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CLUSTERS ARE DRIVING TOWARDS SPECIALIZATION: AN ICT SECTOR APPROACH

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Introduction

In this thesis I will examine the economics around clusters. Clusters are agglomerates of firms related to each other by the sector in which they operate. They form a unique agglomeration capable of gaining a competitive advantage with respect to firms outside the cluster. This is the reason why they are present in the evolutionary policies conducted by the governments of today.

In the first chapter I will go through the theory around clusters. A cluster theory was elaborated by many economists, starting from Marshall in 1800. However we could go back to the first agglomerates of rural cities to see why working together with people with your same task might be an advantage. In going through its main benefits, counter effects and drivers I will use the work of the author who re-elaborated the whole set of the cluster theory: Michael J. Porter.

In the second chapter I will elaborate my hypothesis, explaining that the evolution of modern clusters is to specialize to a specific layer of the chain. In doing this I will take into account the ICT sector, and explain why the sector is fitted to host specialized clusters.

The third chapter will find evidence that a public intervention is admitted in the economics of clusters. After explaining the point of view of Hefner, I will add the example of a European intervention on its ICT clusters (EIPE).

Finally, I will report the instance of one of the main centers of innovation that has started its clustering path in 1980: the Bangalore ICT cluster. In analyzing it I found proof that justifies the theory of the first chapter, in particular the life cycle of a cluster.

1. Theoretical Framework

Aggregates of industries were found to be productive by economists, who studied their dynamics with the intent to extrapolate a tool that could help future economic growth. Michael E. Porter took the previous economic theories on clusters and gave a proper definition of them which could contain the outcomes of the previous studies. He defined clusters as “geographic interconnected companies and institutions in a particular field” (Porter, 1998). In Japan the word Keiretsu is used to describe clusters. The word is formed by the fusion of two words, which in english are representative of “system” and “row”(Fast Company, 2014). The japanese culture uses this word to explain a common economic phenomenon of their society: agglomerates of firms of the same sector, which enter in horizontal or vertical collaborations to compete globally (Grabowiecki J. 2006, 03).
In this first chapter I will go through the main features of the cluster phenomenon.

1.1 Marshall (a neoclassical view)

Alfred Marshall already caught in 1890 the main and intangible feature of economic clusters: the strong force which rises in between firms of the same sector located in the cluster environment. Although he was not precise in its definition, he was sure of its presence because its effects were foreseeable: “The mysteries of the trade become no mysteries, but are as it were in the air”. Furthermore, the economist elaborates a precise formula with which the cluster moves. Having said the intangible components of the cluster formula the author also adds a fundamental underlying condition with which the firms work when they locate in a region: the factors of production. Due to their visibility, the inputs of production were the first condition for which a government and investors could seek for in analysing a cluster. This gave to a region a greater opportunity for external investment.
The growth rate of the cluster was strictly linked to the extent to which the region was depending on the cluster. Hence, specificity was the core operator of the formula,

which allowed the cluster to canalize the resources towards one sector and increase productivity.

Marshall’s study of the agglomerated industries added another dimension to the theory. He analyzed the demand side of the agglomerates and explained how closely-located retail stores could attract the demand for a product. The main suppliers of a product should co-locate their customer reach. This approach will be then abandoned with the advent of modern communication and transportation systems. However retail based industries such as the food industry, still find it profitable to co-locate. If we use a cause-effect analysis this approach might not make sense. In fact, nowadays, metropolises are attracting the supply side to locate their retail stores where they have the greatest visibility and not viceversa. In the world of today the final consumers demand and shape the whole marketing concept. We can understand how Marshall, in his days, could not find this reasoning realistic (Bergman).

Back in the days agglomerates were thought to be actionable in any region that could satisfy the above needs. If the factors of production were present, any government was thought to be able to build up a cluster through financing and reorganization of the regional industry structure. Local institutions needed to analyze carefully the situation of the existing firms and especially the resources. The mobility of resources was not as high as today. A specialized cluster was not even imaginable far from the inputs and the other players along the value chain.

To conclude the section, we can delineate two main points that summarize how the ‘Marshallian’ cluster differs from the current theory:

- Clusters needed to have the whole value chain in it or around it.
- The demand was local, and for this reason it was affecting the cluster performance.

1.2 Porterian View

Porter himself strongly believed in clusters as the main drivers of our global economy. However he encountered a paradox in his study of clusters: “the enduring competitive advantages in a global economy lie increasingly in local things”. The local economy was driving the national aggregate economy. Due to this reason he strongly supported the power of interconnections between firms in the same region. They are strong relationships between the players of each layer or between players at different layers, which are vertically collaborating with the whole chain in order to create complementary products or services that can compete globally.

Porter elaborated a vectorial system with 4 different forces moving the cluster, which he called the "diamond". The system is composed of four main points which are occupying the angles of the diamond:

1. Demand characteristics of the region in which the cluster locates
2. Availability and level of inputs of production which can be found in or from the industry
3. nature and intensity of the local competition
4. intangible assets and information flows which are moving vertically along the supply chain of the industry.

The diamond is really close to Marshall's previous interpretation of agglomerates, but what comes out of this diamond is Porter's view on clusters, as economic drivers of competitive advantage. It is the aim of the players of the global economy, to compete and beat the competitor in the market share race. Todays technologies are well developed and they are satisfying human needs close to perfection. It is hard to enter in a market with an innovative product and enlarge the market. It is for this reason that the congested global market is nowadays more competitive than ever. Another reason is given by the globalization effects, which are enabling firms to compete globally and therefore cutting the market boundaries beyond national territories (Bergman).

The author thinks that the main contribution that clusters give to the microeconomics of the area is given through competition. Through this mean, clusters avoid firms from fronting each other, rather, they direct the competition towards the world market in a unique and shared objective. Therefore firms in clusters will compete for the same goal, establishing a healthy competition, which, in turn will yield:

- a greater level of productivity
- higher “pace of innovation”
- higher rate of business formation.

1.2.1 Productivity

A greater level of productivity can be explained by going through the cluster forces listed above. As we explained, a higher local interaction will lead to greater cooperation between firms along the industry vertical chain and also along the horizontal chain. This will create a pool of expert labor force from which every member of the cluster can benefit. Consequently, every supplier will be reachable, before outsourcing to other areas. This loop will make sure that firms will continue to give business to each other and still not disperse their forces. This will strive in a global wide reputation built on this auto-fostering process.

In theory, the first benefit that economists saw from clusters was given by the reduction of transportation costs, including timing. This tangible reduction of costs is dependent to the sector and to its dynamics. As we go further in our study, we will learn how distance is decreasing in its importance. This discussion can still be made in manufacturing sectors where firms base themselves next to their suppliers to avoid high shipping rates and long supply timing. Finally, what distinguishes a cluster from a normal industry is its ability to transform the relationship along the vertical chain to an organization-like relationship, where firms in different layers of the chain would be treated as different departments.

1.2.2 Innovation

What then drives innovation is this continuous flux of information that goes around the managers and employees of the cluster. The workforce lives in close connections between each other and have no choice but to incorporate the highest level of information available, due to what Porter calls a “constant comparison”. Therefore, every player will be able to imitate and play at the same level (or almost, depending on the industry) of the others, independently of its share of the market..

Porter does not make any difference on the types of innovation that the knowledge sharing dynamics could bring (product or process), however, regardless of its type, any innovation coming from such a dynamic center of information is, on average, going to be a radical innovation. A radical innovation is the commercialization of a disruptive invention, which, without any previous roots, will oppositely shift the direction of the strategies of the company and use new resources. As we will see later in the thesis, when an environment has such a disruptive (Schumpeter's Creative Destruction, Aghion, 1992) innovative forces, the only firms which can survive are the ones who are extremely flexible, with almost no roots (Kuah 2002).

1.2.3 New Business Formation

An enormous part of the studies about modern agglomeration of firms has proven that clusters are fostering new business formation. Porter finds the causes of this constant formation process. First of all, it is defined by the theory of the second best that opportunities are easily recognisable in competitors and followers can look at them, imitate them and exploit opportunities that come from what competitors were missing; it can be said then that in such closely tied agglomerates of firms opportunities can be perceived by all of the players and not only, but also to the outside world, which sees the cluster as a readily available pool of labor and skills that can be exploited with a lower amount of risk with respect to the external market. Firms will then find it profitable to enter the cluster through relocation of one of its departments or by locating a new start up in the cluster. The cluster dynamics will either foster a rapid period of growth of the firm, or expel the firm that was not able to adapt to the high mobility and dynamics of the cluster. A new entrant should be able either to innovate or to be flexible enough to adapt. As we will see small and horizontal structured firms are the most flexible ones and as such also the ones who are most likely to be found in a cluster.

1.3 Cluster Formation

As we will see later in the ‘Public Policy’ chapter clusters cannot be created from scratch. Governments and economists are nowadays examining cluster formation, without any clear results of the rooting process. At least, if any exhaustive study has been made on agglomerates and it has been extrapolated the real cause of clustering, the latter cannot be replicated by local institutions in any other area with the same ingredients. If the analysis of formation seems to come to an end, we should remember that clusters are formed by firms, which are formed by individuals, who are humanly taking irrational decisions, committing mistakes to learn from and innovating, a process where rational behaviors are not even imaginable.

The fact that theorists think that clusters are not replicable does not mean we cannot foster and sustain them. To do this we need to understand from what sources they may come to exist.

1.3.1 From Needs

The first source could be embedded in the needs of a region. A cluster that comes from a region’s demand of producing a product or delivering a service in order to satisfy the needs of its surrounding population. This demographic effect is only a starting cause, from which the agglomerate will need to prove to own the full set of characteristics that a cluster has. When an entrepreneur sees an opportunity, it will become an innovation only if the entrepreneur will be able to build an organization that can effectively satisfy those needs and adapt to the external environment. When we reason with a group of companies the external environment becomes crucial to the life of what might come to be a cluster. To summarize, if the an industry comes from the needs that a region’s demand side is experiencing it will become a cluster if the supply side will be able to satisfy the demand side and so creating a unique process that constantly leads to a competitive advantage with respect to other regions’ industries. For example, the Silicon Valley hosts on of the biggest clusters active in the world today, and the causes that generated such an economical phenomenon are the perfect application of our theoretical causes. The Californian region was demographically more spread than the eastern region. Due to the fact that new cities and areas were spreading all over the region, a problem arose: the inner land cities weren’t able to generate the electricity that the coastal cities were generating from water sources. Hence the engineers of the area grouped under the leadership of Harris Ryan (an eastern educated engineer who was working for the Electrical Engineering Department at Stanford University) to solve the problem. The laboratory was able to manage the creation of the longest infrastructure for the transmission of electrical energy ever built in the United States. This need started one of the key collaborations of the area, which generated one of the first generations of electrical engineers in 1900 (Rao, 2011).

1.3.2 From Expertise

The cluster that comes from the expertise of the pool of labor of the region is the one that develops after years of activity of the region’s firms. In this case the process starts from a prolonged supply of a specific asset or product per years, which integrates in the tradition of the region and finally culminates with the vertical downward integration of suppliers to deliver the final product to the world. We will see later on that this is the main driver of the clusters that are active today. Its firms’ culture differentiates clusters from usual industries because of their firms’ specific capabilities. With the years firms and employees will have a high turnover, because of the low entry and exit barriers of clusters. However, the tacit knowledge (processes, techniques and other capabilities) created by the employees will be kept in the cluster because of the clusters’ nature to create a high level of knowledge-sharing activity, which in turn enables the information to stay in the cluster for prolonged terms, until the businesses will be able to operate. Furthermore, if the core competences that the businesses of the cluster have developed are rooted in the culture of the region, they will be able to be a common source of expertise for every new firm of the region. In this way the high turnover of the businesses will not affect the region’s competitive advantage with respect to the global market. Consequently, we can state that a cluster that comes from a core competence, that is intrinsic in a region, will be a long lasting cluster. Another time, it is in the Silicon Valley that we find the most clear example of how the culture of a region can become a driver of innovativeness. Before the characteristics of semiconductors were even discovered, the Californian region started to host wealthy entrepreneurs, who brought their fortunes to the new area thanks to the new railroad infrastructure. It is not a case that Leland Stanford was the owner of the Southern Pacific Railroad. He created the University of Stanford in 1891, to give to the region the possibilities to compete with the eastern areas. It was the long sight of this entrepreneur and of others like James Lick (who built the Lick Observatory) which directed the area towards an IT specialization. When the University of Stanford was built, Berkeley was already in place, but it was the investment in personnel of the former to bring the area to the leading position of today. The potential of the region's human capital proved itself soon enough. When the first radio transmission was created by Guglielmo Marconi in 1897, engineers from all over the world tried to make the invention an innovation by amplifying the signal and making it usable by the population. Lee DeForest, relocated in San Francisco, was able to apply the first signal amplifier, broadcasting from coast to coast. At the same time, Cyril Elwell founded a telephone company, which was then able to use DeForest's invention as repeaters in between the west and the east coast, to allow for the first telephone company, FTC, to operate. The patent was then sold to Graham Bell, which was the founder of one of todays biggest mobile operators: AT&T. I wanted to use this brief history excursus to prove how a capability can remain rooted for hundreds of years in a region, which experienced a continuous innovative capability in the IT sector (Rao, 2010).

1.3.3 From a Leader

Clusters commonly arise from a **leader** firm. Adrian T. H. Kuah states that most of the first starters of the innovative activity in the cluster come from a parent company. The latter is able to build the roots of the cluster, the initial information from which new entrepreneurs will start from, to create new information (Kuah, 2002). When start-ups become established firms, they tend to create spillover enterprises, which leak from the innovative potential inside the leader firm, the one who can compete globally, the one who sparked the cluster. It is then possible for these new firms to deviate from the initial innovation and radically surpass the established one with more flexibility and higher risk taking possibilities. It is obvious that this determined path is not the only one, but we can say that it is peculiar to the ICT sector, where elasticity and quickness are fundamental features for a business. Every agglomerate is fulfilled by its employees, whose habits characterize the features of the agglomerate. Leader firms in clusters allow for the prospicious growth of their own employees, which are left space and time to undertake projects coming from personal intuitions. If the employee will not be able to undertake its project in the firm, for legal, financial or organizational culture issues, he could decide to externalize it, creating the so called Spin-off. This is a term used to explain the startups created by former employees of leading companies. These employees are able to use the expertise and innovativeness of the leading firm and recreate its dynamics applied to a new product or service. Spin-offs were one of the driving forces which populated the Silicon Valley area with thousands of startups year by year. The US was a fertile land in which new start up firms could have been created. In fact, the US market is characterized by low entry and exit barriers, which allow for a high turnover of firms in the cluster. This leads to a system which relies on a simple reasoning: failure is king. When firms are 'allowed' to fail and try many and many times, people will rather try and learn by failure if their idea was indeed unactionable. This practical system is nowadays intrinsic in the American culture, which fosters the greatest percentage of startup firms in the world. If we go back to its origins we see that even the first semiconductor company, Fairchild Semiconductor, was founded by 8 engineers who decided to quit their work to engage in something of their own: "The Fairchild Eight"

Figure 1

Gordon Moore, C. Sheldon Roberts, Eugene Kleiner, Robert Noyce, Victor Grinich, Julius Blank, Jean Hoerni and Jay Last.

With all their expertise they were able to found the basis of the production of the first marketable circuits. When they started the innovative semiconductor company, they could not imagine how far their efforts would have been heard in the IT history. Around 400 companies are proven to have roots in the Fairchild Semiconductors company. Not only from the company's product, which enabled the creation of the computer industry, but it is also from its 8 starting engineers that spin offs flourished as soon as they undertook new business experiences. Two of them, Robert Noyce and Gordon Moore, decided to leave the company to found a new start up, Intel Corporation, the one that today leads the chip-manufacturing sector (Marketwatch, 2011).

