of Living (11th). Commute (12th) is also a struggling variable for Bucharest.

The outputs index show that Bucharest is the first ranked on the Ease of Getting Credit Variable, putting Bucharest at the fifth position at the Finance theme. At the Startup Scene theme, Bucharest has mid ranks in every variable of the theme with its lowest score at Dynamism of Startup Nationwide per Capita.

➢ Sofia (Input: 11th - 0,296; Output: 6th - 0,353; Overall: 8th - 0,324)

Sofia has mentioned before, has the particularity of having a higher aggregated output score than aggregated input score.

Has expected, due to its eleventh rank for the inputs index, Sofia is the last at two input themes and also ranks at the bottom half at another three themes. However, Sofia has decent scores for the Talent theme such as Importance of ICT (2nd) and Access to Graduates (3rd), and with this results Sofia ranks fourth for this theme, being considered its strongest point at the inputs index. Sofia is also top three at Employment and Airport Connectivity variables. However, once again, this city follows the tendency of most Eastern cities ranking bottom three at Political Stability (11th) and Government Policies (12th). Sofia also has lower ranks for Multicultural Diversity (12th), Engagement with Digital Startup Scene

(11th), Entrepreneurial Education (11th), showing that the entrepreneurial mindset is not yet established. At the Infrastructure theme (9th), besides the top three ranking at Airport Connectivity, Sofia lacks on Commute and Mobile Internet Speed (both 11th position). The Market theme (12th) is affected by the low ranks for Potential Digital Market Size (12th) and Ease of Doing Business (11th).

On the outputs index, Sofia is in mid ranked for both themes, being second on the Contribution to the National Startup Scene variable of the Startup Scene theme (4th) and also second on the Ease of Getting Credit variable of the Finance theme (6th).

➢ Zagreb (Input: 8th – 0,381; Output: 9th – 0,261; Overall: 9th – 0,321)

One of the closest differences in the overall ranking is between Sofia and Zagreb with only 0,04 points of distance to each other.

Zagreb is one of the cities with more mid ranked themes at the inputs index, with its worst ranks at the Market (11th) and Entrepreneurial Culture (11th) themes. On the Market theme, Zagreb never ranks below the ninth position with its lowest score at Potential Digital Market Size variable (11th). The same happens at the Entrepreneurial Culture theme with all variables ranking below the ninth position, with the exception of Multicultural Diversity variable (7th), in this theme, the lowest ranks are Government Policies (11th) and Entrepreneurial Education (12th). Zagreb also lacks Access to Business Angels (11th) and Tolerance (11th). Even so, its best rankings positions are Airport Connectivity (2nd) and Networking and Mentoring event (3rd).

On the outputs index, the Contribution to the National Startup Scene is the best ranked variable (4th) with all the others between the seventh and sixth positions, the exception goes to Zagreb's worst ranking at Dynamism of Startups per Capita (9th). The result is the seventh position at the Startup Scene theme and eighth on the Finance theme.

➢ Milan (Input: 9th -0,357; Output: 11th - 0,119; Overall: 10th -0,238)

Reaching the bottom three of the overall ranking, the second case of double representations of the same country appears, so as another southern city after three eastern cities in a row at the mid ranking positions.

Milan best ranking at the inputs index is the Entrepreneurial Culture theme. This is a result of four out of five variables in which this city ranks above fifth, the exception goes for Multicultural Diversity (8th) and its best rank is second at Entrepreneurial Education. Perhaps surprisingly (due to the fact that Italy is considered a developed country) the worst ranked theme is Talent. This is a consequence of low rankings at Access to Graduates (12th) and English Use (11th) variables. Regarding the remaining variables, all of them are in the mid positions with the exception do Airport connectivity (11th).

Once again maybe because of the nationally covered variables and because Italy hosts more than entrepreneurial hub, Milan is eleventh at the outputs index's Startup Scene theme with rather low ranks at its variables: Dynamism of Startups per Capita (10th), Dynamism of Startup nationwide per capita (11th) and Contribution to the National Startup Scene (10th). At the Finance theme Milan does

not do much better, with any variable ranked over eighth and its lowest at Ease of Getting Credit (10th).

➢ Athens (Input: 12th - 0,289; Output: 10th - 0,155; Overall: 11th - 0,222)

Currently recovering from an economical and pollical crisis, Athens is the city that is creating less conditions to evolve its ecosystem stage maturity, being the least of the inputs index ranking.

The fact that the best inputs index theme rankings are seventh for Talent and Entrepreneurial Culture, and being the least of the Lifestyle and Infrastructure theme explains much about why is Athens the least on the inputs index. The variables at the Talent theme may are all in the fifth position with the exception of Importance of ICT, in which Athens is the least. In the Entrepreneurial Culture theme, the highlight is the first position at the Engagement with the Digital Startup Scene, which may reveal that the city inhabitants are getting in touch with entrepreneurial mindset. On the other hand, the political and economic crisis left its marks, since Athens is the least at all the Lifestyle theme's variables (including Political Stability and Employment) except for Standard of living, in which Athens does not much better occupying the tenth position. In the Market theme is another good result, with Athens ranking first at the Ease of Starting Business variable, contrariwise, this theme does not have a higher-ranking position (eighth) because of the eleventh rank at Ease of Doing Business. Athens is also eleventh at Importance of ICT and Access to Accelerators variables and twelfth at Access to Business Angels.

