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How is a regional technology cluster created? Insight from the construction of the nanotech cluster in Grenoble

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Abstract

Through the analysis of a success story – namely the nanoscience and nanotechnology cluster in the region of Grenoble in France, the present chapter examines what the favourable conditions are, besides public investment, for the emergence of a successful technology cluster? Through the analysis of the construction of Minatec in Grenoble, it proposes that technology clusters can emerge more successfully in sites where the social, intellectual and infrastructure capital is high – in other words history and geography matter. Endogenous technology cluster are triggered into emerging by charismatic leaders who are a combination of social and techno entrepreneurs. They trigger collective conversations which are necessary for the transformation of expectations transformed into tangible infrastructure. Then the region becomes a basin of attraction for talent as individuals and organisations start to believe that they can enjoy higher returns by being a part of the cluster rather than by being outside of the cluster. However, as talent gets concentrated in the region, it creates a competition for scarce resources, which can trigger dissent.

How is a regional technology cluster created?
Insight from the construction of the nanotech cluster in Grenoble[1]

1. Introduction

A technology cluster refers to a regional enclave where the generation of technological innovations is far higher than the local, national or international average. On the one hand, they can be constructed through a state initiative in the form of a science and technology park. On the other hand, they can emerge in an endogenous fashion through the concerted efforts of economic actors. An example of the latter is the famous "silicon valley" phenomenon during the 1950s in informatics. Some other examples of successful technology clusters in emerging countries are Bejing, Bangalore, São Paulo, Campinas, Buenos Aires etc. Yet, in many countries technology clusters fail to emerge and very few science and technology parks have earned renown. This leads to a puzzle: besides public investment, what are the conditions that favour the emergence of a successful technology cluster? The present chapter seeks to answer such questions through the analysis of a success story – namely the nanoscience and nanotechnology (NST) cluster in Grenoble. Through the construction of this case study, our larger purpose is to identify the parameters that give rise to a collective activity between a variety of scientific and economic actors that creates new knowledge, new technology and innovations in a region.

Innovation studies of high-tech sectors like microelectronics, telecommunications and biotechnology propose the Sábato triangle (Sábato, J., 1975) and the 'Triple Helix Model' to identify universities, the state and knowledge intensive firms as the core team leading the construction of technological capacity building (Etzkowitz, H. and L. Leydesdorff, 2000). Under the Triple Helix model, actors from the university, industry and state interact in recursive cycles to build industrial capabilities in new knowledge intensive sectors. Extending their arguments, it would seem that for the emergence of technology clusters, cooperation and collaboration between university researchers, scientists from firms and policy makers is necessary. This is because, as the frontiers of known knowledge expand, it becomes more challenging for firms to create innovations. They rely on public laboratories to identify knowledge of commercial value and test it at a pilot scale. The State participates in this process through supporting scientific research and its transformation into innovations through public investment and policy reforms. For instance, with the implementation of clones of the US Bayh Dole act in various countries, allowing public researchers to patent, now public labs also compete with private firms in patenting and start-ups from public laboratories vie with established firms to bring innovations into the market place. But how do the conversations take place between the actors of the triple helix? Innovations studies seem to assume that given pools of scientific and technological capabilities and a progressive State, the triple helix will somehow spring to life and catalyse innovations. However, this is simply not the case. Indeed, our recognition of the importance of the triple helix model for technology clusters does not match our understanding of how interactions are effectuated. The present paper hopes to contribute to making this lacuna smaller.

The Grenoble nanotechnology cluster is the second largest cluster in France in nanotechnology after the Parisian one. The success of the Grenoble cluster is mainly attributed to the scientific and technological capabilities of the region. Like most nanoscience and nanotechnology (NST) poles, it is made up of universities, national and international research organizations as well as small and medium sized firms. At the same time, its

[1] Parts of this chapter are taken from Vinck D., 2010.

evolution has been deeply marked by the actions of three big players: A research and publications intensive university (Joseph Fourier university or UJF**) ;** the Atomic energy commission, a public laboratory and technology transfer center (CEA-LETI) ; and a cluster of research intensive firms like STMicroelectronics. It is also marked by a higher than average proportion of researchers – for instance out of its 400 000 habitants, 53 000 are university students and 20 000 are researchers, technicians or engineers engaged in scientific pursuits.

At first glance, the Grenoble cluster seems to confirm the standard hypothesis that the necessary and sufficient condition for a successful cluster is the capacity to invest in equipment and the presence of scientific and technological capabilities in the form of efficient human capital and institutions. But is the simple existence of human capital and institutions on a critically large scale sufficient to guarantee the kick-start and success of a technology cluster? This brings us back to the question – is a technology cluster born or created? Moreover, why is it that some regions like Grenoble are endowed with a higher scientific and technological capability than others in the first place? After all, even this configuration of human capital and institutions could not simply have fallen out of the sky. And how has the social capital been constructed between the actors involved? Seeking answers to these questions will throw light on the factors that determine the success of any technology cluster.