1.3.4 Firms translation or firms creation? (Porter V.S. Zhang)

Along with the cluster formation we need to consider also, in a second step, the translation of firms to the cluster.

Porter's view supports the theory among which firms and entrepreneurs (before formation) decide where to locate for one main reason: to gain a competitive advantage from this choice. The competitive advantage can come from many different factors. The main drivers are inputs which could represent a disadvantage, if far from the organization. By far we do not only mean geographical distance, but also access to key resources. Firms can then decide to locate in a cluster or next to a firm with good reputation in order to play the "second best" and compete as an insider with the benefit of receiving its information from many sources related to the proximity of the plants. When it comes to ICT firms an insider participation is crucial to receive information from the surrounding firms. When firms locate in clusters they also gain in visibility from the outside world. In fact, reputation plays a key role in bringing investment to the cluster, usually from multinational companies. Here Porter brings the example of the giant Nestlè, which reallocated its confectionary business because the new-acquired Rowntree Mackintosh was located there, where a food cluster vibrates.

Zhang view is far from Porter's one. He claims the opposite to be true, he quotes Cooper and Folta, 2000: "evidence suggest that entrepreneurs rarely move when they establish high tech start-ups". It is all in the hands of the first player, the entrepreneur, who innovates and establishes the leader firm, from which many other inventors will try to imitate the unique art of entrepreneurship. He believes in path dependency, the phenomenon from which spinoffs are created from the leader firm. These knowledge based spillovers create a form of culture of entrepreneurship and lower to the minimum the risks of starting a business or, at least, increase the opportunity visibility for firms in the cluster (Zhang, 2003).

1.4 Cluster and Entrepreneurship

Also the opposite is true, entrepreneurs establishing startups are perfectly fitted to work within clusters. They are able to satisfy the rapid environment of modern clusters, which are constantly changing, and consequently require the maximum flexibility of its participants. Entrepreneurs start new and small firms, which are risking their way to the top with new and non-affirmed ideas, which can be easily adapted to changing circumstances, as no structured production chain still relies on it. Delgado, in its *Clusters and Entrepreneurship* goes forward into the matter by looking at the consequence of this reasoning: entrepreneurs are more flexible to new opportunities with respect to incumbent firms. Moreover, he explains their perfect fit with the natural dynamicity of startups. When new and innovative startups try to enter the market they do not need any high barrier to entry. The cluster makes sure firms are able to be part of the pool as soon as they establish in the cluster. Indeed, the cluster speeds up the process of rooting in the region by connecting new firms to suppliers and to the prospected outlets. The process of establishment is fostered by proximity and cooperation, which renders the region appealing for startups. It is obvious that entrepreneurs, in such environment, are likely to see opportunities and be willing to pursue them, with a propositive risk-taking behavior.

It is now that Delgado makes its complete explanation of this fit, by showing how entrepreneurs drive risky investments, with a high probability of exit (Delgado, 2010). This means that since 44% of startups are are statistically failing within their third year of activity, they are naturally fitted to the low exit barriers of clusters.

Table 1

Year	Percent Failed
Year 1	25 %
Year 2	36 %
Year 3	44 %
Year 4	50 %
Year 5	55 %
Year 6	60 %
Year 7	63 %
Year 8	66 %
Year 9	69 %
Year 10	71 %

(Startup Business Failure Rate By Industry, 2014)

The low barriers are associated to contexts with a high turnover of firms. In fact, the cluster is an environment in which startup firms account for the greatest percentage of the companies in the region. In its nature, the cluster is formed by individuals and businesses who are seeking for innovation. The aim leads them towards inevitable risks, related to the fact that an innovative product service or process is new to them and to the world around them. However they decide to make these experiments in the laboratory, the cluster, where failure is an everyday task. Furthermore, the individual who is, by definition, ready to fail is the entrepreneur. These individuals are the core force of the cluster, the ones who drive growth.

This is proven in a study conducted by Jeffrey G. Covin, Dennis P. Slevin and Teresa Joyce Covin called *Content and performance of growth-seeking strategies: A comparison of small firms in high- and low technology industries*. The authors analyze the strategies of 57 executives on a database composed of 344 different firms in low-tech and high-tech clusters. They go straight to the point to evaluate the intentions and actions of entrepreneurs. In particular small and high-tech growth seeking firms are strictly associated with entrepreneurial activity. The most important finding is the variability in decision making between CEOs of small high-tech firms and CEOs of small low-tech firms. While a differentiation strategy is common among small high-tech firms, a cost-leadership strategy, is common among small low-tech firms. This can tell us that small firms in high-tech clusters are seeking for an innovative position in the market. Specifically in high-tech markets they need to enlarge the market by innovating, in order to fit in the dynamics of the cluster and pursue their long term goals.

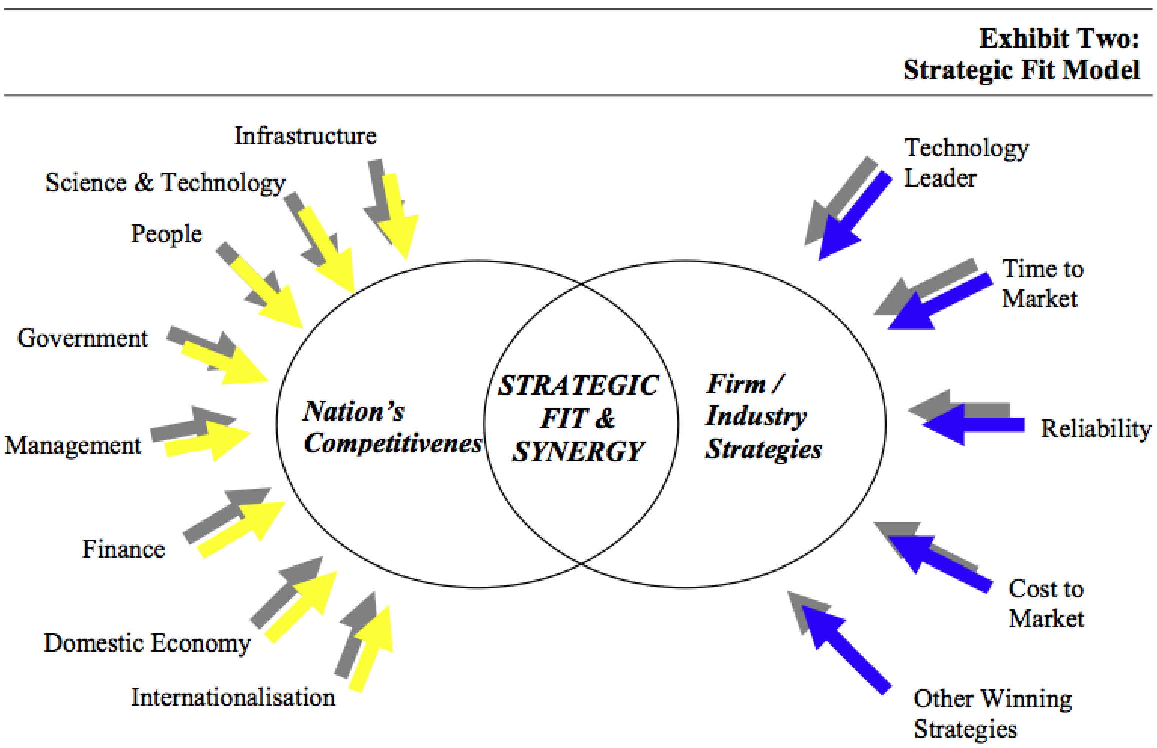
1.5 Positive Feedback Loop

It is hard to think of a rapid growth of a region that we know. This is because agglomerates take years and years before they can be called clusters and it might take a human life to see a new cluster growing. Firms are created and dismissed with an average of 30 years. Some of them last longer than 30 years and some of them last less, however what is important is that there is a constant turnover of firms which belong to industrial agglomerates. Just like firms, even whole industries have cyclical high and low levels of worldwide competitiveness. It is when an agglomerate breaks the cyclicality and passes the decline phase that a cluster starts to grow. We have already explained what are the main sources from which clusters are generated and we have concluded that the most common source is a mix of sources.

When individuals start to acknowledge of a regional competitive source, they might decide to locate their start up or just bring their money there. This is not a point in time, nor a single year, but it is a gradual path through which the cluster is reinforced by new investments and by human resources. When this system is established the region becomes a cluster. A vicious loop in which a high quality level of information is created and remains rooted in it. The expertise of the firm will be the main driver for their worldwide competitiveness. Years after years they will reinforce their competitiveness if they will be seeking to grow and satisfy, every day, a greater share of the world demand.

In 1998 Peter Swann analyzed the factors that could contribute to such a positive loop and developed the following graph.

Table 2



As we can see he makes a clear distinction between forces that come from the external environment of the region (yellow arrows) and forces that come from the internal environment within firms. It is only when the "Nation's Competitiveness" meets the "Firm/Industry Strategies" that an economic synergy is created and allows for every single factor to reinforce the others. Internationalization will bring more financial investments, and, consequently a technology leadership will increase their reliability and so on in a positive feedback loop (Peter Swann, 1998).

1.6 Reputation

The positive loop will inevitably bring the cluster to incorporate the leader firms of the international market. The Disk Drive industry is an example of the strength of the reputation concept which. In 1980 the industry grew steeply thanks to the arrival of the compact disk and the increased network effects of the computer industry. What is peculiar is that Singapore hosted 80% of the world production of Disk Drives with companies like Seagate, Quantum and Maxtor. This phenomenon can only be explained by a cluster effect based on reputation. The region was experiencing worldwide popularity and respect in Disk Drives production, and hardware companies went to seek their suppliers there, where the standard was born (Kuah, 2002). The standard is a worldwide known form, design, technique or tool that is created by a firm or by an individual and is learned by other firms or individuals and applied to a production process as such, by copy. As we have seen above, the disk drive cluster in singapore had an international reputation for producing the ones and the only forms of compact-disk readers and writers (with the advent of CD-ROM). However they had to be compatible with one of the largest standards ever seen from world history: the compact-disk round form. When an audio engineer, L. Ottens, at Phillips in the Netherlands called for a 7 people team to create the 11.5 centimeters CD that we know of today. In 1977 the digital disk was created, but on the other side of the world, Sony developed another form of the digital disk. Fortunately the two audio makers joined together to create a worldwide standardized form of the compact disk, which was formally adopted by the International Electrotechnical Commission in 1987 (History of CD-ROM In Brief). Standards are extremely sticky, as they remain immune to the variability of the world production techniques. Even the Singapore cluster worked for years and years with the round shaped CD that Toshitada Doi and Kees Schouhamer Immink created. The importance of standards is easily recognizable, we just have to think that if Philips and Sony engineers had decided at that time to create a different prototype, a whole industry would have been different. The only phenomenon that is able to take on the already established standard is a new technology, which is of a higher level than the previous one in terms of costs, time-consuming and design. What plays a key role is compatibility. The two-side effect of a technology with respect to another in a different layer is enormous and quick in its diffusion. We just have to think of how the adoption of the USB port in every Apple, IBM, Dell and other manufacturers set for a standard that revolutionized the modern data transfer. Although standardization is an easy way to gain worldwide recognition, it is also a rare event.

How are then regions acquiring worldwide recognition? Obviously quality is one of the ultimate causes of recognition. From quality recognition the channels to a worldwide notoriety are many and mixed between each other, for example the word of mouth between firms at different layers of the chain, especially at lower layers.
Furthermore, when a firm or a group of firms are able to carry out a task or a set of tasks better than any other regions, other firms in the production chain start to realize that outsourcing could be a plausible solution to: exploit the cluster expertise, relieve the internal production department from the task and focus on other issues and part of the chain. In carrying out a part of the production chain or the full production process cluster firms build profitable relationships with outsourcers, support industries, retailers and indirectly with customers. The vibrancy, innovativeness and past experience of the cluster gives to all the firms in it a common trust on which financiers often rely.

1.7 Life of a Cluster

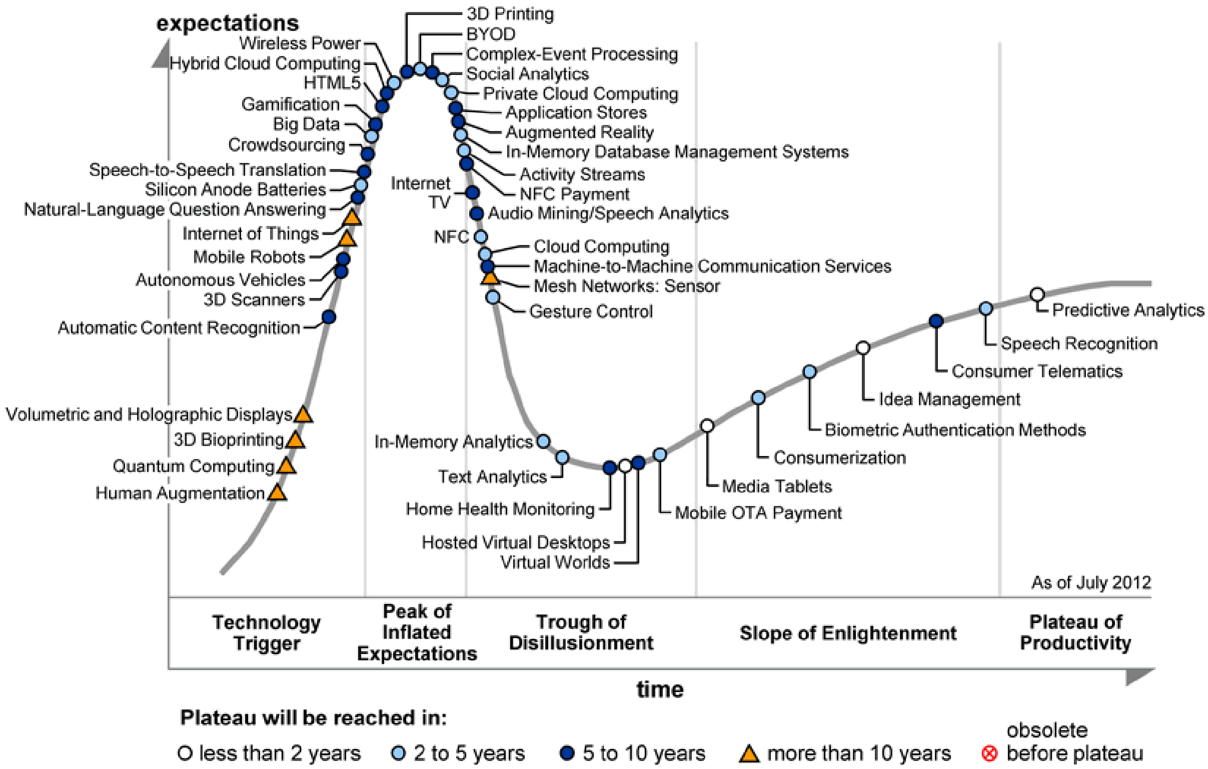
We have already talked about clusters' birth and we will take into account in our discussion, the clusters' break down. It is obvious that clusters are formed by firms and firms are formed by people, who in turn are sometimes acting irrationally and differently from each other. Also, depending on the sector on which the agglomerate it is first based on the cluster takes a different shape. Hence, we expect not to see precise paths of adoption and recognition of clusters. However we can delineate a clear path in history. This path takes the form of an S-shaped curve, which is usually applied by economists to study the market life of a new technology. This S-shaped curve can be applied to clusters born from:

- essential raw materials in the industry
- breakthrough innovation

Because they do not rely on built expertise or tradition, but on an innovative technology or rare raw material that is driving the economic performance of the cluster in the present, but might not be as efficient in the future.

This curve is precisely explained by the world's leader in Information technology research and advisory company: Gartner, Inc.

