IASP International Association of Science Parks and Areas of Innovation

35th IASP World Conference
on Science Parks and Areas of Innovation 2018
Isfahan, Iran

The Evolution of Silicon Valley's Innovation Ecosystem: From 2006 to 2016.

Plenary session 6:

Entrepreneurship for growth and sustainability in STPs and AOIs

Authors:

Monica Botey
Josep Miquel Pique
Francesc Miralles

Hosted by:

ISFAHAN
SCIENCE & TECHNOLOGY TOWN
(ISTT)

ISBN: 978-84-09-17612-0

The Evolution of Silicon Valley's Innovation Ecosystem: From 2006 to 2016.

Monica Botey, Josep Miquel Pique* and Francesc Miralles
La Salle – Ramon Llull University
Sant Joan de La Salle 42 – 08022 Barcelona - Spain
Email: st09748@salleURL.edu
Email: jmpique@salleURL.edu
Email: fmiralles@salleURL.edu
*Corresponding author

ABSTRACT

Silicon Valley Innovation Ecosystem keeps finding ways to improve and become more efficient. We aim to understand *how* and *why* Silicon Valley evolves by identifying changes on the role played by the Triple Helix Agents (Universities, Government and Industry) from to 2006 to 2016. We also aim to identify if changes in one of the agents trigger evolution of the others.

From the startup perspective, we identify — applying case-study methodologies — how the role of Triple Helix Agents affects each stage of the startup development process. A qualitative study is based on key interviews and a quantitative study is included in order to validate the findings from the interviews.

By identifying the changes, we conclude that the role of the Triple Helix agents evolves over time and therefore the Innovative Ecosystem also evolves over time.

Keywords: Silicon Valley; Triple Helix; Clusters of Innovation; Evolution; Entrepreneurs; Startup; Corporates; Accelerators; Corporate Venture Capital.

Biographical notes:

Monica Botey is Master's in Information Technologies Management by La Salle - Ramon Llull University. Business Consultant at Catalonia Trade & Investment Agency for Silicon Valley markets from 2012 to 2017.

Josep Miquel Pique is President of the International Association of Science Parks and Areas of Innovation (IASP) and Executive President of Technova Barcelona La Salle - Ramon Llull University.

Francesc Miralles is Academic Dean of La Salle - Ramon Llull University and Director of the Innova Institute.

1. INTRODUCTION

Silicon Valley Innovation Ecosystem has been the topic of numerous studies, papers and articles for years. The highly successful entrepreneurial region is the main reference for those — mainly governments but also Universities and private institutions — willing to re-create a “Silicon Valley” in their homelands. Even though other innovation ecosystems are trying to catch up, Silicon Valley always seems to be one step ahead. While we have observed that weak-entrepreneurial ecosystems evolve — mainly in response to government incentives, regulations or funds — the evolution in strong-entrepreneurial ecosystems, such as Silicon Valley, and the effects in the startup development process remained unclear.

In this paper we study the evolution of the Silicon Valley Innovation Ecosystem from 2006 to 2016 focusing on the effects that these potential changes have in the startup. As a guide and baseline for our research, we will use the information collected in 2006-07 by del-Palacio (2009) for her PhD Thesis “The Capital For Small Technology Companies In Spain: Public Venture Capital To The Rescue?”. In her study, del-Palacio interviewed founders and CEOs to gather detailed data related to the support provided by University, Government and Industry (Triple Helix Agents; see 3.1.) in each stage of the startup development process (Inception, Launch, Growth, Maturity; see 3.3.) in Silicon Valley.

Following her model, we interviewed six founders and ten key experts to identify the main changes on the Triple Helix Agents role and try to determine if the evolution is driven by changes of one agent, forcing the rest to evolve.

As it was pointed out, almost all innovation ecosystems try to become ‘the new Silicon Valley’, different approaches with unalike results have been tried, from Singapore to Shenzhen, Chile or Barcelona. The results of this research may offer a guideline for other ecosystems to use in evaluating their initiatives for fostering technology entrepreneurship and to better respond to the changing needs of entrepreneurs and markets. Instead of copying what Silicon Valley does now, other ecosystems should look at the different stages Silicon Valley has gone through and identify which practices may apply to each innovative ecosystem based on its stage of development.

From 2006 to 2016, a lot has happen within the Silicon Valley. Facebook opened to everyone older than 13 years old in 2006 and Apple launched the first iPhone in 2007 which is considered the start of the digitalization era. By 2009, Dropbox and Airbnb were already operating after being accelerated at YCombinator. That same year, Google Ventures and Uber were funded. In 2012, while Facebook was filling its IPO, San Francisco started to see the benefits of the Payroll Tax Exclusion launched in 2011 to redevelop the Central Market Street & Tenderloin areas when Twitter — that had recently raised $400M — decided to keep its office in the city. While all these was happening, what were Silicon Valley Universities, Government and Industry doing to secure a new hype of successful entrepreneurs?

This paper begins with the state of the art; followed by a presentation of our research questions and approach; qualitative and quantitative information; data analysis and key findings; and finally, recommendations and areas for further consideration.

We based our analysis on three widely accepted models. The first is the Triple Helix (Etzkowitz, 2000) model, one of the most referenced models used to characterize an innovation ecosystem. The second is the general business development model which divides the startup process into four stages: inception, launch, growth and maturity (Freeman and Engel, 2007). Finally, we also use the Clusters of Innovation Components defined by Engel and del-Palacio (2009) to better understand the Silicon Valley Innovative Ecosystem.

The paper has two main parts. In the first part —qualitative approach — we characterize our analysis as a case-study research, we list the questions, set forth the hypotheses, define the units of the analysis and variables and explain how the interviews are conducted and how the results are interpreted. The results of this interviews include the analysis assessing the role played by the government, the university and the industry in each stage of development. The second part — quantitative approach — focuses on identifying the present actions and activities of the Triple Helix Agents, while allowing us to corroborate or contradict the findings on the qualitative approach. Specifically, we identified and compared the incentives (for public administration), type and source of investments (for industry) and new programs (for universities) established after 2006. We also considered other facts such as population, employment, housing or commute to better understand the region.

Finally, we present our findings, compare them to 2006 and draw our conclusions. The results of the analysis are presented in two forms: identifying changes and movements of the three agents of the Triple Helix compared to their roles in 2006; and a graphic to represent the relative support of the three agents in each stage of business development compared to 2006. We expect the agents to evolve, taking part of role of the others over time understanding how and why this happened.

2. GOALS

Silicon Valley has been at the top of Innovation Ecosystems for so many years now that many voices arise trying to identify why it will soon fail. But Silicon Valley seems to always recover and find a way to improve and tune its ecosystem in a way that its more efficient.

For Innovation Ecosystem *followers* it is easier: they study, analyze, compare, discuss and finally apply the “innovations” that were first implemented in Silicon Valley. But, *how and why Silicon Valley evolves without references?*

In this research, we aim to identify the changes on the role played by University, Government and Industry — the Triple Helix Agents — in a strong entrepreneurial environment such as Silicon Valley.

We also aim to identify if changes in one of the agents trigger evolution of the others.

To be able to do that, we established a timeframe: from 2006 to 2016; a unit of analysis: startups; and our research questions: (1) How have the University, Industry and Government’s role changed during the startup creation process in Silicon Valley during the last 10 years?; and (2) Why have they changed?

We will do our research from the startup perspective, asking entrepreneurs how Universities, Government and Industry affect their companies at each stage of the business development. The qualitative study will be backed up by key expert interviews. We will later proceed with the necessary quantitative study in order to corroborate or contradict the findings from the interviews. The quantitative study does not aim to be a collection of all the incentives, programs or regulation changes since 2006; since their existence does not prove their success. We have focused our research on those initiatives or programs identified by the interviewees.

The study will show trends and changes specifically on the IT sector. Biotech and MedTech companies were discarded from the beginning since its development process and necessities are specific and different from other sectors. Although hardware companies were not initially excluded, none was included in the analysis and therefore, we will not consider our results applicable to hardware startups neither.

3. STATE OF THE ART - FUNDAMENTAL THEORIES

We review relevant literature to define the academic framework of the study and to better delimit the present research. Following the model del-Palacio (2009) set in her thesis — “The Capital For Small Technology Companies In Spain: Public Venture Capital To The Rescue?”, and with the aim to compare our research with the results she established in 2009 — this research will be based on the same fundamental theories: Triple Model Helix and Clusters of Innovation (COI).

The Triple Helix model, defines an innovation system as a system of three interconnected components: the university, the industry and the government. This model is used to support the quantitative and qualitative analysis. Later, we will compare the role played by the three agents in a strong entrepreneurial environment such as Silicon Valley in a 10-year period.

We also use the COI components established by Engel (2015) in “Global Clusters of Innovation: Lessons From Silicon Valley” to deeper analyze the Silicon Valley Innovation Ecosystem.

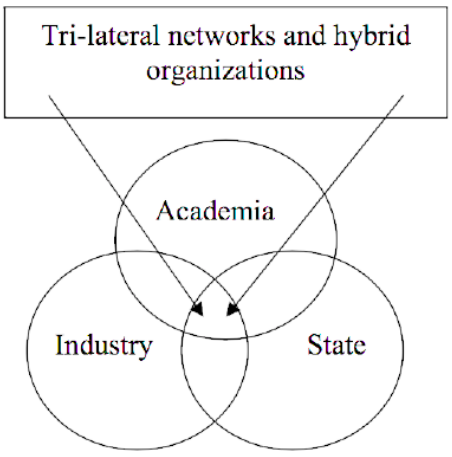
We will also introduce some general aspects related to the business development process and the investment stages related to each one (Freeman and Engel, 2007). We used this model to easily determine the development stage of the startups analyzed in the qualitative approach.