To answer our central queries, we have opted for the case study approach, as it is useful whenever the purpose of the scientific query is to understand the 'how' rather than the 'why' of a process (Eisenhardt, 1989; Yin, 2002). In the present chapter the focus of study is the process of progressive construction of a scientific and industrial trajectory that is bound by a tissue of social capital and cooperation. Our case study is built following a two-stage procedure, using two sources of data: archives and notes from direct observations over many years.

The methodology pursued to present the case study is the historical narrative. The data analysed was gathered by the first author over a period of fourteen years (1994-2008) in the form of detailed notes, i.e. ethnographic observations of stakeholders such as decision makers in laboratories and firms, policy makers, researchers in think-tanks and citizens' groups in informal get-togethers, strategic discussions as well as public meetings. The author acted as secretary to the group, taking many detailed notes[2]. These notes are used in the present article to reconstitute exchanges between those scientific representatives at the time. These were connected to other sets of recent ethnographic observations between 2004 and 2008 noted at the monthly meetings of an informal think-tank dedicated to furthering the activities of NST in Grenoble; observation of meetings in three research labs (general meeting of the lab, project review meetings, technical meetings, meetings between lab members and visitors or industrial partners); monitoring a number of visitors (journalists and scientists) through various meetings with researchers, representatives and industrialists; observation of more than 10 local public debates on NST. Data was also gathered through formal and informal discussions with the actors (researchers, industrialists and political delegates) involved in those meetings. Furthermore, documents circulated by local actors were used including e-mails send to researchers by an opposition group. The resulting material is therefore highly heterogeneous. It is explored in a qualitative way through content analysis and construction of intermediary hypotheses, which are confronted with the data. A critical distance with respect to experiences of the local actors is set up by describing them as a narrative.

[2] The notes were taken without any research perspective at that time.

The rest of the chapter is organized as follows. Section 2 contains the detailed case study. Section 3 discusses the results and section 4 concludes.

2. Case study: The Nanotech cluster in Grenoble, France

Even before the Sábato triangle or Triple Helix Model had been identified, Grenoble had experienced at least two main waves of the same before the emergence of the NST cluster.

The first Triple Helix wave: White coal

According to local history, the origins of the scientific and technological intensity of the Grenoble region date back to the second half of the 19th century, when 'white coal' or hydroelectric power was being mastered. In the Rhone-Alps region, at the foothills of the Belledone chain, led by Aristide Berges, this triggered a battle for water for the development of the paper industry. During the 1870's the installation of hydroelectric power stations gave a breath of new life to the sleepy science faculty in the (then) small town of Grenoble with a population of 25,000. The scientists held discussions with the local municipality to put in place 'free evening lectures' for the public on the generation and uses of hydroelectric power. The Chamber of Commerce launched a course on the same in the science faculty. The municipality gave a subvention for the opening of the 'Institute of Electrical Technology' in 1990. In turn, the science faculty and the engineering school created qualified personnel to man the local industries.

This first triple helix wave generated other positive externalities that led to local development. With the success of the paper processing firms, other paper processing firms and paper and carton retailers flocked to the region. They eventually created a 'Paper Technology Engineering School' in Grenoble. The leader in aluminium production, Pechiney, also settled in the region as two of the key inputs of aluminium production are water and electricity. This generated a need for further research and another engineering school with specialization in chemical engineering was opened. In 1902, the network of engineering schools were grouped under the name 'The National Polytechnique Institute of Grenoble' or INPG[3] in French. In 1920, Paul-Louis Merlin and Gaston Gerin founded the company known todays as 'Schneider Electric' that manufactured heavy equipment for electricity production and is renowned for its breakthrough innovations in this field. The conglomeration of firms specialized in electrochemicals and metallurgy led to further research being undertaken in these fields in collaboration with the local research institutes.

The second Triple Helix wave: Energy leader

At the end of WWII, the French government took charge of research, allocating the task of pursuing 'fundamental research' to Parisian institutions and leaving 'applied research' to the provincial schools. Such a division only served to strengthen the triple helix model in Grenoble. Louis Néel, a physicist, and Louis Weil, his assistant, moved into the empty premises of the Institut Fourier in 1940. Their work attracted entrepreneurial minds from the scientific community and slowly they built a top notch team in applied physics in Grenoble. Louis Néel, eventually won the Noble Prize in Physics in 1970 for his work on the magnetic properties of solids, while Louis Weil won renown in the field of physics at low temperatures.