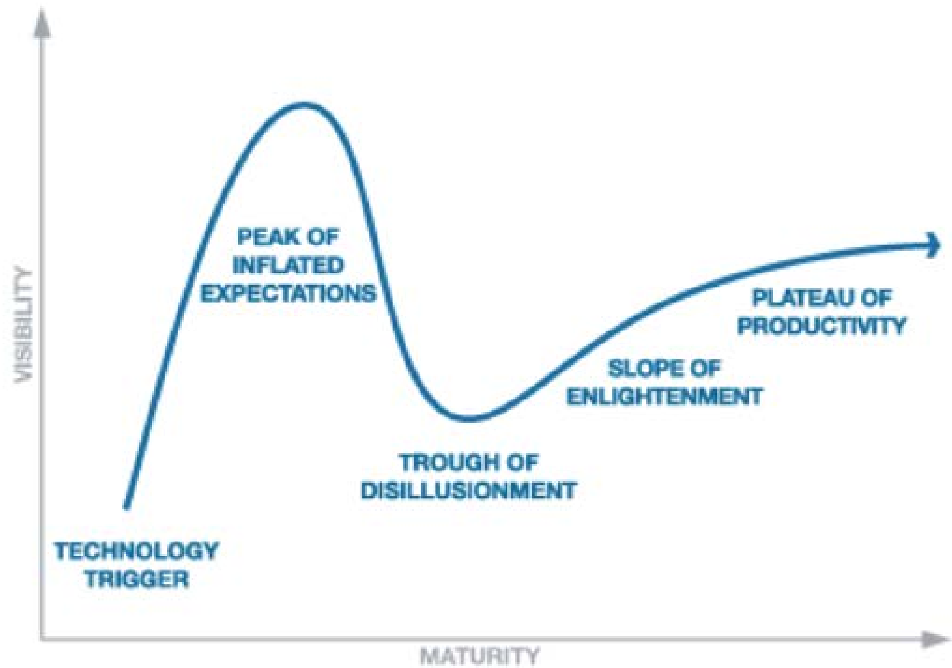
Table 3



(Gartner, 2014)

In particular scholars have studied the cyclical development of growth of technologies. A clear path is pinned down by them: at first a technology strives to spread in its period of 'technology trigger', then it encounters a period of steep growth thanks to a shared adoption in its 'peak of inflated expectations'. Consequently its inflated expectations are realized by the adopters who find themselves in 'trough of disillusionment'. After this step the technology restarts its market take-on by showing its real value, which is understood by new adopters in a 'slope of enlightenment'. Finally its slope decreases in a 'plateau of productivity', when the market for the technology is saturated (in this final period the rate of growth will be declining, hence the slope of the adoption line will be equal to zero).

Table 4

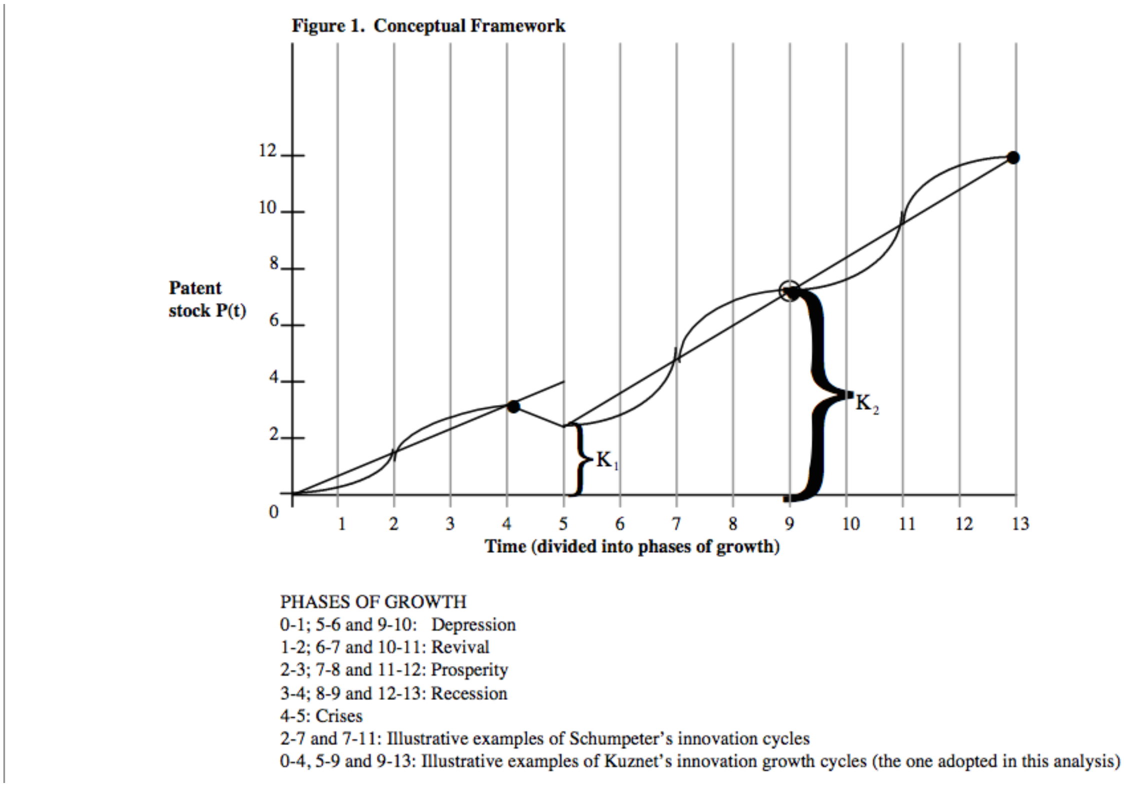


Each Hype Cycle drills down into the five key phases of a technology's life cycle. Roll over the phases in the graphic above for more information.

(Gartner, 2014)

This finding is proven to be cyclical by economists, which, setting aside external shocks, forecast the growth curve as following.

Table 5



(Andersen, 1998) (Here K is only a constant applied by the authors to offset the previous stats of the patent).

In the above graph we can see how a technology adoption curve, represented by its patent, is constantly accelerating and decelerating, with respect to its initial level of adoption. Here, we can even take into account external forces like a sudden macroeconomic crisis (x-axis, 4th point). The author references to the well known study by Joseph A. Schumpeter: *Business Cycles, A Theoretical, Historical and Statistical Analysis of the Capitalist Process*; in which Schumpeter defines the whole life of a business as a cycle, hence, not only as the initial S-shaped curve but as a cyclical path. He does not provide one specific reason for this clear path of development, but he finds many reasons in human nature. In fact, people are likely to adapt to situations in order to imitate and engage in already tested tools. In chapter III for example he explains the cyclicality as a process of "passive adaptation" with the example of a government adopted weapon, which suddenly increases its demand by other businesses because of adaptation to standards (Schumpeter, 1939).

1.8 Structure of a Cluster:

A cluster needs to have a wide open communication between the parties. The structure must ensure an horizontal flow of information between players of the same layer. This will be enhanced by the geographical proximity which automatically creates a common ground with increased “impact and frequency of communications interactions”. (Kuah, 2002)

Although the relationship in between firms is a must for the life of a cluster, firms need to be ready to leave old relationships and establish new ones. With this reasoning I call for open-minded entrepreneurs, who are aware that survival is strictly correlated to flexibility and acceleration. A firm in a cluster will inevitably establish strong relationships, but as the technology or market changes, they will need to be ready to shift to new suppliers or collaborators.

Thus, the structure of a common cluster does not need to have a fixed vertical industry organization, but it needs to fit the current economic situation in which the industry is living. If for example the industry is in a technological sector and the agglomerated firms are experiencing a shared growth, they need to have the tools to link their forces and team up towards a global market.

1.8.1 Cooperation:

When one of multiple entrepreneurs have developed an innovative product, service or competence, this innovation becomes part of the pool of information in the cluster.

In a cluster with perfect cooperation almost every component of the cluster is potentially able to incorporate the expertise that any other component has developed. In this way the act of imitation might foster the growth of the cluster by enabling any other else to use an innovative information with other tools, with other competences. In fact, most of the time, innovation is not radically built from scratch, otherwise, it is a creative collocation of different and innovative components that make the final product a new one. We can conclude that if we have an innovative information and we share it with others it is likely that other entrepreneurs will re-assemble it in a new way, because they have a diverse expertise and consequently a different approach.

When the region participants are not perfectly cooperating the level of information flow is limited to the relationships established between the players. It is really hard to think of a cluster where horizontal information between components of the same layer (competitors) is blocked by the participants themselves. The region's industry cannot be called a cluster as it does not differ itself from firms who compete internationally. The firms would be individually acting without the support of any other firm at its level. This reasoning cannot be applied to the vertical flow of information, which is shared between players of different layers. In fact we will see how in modern clusters firms represent only one layer of the full chain, which is easily internationalized.

What will enhance cooperation is a repeated interaction between the firms and its employees. In a region where firms are working on the same sector it is inevitable to find intertwined companies. This is a consequence of shared objectives, shared pool of workforce and, therefore expertise. Accordingly, this repeated interaction will result in strengthening mutual trust and loyalty between firms of the same region. Trust will be the common language between the players of the vertical chain. I will be the glue that on which relationships will rely on. Information is shared because of the presence of trust, that lets the participants be safe in their interactions. The natural direction will be directed toward cooperation in order to keep up with the worldwide market.

At the end, what comes out of the complex formula of interpersonal relationship, smart specialization, government support and highly specialized R&D is a "robust organizational form that offers advantages in efficiency, effectiveness and flexibility". In other words a cluster-wide corporation where companies themselves are competing departments.

1.8.2 Competition

Firms on the same layer are related to each other competitively by definition. In a closed industry they would have been competing for the regional market, if the demand was in the same region as the supply. However, Clusters are open agglomerates of companies which form international industries through global relationships. The global market of clusters is key to understand how firms in it are usually too small to affect each other in the global market they are in. Nevertheless, they might find it more profitable to tie up connections between each other and toward the regional society as well, in order to have a channel to the cluster's common pool of information and human resources.

In its study, Kuah explains in detail the benefits that competitors get from clustering. The main factor is linked to benchmarking. The author explains that, given the fact that firms are working closely to each other, they can see, hear, experience how their competitors work and take it as a model or just simply monitor it with respect to the internal processes. Benchmarking enables firms to keep up with the cluster pace. If some or a leader firm is able to produce a breakthrough innovation, its cluster competitors won't be estranged from it. They will be able to copy it by word of mouth or through suppliers relationships or use it through royalties. Other firms know that and they are aware of this close relationship. In an established cluster firms will end up taking it into account in their decisions and workflows. The result will be a global competitive region, in which no firm is able to stay alive if it is not pacing with the others.

1.9 Fundamental Characteristics

Every cluster forms itself in a unique way, given the fact that there is no pure cause of the clustering phenomenon. Porter brings us the example of the Omaha cluster in Nebraska, which developed its unique capabilities from an uncommon cause: the decision of the US Air Force to locate the Strategic Air Command in the region. It led to a high demand for a high-speed telecommunication infrastructure, which was fulfilled by the local Bell company with the creation of the first use of fiber optic cables in the world. Here the theory can find proof of another characteristic of clusters: there must exist a base to build on. A standard environment from which entrepreneurs and investors can build the new innovation on. In the Omaha case Porter finds the existence of two main drivers: centrality of the time zone and an "easily understandable local accent".

As we described until now, any region could be the center of an agglomerated industry, however, not every region has the chance to host a worldwide competitive industry sector in his area. This is because these forces explained above need to take place on a prolific ground for clusters. The ground of the region needs to feature very specific fixed characteristics, which Peter Swann called “fixed effects” (Kuah, 2002).

1.9.1 Government Support:

We will see later on what are the tools that the government can use to affect the cluster in its life. I called it support as government is not supposed to intervene in clusters as the current economic theory is still uncertain if a national or local institution should or even could intervene to help an agglomerate to become a cluster.

Funding is a general and broad tool, that broad that should be used with caution. If economists are not sure if governments could help clusters, then, what can they do to host them in one of their regions?

First of all a non-intrusive behavior shall be used as a common base for reasoning. Afterwards, the principle of subsidiarity is applicable to the situation: local institutions have a better access, knowledge and tools to deal with regional clusters. Accordingly, the power should be given to them. However, national authorities should make sure that the growing sector is allowed to export, by controlling the currency and by keeping in place, international tax deals on international trade.

The cluster is not an association, nor a finite group of individuals, therefore the government is hardly going to be able to affect it directly. Firms are the represent ants of clusters, they are the only subgroups existent in the dynamic horizontal flow of clusters. Institutions should only target firms and allow for their growth. I used the term allow because no precise intervention is suggested if the institution does not understand the dynamics within clusters. A firm could be related to another, which might be in a contract with a supplier, which in turn might be deciding to downward integrate. This example gives a clear explanation of how a myopic intervention from the government side might cause unforeseen effects.

1.9.2 Universities:

Apart from being centers of formation, universities can also be support partners of a cluster. In this case we look at universities as pools of innovation, knowledge and human resources. Research centers hold in their rosters a potential knowledge that needs to be applied to the field. It is when this application happens that clusters can benefit from the presence of a strong R&D center. We can see that back in the 50' universities were already considered centers of innovation. Only a few firms, the largest ones, had their own internal R&D department, the rest was only adopting the innovations coming from Berkeley, MIT, Stanford and many others. I will report a few examples hereafter.

Wes Clark, who graduated from Berkeley in 1947 was the one to realize the MIT's minicomputer in 1962. Then, at the University of Washington, he called for a hierarchical structure of the internet against the existing node- to-node structure. He started the internet structure revolution by thinking of a 'gateway' a computer in the middle that could be used as a node for an area. It was the birth of the first routers.

The first time-sharing system was created in a MIT laboratory in 1961 by Fernando Corbato. It was the first time that multiple users were able to access a computer, even from a remote position. The invention was readily applied to academic and industrial systems in order to reduce time consuming processes.

Ivan Sutherland, also an MIT student created the first computer with a Graphical User Interface in 1963. This innovation was necessary to the interaction of a human with a computer.

Universities are centers in which the R&D departments cease to be departments and start to function as absolute firms. The link and the relationships with other firms and especially the biggest firm, the government, are only their final demand. In clusters we can consider universities as centers of innovation from which various firms in the industry gather knowledge for their processes and recruit human resources (Rao, 2011)

1.9.3 Financial Support:

What differs an innovation from an invention? An innovation is the completed process of commercialization of a successful invention. Without the possibility to put your invention in the hands of the consumers it will never become an innovation. What determines the final outcome is the market. However if the invention does not even reach the market, we cannot call it an innovative product (or service). There are a lot of causes which could stop the process of innovation, one fundamental one is Financing. If the startup or new product has a limited or insufficient budget it will suffer shortcomings in production and for services in consumer satisfaction. Moreover, if the idea does not find any pre-concretization investor, it will not even touch the ground with a blueprint. We can say that financiers can make the difference in supporting fermenting clusters. A region where ideas are constantly supported has more opportunities, more experience from failure and a greater interest in the area from outsiders. This last will build on the existing reputation of the region and bring the opportunities of the entrepreneurs of the region to the ears of investors from every part of the world. This will create a positive loop, like the silicon valley one, where international investors are pouring their money whenever they are seeking for a risky stock.

1.9.4 Meetings:

The firms and people that constitute the cluster need to focus their forces and especially their knowledge. This can be done with various tools, the most informal one is the word of mouth, but it is sometimes sporadic, inconsistent and relies on personal relationships. Regions should find a way to connect their players to fight towards the same direction. There is no right form of meeting to have in clusters. Usually, agglomerates of firms of the same sector gather up in annual meetings such as conferences and fairs, where also international players could see what opportunities the cluster can offer.