3.1. Triple Helix Model

The Triple Helix model, developed by Etzkowitz and Leydesdorff (2000) is one of the most referenced models used to characterize an innovation ecosystem. The Triple Helix thesis postulates that the interaction among university-industry-government is the key to improve the conditions for innovation in a knowledge-based society: (a) Industry operates as the center of production; (b) government as the source of contractual relations that guarantee stable interaction and exchange; and (c) the university as a source of new knowledge and technology.

The university has traditionally been viewed as a support structure for innovation, providing trained persons, research results, and knowledge to industry. Recently the university has increasingly become involved in the formation of firms, often based on new technologies originating in academic research.

Figure 1 - The Triple Helix Model of University-Industry-Government Relations



Source: Etzkowitz and Leydesdorff, 2000

The Triple Helix raised the university to an equivalent status in a knowledge-based society, unlike previous institutional configurations where it had a secondary status. Rather than being subordinated to either industry or government, the university is emerging as an influential actor and equal partner in a "Triple Helix" of university-industry-government relations.

As the behavior of each component in a system depends on the behavior of the others, government's role in the Triple Helix model is interdependent on the role played by the university and the industry within the same system. Triple Helix Agents play different roles in urban, economic and social development (Pique et al., 2018b)

A Triple Helix regime typically begins as university, industry, and government enter into a reciprocal relationship with each other in which each attempts to enhance the performance of the other. Then, usually starts collaboration among the institutional spheres most involve with innovation, taking place through their traditional roles.

The increased interaction among university, industry, and government as relatively equal partners, and the new developments in innovation strategies and practices that arise from this cooperation, are the core of the Triple Helix model of economic and social development.

The creation of new organizational formats to promote innovation such as the incubator, Science Park, and the venture capital firm are another result from the interaction among the Triple Helix Agents to promote innovation and are themselves an example of the Triple Helix collaboration.

The next step of development of the Triple Helix is that, in addition to performing its traditional tasks, each Triple Helix agent "takes the role of the other". This statement relates to the fact that, with time, each agent assumes some of the capabilities of the other while maintaining its primary role.

The case-study analysis that is developed in this research seeks to identify which new capabilities have assume each triple Helix Agent in a 10 years period in Silicon Valley. This approach have been applied in the evolution of other ecosystems of innovation as 22@Barcelona (Pique et al., 2018a).

3.2. Clusters of Innovation

Clusters of Innovation (COI) are global economic "hot spots" where new technologies germinate at an astounding rate and where pools of capital, expertise, and talent foster the development of new industries and new ways of doing business. A Cluster of Innovation is similar to, but somewhat different from, the well-established understanding of a business cluster (Freeman and Engel, 2007).

In a COI, the entrepreneurial process is a mechanism for continuous and rapid innovation, technology commercialization, business model experimentation and new market development, and the process is encouraged by a dense venture capital cluster and the related facility for the creation of well structured, funded and connected startups. In these environments, startups benefit from being co-located with other providers, including lawyers, bankers, venture capitalists and a myriad of consultants who are well versed in the needs of startups and small technology companies (Saxenian, 2006).

The emergence of clusters in new industries that do not benefit from agglomeration externalities indicates the presence of several factors that characterize a COI, namely, (1) new firm creation as a rapid and frequent mechanism for innovation, technology commercialization, business model experimentation and new market development, (2) staged risk taking and commitment of resources, (3) rapid market testing and validation

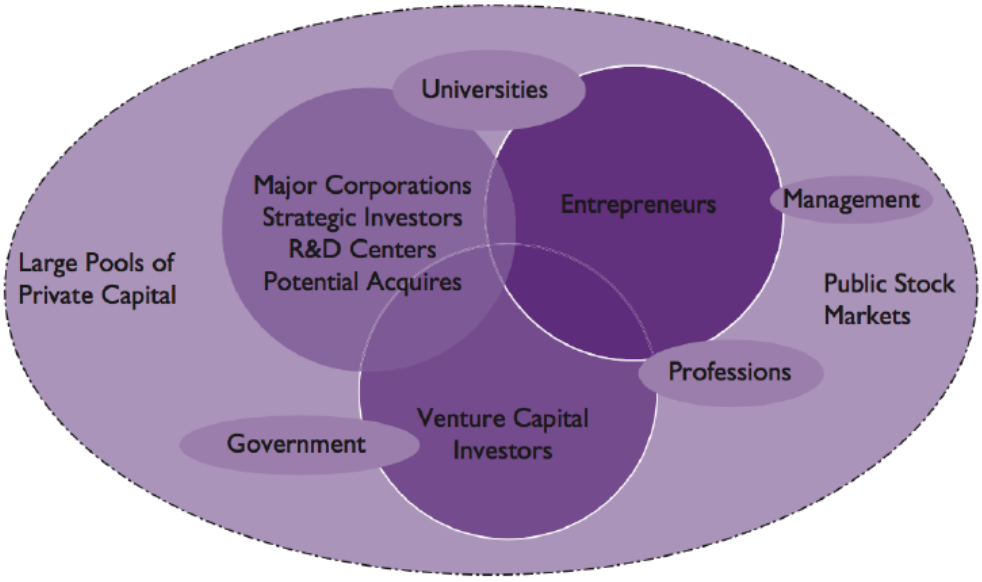
or failure, (4) tolerance of failure, (5) continuous recycling of people, money, ideas and business models, (6) intra- and inter-firm mobility of resources, (7) shared identities and values, (8) alignment of incentives and goals and (9) a global perspective (del-Palacio, 2009).

In 2009, Engel and del-Palacio (2009) extended Porter's definition of industrial agglomeration to delineate a Global Cluster of Innovation Framework that describes business clusters defined not primarily by industry specialization but by the stage of development and innovation of the cluster's constituents. While industry concentrations do exist, they are not definitive. It is rather the nature and the behavior of the components that is distinctive—the rapid emergence of new firms commercializing new technologies, creating new markets, and addressing global markets (Engel, 2015).

COI Components in Silicon Valley

According to Engel and del-Palacio (2009), the key components that identify the Silicon Valley aggregations are: entrepreneurs, venture capital investors, mature corporations and strategic investors, universities, government, R&D centers, and specialized service providers and management.

Figure 2 - The Innovation Engine of Clusters of Innovation



Source: Developed by Engel, 1995. Published in J.S. Engel, Global Clusters of Innovation: Entrepreneurial Engines of Economic Growth around the World (Northampton, MA: Edward Elgar Publishing Inc., 2014).

In the study from 2015 *Global Clusters of Innovation: Lessons From Silicon Valley,* Engel identified the main components of the COI in Silicon Valley as follows:

Three main components with an historic role:

I. Universities: In the early 1900s, the University of California at Berkeley, UC San Francisco and Stanford University, initially focused in practical disciplines such as agriculture, mining and mechanics, expanded to integrate business and education. Through their collaboration with private industry, the universities helped early high-tech firms flourish. Stanford Industrial Park (now Stanford Research Park) is an example of

this strong collaboration with large corporations such as General Electric, IBM, Eastman Kodak, Lockheed, Varian, and Hewlett-Packard.

II. Government: The long-term US government spending in Silicon Valley can be considered crucial in the early development of the Silicon Valley. Since the World War II the US military research programs, funded engineering efforts in universities (electronics at Stanford and high energy physics at UC Berkeley), national government laboratories, and private firms in Silicon Valley. The Bayh–Dole Act from 1980 changed the ownership of commercialization rights unlocking potential opportunities for universities, entrepreneurs and investors and starting a new wave of commercialization of government research.

III. Entrepreneurs: Silicon Valley workforce is not only highly educated (see 6.4.1. for further details), but extremely innovative and entrepreneurial. Silicon Valley entrepreneurs seek big scale opportunities and are willing to use high price capital to unlock their potential. Startups, and the entrepreneurs that drive them, are often highlighted in popular culture and have become cultural icons. (Freeman and Engel, 2007).

Other significant COI components:

IV. Venture Capital: Since their appearance after the firsts Silicon Valley based startups IPOs in 1956-58 (Varian, Hewlett-Packard and Ampex), Venture Capital investors have played a critical role in the inception and rapid growth of new ventures taking active involvement in governance, recruiting, and compensation policies.

V. Mature Corporations: Collaborations between mature corporations and startups can take many forms, from agreements, to investments, partnerships, or acquisitions. Silicon Valley corporations take full advantage of their past as startups engaging early with new ventures.

VI. Industrial Research Centers: The growth of Silicon Valley also attracted a broad spectrum of research centers, from Federally funded research labs (Lawrence Berkeley or Stanford Linear Accelerator), to R&D Private Centers (IBM, Xerox, Samsung or more recently Walmart or Baidu) along with independent R&D Centers spun out of universities such as Stanford Research Institute (SRI). This tendency keeps providing the Valley with top technical talent and technologies.

VII. Service Providers and Management: lawyers, accountants, design professionals, recruiting firms, investment bankers, incubators, and accelerators provide tailored professional services, while discounting or deferring their fees in exchange for a small share in the venture's eventual returns.