[3] Institut Nationale Polytechnique de Grenoble

Not only were the two Louis's, scientists *hors norme* but they were also scientist-entrepreneurs who managed to mobilize a large section of the scientific and industrial community around industrial and economic goals with a *passion* that was largely unmarked by interests of personal gain. Together, they motivated the creation of many start-ups and attracted captains of industry to invest in research. The efforts of Louis Néel led to the creation of premiere laboratories in Physics of the CNRS (National Centre for Scientific Research) and the antenna of the CEA or the Atomic Energy Commission in Grenoble among other laboratories. He was avant-garde in proposing collaboration between university and industry as a means to promote economic development and growth of a region and his experiments in public-private partnership via technology transfer contracts singularly marked out Grenoble from the rest of France, including ivory-towered Paris (Caroline Januel, 2007[4]). The legacy of Louis Weil is also kept alive as the website of the Grenoble-Isere Economic Development Agency announces: "Determination, dynamism, spontaneity, sharing, altruism, efficiency and creativity are among the values that inspired the founders of the Grenoble-Isère economic development model. This approach, promoted by scientist Louis Néel, business leader Paul-Louis Merlin and academic Louis Weil, is based on a powerful symbiosis between research, industry and training. The same virtuous circle is still turning, fed by the work and will-power of many talented men and women."[5]

Fall from glory and creation of a collective consciousness

In Grenoble, during the mid1990s, in the the *l'Alliance Universitaire de Grenoble*[6] or in the think-tank federating different research units, academics and industrialists, often ex-graduates, rubbed shoulders in informal encounters to debate about the future. The burning question was: Could synergy be created from the Grenoble cluster of research units by working together on a collective theme? These queries were but natural to Grenoble – given its extraordinary past carved by heroes. They sighed over Aristide Berges, Louis Weil, Louis Neel. They lamented that while Silicon Valley and Cambridge Scientific Park were still being nourished by universities, the triple helix model was very sluggish in Grenoble. In Europe, Grenoble had been the Silicon Valley, a beacon for other regions which vied to imitate its strategy for creating synergy through creative and intense interaction between scientists and industrialists. What had happened to this leadership position? Innovations issuing from public laboratories and universities had transformed this region into one with an unusually high density of scientists – did this represent disequilibrium given the reality of the day?

To ensure themselves that it was not the case, they counted their troops and found they had nearly 900 scientists working on the life sciences full time. Then they grouped the laboratories in Grenoble to gain better international visibility. Finally, this movement led to discussions between the different directors of laboratories and some transversal projects were initiated. But the debates continued. How could they reignite the dynamics of the past? Should the new science-technology adventure be in the cognitive sciences or in the life sciences? They lamented again and again that "the industrialists are disappointed because the scientists are no longer the carriers of new visions for the future"; science was becoming a disappointing past-time due to the "absence of new epics". As their jeremiads took more final shape, so did their anticipations and their longing for change.

[4] http://www.millenaire3.com/uploads/tx_ressm3/Grenoble_Recherche_Industrie.pdf
[5] http://www.grenoble-isere.com/eng/Why-invest-in-Grenoble-Isere/Our-talents
[6] Known earlier as the Amis de l'Universitaire de Grenoble

The emergence of a charismatic leader and the transformation of desires into reality

Industrialist and researchers in Grenoble, in charge of university and research institutions, were hoping and preparing for the coming of a new charismatic leader, a new scientific entrepreneur who would give them “renewed faith and passion”. Cross-cutting themes (shared by both institutions and disciplines) came up repeatedly, especially research on materials. One theme gradually emerged: thin-film processing. It was considered to be a good opportunity given that it could benefit from the existing instrumentation, which constituted very specialized resources. Talk focused in particular on the study of promising materials and of compact materials and systems, with the local presence of internationally-respected laboratories. A federating topic to constitute a future epic was suggested. A very slight breeze of hope blew over the researchers. Future possibilities and local resources were investigated, and preparations made to launch something. But they still had to find somebody to federate the entire movement and promote the new epic.

By 1998, Jean Therme rose to being the assistant director of LETI and in 1999 he was nominated as the head of both CEA-LETI and CEA-Grenoble. Jean Therme is a son of the Grenoble soil. A graduate in physics from the INPG of Grenoble, he worked in the research divisions of multinationals implanted in the region like Philips, Thompson, Alcatel and STMicroelectronics. In 1990, he was sent by STMicroelectronics to lead a joint-research team with members of LETI of the CEA (or Atomic Energy Commission), that was a premiere laboratory in microelectronics, microsystems, and optronics. At the end of the 1990s, he set up an in-house think-tank to work on a strategy. The group began by exploring the potential for increasing collaboration between the fundamental and applied researchers of the region. These discussions led to introspection on whether a new ‘technology epic’ could be triggered in the region. Again, the conversations converged on the study of promising materials and of compact materials and systems, topics related to nanotechnology on which the local laboratories had expertise.