In California, the biggest entrepreneurs of the region, Bill Gates included, gathered together to found a stage on which entrepreneurs and engineers could have their idea heard globally, maybe by investors, maybe by other firms that could internalize the idea with the entrepreneur. The organization's mission goes as follow: *"TED is a nonprofit devoted to spreading ideas, usually in the form of short, powerful talks (18 minutes or less). TED began in 1984 as a conference where Technology, Entertainment and Design converged, and today covers almost all topics — from* *science to business to global issues — in more than 100 languages. Meanwhile, independently run TEDx events help share ideas in communities around the world."* (Our organization | About | TED.)

The latest form of seminar is called 'webinar' a globally accessible online seminar (using VoIP libraries) to which anyone interested in the issue discussed could participate and ask some questions at the end. One of the biggest app community, Fiksu, enables its registered developers to stay updated with the platform tools and innovative market activities through 'webinars' (Fiksu Webinars)

1.9.5 Infrastructure

This one is a characteristic that is going to influence the industry only at extremely low levels. In practice, if the infrastructure of a nation enables standard levels of connection between firms and individuals within clusters and towards the outside environment this basic factor is neutral to the agglomerate. To find examples we need to think to some of the third world nations, in which, it is even hard to get from a place to another because no total highway system is built yet, or it is even harder to call another place with a mobile phone because of the missing repetitors (same reasoning with internet connection).

Sometimes the innovative infrastructure is able to better connect players at different layers of the chain and enable for a low cost transportation. In turn the proximity of a supplier to a production firm becomes an optional factor (Kuah 2002).

1.10 Counter Effects

It is not so hard to think at the benefits that can arise from clustering, nonetheless the theory must analyze also its counter effects, which are somewhat more implicit than the positive ones.

We are arguing about an economical phenomenon so we can all agree that the market forces that must be in place before its formation comprehend a social-wide variety. Hence, when clusters concentrate the economics of the region into one sector, the other sectors are normally neglected. Consequently, this will affect the satisfaction of the needs of the citizens of the region. In particular:

1.10.1 Demand Side

- The final products are necessarily going to be outsourced globally. The final consumers will have to take transportation costs for granted.
- The region's government will need to take this into account and balance this disproportionate import/export capital.

1.10.2 Supply Side

- In very specialized clusters firms will need to outsource various function of the process.
- In industry wide clusters firms support the whole chain (or almost) of the product process. Hence they will not need to adjust their shape and sources to the evolution of the cluster.

1.10.3 Groupthink

Another counter effect could be related to the formation of a social activity: a group. Whenever a group is formed, humans, different by nature, need to set aside divergences to interact with each other. This is called Groupthink, a common solution established between the players of the market in order to avoid a competitive race. This solution is, however, of a lower level than the one that competition could extrapolate from firms.

Firms in a cluster could be interacting perfectly with each other and focus in their innovative processes, but they need to remain updated with the external world and eventually adapt to new innovations and standards of their sectors. Sometimes it might be hard for individuals who are working in a vibrant cluster to constantly monitor outsiders' work. This vicious conduct is called by Michael J. Porter 'inward looking' (Porter,1998).

1.10.4 Convergence

In a study by Mercedes Delgado, Michael Porter and Scott Stern it is introduced the concept of "convergence" which is opposed to the above explained concept of "agglomeration". Convergence is explained as one of the two ways that an agglomerated industry of firms might result as. When firm create an hostile competition between each other and fill to the maximum the space in the agglomerate the convergence phenomenon results in diminishing returns. Delgado explains the effect as the level of growth that decreases as the level of economic activity increases. Two main causes of this effect are: the so called "crowding out effects", which in this case is explained as the effect for which, if there is a greater level of initial startup activity the region is likely to experience a lower level of growth in startup activity; the second is the cause by which input availability decreases as businesses congest in the same area. Here the author makes the example of how, if the price of inputs increase as the demand for them in the region rises, there will be an inefficient rise of prices due to competition (Delgado, 2010).

1.10.5 Bridging and Bonding

Firms in a cluster could be interacting perfectly with each other and focus in their innovative processes, but they need to remain updated with the external world and eventually adapt to new innovations and standards of their sectors. Sometimes it might be hard for individuals who are working in a vibrant cluster to constantly monitor outsiders' work. This negative effect is called by Keld Laursen, Francesca Masciarelli and Andrea Prencipe as a "Bonding" effect, as it creates a metaphorical wall with the external world. They find a clear example of this in the Prato agglomerate of textile manufacturers, who, apart from their historical textile production tradition, they failed to remain updated with the international market in 1990s "due to excessive and overly tight local relationships". The solution is called by them "Bridging": creating a channel with the external environment to keep the information flow going. This will enable the cluster to remain updated and gather international and heterogeneous info that could result in new, innovative activity (Laursen, 2012).

1.10.6 Surrounding Regions

Every regulator should takes into account the effect of a cluster on surrounding regions. As a spiral, the fermenting cluster will be incorporating the surrounding opportunities and human capital, as a result, if the sector is dictated by a dynamic competition, the result will be a winner takes it all game. Unless the surrounding region will be smartly appointed to complement the cluster's layer. For example, from the Californian wine cluster, many other relative businesses were born, like the glass production in Illinois that was smartly appointed to satisfy the growing Napa Valley Wine Cluster.

The Napa valley cluster was born in 1838 after years and years of colonization and land exploitation. As the cluster began to grow the region's forces started to shift towards wine production. Wine related wages in the cluster and in the surrounding region are calculated to be as high as 1.2M in US dollars. Moreover, wine producers are regardless exploiting the Californian land with an intensive cultivation of grapes. The surrounding regions are indirectly going to face negative externalities from the exploited lands. This is a millennial issue that faces the private owners against the public, who care about their lands (Porter, 2008).

It is also hypothesized by Delgado, Porter and Stern when they empirically prove that the strength of clusters in the neighboring regions affect negatively the startup growth rate (if a surrounding cluster specificity increases by 1% the internal startup growth of our cluster decreases by 1.8%; (see Table 6).

Table 6: EA-industry growth i start-up employment (N=53213)

	START-UP EMPLOYMENT GROWTH				
					No zeros N=11981
	1	2	3	4	5
Ln START-UP EMPLOYMENT$_{91\text{-}94}$	**-.299**	**-.358**	**-.680**	**-.684**	**-.827**
	(.012)	**(.011)**	**(.009)**	**(.009)**	**(.011)**
Ln INDUSTRY SPEC$_{Employ, 90}$	**.030**	**.045**	**.112**	**.107**	**.283**
	(.003)	**(.003)**	**(.003)**	**(.003)**	**(.014)**
Ln CLUSTER SPEC$_{Employ, 90}$	**.031**	**.017**	**.025**	**.013**	**.093**
(Outside the industry)	**(.002)**	**(.003)**	**(.003)**	**(.003)**	**(.019)**
Ln LINKED CLUSTERS SPEC$_{Employ, 90}$		*.013*		**.061**	**.110**
		(.007)		**(.007)**	**(.030)**
Ln CLUSTER SPEC in		**-.018**		**.031**	**.076**
NEIGHBORS$_{Employ, 90}$		**(.007)**		**(.007)**	**(.027)**
Ln REGIONAL EMPLOYMENT		**.157**			
		(.005)			
EA FEs	**No**	**No**	**Yes**	**Yes**	**Yes**
INDUSTRY FEs	**No**	**No**	**Yes**	**Yes**	**Yes**
R-Squared	**.084**	**.115**	**.267**	**.269**	**.400**

Notes: Bold and italic numbers refer to coefficients significant at 1% and 10% levels. Robust standard errors clustered by EA-Cluster. The explanatory variables are in logs.

(Delgado, 2010)

However, the main findings go further and show that if the strength of surrounding regions is increasing the competition of resources, it is also true that “the cluster environment that surrounds an industry will increase the pool of competitive resources and reduce the barriers of entry for new firms”. In other words, if the surrounding region creates sectorial diversity it will also increase entrepreneurial opportunities. In fact, when the authors take into account for “cluster-related complementarities” of the surrounding region with the cluster, they are able to show that presence of related industries around the cluster foster entry in the cluster (see Table 7).

Table 7: EA-industry growth in entry (all new establishments, N=53213)

	ENTRY EMPLOYMENT GROWTH		ENTRY ESTABLISHMENT GROWTH	
	1	2	3	4
Ln ENTRY $_{91-94}$	**-.708**	**-.712**	**-.872**	**-.875**
	(.007)	**(.007)**	**(.005)**	**(.005)**
Ln INDUSTRY SPEC $_{90}$	**.145**	**.139**	**.621**	**.604**
	(.003)	**(.003)**	**(.010)**	**(.010)**
Ln CLUSTER SPEC $_{90}$	**.032**	**.019**	**.035**	*.011*
(Outside the industry)	**(.003)**	**(.004)**	**(.006)**	*(.007)*
Ln LINKED CLUSTERS SPEC $_{90}$		**.083**		**.185**
		(.009)		**(.019)**
Ln CLUSTER SPEC in NEIGHBORS $_{90}$		**.031**		**.068**
		(.007)		**(.015)**
EA FEs	**Yes**	**Yes**	**Yes**	**Yes**
INDUSTRY FEs	**Yes**	**Yes**	**Yes**	**Yes**
R-Squared	**.325**	**.328**	**.454**	**.455**

Notes: Bold and italic numbers refer to coefficients significant at 1% and 10% levels. Standard errors are clustered by EA-Cluster. The variables are based on employment in 6-1-6-2 and count of establishments in 6-3-6-4.

(Delgado, 2010)

1.11 Decline

As we have seen in the Life of a Cluster paragraph the economic life of a cluster is historically S-shaping, but in particular it faces constant technological discontinuities. These discontinuities are not related to the production or to the functioning of the technological products, they are rather related to shifts in buyers needs which might be satisfied by disruptive innovations. Disruptive innovations are also called radical innovations because to build them you need to have a clear ground on which to build on. The old techniques, machine and knowledge is of little or no use for the processes of the new disruptive innovation. This one goes to satisfy old needs of customers in a different and better way (differentiation strategy) or just satisfy new needs (new market creation) (Porter, 1998). If the cluster is not awake to see, capture and adapt to the new technology, it will inevitably pass by sticking to the old one. It will be then hard to be competitive to meet the global demand. What firms in clusters should always remember is that consumers are the leaders of the world of today and firms are only working in partnership with them to satisfy their needs by meeting their values (Godin, 2011).

When a cluster is born it constantly creates new and driving innovations, which are pursued by the seeking entrepreneurs in the region (or moving in the region). However, as soon as those entrepreneurs (as businesses) find themselves a part in the system, which ensures them a stable economic situation, they may become reluctant to change. This is a common behavior of humans, which is related to needs and satisfaction. We do not need any scientific proof to state that when an objective is pursued, it is in human nature to protect it and make sure no new and disrupting innovation will render obsolete the efforts spent to reach it. This process creates rigidities in the evolution of new technologies. If a new technology is proposed to an entrepreneur who has to put aside its previous innovative product or service to pursue it, he will need to take into account his sunk costs (Cost-benefit analysis) before engaging into a new project. If this is proposed to a cluster of businesses who have developed the same technology, and have fighted to establish an equilibrium in between the industry competitors and stakeholders, each one of them will find themselves in a difficult position, from which the easiest escape is a common and of a lower level solution, “groupthink”. (Porter, 2000)

For these reasons, a cluster is not an infinite process of agglomeration, in fact, this inward loop must find an equilibrium that generates constant, radical and incremental innovation. With this process, destruction and rebirth of new firms is a must in the equilibrium state. As we will see this is not a problem for the cluster as its essence lies outside the businesses itself, but in between them.

1.12 Conclusion

The theoretical framework that Porter reorganized, based on past theory, was perfectly applicable to the 90’ context, but, nowadays, the clusters organizational form are driving towards the opposite side: Specialization. Porter foresaw this development, when he called for a generational shift of the global economy, from an input-based one to a more dynamic one where the input costs were minimized by global sourcing.

The clusters of today are formed not to be a porterian “robust organizational form”, but to be a pool of highly specialized firms which carry out a very peculiar layer of the production chain.

2. IT Firms Characteristics

The Information and Communication Technology sector (ICT or simply IT) was defined in 1998 by the OECD countries as “a combination of manufacturing and services industries that capture, transmit and display data and information electronically”. There are two main categories of ICT: manufacturing firms and services firms (also those who are carrying out one of the two as a core function and the other as a support function). ICT manufacturing is the creation of products that enable humans to display process and communicate information or simply used to monitor processes. ICT services consist in the development of systems that enable humans to communicate and process information through electronic means (OECD, 2002).

Before starting our study of the sector, we must state that the IT sector is always dealing with information, which is strictly related to the human character. Information is created and stored since the world’s birth. It now takes multiple and different forms, but we must keep in mind that the IT sector is formed to better store, organize and create systems of information retrieval in order to ease its accessibility and actionability by humans. The information itself has no meaning without an objective and a physical hand of a human.

The IT sector is affecting the industries in two ways: first of all, information systems are improving the speed, reliability and so productivity of many existing sectors; secondly, it is creating many new and growing industries: like the app industry. In this chapter we will go through the main forces that drive these new industries generated from the Information Technology activity.

2.1 Flexibility

Firms need to be flexible in order to keep up with innovation and be adaptable for new and destructing radical innovation. This is the case of the Silicon Valley, where firms are “quick to react to changing business needs yet they are able to tap on mutual resources and successful business ideas" (Kuah, 2002). In the example of the Silicon Valley the region can be roughly grouped in two main corporation sizes: giants, and startups. The latter composes the base of the region. It is in fact from this pool of entrepreneurs, willing to take risks to innovate, that the Silicon Valley has built its reputation on. What keeps its system flexible and redirectable is the size of the startup firms of the Valley. Entrepreneurs first have ideas, then they take on risks to implement them, in turn either they fail to constitute a long lasting business or they establish a profitable firm in the industry. In the theoretical framework we saw how almost half of the startups fail within 3 years. We can definitely say that the base on which leader firms in clusters stand on is a base of small firms which are stepping in and out of the cluster with a high turnover.

If we want to understand into deep the meaning of flexibility we need to look at IT firms and go over the reasons that make them flexible by nature.

2.1.1 Inputs

This is possible in the IT sector where even small firms are able to create the main asset to feed consumers with. In contrast with other sectors, this service sector does not need any physical machinery in house, nor inputs to process. In most of the cases the only inputs are the expertise and time of the employees who program, create new systems and solve problems. When a service company has in its rosters enough expertise to start the activity it could usually leverage it to the maximum with ease. The knowledge of its human resources are applicable to multiple situations, the only restriction is time. For instance, the app leader firm King (founded by Riccardo Zacconi) has recorded a market capitalization on the New York Stock Exchange of $5.5 billion, hosting only 665 employees; the modest workforce number resembles the scalability of the expertise of its employees (King Digital Entertainment PLC: NYSE:KING).

Manufacturing IT companies on the other end need physical inputs to create the final product to deliver to the customer or to the business at another layer.

2.1.2 Sunk Costs

Most of the startup firms in the IT sector don’t even own an office until they become real businesses. Engineers work from their homes and wait for financiers before taking on risky investments. The American Census of Bureau analyzed that home-workers are increasing, from 4.8% in 1997 to 6.6% in 2010. The greatest cause of this shift is the greater ability to telecommunicate through improved and new means For instance the latest VoIP libraries are killing the world’s phone operators, but at the same time they are alleviating the worlds traffic.

At the same time it was proven that on average the US population loses 1 accumulated working day per week only to move from home to the office (Mateyka, 2012).