Concerning with the outputs index, Athens is the tenth at both themes, with its best result at Contribution to the National Startup scene, and lowest in Dynamism of Startups per Capita and Availability of Early-stage Funding (11th at both variables)

➢ Rome (Input: 10th - 0,331; Output 12th- 0,072; Overall: 12th - 0,201)

The last city of this model is the second represented city of Italy which ranking position is highly impaired by its poor results at the outputs index.

Notwithstanding being the last of the overall ranking, this is not because of not providing conditions to promote the entrepreneurial activity. It does not mean that Rome is a best in class example of the inputs index, but it is certainly not the worse. Rome worst theme rankings are Lifestyle and Infrastructure (both 11th position), and its best is the Entrepreneurial Culture theme (8th). At Entrepreneurial Culture variables, Rome stands out in Entrepreneurial Education and Willingness to Take on Risks (both 3rd position), Rome does not have a higher position on this theme ranking because of its twelfth position at Engagement with Digital Startup Ecosystem variable. The Lifestyle theme is impaired by the Standard of Living variable (12th) combined with the mid ranked positions at the remaining variables. Concerning with the Infrastructure theme, Rome struggles with Airport Connectivity (12th) and Mobile Internet Speed (10th).

In the outputs index is where the biggest problem lies. Rome is the twelfth at the Startup Scene theme and eleventh at the Finance theme. The reason for this is for being the least at every variable of Startup Scene theme probably for the same reason as Milan: Since Italy hosts more than one

entrepreneurial hub city, the nationally covered variables and standardization bases have influence, however, it is worth noting that the same does not happen with Spanish cities, due to their better performance at this theme (6th for Madrid and 8th for Barcelona). At the Finance theme, Rome is in ninth at Availability of Early and Late-stage Funding and eleventh at Ease of Getting Credit variables.

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7. Conclusions

In this chapter, using the analysis previously performed, the research questions proposed earlier are addressed so as the final general conclusions of the study are presented. The chapter ends with the presentation of the limitations of the study and the suggestions for future research.

7.1. Research questions addressing

➢ How to build a composite index model to be applied to less matured digital business ecosystems?

This research question has been addressed throughout the chapters 4 (The Model) and 5 (Application), however, summing up the most important insights to lay emphasis on are:

- Have a clear idea of the aim of the subject to be analyzed throughout the whole development of the model, identifying which characteristics of the ecosystem should be explored, empowering the correct virtues without biasing the data gathered and jeopardizing the credibility of the index. This strategy definition should be settled in accurate defined premises;
- Adapt the choice of the geographical area with the entrepreneurial ecosystem maturity stage to be analyzed, making sure that, at least the majority of the cities covered possess most of the characteristics supposed to be explored. The more accurate the geographic zone selection the fewer outliers will occur;
- Develop the dynamic that the model should have: index configuration, themes and variables selection, and final data display formats;
- Make sure that the data sources are credible, reliable and the most current possible. All data should be processed (missing data imputation, standardization and normalization) using processes in accordance with the previously developed strategy;
- Assign the weights of the themes and variables in accordance with the strategy defined, and balance it up until incoherence points are verified;
- Test the sensitivity of the of the methods used and check the correlations between data making sure the robustness is guaranteed;
- Present the final conclusions with clarity highlighting the principal aspects.

Aside the seven points mentioned, it is important to follow the defined strategy during the entire process and constantly question the results that are being generated throughout every step of the algorithms, bearing in mind the final aim of the study and the particular characteristics of the target analyzed.

➢ What are the most relevant characteristics of the southern and eastern European digital business ecosystems?

Analyzing the input and outputs indexes scores of this model, the most relevant characteristic of this DBE's region that stands out is that the entrepreneurial conditions are not yet producing the acceptable number of output. Ultimately, for the benefit of the DBE, this acceptable level of output is attained with the direct and indirect wealth generation. For ecosystems with less maturity this wealth generation is measured by the availability of funding and the number of ventures established. However, as referred before, there is no doubt that in most cities analyzed the entrepreneurial conditions to produce those results are created or, at least, there are evidence that those conditions are being created. Therefore, such as any common process, if the correct inputs are not generating the expected amount of output the problem must be in the process itself. In this context, the process misfunction should be related the only common factor found between the twelve cities analyzed: Lack of entrepreneurial culture. According to the online version of the *Oxford Dictionary* (2018) one of the definitions of culture is: "the ideas, customs, and social behavior of a particular people or society". Transposing it into the entrepreneurial context, SEE countries with the proper assets, knowledge and skills are the ones closer to first attain the engagement with the entrepreneurial culture. It is believed that, among all the discrepancies between matured DBEs and less-matured DBE, the entrepreneurial mentality and culture is the determinant factor that separates them. It is the entrepreneurial culture that drives individuals to pursue an entrepreneurial behavior adopting ideas related to self-employment, job and venture creating. However, taking in account that the correct procedures are being taken, time is still needed to attain the desirable state o maturity, and despite the favorable scores at the inputs index that boost the entrepreneurial culture, the time variable is irreplaceable.

As demonstrated on the results analysis and without neglecting the fact there are more southern than eastern cities analyzed on this model, although this study is focused on the SEE region (which, as demonstrated, have points in common), it is never too much to point out and analyze the differences between the southern and eastern cities. Southern cities are on the top of most categories analyzed (themes, input, output and overall indexes) and eastern cities in the middle. The Matrix of maturity stage evolution also shows that southern cities are doing better than eastern cities. The most prominent patterns that justify this assumption is the tendency of eastern cities to have lower scores in variables that indicate issues related to political stability, government policies and lower quality of living. This suggests that southern cities are in a more matured entrepreneurial stage than southern cities.