In this research, we will identify changes on Universities, Government, Entrepreneurs, Venture Capital and Mature Corporations activities during the last 10 years. This information will allow us to detect the evolution of the Cluster of Innovation.

3.3. The Entrepreneurial Venture: Periods of Development

As the company grows, it evolves and qualitative changes are often observed in its internal organization. Companies' development is determined by financial events and the exigencies or milestones that need to be achieved to move to the next financial event. Startups are financed through a series of staged investments where each stage of investment is designed to carry the venture to a higher level of achievement and validation, called a milestone (Freeman and Engel, 2007). Staged investments help investors minimize risk while increasing the valuation of the firm.

The Figure 3 assumes a great deal of good luck and much hard work on the part of entrepreneurs and investors alike. The scales for both dimensions vary substantially

across industries, business models, and organizational forms. The vertical dashed lines represent notable financial events.

These events drive changes in organizational structure and management activities

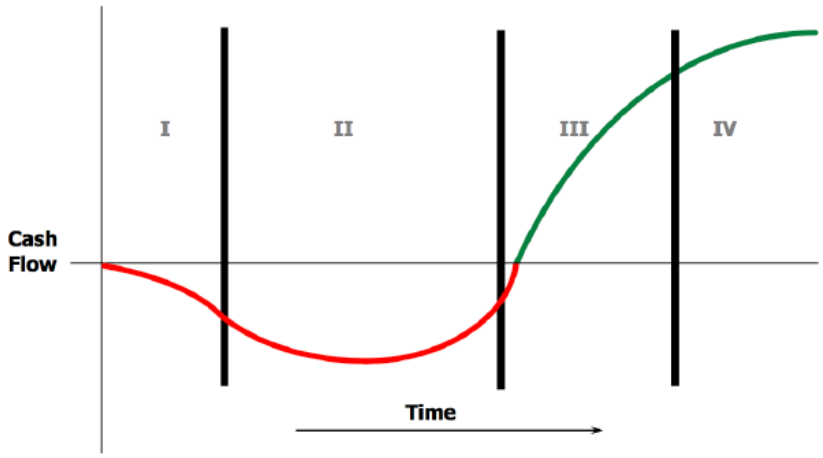
I. Inception or Pure Entrepreneurship: the process starts with a small founding event, which commits the founders' efforts to build a new business organization. *During/Prior to* this time, startups tend to be organic in structure; leadership resides with the inventors; business plans are developed and resources are gathered. The search of capital occupies a substantial portion of the founders' time. The fund is used to define the concept, build the team, determine the customers, analyze competitors and build prototypes. The period ends when prototype versions of the product or service are sold to customers, generating income.

II. Launch or Strategic Focus: The second period commences when the company begins to generate revenues from sales. The team grows and focuses on improving the product/service based on customers' feedback. Startups seeks its first round of institutional investment at this point. During this period, with the Venture capitalist investment, organizational routines are developed and formalized, a board of directors is created, and a experienced management team is hired. All these events leads to a dilutive effect on the equity position of the founders, often resisting loss of control and shifting from creativity to discipline. With continued success, product designs are finalized, marketing and sales efforts expanded, and business systems developed. As this process accelerates, cash flows turn positive ending this period.

III. Growth or Building Systems: Once the scalability of the product is validated, the company is able to successfully compete with older rivals. This is a period of structural development, managerial skill expansion, organizational routines and roles and build stable relations with suppliers and customers while growing the resources. Access to capital is required to fuel continued rapid growth, and to be ready to scale to large size.

IV. Maturity or Corporate Management: At this point, institutional investors usually want to get their money— including their returns on the successful investment—out. Often the exit strategy consists of one major "exit event" such as an IPO (Initial Public Offering) or an M&A (Merger and Acquisition) where the company is acquired. At this time, the full weight of financial regulation and fiduciary responsibility falls on the board and officers of the company.

Figure 3 - Evolution of the Entrepreneurial Venture



Source: Engel, from "The Innovative Organization" session held in June, 2017. Berkeley, CA

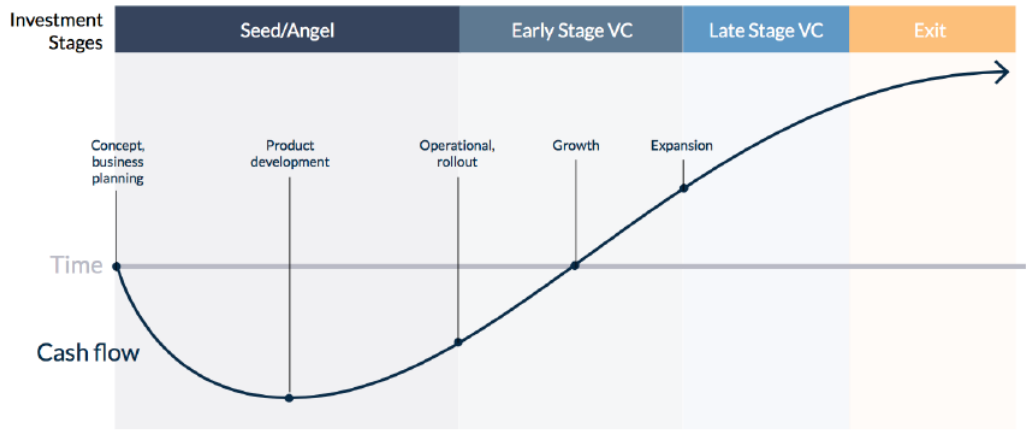
3.4. Investment Stages

Venture capital is the earliest stages of PE investment, typically when companies have little or no revenue. Companies that seek venture capital will often go through multiple financing rounds with different valuations. As the valuation and operating costs of the company should be theoretically be growing with every financing, each round tends to be bigger than the last.

We will now define investment stages following the PriceWaterhouseCoopers & CBInsight classifications. This classification is used for investment stages, not for startup development process. Note that when analyzing the capital deployed as Early, the company might be in either launch or growth stage according to the model expose above.

To clarify the scenery, we link every investment stage to the most frequent milestones venture capitalists expect to be achieved at the end of each investment period.

Figure 4 - Stages of Investment related to cash flow



Source: National Venture Capital Association - 2017 Yearbook, data provided by Pitchbook

I. Seed

The earliest stage of venture financing is known as the seed round, which usually involves a smaller amount of equity and lower valuations. Seed-stage financings are often comparatively modest amounts of capital provided to entrepreneurs to finance the early development of a new product or service. These early financings may be directed toward product development, market research, building a management team and/or developing a business plan. It is a pre-marketing stage and thus does not involve production for sale. Seed and Angel rounds are under Seed stage.

A round is labeled as angel when there are no PE or VC firms involved in the company to date and one cannot determine if any PE or VC firms are participating or if its stated as one by the company or investors press release. As for seed, when the investors and/or press release state that a round is a seed financing, or it is for less than $500,000 and is the first round as reported by a government filing, it is classified as such. If angels are the only investors, then a round is only marked as seed if it is explicitly stated.

After the company has begun to develop a prototype and a more comprehensive business plan, it will often seek additional capital through one or more early stage financings. Seed-stage VC funds will typically participate in later investment rounds with other equity players to finance business expansion costs.

II. Early-stage

For companies that are able to begin operations but are not yet at the stage of commercial manufacturing and sales. At this point, new business can consume vast amounts of cash.

Early stage venture rounds is where more established VC firms and corporations may begin invest, with seed-round investors usually continuing to play a role as well. Venture capital firms often provide their portfolio companies with resources, connections and advice but have less hands-on involvement. Rounds are generally classified as Series A. A round can be classified as Series A either by the series of stock issued in the financing or by the age of the company, prior financing history, company status, participating investors, and more.

The early stage can consists of different sub stages: startup and first stage. Startup financing provides funds to companies for product development and initial marketing. Usually at this stage, companies that have not yet sold their product in the marketplace. First-stage capital is used to initiate commercial manufacturing and sales. Most first-stage companies have a product or service in testing or pilot production. In some cases, the product may be commercially available.

III. Expansion Stage

The expansion or growth stage includes series B, C and others required to launch and grow the company. The company is probably still unprofitable at the beginning of this phase (expansion stage) but is likely to be thinking of an exit mechanism at the end of the stage.

Here, companies are producing and shipping products to customers and, although not required to be profitable, are likely to have real feedback from the market. The capital will be used for further plant expansion, marketing, working capital or development of an improved product.

IV. Late-stage

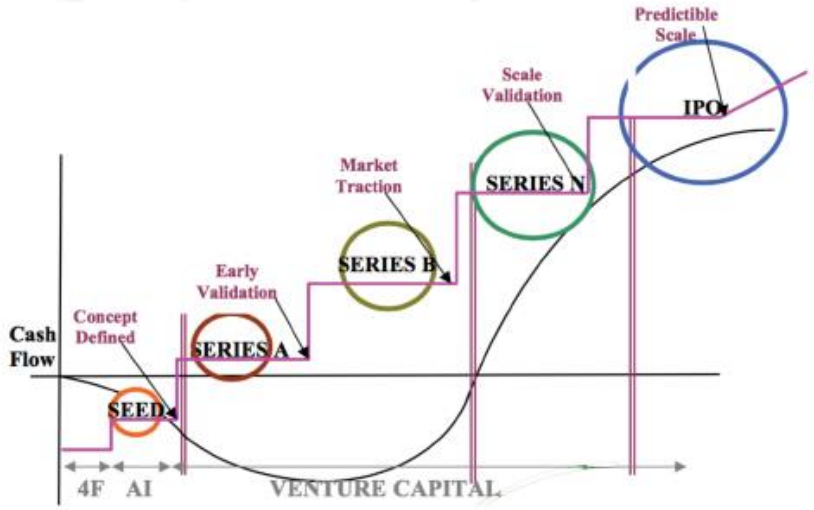
Rounds are generally classified as Series D or later. In this stage, capital is provided after commercial manufacturing and sales but before any initial public offering or for major expansion such as physical plant expansion, product improvement and marketing. The product or service is in production and is commercially available. The company demonstrates significant revenue growth, but may or may not be showing a profit.