Furthermore, recent studies have showed how home-working increases the productivity of people. The study conducted by professors from Stanford and from the Beijing University have shown that working from home improved the performance of the employees of a Chinese travel call center by enabling them to work more ‘per shift’ 9% thanks to the fact that they had more time to pause. A 4% increase in calls per minute was justified by the fact that the comfortable and familiar environment that the house offers gives them a way to ‘work in peace’. This is a clear example in which flexibility turns into greater performance of firms (Bloom, 2013; New York Times, Location Location Location, 2012)

The firms that the information technology sector hosts are first of all acting on a specific layer, then if they are able to expand they will take the investment to keep up with the competition. However until that point entrepreneurs are usually able to stall and maybe keep working on their projects on a part-time basis.

We can say that on average the greatest sunk cost is related to time consumption. The engineer, the programmer, the technician, the supervisor is able to apply its expertise on every situation (assuming a base level of ability), however their main cost is time, setting aside support activities like driving and equipment fixed costs.

2.1.3 Outsourcing

The specificity of the IT sector is the characteristic that makes it so flexible. In it there is embedded the ability to shift on to new clients, Also they have the ability to act globally; such firms are able to develop your program or build your industrial information system from the other side of the world. Obviously a bunch of meetings are going to be set but just enough to respect the formalities of the contractual legal system. Engineers are wisely clustered together in specific areas of the world. As Seth Godin would say, nowadays people are able to group with their similars (Godin, 2011). The two main poles of the IT industry of today are established in India and in California, but, congruent with its nature, this could easily change (for example in London and Paris there are high tech districts in which most of the EU programming forces rely on).

There are almost no suppliers, or players at higher layers to which the IT firm depends on. Almost no physical processes to carry out, and if there are they are carefully carried out by other machines, making the ratio man to machine lower than in any other sector.

To summarize, the Business to business nature of the IT sector enables it to have a sort of independence with respect to the players at higher layers.

2.1.4 Innovative

The only way to be alive in the IT sector is to innovate or to rapidly adapt to innovations in other layers. To be innovative firms have to be ready to shift rapidly their objectives and the activities that were strategically planned to pursue them.

Here, the firm's main asset, the human resource capital, can be reallocated to new departments and tasks at willing, always respecting the national union laws.

Individuals are able to be re-assigned to new roles better than machines are. They are extremely flexible by nature as their capabilities and expertise is able to interface with the machines in multiple and infinite ways, if the task falls in their capabilities. Employees are employed by firm for their ability to interact with machines and control them. In a research paper written by Robert U. Ayres at the Carneige Mellon University it is reported a study conducted by the Education and Training Administration of the U.S. Department of Labor, named *A Methodology to Predict the Substitutability of Robots for Factory Workers, Based on a Dexterity Measure.* The study shows how humans are not employed by manufacturing firms for their manual skills, but to perform a 'real-time' control function, which is the task that requires humans to intake a constant flow of information and apply their expertise to process it and react to it. In practice carrying out the tasks that ‘sensor-based’ are not able to perform yet (Ayres, 1984).

We can finally give an example of a phenomenon that characterizes the IT world in all its flexibility. Most of the IT firms are heavily relying on virtual servers and databases to store and process their data and deliver it to users. As of now, not only small firms, but the majority of the ‘pure player’ operators (companies that are exclusively offering their services online) are using virtual databases like the Amazon Web Services (the widest in the world) and the private virtual server platform Linode (Amazon; Linode). Virtual platforms like the latter enable firms to:

1. Avoid sunk costs like the expensive purchase of hardware like mainframe computers.
2. Outsource the processing and data storage needs, without having to employ new human resources to carry out and monitor these two support activities.
3. scale it easily, at any time, without any restriction. Also, capacity could be fragmented to minimal quantities.

I personally co-managed the creation a mobile application called Ulocal. Me and my business partner were able to externalize these two activities to the above cited platform operators, without having to carry on our shoulders the heavy burden of buying and managing a physical server and database system. It would have never been possible without the possibility to rely on such easily scalable platforms.

2.2 Disadvantages:

The sector is extremely complex and its firms are dynamically interlinked between each other. Firms at different layers are strictly dependent to each other. This is because one operates on the platform of the other. Every player might need the demand and the tools that another platform offers. The only exception is given by giants, that growing, gained a strong enough position to internalize the whole chain. However they still need to face the constraints imposed by antitrust authorities.

2.2.1 Compatibility

One factor that drives demand for a product or platform is the compatibility with other operators. If you build a social platform, for example, you will need to install a Facebook SDK (Software Development Kit, usually just a few lines of code to insert in a software to interface it with another running software) in it in order to enable your users to register with Facebook. When choosing an IT product even non expert users are able to understand the advantages of choosing the one with the highest compatibility. Nevertheless, compatibility with other standards at different layers inevitably reduces the independence of IT firms and consequently their flexibility. Operators will always have to keep their platform interfaces updated with the other players at different layers and they will have to accept their changes without any say in it.

2.2.2. External Risks

By externalizing servers or databases the company poses the availability of the servers at risk. The reliability of the above mentioned operators is nowadays to the maximum level available. Although they ensure the availability of the service with a 99% probability, they reserve the right to exempt themselves of any responsibility related to unexpected events. It has happened multiple times that whole server systems went down for a few hours without any backup. The only thing that the consumer will understand is a dysfunctional platform.

2.2.3 Unexpected Attacks

Last but not least, any online operator has to take into account for possible hacks or viruses. An internal or external department must be always ready to face this kind of unexpected attacks, that the free internet environment poses.

2.2 Convergence

The peculiarity of the IT sectors is intrinsic to its natural heterogeneity. What we want to stress generically in the thesis and in particular here, is that IT clusters, during their life, tend to converge to one main subsector, in which the cluster businesses and its workforce have developed above average capabilities, called core competences.

Firms within clusters converge towards the same subsectors in which the cluster is globally competitive and innovative. This convergence develops in two ways: the more flexible firms find their way into the cluster by adapting to the new and innovative field that is driving the cluster and by imitating the market leader; while the more established firms, which are not already focused on the innovative subsector and find it too costly to switch their business organization towards the driving technology will inevitably shrink. The only choice they can make is to start from scratch or friction the process by continuing to pursue their surpassed business product or service. This reasoning is not completely realistic as there are firms which found their way in a complementary market, but on average the statistics prove this convergence to be the nature of the IT sector. Failure to adapt is proven in reality by the Canadian firm Research In Motion (RIM), owning in its portfolio the billion dollar product Blackberry. The company, now known as BlackBerry L.t.d. (NASDAQ: BBRY), failed to adapt to the new radical innovation that, starting from 2008 was revolutionizing the smartphone industry: the touchscreen. The company, during the years, managed to acquire a good share of the market through its keyboard device, the BalckBerry, an item that every businessman in the world needed to have. To grow, they targeted the segment of the market that needed a simple tool to work with (send emails and navigate) in any place, at any time. When Apple launched the first working touch screen phone, they realized the market was shifting, but the directors weren't prepared enough to adapt to it. Mr Lazaridis, the creator of the first BlackBerry strongly opposed the adaptation, while the other CEOs wanted to adapt with a product that, unfortunately was of a lower level and always late to the market: the Z10 (The Globe and Mail).

The adaptation failure was reflected in the stock prices of the company:

<u>Table 8</u>: Balckberry Ltd Stock Price

(BlackBerry Ltd)

In a study conducted at the University of Portland, we can find proof that all the resources of the businesses of the high tech clusters are deployed for a specific subsector of the IT sector. The authors built the study on a dataset composed of 14 US cities, which contained the main centers of the American high-tech sector. They divided the IT sector in 4 subsectors: “Computer & Electronic Product Manufacturing”, “Software Publishers”, “Information Services & Data Processing Services”, and “Computer Systems Design & Related Services”.

The first resource that is analyzed is the workforce. As we can see below from Table 9 each area has its own specific segment of the market in which most of its employees concentrate. San Jose’s statistics are describing the importance of the Silicon Valley Cluster for manufacturing computer related products, while Boston's workforce is especially oriented towards Software Publishing jobs.

<u>Table 9</u>: Location Quotients for Employment in High Technology Industries, 1997

Region	Computer & Electronic Product Manufacturing	Software Publishers	Information Services & Data Processing Services	Computer Systems Design & Related Services	Overall High Technology Location Quotient
NAICS	334	5112	514	5415	
San Jose	**13.1**	**11.3**	1.4	**3.3**	9.2
Austin	**4.9**	**2.8**	0.7	**1.9**	3.5
Raleigh-Durham	**3.7**	1.4	0.7	**1.9**	2.7
Washington D.C.	0.6	**1.8**	**3.0**	**5.7**	2.2
Boston	**2.2**	**4.8**	**1.6**	**1.7**	2.2
Portland	**2.6**	**2.7**	0.6	1.0	2.0
Seattle	**1.9**	**3.5**	0.8	1.2	1.7
Minneapolis	**1.8**	1.1	1.4	**1.8**	1.7
Phoenix	2.4	0.9	0.8	0.8	1.7
San Diego	1.8	**1.7**	0.9	1.2	1.6
Sacramento	1.5	1.4	**2.0**	0.9	1.4
Salt Lake	1.5	1.3	1.2	1.1	1.4
Denver	0.6	1.3	**1.9**	**2.3**	1.2
Atlanta	0.7	**1.7**	n/a	**2.2**	n/a

Source: Authors' calculations, Economic Census, 1997, Bureau of Economic Analysis
Note: Location Quotients greater than 1.5 shown in **bold**. Location quotients computed based on employment data. Because 1997 total employment for metropolitan areas was not available from the 1997 Economic Census, 1997 BEA Regional Economic Information Systems totals were used in computing location quotients. Because of data suppressions for NAICS 514 for Atlanta, location quotients were not computed.

(Cortright, 2001)

These areas are extremely essential to the national economy as they account for the main centers of innovation in the country.

While nationally, metropolitan areas issue 38 patents per thousand workers, our 14 metropolitan areas show a higher level of patents ratio: 62 patents per thousand workers. This is peculiar to the characteristics of our areas, which are indeed high technological centers, which, by definition, should have a higher level of innovation than the national average.

Table 10: Location Quotients for Selected Technologies, 1994-98 Patents

Technology	Electronics and Software Technologies			Biomedical Technologies		
Patent Class	Class 345	Class 364	Class 395	Class 438	Class 435	Class 514
Class Description	Computer Graphics Processing *	Electrical Computers and Data Processing	Information Processing System Organization	Semiconductor Device Manufacturing Process	Chemistry: Molecular Biology and Microbiology	Drug, Bio-Affecting and Body Treating Compositions
Atlanta	0.5	0.4	0.4	0.1	0.8	0.5
Austin	**4.1**	**4.5**	**7.6**	**6.3**	0.3	0.2
Boston	1.2	0.9	**1.8**	0.5	**2.3**	1.3
Denver	0.4	0.7	0.6	0.7	1.0	0.6
Minneapolis	0.3	0.9	0.5	0.3	0.4	0.2
Phoenix	1.5	**1.8**	1.4	**4.5**	0.1	0.2
Portland	**3.9**	**2.2**	**4.9**	1.2	0.5	0.2
Raleigh-Durham	**1.7**	1.4	**2.0**	0.7	**3.2**	**2.1**
Sacramento	0.5	1.0	**3.4**	0.4	0.2	0.2
Salt Lake	1.3	0.5	0.3	0.0	1.2	0.7
San Diego	1.1	0.8	0.6	0.5	**3.5**	**1.9**
San Jose	**3.4**	**3.2**	**3.6**	**3.8**	0.8	0.4
Seattle	**4.5**	0.9	**2.3**	0.1	**2.2**	1.0
Washington D.C.	0.8	0.2	0.7	0.3	**3.3**	**2.7**

Source: Authors calculations, U.S. Patent and Trademark Office, 1999
Location Quotients greater than 1.5 shown in **bold**.
* - Complete class description is Computer Graphics Processing, Operator Interface Processing, and Selective Visual Display Systems.

(Cortright, 2001)

Among the above table, the metropolitan areas can be divided in two categories: cities like Washington, Raleigh-Durham, San Diego, Boston and Seattle are strongly specialized in the Biomedical field; while cities like San Jose, Phoenix, Portland and Austin tend to focus their specialization on Electronics. This gives us a strong result on the outcomes of clusters. Here we see how, except for the unique zone of San Jose, the rest ended up to specialize in one and only specialized category. The region will ensure its future life by building this center of innovation, which will need to be recognised into the world market. A good example of our reasoning is the area of Boston, which is extremely efficient in the development of Biomedical technologies.

From this last Table 11 we get from the study we are able to see how the lifecycle of the cluster will only foster the specialized layer by decreasing the efforts put into the other layers. In this particular study, by effort we mean financing. We need to take it into account as it is the common food resource innovation is eating, the underlying condition without which there would be no start up activity. When the cluster is worldwide known as a center of innovation, it is likely that it will attract new and foreign investments from every corner of the world (given today's new communication tools which are allowing for to ease the practice of international management).

<u>Table 11</u>: Location Quotients for Venture Capital Investments in Selected Metropolitan Areas, by Industry Segment, 1996 to 1999

Industry	San Francisco	Boston	Denver	Seattle	San Diego
Communications	1.0	0.9	**2.0**	**1.2**	0.7
Computers & Peripherals	**2.0**	0.4	**1.5**	0.1	0.4
Electronics & Instrumentation	**1.3**	0.6	0.9	-	**1.4**
Medical Instruments/Devices	1.1	1.2	0.0	0.0	**5.3**
Semiconductors & Equipment	**2.6**	0.9	-	-	-
Software & Information	**1.4**	**1.2**	0.6	**1.3**	0.5
Biotechnology	0.8	**1.6**	0.9	**1.3**	**4.8**

Source: Zook, 1999
Note: Numbers shown in **bold** represent industries with a location quotient greater than 1.10. San Francisco is the San Francisco Bay Area, including San Francisco, Oakland and San Jose.

(Cortright, 2001)

What is peculiar is that 46% of the national investments of venture capitals was directed towards the 14 metropolitan areas. In those, 60% of the total capital was directed towards 5 metropolitan centers. Hence, after having seen the patents and the financing analysis, we can empirically state that innovation is driven by clusters in the US.

From the above table we can infer another argument, which is related to our last one: funds are channeled towards few and specific subsectors of interest. Here we see how, not surprisingly, Boston is allocating most of its venture capital funds to "Software & Information" and "Biotechnology" and how San Diego is focusing almost all of its funding resources towards the "Medical Instruments/Devices" category. Here the phrase should be re-formulated to mean the opposite: it is the funds that are directed towards the most proficuous sectors, not vice versa.

The tables I wanted to report from the study are representing the quotients forms of the data collected. This is useful to have cluster data related to the national economy, in order not to take into account for subsector divergent characteristics. Some subsectors like the "Computer & Electronic Product Manufacturing" are by nature counting more employees than others like the “Software Publishers” or the “Information Services & Data Processing Services”, as the latter are not even requiring a processing department to build up the final product (Cortright, 2001).

2.3 Hypothesis

When individuals decide to establish a company they can either take account of the industry location (locating next to its suppliers, customers, or both) or simply locate where it is convenient at that time. As of now, the trend is to locate where the company could benefit from a pool of experienced employees. In an era driven by knowledge-based resources the roots of this phenomenon are easily recognizable in the rising of the outsourcing of different activities of the corporation. When firms are risen from the duty of co-location next to their value chain partners, its executives will decide to locate depending on the core competences of the startup. An IT startup may decide to locate in the Silicon Valley, while a winery might prefer to locate in the Californian San Joaquin Valley, where one of the leading wine clusters rely (Porter, 1999).

What I want to stress here is that industry co-location is nowadays not crucial and we should not analyze firms from the core competence they have developed. Support activities are extremely available in almost every corner of the world.

As globalization drives the modern world, geographical proximity becomes insignificant in its mere sense. Why would we need to go to Beijing for a meeting if we can talk on Skype?

