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The Silicon Formula: Mixing engineering, finance and passion to change the world.

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Abstract

Over the last 60 years Silicon Valley has become the world's leading cluster of innovation by a significant margin. With humble origins but with the benefit of hosting the mighty Stanford University, Silicon Valley emerged as the unexpected victor in its race with Boston Route 128 to occupy the throne as the leading hub of technological innovation in the world. Silicon Valley developed a unique style and business mentality, encouraged entrepreneurial activity and was able to attract capital, talent and companies like no other place on earth. And even more significantly, it led a revolution that transferred enormous amounts of power from big corporations to individuals and small teams, in a tectonic movement that came to define the 'old' and the 'new' way of doing business. The purpose of this paper is to help understand the phenomenon of Silicon Valley through the analysis of its evolution and of the key factors that have enabled it to reach the position it has today, assess its resilience and potential decline, comment on the aspects that must be taken into account by aspiring clusters in order to succeed, and reflect on the significance of Silicon Valley beyond its material aspects.

An evaluation of the timeline of Silicon Valley reveals the relevant parties in the Valley's ascent such as Stanford University, the US Government and specific companies and individuals. The paper identifies and analyzes the subtle combination of 11 elements that gives Silicon Valley its unique character and vitality. Also, it recognizes the importance of the quality of the location of clusters, based on the analysis of existing and emerging clusters around the world, giving a warning sign against efforts to design and manufacture new clusters in isolation, starting almost from scratch.

An analysis of the current situation of Silicon Valley addresses an intriguing paradox: growing venture capital investment and increasing strength of its companies going hand in hand with fewer venture capital deals and a lower rate of startup creation, and goes on to assess its potential transformation or decline. The paper also reflects on the future of innovation, the significance of Silicon Valley as a model and symbol of a better way of doing things and its transformational effect, which transcends what meets the eye when you get to the 'Valley', no matter how impressive this may seem to you.

Resumen

A lo largo de los últimos 60 años, 'Silicon Valley' se ha convertido en el 'cluster' de innovación más importante del mundo, con gran diferencia. Partiendo de orígenes humildes pero con la gran ventaja de albergar a la poderosa universidad de Stanford, 'Silicon Valley' resultó inesperado vencedor en su carrera frente a la Ruta 128 de Boston para decidir quien iba a ocupar el trono como principal centro de innovación en el mundo. 'Silicon Valley' desarrolló un estilo y una mentalidad de negocio diferentes, alimentó el emprendimiento y fue capaz de atraer inversión, talento y empresas como ningún otro sitio en el mundo. Aún más importante, 'Silicon Valley' lideró una auténtica revolución que se materializó en una enorme transferencia de poder desde las grandes corporaciones a las personas y a los

equipos pequeños, provocando un auténtico terremoto que ha venido a definir lo que hoy entendemos como formas antiguas y modernas de hacer negocios. El propósito de este trabajo es ayudar a entender el fenómeno de 'Silicon Valley' a través de un análisis de su evolución y de los factores clave que le han permitido alcanzar la posición que tiene hoy, valorar su capacidad de resistencia y posible declive, comentar los elementos que los posibles 'clusters' del futuro deben tener en cuenta para tener éxito y reflexionar sobre el impacto de 'Silicon Valley' como idea más allá de los aspectos materiales.

La valoración de la secuencia histórica de 'Silicon Valley' revela las piezas relevantes en su ascenso, como fueron la universidad de Stanford, el gobierno de los Estados Unidos y una serie de compañías y personas que dejaron su impronta. El trabajo identifica y analiza la sutil combinación de 11 elementos que confiere a 'Silicon Valley' su carácter y vitalidad. Además reconoce la importancia de la localización de los 'clusters', basándose en el análisis de 'clusters' consolidados y emergentes de todo el mundo, y manda una señal de advertencia frente a los intentos de diseñar y construir nuevos 'clusters' aislados, casi partiendo de cero.

El análisis de la situación actual de 'Silicon Valley' nos pone frente a una inquietante paradoja: cada vez hay más inversión en 'Silicon Valley' y sus compañías son más fuertes y, sin embargo, cada vez se hacen menos operaciones y el ritmo de creación de 'startups' ha bajado. A partir de esta paradoja se plantea el futuro del 'Valley'. Además, el trabajo reflexiona sobre el futuro de la innovación, sobre la trascendencia de 'Silicon Valley' como símbolo y modelo de una manera mejor de hacer las cosas y sobre sus efectos como factor de cambio, que van mucho más allá que lo que uno ve cuando llega al 'Valley', por muy impresionante que esto sea.

Introduction

I chose this topic for three reasons. First, I had a preexisting interest in technology and technology companies, as well as in their products and innovations. I was eager to explore why so many of the companies that lead the software, hardware, and applications industries are based in a valley, that up until not very long ago, produced apricots instead of Apples.

Second, I had the opportunity to live and work in San Francisco from July to December of last year. My time in San Francisco was eye-opening and one of the reasons I wanted to delve deeper into what makes the Bay Area so special. Working at L.E.K. Consulting, I was involved in many projects with tech-based companies and products, which gave me great exposure to the cutting-edge tech being developed in Silicon Valley. Also, I met a number of people outside of work that were working for companies like Airbnb or Uber, or smaller startups in the city and I was fascinated with what they told me they were working on. I even met a few CEOs of startups, not much older than me and was mesmerized by the drive and passion they possessed.

The third reason for choosing this topic was my belief that the approach to business, management, and innovation of Silicon Valley will be more and more influential in our careers as time goes on so understanding the ecosystem is extremely valuable.

There were three questions I wanted to address in this paper: “What are the factors of Silicon Valley’s success as a Cluster of Innovation?; how replicable are these factors?; and how likely it is for Silicon Valley to be displaced from its position of leadership?” I have attempted to answer these questions through the analysis of various types of sources. I have analyzed multiple databases such as the Silicon Valley Index, Global Cities Index, and the PwC MoneyTree Venture Capital Report. I have analyzed secondary sources on the topic such as articles, books, and studies, and drawn my own conclusions from the literature. I have used a specific methodology developed by N. Esmaeilpoorarabi et al., to analyze the quality of locations. I have also factored in conversations I have had with industry players and people familiar with the Valley’s ecosystem. It is worthwhile to mention that the literature on the subject of Silicon Valley is seldom holistic and tends to focus on specific factors that make the Valley successful as opposed to giving a fuller picture, as I have tried to do in this paper.

I have structured the paper in five main sections. The first section explores the origin of Silicon Valley and discusses the importance of certain figures and institutions in the region’s early history. The second section aims to dissect all the factors and their unique combination that have made Silicon Valley the successful cluster it is today. These factors are divided into two categories, hard factors (venture capital; academia & research labs; government; private business; people; specialized support services; and infrastructure) and soft factors (lifestyle; business mentality; networking & mentoring; and approach to failure). The third section evaluates the place quality of existing clusters, something highly influential in the appeal of a cluster and extremely difficult to manufacture. The fourth section reflects on the current situation of Silicon Valley and evaluates a possible decline. The fifth and final

section contains my final remarks on Silicon Valley, on the development of other clusters and the potential for a newcomer to have a comparable impact and replace Silicon Valley as the epitome of innovation.

1. Understanding Silicon Valley (SV)

Just as Steve Jobs once said to Leslie Berlin, the author of the book *The Man behind the Microchip*, “you cannot understand what happens here without knowing what came before it” (Berlin, 2005, p.1).

1.1. Trailblazers and events that sealed the fate of SV

Until midway through the 19th century the Santa Clara Bay, just South of San Francisco, was known as ‘The Valley of Heart’s Delight’ for its abundant production of apricots and other fruits. All that changed once William Shockley chose Mountain View as the desired location for Shockley Semiconductor Laboratory (SSL) in 1956.

Shockley

William Shockley was born in London in 1910 but was raised in Palo Alto since the age of three. After having studied in both Caltech and MIT, Shockley began to work in Bell Labs in New York just before the start of the Second World War. During the war, and the years that followed he continued to work for Bell Labs in the East Coast. In 1955 he decided to leave Bell Labs in order to create his own company of semiconductors in Mountain View, one of the reasons being to remain closer to his mother who was ill at that time. In this way Shockley Semiconductor Laboratory (SSL) became the first company to work on semiconductors made from silicon, in what is now referred to as Silicon Valley.

In order to build a prosperous and profitable business, Shockley knew he needed to hire the most brilliant and promising minds of the country, and so that was exactly what set out to do. Julius Blank, Victor Grinich, Jean Hoerni, Eugene Kleiner, Jay Last, Gordon Moore, Robert Noyce and Sheldon Roberts were the eighth chosen to lead this new adventure. In November 1956, it was announced that Shockley had received the Nobel Prize for Physics, alongside John Bardeen and Walter Houser Brattain for their work on semiconductors and their discovery of the ‘transistor effect’. From that moment forth, Shockley’s ego started to grow, even exceeding the brilliancy of his mind, and his leadership style became erratic and abusive.

In June 1957, the eight engineers had a secret meeting, in the luxurious Clift Hotel in San Francisco, in which they decided the future of Shockley Semiconductor Laboratory. From that moment forth, they were known as ‘The Traitorous Eight’, a name chosen by William Shockley himself. Once the decision was made that they would be leaving SSL, they needed to appoint a man who would lead them through the journey of creating their own company.

They believed that the person best fitted to this job was a man called Robert Noyce, or as otherwise known 'Rapid Robert'. At that time, Robert was only 29 years old and had a young family, something that would traditionally make someone more risk-averse. He was a great admirer of Shockley, so much so that when he received a call from Shockley himself to offer him a job at SSL, he confessed that "it was like talking to God" (Documentary: Silicon Valley, 11:39, 2013).

The other seven were aware that Robert would not find it easy to leave someone who he had so much appreciation for along with a stable job, however he had to make a decision. He had to choose between Shockley's poor leadership and obsession with working on a new but complicated technology (the four-layer diode) or take off and pursue the development of the promising silicon transistor. Noyce left SSL and, together with his seven colleagues, gave birth to the now revered Fairchild Semiconductor company.

Noyce & Fairchild

According to Sherman Fairchild, it was the Noyce's enthusiasm when he presented his vision, that ended up convincing Fairchild Camera and Instrument to create a new operation called Fairchild Semiconductor. The parent company was based on the East Coast and developed material for 'flash photography'. However, Fairchild Semiconductor was established in San Jose and, following Noyce's and the rest of the team's vision, focused on the fabrication of silicon transistors, that was a cheaper alternative compared to the traditional germanium semiconductors as it reacts better to high temperatures.

In 1959, using the planar process developed by Jean Hoerni, Robert Noyce invented the monolithic integrated circuit chip. A year later, Fairchild built its first integrated circuit (IC), the success that spawned the modern computer chip industry. The planar process was a major step forward in the creation of reliable and fast to produce ICs.

Fairchild took advantage of the opportunity offered by the US Government's Department of Defense that was putting a lot of resources into projects such as the Minuteman Missile that, according to Charlie Spork, late General Manager of Fairchild, was "a blessing from God" (Documentary: Silicon Valley, 15:22, 2013). The Government was prepared to pay a very high price for superior efficiency, and despite Fairchild not being especially enthusiastic about contracts with the Military, they still accepted. On the other hand, Fairchild was completely in favor of NASA and the Apollo program, which generated unprecedented demand. 100 000 integrated circuits were sold to NASA in 1964 alone (Lojek, 2007).

Fairchild's success rippled across the valley. Throughout the next 20 years, more than 100 companies were created in the valley that competed with Fairchild directly. Nearly all of

them had ex-Fairchild employees, and many of them were formed by entrepreneurs who had left Fairchild to do so, like Signetics and Amelco. Other Fairchild alumni went on to found leading Venture Capital (VC) firms such as Sequoia and Kleiner Perkins. Many of today's household names had in their origins a connection with Fairchild, among others Oracle, Apple, Sun, Cisco, Nvidia, eBay and Google. All these companies are now referred to as 'Fairchildren'.

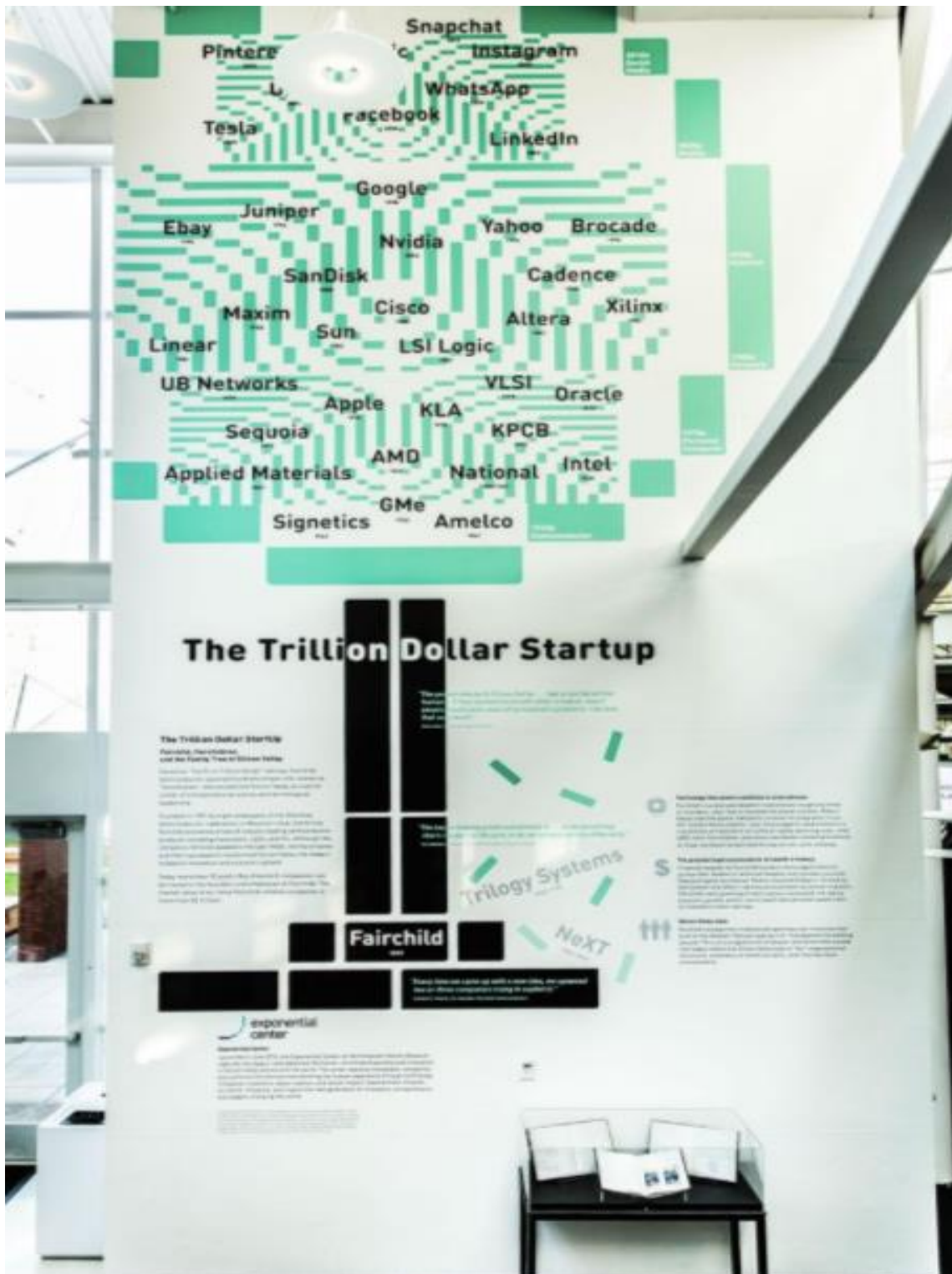


Figure 1
Exhibit display in CHM lobby, Menlo Park. Courtesy of Douglas Fairbairn Photography.