As mentioned earlier, despite several S&EE countries having issues regarding political situation and power of generating hard skills correct and modern tools (infrastructure and ICTs for instance), S&EE countries are leveled with northern and western in soft skills. It is believed that, without diminishing the importance of the hard skills, the soft skills may be a key to boost the entrepreneurial culture and proliferate the entrepreneurial activity.

With the analysis made over the Matrix of maturity stage evolution, it is safe to conjecture that S&EE countries, in the future may certainly shift its average mid-point from the scenario 1 to the scenario 3, "the Prospect". So that, in the future, it is expected that the best ranked cities will be able to produce better results for the output indicators. This conclusion confirms that the assumptions taken before are accurate and the whole model reflects the emphasis on the DBEs' potential.

7.2. General conclusions

The development of this dissertation allowed to study a specific part of the DBE that is less mentioned in the literature review with the adequate depth. To do so, a tool (the model) was developed to test a specific region (S&EE cities) and analyzed the final results technically and contextualizing them.

To attain the necessary knowledge about the topic of research, a literature review was conducted to develop the foundation of knowledge on the numerous points of contact with the scope of this dissertation. Supporting the literature review, the research over the region selected to represent the ecosystem maturity stage was studied.

After having solid knowledge basis, the model was developed bearing in mind the strategy defined for it. This strategy is translated into restrictions and assumptions to create the configuration of the model, mathematical methods that fit in it and results displays to show what was meant to observe.

The final results were analyzed and justified regarding the context of research, and in accordance to it the research questions were addressed. This way it is concluded that the less-matured DBEs can and should be studied and evaluated in a different perspective, and regarding the same parameters and criteria as if a more matured ecosystem was in matter. The SEE countries match with the definition of entrepreneurial maturity stage intended to be analyzed. This region can be described as a possible prospect of the broadness of the entrepreneurial culture in Europe, in several cities the conditions to build a cohesive and prospective DBE are settled or managed to be settled, but there is still lack of engagement with the entrepreneurial culture and entrepreneurship mindset. Providing the necessary conditions will bring the DBE actors together forming a proper community that seeks common objectives, creating the so called entrepreneurial culture. This is the combination that profilers the results and helps the actors to succeed in each activity, creating wealth and strengthening the ecosystem and ultimately, evolving the maturity stage of it.

By having developed such a singular model to study this target, and tested it with this specific region of Europe, some valuable insight was provided to the community. This research allowed to have a deeper knowledge about the specificities of both less-matured DBE and entrepreneurial activity of SEE, and how to build a model with these characteristics.

7.3. Limitations

Even though the objectives proposed were successfully achieved since it was possible to provide knowledge to the community regarding the less-matured DBE, a study over this region of Europe and build a model to produce satisfactory results analyzed, throughout the development of this study, some limitations occurred which could compromise the analysis and the final results.

One of the most important limitations concerns with the availability of data. Since all the sources of information were gathered from free for online consulting websites and platforms, it was impossible to assure that the most actual data was gathered. The most prominent cases are the variables: Importance of ICT (2014), English Use (2012), Willingness to Take on Risks (2013) and Multicultural Diversity (2011). Furthermore, it was not possible to achieve 0% of missing data even though the percentage of complete data is acceptable (97,35% for the inputs index and 94,44% for the outputs index). The most problematic cities regarding this subject are: Valletta, Bucharest and Nicosia.

The robustness of variables and themes was not tested, although the sensitivity analysis tests several aggregation methods and the presence of the Finance theme in the inputs index, giving robustness to the model, because it would be a lengthy and complex process, it was not tested what would happen if a certain variable or the was withdrawn of the indexes. This limitation is minimized by a deep variable/variable, theme/theme and variable/theme correlation analysis inside both indexes and between them.

Although a solid literature review was developed and a geographical coverage study was made, nothing would replace the deeper knowledge of getting in touch directly with the reality of each city analyzed. This limitation would only be surpassed with time to develop the model and with a specialized and experienced team with knowledge about each city reality (preferably locals). This way, the model would be even more adapted to the target to be tested.

7.4. Recommendations for further research

This research work shows how to develop a model with certain characteristics that are different to the more general ones available, so that, and since no other similar to this was found available, a future research that encompasses the development of a similar model would benefit with an even deeper knowledge over the region in matter. This would have to include contact with the different cities proposed to be analyzed, whether visits to explore the region or team working with local institutions or academic researchers.

It would be a point of interest to expand the number of cities analyzed in the index, along with that a deeper sensitivity analysis and a statistical study over the list of cities selected.

To enrich the potentialities of a similar future research, studying how and in what can cities learn from others would be, not only an interesting matter to discuss, but also a productive result.

The most relevant aspect that this study may bring to future researches is however to shorten the gap of knowledge and know when transposing a more general model to a more specific. As such, a study over a region which the DBE maturity level is even lower keeping the most important features applied in this model (strategy, configuration and the three-way final results display used) would certainly bring value to the community. Suggestions for that could be African countries for having less entrepreneurial maturity than most European countries, or reducing the geographical coverage to a certain country (testing different cities of the country) or a smaller region.

Bibliographic references

Accenture. (2014). Retrieved from https://pt.slideshare.net/AccentureNL/accenture-digital-business (13/02/2017)

Aidis, R. & Estrin, S. (2010). Centre for the Study of Comparative Economics Size Matters: Entrepreneurial Entry and Government Economics Working Paper No. 81 September 2007 (rev. June 2010)', 2007(June).