In 1999, as director of CEA Grenoble, Jean Therme was also invited to participate in discussions led by the city council on how to make best use of some unused public land next to the CEA site. The municipal council wanted to make it into a technology park for start-ups that would collaborate with LETI. However, the council was concerned that left to themselves the CEA would simply annex the land for their own use. Therefore, they also invited university researchers to be a part of this panel. Here Jean Therme began to float the idea of a collective project – a grandiose collective project – that could be housed on the site. Jean Therme did not stop there. He first approached the INPG, his Alma Mater, where he was also a member of the council. He wanted their feedback on initiating a collective project. Then he met with researchers from an engineering school specialized in electronics next to the CEA.

By this time, he had the three main elements of the collective project in place. First, the project would welcome any local research institution that was interested in undertaking research in the theme of the collective project could join, i.e. there was no entry fee. Second, every member of the consortium would have access to costly equipment. Third, in return every member would have to exert efforts to expand the installation.

Once the idea of a ‘cost sharing technology platform’ found acceptance within the CEA and with the directors of other local research establishments, Jean Therme sought to find state support for the project. He won the support of the Mayor of Grenoble, himself an ex-engineer of the CEA and the founder of a start-up. He also began to present it to key policy makers at the national and European level. Talk of the project continued and it gained a life of its own and grew in prestige. Something that had started out as a discussion about what to do with some unused public land now took on the contours of a flagship project of the Grenoble region.

Mangematin et al. (2006) have analysed 102 presentations of the project, given over 28 months by Jean Therme, including more than 700 slides. Their analysis reveals that contrary to practical business principles, the presentations did not contain any detailed business plans. The specificities of the scientific research were not pinned down. Instead the concrete form that an institute could take in terms of a building and the types of equipment it could house were discussed.'Minatec', the future nanotechnology warehouse, was born before it got its name. It became embedded in linguistic artefacts and images as it got transformed (Callon, 1986). As each presentation was given and the feedback was integrated, it refined the presentation more to reflect the interest of the economic actor consulted. From an individual's vision, the project became a collectively sculpted object.

Different types of advantages were pointed out to the different economic actors. For example, policy makers were made aware that by pooling together competencies and creating a continuum from scientific to technological and finally innovation capabilities – Minatec would establish French leadership in nanotechnology in the face of competition from the USA and China. On the other hand, the CEA and public establishment researchers were assured that none of their research would be adversely affected by the new entity while evoking the past with Minatec being a new avatar of the Grenoble model. In his speech for the 50 years commemoration of CEA, he explained: "We have not invented it. It comes from Aristide Berges. It comes from the Three Louis: Louis Néel, Louis Weil and Louis Merlin. It is the genetic patrimony of Grenoble. Our responsibility is to sustain and expand this model even more". To start-ups, he clarified that as a centre of resources, a platform for training and research, it would also be an ideal location. They could consider collaboration with one 220 local laboratories, 5 international centres of research and 30 multinationals.

Jean Therme's speeches resounded with truth and passion on the state of the world and the place of Grenoble in it and its possibilities to shine as a technology cluster. They created expectations about the possibilities of a project that was still residing only in his computer. The site and the form it would take were planted in the minds of the scientific, political and economic actors of the innovation system, before its interior and contents were defined.

But, as the conversations continued, the project took concrete shape and it came to be defined more precisely. There was an auto-selection of partners, made up of those who interests matched those of the project. As the physical construction of the building began, the financial details were attended to.

The Minatec imagined in 1999 was launched in 2001. By 2005 the buildings were ready and by 2006, they were functional. Around 400 million euros had been mobilized to create the infrastructure. Its year of opening coincided with the commemoration of 50 years of existence of the CEA. In June 2006, it was inaugurated in a major political, industrial and social event. As Jean Therme explained the ambition of Minatec is to offer: "global approach to innovation through the establishment of a continuum of research between fundamental sciences and technology", which would be indispensable for success. National and local government officials joined industrialists in a series of international seminars while a group of dissenters protested outside the premises. We now turn to the latter.