Fairchild adopted an unconventional strategy following the observation of one of its founders. Gordon Moore, a chemist working at Fairchild and one of the Traitorous Eight, stated that the number of transistors incorporated in an integrated circuit could be doubled every 18 months (known as 'Moore's law'). This underpinned the idea that, in manufacturing integrated circuits gaining scale in production was especially critical to

reduce costs. Under the close leadership of Noyce, Fairchild decided to start selling integrated circuits for less money than it cost to produce them. It was a risky choice, but the bet paid off. At the prices offered by Fairchild, demand for integrated circuits grew exponentially which in turn allowed the reduction production costs.

The rapid growth of Fairchild Semiconductors produced benefits for its parent company on the East coast, Fairchild Camera and Instrument. Other companies such as Texas Instruments and Motorola re-invested their profits in the development and growth of their semiconductor business. It was not the case of Fairchild, and this generated resentment amongst the workers of Fairchild Semiconductor. Noyce had the responsibility of leading and guiding the company forward and for taking charge of the final results but did not have the required capabilities to motivate his employees and get them to invest in new infrastructure and materials. The lack of resources was not the only issue which Fairchild Semiconductors had to face in the later years of the 1960s; there were also management issues. Noyce's style of leadership was so relaxed that he struggled to resolve internal disputes, which rendered difficult the operation of the company, causing internal problems, and elongating order completion times.

The problems reached their peak when in 1967, Charlie Sporck, Noyce's right hand, announced that he was leaving Fairchild to manage National Semiconductor, one of Fairchild's top competitors. Once he had arrived at National, Sporck began to recruit a large number of Fairchild's employees. National Semiconductor's success made Noyce rethink Fairchild's future. Anyhow, after a few months Noyce told Gordon Moore that he was going to leave Fairchild to found a new company, asking whether he wanted to join him in this new endeavor.

Noyce, Moore & Intel

In the summer of 1968, Noyce and Moore left Fairchild. Noyce was looking to be close to the most up-to-date technology once again, something he felt that Fairchild had been lacking in the last few years.

Due to their prestigious reputation, Noyce and Moore did not face many setbacks when raising capital for their new company. They were able to raise \$2,5 million in a matter of hours and were able to draw in many of the industry's most brilliant minds. They decided to shorten the company's original name, Integrated Electronics, to give Intel its now well-known name. In 1971, Intel produced the first ever microprocessor available commercially on the market, the Intel 4004. After having established themselves as the main microprocessor supplier in the later years of the 20th century for businesses such as IBM in the emerging PC (Personal Computer) market, they became one of the most relevant,

largest and most profitable technological businesses worldwide, and in 2019 they had a revenue of \$72 billion and net income of \$21 billion (Intel, 2020).

Terman & Stanford University

It is impossible to understand the origins of Silicon Valley without studying the impact that Stanford University has had and has to this day on its surrounding areas. It could also be argued that nothing has been so key in the relationship between the university and the valley than Frederick Terman. Terman studied his undergraduate degree in chemistry and his master's degree in electrical engineering at Stanford, he later completed his doctorate in electrical engineering in MIT. After having graduated from MIT, he went back to Stanford to be part of the Faculty of Engineering for 16 years until the start of the Second World War. During the war, he was in charge of a laboratory that produced radar jammers of the allied planes, and his work was recognized and appreciated by the US Government, which greatly benefited the Valley in the future. When the war ended in 1945, Terman went back to Stanford and became the Dean of the Engineering Department, and from 1955 to 1965 he served as provost (equivalent to Chief Academic Officer) of the university. During all his time at Stanford, both before and after the war, he encouraged his students to create their own businesses, which he himself invested in many of them. Businesses such as Hewlett-Packard and Varian Associated were founded by some of his students.

In 1951, Terman was on the front line of the Stanford Industrial Park's creation, which is now known as Stanford Research Park (SRP), taking advantage of the large amounts of terrain that Stanford had in order to gain income via letting the land to technological businesses. In 1953, Varian Associates became the first business based in SPR, and today companies such as Tesla, Skype, Lockheed-Martin, SAP, or HP have their offices in the Park. Stanford Research Park has not only given the university an economic income but has also facilitated flow of talent from the university to these tech-companies, and many of them employ its students, which renders Stanford an even more attractive place to study.

Stanford has produced a great number of founders of companies, many of them based in Silicon Valley. Similarly to Bill Hewlett and David Packard in the 1930's, Jerry Yang and David Filo met whilst studying at Stanford and founded Yahoo! in January 1994, in Sunnyvale. Sergey Brin and Larry Page also met at Stanford in 1995, and in 1998 founded Google, which has its headquarters in Mountain View. Companies such as Netflix, Instagram or PayPal were founded or co-founded by Stanford students and are based in the Valley, creating a jobs and income for the area and in turn making the surrounding area of Stanford an entrepreneurial hub.

Venture Capital

Venture Capital (VC) has been one of the pillars of the growth of Silicon Valley as a hub of innovation and entrepreneurship since the 1950s. The Venture Capital is channeled by VC firms, that invest in the creation and development of private companies from an early stage through to the consolidation stage. In addition to capital, VC firms support companies they invest in in a variety of ways, including assistance in different management functions, access to networks, active board membership and financial management and control.

In Silicon Valley, VCs have had a significant part to play in the development of a large number of startups that would go on to become the multibillion-dollar corporations that we know today. What VCs look for is a combination of a disruptive idea and a team of people behind it capable of getting things done. Arthur Rock is considered the founding father of Venture Capital in Silicon Valley. He backed companies such as Apple, Intel, Scientific Data Systems and Teledyne.

The first VC firm in the world, American Research and Development Corporation (ARDC), was founded in Boston by George Doriot, Ralph Flanders, and Karl Kompton in 1946. In 1957, they invested 70 thousand dollars in DEC (Digital Equipment Corporation), a company that would be at the forefront of computer technology for a large part of the twentieth century. By the time DEC went public 11 years later, the investment was worth 355 million dollars, more than 5000 times the original amount.

The VC firms received a boost from the government by way of the SBIC program (Small Business Investment Company) in 1958. This program was a way for the Federal Government to create growth and expansion of small businesses across the country, and Silicon Valley VCs and startups took full advantage.

Arthur Rock

Arthur Rock had already had a part to play in the origins of Silicon Valley before even moving there himself. In 1957, as the Traitorous Eight were looking to defect from Shockley Semiconductor Laboratories, it was Rock that managed to get Robert Noyce an audience with Sherman Fairchild that would later result in Fairchild providing the funding for Noyce and the other 7 defectors to establish the foundations of the Valley we know today. Still based on the East Coast during that time, it is said that Rock approached over 30 companies before managing to secure the meeting with Fairchild. Once Noyce had secured the funding from Fairchild, Rock invested ten thousand dollars of his own money and also helped Fairchild Semiconductor find a place to set up shop.

By the time Noyce and Moore left Fairchild to start Intel in 1968, Rock (along with Noyce and Moore's) was so revered in the industry that it only took him one afternoon of phone calls to obtain 2.5 million dollars in funding for their new adventure (Intel). In 1977, he invested 57 thousand dollars in Apple Computers and, three years and one IPO later, he was 14 million dollars richer. His investment in Apple, where he multiplied his initial capital 250 times, cemented his status as a legendary venture capitalist.

In 1961 Rock had teamed up with lawyer Tommy Davis to form the Davis and Rock partnership, whose motto "Back the Right People" has since inspired venture capitalists to place the same, if not more, importance on the team as on the idea. Rock has also been credited to be the first person to use the term Venture Capital.

Kleiner & Perkins

In 1972, Eugene Kleiner (one of the Traitorous Eight) and Thomas J. Perkins (from HP), along with Frank Caufield and Brook Byers who joined later on, established the first Venture Capital firm at 3000 Sand Hill Road, a venue that would later become the "Wall Street" of the Silicon Valley VC world.

Kleiner Perkins Caufield Byers (KPCB) operated in a very hands-on way, in pure Silicon Valley style. KPCB worked closely with the executives and engineers of the firms it invested in and provided active advice along with capital to help its ventures succeed. Facebook, Google, and Amazon are examples of KPBC investments.

KPCB also encouraged its own associates to form companies of their own, as evidenced by two former partners of the firm, James G. Treybig and Robert A. Swanson, who left KPCB to create and run Tandem and Genentech, respectively.

Today, Sand Hill Road is home to close to 100 of the country and the world's leading venture capital firms like KPCB, Sequoia Capital, Andreessen Horowitz, Greylock Partners or Mayfield Fund, among others. Almost every single successful startup in Silicon Valley has received funding from a VC on Sand Hill Road.

Not so long ago, Rogier van der Heide, Chief Design Officer of Philips Lighting said that "innovation works like a pressure cooker" (Spruijt, 2012). This statement encompasses better than any other the driving force behind the development of SV over the years, because no one cranks the pressure higher than the Valley.

The key ingredient in this pressure cooker is the motivated people that are drawn into the area. During the mid-nineteenth century, thousands of risk-taking immigrants moved to the west coast of the continent to profit from the California Gold Rush. The Gold Rush led to enormous development and prosperity of the region, and it was effectively the birth of civilization in the Bay Area. A population of 200 people in 1846 turned into 300 000 in 1855. These immigrants came from a variety of different origins, cultures, and beliefs, and when they settled in California, these became ingrained in the essence of the region, and they are the origin of the diversity that still exists today.

In 1965, as one of the measures to try to close the 'Missile Gap' with the USSR during the Cold War in the years after the launch of Sputnik, the US Congress passed the Immigration Act, which allowed highly skilled professionals from all over the world to move to the US in search of better education and job opportunities. However, the Act was not popular among regular Americans, so a large portion of the migrants found it easiest to settle on the West Coast, where diversity and openness was highest. This further increased diversity and tolerance of risk among the population, as well as the density of exceptionally competent people, along with a 'brain drain' in the countries where the migrants originated from, mainly China and India.

1.2. Why Boston Route 128 fell behind

On the 24th of August 1951, the first segment of what is now-known as 'Route 128', a highway with which Massachusetts' Government pretended to facilitate the flow between Boston's suburbs, and reduce the traffic back and forth the city itself. But what people could not imagine is that Route 128 was to become not only a way to get from one place to another, but also its own destiny to a cluster of innovation on the same level as Silicon Valley at the time.

The state of Massachusetts has a long history of innovation and it can also be said that it is the cradle of many American businesses. At the start of 20th century, many great investors and scientists were focusing their attention on the new circuits, magnetic fields, electric current, etcetera. At the forefront of the research on these technologies were the investigation labs of Harvard University and MIT.

In the same way as the industrial activity of the 19th century was located in the surroundings of rivers that provided a source of energy, in the 50s it was a highway that attracted this activity. Having realized this, the state agencies started building the first 'modern industrial parks'. Getting established on Route 128 was quite affordable, very efficient in terms of transportation, and it also benefited companies due to the proximity to research laboratories and other highly valuable companies.

Route 128 witnessed the creation of many significant tech companies, such as Raytheon, DEC, Data General, Wang, Prime, GTE and AT&T Bell Labs, which pioneered leading technologies such as the commercial transistor, the analogic protocol, semiconductors and the mini-computer.

In the 1970s, Silicon Valley and Route 128 were undeniably the two biggest and most promising technological clusters of the country, it could even be said that Route 128 started with an advantage over its opposite number to claim the title of main technological destination in the country, and perhaps the world. At that time, the similarities were evident; there was a constant technological vitality, and both places were close to world-class universities (Route 128 had Harvard and MIT whereas Silicon Valley was close to Stanford).

However, the differences that would ultimately decide the race to become the technological capital of the United States were already becoming apparent. Mainly, the culture that existed at that time in Silicon Valley of job-hopping, fluid information exchange, and risk-taking contrasted directly with the approach of its counterpart in the East, where things were more traditional and the companies were more oriented towards a vertical and top-down approach. As a result, a lot of technology and know-how was trapped within the companies themselves. Proof of this is the fact that many Route 128 companies made their employees sign a non-compete agreement that prohibited the workers of a company from working for a competitor of the company once they left their current job (even if they were fired). Instead, the state of California prohibited this type of clauses allowing an exchange of workers and, as a result, information, that was very beneficial for the technological advancement of all companies. Furthermore, the fact that the non-compete clause was illegal made California (and therefore Silicon Valley) a much more attractive destination for workers. Wages were higher since employees had more bargaining power. Workers also had a wider range of companies to work, as they were not constrained by the “non-compete” agreements prevalent in Route 128.

Another difference that would end up being decisive between Silicon Valley and Route 128 was the magnificent ability that Silicon Valley had and continues to have to attract Venture Capital. This is due to the digital transformation of Silicon Valley and its superior growth with respect to the life sciences and biotech focus of Route 128. VCs are very attracted by the ability that Silicon Valley companies have of scaling up, which is related to the type of tech companies that thrive in the Bay Area. In return, many startup founders move to SV attracted by the strength of its VC industry. Probably the most famous and symbolic of them all is Mark Zuckerberg, founder of Facebook, who left Boston for Silicon Valley.

2. The anatomy of innovation clusters. The building blocks of Silicon Valley

When trying to make sense of the creation and prowess of a phenomenon like Silicon Valley, it is always difficult to decide where to start.

There are many critical elements that contribute to and reinforce each other. The amalgamation of them all results in a delicate and unique combination, able to produce the incredible results that SV has yielded and continues to yield.

All of the elements are necessary but none of them in isolation can start to explain its incredible power; it is like a powerful formula in Chemistry.

We have borrowed the term 'Formula' and have applied it to the situation. I have summarized the elements under the categories of 'Engineering, Finance and Passion', which give a good feel for the disparity of the combination and the uniqueness of the enterprise.

As we shall see, the formulation is incredibly difficult to replicate under different circumstances and environments, but the 'Silicon Formula' still serves as a powerful inspiration in the attempt to propel bold commitments and, ultimately, make the world a better place.

For the sake of analysis, I have broken down the Formula into 11 constituent elements or building blocks, as shown in the spider diagram below.

There are seven 'hard elements', which have to do with specific participants and resources available, and are:

- venture capital;
- academia & research labs;
- government;
- private business;
- people;
- specialized support services; and
- infrastructure.

And four 'soft elements', which refer to the atmosphere of the place, the frame of mind, style and attitudes, and are:

- lifestyle;
- business mentality;
- networking & mentoring; and
- approach to failure.

In the walk through the history of SV in the first part of this paper, there are plenty of references to appreciate the quality of the people involved, the extraordinary contributions of academia (primarily of Stanford University), the private sector and the Federal Government (through grants, contracts and legislation) and the pivotal role of VC in the SV phenomenon. For this reason, I will go through those elements relatively quickly, just touching on aspects not sufficiently explained before. I will also make reference to the importance of the other two hard elements, specialized support services and local infrastructure.

Finally, I will concentrate on the discussion of the soft elements that are so distinctive and critical for the success of SV. These soft elements embody what Alfred Marshall refers to as the 'something in the air' for the case of SV (The Economist, 2012).