Audretsch, D. & Belitski, M. (2016). Entrepreneurial Ecosystems in Cities – Establishing the Framework Conditions'. https://doi.org/10.1007/s10961-016-9473-8, pp. 1–23.

Baird, Ross, Lily Bowles, & Suaraph Lall. (2013). Bridging the 'Pioneer Gap: The Role of Accelerators in Launching High-Impact Enterprises. Aspen Institute, Innovations, 8(3/4), pp. 105–137. doi: 10.1162/INOV_a_00191.

Bannerjee, S., Bone, J., Finger, Y., Haley, C. (2016). Methodology for Constructing the European Digital City Index, pp. 1–47.

Barrehag, L., Fornell, A., Larsson, G., Mårdström, V. & Wrackefeldt, S. (2012). Accelerating Success: A Study of Seed Accelerators and Their Defining Characteristics.

Berea, A. (2013). Essays in High-Impact Companies and High-Impact Entrepreneurship. Journal of Chemical Information and Modeling 53(9), pp. 1689–1699. doi: 10.1017/CBO9781107415324.004.

Bharadwaj, A., Sawy, O. A. E., Pavlou, P. A., and Venkatraman, N. (2013). Digital Business Strategy: Toward a Next Generation of Insights, MIS Quarterly (37:2), pp. 471-482.

Blank, S., & Dorf, B. (2012). The Startup Owner's ManualTM The Step-by-Step Guide for Building a Great Company. K and S Ranch Inc., K&S Ranch Publishing Division (Vol. 53).

Brockhaus, R. H. (1980). Risk taking propensity of entrepreneurs, Academy of Management Journal. Vol. 23, No. 3, https://doi.org/10.5465/255515

Burt, R. S. (2009). Structural Holes: The Social Structure of Competition, Harvard University Press, Cambridge Massachussetts, pp. 38–40. doi: 10.1177/0265407512465997.

Bygrave, W. & Hofer, C. (1991). Theorizing about entrepreneurship. Entrepreneurship Theory and Practice, Vol 16, Issue 2, pp. 13 – 22, https://doi.org/10.1177/104225879201600203

Cantillon, R. (1755). Essay on the Nature of Commerce in General.

Carvalho, A. (2016). Accelerators in the world: analysis of the current and future trends. http://hdl.handle.net/10362/20023

Casson, M. (2003). The Entrepreneur: An Economic Theory. Northampton MA: Edward Elgar Publishing. doi 10.4337/9781843765639.

Chinsonboon, O. (2000). Incubators in The New Economy, New Economy, p. 136. Retrieved from: http://chinsomboon.com/incubator/incubator_06-2000.pdf (17/04/2017)

Cohen, S., & Hochberg, Y. V. (2014). Accelerating Startups: The Seed Accelerator Phenomenon. SSRN Electronic Journal. pp. 1–16. doi: 10.2139/ssrn.2418000.

Davila, A., Foster, G., & Gupta, M. (2003). Venture capital financing and the growth of startup firms. Journal of Business Venturing. Volume 18, Issue 6, November 2003, https://doi.org/10.1016/S0883-9026(02)00127-1

Dempwolf, C. S., Auer, J. and D'Ippolito, M. (2014). Innovation Accelerators: Defining Characteristics Among Startup Assistance Organizations, Small Business Administration, (October), pp. 1–44. under contract number SBAHQ-13-M-0197

Di Gregorio, D. and Shane, S. (2003). 'Why do some universities generate more start-ups than others?', Research Policy, 32(2 SPEC.), pp. 209–227. doi: 10.1016/S0048-7333(02)00097-5.

Drucker, P. (1985). Innovation and Entrepreneurship. New York, NY: Harper Perennial. doi: 10.2307/3101027.

EUROSTAT. (2011). Regions in the European Union, Regions in the European Union Nomenclature of territorial units for statistics NUTS 2010/EU-27. doi: 10.2785/15544.

Fabre, F. (2016). Judge an Economy by the Number of Scale, not Start, 11, pp. 2014–2016.

Fang, S., Fawley. D., Konanahalli, S. & Hill. B. (2015) Accelerating start-up ecosystems with the "Power of 5". 7(4), pp. 10–19.

Feldman, M. & Zoller, T. (2012). Dealmakers in Place: Social Capital Connections in Regional Entrepreneurial Economies. Regional Studies. 46:1, 23 37, DOI: 10.1080/00343404.2011.607808

Florida, R., Adler, P., & Mellander, C. (2016). The City as Innovation Machine. *Regional Studies*, 51(1), pp. 86–96. doi: 10.1080/00343404.2016.1255324.

Florida, R., & Kenney, M. (1988). Venture capital and high technology entrepreneurship. Journal of Business Venturing. Volume 3, Issue 4, Autumn 1988, Pages 301-319. https://doi.org/10.1016/0883-9026(88)90011-0

Gartner, W.B. (1985). A conceptual framework for describing the phenomenon of new venture creation. Academy of Management Review 10, no. 4: 696–706. www.jstor.org/stable/258039.

Gedeon, S. (2010). What is Entrepreneurship? Entrepreneurial Practice Review, 1(3), 16–35. http://www.entre-ed.org/_what/stds-prac-brochure.pdf

Gnyawali, D. R., & Fogel, D. S. (1994). Environments for entrepreneurship development: key dimensions and research implications. Entrepreneurship: Theory & Practice. 18(JULY 1994), 43–62.

http://libproxy.tulane.edu:2048/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=9502013222&login.asp&site=ehost-live&scope=site

Harper-Anderson, E., Lewis, D. a. & Molnar, L. a. (2011). Incubating Success. Incubation Best Practices That Lead to Successful New Ventures, US Department of Commerce Economic Development Administration, pp. 3–108. doi: 10.13140/RG.2.1.2732.6881.