The creation of spaces of doubt and dissent (2003 -

In the research laboratories, employees, who were not necessarily scientific entrepreneurs, generally followed the movement with enthusiasm. Either moved by a fascination for the new fields of knowledge opening up and their applications, or by a concern that if they did not move, they would lose out in the international technology race, most approved the local dynamics set in motion with pride. However, some researchers were concerned that they were working on fundamental research with applications that could be exploited by either the military or the industry – and over which they would have no control. Researchers in the life sciences worried over some ethical issues. A section of both young and old researchers working on research projects or knowledge transfers for industrial development, questioned the ultimate goals and conditions behind the partnerships between public research and the industrial world. Laboratories became arenas for political debate (Marris 2001).

From 2003, an unknown citizens group began to circulate a series of critical texts, using billboards and their internet site[7]: “The true story behind NanoBio (as far as we know)” (March 10th, 2004); “Research: what exactly is the financing for?” (May 12th, 2004); “The sect behind nanotechnologies” (May 25th, 2004); “Grenoble, new technologies: the job carrot” (October 19th, 2004); “2001 Necrotechnologies”; “STOP THE RESEARCH!” (April 6th, 2005); “The mobile phone, a gadget of mass destruction” (June 24th, 2005). They claimed to be members of the ‘Handmade Pieces’ a civil society group for the construction of a critical spirit created in 2000[8]. Their mission was to prove that technology is a pillar of contemporary capitalism pushing for globalization and deepening cleavages between the powerful and the powerless (as determined by the technology). They diffused their manifesto through discussion and diffusion of information via surveys, squats, meetings, books, tracts, posters, brochures, interventions etc.

The opposition group also participated in various public debates, creating noise, theatricals and general disturbance. Some of these “simple citizens” became quite well known in meetings through their consistent presence. They argued that public money was used without any genuine democratic debate beforehand, projects (in which the military was involved) will lead to manipulation and social control of people, local communities were being exposed to pollution and toxicological risks, real estate prices were soaring due to the presence of an international elite formed of managers and engineers and consumerism and the technico-economic competition model were being promoted. To draw attention the “simple citizens” used outlandish expressions, which nevertheless drove home their points. For instance, one “simple citizen” would leave debates assailing the assembly with “Adieu slaves!”

The opposition group also engaged in visible collective acts of defiance such as occupying the work site of Minatec amidst the cranes and holding their own public debates, notably in squats. The general debate attracted a highly diverse public ranging from anti-globalization groups to researchers from major local research organisations. The university community began to be swamped with texts, which were regularly dismissed as fallacious and devilish by research leaders in public meetings. Nevertheless, many researchers actually read them and discovered a mine of facts and opinions they had not been aware of. They began to use the facts brought to light by the opposition group to prepare their own presentations on NST.

By 2004, some local politicians also began to ask themselves questions. They said that they were wary of the local scientific entrepreneurs with their seductive speeches, who had

[7] http://www.piecesetmaindoeuvre.com/
[8] http://www.piecesetmaindoeuvre.com/

"sold" them the project. Questioning began as soon as these same local scientific entrepreneurs came back for financing another project. Hesitant, owing to the overall cost to the community, the local politicians learnt that this was the logical next move and that it would be ridiculous to support the original project and then hold back on any spin-off projects. The local politicians felt trapped and so began to dig deeper into the ultimate goals of the Minatec project. Little by little, societal debates had created spaces of dissonance against the NST cluster.

Attempts at dialogue

By 2003, opposition to Minatec in Grenoble had a visible face and a loud voice. Naturally, this triggered moves to assuage fears.

In the public institutions, researchers wanted to restore public trust in nanotechnology through a more organized and public debates. However, communications specialists, who were getting more contracts from local scientific, industrial and political leaders were against leaving the field open to the "anti-nanos" to be caught in a "battle waged by guardians of ethics". They suggested occupying the debate, communications and media fields by sending out young researchers who were bound to be more credible than the older generation of bosses, industrialists and politicians. Although the scientific and industrial actors were shielded by the prestigious scientific image held of them by the local public, the communications specialists suggested that ostentatious communications and impressions of power should be avoided at all costs.

Following the communication specialists, in May 2005, a key event, a major public debate was organized in Grenoble. A well known social scientist was engaged to animate the debate and promptly got labelled as a "mercenary" and "dialogue technician". The opposition group described the debate as an "acceptability trick", designed to persuade people to carry on "as before": "now the decisions have been taken and the site is already under construction, it's time to get the population to agree, whatever disasters may be lying on the path to growth."