V. Mezzanine (bridge)

Mezzanine Stage finances the step of going public and represents the bridge between expanding the company and the IPO. This stage is needed when a company plans to go public within six months to a year but needs more capital to sustain rapid growth in the interim. It can also involve restructuring major stockholder positions through secondary transactions. This happens when there are early investors who want to reduce or liquidate their positions or if management has changed and the stockholdings of the former management, their relatives and associates are being bought out to relieve a potential oversupply after going public.

The Figure 5, developed by del-Palacio in 2009, help us to link each noticeable financial event —represented in the figure by vertical lines — with the evolution of a startup's cash flow and the business development stages introduced above (3.3. The Entrepreneurial Venture: Periods of Development).

Figure 5 - New-venture funding stream: venture capital rounds, financing to milestones



Source: del-Palacio, 2009. (Adapted from Freeman and Engel (2008), based on Engel's lectures at UC Berkeley)

4. METHODOLOGY

4.1. Qualitative Approach

Qualitative methods included a combination of interviews, with startups and key informants; observations and document review. A total of sixteen interviews were made for the purpose of this study, mainly comprising in-person conversations and phone calls ranging from 40 to 90 minutes, some information was also gathered by email correspondence. The list of interviewees was based on recommendations and connections. The interviews were semi-structured, beginning with a set of open-ended questions and then allowing for free-form conversation.

We would like to know HOW and WHY the triple helix agents have evolved in the startup development process. When a research aims to answer “how” and “why” questions, when the investigators have little control over events, and the focus is posed on a contemporary phenomenon within some real-life context, case studies are the preferred research strategies (Yin, 1984).

In our specific research, the case study seeks to understand:

- *How have the University, Industry and Government’s role changed during the startup creation process in Silicon Valley during the last 10 years?*

- *Why have they changed?*

We include the university, industry and the government in the research questions following the principles of the Triple Helix Model (described in 3.1.), which shows that the roles of the three agents overlap and that therefore each one takes the role of the other with hybrid organizations emerging at the interfaces (Etzkowitz and Leydesdorff, 2000). We aim to understand how and why this overlap has changed over a 10 years period.

Hypothesis

The Triple Helix Model shows us that the roles of the three agents overlap and that therefore each one takes the role of the other. As the population and environment changes; and entrepreneurs and investors gain experience; we expect the Triple Helix Agents to adjust its roles.

- **Hypothesis 1:** The role of the agents in an Innovative Ecosystem evolves.
  Once we acknowledge the evolution of the innovative system through the changes on the role of the Triple Helix Agents, we aim to understand the motivation of the changes. Our goal is to understand if one agent changed first, forcing the rest to readjust, or, on the contrary, each one has evolve by itself.

- **Hypothesis 2:** The evolution is caused by the change of at least one agent, forcing the rest to evolve.

Units of Analysis: Silicon Valley Start-ups

We interviewed the founders and managers of 6 startups in Silicon Valley. The goal was to obtain data to analyze and compare the roles played by the Triple Helix agents in the start-up process and its evolution in the last ten years. The interviews were collected between March and July 2017.

As established by Robert Yin (1984) in his book about Case Study Research — in order to collect more compelling data and develop more robust study — we’ve conducted 6 case studies arranged within a multiple-case design.

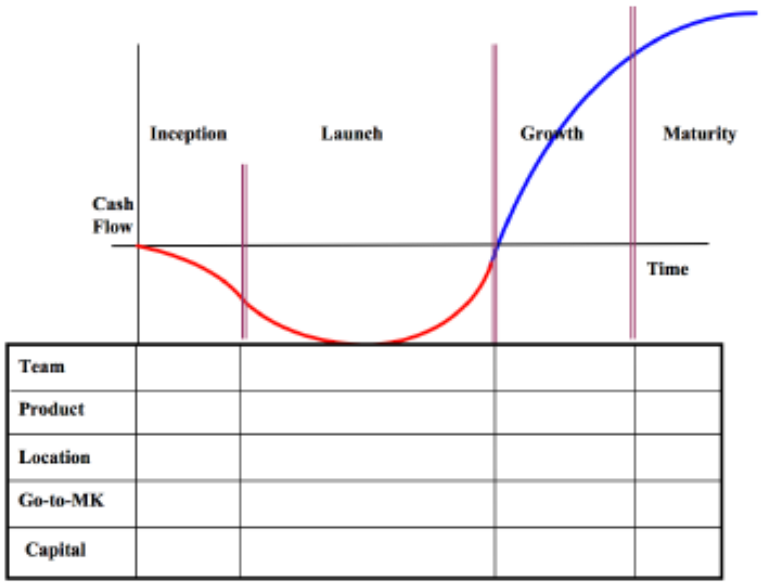
Tracks: Linking data to propositions

For a deeper analysis and in order to obtain comparable results with del-Palacio’s research, we focused on five core tracks of the business development process. The five tracks linking data to propositions are developed on Table 1 and Figure 6.

Table 1 - Tracks on the Business Development Process

Talent/Team	Educational and Professional Background Global Diversity, Mentality and Networks Organization of Human Capital Alignment of Roles and Functions
Technology	Research and Development Intellectual Property Rights Product and Production Resources
Location	Local/Global Space Technology Platforms
Evolution/Go to Market	Value Proposition, Business Model, Business Plan Local and International Sales Local and Global Customers Value Chain
Finance/Capital	Sources of Financing Conditions Domestic or International

Figure 6 – Business development stages and the analysis of the five tracks



Source: del-Palacio, 2009

The criteria for interpreting the findings

The data collected from the interviews is analyzed on the basis of the Triple Helix Model, Clusters of Innovation and Coevolutionary theory. In this study we identify the role played by universities, industry and government during the different stages of the start-up process. We also aim to identify the changes in the role of each agent in each stage of business development since 2007.

The results of the analysis are presented in two forms. On the one hand, we build a table that identifies the changes and movements of the three agents of the Triple Helix

compare with their roles in 2007. On the other hand, we build a table to represent the changes in the different tracks (talent, technology, location, go-to-market and capital) of the business development process. Finally, we create a graphic to represent the relative support of the three agents in each stage of business development compare with the representation from 2007.

4.2. Quantitative Approach

The goal of the quantitative study is to identify some hints on the changes while allowing us to corroborate or contradict the findings on the qualitative approach.

We analyzed the Triple Helix Agents: Public institutions, Universities and Industry. We also considered other facts such as population, employment, housing or commute in the study to better understand the changes.

Specifically, we identified and compared the incentives (for public administration), type and source of investments (for industry) and new programs (for universities) established after 2006.

5. QUALITATIVE RESEARCH: CASE STUDY

5.1. Interviews with Start Ups

In this research, we conducted in-depth personal interviews with 6 high-position founders or managers of startups to identify the support of and relationship established with universities, industries and government in each stage of business development. Interviews are very useful because they directly target the case-study topics and focus on causal inference (Yin, 1984).

Following del-Palacio's guidelines, the interviews were structured in three parts. First, we started the interview by introducing ourselves and by summarizing the goals of the study. Second, we asked the interviewees to introduce themselves and to give a short explanation of their company and technology. The third and most important part of the interview was the collection the data needed for answering the questions of this research. This last part was conducted through direct questions with the goal to fill out the data table while reporting additional information. The data table aims to collect information about the team, the technology, the location and the go-to-market strategy in each of the stages of the business development cycle (early stage, launch, growth and maturity).

Finally, we asked the interviewees about their views and observations about the evolution of the Silicon Valley during the last 10 years. This part allowed us to have a fluid conversation while collecting key information. The interviews took place between March and July 2017. All interviews were also recorded to ensure a more accurate attention to the interviewee and the conversation. The structured interviews became sometimes conversational in order to better understand 'how' the three agents of the innovation system provided support and 'why' it was beneficial. The role played by the university, the industry and the government has been identified for each company in the different stages of development.

5.2. Interviews with experts

As a part of the research, ten more interviews with key informants were conducted during the same period. These interviews were open-ended. The informants were ask about the facts of the matter allowing them to propose his or her own insight into

certain occurrences. Key informants are often consider critical for the success of a case study.

Key informants provide insights into a matter and also can suggest sources of corroboratory or contrary evidence. In order to avoid dependency or interpersonal influence it is important to be cautious and search evidence to corroborate or contradict the shared insights.

6. QUANTITATIVE RESEARCH: SILICON VALLEY INNOVATIVE ECOSYSTEM

The goal of the quantitative study is to identify some hints on the changes of the Triple Helix Agents — Public institutions, Universities and Industry — in the last 10 years. We also considered other facts such as population, employment, housing or commute in the study to better understand the changes.