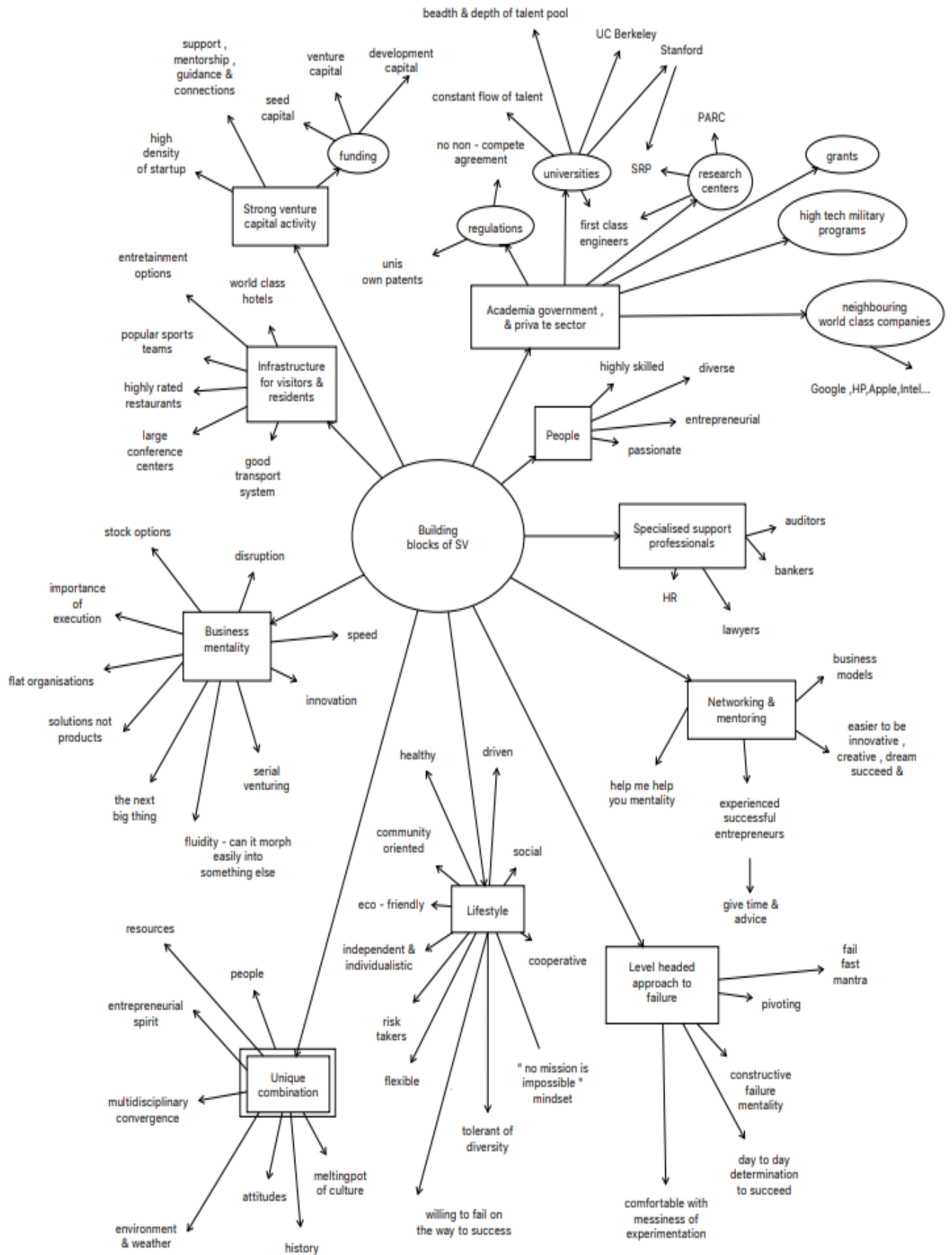
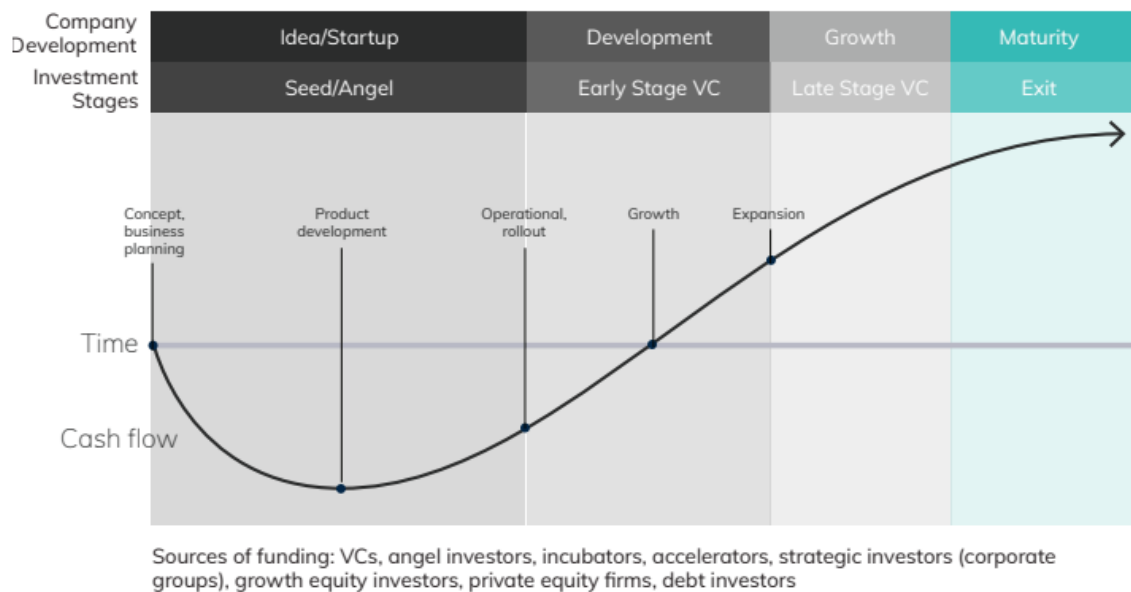


Figure 2: Prepared by author.

2.1. Hard elements

Going back to *Venture Capital*, it is impossible to stress too much its importance as a way to funnel the necessary funding into projects devised by engineers and scientists. Even more important, to infuse the necessary business and management acumen into projects that need to make the transition from ideas to commercially viable products, and then to create the necessary organization around them to create viable companies. To this end, the technical, financial and managerial expertise of VC professionals, together with their hands-on style are critical factors for the ventures to go through the different phases of development and financing.

Role of VC in the growth of a startup



8
NVCA 2020 YEARBOOK

Figure 3

Silicon Valley VC firms operate with a very hands-on style, with deep involvement with the companies they invest in, which is a unique and distinctive feature of the firms in SV. This involvement gives the ventures a unique and valuable experience that they would not get if the VCs were just financially oriented, arms-length traditional ones. The Silicon Valley entrepreneur's relationship with his venture capitalist is very hands-on, dedicated and time consuming. Given the strong deal flow of opportunities in the Valley, VCs have plenty to choose from and concentrate a lot of their attention in the region. Conversely, this makes Silicon Valley even more attractive to potential entrepreneurs, as they know that they would potentially have access to the best and more powerful VC firms to get financial, networking and managerial support, that would be much more difficult to reach were they to be based somewhere else.

Along with VC comes another hard piece of the formula, the *specialized support services* element. This is made by the teams of expert lawyers, auditors, bankers, human resource consultants and other professions that are critical for the process.

The specificities of start-ups and ventures at different stages of their often tumultuous development require very specific capabilities and experience, very different from the one required by more mature and stable corporations.

Hiring people in hordes, putting together compensation packages that rely heavily on stock options; contracting with companies of totally different nature; litigation on copyrights of elusive concepts like 'look and feel'; raising capital for companies with heavy losses at higher and higher share prices while looking at the 'burn rate' (of cash) through the rear window; and registering sets of accounts in which the largest item is 'accumulated losses' and still keep the company afloat, are all areas of expertise that you do not easily find in New York or, for that matter, anywhere else in the world except for SV.

While we have already sufficiently discussed the character and impact of the *people* in SV and covered the elements of *academic research, government and private sector activity*, and their fruitful and deep cooperation, as a key factor in the success of SV (which has been dubbed the 'Helix Model'), we cannot fail to underline the significance of Bob Taylor, a pioneer at the helm of Xerox PARC, one of the most influential basic research centres in the world of computer science, funded by Xerox Corporation.

PARC is credited for inventing much of the personal computer technology that underpinned the development of the field well into the XXI century. Ethernet, the technology to link computers into networks; the first easy-to-use computers with intuitive graphical displays and the first laser printers. Steve Jobs said he was inspired by PARC inventions to develop some of the most striking products of Apple. PARC also developed in the 70s the vision of 'Information at your fingertips' that Bill Gates heralded in the 90s.

Furthermore, Bob Taylor developed at PARC a management method that inspired the industry for years to come. He created a very flat organization of scientists and engineers and made them talk and cooperate with each other. Taylor cross fertilized projects breaking the silos and making scientists work on two or three projects at the same time.

Taylor, a psychologist by training, was recruited by Xerox in 1970 to create the Computer Science Lab (CSL) of PARC. He had previously worked at NASA and by 1965 (at the age of 33) was in charge of the Advanced Research Project Administration (ARPA) at the Department of Defence.

ARPA was a government program designed by the Kennedy Administration to channel government funds into basic research, without the massive bureaucracy associated with federal funding. At the time, it was the largest budget in the world for computer research. ARPA funded projects at universities and private companies in the U.S. and promoted the creation of ARPAnet, the first computer communications network to keep researchers connected.

Bob Taylor had a huge influence in the development of personal computers, comparable to that of Fred Terman from Stanford in the development of semiconductors.

The last hard element of the Formula to be considered is everything I classify under the term *Infrastructure*, to make the life of residents and visitors, and their organizations, nice and efficient. It starts with accessibility and a good transportation system and includes the availability of hotels and conventions centres, good entertainment options, restaurants and all the environmental aspects that are important for everyday life.

The Bay Area is well connected by air traffic and has five airports from San Francisco to San Jose (SFO, San Carlos, Palo Alto, Moffett and Mineta). It enjoys a collection of top hotels such as The Rosewood Sand Hill, The Four Seasons, The Nobu and The Fairmont, and well known cafes such as The Coupa Cafeé and the Churchill Club, famous for its motto “allow important people say important things”. Top sports teams and music festivals provide plenty of entertainment.

From an environmental standpoint, Silicon Valley continues to be a place of privilege. The landscape of the area is plentiful with green spaces. SV is respectful to the environment, with wide avenues and low-rise construction. Today the area hosts a plethora of architectural design masterpieces, such as Apple ‘Spaceship Campus’ (by Norman Foster), Facebook’s Menlo Park Headquarters (by Frank Gehry) and Google’s Mountain View Campus (by BIG) and allows for plenty of space to live, work and play. The design and growth of Stanford University campus is a tribute to visionary planning, a truly unique, inspirational place.

Outdoor activities are facilitated by the fact that the Valley is not a concrete jungle, and is close to the bay, the ocean, and the mountains. Couple this with the extremely mild and year-round stable weather and you have an extremely attractive environment for anyone.

Many successful leaders and communities are actively pursuing endeavors in order to improve things like education and sustainability. The area is making a noticeable effort to do their part by reducing water and electricity consumption, supporting farmer’s markets, and enabling and encouraging sustainable practices like having an electric car or recycling to reduce waste. Cleantech has also been a big focus for everyone in the Valley recently and the numbers are starting to show it. The past three years have seen a striking transformation in the number of people being served by Silicon Valley’s community choice energy programs. At the moment, 69% of the commercial market and 89% of the Valley’s residential customer are in clean energy programs. These things create a unique, positive and constructive environment that helps motivation and productivity, and cultivates creativity.

However, road traffic is dense and becoming increasingly problematic for the residents of the Valley and housing prices have become incredibly expensive. Also, top lodging infrastructure, nightlife and major cultural events are scarce in SV. As a result of all these, more young people and companies are moving to San Francisco, despite the fact that housing is not cheap either and the city has significant social issues, like the very high level

of homelessness. The location of Salesforce in San Francisco, one of the last tech giants to emerge, is a perfect indicator of the shift. As a result, when people refer to the concept of Silicon Valley, they are now referring to the entire Bay Area, including San Francisco and Oakland.

In this paper, when we refer to the most recent phenomena of Silicon Valley, we are also referring to the entire Bay Area.

SILICON VALLEY

TECH ME TO THE MOON



- DENSELY POPULATED URBAN AREAS
- INTERNATIONAL AIRPORTS
- NASA AMES RESEARCH CENTER
- LEADING UNIVERSITIES

JUNE 2018

CHRISTOPHE CHABERT

Figure 4

2.2. Soft elements

Lifestyle in the Valley is unique and embodies many of the values that inspires the companies that thrive in the area. It is flexible, social, cooperative, community oriented, eco-friendly and healthy. This approach to life is very helpful to promote networking, another salient feature of SV. But we cannot be tricked by the apparent 'cool and laid back' appearance of the people. They are extremely driven and focused. Things happen very quickly and there is no room for complacency.

Dress code is extremely informal, but under the ubiquitous t-shirts there are extremely worked-out bodies, reflection of very long hours in the gym (often in the company premises) working hard. Anywhere you walk you see hordes of people exercising, cycling, running. That same attitude is transferred to the office.

Wake up calls at 4.00 a.m. are very much the norm (helped by early sunrise) and office meeting at 6.00 am are pretty common, so do not be mistaken, great outcomes are the result of very hard work, not mysterious inspiration.

There is also an obsession with education, modern progressive education, and a natural inclination to embrace new things, to push for new things and innovation.

Under '*business mentality*' we encompass a series of attitudes towards business and well as the style of doing things in the Valley.

The first salient feature is a relentless pursuit of innovation, which results from open-mindedness, creativity and hard work.

In terms of creativity, Silicon Valley has a lot in common with another place in another period, Florence in the Renaissance. Walter Isaacson believes that creativity occurs in the intersection of disciplines, and no example is a better illustration of this than Florence during the Renaissance period. Leonardo Da Vinci was perhaps the most versatile mind in human history and according to Isaacson "the basis of his creativity was an enthusiasm for interweaving diverse disciplines" (Isaacson, 2017). This reflects something more recent we have heard from Steve Jobs, a more contemporary celebrated inventor.

In his celebrated and widely reproduced 2005 Stanford Commencement Address, Jobs talked about his college experience, and how he dropped out of his degree in college after six months because he didn't see the value in a lot of the classes he was required to take, but continued to go to some classes he actually was interested in during the following year and a half. One of these classes was calligraphy, something that Jobs enjoyed very much but really didn't see how it could be applied to all the other things he was interested in. It was 10 years later when he found an application for it, the design of fonts for the Macintosh, and it was this concoction of seemingly unrelated specialties that led the way for aesthetically attractive typography that was built into the Macintosh and in personal computers ever since.

Hard work results from passion and drive. Sometimes just one word becomes the symbol and nucleus of an entire movement. The statement “Greed, for lack of a better word, is good” made by Gordon Gecko in the 1987 film Wall Street may have been made by a fictional character, but it resonates with very real people working in Wall Street. Greed, he said, acts as a driver for growth, it “captures the essence of the human evolutionary spirit”. In Silicon Valley, that word is passion. Passion is what drives an entrepreneur to tackle a problem, to push new ideas, to stretch the limits of imagination, to work endless hours, and it is something that venture capitalists look for in an entrepreneur. Passion is one of the key elements in all successful entrepreneurs and is a key driver for creativity and innovation. Along with some greed.

Diversity is measured in terms of disciplines, but also in terms of backgrounds, cultures, and nationalities. SV has attracted more and more foreign entrepreneurs, and they have been incredibly successful. The drive and determination it takes to move from your country and your family to come to the Valley is already a key indicator of a successful entrepreneur. Besides this, the international connections they bring to the party (what AnnaLee Saxenian calls “cross cultural connections” in her book *The New Argonauts: Regional Advantage in a Global Economy*). The relationship that these foreign entrepreneurs have with their home countries is something extremely valuable in terms of expanding a company outside of the US, which provides them with a competitive advantage over American born entrepreneurs.

Another key factor in the compound of business mentality is the positive attitude towards failure, but this one is so important and unique that I will dedicate to it its own section.

In terms of style of doing business, SV favors flat organizations, in true Bob Taylor style, that tend to be more dynamic and agile and places a premium on execution.