Hawley, F. (1907). Enterprise and the Productive Process. New York, NY: Putnam.

Hayek, F. (1937). Economics and Knowledge. Economica. 4(1), 33-54.

Hebert, R. & Link, A. (1988). In search of the meaning of entrepreneurship. Small Business Economics. 1: 39. https://doi.org/10.1007/BF00389915

Hellmann, T. and Thiele, V. (2015). The Interrelationship between Angel and Venture Capital Markets, Journal of Financial Economics. DOI: 10.3386/w20147

Hill, B. E. & Power, Dee. (2002). Attracting Capital from Angels: How Their Money and Their Experience Can Help You Build a Successful Company. New York: John Wiley & Sons. Volume18, Issue7-8. https://doi.org/10.1002/jsc.852

Hochberg, Y. (2015). 'Accelerating Entrepreneurs and Ecosystems: The Seed Accelerator', Innovation Policy and the Economy, 16, pp. 25–51. doi: 10.1086/684985.

Hoover, E. M., & Giarratani, F. (1999). An Introduction to Regional Economics (The Web Book of Regional Science.) doi: 10.2307/2231342.

Hsu, D. H. (2007). Experienced entrepreneurial founders, organizational capital, and venture capital funding. Research Policy, 36(5), 722–741. http://doi.org/10.1016/j.respol.2007.02.022

Isenberg, D. (2011). the Babson. and Ecosystem. The Entrepreneurship Ecosystem Strategy as a New Paradigm for Economic Policy. Pprinciples for Cultivating Entrepreneurships. The Babsos Entrepreneurship Ecosystem Project,1(781), 1–13. http://www.wheda.com/uploadedFiles/Website/About_Wheda/BabsonEntrepreneurshipEcosystemProject.pdf

Jaffe, A. (1989). Real Effects of Academic Research, American Economic Review, 79(5), pp. 957–70. http://links.jstor.org/sici?sici=0002-8282%2819891...O%3B2-T&origin=repec

Jacobs, J. (1969) The economy of cities, Random House, 201 East 50th Street, New York 10022, 1969. 268 pp. https://doi.org/10.1002/ncr.4100580916

Kelley, D., Singer, S. & Herrington, M. (2015) Global Entrepreneurship Monitor 2015 / 16, Retrieved from: http://gemconsortium.org/report.

Keuschnigg, C. and Nielsen, S. B. (2003) Tax policy, venture capital, and entrepreneurship, Journal of Public Economics, 2003, v87(1, Jan), 185-203.DOI: 10.3386/w7976

Knoema. (2016). Contribution of tourism to GDP. retrieved from https://knoema.com/atlas/topics/Tourism/Travel-and-Tourism-Total-Contribution-to-GDP/Contribution-of-travel-and-tourism-to-GDP-percent-of-GDP (24/01/2018)

Lewandowski, C. (2015). Why are big businesses looking to start-ups for innovation? Kpmg, 1(February), p. 23. doi: 10.1017/CBO9781107415324.004.

Lopez, J. (2014). Retrieved from: https://www.forbes.com/sites/gartnergroup/2014/05/07/digital-business-is-everyones-business/#5f90d5be7f82 (03/02/2017)

Lowe, R. A. and Gonzalez-Brambila, C. (2007) Faculty entrepreneurs and research productivity, Journal of Technology Transfer, 32(3), pp. 173–194. doi: 10.1007/s10961-006-9014-y.

Lowe, R. A., & Quick, S. (2004). Measuring the Impact of University Technology Transfer: A Guide to Methodologies, Data Needs, and Sources. The AUTM Journal, XVI, 43–60.

Lundberg, A. (2015). Retrieved from: http://lundbergmedia.com/blog/2015-12-15-what-is-digital-business (19/08/2017)

Marmer, M. & Bjoern, H. (2011). Startup Genome Report', Berkley University, 1(March). (startup8) http://pdf-release.net/external/2996902/pdf-release-dot-netStartup_Genome_Report_version_2.1.pdf

Mason, C. & Stark, M. (2004). What do Investors Look for in a Business Plan? A Comparison of the Investment Criteria of Bankers, Venture Capitalists and Business Angels. International Small Business Journal22, no. 3 (June). https://doi.org/10.1177/0266242604042377

Mayer, H. (2013). Entrepreneurship in a Hub and Spoke Industrial District: Firm Survey Evidence from Seattle's Technology Industry, Regional Studies 47, 1715-1733.

McClelland, D. (1987). Characteristics of successful entrepreneurs. Journal of Creative Behavior, https://doi.org/10.1002/j.2162-6057.1987.tb00479.x

McClelland, D. (1961). The Achieving Society. Princeton, NJ: Van Nostrand Publishing Company, The Journal of Economic History. 23. 118-121. 10.1017/S002205070010364X.

McGee, K. Morello, D. & Weldon, L. (2014). A research summary report with highlights from "Six Key Steps to Build a Successful Digital Business'". http://docs.media.bitpipe.com/io_11x/io_116154/item_914477/Gartner%20Six%20Steps%20to%20Build%20a%20Digital%20Business%20Summary%20Report.pdf

Morgan, K. (2004). The Exaggerated death of geography: Learning, proximity and territorial innovation systems. Journal of Economic Geography, 4(1): 3–21, doi: 10.1093/jeg/4.1.3.