On the day of the great debate, only 40% of the room was filled. When the host called out a "bonjour" to the audience, a gentleman got up and replied "bonjour, my name is simple citizen" and shouted out his text in order to be heard without a microphone. Smiles on the faces of the audience disconcerted the organizers, The host kindly put a hand on the shoulder of 'simple citizen' and told him "don't be scared" while opposition sympathizers went around the room distributing leaflets against the NST cluster in Grenoble. But when 'simple citizen' decided to carry on, many in the audience demonstrated their discontent by whistling or shouting "enough, enough". Invectives flew: "stupid bastard", "get out" "have you finished yet?", "stupid idiot", "dickhead", "are you going to make sure our kids have enough to eat?", "go and take your shots", "go and smoke your dope". When he finished his speech, he was escorted to the exit by two security guards who had been waiting patiently. Then, the people on the stage reminded the gathering that democratic life requires a number of basic rules of communication to be followed (Powell, D. and Leiss, W., 2004)

The debate showed how increasingly large sets of people in society were concerned by institutional communications, debates and events. After all an epic is an epic because of the pride and questioning surrounding it.

Present co-existence

Today Minatec announces itself as a micro and nanotechnologies innovation campus: "The MINATEC innovation campus is home to 2,400 researchers, 1,200 students, and 600 business and technology transfer experts on a 20-hectare state-of-the-art campus with 10,000 m² of clean room space. An international hub for micro and nanotechnology research, the MINATEC campus is unlike any other R&D facility in Europe"[9]. It comprises Minatec (research network on micro and nanotechnology), Minalogic (research network on micronanotechnologies and embedded software), Nanobio (research network on nanotechnology combined with the life sciences targeting health sector) and Tenerrdis (research network using nanotechnology for renewable energy production).

'Handmade Pieces' is still alive and active in Grenoble and they continue to raise serious questions on the implications of Minatec for the region and humanity in general. For instance, in December 2012, their leading article discussed the potential of the use of innovations from Minatec by the military[10].

3. Discussion of results

So what does the case study tell us about the original research question – is the Sábato triangle or the triple helix model a necessary condition for a high-tech technology cluster to emerge? By way of answer, the case study clearly confirms that interactions between the state, industry and academia are necessary for a technology cluster to emerge in an endogenous fashion. High initial fixed costs of the infrastructure, inputs from frontier research and the need to amortize the investment through generating revenue makes it impossible otherwise. Then, the case study yields a number of testable hypotheses for future research, to which we turn now. These are presented as results of the case study.

Result 1: Endogenous technology cluster are triggered into emerging by charismatic leaders who are a combination of social and techno entrepreneurs.

A social entrepreneur is described as a very creative, radical and effective individual who is committed to serve society and achieve specific 'social missions' or 'social projects' to improve the quality of life of a marginalized group or victim group or needy group (Shaw, 2004). Social entrepreneurship is the intent of an entrepreneur to create social value instead of shareholder value (Zadek and Thake, 1997). The role of the technical entrepreneur in industrial development and regional growth has been recognized (Oakey, 2003). However, there is little in the literature on the captains of growth from the public sector, who foster economic development through building technology clusters – which is what Jean Therme is.

Jean Therme is an entrepreneur in the sense that he recognized an opportunity and he took personal reputational risk to work towards the realization of a collective dream. Moreover, he is a social entrepreneur because he was committed to the social mission of providing new technical services based on nanotechnology as the core competency of a public institution. Like most social entrepreneur he achieved his social mission by bringing different groups together. He created faith by lending words to dormant dreams and speaking

[9] http://www.minatec.org/en/minatec

[10] http://www.piecesetmaindoeuvre.com/spip.php?page=resume&id_article=399

confidently about what others had imagined but not started believing yet. His charisma made local actors feel as if they were a part of new epic – being written just for them.

Passion and commitment are the two characteristics especially noted in entrepreneurs and this is reflected in the strategies deployed by Jean Therme. He had not used any public relations company or any marketing company to rally the local actors. He just invested in creating the social capital personally in the tradition of social entrepreneurs. His strategy was "to engage in conversation". Mangematin *et al.* (2006) report that he transmitted his vision to potential project participants through a long series of slide shows, adapted to the target parties and situational developments. Moving from one institution to another, he went about constructing meaning, since actors were still involved in a quest for identity as nanotechnology was a new emerging field.

Result 2: (a) An endogenous cluster is created whenever a region becomes a basin of attraction for talent wherein individuals and organisations become attracted to the region because they come to believe that they can enjoy higher returns by being a part of the cluster rather than by being outside of the cluster.

(b) As talent starts to concentrate on the region, it generates a greater competition for scarce local resources, which in turn can trigger dissent.

A region becomes a basin of attraction for talent people, when the potential of the region gives rise to beliefs that *by joining* the cluster they can do better than by *not* joining the cluster. Minatec satisfied the above condition for each of the different stakeholders in the innovation system: universities, technology transfer units, industrialists and governments. For universities, it was a pathway to gain access to high-level facilities that would enable the training of new generations of researchers and improve their international visibility. For technology transfer centres it was a great business opportunity. For industrialists the project was a means to gain access to a complete research infrastructure to back up their innovation strategy. For local governments it was a possible instrument to generate not only industrial growth with employment but also to contribute to the construction of a project that would enhance the renown of the region such that the region itself becomes the brand ambassador of the sector.