6.1. Public institutions

Public Administration in the US has three levels: federal, State and local, either county or city. Each administration plays a different role in the Triple Helix Model.

All U.S. Public R&D Funds are controlled by the Federal Government. U.S. Government releases every year the total spending of the different agencies. As a general perspective, R&D Federal Funds have declined since 2006. Some agencies such as Department of Homeland Security or Environmental Protection Agency have seen the most drastic cuts, while Department of Energy (DOE) and National Science Foundation (NSF) are the agencies with major gains in this period.

Nuclear, efficiency, and renewable energy have all seen the greatest growth since FY2006.

The two main Federal funding programs for startups, SBIR and STTR, have remained stable. From 2007 to 2016, roughly 400 companies each year have been funded through these programs. To date, the Program has resulted in 70,000 issued patents, close to 700 public companies, and approximately $41 billion in venture capital investments.

NSF launched in 2013 the i-corps initiative to increase the impact of NSF funded research. The goal of this program is to encourage commercialization of science and technology through partnerships between academia and industry. The Bay Area Node is focused on helping early-stage teams which have a fundamental technology, engineering or business model innovation, by learning how define a scalable business model through the Customer Discovery process: Lean LaunchPad.

The State of California — a high-cost tax state — employs tax exemptions as a way to keep companies within the State. During the last ten years manufacturing, specially related to biotechnology, physical, engineering, and life sciences have been prioritized. Through modifications of the Federal R&D Tax exclusion, California is also securing high-skilled jobs.

The State direct support to its entrepreneurial ecosystem is through the iHub program launched by Governor Brown in 2013. The program run out of money leaving consortiums without resources to achieve their original plan.

At a local level, we have seen two different strategies. San Francisco has been highly competitive at attracting new businesses into the city through incentive programs such as the Central Market Street & Tenderloin Payroll Tax Exclusion. Although the program attracted new ventures into the city, and allowed them to maintain their offices there, the economic effects remain to be seen when the actual incentives finish by the end of 2018. If a high percentage of the attracted companies choose to keep their offices in the city, the project will be seen as a success. On the contrary, if most of them or the famous ones decide to move out, only the negative effects (gentrification, rise of housing prices, and mobility problems) will remain and the project will be seen as a failure.

On the other hand, San Jose has chosen to become a facilitator of technology on the streets, allowing emerging and consolidated companies to showcase or test their new technologies in a real environment. This also has allowed the city to reduce the cost of some expenses like lighting and Wi-Fi services. On May 2017, San Jose identified five corridors[8] to be used by companies as a demonstration site for Autonomous Vehicles technology.

Although we have not studied changes of Federal Policies, according to a recent study from Silicon Valley Bank, 26% of startups are prompted by U.S laws or regulations to locate facilities or move non-sales operations outside the U.S.

6.2 Industry

The main changes seen in the industry are the emergence of accelerator programs and the role that big tech corporations are taking in Silicon Valley.

While in 2007 there were just 2 accelerator programs in the US, by 2014 the number reached 170.

The leading accelerator programs include funding, which combined with training and access to powerful networks suggest a positive impact on the startups but their overall impact remains to be assessed. A clear benefit of these programs is the big increase of seed deals sealed.

Traditional Tech Corporations have been involved with startups. However, big tech companies that were startups 10-15 years ago are changing the “rules” by engaging sooner with startups.

Corporate Venture Capital funds (CVCs), Corporate Accelerators and acquisitions are the most popular ways of engagement, but also becoming early costumers, organizing hackathons or engaging in partnerships.

Despite the long time existence of CVCs, the present amount of funds is extraordinary. This growth is in part caused by traditionally non-tech buyers entering the market seeking innovation and technology: Walmart, L’Oreal, Unilever, 7-Eleven, Campbell Soups or General Mills have now their CVC program.

The immaturity of some of these CVCs is causing a high level of skepticism from some entrepreneurs and investors. As they keep their presence in the market, speak up their intentions and start leading some rounds, their role will consolidate as a mature agent of the ecosystem.

Corporations are following the trend of accelerators by creating their own programs. While models continues to evolve — most organizations are still experimenting with different ways of setting up and managing their accelerator initiatives — we will have to wait to see the real benefits of these initiatives.

As more accelerator programs appear, and angel investors are more organized and reachable, sources of investment for seed and early stages have increased rapidly. Some corporates are also participating at these stages to keep track on early development technologies.

While the number of seed and early stage deals is increasing — which is encouraging for new startups — the investment funnel in later stages is shrinking. We see now less deals but bigger share of the investment at expansion and later stages, therefore fewer companies are being funded with larger amounts of money.

We are also seeing less IPOs in Silicon Valley. High valuations of some Silicon Valley Tech companies including Uber, Dropbox or Zenefits are challenging their odds of a successful IPO, while their investors cannot cash out or even increase their investments.

VC Firms are also getting bigger with offices all around the US. Interestingly, those that did not have their headquarters in SV back in 2006, now have it. The amount of deals made in 2016 by the most active firms have almost doubled those in 2006, and more surprisingly two accelerators and some angel groups are on the top 15 in number of deals.

In 2016 the hot thematic areas of investment in the US were Artificial Intelligence, Cybersecurity and Auto Tech, but all of them saw a recede in invested dollars during the last quarter of the 2016 so they might change in 2017.

6.3 Universities

As young companies have been responsible for a majority of net job growth over the last couple decades, entrepreneurship has increasingly become a fundamental force at universities nationwide.

To attract the best aspiring entrepreneurs, many universities are thinking outside the box and expanding their offerings to support students across various programs. Universities are fostering entrepreneur-friendly environments through a combination of:

I. **Going beyond business students:** Students with an interest in entrepreneurship grow out of diverse industries. Schools need to provide the adequate resources outside their main course.

Some schools are integrating entrepreneurship courses in concentrations including engineering, medicine and journalism.

II. **Industry engagement:** more schools are teaming up with organizations, to allow students to gain experience by working at startups or venture capitalist firms.

III. **Experiencing fundraising:** As fundraising is one of the more difficult jobs as an entrepreneur, some universities are helping their students to master it through real practice.

IV. **Mingling departments/ Cross-campus collaborations:** In order to succeed in a business, people from different backgrounds and skills are needed. Universities are creating multidisciplinary programs were students from engineering, medicine, law or business work together in a project.

This initiative helps entrepreneurs meet peers and gain insight into how to work with them.

Universities are offering more and more ways for students to pursue an entrepreneurial path and at the same time, strengthen ties between University and future entrepreneurs. To achieve this, different approaches are being deployed: (1) Business/Lean Plan competitions or awards; (2) crossfaculty programs; (3) providing infrastructure through incubators and accelerators; and (4) promoting commercialization of science (i-corps).

Offices of Technology License (OTL) are also becoming more 'startup-friendly'. In 2006, OTLs did not consider creation of university related spin-off or technology transfer to a startup as a key indicator. Today, Silicon Valley universities include both as performance indicator in their annual reports. Even further, some Universities have developed specific programs to help their researchers or professors to pursue a business based on a OTL technology.

Through the prolific rise of University-backed VC Funds, Universities are also getting closer to investors and VC firms. Investing in their own students, researchers or professors ventures,

Universities are demanding their share in the seed/early round space. This also means, an increasing need to establish formal connections and relations with other investors to help their companies secure next rounds.

Universities and VC Firms are creating their own collaboration space. The Student Programs that some VCs run each year are just an example. Investors and VC firms also participate as a supervisors or advisors in affiliated VC Funds or Student Venture Funds.

Law firms are also partnering with university-related incubators or accelerators to provide free guidance to young companies, either directly or through the University's Law Faculty and students.

6.4 Other Facts

The addition of San Francisco to Silicon Valley, initially limited to Santa Clara County, has changed the demographics of the area.

The inclusion of San Francisco was not induced only by incentives given by the city from 2008.

Silicon Valley's younger generations, following the millennial demand of living in a "walkable city" (Florida, 2002) were forced to move to the closest: San Francisco — even if they had to do up to four hours commute per day.

San Francisco embraced this young population, and helped to create an environment to attract tech companies. The redevelopment of SOMA and Potrero Hills, and the widely criticized Payroll Tax Exclusions are some of the examples that have driven the city to lead job creation in Silicon Valley during the last 10 years. This has caused the known bad-effects of gentrification (Atkinson, 2004), and the creation of a New Economy in the inner city (Hutton, 2000, 2004).

The exponential growth of the main tech companies' workforce is a challenge for the area. While these companies are growing around Mountain View, Cupertino, Menlo Park and Santa Clara by building their own "private cities", the real cities and counties can not grow at same pace and provide the necessary infrastructure. Low housing availability and skyrocketing rent prices are coercing non tech employees to move further away or submit and pay unreasonable and highly unstable rents.

San Francisco and Silicon Valley have developed a synergy. Singles and couples with no children tend to live in the city. Once their family grow, they move out of the city to quieter and *family-friendly* areas like Palo Alto, Los Gatos or Mountain View.

A similar phenomena occurs to companies. Startups begin their journey in the city, where companies take advantage of social agglomeration factors such as critical masses of skills and relationships, access to information, and the availability of specific infrastructure (Utterback and Afuah, 1998; Hutton, 2004; Porter, 1995). Once their venture reaches a certain level (after early stage), they are forced to leave the city to grow on a cheaper and distraction-free environment.