Moore, J. F. (1996). The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems, New York: Harper Business, p. 297. doi: 10.1017/CBO9781107415324.004.

Nachira, F. (2002). Toward a network of digital business ecosystems fostering the local development, retrieved from

http://www.europa.eu.int/information_society/topics/ebusiness/godigital/sme_research/index_en.htm (18/02/2017)

Nachira, F., Dini, P. and Nicolai, A. (2007) A network of digital business ecosystems for Europe: roots, processes and perspectives, Bruxelles, Introductory Paper, (Com), pp. 5–24. http://www.digital-ecosystems.org/book/DBE-2007.pdf.

NASSCOM, 2017. https://community.nasscom.in/docs/DOC-1430 (8/1/2017)

Neck, H. M., Meyer, G. D., Cohen, B., & Corbett, A. C. (2004). An entrepreneurial system view of new venture creation. Journal of Small Business Management, 42(2), 190–208, http://doi.org/10.1111/j.1540-627X.2004.00105.x

NUMA. (2014). Accelerate Now Trends, C., For, S. and Future, T. H. E. (2014) Accelerate Now! http://cordis.europa.eu/docs/projects/cnect/8/611878/080/deliverables/001-PR1D62WhitepaperEuropeanAcceleratorsSummit.pdf.

Numbeo. (2018). Cost of living rankings relative to New York city. retrieved from https://www.numbeo.com/cost-of-living/rankings_by_country.jsp?title=2018&region=150 (23/01/2018)

OECD. (2007). Eurostat-OECD Manual on Business Demography Statistics, OECD-Eurostat. doi: 10.1787/9789264041882-en.

OECD, (2008). Handbook on Constructing Composite Indicators: Methodology and User Guide. doi: 10.1787/9789264043466-en.

Ordanini, A., Miceli, L., Pizzetti, M., & Parasuraman, A. (2011). Crowd-funding: transforming customers into investors through innovative service platforms. Journal of Service Management, 22 (4), 443-470

Oxford Dictionary Online version. retrieved from https://en.oxforddictionaries.com/definition/university (29/12/2017)

Oxford dictionary online version. retrieved from https://en.oxforddictionaries.com/ (14/12/2017)

Oxford Dictionary online version. retrieved from https://en.oxforddictionaries.com/definition/culture (19/03/2018)

Palmer, M. (1971). The application of psychological testing to entrepreneurial potential. California Management Review, 3(3), 32-29

Porter, L. W. and L. E. McKibben (1988). Management Education and Development: drift or thrust into the 21st century? New York, McGraw-Hill Book Co.

Preston, S. L. (2007). Angel Financing for Entrepreneurs, Early-Stage Funding for Long-Term Success.San Francisco: Jossey-Bass

Provatas, M. & Barry, D. (2013) 'Using Web Startups As A Paradigm Shift For Entrepreneurship In Troubled Economies Acknowledgments', (April). http://studenttheses.cbs.dk/handle/10417/3742

Rietveld, P., & Vickerman, R. (2004). Transport in regional science: The "death of distance" is premature. Papers in Regional Science, 83(1), 229–248.

Rodriguez, E. M. (2011). Angel Financing: Matching Start-Up Firms with Angel Investors. pp. 7–35.

Rutgers, S. G., (2010). Handbook of Entrepreneurship Research. doi: 10.1007/978-1-4419-1191-9.

Saisana M. and Tarantola S. (2002). State-of-the-art report on current methodologies and practices for composite indicator development, EUR 20408 EN, European Commission-JRC: Italy

Saltelli A. (2007). Composite indicators between analysis and advocacy, Social Indicators Research, https://doi.org/10.1007/s11205-006-0024-9

Shaver, K. G. (2010). The social psychology of entrepreneurial behavior, in Handbook of Entrepreneurship Research, Springer, 359–385, https://doi.org/10.1007/978-1-4419-1191-9_14

Lonergan, K. (2014). Retrieved from http://www.information-age.com/what-does-it-really-mean-be-digital-business-123458466/ (22/08/2017)

Shane, S. A. (2009). Fool's Gold? The Truth Behind Angel Investing in America. New York: Oxford University Press. number 9780195331080., https://ideas.repec.org/b/oxp/obooks/9780195331080.html

Sherman, H. (1999). Assessing the intervention effectiveness of business incubation programs on new business start-ups. Journal of Development Entrepreneurship. Norfolk State University Foundation Norfolk State University. 1999. HighBeam Research.

Simonton, D. K. (2011). Big-C creativity in the big city, in Handbook of creative cities, Andersson, D et al. (eds), p 72–84–55. https://doi.org/10.4337/9780857936394

Smilor, R. W. (1987). Managing the incubator system: critical success factors to accelerate new company development. Engineering Management, IEEE. Transactions on, (3), 146–155

Sohl, J. E. (1999). The early-stage equity market in the USA. Venture Capital: An International Journal of Entrepreneurial Finance1, no. 2 (April 1). https://doi.org/10.1080/136910699295929

Statista. (2017). Unemployment rate between EU countries. retrieved from http://www.theglobaleconomy.com/rankings/wb_political_stability/ (23/01/2018)

Stevenson, H. H., & Jarillo, J. C. (1990). A Paradigm of Entrepreneurship: Entrepreneurial Management. Strategic Management Journal, DOI: 10.1007/978-3-540-48543-8_7

The World Bank (2015). Political stability - country rankings. retrieved from http://www.theglobaleconomy.com/rankings/wb_political_stability/ (21/01/2018)

Vafaei, N., Ribeiro, R. A. & Camarinha-Matos, L. M. (2015) Importance of Data Normalization in Decision Making: case study with TOPSIS method, International Conference of Decision Support Systems Technology, An EWG-DSS Conference. Them: Big Data Analytic for Decision Making

Vesper, K. H. (1990). New Ventures Strategies Englewood Cliffs, NJ: Prentice Halls. https://trove.nla.gov.au/work/8720082

Vogel, P. (2013). Chair for Entrepreneurship & Technology Commercialization. Building and Assessing Entrepreneurship Ecosystems. The Hague.