SV entrepreneurs focus on speed and pivoting. The key is to get the minimum viable product out fast and test it in the market, then adapt and move in a different direction if the market requires (this is ‘pivoting’, a widely used concept in SV). They look for disruptive ideas, to create new markets and not just occupy a piece of existing ones (this is the ‘blue ocean concept’), they look for the next big thing. Yes, Big, as the scalability of a venture is a key feature to attract VC funding. True entrepreneurs often pursue multiple ventures in their professional careers which gave birth to the term ‘serial entrepreneur’ a common species in SV.

As for employees, they easily move between companies and new ventures (made possible by the multiple job opportunities available and the absence of non competes by law), and are motivated more by stock options packages and the possibility to hit it big rather than by the security and stability of a well-paid job in a traditional corporation.

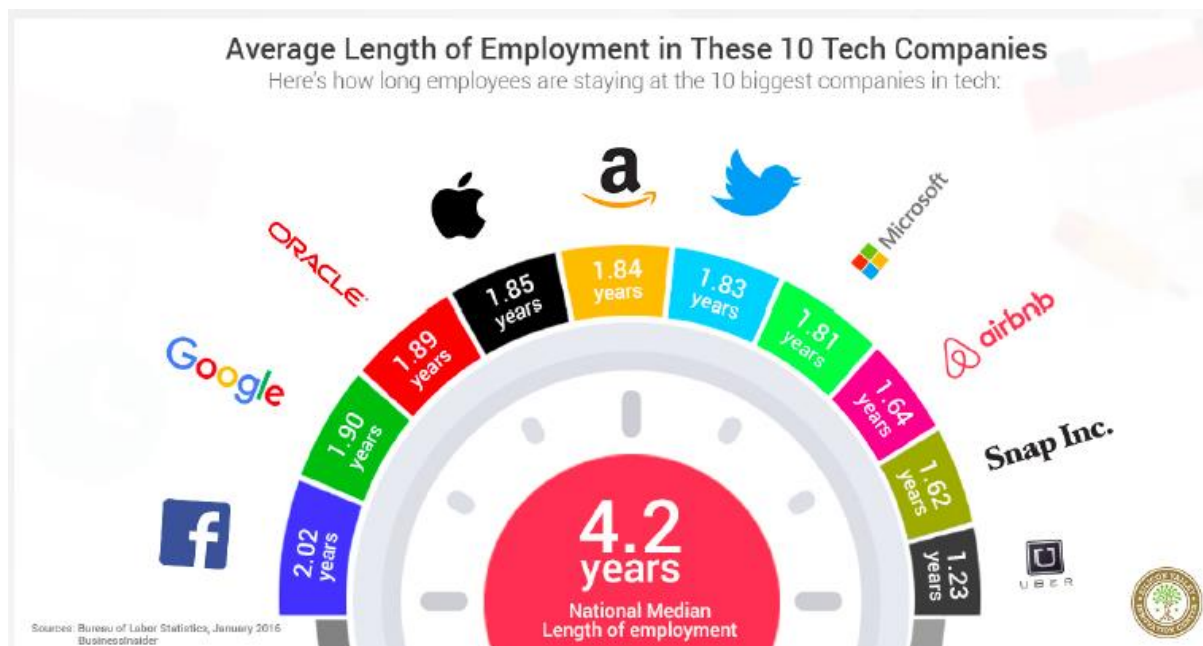


Figure 5

Networking and mentoring are deeply ingrained in the ethos of SV.

Silicon Valley is the epitome of networking in the tech industry. The concentration of power, capital and know-how is unparalleled in the world and the focused but approachable style of the residents makes networking a natural byproduct.

Networking is a critical element of business in SV and one of the key reasons for the concentration of people and companies in the area. If you are into computers, you have to be present in the Valley. Networking provides resources, support, market access, eventual partners, prospective employees and so many other things that individuals and companies require at different stages of their development. It is impossible to think of a phenomenon like SV discounting the effect of networking; it is impossible to develop so many innovative concepts and products working in isolation.

The attitude and lifestyle of the people in the Valley facilitate making valuable connections. It is difficult to find words to adequately portray how easy it is to make friends and engage in conversation on themes of mutual interest, on new ideas or projects and how much people are willing to offer help. Nothing comparable with what you are likely to find on the East Coast.

Along with networking comes mentoring. The culture of mentorship is heavily ingrained in SV. People are approachable and ready to help. If you come with good ideas and the right attitude and determination, you will find experienced entrepreneurs ready to give you a hand. The attitude of giving back to society is also heavily ingrained among the successful entrepreneurs in the Valley, especially in the latter part of their careers (often as early as 40). They will provide good advice, access to other people, and even invest in your venture or join your Board of Directors. They were helped by others when they started so they now help you.

But not everything is so rosy. Ariel Poler, a successful entrepreneur in the Valley that I will discuss later on in this paper, talks about the 'help me help you' mentality. It refers to the need to be specific, and relevant and committed when asking for help. Successful people are ready to help but not to waste their time daydreaming with dilettantes not ready to do what it takes to make it in SV.

The final element of the Formula is a level-headed approach to failure, an absolutely key aspect of the culture of SV. A balanced approach to failure is a critical element for eventual success. At Google they talk about 'productive failure', the kind of failure that helps you learn things and contributes to future success. Failure that does not result from stupidity, absence of preparation, or lack of resilience. Failure that helps you learn from mistakes and be better prepared next time. The serial entrepreneur (founder of many companies in succession) tends to be well acquainted with failure, as successes and disasters succeed one another. Failure tests your resilience, ideas, and determination. All of these features are required in the rollercoaster ride of the entrepreneur.

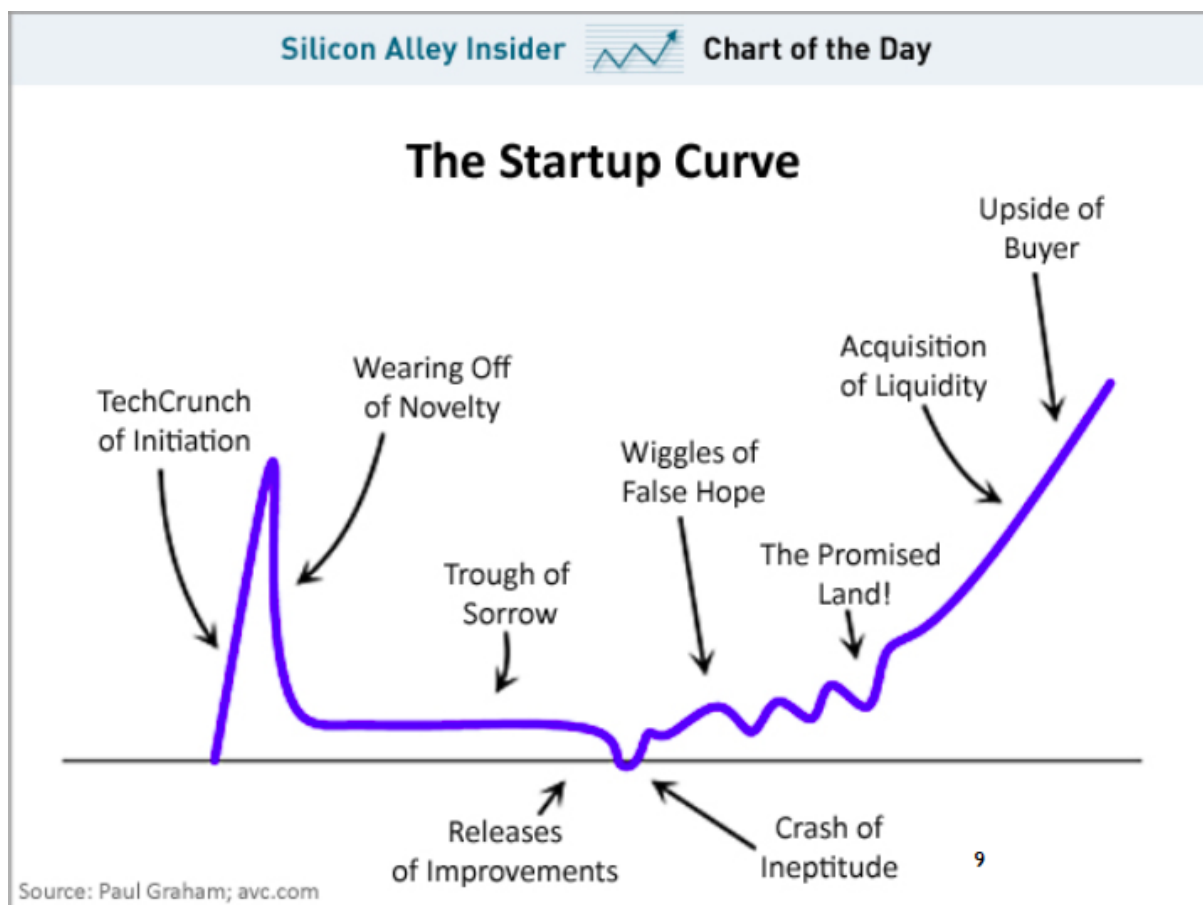


Figure 6

While other cultures and industries are fearful and hostile towards failure, in the Valley it is welcome if it is paired with resilience. It is on failures that success is built upon. In a world that is evolving so rapidly, failure at one point or another, is inevitable.

A shining example of productive failure is Elon Musk, one of the most recognizable names in the world of entrepreneurship, and one of the world's foremost experts on failure. He

was ousted as CEO of Zip2 in 1996, a company that he cofounded, and four years later, he was ousted from PayPal, which he also cofounded. His first three SpaceX rocket launches crashed and burned (Brown, 2018). These are but a few of the setbacks he has endured during his career. Still he has built a net worth of \$38.9 billion (Forbes, 2020) from the market value that reflects well the potential of his ventures (which include Tesla). Mr. Musk has clearly mastered the art of 'failing successfully'. To finish on a positive note, on May 30 as I am writing this paper, a new manned SpaceX mission was successfully launched and linked to the international space station. Another great example of successful cooperation between public and private initiatives, in true SV spirit.

To me, Silicon Valley, the place, the community, and the idea, is the result of a unique combination of all these hard and soft elements. Engineering, finance and passion put together to transform the world.

3. Can clusters be designed? The impact of place quality in the development of a cluster

Technology and innovation have become the mantra of all governments around the world to generate wealth, improve the standard of living of their communities, attract (or give birth to) vibrant knowledge based industries with highly paid jobs and promote strong economic activity that can pay for public services. With this in mind, the question to answer is if it is possible to design and create a COI from scratch or, at a minimum, how can the government facilitate and promote the creation of a COI.

If we look at the history of Silicon Valley, a superficial analysis may conclude that it was created from scratch, almost by chance with the arrival of Bill Shockley and, therefore, it would be possible to do it again. We know by now that there is more than meets the eye. By the time Shockley arrived to the area, Stanford was already a leading university in science and technology, California dwellers had a deeply ingrained entrepreneurial spirit rooted in the gold-rush days and the Federal Government had been pouring money into Military and NASA related projects for quite some time, under the vision and leadership of Fred Terman. Furthermore, the rise to dominance of Silicon Valley occurred over an extended period of time, a time much longer than the one that the short-term vision and needs of most governments and administrations allows them to accept.

There have been experiments, primarily in the Middle East in the late 70s and 80s, which tried to artificially create clusters of knowledge, through the creation of well-funded universities and research centers that lured western scientists and professors through generous research grants and pay checks. They were all short lived.

The only clear exception to the rule was the effort sustained by the Chinese government over the last 30 years through the Torch program, run by the Ministry of Science and Technology. The biggest achievement of this program has been the creation of multiple Science and Technology Industrial Parks (STIPs). There are almost 50.000 officially designated high tech companies in these parks, which are generously funded and receive lots of perks, including significant tax breaks. The program, started in 1995, took over 10 years to show any progress.

Beyond the Chinese case, and despite the efforts of Steve Case (founder of AOL) and his 'The Rise of the Rest' initiative to promote the development of marginal communities as home of COIs, we see that COIs tend to appear in or around consolidated communities. When we look at the hosts of relevant new COIs, we find the names of Los Angeles, Chicago, Boston, New York, Singapore, Toronto, London, Berlin or Amsterdam that can hardly be considered marginal locations. It is for this reason that it is so relevant to analyze the 'quality of the place', to take advantage of their pre-existing positive conditions and make up for their deficiencies through public and private initiatives, when possible.

3.1. How to analyze place quality

A good way to analyze the place quality and the extent to which it contributes to the attractiveness of innovation clusters is following the methodology developed by Niusha

Esmaeilpoorarabia, Tan Yigitcanlara and Mirko Guaralda (2018). The authors utilize a framework that uses both tangible (investment availability, job opportunity, cost of living) and intangible (quality of life, urban ambiance, cultural and social characteristics, diversity of the population) factors to determine the place's attractiveness for knowledge industries and workers.

The five conditions analyzed are context, form, function, ambiance, and image, defined as:

- **Context** refers to the reputation of the area in terms of knowledge economy, plans to promote innovation, diversity and quality of the workforce and strength of universities.
- **Form** refers to location, urban form, design, and amenities.
- **Function** refers to management of infrastructure and anchor projects, promotion of public-private cooperation, land use, policies geared towards attracting and developing talent and policies geared towards attracting and nurturing technology-based companies and research centers.
- **Ambiance** refers to cultural milieu, networking, diversity, and creativity.
- **Image** refers to lifestyle, safety, sense of place uniqueness and identity and branding of the place.

See Appendix 1.

The authors use the methodology to evaluate four innovation clusters from different continents and of relatively the same size: 'One-North' in Singapore, 'Arabianranta' in Helsinki, 'DUMBO' (Down Under the Manhattan Bridge Overpass) in New York, 'MPID' (Macquarie Park Innovation District) in Sydney. The Singapore and New York clusters are located inside the city, while the Helsinki and Sydney clusters are suburban. Helsinki and New York are 'creative clusters' while Singapore and Sydney are more technology focused. In the following paragraphs I review the main findings of the study, as examples of what to look for and examples of good facilitation strategies.

Pre-existing conditions of the place and focus of the hubs play a major part in the results of the study.

Creative clusters (i.e. art, performance, design, film making) are more deeply rooted, sometimes embedded, in socio-cultural abilities of their context. Tech clusters pop up around world class research centers and universities, that often, although not necessarily, are located in less densely populated areas.

Having a worldwide reputation as a knowledge-based economy is very desirable and attracts companies and workers to a place. The best example is Silicon Valley.

Clusters that are in a city benefit from density, diversity, and innovation of the area, as well as infrastructure, talent/labor pool and proximity to other businesses and clusters. Clusters that are in the suburbs do not have those perks; a good way to promote innovation, improve social life and attract workforce is by having or developing a strong and vibrant

university close by. A textbook example of this is the development of the Arabianranta district in Helsinki. An industrial and waterfront site on the northeastern edge of the Finnish capital was once the Arabia ceramics factory, which settled there in 1874. During the 1980s, the Helsinki Art and Design University (TiaK) was relocated to the unoccupied industrial buildings. The urban and architectural design was based on connecting the natural environment with organic urban grids, intertwining science, and technology with art. This distinctive architectural style coupled with Helsinki's exceptional public transit which connects Arabianranta to the central business district and the rest of the city has significantly improved the appeal of the cluster.

City clusters benefit from current infrastructure but are limited in terms of availability of suitable and affordable land for development. Suburban clusters generally show the opposite features: plenty of land but little infrastructure. One-North is a 200-hectare innovation cluster development strategically located between Singapore's Central Business District and the Nanyang Technological University. As the development is located in a city, existing infrastructure was carefully considered. Factors such as proximity to public transport and location of research and development institutions and universities were taken into account to ensure that the development was as successful as possible.