The increase of movements between cities, neighborhoods and corporate-cities are collapsing the infrastructure, which is becoming a real problem in the area. It is important to notice that Bay Area was for decades a low densely populated area and its infrastructure is rather outdated. As O'Mara already pointed out in 2011, *"Silicon Valley may be a unique ecosystem for technology creation, but it falls short on many fronts in terms of functioning well as an urban place. It is haphazardly planned and economically polarized. It is crowded and car-dependent to a degree that lowers its quality of life and degrades the natural beauty that lured people there in the first place."*

Listening to their employees demands and usually against their corporate philosophy, some companies are recently opening small offices in San Francisco, or redesigning their campuses to look less like industrial parks and more like main streets of very hip and cosmopolitan small towns (O'Mara, 2016). As O'Mara pointed in the same article, being in a cool neighborhood helps with recruitment and retention. For example, different sources reported that Facebook is in talks for a space in SOMA district in San Francisco, considering this a "pilot" of a San Francisco office space.

All this job growth comes with an increase in base salary of high-skilled professionals. Increasing not only *per capita personal income* but also the disparity in Silicon Valley. But, the increase of personal income is also becoming the main problem for new ventures, which struggle to recruit their first employees.

Silicon Valley's population is growing less rapidly in recent years, primarily due to the large increase in net domestic out-migration. The region's birth rates remain relatively low, and the population has aged significantly over the past decade.

7. FINDINGS/RESULTS OF THE ANALYSIS

7.1. Evolution of the Triple Helix Agents

From the analysis of the data collected in the interviews, we can conclude that there are some general roles played by universities, industry and government in each stage.

From the analysis of data collected during interviews and validated by quantitative study, we can conclude that the role played by universities, industry and government have changed since 2006.

The summary of the findings are:

GOVERNMENT

As a general perspective, Federal R&D Funds have clearly declined and become more sophisticated since 2006. Now State Funds require consortium agreements, and

Universities can access to specific programs to promote commercialization of science. Main changes:

1. Investor: The government role as an investor is steadily shrinking in Silicon Valley; both startups (SBIR/STTR Funds) and universities (R&D Programs) are relying on private funds to develop their new technologies.

2. From Customer to Facilitator: We are seeing a shift in cities role from customers to facilitators. Cities are becoming technology platforms, allowing emerging and consolidated companies to showcase their new technologies in a real environment.

3. Policy Maker: According to Silicon Valley Bank, U.S Laws and Regulations affect 1 in 4 startups in the US.

Main drivers:

- Immigration: the collapse of the H1B Visa Program - defined to attract international talent - has caused a shortage of engineers forcing startups to move their engineering teams totally or partially abroad.

- The Tax Exclusion Program launched by the City of San Francisco, along with Millennials demands to live in a walkable city, has extended Silicon Valley (historically related to Santa Clara County) to the city.

- Housing regulations around San Francisco and Silicon Valley are not allowing enough construction to keep up with demand. This has raised the price of housing beyond a reasonable level, creating more separation between high-tech workers and the rest of the population

UNIVERSITIES

Universities are still the main place were entrepreneurs meet and decide to start a business. For long time, universities were not taking full advantage of this, loosing an opportunity to increase their revenue. During this period, we have seen universities taking new roles and embracing their entrepreneurs:

1. Actively promoting entrepreneurship: Universities are actively supporting their entrepreneurs both while they are students and after graduation. Through Business Plan/Lean competitions, awards, cross-faculties programs or clubs, universities are providing soft-skills to future entrepreneurs. With incubator and accelerator programs they are also providing the necessary infrastructure to begin a venture.

2. Investor: A rise on University-backed VC Funds is clear in Silicon Valley and California in general, mainly as a result of a $250Million Fund from the University of California. Additionally, universities also invest in their startups through affiliated VC Funds, Student Venture Funds and Accelerator Programs.

3. Strengthening ties with VCs and Investors: at least 9 VC funds in SV are running a student program involving students as scouters of new ventures in their campuses.

4. Source of knowledge, not only in their classic meaning. Universities, an especially their professors, have become a source of knowledge for investors that want to keep track on what is disruptive and feasible technologically speaking.

5. Source of entrepreneurs: Financial and corporate investors are approaching university labs or technology transfer units to find high-tech startups. Technology Transfer Offices are also including creation of startups as a performance indicator.

6. Promoting commercialization of science: Programs such as i-corps are moving research closer to private companies, increasing relationships with private sector.

INDUSTRY

The main changes seen in the industry are the emergence of accelerator programs and the role that big tech corporations are taking in Silicon Valley. Other movements are identify below:

- Startups:

1. Startups have now easier access to technical and marketing (digital) resources, such as cloud or Adwords. Technological infrastructure is also cheaper. These two events lead to cheaper and easier beginning for startups compared with thus starting in 2006.

2. Talent has become the most precious resource in Silicon Valley. It's always been precious but for startups is becoming more challenging to attract and retain engineers in their Silicon Valley teams.

3. Due to the shortage of engineers, startups are forced to move their engineering teams totally or partially abroad.

4. Growth has become the toughest stage. Companies have more competition (more companies are funded in seed&early stages), hiring is more expensive, and investment is concentrating in less companies in this stage.

5. Startups are more technical.

6. Raise of micro-multinationals: Silicon Valley IT startups establish subsidiaries abroad sooner than 10 years ago.

7. Lack of International Market strategy: Decisions to open overseas offices were based on merely economics (recruitment) or personal reasons, not responding to market assessment or strategy.

8. Entrepreneurs start their businesses everywhere but tend to move to Silicon Valley to grow.

9. Stronger ties with expert knowledge via the formalization of Advisory Boards.

10. Entrepreneurs are younger now than 10 years ago.

- Corporations:

11. New big tech companies are engaging sooner with startups: as an early costumer, investing through CVCs, accelerators, etc.

12. Some Silicon Valley investors question that early engagement of Corporates might have a negative effect on the ecosystem.

- Investment:

10. Venture Capital funds are more sophisticated, focusing in specific technologies and providing an array of other services to their companies.

11. Business Angels are more organized and syndicated.

12. Incubators have disappeared in favor of Accelerator Programs, which are considered an efficiency of the system.

13. Easier to get Seed&Early Funds: With more resources concentrated on Seed&Early stage (Business Angels, Corporations & accelerators) more startups are being funded.

14. Less risk in later stages: VCs are concentrating their investments in later stages, with larger investments in fewer companies, playing “Too Big to Fail” (Lazansky, 2017).

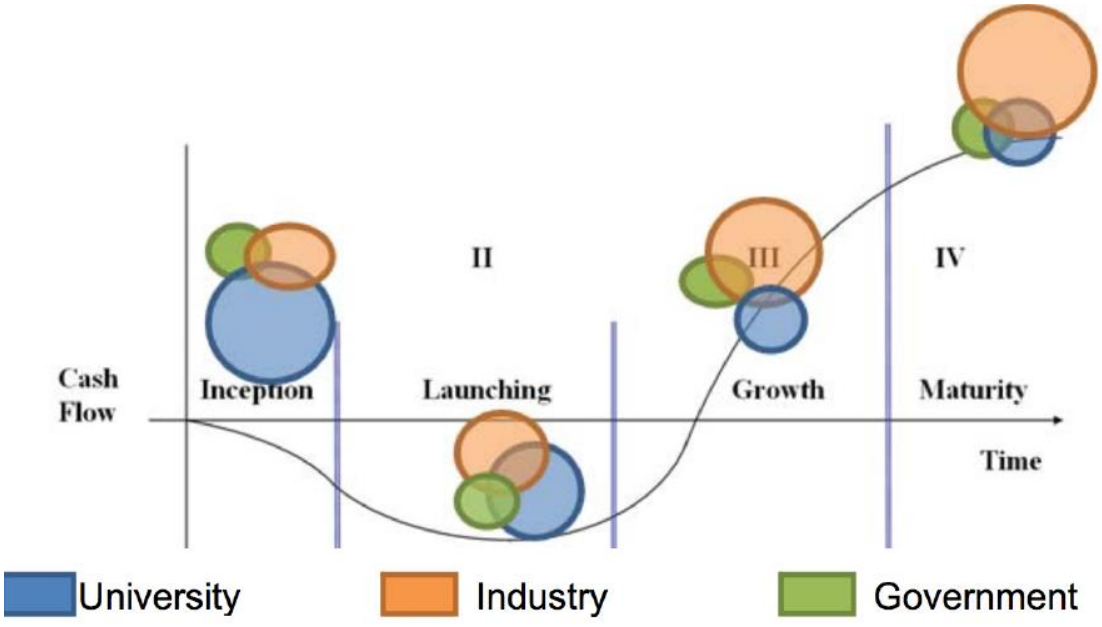
7.2. Evolution of the tracks with a Triple Helix perspective

In this part we will take a closer look at the changes identified above, identifying to which track and stage of development each one of them correspond. We will further analyze them by assigning to each one a level of change according to the following:

I. No-change: when the agent is keeping the same role. Some changes in the performance or development can apply, but the expected results by the agent are the same.
II. II. Incremental Change: the agent is developing the same role with a different approach or perspective. This may lead to bigger influence of the agent in one specific track and/or stage development
III. Disruptive Change: the appearance of a new agent, a new role or task developed by an agent not usually involved in that track and/or stage of development.