Wortmann, F. and Flüchter, K. (2015) Internet of Things: Technology and Value Added, Business and Information Systems Engineering, 57(3), pp. 221–224. doi: 10.1007/s12599-015-0383-3.

Yaribeigi, E. Hosseini, S. J. Lashgarara, F. Mirdamadi, S. M. & Najafabadi, M. O. (2014). 'Development of Entrepreneurship Ecosystem', International Journal of advanced biological and biomedical research, 2(12), pp. 2905–2908.

Appendixes

Appendix 1 – Input and output data gathering sources

Table A.1 – Input variables' sources.

Theme	Variable	Source	Year	Coverage
Market	Ease of Doing Business	http://www.doingbusiness.org/rankings	2018	National
	Potential Digital Market Size	http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database	2017	National
	Ease of Starting Business	http://www.doingbusiness.org/rankings	2018	National
Talent	Importance of ICT	http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database https://www.econdb.com/dataset/TIN00074/percentage-of-the-ict-sector-on-gdp/	2014	National
	Access to Graduates	http://ec.europa.eu/eurostat/tgm/mapToolClosed.do?tab=map&init=1&plugin=1&language=en&pcode=tgs00109&toolbox=types	2016	NUTS2
	English Use	https://dbk.gesis.org/dbksearch/SDesc2.asp?ll=10&notabs=1&af=&nf=1&search=&search2=&db=E&no=5597	2012	NUTS2
Infrastructure	Mobile Internet Speed	http://www.ookla.com /	2017	City
	Availability of 3g 4g*	https://opensignal.com/reports/2016/08/global-state-of-the-mobile-network/	2017	National
	Airport Connectivity	https://teleport.org/	2016	City
	Commute	https://www.numbeo.com/traffic /	2017	city
Mentoring & Support	Networking and Mentoring Events	https://www.meetup.com/pt-BR /	2016	City
	Access to accelerators	https://digitalcityindex.eu/	2016	City
	Access to Business Angels	http://www.eban.org/wp-content/uploads/2016/06/Early-Stage-Market-Statistics-2015.pdf	2015	National
Entrepreneurial Culture	Government Policies	Global Entrepreneurship Monitor 2016/2017	2017	National
	Entrepreneurial Education at School Stage	Global Entrepreneurship Monitor 2016/2017	2017	National
	Willingness to Take on Risks	https://digitalcityindex.eu/	2013	NUTS2
	Engagement with Digital Startup Ecosystem	https://digitalcityindex.eu/	2016	City
	Multicultural Diversity	https://digitalcityindex.eu/	2011	NUTS2
Lifestyle	Standard of Living	https://www.numbeo.com/quality-of-life/rankings_current.jsp	2016	City
	Tolerance	Global creative index 2016	2016	National
	Political Stability	http://www.theglobaleconomy.com/rankings/wb_political_stability/	2017	National
	Employment	https://www.statista.com/statistics/268830/unemployment-rate-in-eu-countries/	2017	National

The table A.1 shows the sources (websites or publications) from where the raw data for each input variable was retrieved, as well as the year and coverage.

Table A.2 – Output variables' sources

Theme	Variable	Source	Year	Coverage
Startup Scene	Dynamism of Startups per Capita	https://markets.funderbeam.com https://angel.co/	2017	City
	Dynamism of Startups Nationwide per Capita	https://digitalcityindex.eu/	2017	National
	Contribution to the National Startup Scene	…	2017	National and city
Finance	Availability of Early-stage Funding	https://digitalcityindex.eu/	2016	National
	Availability of Late-stage Funding	https://digitalcityindex.eu/	2016	National
	Ease of Getting Credit	http://www.doingbusiness.org/rankings	2017	National

The table A.2 shows the sources (websites or publications) from where the raw data for each output variable was retrieved, as well as the year and coverage.

Appendix 2 – Input raw data gathered

Table A.3 – Raw data in.