Government activity and investment is particularly important in the early/planning stage of a cluster. However, no matter how important government funding is, there must be a certain level of private contribution in the creation of a successful cluster. A public-private partnership provides the cluster with a sense of identity and belonging. A great example of this type of compromise can be seen in Singapore, where the government has played a major part in the development of the aforementioned One-North. During the late twentieth century, Singapore underwent a transition from a manufacturing economy to a knowledge-based one. In the year 2000, One-North's management and co-ordination was assigned to a public agency, putting them in charge of developing anchor projects and infrastructure. However, not everything was done by the government. A flexible and non-continuous master plan was designed to integrate the private sector in One-North, and today, 80% of One-North has been developed by the private sector.

In creative clusters and clusters with rich cultural heritage, there is a high presence of artists, bohemians, tourism, cultural events, and street arts. This is not necessarily the case in high tech suburban clusters. Nonetheless, being close to a university improves the ambiance of a cluster due to the attraction of diverse people with different background, race, age, orientation, etc. Take Macquarie Park Innovation District (MPID), a technologically focused cluster located in the Sydney suburbs. MPID englobes Macquarie University, and as a result is able to benefit from the libraries, museums, collections and art galleries that the university brings about. The University's Learning Centre and the Network Management Centre facilitate the business-networking system and the vibrant and creative ecosystem creates an alluring ambiance for companies and workers.

Having a high density of artists and cultural events is paramount to clusters that are creative in nature, the importance of this in technologically oriented clusters should not be understated.

Many companies and workers consider their respective clusters home, for whom having a compelling imagine is crucial, as it is to attract new people to the area. Places that are authentic and unique are sought after, especially from the point of view of workers. Clusters like New York excel in this condition. The industrial vibe, one-of-a-kind street buzz and charming view of the Brooklyn Bridge that you have from DUMBO reminds the incumbent that he is in a place like no other. Talented workers have a wide variety of options with regards to where they want to live and work, which is why having an image of desirable lifestyle and identity is vital. It is crucial for companies to be in the most exciting places if they want to attract and hire the most exciting talent.

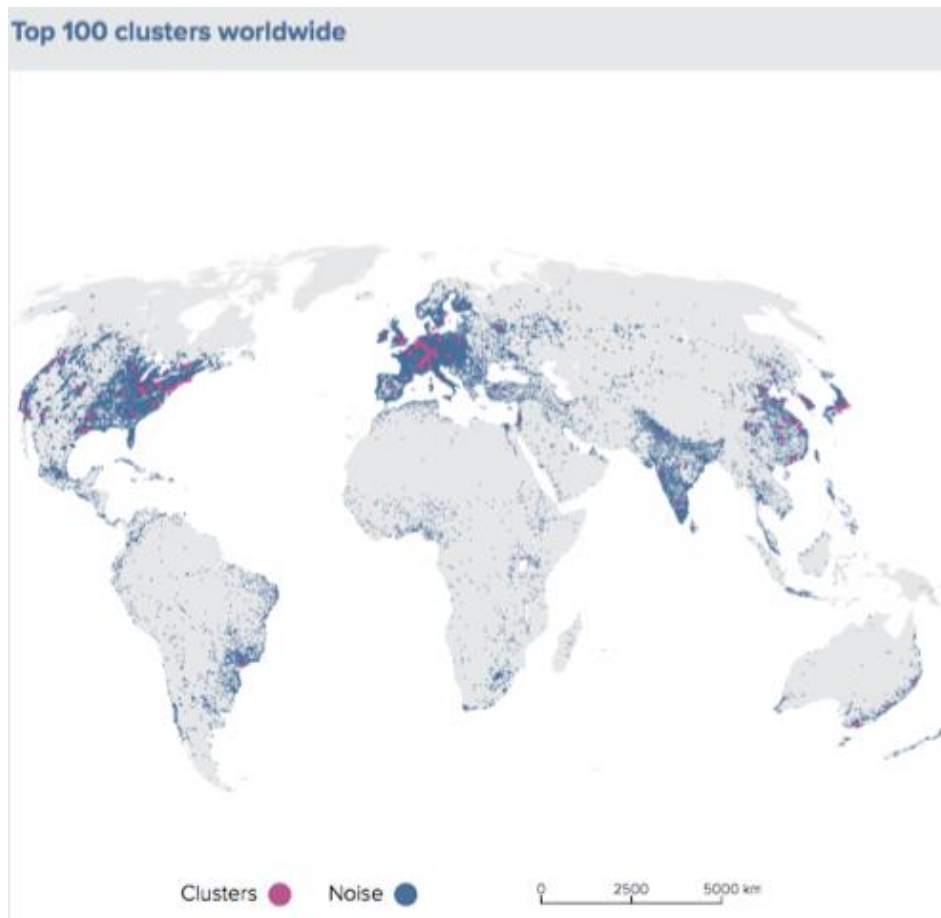


Figure 7. Source: Global Innovation Index 2019

Using the same methodology described above, I will now review London, Tel Aviv and Shenzhen three other very successful innovation hubs with focus on technology, to understand their salient features as a 'quality place' and the policies and initiatives carried out to promote and cement their position. I will also explore some current setbacks that threaten their status as 'quality places', such as the likely consequences of Brexit for London and the uncertainties generated by the mounting pressure of the China's government on Hong Kong.

3.2. Case Study: London

Context: London is recognized around the world as a successful innovation and finance cluster, and its East London Tech City is also referred to as 'Silicon Roundabout', excelling particularly within the fintech sector.

London is consistently one of the most visited cities in the world (3rd in 2019). Even more impressive, London was once again ranked 1st in 2019 in the Global Power Cities Index, for the eighth year in a row. This index ranks cities based on 6 categories: Economy, Research and Development, Cultural Interaction, Livability, Environment, and Accessibility, London ranks top in cultural interaction, and second in accessibility, economy, and R&D. There is a plethora of world-class universities like University College London, Imperial, and King's College. In summary, it is difficult to envision a better urban context than the one provided by London.

Form: London takes 3rd place in Oliver Wyman's ranking of cities with the best public transport systems. It has five commercial airports (Heathrow, Gatwick, Stanstead, Luton, and City) making accessibility one of the key strengths of London. Heathrow is the busiest airport in Europe, with more than 80 Million passengers per year, with Gatwick adding another 46 Million.

London also places 1st in the ranking of The World's Most & Least Eco-Friendly Cities In 2020 (compiled by British Business Energy), a ranking which takes into account indicators such as tree canopy cover, walking & cycling, environment tech patents, renewable energy and number of vegan/vegetarian restaurants. London was also named the world's most sustainable city in 2018 by the Arcadis Sustainable Cities Index.

Function: The importance of London's Tech city for the UK economy led the government to launch the Tech City Investment Organization (TCIO) in 2010. This government agency is dedicated to build help the profile of the area, attract investment and channel government backing.

In an effort to provide the best infrastructure to attract and retain tech companies, London hosts and supports private sector initiatives such as Level39 (named after the 39th floor of the One Canada Square at Canary Wharf), a highly successful startup incubator that provide space, connectivity, mentorship and access to resources and clients. With focus on finance, retail, and cyber-security technology, Level39 has backed some big hits, such as Revolut (fee-free currency exchange), Bankable (platform banking-as-a-service) and Capexmove (blockchain-based debt management).

Ambiance: London is tremendously multicultural, with over one third of the population of the city having been born outside of the United Kingdom (The Migration Observation at the University of Oxford, 2013). The Global Power City Index ranks London 1st for cultural interaction and the European Commission's Cultural and Creative Cities Monitor places it as the top city in Europe for Openness, Tolerance and Trust. London has been for some time now the financial capital of Europe and as a result, it is a major center for networking and raising capital.

Image: London is home to some spectacular venues in terms of entertainment for both tourists and residents, a must go destination with a buzzing nightlife. Shakespeare’s Globe takes spectators back to Elizabethan times, the Royal Opera House is one of the premiere opera venues in the world, and there is no shortage of action for sports fans, with events such as Wimbledon, the British Grand Prix and Premier League football occurring throughout the year. London has some of the most attractive inner-city parks in the world and a number of unique and picturesque architectural landmarks that shape the image and identity of the city. Westminster Abbey, Palace of Westminster, and Tower Bridge contrast the modern architecture of the Shard, the Gherkin and City Hall, and make London a brand known worldwide.

Having said all this, there is a question mark right now about what effects will Brexit have on the city, both in terms of business and as a melting pot of cultures. The prospective loss of the European passport for banks is already driving financial institutions out of London and into the continent, and as a result, we should expect its deterioration as the primary center for fintech ventures. Likewise, the succession of racist incidents on the streets aimed at foreign nationals is reducing the allure of London as a welcoming city and its magnetic effect on would-be entrepreneurs.

While the infrastructure will stay, the effects of Brexit on the soul of the city remain to be seen.

3.3. Case Study: Tel Aviv

Context: Israel is seen as one of the countries with the most promising future in technology and innovation. Warren Buffet says that “if you’re going to the Middle East to look for oil, you can skip Israel. If you’re looking for brains, look no further” (B-Hive Tel Aviv Report, 2018). It is not a coincidence that Israel’s nickname is the ‘Startup Nation’ and Tel Aviv’s is ‘Silicon Wadi’. Valuer’s, a leading startup engagement platform of reference for corporations, venture capitals and accelerators from Denmark, gave Tel Aviv the 2nd spot in its ranking of the Best Startup Cities in 2019, with a particularly strong reputation in the fintech and cyber security sectors.

Tel Aviv is surrounded by a number of reputable universities, such as Technion Israel Institute of Technology, Tel Aviv University, Weizmann Institute of Science and Bar-Ilan University. But more important than this is the strong connection between Israel and Silicon Valley, that can be considered a super cluster, in which two geographically separate clusters are characterized as one due to strength of their relation (Engel, 2015). Participants move back and forth between both locations and participate in projects together, which favors the spillover of knowledge.

Form: Located right on the Mediterranean coast, the city possesses a strong public transportation system, and is 20 kilometers away from Ben Gurion Airport, the nation’s largest airport. The city of Tel Aviv is a modern development founded at the start of the 20th Century and has an abundance of Bauhaus-style buildings, constructed by German-Jewish architects who immigrated to the region after the rise of the Nazis in the 1930s and 1940s.

Tel Aviv is nicknamed the 'White City' due to the buildings' whitewashed façades. The White City of Tel Aviv was named a modern UNESCO World Heritage Site in 2003, an ideal place to live and work.

Function: The Israeli government understood that investment in industrial R&D was crucial so in the late 1960s it created the Office of the Chief Scientist, now known as the Israel Innovation Authority (IIA). The IIA encourages entrepreneurship and high-tech startup companies, leverages the nation's highly skilled technological labor pool, and promotes and facilitates the transfer of technological know-how. In 2019 Israel invested 4,25% of its GDP in R&D and ranked 2nd in the world right behind South Korea (4,3% of GDP) (UNESCO Institute for Statistics, 2020). See Appendix 2.

In order to counterbalance the lack of investment on startups from venture capital firms, the government established in 1993 the Yozma program (Yozma means 'Initiative' in Hebrew). The program included tax breaks and a 'matching fund' to stimulate foreign venture capital involvement with Israeli tech firms. In the initial three years, the government provided \$100 million to the program. Similar 'matching funds' programs, with tax breaks and subsidies for expenses continue to this day. They are set up to target specific segments of promising technologies such as Fintech, cybersecurity or blockchain.

In terms of regulation, Israeli governments are well aware and supportive of the needs of entrepreneurs and innovative projects, and the Bank of Israel exerts a lot of positive influence in this regard. This is a significant pull factor for entrepreneurs considering to setting up a business.

Ambiance: The culture in Israel and in Tel Aviv is very favorable to the creation of startups, there is a risk-tolerance and perseverance that fosters entrepreneurship. Furthermore, the Israeli laws on bankruptcy and creating new companies make Israel the most straight-forward place to start a company in the Middle East, and one of the easiest places in the world.

Israel's culture is also one where science and technology is very highly regarded. In 2019, Israel had 8341 researchers per million inhabitants, while Germany, France, the UK, and the US stand at approximately 50% of that ratio (UNESCO Institute for Statistics, 2020). The city is vibrant, energetic, and open minded, an inviting atmosphere for disruptive thinkers and entrepreneurs. Tel Aviv and Israel as a whole are home to a number of organizations that foment networking and link companies with their clients, especially international ones. For example, the Israeli Bitcoin emBassy, promotes the use, development, and regulation of bitcoin; The Floor connects the Israeli fintech industry with Asian markets; and Deloitte's Innovation Tech Terminal (ITT) links Israeli innovation with Deloitte's global clients. This advantageous culture for innovation and entrepreneurship is a very enticing ingredient of Tel Aviv's not so secret sauce.

Image: If being a UNESCO World Heritage Site isn't enough, Tel Aviv's Mediterranean beaches, vibrant night life, and buzzing cultural scene make the city one-of-a-kind. It is nicknamed the 'Big Orange' for its 24-hour lifestyle resembling New York. Tel Aviv boasts a wide variety of theaters, galleries, and museums as well as historic buildings and landmarks.

In terms of sporting events, Tel Aviv and Israel lag slightly behind other hubs like London and the Bay Area but there are plenty of opportunities to go outdoors and take advantage of the coastal setting and year-round mild weather.

3.4. Case Study: Shenzhen

Context: Shenzhen in China in the 1970s was a small fishing village home to about 50 000 people. The city now has 12.5 million habitants (Baldinger, 2019) and has been nicknamed “China’s Silicon Valley”. Its economy shifted from fishing, to manufacturing and then to knowledge-based industry in a short period of time. This meteoric rise has been propelled by the Special Economic Zone (SEZ) status granted to the city in 1980 -the first SEZ in China-, which gave the area much more flexibility to trade and invest. Shenzhen now has a reputation for being a leader in the hardware sector and having the supply chain and expertise to produce quality products fast. The city also possesses an abundance of intellectual capital, with an active inflow of technicians, graduate programs from the leading Chinese universities of Peking and Tsinghua and over 100 000 university students (Baldinger, 2019).

Form: Shenzhen is supremely well connected, a perk of being sandwiched between Hong Kong and Guangzhou. Shenzhen Bao’an International Airport is one of the five largest airports in the country. In 2002, Shenzhen received a top award by the United Nations for being one of the world’s most environmentally friendly cities, and since it has only improved in its quest for sustainability, being by far the most sustainable city in China. It has introduced low-emissions electric buses and taxis and closed down polluting factories (Baldinger, 2019). The city’s government has aggressively pushed for urban regeneration to utilize old industrial buildings in order to expand. Moreover, Shenzhen has actively tried to cut air pollution, developing cars which pollute less and planting rows of trees along the streets of the city. As a result, in 2018 it was reported that the city got the cleanest air of the last 15 years (Baldinger, 2019), as a tribute to governmental efforts in that direction.

Function: The status of Special Economic Zone made Shenzhen the first place in mainland China where foreign and domestic trade could take place without the explicit authorization of China’s central government, which made the city very appealing to foreign investors. The city’s government actively supports new businesses, especially in high tech sectors, with subsidies and investment in R&D. Despite Shenzhen not having an academic reputation as strong as Beijing’s, there have been recent improvements, and Shenzhen’s Institute of Advanced Technology along with graduate programs from Peking and Tsinghua are increasing the already abundant skilled labor force of the city.

Ambiance: Shenzhen’s population is made up heavily of Han Chinese people that have migrated from other parts of China, in a similar fashion to Silicon Valley. Due to its somewhat recent beginnings, it does not have a rich cultural history to appeal to tourists, workers, and companies. However, Shenzhen is making a notable effort to create an ambiance of diversity and creativity. A perfect example of this would be the OCT LOFT Creative Culture Park, created in 2003, which revitalized an old industrial district and turned it into bookshops, bars, artist studios, etc. and hosts exhibitions, galleries, and festivals.