This will allow us to build a graph to represent the relative support of the three agents in each stage of business development in comparison with the graph from 2007.

Figure 7 - Relative importance of the three Agents at the Triple Helix Model for supporting the development of technology ventures in Silicon Valley in 2007



Source: del-Palacio, 2009

We expect the importance of these three agents as support providers to vary from one stage of the business development to another. The interviews showed that universities, industry and public administration play different roles at each stage of development of a new venture.

Inception: Universities keep their important role during the inception of companies. A new industry agent raised at this stage: Accelerators. Business Angels are also increasing the role of industry at inception stage. Government is trying to get closer to both universities and industry enlarging the collaboration area.

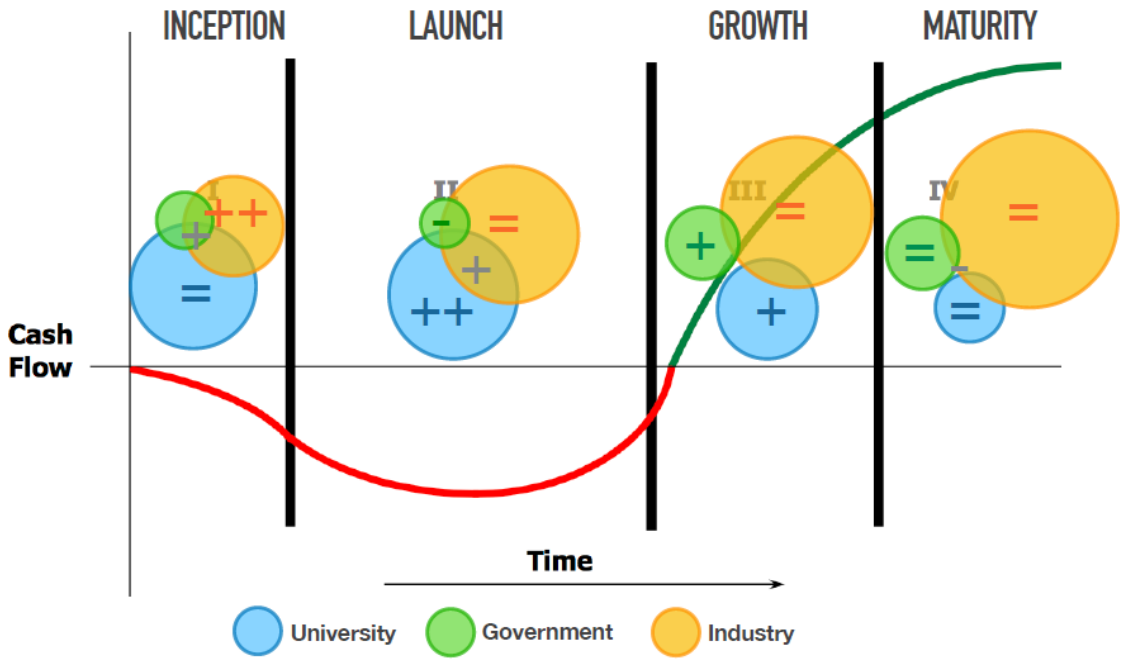
Launch: Few changes are observed in the relative importance of each agent in this stage. Universities and Industry are increasing their ties while government plays a relatively smaller role in this stage.

Growth: As companies grow, their necessities change and regulations start to affect them. Public administration has a slightly bigger influence in this stage: allowing companies to showcase their solutions in cities and through policy regulations. At this stage, Universities lose part of their influence but less than they did 10 years ago. Now, Universities keep ties with their startups longer through their VC Funds.

Maturity: Industry remains the most important agent at this stage. Administration keeps its role as a regulator while universities lose relevance. Less interaction between the three agents is identified compared with 10 years ago.

As a summary, when comparing both moments we find that relative importance of support provided by the three agents changed incrementally. This proves the evolution of the Triple Helix Agents; therefore, the evolution of the Innovation Ecosystem.

Figure 8 - Relative importance of the three Agents at the Triple Helix Model for supporting the development of technology ventures in Silicon Valley in 2017



8. CONCLUSIONS AND DISCUSSION

In this research, we have analyzed the support that Silicon Valley startups receive from Universities, Government and Industry throughout their Business Development Process and identified the incentives from public administrations; type and source of investments from the Industry; and new programs from universities, established after 2006. We have focused our research on Silicon Valley — a highly competitive Innovative Ecosystem — to determine how and why strong entrepreneurial ecosystems evolve with time. We also aim to identify if specific actions or events trigger evolution.

The study was developed in two parts. The first part use case-study methodology to compare the startup development process in Silicon Valley now and 10 years ago. A total of sixteen interviews — six of them with entrepreneurs and ten with key experts — compose this part. The second part analyzes the role of the Triple Helix Agents in Silicon Valley, compared with 10 years ago from a quantitative approach.

The Role of Triple Helix Agents Evolves Over Time

From the analysis of data collected during the interviews, we can conclude that the role of the triple helix agents evolved with time. The main changes identified during the study are (1) raise of accelerator programs as new player in the ecosystem; (2) early engagement of some corporations with startups; (3) geographical expansion of Silicon Valley, now including San Francisco; (4) increasing commitment of universities with capital funds; and (5) raise of micro-multinationals due to talent shortage and fierce competition in the area. Other changes have helped to increase the efficiency of an already highly innovative ecosystem.

The Rise of Acceleration Programs

While in 2007 there were just 2 accelerator programs in the US, by 2014 the number reached 170, more than 20 in Silicon Valley. The leading accelerator programs include funding, which combined with training and access to powerful networks suggest a positive impact on the startups. Their overall impact still remains to be assessed. By now, the clear benefit of accelerator programs is a big increase of seed deals sealed. In 2016, two accelerators were on the top 15 list of the most active US VC Firms by number of deals.

Big Companies Engage Sooner With Start Ups

Big tech companies that were startups 10-15 years ago are changing the “rules” by engaging sooner with startups. Corporate Venture Capital funds (CVCs), Corporate Accelerators and acquisitions are the most popular ways of engagement.

Despite the long-time existence of CVCs, the present amount of funds is extraordinary, including traditionally non-tech companies such as 7-Eleven or Walmart. Regardless the high performance of some of them: Intel or Google Ventures (GV); the immaturity of other CVCs is causing a high level of skepticism from some entrepreneurs and investors. Overall, we expect that CVCs will consolidate as a mature agent of the ecosystem in the near future.

Accelerator programs is another way corporates engage with startups. Since most organizations are still experimenting with different ways of setting up and managing their accelerator initiatives — either running the program in-house or outsourcing its administration to a partner such as Techstars, LMarks, or Nest — we will have to wait to see the real benefits of these initiatives.

Shifts within Investment Stages — Less chances to become a Unicorn

Investors have also advanced. Business Angels are becoming more organized and syndicated which is helping to spread their work and professionalize their role. On their side, VC Firms are focusing in specific technologies while providing an array of other services to their companies.

As more accelerator programs appear; angel investors are more organized and reachable; and corporates invest on early development technologies, sources of investment for seed and early stages have increased rapidly. But, while the number of seed and early stage deals is increasing, the investment funnel in later stages is shrinking, turning growth stage as the most difficult for startups.

Now, VC Firms as “Playing too big to fail” (Lazansky, 2017). Now, we see less deals but bigger share of the investment at expansion and later stages, therefore fewer companies are being funded with larger amounts of money.

San Francisco & Silicon Valley Synergy

All these changes concurred with Millennials reaching an adult live and demanding to live in a walkable city. The City of San Francisco embraced this young population, and helped to create an environment to attract tech companies. The redevelopment of SOMA and Potrero Hills, and the widely criticized Payroll Tax Exclusion Program are some of the examples that have extended Silicon Valley (historically related to Santa Clara County) to San Francisco. Although the Payroll Tax Exclusion Program attracted new ventures into the city, and allowed them to maintain their teams there, the

economic effects remain to be seen when the actual incentives finish by the end of 2018.

By now, this has caused the known bad-effects of gentrification (Atkinson, 2004), and the creation of a New Economy in the inner city (Hutton, 2000, 2004).

Some corporations, listening to their employees demands and usually against their corporate philosophy, are recently opening small offices in San Francisco. Being in a cool neighborhood helps with recruitment and retention (O'Mara, 2015).

We are also seeing a shift in cities' role from customers to facilitators. Cities like San Jose are becoming technology platforms, allowing emerging and consolidated companies to showcase their new technologies in a real environment.

All being said, San Francisco and Silicon Valley seems to have developed a synergy: singles and couples with no children tend to live in the city, once their family grow, they move out of the city to quieter and family-friendly areas. A similar phenomenon occurs to companies: startups begin their journey in the city, where companies take advantage of social agglomeration factors, once their venture reaches a certain level (after early stage), they leave the city to grow on a cheaper and distraction-free environment.

Universities are getting closer to Industry

Universities are offering more and more ways for students to pursue an entrepreneurial path — Business/Lean Plan competitions and awards; cross-faculty programs; incubators and accelerators; commercialization of science — and at the same time getting closer to investors and VC Funds through the prolific rise of University-backed VC Funds. Investing in their own students, researchers or professors ventures, Universities are demanding their share in the seed and early round space.

This also means an increasing need to establish formal connections and relations with other investors to help their companies secure next rounds.

Through the i-corp Program — a Federal Program that promotes commercialization of science — Universities are increasing their relationship with companies and markets.