Many researchers are trying to prove the insignificance of geographical proximity in the economical context of today. This might seem a plausible consequence of the increased ability to connect worldwide with any other business of the world, however I found more plausible to believe the opposite. In fact the increased opportunity of information sharing only renders futile, or almost, the marginal competences of your firm. This is due to a simple fact: on the other side of the world there might be someone more specialized than you, that delivers only one part of the production chain and for this reason might perform better and at lower price, and, now you can externalize the work to him with the same ease as you would have done with your neighbor. The difference is that now the market on which you can offer your services does not limit to your region but it is worldwide.

To give a personal example, me and my business partner were able to exploit the services of Mobisoft, ranked 4th between the best mobile application developers in the whole world. We were able to exploit the expertise of the Mumbai IT cluster. We share this ability with any other executive of the world that needs an application, and this reinforces the Mumbai cluster by giving them the ability to extend their demand beyond national boundaries.

Stéphane Garelli, Director of the World Competitiveness Project at IMD has studied how modern competition has developed. It its study *Competitiveness of Nations: The Fundamentals* he explains how the international competitive game has changed. The common trend is one: “Frontiers between nations are losing importance”. He also introduces an important term: Holism, “a tendency in nature to produce organized wholes, which are more than the mere sum of the components’ units (as defined by the Shorter Oxford”. An agglomerate of firms, composed of specialized firms, is able to carry out its activities without the need of being geographically close to its end user (Garelli, 2006).

Clusters are then becoming agglomerates of firms of the same layer, who are competing also with each other. We have already explained in the theoretical part how the common pool of resource enables them to gain a stronger position towards the rest of the world. Employees in the cluster are extremely mobile and from one firm to the other they acquire expertise. This expertise attracts other expertise and results in a worldwide reputational gain. This gain reflects also in a higher demand. When the cluster starts to reinforce itself in a particular layer the complementary activities become excessive practices to carry out. It is embedded in human nature to end up doing the work they are best at. What was then stopping this process of evolutionary specialization? The means by which we interact are the main suspect. Communication, the flow of information is changing, becoming faster and global. Every year the world shared information increases, more and more people are able to have a minimal education.

This directly affects the abilities of workers to pursue the job that fits their capabilities at best. The discussion on the cost benefit analysis of specialization has been going on for decades.

The reasoning made by Delgado, Porter and Stern in their 2010 article is in contrast with our hypothesis. They affirmed that if an industry increases the demand for complementary products, the industry will be fostering entrepreneurial opportunities and so entry in the cluster. Thus, the authors come right away with my same hypothesis: is specialization fostering the cluster's entrepreneurial activity? The findings result in an ambiguous outcome. First of all, before jumping to their results, I want to report the accuracy of their econometric model. In order to measure the startup activity within regions they created two variables: number of establishments by new firms and the employed workers of these firms. Also, they accomplished the hard task of circling out the role of the regional cluster by accounting for related industries and clusters lying outside the industry.

The final model comprehended the following variables:

Table 12

$$\begin{aligned}\ln\left(\frac{\text{Start-up Activity}_{i,c,r,2002-2005}}{\text{Start-up Activity}_{i,c,r,1991-1994}}\right) &= \alpha_0 + \delta \ln(\text{Start-up Activity}_{i,c,r,1991-1994}) \\ &+ \beta_1 \ln(\text{ Industry Spec}_{i,c,r,1990}) \\ &+ \beta_2 \ln(\text{Cluster Spec})^{\text{outside } i}_{i,c,r,1990} \\ &+ \beta_3 \ln(\text{Linked Clusters Spec}^{\text{outside } c}_{c,r,1990}) \\ &+ \beta_4 \ln(\text{Cluster Spec in Neighbors}_{c,r,1990}) \\ &+ \alpha_i + \alpha_r + \varepsilon_{i,c,r,t}.\end{aligned}$$

The dependent variable is composed of a rate between the level of startup activity between two lapses of time: 2002-2005 over 1991-1994; this represents the growth in startup activity of the cluster. In order to control for "unobserved factors" the authors inserted the constants α_i, α_r, α_o, which represented industry fixed effects, regional fixed effects and initial fixed effects respectively. The first independent variable LN (Start-Up Activity $_{i,c,r,1991\text{-}1994}$) has negative coefficient, which represents the negative effect of initial startup activity on future growth of startup activity (before named 'convergence effect'). The second independent variable LN(Industry Spec $_{i,c,r,1990}$) measures the level of specialization of the industry in 1990 (this is the key variable for my hypothesis). By relating (with a division) the "share of regional employment in the industry" with respect to the national industry, the authors are able to create this variable measuring by how much this industry is "over represented" in the economic activity of the region with respect to the national level. The same reasoning is applied to construct the third variable: LN (Cluster Spec$^{\text{outside } i}_{i,c,r,1990}$), which in contrast represents by how much the sector is relevant in the cluster. To measure the strength of the environment around the cluster, Delgado created the fourth variable: LN (Linked Clusters Spec $^{\text{outside } c}_{c,r,1990}$). Finally the last variable is LN (Cluster Spec in Neighbors$_{c,r,1990}$); it is linked to the fourth variable, but it represents the how specific are the industries in the area surrounding the cluster.

The results prove the authors to be right in their three hypothesis:

1. the region-industry growth rate of start-up activity will be declining in the initial level of region-industry start up activity.
2. the empirical relationship between industry specialization and the growth rate of entrepreneurship in that industry is ambiguous, and will depend on the precise nature of competition (cost-based or innovation-based) and the pattern of strategic interaction between entrant and established firms.
3. the growth rate of entrepreneurship will be increasing in the strength of the cluster environment in the region.

While the first and the third hypothesis are confirmed by the empirical results, I want to go into deep into the results of the second hypothesis, which is also confirming my theory. The authors show the empirical results of their econometric model in tables 13 and 14.

Here we see how a 1% increase in industry specificity will increase the industry growth of startup employment between 3% and 28.3%.

Table 13: **EA-industry growth in start up employment (N=53213)**

	START-UP EMPLOYMENT GROWTH				
					No zeros N=11981
	1	2	3	4	5
Ln START-UP EMPLOYMENT$_{91\text{-}94}$	**-.299**	**-.358**	**-.680**	**-.684**	**-.827**
	(.012)	**(.011)**	**(.009)**	**(.009)**	**(.011)**
Ln INDUSTRY SPEC$_{Employ,\ 90}$	**.030**	**.045**	**.112**	**.107**	**.283**
	(.003)	**(.003)**	**(.003)**	**(.003)**	**(.014)**
Ln CLUSTER SPEC$_{Employ,\ 90}$	**.031**	**.017**	**.025**	**.013**	**.093**
(Outside the industry)	**(.002)**	**(.003)**	**(.003)**	**(.003)**	**(.019)**
Ln LINKED CLUSTERS SPEC$_{Employ,\ 90}$		*.013*		**.061**	**.110**
		(.007)		**(.007)**	**(.030)**
Ln CLUSTER SPEC in		**-.018**		**.031**	**.076**
NEIGHBORS$_{Employ,\ 90}$		**(.007)**		**(.007)**	**(.027)**
Ln REGIONAL EMPLOYMENT		**.157**			
		(.005)			
EA FEs	**No**	**No**	**Yes**	**Yes**	**Yes**
INDUSTRY FEs	**No**	**No**	**Yes**	**Yes**	**Yes**
R-Squared	**.084**	**.115**	**.267**	**.269**	**.400**

Notes: Bold and italic numbers refer to coefficients significant at 1% and 10% levels. Robust standard errors clustered by EA-Cluster. The explanatory variables are in logs.

In addition, in the following table we see how a 1% increase in industry specificity will increase the industry growth of startup employment by 11.54 on average (between the quartiles); and a 1% increase in cluster specificity will increase industry growth by 3.58%.

Table 14: EA-industry growth in start-up establishments (N=53213)

	START-UP ESTABLISHMENT GROWTH				
					No zeros N=11981
	1	2	3	4	5
Ln START-UP ESTABLISHMENTS$_{91\text{-}94}$	**-.375**	**-.406**	**-.863**	**-.865**	**-.654**
	(.007)	**(.006)**	**(.005)**	**(.005)**	**(.012)**
Ln INDUSTRY SPEC$_{Estab,\ 90}$	**-.107**	**-.066**	**.570**	**.557**	**.295**
	(.008)	**(.009)**	**(.009)**	**(.010)**	**(.012)**
Ln CLUSTER SPEC$_{Estab,\ 90}$	**.086**	**.047**	**.026**	.007	**.067**
(Outside the industry)	**(.006)**	**(.007)**	**(.006)**	(.006)	**(.017)**
Ln LINKED CLUSTERS SPEC$_{Estab,\ 90}$		**.092**		**.152**	**.100**
		(.020)		**(.018)**	**(.032)**
Ln CLUSTER SPEC in NEIGHBORS$_{Estab,\ 90}$		.018		**.050**	.010
		(.018)		**(.014)**	(.025)
Ln REGIONAL ESTABLISHMENTS		**.213**			
		(.010)			
EA FEs	**No**	**No**	**Yes**	**Yes**	**Yes**
INDUSTRY FEs	**No**	**No**	**Yes**	**Yes**	**Yes**
R-Squared	**.176**	**.193**	**.440**	**.442**	**.311**

Notes: Bold numbers refer to coefficients significant at 1% level. Robust standard errors clustered by EA-Cluster. The explanatory variables are in logs.

While from Table 14 we see how a 1% increase in industry specificity will increase the growth in startup establishments by 24.98% on average; and a 1% increase in cluster specificity will increase the growth in startup establishments by 4.66%.

The ambiguity of their findings are clearly shown by the alternating signs of Table 14. With regards to the regressions 1 and 2, the coefficients are negative, showing that the specificity is decreasing the number of new startups, while when they include the industry fixed effects (stemming for possibility of shocks and crises), the coefficients become significantly positive (Delgado, 2010).

We could then ask, why do clusters need to be this sector specific? They do as technology is the substitution of a human capability, and as such it needs to be uniquely created by a human to carry out some tasks at a larger scale. The Information Technologies are able to substitute our work with a higher reliability of performance, but with a low flexibility to change. In fact IT creators are trying to 'teach' to the machines to be prepared to respond to heterogeneous situations.

We can conclude that the main driver of specialization in clusters is growth, the increase of reputation demand and expertise of a particular subsector of the industry.

Lately, economic growth has been driven by young sectors, like the IT one. This has created an optimistic smell around the sector, which is nowadays attracting investments and human capital to shift their work towards, with or directly in the sector. Frank Hefner, in his Chapter on Cluster Theory, calls these “hot industries”, which are attracting also the interest of Institutions, which see in it an easy way to gather consensus and seek for economic development (Hefner).

3. Public Policy

Governments, in seeking for new tools for economic growth, have considered cluster development as one of the main means to conduct regional and national growth. As we've seen in the theoretical framework, researchers acknowledged that clusters are in fact proven to be drivers of growth. For what reason, to what extent, and under which conditions has now come to be a matter of many debates among economists, where the broadest theory has usually come to be the standard, taking for example Porter. Nonetheless, there is still an open question on which we can apply our cluster theory: how should governments study and interact with clusters?

3.1 Analysis of Clusters

Under this paragraph we'll go over the first step towards a proper Government regulation: the analysis of clusters. This is a very open question, even today, after Porter's re-assemblement of the whole cluster theory.

3.1.1 Variables

As explained in the theoretical framework Porter uses employment quotients to compare the extent to which an industry is important to the region with the degree of importance of a region to the whole nation (Hefner). After having identified the main variables for cluster performance and having categorized them, with quotients we are able to attach a weight to each variable. This weight represents by how much the variable is more pronounced with respect to the national variable.

3.1.2 Boundaries

It seems plausible to analyze the region as a whole. If we extrapolate the cluster from its roots we might lose some interlinks that are present between the cluster and other regional industries. These forces make sense if we analyze the whole, they do not if we analyze industries on an independent basis. The interlinks are the external forces, legal agreements and externalities produced by an industry and affect another industry of the region.

A recent example of an analysis of a region is given by the 2002-2003 partnership between the ISC (Institute for Strategy & Competitiveness) at Harvard University and the South Carolina governor Jim Hodges. One of the many initiatives that the ISC has started in collaboration with local governments. Wherever a cluster is found, economists with a knowledge in clustering are able to match the needs of regional institutions.

In this partnership Porter was called to analyze the economic dynamics of the state and elaborate a strategy. He came out with a list of "Identified Clusters" in South Carolina. We can see here in figure 2 how he included basically every industry of the region.

<u>Figure 2</u>: Clusters Identified in Porter Study of South Carolina, 2002

Textile	Medical Devices
Business Services	Construction Materials
Hospitality and Tourism	Building Fixtures, Equipment and Services
Heavy Construction Services	Publishing and Printing
Automotive	Lighting and Electrical Equipment
Apparel	Communications Equipment
Chemical Products	Heavy Machinery
Financial Services	Pharmaceuticals
Production Technology	Information Technology
Power Generation	Prefabricated Enclosures
Distribution Services	Analytical Instruments
Motor Driven Products	Leather Products and Sporting Goods
Education and Knowledge Creation	Aerospace Vehicles and Defense
Processed Food	Agricultural Products
Transportation and Logistics	Aerospace Engines
Metal Manufacturing	Power Transmission and Distribution
Plastics	Jewelry and Precious Metals
Furniture	Tobacco
Forest Products	Fishing and Fishing Products
Entertainment	Oil and Gas
	Footwear

Note: The clusters were ranked by employment. In 2002 textiles had the largest amount of employment and footwear manufacturing had the least.

After analyzing a cluster the regulator ended up taking into account every functioning industry of the region. Industries that affect or are affected by the Cluster in question must be taken into account but only to the extent to which they link to the cluster. By this I mean that every business must have links to the external world and as such every cluster must have links as well, but a regulator should only take into account the effects not the surrounding industries, as they were part of it.

What is then the difference between clusters and industries? We know that an industry must be interconnected (vertically) to be alive and the Harvard professor defines clusters as strongly interconnected companies and institutions. How are governments going to define clusters in order to be able to separate them from normal industries and be able to foster them? The definition that a government gives to a cluster is fundamental to the intervention outcome. Given that government action always come with costs, local or national authorities need to be sure about the precise definition of clusters before they allocate funds. There is no general and universally accepted definition of cluster. Every agglomerate must satisfy the conditions reported in the theoretical framework (chapter 1) to be considered a cluster (Hefner).

If the study conducted by the institution should seek for the main drivers of the economics growth brought by clusters, it should also search for the causes and consequences that a cluster focused action might bring to the regional economy.

3.2 Action

3.2.1 Tools

After the cluster is analyzed, the next step is to decide what are the best tools to use to intervene to the cycle. Tools could be of any type or level. Lately, many governments are seeking not to rely on pure financial tools to give help to an economic situation of any kind. Governments are trying to create new and different tools to affect directly the real economy.

International institutions like the IMF (International Monetary Fund) and the World Bank have used the following to interact with clusters:

- “incubators”
- industrial areas
- “targeted recruitment”
- “enterprise zones”
- “foreign trade zones”
- ”centers of expertise”

The set could be composed by an infinite number of tools, but the regulators should have a base on which tools should be considered appropriate. What we see from the above tools is that they are all oriented toward a specific objective. The latter is the common base on which they should be discriminated. While funds could be a needed tool they should also be addressed toward the objective. For example they could be used to create incubators or recruit a sector specific expert team.

3.2.2 Decisional Power

The decisional power could be coming from any institution which decides to help the businesses in the cluster. However, one common rule should be in place: subsidiarity. The rule limits the power to the lowest institution level that has the maximum efficiency and effectiveness toward the matter. If a local institution, even from a rural area, has a prolonged experience and knowledge of the dynamics of the cluster that institution should have the control of the intervention program.