Image: The city's lifestyle and entertainment scene is growing by the minute: in 2018, there were 638 public libraries, 43 museums, 46 theatres and over 400 art galleries (World Cities Culture Forum, 2020). The five-year Shenzhen cultural Innovation Development Plan released in 2016 prioritized the protection and development of cultural heritage and traditions. Its goal also included the protection of new cultural landmarks and the promotion of the city's original cultural works. Being the most sustainable city in China by some distance also gives Shenzhen an image and identity that is extremely attractive for workers and companies looking to move to the city.

Shenzhen is 30 km away from Hong Kong ('next door' by Chinese standards), a major financial and trading district in its own right with a rich tradition of entrepreneurship. The proximity to Hong Kong has benefitted the development of Shenzhen, but this positive externality is about to deteriorate. As I am writing this paper, the tighter controls that the Chinese government is increasingly imposing on Hong Kong and the fading away of the 'one country, two systems' status is starting to reduce the economic dynamism of Hong Kong. Companies and businesspeople are fleeing the area in anticipation of an escalation of the conflict and reduced civil rights and economic freedom. It remains to be seen what impact this will have on Shenzhen, but it will most certainly be negative.

In summary we conclude that the design and creation of a COI from scratch in a marginal location is an extremely risky exercise and one that takes a very long period of time to materialize against very strong odds. The success of places like Silicon Valley or the coastal Chinese clusters should not blurry our vision and make us overlook the very important adversities to overcome in attempting a project of such difficulty.

Taking that into account, in the absence of huge resources and a very long term vision, we should take advantage of existing 'quality places' along the categories described above and concentrate our efforts in promoting their existing strengths and compensating their deficiencies, in a concerted effort of private and public initiatives. The presence of leading universities and research centers, widely recognized expertise in particular areas of business, good living conditions, strong government funding and support and an entrepreneurial culture are all key factors in the generation of successful COIs.

4. Is Silicon Valley declining?

The current situation of Silicon Valley has a lot in common with its prosperous and successful history. According to the 2020 Silicon Valley Index, the San Francisco Bay area (which includes San Francisco and SV) created 120 000 new tech jobs between 2013 and 2019 (30 000 in 2019 alone), at a much higher rate than the whole of California and the United States. Unemployment in the area went down to 2.1% in 2019, a 19-year minimum.

Along with this, the regional GDP of the Valley increased by \$17 billion in 2019, representing a gain of 5% year-on-year. The value added per employee in 2019 was \$241 000, a 53% increase in inflation-adjusted terms with respect to 2001.

In 2018, per capita income in Silicon Valley reached \$131 000, an all-time high, and was growing considerably faster than the per capita income in California and the rest of the United States (see graph below).

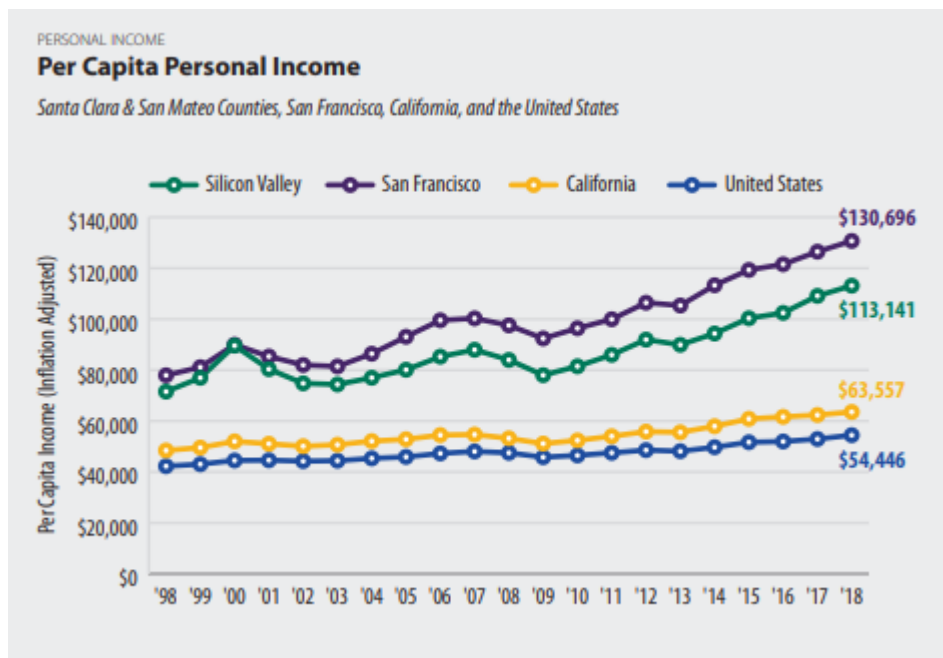


Figure 8. Data Source: United States Department of Commerce, Bureau of Economic Analysis
Graph Source: Silicon Valley Institute for Regional Studies

Venture Capital investment in the region has been remarkably high in 2018 and 2019, continuing the growth trend of previous years. There were 92 'megadeals' (deals over \$100 million) in the Bay Area in 2019, which represented a record in the historical series, including 22 Initial Public Offerings (IPOs).

Silicon Valley continues to attract foreign talent. More than two thirds of the new tech talent in the area, with age between 25 and 44, come from Asia, mainly from India or China. As of 2019, 38% of the Valley's population were born outside of the US, continuing a slow but steady increase.

Stanford University continues to thrive, grow in reputation, and attract more donors and talent from all over the world. Stanford now gets more than \$1 billion per year in donations

(Kottasova, 2015), with almost half of that amount routinely going into research programs of different kinds. Stanford conducts many multi-million research projects in collaboration with tech companies (including Chinese companies like Huawei -now under review-) and, even more important, the Federal Government continues to provide funding for research in excess of \$1 billion per year (Stanford Facts, 2020).

Strong companies such as Apple, Alphabet/Google, Facebook, and Tesla continue to thrive in the area. More recently Salesforce has emerged in San Francisco as the world leader in cloud-based management systems.

New ventures continue to pop up, supported by well-established VC firms (such as Andreessen Horowitz or Kleiner Perkins) or early stage firms (such as TDK or Corner Ventures), as a tribute to the many intangible features so unique to Silicon Valley.

Despite all this, successful entrepreneurs are starting to voice their concerns about the future of SV. Schwark Satyavolu, founder of two Silicon Valley companies (Yodlee, an account aggregation service; and Truaxis, a loyalty rewards and personalized statements company) and currently partner at VC firm Trinity Ventures, speaks from experience. In 1998, Schwark was about to start Yodlee in Seattle, where he was based at the time. His partner and cofounder of Yodlee asked him to check out Silicon Valley for a couple of days before he made his final decision on location and he finally settled for the Valley. Satyavolu tells us that back in 1998 in Seattle, people were reluctant to go work for a start-up. Meanwhile in the Valley, everyone wanted to work on the next big thing, so they only needed to be convinced to work for *his* startup, as oppose to *a* startup. On top of this, there was no shortage of venture capital funding in the Valley and costs were affordable. (Satyavolu, 2019)

Ariel Poler, serial entrepreneur in SV (founder of IPRO, Topic and Textmarks) and Board Member in 20 other startups over the last 25 years, still appreciates the energy and incredible resources available in the Valley, but he says that it “has become obscenely expensive and dystopian” (A. Poler, personal communication, November 11th, 2019). Russ Siegelman, former partner at Kleiner Perkins and lecturer in entrepreneurship at Stanford speaks along similar lines.

To underpin these opinions, there are certain statistics that already show disturbing trends in the recent evolution of SV.

In terms of new patents registered, a proxy for innovation, the number registered to Silicon Valley inventors doubled from 2008 to 2014 but it has remained more or less constant since (Silicon Valley Index, 2020).

From 2017 to 2018 the number of new patents registered decreased 5.5% or 1084 patents (from 19 539 to 18 455) (Silicon Valley Index, 2020).

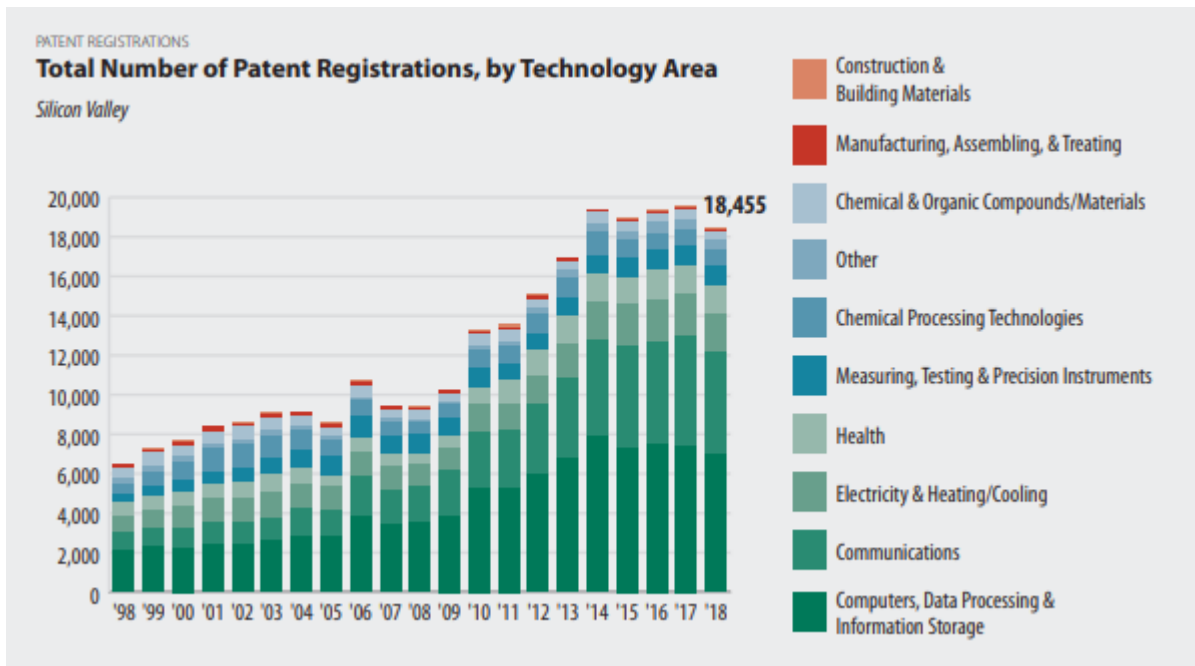


Figure 9. Data Source: United States Patent and Trademark Office
 Graph Source: Silicon Valley Institute for Regional Studies

Along with the stagnating number of new patents, a surprising reality of Silicon Valley (and the San Francisco Bay Area) in recent years is the dramatic decline in new startups being created. The number of startups right now in the region receiving seed or early stage funding is only 12% of what it was five years ago (Silicon Valley Index, 2020).

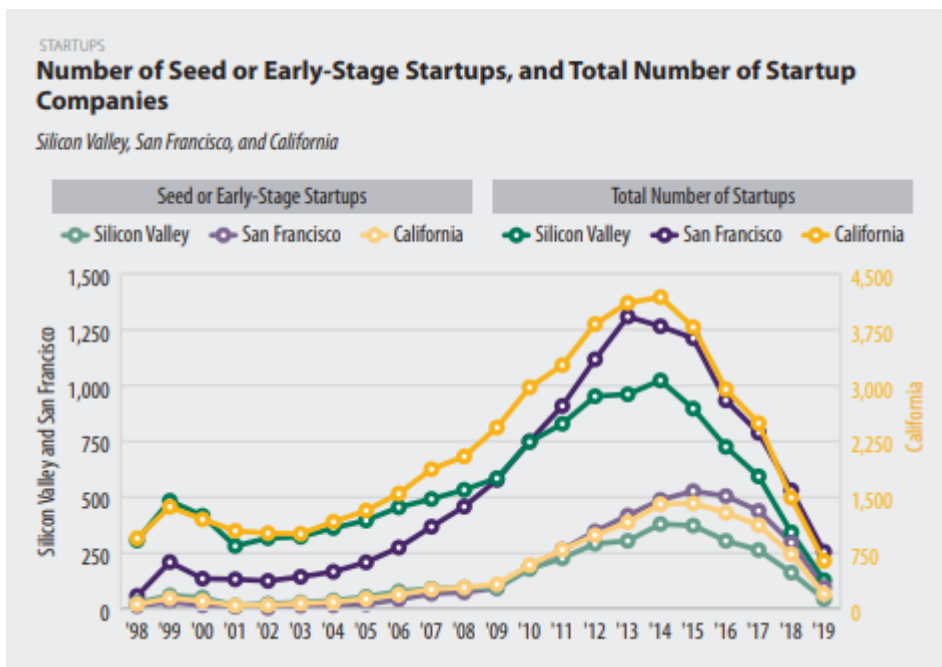


Figure 10. Data Source: California Department of Finance
 Graph Source: Silicon Valley Institute for Regional Studies

And, despite the increasing amounts of venture capital invested in the Valley and Bay Area in recent years, angel investing in the region declined in 2019 to \$121 million (an 8 year low) and the number of funded start-ups in 2019 (130) was the lowest in the last 20 years (Silicon Valley Index, 2020). Furthermore, increasing amounts of capital from Silicon Valley VC firms is being invested outside of the Valley (over 65%; The Economist 2017).

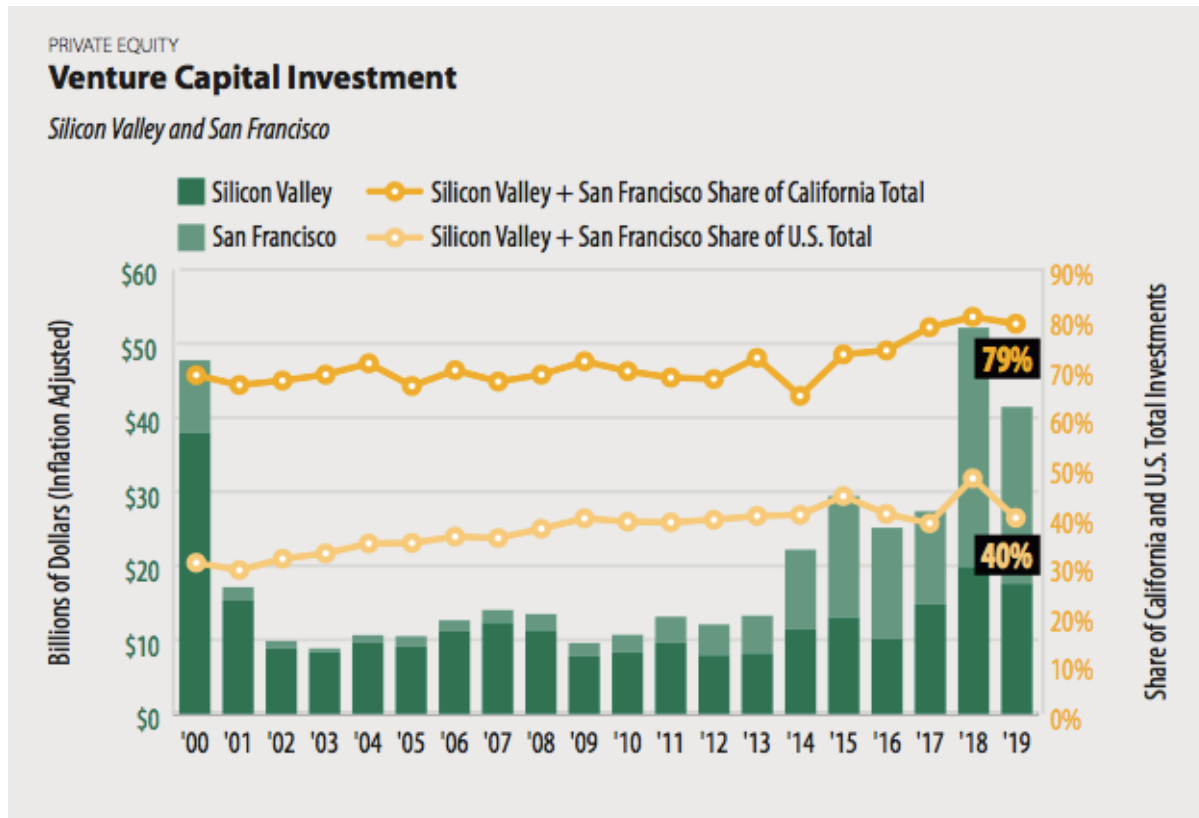


Figure 11. Data Source: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report (2000-2015); Thomson ONE (2017-2019)
Graph Source: Silicon Valley Institute for Regional Studies

Moreover, relatively new to the Valley is the intense out-migration of people. Just like in 2017 and 2018, more people are leaving Silicon Valley than migrating in, though the population is still increasing due to natural change of births minus deaths. Over the last two years, the average number of homes in Silicon Valley listed up for sale each month has increased by 37%, meanwhile the number of homes sold has decreased significantly in that time (Silicon Valley Index, 2020).