Again, as the resources like water began to be used more or the influx of outsiders created a greater competition for housing or the exalted position of nanotechnology and its applications rendered the other sciences less fitted to the local context, dissent began to brew.

Result 3: Collective conversations are necessary for the transformation of expectations transformed into tangible infrastructure.

The case study provided one concrete example of how the triple helix operates. As Czarniawska and Joerges (1996) point out that when one actor translates and structures the objectives of existing actors, while at the same time obliging them to make detours, assumed to be necessary for the objectives of each to be reached, the seeds of cluster formation are planted. And Jean Therme succeeded in doing this with Minatec by co-creating the project with other stakeholders of the innovation system. By getting them interested and jointly defining the terms of commitment with them, he helped to redefine their existing roles and relations. Existing institutions mutually redefined each other. Jean Therme negotiated with the different actors so that each found its place in the NST cluster. The project was translated to give a different perspective on its raison d'être to different institutional actors to gain collective approval. Slowly his ideas were thus transformed into linguistic artefacts, images, finance and finally buildings.

Result 4: Clusters can emerge more successfully in sites where the social, intellectual and infrastructure capital is high – in other words history and geography matter.

This is the explanation for why certain regions become renowned for their technology prowess. In the Minatec, epic, history and geography played a triple role.

First, history speaks of itself and if a region has enjoyed glory, it sets a precedent that the following generations always strive to revive. In this respect, Grenoble has been singularly marked by the work of great techno-social entrepreneurs. For instance, given that Grenoble is situated in the valley surrounded by the Alps and fed by many clear mountain streams, hydraulic power generation technology developed here at the end of the 19th century. Under the leadership the great leader-engineer Aristides Berges, the hydraulic technology was improved upon greatly and applied to different industries. Thus, the paper industry was developed in Grenoble and electrification was made accessible to households, an extraordinary feat for the epoch.

Second, the industrial growth generated funds for the setting up of academic institution, the creation of a scientific community and the accumulation of a rich collection of costly instruments and equipment. For example, the development of the paper industry instigated the creation of an engineering specialized in this industry. The Noble Laureate Louis Néel set into motion what would finally emerge as the European Synchtroton Radiation Facility (ESRF) in Grenoble and it is very active in offering the use of its equipment to industrial units. In turn the instruments oriented research towards certain themes, which formed the foundation for the creation of the new epic.

Third, the presence of reputed public laboratories open to cooperation with private firms set into motion the entry of knowledge intensive international firms into the region. Again, returning to the paper industry, other organizations involved in the vertical supply chain of the paper industry settled in Grenoble. Later on in the 20th century, given the unusually high concentration of scientists and engineers in the region, companies like Motorola, Philips, IBM, STMicroelectronics, Hewlett Packard settled in the region and they are joined by regularly mushrooming hi-tech start-ups.

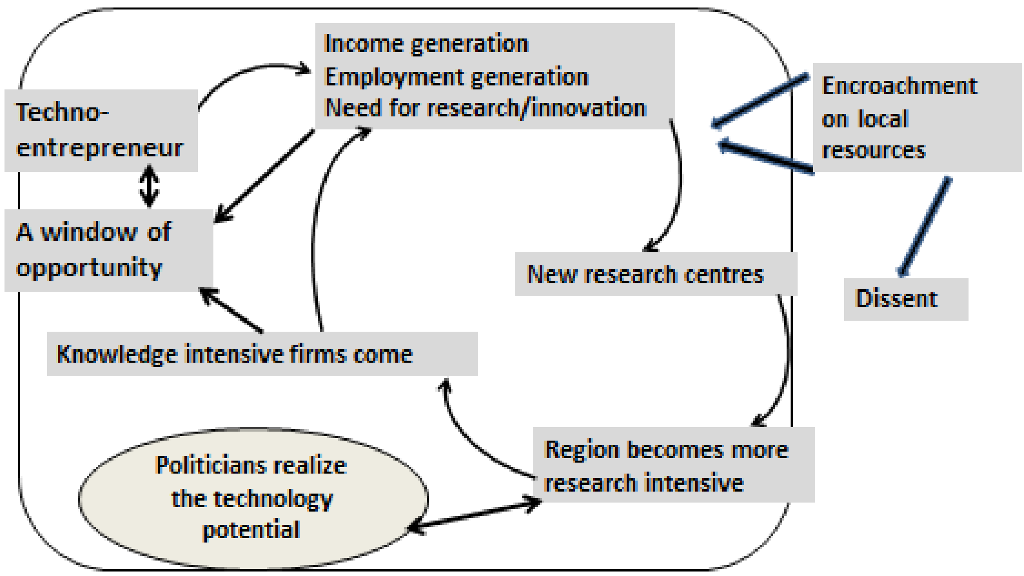
Thus, the ground was prepared with shared visions and accepted rules for coordination between public laboratories and private firms.