Offices of Technology License (OTL) are also becoming more 'startup-friendly' with the inclusion of spin-off companies or technology transfer to startups as key indicators. Other Universities have developed specific programs to help their researchers or professors to pursue businesses based on OTL technologies.

The Rise of Micro-Multinationals

Talent, main driver of Silicon Valley's growth and success is becoming a challenge, specially for new startups that struggle to recruit their first employees. The recent collapse of the H1B Visa Program — defined to attract international talent — and the exponential growth of the main tech companies' workforce has caused a shortage of engineers that have seen an increase of base salary over the average.

New startups are inclined to move their engineering teams partially abroad. Other entrepreneurs are following a different path, starting their companies elsewhere and moving to Silicon Valley to grow.

Both models seems to replicate the Israeli model, followed also by most of international companies when entering in Silicon Valley. These might lead to a change in the type of companies seen in Silicon Valley in the near future where less engineers will be needed, and only the core of the company — founders, business development and design team — will be in Silicon Valley.

Final Conclusions

Hypothesis 1: The role of the agents in an Innovative Ecosystem evolves.

Through the changes identified in this study, we can conclude that the role of triple helix agents have evolved over time in Silicon Valley. Since the Triple Helix Model is used to characterize an Innovative Ecosystem, we can extrapolate that the Innovative Ecosystem also evolves over time.

Hypothesis 2: The evolution is caused by the change of at least one agent, forcing the rest to evolve.

We cannot conclude if the changes are driven by the evolution of one of the agents or if each one of them evolved by its own. The information collected through interviews and qualitative report does not show an specific event that triggered changes on the rest.

A further analysis in this field could result interesting for future studies since it will allow us to identify the ties and connections between the Triple Helix agents. Further studies are also needed to determine the impact of accelerator programs and Corporate Venture Capital Funds. Even though this study helps to identify evolution in Innovative Ecosystems, additional analysis may be needed to further clarify their stages of development and their characteristics (Etzkowitz and Klofsten, 2005 and Etzkowitz and Dzisah, 2008). Similar comparisons in weak entrepreneurial ecosystems might be interesting since more changes are expected in less advanced innovative ecosystems.

REFERENCES

Atkinson, R. (2004). The evidence on the impact of gentrification: new lessons for the urban renaissance?. *International Journal of Housing Policy*, 4(1), 107-131.

Atuesta, M., de León, A. D. D. P., Monroe, M., & Womack, R. Redevelopment in the Central Market and Tenderloin. Available at: http://karenchapple.com/wp-content/uploads/2015/06/Redevelopment-in-the-Central-Market-and-Tenderloin.pdf

Barrehag, L., Fornell, A., Larsson, G., Mårdström, V., Westergård, V., & Wrackefeldt, S. (2012). Accelerating success: A study of seed accelerators and their defining characteristics. *Bachelor Thesis TEKX04-12-10 Chalmers University, Sweden*.

Bathelt, H., Malmberg, A., & Maskell, P. (2004). Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in human geography*, *28*(1), 31-56.

Bugliarello, G. (2004). Urban knowledge parks, knowledge cities and urban sustainability. *International Journal of Technology Management,* 28(3-6), 388-394.

Eesley, C. E., & Miller, W. F. (2012). Impact: Stanford University's Economic Impact via Innovation and Entrepreneurship. Available at http://engineering.stanford.edu/sites/default/files/Stanford_Alumni_Innovation_Survey_Report_102412_1.pdf

Chesbrough, H. W. (2002). Making sense of corporate venture capital. *Harvard business review*, *80*(3), 90-99.

Chesbrough, H., & Tucci, C. L. (2002). Corporate venture capital in the context of corporate innovation (No. CSI-REPORT-2005-001). Available at https://www.researchgate.net/publication/37421748_Corporate_Venture_Capital_in_the_Context_of_Corporate_Innovation

Costa, P., Magalhães, M., Vasconcelos, B., & Sugahara, G. (2008). On 'creative cities' governance models: a comparative approach. *The Service Industries Journal*, *28*(3), 393-413.

Cohen, S., & Hochberg, Y. V. (2014). Accelerating startups: The seed accelerator phenomenon.

Cohen, S. (2013). What do accelerators do? Insights from incubators and angels. *Innovations: Technology, Governance, Globalization*, *8*(3-4), 19-25.

Del-Palacio, I. (2009). The Capital Gap for Small Technology Companies in Spain: Public Venture Capital to the Rescue?. PhD Thesis.

Engel, J. S. (2015). Global clusters of innovation: Lessons from Silicon Valley. *California Management Review*, 57(2), 36-65.

Engel, J. S. (2014). *Global clusters of innovation: Entrepreneurial engines of economic growth around the world*. Edward Elgar Publishing.

Engel, J. S., & del-Palacio, I. (2009). Global networks of clusters of innovation: Accelerating the innovation process. *Business Horizons*, 52(5), 493-503.

Engel, J.S. & del-Palacio, I. (2011). Global Clusters of Innovation: the case of Israel and Silicon Valley, *California Management Review*, 53(2), pp. 27-49.

Etzkowitz, H. (2008). The triple helix: university-industry-government innovation in action. Routledge.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and “Mode 2” to a Triple Helix of university–industry–government relations. *Research policy*, *29*(2), 109-123.

Etzkowitz, H. & Klofsten, M. (2005). The Innovating Region: Toward a Theory of Knowledge- Based Regional Development, *R&D Management*, 35(3), 243-255

Etzkowitz, H. & Dzisah, J. (2008). Unity and Diversity in High-Tech Growth and Renewal: Learning from Boston and Silicon Valley, *European Planning Studies,* 16(8), 1009-1024

Etzkowitz, H., Solé, F., del-Palacio, I. & Piqué, J.M. (2008). Science Parks as Global Entrepreneurship Platforms, *XXV IASP World Conference on Science and Technology Parks*, Johannesburg (South Africa)

Etzkowitz, H., Solé, F., & Piqué, J. M. (2010). The creation of born global companies within the science cities: an approach from triple helix. *Engevista*, *9*(2), 149-164

Fan, J.S. (2016). Catching Disruption: Regulating Corporate Venture Capital. Legal Studies Research Paper No. 2016-25. University of Washington School of Law.

Florida, R. (2002). *The Rise of the Crative Class–and how it’s transforming work, leisure, community and everyday life*. New York.

Freeman, J., & Engel, J. S. (2007). Models of innovation: Startups and mature corporations. *California Management Review*, *50*(1), 94-119.

Granovetter, M. S. (1973). The strength of weak ties. *American journal of sociology*, *78*(6), 1360-1380.

Hathaway, I. (2016). Accelerating growth: Startup accelerator programs in the United States. *Advanced Industry Series*, (81) Henton, D. (2000). A Profile of the Valley's Emerging Structure, In Lee, C.M.; Miller, W.F.; Hancock, M.G. & Rowen, H.S. The Silicon Valley Edge: A Habitat for Innovation and Entrepreneurship, Stanford, CA: Stanford University Press

Hutton, T. A. (2000). Reconstructed production landscapes in the postmodern city: applied design and creative services in the metropolitan core. *Urban Geography*, *21*(4), 285-317.

Hutton, T. A. (2004). The new economy of the inner city. *Cities*, *21*(2), 89-108.

Jahnke, A. (2015). *Who picks up the tab for science*. *BU Today*.

Lee, C. M. (2000). *The Silicon Valley edge: A habitat for innovation and entrepreneurship*. Stanford University Press.

Lever, W. F. (2002). Correlating the knowledge-base of cities with economic growth. *Urban studies*, *39*(5-6), 859-870.

Nelson, R. R. (1994). The co-evolution of technology, industrial structure, and supporting institutions. *Industrial and corporate change*, *3*(1), 47-63.

O'mara, M. (2011). Silicon Valleys. *Boom: A Journal of California*, *1*(2), 75-81.

Pique, J.M., Miralles, F. & Berbegal-Mirabent, J. (2018a). Areas of Innovation in Cities: The evolution of 22@Barcelona*. International Journal of Knowledge-Based Development,* In Press.

Pique, J. M., Miralles, F., Teixeira, C. S., Gaspar, J. V. & Ramos Filho, J. R. B. (2018b). Application of the Triple Helix Model in the revitalization of Cities: the case of Brazil. *International Journal of Knowledge-Based Development,* In Press.

Porter, M. E. (1995). The competitive advantage of the inner city. *Harvard business review*, *73*(3), 55-71.

Pratt, A. C. (2008). Creative cities: the cultural industries and the creative class. *Geografiska annaler: series B, human geography*, *90*(2), 107-117.

Saxenian, A. (2007). *The new argonauts: Regional advantage in a global economy*. Harvard University Press.

Utterback, J. M., & Afuah, A. N. (1998). The dynamic 'diamond': a technological innovation perspective. *Economics of Innovation and New Technology*, *6*(2-3), 183-200.

Weiblen, T., & Chesbrough, H. W. (2015). Engaging with startups to enhance corporate innovation. *California Management Review*, *57*(2), 66-90.

Williamson, O. E. (1981). The economics of organization: The transaction cost approach. *American journal of sociology*, *87*(3), 548-577.

Williamson, O. E. (1985). *The economic institutions of capitalism: firms, markets, relational contracting*. Free Press.

Yin, R.K. (1984*). Case Study Research: Design and Methods*. Beverly Hills, CA: Sage Publications.