In 2018, 46% of Bay Area residents declared that they plan to leave the area in the next few years, up from 34% in 2016 (The Economist, 2018). The term ‘Off Silicon Valleying’ coined to reflect the phenomenon of people leaving or planning to leave the area shows well how relevant it has become.

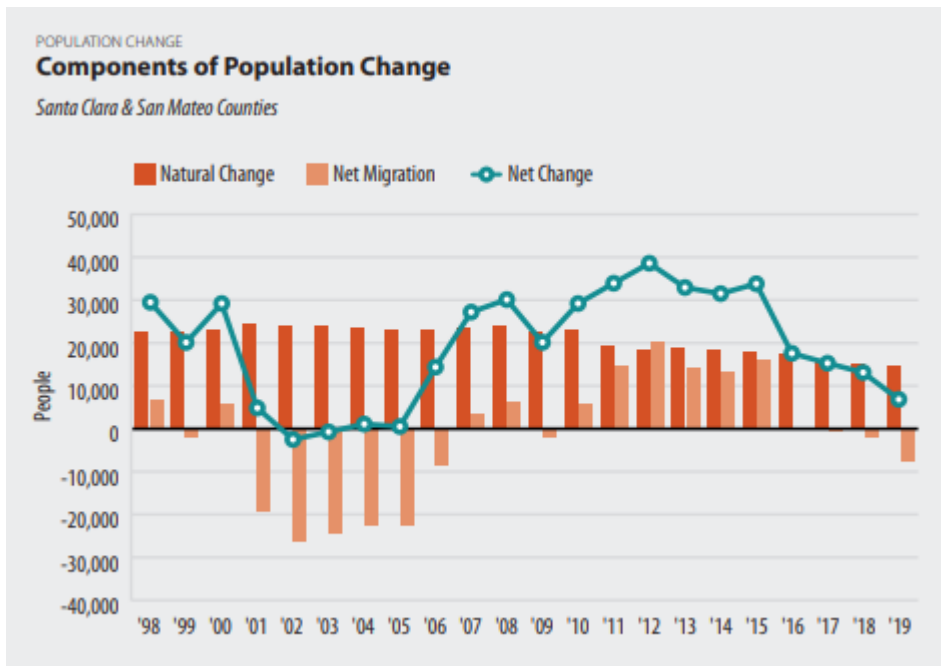


Figure 12. Data Source: California Department of Finance
 Graph Source: Silicon Valley Institute for Regional Studies

All these statistics underpin the notion anticipated by local entrepreneurs and industry experts. Silicon Valley is still one of the most economically prosperous regions in the United States and the world, but a noticeable shift is going on. If not a decline, there is sufficient evidence to conclude that the Valley is going through a shift in its nature and in the companies that populate it. At a minimum, there is transformation away from the start up heaven it used to be towards an environment more suited to the large, established corporations. We have to ask ourselves why this is happening.

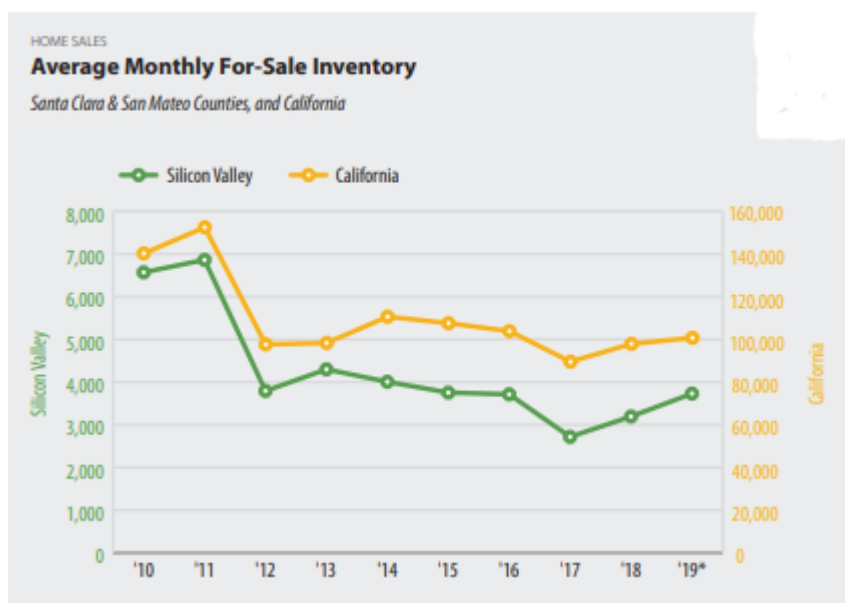
The main factors that help explain the transformation of the SV ethos can be classified in five categories:

- Cost of living and environment
- Demographics
- Impact from large tech corporations
- Alternative working models offered by technology
- Emergence of alternative destinations and themes

4.1. Cost of living and environment

One of the main complaints coming out of the Bay Area is the exorbitant housing practices that make it exponentially harder for a startup with limited funds to survive. These complaints are not without cause. The median price of a house in Silicon Valley in 2019 was \$1.12 million, and \$1.35 million in San Francisco. These are more than double California's median (\$487 000) and more than four times the country's median price (\$251 000) (Silicon

Valley Index, 2020). Ajay Royan, Founder of investment fund Mithril Capital, puts it in very graphical terms: “How are you supposed to have a startup in a garage if the garage costs millions of dollars?” (The Economist, 2018). The median home sale price in Silicon Valley was just over \$600 000 as recently as 2011, still well above the state and nationwide price but a far cry from the current situation. This rapid increase is a result of the disparity between the supply and demand of housing in the region. Since the global financial crisis of 2008, Silicon Valley has created 821 000 jobs but only 173 000 new housing units, and this disparity of 5 to 1 has made Silicon Valley the area with the highest housing prices in the United States. Fewer homes were sold in 2019 in Silicon Valley than any other year since the year 2000 (no data from previous years), and the number of Silicon Valley homes listed for sale each month is just under 4000, whereas in 2011 it was at almost 7000 (Silicon Valley Index, 2020).



*Includes data through November

Figure 13. Data Source: Zillow Real Estate Research

Graph Source: Silicon Valley Institute for Regional Studies

It seems that local authorities are making efforts to combat the rising house prices and the lack of affordable housing lately. In 2019, there were more ‘affordable’ housing units approved than in any other year over the past 20 years. However, ‘affordable’ defined as affordable to those earning up to 80% of the median income of the area, which is a far cry from what most people would actually consider affordable.

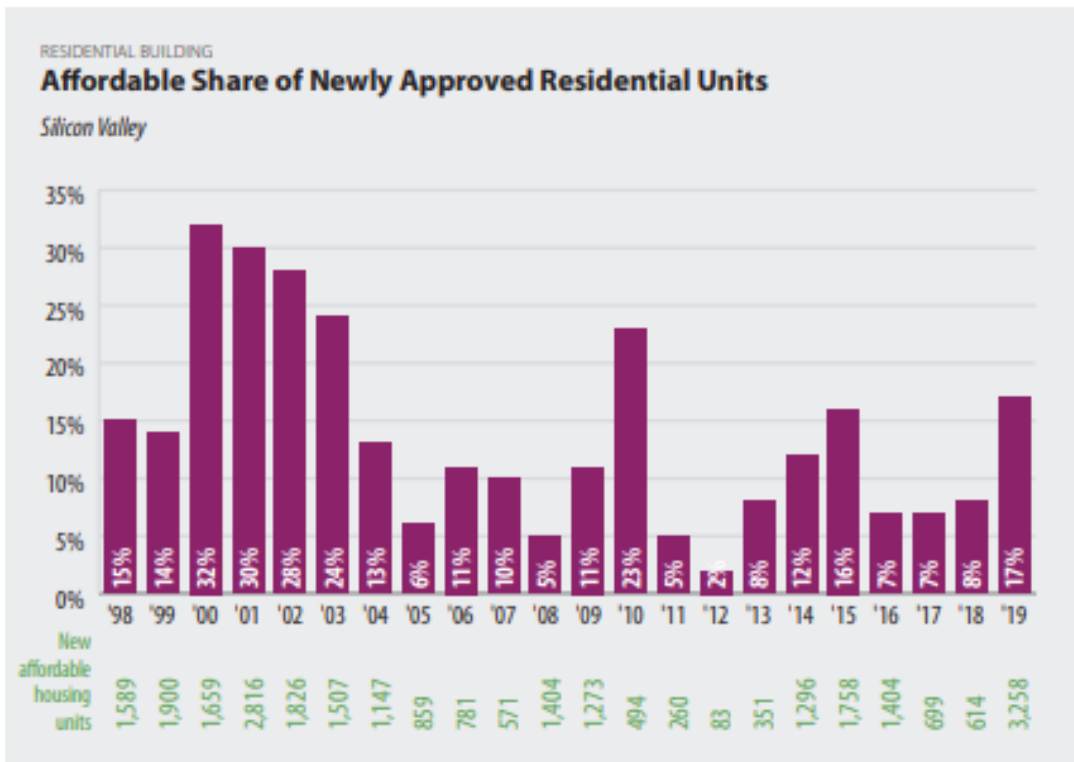


Figure 14. Data Source: City Planning and Housing Departments of Silicon Valley
 Graph Source: Silicon Valley Institute for Regional Studies

Despite efforts from the authorities trying to keep housing practices in check homelessness continues to rise in the area. San Francisco has a homeless population of more than 8,000; San Mateo and Santa Clara counties have more than 11,000 between them (Silicon Valley Index, 2020).

The income inequality in the Bay Area is at a historic high, 13 percent of households hold more than 75 percent of the region’s wealth (Silicon Valley Index, 2020). The homelessness problem is a serious issue facing Silicon Valley and San Francisco right now. United Nations Special Rapporteur for Adequate Housing Leilani Farha has gone as far as calling the situation in San Francisco a “human rights violation” (Business Insider, 2018). According to Business Insider, San Francisco has the highest rate of street homelessness in the US and walking down the streets of the South of Market (SOMA) it is not uncommon to see discarded needles or excrement.

Housing prices along with the fact that the Valley is relatively large in surface area means that commuting is a pain. Three hour commutes between San Francisco and Palo Alto are not unheard of (a drive that would take 30 minutes without traffic) and this is due to the fact that 73% of people travel by car on their own, while the share of people that utilize public transportation is low and declining (Silicon Valley Index, 2020).

High traffic congestion, dirt on streets and highways, high cost of living, high income inequality, drug abuse and a huge homelessness issue, increasingly make the Bay Area a difficult place to live in.

4.2. Demographics

The Valley has always excelled at attracting talent, but in six of the last seven years, the Bay Area has experienced a decrease in net migration, with 2019 being the year with the largest net outflow of people from the region since 2006.

The decrease in net foreign immigration over the last few years shown in the graph below is a result, among other things, of a stricter policy in the concession of visas to foreign migrants introduced by the Trump Administration. Now it takes more than 18 months for companies to obtain visas for foreign workers, whereas before they would have been issued almost immediately. More and more, foreign students that come to the U.S to obtain advanced degrees and PhDs in technical fields have to go back to their country of origin. Randy Komisar, a partner at Kleiner Perkins, puts it very bluntly: “If you ask me ten years from now why Silicon Valley failed, it will be because we screwed up immigration” (The Economist 2018).

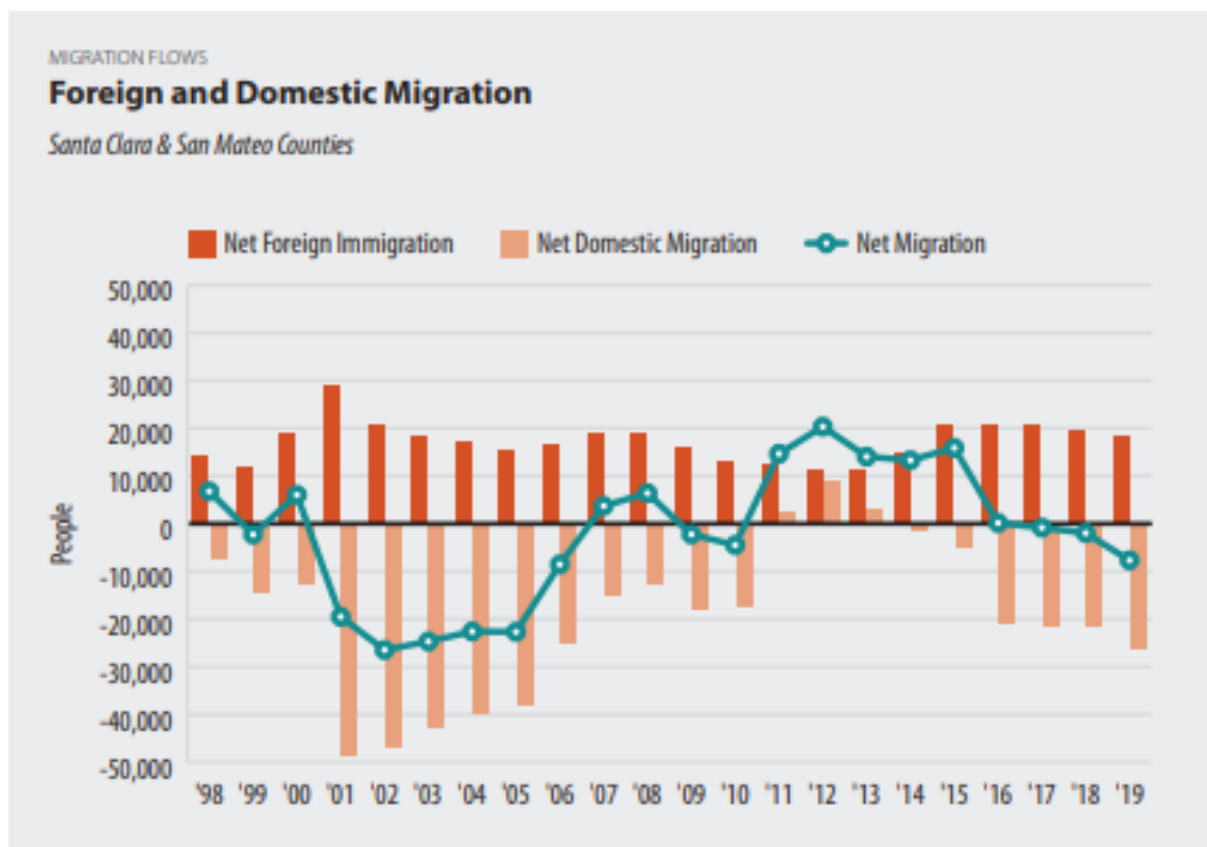


Figure 15. Data Source: California Department of Finance
Graph Source: Silicon Valley Institute for Regional Studies

4.3. Impact from large tech corporations

Crowding out effect. Startups are facing off against the established corporations in a way that they have not had to do until the last five or ten years. In the past, working for a big

company was a stable but not extremely well-paid job in most cases, and the way to really get a big pay day was to go work for a startup early that ended up succeeding and reap the benefits from cashing out a generous stock option package. Now, however, the big firms like Facebook or Google pay their employees generously and their option packages have yielded huge gains as a result of their stock performance since the tech bubble. As a result, spending time at a successful startup would not yield a significant financial gain in comparison to spending the same amount of time at one of these tech titans. Facebook offers a median wage of \$240 000. The median wage at Alphabet (Google's parent) is \$200,000. In addition to these generous wages, these firms offer many perks, like stock options, incredible working facilities (or the possibility to work from home) free gym at the premises and highly subsidized cafeterias. Startups in the Valley are competing for the same talent that companies like Facebook or Alphabet are hiring. Startups are finding it harder and harder to lure talented workers away from the big corporations in the area, and they are also finding it harder to retain them.