Also, the authority that is acting directly on the firms should be financed and helped by the national government as the latter will be benefiting indirectly from the cluster prosperity. The political form of the nation will inevitably affect this relationship. Federal forms of government are allocating many matters to the local institutions and as such they might be more in line with the subsidiarity principle.

3.3 Ex-Post

3.3.1 Picking Winners Government Creates Losers

Who receives government support will inevitably distort the competitive equilibrium of the region. In macroeconomics 101 it is taught that if a government enters the game and affects the competitive dynamics in between firms it will distort competition: the demand and supply curves. Shortly, by helping one player or one category of players (assuming that regional development is cluster directed policy makers should target a sector) governments will decrease the slope of their supply curve, allowing them to be more competitive with respect to other sectors and shifting the regional pool of workforce and R&D towards it, as it is the most profitable sector. (Sanders, 2013)

If the demand is extended globally, then the market competitors are internationally wide and disperse; this means we cannot take into account this kind of reasoning, as the local cluster will be benefiting from government intervention and it will be able to better compete with a global point of view.

Now the main question is if the outcome of the government action will be outperforming the decrease led by the decreased competition. Depending on the cluster examined a cost benefit analysis should be formulated (Hefner)

3.3.2 Do not Replicate

As we stated in the theoretical framework clusters economists did not find ways to build clusters from scratch. Policy makers should not try to replicate other areas and foster clusters without the presence of a natural tradition for the specialized layer of the chain. Workers should already have a knowledge base from which the cluster should be naturally built on. There is no universal recipe to build a high tech cluster. Even if clusters present similarities in specialized R&D, employment and innovation, they also show a highly variable specialization in each sub-sector of the above-lying technology (Cortright, 2001).

3.3.3 Monitoring

As any other intervention requires, an ex-post activity is required. As clusters are a form of an economic phenomenon, they constantly change, taking different forms.

Clusters are formed by firms, which are formed by people and as such they change, they develop trends and take unexpected paths. Forecasting the outcomes of a public policy is a task that must be done on a constant basis. Relying on past experience or other clusters' developments is a risky task. This is because clusters are different from each other. It is in their nature to be differentiated from 'normal' industries. The meaning is embedded in their essence, their uniqueness with respect to other agglomerates of firms of the same sector.

However, in order for a public policy to be put into place, there must be a minimum amount of certainty. This certainty will not only be given by a prolonged ex-ante analysis but also by a dynamic ex-post activity. This ex-post activity will include the monitoring process. Monitoring is the activity of looking at the results of a policy, following its implementation time by time. It will require a dedicated task force that constantly analyses the firms in the clusters and the links in between them. Looking at the contractual activity between them is a good tool to implement a monitoring strategy. It will show how the firms are relating to each other. However a competitive analysis should include a detailed internal analysis of the cluster, it should also analyze the global demand on which the businesses of the cluster are competing on.

When the task force has looked at every indicator that the public sources offer, they should also require a constant feedback from the decisional departments of every firm. They will be able to give insights that are not publicly mentioned. The interlinks and the dynamics are to be analyzed from the feedback sources.

3.4 European Action

3.4.1 European ICT Poles of Excellence

European institutions are addressing a part of their work to foster the already present ICT areas located in Europe, which are able to compete with the world ICT clusters. These are called the "European ICT Poles of Excellence" or EIPE. They are defined by the EU authorities as "geographical agglomerations of best performing Information and Communication Technologies production, R&D and innovation activities, located in the European Union, that exert a central role in global international networks".

This is a clear example of an institutional intervention addressed towards sector specific clusters. The center constructed a detailed system of variables which are found to be affecting a cluster.

Table 15

Activity	Characteristic	Name of Indicator	Indicator ID	Nr
R&D	Agglomeration	Universities ranked in the QS University Ranking	AgRD 1	1
		Academic ranking of a Computer Science faculty	AgRD 2	2
		Employer ranking of a Computer Science faculty	AgRD 3	3
		Citations ranking of a Computer Science faculty	AgRD 4	4
		R&D expenditures by ICT firms	AgRD 5	5
		FP7 funding to private organisations	AgRD 6	6
		FP7 participations	AgRD 7	7
		FP7 funding to SMEs	AgRD 8	8
		FP7 participations by SMEs	AgRD 9	9
		Location of ICT R&D centres	AgRD 10	10
		Ownership of ICT R&D centres	AgRD 11	11
		Scientific publications in Computer Science	AgRD 12	12
	Internationalisation	Outward ICT R&D internationalisation	IntRD 1	13
		Inward ICT R&D internationalisation	IntRD 2	14
	Networking	Degree in ICT R&D network	NetRD 1	15
		Closeness centrality in ICT R&D network	NetRD 2	16
		Betweenness centrality in ICT R&D network	NetRD 3	17
		Eigenvector centrality in ICT R&D network	NetRD 4	18
Innovation	Agglomeration	Investment in intangibles by ICT firms	AgIn 1	19
		Venture Capital financing to ICT firms	AgIn 2	20
		ICT patents	AgIn 3	21
	Internationalisation	International co-inventions	IntIn 1	22
	Networking	Degree in ICT innovation network	NetIn 1	23
		Closeness centrality ICT innovation network	NetIn 2	24
		Betweenness centrality ICT innovation network	NetIn 3	25
		Eigenvector centrality ICT innovation network	NetIn 4	26
Business	Agglomeration	Location of ICT Scoreboard Headquarters	AgBuss 1	27
		Ownership of ICT Scoreboard affiliates	AgBuss 2	28
		Location of ICT Scoreboard affiliates	AgBuss 3	29
		Location of ICT firms	AgBuss 4	30
		ICT employment	AgBuss 5	31
		Growth in ICT employment	AgBuss 6	32
		Turnover by ICT firms	AgBuss 7	33
		Growth in turnover by ICT firms	AgBuss 8	34
		New business investments in the ICT sector	AgBuss 9	35
	Internationalisation	Outward ICT business internationalisation	IntBuss 1	36
		Inward ICT business internationalisation	IntBuss 2	37
	Networking	In-degree in ICT business network	NetBuss 1	38
		Out-degree in ICT business network	NetBuss 2	39
		Closeness centrality in ICT business network	NetBuss 3	40
		Betweenness centrality in ICT business network	NetBuss 4	41
		Eigenvector centrality in ICT business network	NetBuss 5	42

(Nepelsky)

We see from Table 15 that the chosen variables are grouped into 3 characteristics: “Agglomeration”, “Internationalization”, “Networking”. Next, these characteristics are grouped into 3 main activities of the firm: R&D, Innovation and Business. A peculiar finding is that universities have a strong power in R&D activity as they have 5 variables affecting it and indirectly affecting the other 13 variables.

The report took into account 3 centers of innovation:

- Munchen, Germany;
- Inner London East, London, UK;
- Paris, France;
- Karlsruhe, Stadtkreis, Germany;

In analyzing these ICT agglomerates, the EU authorities found the following variables to be extremely representative of the area: “Centrality”, “Growth in ICT employment”, “Growth in turnover by ICT firms”, “Location of ICT firms”, “Inward ICT R&D Internationalization”, “ICT patents”, “International innovation collaborations”. The key variables above mentioned are perfectly in line with the drivers listed in the Theoretical Framework. Accordingly, as of now, in Europe the current theory was able to find the drivers of the cluster activity and this empirical analysis gave proof of it.

The EIPE report is neutral to the cluster management method, but it is aimed to report the dynamics, the trends that European clusters are taking. In the report we see that only a very small number of EU regions demonstrate intensive ICT innovative activity, and they concentrate a large share of the total European innovative activity. This fact should be carefully analyzed and taken into account when a continental action should be taken.

This European approach does not contrast our subsidiarity principle as the EU authorities do not act directly on the clusters of every nation. They rather partner up with local authorities to analyze the current dynamics of the firms in the area, elaborate a strategy, implement it and monitor its outcomes.

What comes out from the Joint Research Center of the European Commission is a detailed analysis in which the resources allocated to the ‘Poles of Excellence’ result dispersed. Most of the R&D investments is dispersed between the regions with low R&D. The same reasoning was found to be true also for the Innovation and Business activity. However the funding, as other public resources should be channeled towards those centres that are in fact proven to be driving the greatest economic activity of the sector. The overall study outcome is showing that the greatest percentage of the ICT activity in EU is focused in clusters. This concentration is shown by the enormous gap between the top scorers of the ranking (first 5) and the followers.

Figure 5: Frequency of EIPE Composite Indicator values

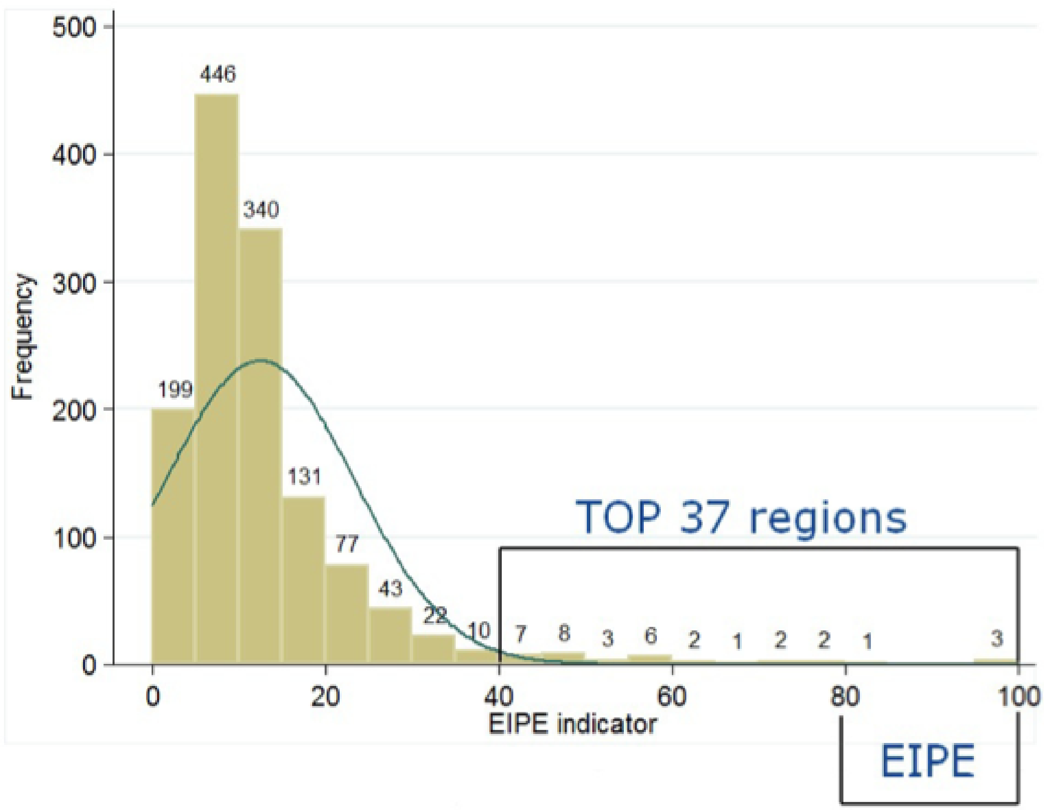


Table 2: Descriptive statistics of the EIPE Composite Indicator

Number of observations	Mean value	Standard deviation	Variance
1303	12.38	10.92	119.30

The composite performance of the three activities in clusters are shown by the "EIPE indicator". They are extremely pronounced among the top 37 regions and relaxed among the other 1266 areas, who are not considered clusters but simple agglomerates of ICT related firms.

3.4.2 Smart Specialization

The EIPE report is part of a larger set of initiatives that the European Commission is assessing to foster European clusters: Smart Specialization concept. The programme is aimed to channel the resources of every region toward the stronger sectors of the area. The EU has understood how the dispersion of its resources was “limiting the impact in any one area”. One key concept of the cluster theory is applied also by the European research center. One of the rules of the Smart Specialization concept tells the regional authorities to “avoid unnecessary duplication”. The concept by which clusters are not replicable and as such institutions should not try to replicate them by searching for the characteristics in a region (Regional dimension of innovation).

The tool by which this concept takes form is the SM3, the Smart Specialization Platform. Through this platform regions and countries are able to follow the European strategies and suggestions to conduct a proper regional policy and foster its core sectors. Also, the platform provides the analysis of the JRC, Joint Research Center, with regards to each European Region (S3 Platform).

In particular, the platform promises to any underlying institution to carry out the following tasks:

- “Providing guidance material and good practice examples”
- “Organising information sessions for policy makers and participating in conferences”
- “Providing training to policy-makers”
- “Facilitating peer-reviews”
- “Supporting access to relevant data”
- “Participating in high quality research projects to inform strategy formation and policy making”

By reading these proposed tasks the EC proposes the SM3 as a real partnership tool between every region and its subsidiaries. If a joint partnership is the right tool to interact with regional clusters is an open matter that calls for further research and experiments.

4. Bangalore ICT Cluster

The indian city of bangalore hosts one of the best ICT clusters in the world. I will go through its characteristics to find evidence to attach to the theory already explained.

4.1 Birth

<u>4.1.1. Incubation</u>

The Indian region was colonized by the UK of King George the fifth until 1947. Until those years the nation's economic situation was exploited by the British colonies. England was colonizing the indian region to extrapolate a constant amount of raw material from it, for example, the salt commerce. The outcome of the colonization is a deep diversity in the cultural and economical dimensions.

<u>4.1.2. Nucleation</u>

While the external environment, the global demand, was increasing its demand for programming skills and IT developers, Bangalore was setting the ground to host the supply of this global demand. While Bangalore had a perfect structure for hosting a low cost workforce, other centers of innovation like Mumbai were not able to recreate the basic characteristics, like the low cost real estate. Bangalore was the city with the highest level of infrastructure services, but with the lowest cost of life.

<u>4.1.3 Agglomeration</u>

As we saw in the Theoretical Framework, the agglomeration of an economic form is usually driven by the growth of a business "unit". This unit grows, increases its demand, connects to new suppliers and customers. The process will inevitably lead to an increased demand along the curve. If suppliers and retailers will be ready, the vertical chain will drive the agglomeration. If competitors understand the profitability and enter the market by locating in the region, they will form an "horizontal agglomeration". Usually, in the process of growth, both the vertical and the horizontal agglomeration forms mix up to satisfy the rapidly growing demand. What we can see is the proof of our hypothesis. With the increase of the level of connectivity and a more global demand the Bangalore ICT cluster is now hosting companies of the same layer, for a highly specialized, but globally competitive, cluster.

4.1.4 Attrition

This is the counter effects of the clustering phenomenon. By being an accelerating phenomenon, the cluster does not find its equilibrium, its firms increase more and more, the existing firms either try to cut a share of the global market or decline leaving space for new entrants. We have already explained that as long as the turnover of firms is high and the employment conditions ground a mobile business to business market, the cluster will be dynamic and vibrant. However, in the attrition stage, existing firms start to create barriers for new entrants, or simply relocate to new regions with a lower demand. This is because the attractive land of the cluster might lead to rising prices of the infrastructures and for the human capital in it. This, consequently leads to a stable clustering activity, in which the turnover almost stops as the players start to breathe risk and diminishing market opportunities.

The Bangalore cluster is now hosting this stage. The cost of human capital is rising, reaching the national standards. Companies like Apple and Fab-city are closing their retailing outlets relocating in new and vibrant clusters that host an international B2B demand, like Dubai. Infrastructure complaints increase, and firms start to think whether it is more convenient to complain or to relocate. Between all these causes the Bangalore ICT cluster is shifted to the 8th Position among the centers with the highest level of growth in the world. It is still globally competitive, but as we said, a cluster that stops its growth will not stay alive for long. A cluster needs growth to stay alive and innovate, a stall period is equal to a decline (Manimala, 2006).