4. Conclusion

During the 1980's public investment in science and technology parks as a means to create technology clusters became increasingly popular in Europe as well as developing countries, as a means for the State to support entrepreneurs and innovation creation. Most of the existing literature in economics seems to assume that given an adequate pool of scientific and innovation capabilities, public investment in the creation of a cluster (whether as a park or a regional enclave) will always bear fruit and therefore, they mainly focus on important issues that are pertinent in the *post-investment* period such as measurement of performance and identification of "best practises" for replication. However, it is widely acknowledged that the rates of return to public investment in the creation of technology clusters in most developing countries are far below the expected mark. So, why is it that investment coupled with the presence of technologically competent firms and laboratories is not always sufficient to create a dynamic technology cluster? This is the question that we sought to explore through a detailed case study of the renowned success story of the nanotechnology science and technology cluster in the Grenoble region of France. Our larger purpose was to identify the parameters that give rise to a collective activity supported by the State that creates knowledge, new technology and innovations in a high-tech sector.

The results of our case study can be summarized as presented in Figure 1. At the root of every endogenously emerging high-tech technology cluster in sectors like nanotechnology, is a socio-techno-entrepreneur, who identifies a window of opportunity to achieve a social mission through the mobilisation of local scientific and technical talents.

Figure 1: How a region becomes a basin of attraction for a technology cluster



If the socio-techno entrepreneur is successful, then the region benefits from income and employment generation, which creates new needs for research and innovation. As new research centres emerge to cater to this extra demand, the region becomes marked as becoming more research intensive. If local politicians are motivated to use this technology prowess as a platform for their own achievements, then they cooperate to invest more in the cluster. This sets into motion a band-wagon effect, by which new knowledge intensive firms are attracted to the region because of government support and the presence of a rich network of universities and public laboratories. This again generates new needs which may be satisfied by both public research and new techno-entrepreneurs. However, as the cluster becomes bigger with the entry of more and more economic actors, local resources are used-up and this may cause social tensions unless managed well.

Thus, our case study shows that the technology clusters need not always rely on grandiose and rational plans of government bureaucrats. They can be built upon the beliefs that past grandeurs can be revived, of epics, of nostalgia and of shared dreams and clashing visions. Endogenous technology clusters are born from a desire of local scientists to recreate past glory and they are brought to life by charismatic techno-social entrepreneurs.

The terms of insight for policy design on technology clusters four points can be made.

First, the case study reveals that while scientific, technological and institutional capabilities are a necessary condition for the emergence of a technology cluster they are not sufficient for its success. A set of additional ‘favourable endogenous conditions’ are required for success of which we can identify at least three: ‘social capital’ in terms of networks between the set of concerned stakeholders; ‘optimistic beliefs’ in reference to high expectations of rewards from cooperation and coordination between the same stakeholders and ‘change leaders’ who enjoy the support of the different stakeholders.

Second, there is no formula for the replication of the favourable endogenous conditions. The exploitation of social capital and optimistic beliefs once constructed, to generate success, requires the presence of ‘change leaders’. The change leaders must not only have the right vision but also enjoy the support and respect of different stakeholders to induce cooperation. The favourable endogenous conditions can emerge through a variety of processes. The case study highlights the importance of little acknowledged features such as ‘drama’, ‘story telling’ and ‘historical glory’ in such trajectories.

Third, given the reality of scarce resources, there is every possibly that investment in the creation of a technology cluster initiates conflict with other stakeholders competing for the same scarce resources. In the ensuing bargaining game, policy makers are more likely to support actions that generate greater short term benefits than long term losses. Indeed, higher the reversibility of the perceived future loss through future action, less the constraint posed on present investment.

Four, and this is the essence of our paper for policy recommendation: public investment in the creation of technology clusters must be in zones which not only have sufficient scientific and technological capabilities but are also supported by strong social networks between stakeholders sharing common high expectations of rewards from cooperation and coordination, rallying under a set of accepted change leaders. The rationale of simply disbursing funds to a set of highly capable scientists or innovators in public laboratories or firms, who are not connected and who do not share similar goals, values and expectations cannot be presumed to produce synergy – rather it is like putting the cart before the horse. Herein lies the reason for the failure of public investment in the creation of technology clusters both in mission and market mode in many countries.

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