Change in culture towards less fluidity of knowledge and talent. AnnaLee Saxenian has written a number of papers studying what made Silicon Valley stand out from the rest of the technology and innovation clusters, and she has always been a big believer in the Valley. Now, however, she believes there has been a critical shift in culture. Saxenian states that the big technology companies have developed a culture that she defines as 'autarkic', one that does not cultivate the flow of knowledge and talent across different firms in the Valley, instead directly disrupts it. This is something that directly opposes one of the critical reasons for the historical success of Silicon Valley, and very reminiscent of the mistakes Route 128 made that allowed the Bay Area to leave it behind.

Generation of 'kill zones'. The tech giants of Silicon Valley are much more agile now compared to the large firms of previous decades. They have basically become better and tougher competitors at everything they attempt to do. This means that startups have a much harder time growing to a significant size as they are imitated or acquired by larger players early on, creating a 'kill zone' around the big firms where startups are not able to survive (The Economist, 2018).

4.4. Alternative working models rendered possible by technology

Somewhat ironically, Silicon Valley has become a victim of its own success. Many products of Silicon Valley like instant messaging, video-conferencing and collaborative working tools have enabled companies to move away from Silicon Valley. The approach taken by a large number of startups is to have the headquarters of the firm located in Silicon Valley but hire engineers and other employees in other locations, where talent is cheaper and less likely to be poached. Furthermore, companies that may have considered moving to the Valley completely a few years ago are now just setting up an office in Silicon Valley to have a presence there and take advantage of the networking and venture capital benefits the Valley offers. Startups still recognize the value of having a presence in Silicon Valley, but they don't have to be based there in order to reap the benefits. Thanks to the inventions of

Silicon Valley, the business world is becoming smaller in operational terms but spreading out geographically.

4.5. Emergence of alternative destinations and themes

The complications for startups in Silicon Valley have coincided with the flourishing of other ecosystems where startups can operate and thrive.

In the U.S., Seattle is home to two of the five largest companies in the world by market cap (Amazon and Microsoft) (The Most Valuable Companies in the World, 2020), and a growing number of startups are sprouting up in the area enticed by the cheaper housing and living costs as well as the increasing quantity of venture capital activity in the city. Los Angeles, Austin, Boston, Tampa, Phoenix, Salt Lake City are examples of locations with renewed vitality that offer better living conditions at a fraction of the cost and living expenses of the Bay Area. More and more VC investment is flowing into these locations, that often maintain close ties with Silicon Valley through a representative office in the Valley and taking advantage of new distributed working models.

Outside the US, we have already singled out London, Shenzhen, and Tel Aviv, but Beijing (Zhongguancun STIP) deserves a special mention, as it is home to over 40% of China's unicorns (Brizzolara, 2020). Other significant clusters of innovation develop in Toronto, Montreal, Berlin, Amsterdam, Copenhagen, Singapore and Bangaluru (home of Wipro and Infosys, in India).

Since the late 90s and early 2000s, a large portion of all innovations was centered around the dot com and internet boom, and some of the companies created in that era have grown to become the most valuable in the world. Now, software is integrated into everyday life, and that coupled with the development of 5G communication networks, propels opportunities in many other sectors and technologies, for which Silicon Valley does not necessarily start from a position of advantage. A couple of examples illustrate this situation:

Take the use of blockchain technology for the development of Crypto currencies. The tiny Swiss city of Zug, in between Luzern and Zurich, famous for its low taxation and with long experience in the management of international flows of financial capital is increasingly becoming a COI of blockchain applied to cryptocurrencies. Zug was the birthplace of Ethereum and has become the home of several cryptocurrency companies like Ethereum, Dfinity, Polkadot, Bitmain, Libra, Tezos, Cardano and Cosmos. The Crypto Valley Association (CVA) was established there in 2019. After all, few people would dare to question the experience of the Swiss moving capital secretively around the world (Lewrick, 2019).

Artificial Intelligence (AI) is another area of computer science that generates a lot of expectations around it. Given that AI depends so much on the availability of data and on the possibility to use it, China seems to be in the driving seat. The country generates an incredible amount of data due to its large population and abundance of data collectors (e.g. security cameras) and its looser regulations in comparison to the West in this matter gives them an advantage in the development of the field. Besides, China's government has set the

goal to become dominant in artificial intelligence by 2030 (The Economist, 2018), and they deserve to be taken seriously.

Despite all these circumstances, we have to bear in mind that this is not the first time that Silicon Valley's decline has been foreshadowed. One of the Valley's main products in the early 1980s was semiconductor-memory-makers, and Japanese manufacturers were more efficient at producing them and captured the large majority of the market. Silicon Valley survived and thrived. In the late 90s and early 2000s, the dot com bubble burst, disproportionately affecting technology stocks. Silicon Valley survived and thrived. The area's regenerative power is exceptional, so interpreting these trends as just another bump in the road of Silicon Valley is not entirely unwarranted.

Silicon Valley is and will likely continue to be significant to startups and innovation for a long time, given that, while the importance of the place shrinks, the model, spirit, and idea of Silicon Valley stays relevant.

5. Final Remarks. Taking part or taking over: could there be a dark horse?

In the 1970s and 1980s, Silicon Valley and Route 128 were two places exhibiting extremely similar characteristics. They both had a mixture of small and big technology companies, world class universities nearby, and large sums of venture capital and military funding. In fact, Route 128 was a clear front runner in these categories. Route 128 benefitted from proximity to Harvard and MIT (not that far away from Yale and Brown). It had numerous corporate research centers nearby, notably Bell Labs, where the transistor (the technology that birthed Silicon Valley) was invented. Route 128 was also much closer to Wall Street, and the majority of venture capital firms were still located on the East Coast, giving the Boston cluster a clear advantage in terms of funding. Now however, the Route 128 cluster is a far cry from Silicon Valley, which illustrates how difficult it is to predict who the future is going to favor. It is important to look back at the Route 128 versus Silicon Valley scenario of 40 years ago to realize that we need to keep an open mind when considering what might drive innovation in the future.

It should also be noted that trying to recreate Silicon Valley around computer technology is futile. Silicon Valley caused an economic and social revolution, provoking an enormous transfer of power from the big corporations to individuals. Now, people are much more able to accomplish all sorts of goals and landmarks, which in the past could only be carried out by large enterprises. Thanks to developments in technology, people can call friends on the other side of the world at no cost, or complete calculations on their laptop or smartphone that a few decades ago were only possible from the computers of large corporations. The inventions that have come out of Silicon Valley have disrupted the way society operates. Perhaps no one in Silicon Valley's history embodied the spirit of trying to make an impact on society better than Steve Jobs. In his attempt to lure John Sculley from Pepsi to Apple, Jobs delivered the now famous line, "Do you want to sell sugar water for the rest of your life or come with me and change the world?" (Rana, 2017).

When we think about who could take the place of Silicon Valley, we should better be thinking about who could lead the next revolution that changes the world and not so much about who can develop existing technologies better, faster, more effectively or into completely new applications.

In chapter 4 I discussed the emergence of alternative destinations to Silicon Valley, that specialize in specific developments of information technology such as blockchain and artificial intelligence. A good number of these destinations are already being very successful, both in the US and abroad, and contributing with very significant developments and more to come. To me though, these COIs will fall in the category of those taking part in the Silicon Valley revolution.

We will see more and more COIs from alternative locations working in close cooperation with Silicon Valley, as parts of SV companies relocate elsewhere, entrepreneurs and employees from SV move elsewhere and the other way around. When the connection between two clusters is robust pursuing shared projects, it usually results in efficiencies and

fluid mobility of people and resources. Furthermore, when the bonds are durable and long-lasting, the clusters form what is called a Super Cluster of Innovation (Super-COI). The case of Silicon Valley and Tel Aviv is a clear example of a Super-COI, one that has stemmed from the traditional ties between Israel and the US, and their large pool of scientific and engineering resources. Today, many Silicon Valley companies have research and development centers located in or around Tel Aviv. With the increasing tools at companies' disposal, developing a relationship with another cluster is becoming less difficult and more advantageous every moment. Also taking part in the revolution.

Clusters that develop a solid and recognizable expertise in a technology that has a significant impact on the way companies and individuals go about business and life, will rapidly draw in talent, funding and companies, and the cluster will likely succeed.

There are several examples of technologies that are already showing great potential, like distributed ledger, autonomous vehicles and technologies geared towards space exploration.

Distributed ledger technology (DLT) is a system to record, process, validate or authenticate transactions, and it does this through a distributed ledger. A distributed ledger is a database that is shared and synchronized across various devices, sites, and geographies, accessible by multiple people. This technology is used for the recording of transaction of assets and unlike conventional databases, it does not store the data in a central unit, making it much harder to tamper with. The most famous type of DLT is the Blockchain, which powers bitcoin and is becoming more and more sought after. Blockchain (and DLT) is far more secure than traditional databases and removing the central unit to store and approve transactions means it is also much faster and less costly. Furthermore, due to the information being shared across multiple devices (nodes), it is a more transparent way of handling transactions.

Self-driving cars offer big potential to improve road safety, reduce traffic congestion and carbon emissions, reduce the costs of distributing goods and increase mobility of the elderly or impaired population. To give a sense of the size of the opportunity, just bear in mind that according to the World Health Organization, there were 703 million people over 65 years old in 2010, but by 2050 that number will be around 1.5 billion (United Nations, 2019).

Space exploration, development, and commercialization is another promising field. On May 30, 2020 SpaceX's Crew Dragon spaceship launched taking NASA astronauts Bob Behnken and Doug Hurley to the International Space Station. This marked the first-ever orbital flight of astronauts on a private spacecraft. SpaceX can get a kilogram into orbit for \$2 720 with their new Falcon 9 rocket, whereas the prevailing cost in government managed ventures was \$54 500 (Reynolds, 2020). This 95% cost reduction means that a whole range of possibilities that were not even close to being commercially viable are now worth of consideration. Things like space tourism, space hotels, lunar mines and asteroid mining are becoming plausible, and in a few years, could become profitable. Eventually, if the world's population keeps growing, they could even become essential.

All these technologies rely heavily on algorithms of artificial intelligence and machine learning, which derive from the advances of information technology in the treatment of big amounts of data. While several COIs are gaining relevance around these technologies, SV is very much playing a leading part in the development of all of them. Therefore, to me COIs around these technologies are just taking part in the SV revolution, not taking over.

For a new COI to have an impact and prevalence comparable to the one Silicon Valley has in the area of computers and information technology and, as a result take over as the leading technological driving force, it needs to be able to change the world as Silicon Valley did.

Many things can be learned from the experience of SV, but we will need much more than incremental advances or extended uses of existing technologies to spearhead a revolution.

No matter how difficult and unthinkable this may seem today, I am sure it will happen one day, probably in the not too distant future. After all Silicon Valley did it, and it all started with a scientist visiting his mother.

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Appendix

Figure 16. Appendix 1: Common attributes of place quality in innovation clusters

Source: Esmailpoorarabi, 2015

Common attributes of place quality in innovation clusters.	
Context	
Regional and city quality	<p>Having worldwide reputation in knowledge economy and KBUD, which support the reputation of innovation clusters</p> <p>Having strong plans for developing and promoting innovation clusters inside their boundaries</p> <p>Having high-levels of tourist, famous universities, educated workforce, and ethnic and cultural diversity</p>
Form	
Location	<p>Well-connecting to important parts of the city—i.e., CBD, airport, other clusters, research centres, universities</p> <p>Surrounding by unique natural or built environment—i.e., waterfront sites, bushlands, historical or old industrial sites</p> <p>Avoiding sprawling development to support the dynamic atmosphere and sustainable urban development</p>
Urban form	<p>Considering the natural features of the area, a mixed-use and a flexible zoning</p> <p>Focusing on pedestrian, bike and public-transport oriented planning rather than car-dependent ones</p>
Design	<p>Emphasising on unique, diverse, high-quality and cutting-edge urban and architectural design—i.e., in workplaces</p> <p>Designing the ground floor more accessible to all to keep the connection with streetscape</p>
Amenities	<p>Respecting environmental-friendly designs and putting the natural environment in the centre</p> <p>Ensuring the accessibility to basic facilities—i.e., schools, hospitals and elderly – /child-care facilities, well-served stores</p> <p>Providing advanced facilities—i.e., cycling and jogging areas, well-equipped sports grounds, café, restaurant, bars, free Wi-Fi</p> <p>Providing high-quality and smart transport systems and fast and reliable ICT infrastructure</p>
Function	
Management	<p>Involving public and governmental agencies to become responsible for developing infrastructures and anchor projects—i.e., roads and utilities</p> <p>Involving private sector to become responsible for building their own blocks based on the master plan</p>
Land use	<p>Aggregating different activities in the same area to shape a place to live, work, learn and play with quite blurred boundaries</p>
Talent	<p>Controlling the value and availability of residential and commercial properties and also work spaces</p> <p>Expanding the pool of knowledge workers through a targeted education system in allied universities and research centres</p>
Technology	<p>Attracting local and foreign knowledge workers through offering variety of work opportunities and high-quality lifestyles</p> <p>Attracting and retaining domestic and international knowledge-based firms and industries through offering variety of state-of-the-art infrastructures—i.e., providing advanced construction of communications technology and digital structure</p> <p>Hosting well-known research centres which facilitate development and spill-over of knowledge</p> <p>Hosting well-known knowledge-based companies which help the reputation of the cluster</p>
Ambiance	
Cultural milieu	<p>Developing social and cultural spaces which are accessible to all people—i.e., meeting places, cultural centres, museum, galleries, cinemas, libraries, theatre</p> <p>Planning events to involve large groups of people—i.e., live performance venues, cultural festivals</p>
Networking	<p>Characterising the cultural environment by the presence of public art, and preservation and regeneration of the existing cultural heritage and sites</p> <p>Facilitating business interactions and relationships to ease the spill-over of knowledge—i.e., developing shared workspaces for peer networks</p> <p>Facilitating social interactions to enhance the sense of community—i.e., developing social communities, public spaces</p> <p>Facilitating interaction of people and firms to develop a dynamic market and to link talent and firms</p>
Diversity	<p>Hosting and accepting different types of people and lifestyles—i.e., people from diverse ethnics and cultures, LGBT community, bohemians</p>
Creativity	<p>Enhancing the artistic, cultural and technological creative atmosphere—i.e., high presence of artists and inventions</p> <p>Enhancing the presence of art within the site in the form of sculptures, paintings and so on to support the creative ambiance</p>
Image	
Lifestyle	<p>Providing different types of entertainment and activity, which support the diversity of lifestyle</p> <p>Providing dynamic and active day and night life in the street level to support the cluster's buzz</p>
Safety	<p>Activating the street level with food, entertainment options and dynamic events to create a safe place in day & night</p> <p>Providing an efficient lightening system in streets and public areas</p>
Sense of place	<p>Promoting the quality of being unique or unusual—i.e., valuing monuments, historic buildings, unique architectures, distinctive buzzes or unique natural environment</p>
Identity	<p>Making a brand for the cluster to support a unique identity and marketing it globally effectively</p>

Figure 17. Appendix 2: R&D expenditure as a % of GDP & Researchers per million inhabitants
 Source: UNESCO, 2020