4.2 A Few Statistics

In India, since the 1980', the cluster of Bangalore is considered the first center of innovation of the ICT sector. It hosts more than 12000 software companies, among which the software developed belong to the subsector of:

- “System (16%)”
- “Application (28%)”
- “Communication (11%)”
- “Services (29%)”
- “Integrated circuit design (4%)”
- “General (12%)“

In percentage, the subsectors are well distributed, with “Services” and “Application” above all others. The employment conditions are strictly related to the Indian relaxed employment regulations. However the region, with 40000 Phd. graduates who work in R&D departments, attracts and grows the largest ICT experts of the city.

The US department of defence created a method to analyze the level of development of software firms, called the CMM (Capability Maturity Model). In it firms are analyzed on the basis of the maturity of their development skills and then leveled with 5 different quality scores. The world hosts 40 software companies at the highest level, the “optimizing” level, with firms that are not only master in the development processes, but also leading the way towards innovative processes. Bangalore hosts 18 of the 29 “optimizing” level companies in India.

As we have already said the region needs to have representative actions to get together the forces of its firms. The city hosts the biggest ICT conference in Asia, the BangaloreIT.COM (Manimala, 2006).

4.3 How the Government Understood the Potential

In 1986 the market was fully liberalized, the government saw the wave coming and it brought down the import/export duties for ICT products or services down to zero. The reform was a pre-emptive action, for the ICT world that was coming. If a government cannot create an ICT cluster, it can clear the way, base an experiment and see whether or not a cluster was actionable.

The so called, Department of Electronics, or ministry of IT, created the first Software Technology Park of India, which was mainly purposed to satisfy an export demand of the ICT sector in 1991 that was about to be the fastest growing sector in the world. The government also created and launched the first indian independent satellite for an indian “exclusive” internet gateway. Moreover, the region of Karnataka, whose capital is Bangalore, hosted the first IT policies of the indian nation and as such it attracted associations and financial corporations like the Karnataka State Financial Corporation (Manimala, 2006).

The institutional help was concrete, effective, dynamic and rightly predicting future happenings. We can definitely conclude that among the clusters that we have analyzed in the first chapter this is the one that is born through a public intuition.

The government also sponsored an “incentive package” to foster the location of

An incentive package and concessions were made available to industries installing themselves in areas around the city of Bangalore, which were identified as backward.

4.4 Causes

In the first of its conferences at LUISS Guido Carli, the Pulitzer Prize Jared Diamond explained his reasoning to analyze the causes of any economic activity. He made a distinction between “proximate causes”, the ones dependent from other causes, and “ultimate causes”, independent from any other cause, they are the start of the process for which a particular economic event has occurred. He says that any researcher needs the “ultimate cause” to explain an event, but to find them he must go backwards between the “proximate causes”.

4.4.1 “proximate cause”

The Bangalore ICT cluster was able to meet the global demand by providing highly skilled programmers at a low cost. Low cost means, not only that their wage is on average lower than a European or American programmer, but also that their services can be acquired with a lower level of duties and bureaucracy. It is obvious that with such relaxed measures the risks of frauds and legal issues increases. Also, when exporting their services, the Indian corporations do not face payment risks as they develop a unique service that their buyers are not able to analyze, resell nor keep updated. Therefore, a European contractor, for instance, will not be able to get ahold of the full product (the coding), whatever language it is written on (Objective C, Java, etc.) every programming company has its own writing type and it keeps documentation of every relation in its subjects. We can now understand that the nature of this market is characterized by long term collaborations. Examples of collaborations could be the relocation of many international players like: "Infosys, Wipro, Tata Consultancy Services and Microland, the world's leading IT companies like GE, Texas Instruments, CISCO, Digital, IBM, HP, Compaq, Motorola, Lucent Technologies, Microsoft, Sun Micro Systems, Oracle, Novell and several others" (Dijk, 2003).

4.4.2 "ultimate cause"

The "ultimate cause" is not easy to find in every phenomenon. In our case cluster formation is the consequence and the government intervention is only a further step, the "proximate cause". The "ultimate cause" is the reason why the government saw a potential in the region. It is embedded in the region characteristics, in its human capital, in its culture.

The main cause can be found in the interception between the development of the global demand that was searching for a low cost service and the fulfilment by the Indian region, that could provide highly skilled labor at a low cost.

Also, the pool of expert force is created by "existing R&D institutions, universities" and other centers of innovative centers of research. As we said the labor force is completely diversified, thanks to the English culture that has affected the low level pool of employees with an advanced managerial culture. Finally, the english culture has been a basic tool of information that, luckily for India, it has become the international language (Dijk, 2003).

4.5 Outcome

What we can derive from the example is that a government action cannot fill in the spots where natural and cultural resources should be already be based, however, in a later stage, once the process has started, institutions could enter the game. The most important fact is that the institution has understood the dynamics of the cluster and of the global market, being able to forecast the outcomes of the global demand, in order to intervene correctly with directed funds and associations.

Conclusion

From the theory we understood that a cluster is not reproducible in any condition at will, however the government could act ex-post to foster its growth and more than anything, make sure there are no institutional barriers that are stopping its growth.

The theory was based on past events and a deep economic analysis. However empirical findings show that ICT clusters are featuring the same trend: specialization. Although, the some economists are applying the globalization concept to say that clusters will inevitably to the ‘obsolescence’ of location, I found the opposite to be true in several analysis of the current economic situation. Globalization will lead towards the opposite, people will be able to do what they want, next to their similar. People will be able to locate where their skills will be extremely valuable, as now, from there, they will be able to satisfy a global demand.

Will specialized clusters revolutionize the division of the global economy? This is an open question that calls for further research.

If we look into the evolution of the global economy some I believe that clusters will become so important to drive innovation and specialization that they will be the only source of economic activity. This is an extreme case, in which every cluster, specialized in a particular layer of its sector will be so competitive that will remain the only region to satisfy the global demand. As we’ve already said, why didn’t this process happen yet? The causes can be many and different from each other as we are analyzing an economic behaviour. However, we could state some frictions that in the future might change. The global communication has changed, increasing the ability to work far from other departments of the same firm. The difference among people living in the same region has vertically maximized, up to the point in which cultural frictions are almost non-existent in some countries. We expect the latter to ameliorate with time. Finally, we’re in the middle of a consumer-oriented revolution, in which people became aware of their potential and of the ability to pursue their dreams. Thanks to the globalized economies of today we are able to experience any kind of product from our home region and become aware of what we can do. If we link this with the willing of a human to become an expert of his sub-sector, we understand that it is only a matter of time before this increased mobility will inevitably lead towards a movement of personnel of any sub-sector towards the region that is internationally competitive in carrying out the task of that sub-sector: the cluster.

References

2GB RAM only $20/mo. - Linode. (n.d.). Retrieved June 24, 2014, from http://welcome.linode.com/14-ram-offer/?gclid=CjkKEQjwzv-cBRD_oY2PouKVvMIBEiQAKuGNCxJ3EuBsCMXMzOtPEKp5riXxorCxEZZAhyd3Qa2Jenzw_wcB

Aghion, P., & Howitt, P. (1992, 12). A Model of Growth Through Creative Destruction. *Econometrica, 60*(2), 323. doi: 10.2307/2951599

Amazon Web Services (AWS) - Cloud Computing Services. (n.d.). Retrieved June 24, 2014, from http://aws.amazon.com/

Andersen, B. (1999, 12). The hunt for S -shaped growth paths in technological innovation: A patent study *. *Journal of Evolutionary Economics, 9*(4), 487-526. doi: 10.1007/s001910050093

Ayres, R. U. (1986, 12). The man-machine interface. *Technological Forecasting and Social Change, 29*(2), 99-118. doi: 10.1016/0040-1625(86)90059-4

Bergman M. Edward and Feser J. Edward, The Web Book of Regional Science. Industrial and Regional Clusters: Concepts and Comparative Applications http://www.rri.wvu.edu/WebBook/Bergman-Feser/chapter1.htm

BlackBerry Ltd. - Stock Information. (n.d.). Retrieved June 24, 2014, from http://ir.rim.com/stockquote.cfm?benchmark1=&Event1=&DisplayType=Area&Period=&CustomFromDate=6/20/2004&CustomToDate=10/30/2014

Blooma Nicholas, Liangb James, Robertsc John and Yingd Jenny Zhichun. DOES WORKING FROM HOME WORK? EVIDENCE FROM A CHINESE EXPERIMENT February 22nd, 2013 http://www.stanford.edu/~nbloom/WFH.pdf

Buesher Reinhard , European Cluster Startegy: 2014-2020 , Head of Unit for Cluster and Support for SMEs, DG Enterprise and Industry, European Commission <http://www.b2match.eu/system/cluster-to-cluster/files/DrReinhardBuescher.pdf?1366271090>

Cooper, A.C.; Folta, T.B. (2000). 'Entrepreneurship and high technology clusters' (with Arnold C. Cooper), in Donald L. Sexton and Hans Landstrom (Eds.) Handbook of Entrepreneurship, Blackwell: Oxford, pp. 348-367.

Delgado, M., Porter, M. E., & Stern, S. (2010, 12). Clusters and entrepreneurship. *Journal of Economic Geography, 10*(4), 495-518. doi: 10.1093/jeg/lbq010

Dijk, M. P. (2003, 12). Government policies with respect to an information technology cluster in Bangalore, India. *The European Journal of Development Research, 15*(2), 93-108. doi: 10.1080/09578810312331287495

Fiksu Webinars. (n.d.). Retrieved June 15, 2014, from http://www.fiksu.com/resources/webinars

Garelli, S. (1997), The four fundamental forces of competitiveness, *The world competitiveness yearbook 1997*, 17th edition, Switzerland: IMD. http://www.imd.org/uupload/www01/documents/wcc/content/fundamentals.pdf

Godin, S. (2011). *We are all weird: The myth of mass and the end of compliance*. New York: Do You Zoom.

Grabowiecki J. (2006, 03). Keiretsu Groups: Their Role in the Japanese Economy and a Reference Point (or a paradigm) for other countries. Institute of Developing Economies, Japan External Trade Organization. http://www.ide.go.jp/English/Publish/Download/Vrf/pdf/413.pdf

Hefner Frank, CLUSTER THEORY: A NEW PRESCRIPTION FOR OLD STYLE GOVERNMENT PLANNING? http://www.unleashingcapitalismsc.org/pdf/chapter6.pdf

History of CD-ROM In Brief. (n.d.). Retrieved June 15, 2014, from http://www.cd-rom.org/archives/21

How "Talent Clusters" Will Help You Win A Sustainable Future. (n.d.). Retrieved June 04, 2014, from http://www.fastcompany.com/3012598/how-talent-clusters-will-help-you-win-a-sustainable-future

How 8 Fairchild alums sparked Silicon Valley Therese Poletti's Tech Tales. (n.d.). Retrieved June 04, 2014, from http://www.marketwatch.com/story/traitorous-eight-feted-as-california-icons-2011-05-10

Hype Cycle Research Methodology | Gartner Inc. (n.d.). Retrieved April 25, 2014, from http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp

Inside the fall of BlackBerry: How the smartphone inventor failed to adapt. (n.d.). Retrieved June 24, 2014, from http://m.theglobeandmail.com/report-on-business/coming-saturday-the-inside-story-of-why-blackberry-is-failing/article14563602?service=mobile#!/

King Digital Entertainment PLC: NYSE:KING quotes & news - Google Finance. (n.d.). Retrieved June 24, 2014, from https://www.google.com/finance?q=NYSE:KING

Kuah, A. T. (2002, 12). Cluster Theory and Practice: Advantages for the Small Business Locating in a Vibrant Cluster. *Journal of Research in Marketing and Entrepreneurship, 4*(3), 206-228. doi: 10.1108/14715200280001472

Laursen, K., Masciarelli, F., & Prencipe, A. (2012, 12). Trapped or spurred by the home region? The effects of potential social capital on involvement in foreign markets for goods and technology. *Journal of International Business Studies, 43*(9), 783-807. doi: 10.1057/jibs.2012.27

Location, Location, Location. (2013, March 02). Retrieved June 25, 2014, from http://www.nytimes.com/2013/03/03/opinion/sunday/working-from-home-vs-the-office.html?_r=1&

Manimala, M. J. (2006, 12). Evolution of the Bangalore ICT cluster: The 'crystal growth' model. *Industry and Higher Education, 20*(4), 249-255. doi: 10.5367/000000006778175775

Mark Sanders, Utrecht School of Economics (2013, 09). Macroeconomics, slides, ECB1MACR

Mateyka J. Peter, Rapino A. Melanie, Landivar Christin Liana. Home-Based Workers in the United States: 2010. Household Economic Studies. P70-132. Issued October 2012.

Monjur Ahmed, Physical Server and Virtual Server: The Performance Trade-offs, BSc (Hons), MSc, MS Daffodil Institute of Information Technology, Bangladesh. European Scientific Journal April 2013 edition vol.9, No.12 ISSN: 1857 – 7881 (Print) e -ISSN 1857- 7431

http://eujournal.org/index.php/esj/article/viewFile/1009/1060

Muellera A. E. Rolf , Sumnerb A. Daniel and Lapsleyc T. James. *Clusters of Grapes and Win*e A Department of Agricultural Economics, University at Kiel, Germany. b. Department of Agricultural and Resource Economics, University of California, Davis, CA, University of California Agricultural Issues Center Member Giannini Foundation. c. Department of Viticulture and Enology University of California, Davis, CA University of California Agricultural Issues Center http://aic.ucdavis.edu/publications/clusters.pdf

Nepelski, D., & Prato, G. D. (2012, 12). Internationalisation of ICT R&D: A comparative analysis of Asia, the European Union, Japan, United States and the rest of the world. *Asian Journal of Technology Innovation, 20*(2), 219-238. doi: 10.1080/19761597.2012.741392

Nepelski Daniel, De Prato Giuditta, *European ICT Poles of Excellence*, JRC-IPTS / DG CONNECT joint project nr 31786-2010-06, European Commission, Joint Research Centre.

OECD, 2002, Internet economy, ANNEX 1. The OECD Definition of the ICT Sector, Measuring the Information Economy http://www.oecd.org/internet/ieconomy/2771153.pdf

Our organization | About | TED. (n.d.). Retrieved June 12, 2014, from http://www.ted.com/about/our-organization

Porter E. Michael, Bond C. Gregory, *The California Wine Cluster* http://www.uwi.edu/ccfc/wp-content/uploads/2013/11/California-Wine-Cluster.pdf

Porter, M. E. (1999). *California wine cluster*. Boston, MA: Harvard Business School Pub.

Porter, M. E. (1998). *Clusters and the new economics of competition*. Boston, MA: Harvard Business School Press.

Rao, A., & Scaruffi, P. (2011). *A History of Silicon Valley: The Largest Creation of Wealth in the History of the Planet: A Moral Tale*. Palo Alto, CA: Omniware Group.

Regional dimension of innovation. (n.d.). Retrieved April 05, 2014, from http://ec.europa.eu/research/regions/index_en.cfm?pg=smart_specialisation

S3 Platform. (n.d.). Retrieved June 23, 2014, from http://s3platform.jrc.ec.europa.eu/home?CFID=6d69bb47-5202-46cd-bf7f-

057f9f1e3699&CFTOKEN=0

Sanders Mark, Utrecht School of Economics (2013, 09). Macroeconomics, slides, ECB1MACR

Schumpeter, J. A. (1939). *Business cycles; a theoretical, historical, and statistical analysis of the capitalist process*. New York: McGraw-Hill Book Company.

Startup Business Failure Rate By Industry. (n.d.). Retrieved April 25, 2014, from http://www.statisticbrain.com/startup-failure-by-industry/

Zhang, J. (2003, 12). Growing Silicon Valley on a landscape: An agent-based approach to high-tech industrial clusters. *Journal of Evolutionary Economics, 13*(5), 529-548. doi: 10.1007/s00191-003-0178-4