Theme	Variable	Athens	Barcelona	Bucharest	Lisbon	Ljubljana	Madrid	Milan	Nicosia	Rome	Sofia	Valletta	Zagreb
Market	Ease of doing business	68,38	74,86	73,78	77,57	75,62	74,86	72,07	71,78	72,07	73,72	63,70	72,71
	Potential Digital Market Size	70	85	70	75	80	85	73	81	73	66	81	69
	Ease of Starting Business	37	86	64	48	46	86	66	50	66	95	102	87
Talent	Importance of ICT	1,84	3,18	3,21	2,99	3,62	3,18	3,23	4,78	3,23	4,9	7,2	4,1
	Access to Graduates	37,0	37,5	33,6	32,5	35,0	46,9	19,3	40,6	23,3	38,6	19,6	21,8
	English Use	59,3	29,5	60,4	40,0	65,6	21,5	28,4	73,9	40,0	36,6	100,0	49,0
Infrastructure	Mobile Internet Speed	17,6	18,4	28,7	20,0	17,4	18,8	18,8	10,7	16,5	16,2	19,4	18,5
	Availability of 3g 4g	76,98	90,77	87,06	85,59	77,16	90,77	86,96	89,5	86,96	89,61	99,5	86,33
	Airport Connectivity	0,479	0,707	0,332	0,475	0,173	0,687	0,711	0,312	0,807	0,235	0,370	0,181
	Commute	2,572	2,271	3,705	2,535	1,950	2,006	2,680	1,641	2,224	3,278	n/a	2,832
Mentoring & Support	Networking and Mentoring Events	162	1140	245	227	121	1249	201	0	108	88	9	246
	Access to Accelerators	1	16	3	6	2	9	3	2	2	2	0	1
	Access to Business Angels	51	2732	n/a	624	78	2732	821	47	821	88	n/a	28
Entrepreneurial Culture	Government Policies	2,8	3	n/a	4,7	4,1	3	3,3	3,8	3,3	2,6	n/a	2,8
	Entrepreneurial Education at School Stage	2,9	2,7	n/a	3,5	2,7	2,7	3,1	2,9	3,1	2,5	n/a	2,5
	Willingness to Take on Risks	56,1	69,3	37,6	32,1	38,9	50,0	36,8	57,9	34,8	50,1	25,0	51,3
	Engagement with Digital Startup Ecosystem	14436	25081	2508	2771	622	27406	20965	332	3975	556	124	575
	Multicultural Diversity	14,37	15,35	1,75	13,90	13,59	15,93	10,14	23,44	9,16	1,39	8,41	13,39
Lifestyle	Standard of Living	127,50	151,08	122,59	170,94	169,69	165,40	134,27	153,71	118,57	134,40	148,60	163,99
	Tolerance	101	12	76	22	35	12	38	45	38	47	25	81
	Political Stability	-0,23	0,29	0,2	0,87	0,92	0,29	0,34	0,54	0,34	0,02	1,04	0,58
	Employment	20,6	16,7	4,9	8,5	6,2	16,7	11,1	10,2	11,1	6,1	3,5	10,5

The table A.3 shows the inputs raw data gathered (the units of measure for each value are referent to the previously mentioned on the indicators (table 4.5))

Table A.4 – Raw data in.

City	Population by City	Population by Country
Athens	3822843	10858018
Barcelona	5432802	46449565
Bucharest	2284200	19870647
Lisbon	2809168	10374822
Ljubljana	534518	2062874
Madrid	6385298	46449565
Milan	4290958	60795612
Nicosia	310355	847008
Rome	4342046	60795612
Sofia	1681666	7202198
Valletta	397752	429344
Zagreb	1247421	4225316

The table A.4 shows the values used for data standardization for each city.

Appendix 3 – Output raw data gathered

Table A.5 – Raw data out.

Theme	Variable	Athens	Barcelona	Bucharest	Lisbon	Ljubljana	Madrid	Milan	Nicosia	Roma	Sofia	Valletta	Zagreb
Startup Scene	Dynamism of Startups per Capita	0,006%	0,018%	0,015%	0,080%	0,028%	0,019%	0,011%	0,015%	0,005%	0,019%	0,024%	0,013%
	Dynamism of Startup Nationwide per Capita	0,004%	0,008%	0,003%	0,008%	0,010%	0,008%	0,003%	0,016%	0,003%	0,006%	0,024%	0,006%
	Contribution to the National Startup Scene	49%	25%	49%	53%	69%	33%	29%	35%	13%	78%	90%	63%
Finance	Availability of Early-stage Funding	66,12	61550,53	759,86	41893,48	1303,18	61550,53	27983,96	n/a	27983,96	2584,83	n/a	1122,54
	Availability of Late-stage Funding	1611,00	59042,34	2611,74	6758,66	651,67	59042,34	18831,77	n/a	18831,77	259,00	n/a	561,34
	Ease of Getting Credit	90	68	20	105	105	68	105	68	105	42	142	77

The table A.5 shows the outputs raw data gathered (the units of measure for each value are referent to the previously mentioned on the indicators (table 4.6))

Table A.6 – Raw data out.

City	Population by City	Population by Country	GDP (euros)
Athens	3822843	10858018	155969,3819
Barcelona	5432802	46449565	1001469,128
Bucharest	2284200	19870647	151842,2893
Lisbon	2809168	10374822	165800,5228
Ljubljana	534518	2062874	36188,40142
Madrid	6385298	46449565	1001469,128
Milan	4290958	60795612	1504656,773
Nicosia	310355	847008	16226,61827
Rome	4342046	60795612	1504656,773
Sofia	1681666	7202198	43092,24445
Valletta	397752	429344	8902,939505
Zagreb	1247421	4225316	41050,11769

The table A.6 shows the values used for standardization for each city

Variable	Athens	Barcelona	Bucharest	Lisbon	Ljubljana	Madrid	Milan	Nicosia	Roma	Sofia	Valletta	Zagreb
Number of startups (city)	234	954	334	429	147	1235	477	48	215	326	94	167
Number of startups (nationwide)	474	3759	688	811	213	3759	1659	138	1659	418	104	267

The table A.7 show the number of startups at city level and nationwide for each city. Resorting on the standardization bases (table A.6), these data was used to calculate the values for the following output variables: Dynamism of Startups per Capita and Dynamism of Startups Nationwide per capita