UNIVERSITÀ DEGLI STUDI *MEDITERRANEA* DI REGGIO CALABRIA

DIPARTIMENTO PATRIMONIO ARCHITETTURA URBANISTICA -PAU
HERITAGE, ARCHITECTURE AND URBAN PLANNING DEPARTMENT

DOTTORATO DI RICERCA IN
URBAN REGENERATION AND ECONOMIC DEVELOPMENT

INTERNATIONAL DOCTORATE PROGRAMME IN
URBAN REGENERATION AND ECONOMIC DEVELOPMENT

XXVIII CYCLE
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THE IMPACT OF TECHNOLOGY TRANSFER ON REGIONAL ECONOMIC DEVELOPMENT: INNOVATION POLES AS INNOVATION ECOSYSTEMS

EXPERIENCES AND CASE STUDIES FROM EUROPE AND UNITED STATES OF AMERICA

PH.D. CANDIDATE/DOTTORANDO:
Saverio Alessandro Falcomatá

TUTOR:
Prof. Massimiliano Ferrara

CO-TUTOR:
Dr. Dave Norris

PROGRAMME COORDINATOR/COORDINATORE:
Prof. Paolo Fuschi

REGGIO CALABRIA, FEBBRAIO 2016

SAVERIO ALESSANDRO FALCOMATÁ

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This research was supported by the European Union.
I would like to express my gratitude to Prof. M. Ferrara and Prof. D. Norris for their motivating, encouraging and enlightening supervision during the writing of this thesis. I am also very grateful to the remaining members of the Academic Board. Their support and input have been greatly appreciated during the past three years. Thank you.

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ABSTRACT

This study investigates the potential contribution of Technology Transfer to Regional economic development. Along with the design and implementation of a Smart specialization strategy (S3), the place-based policy approach is shown through a brand new concept for the Italian context, the Innovation Pole (IP), where innovation is the result of the integration of "cross-cutting" technology/knowledge- domain specific actors.

The goal of this work is to contribute to the regional policy choices for managing active and integrated innovation as a lever for the competitive repositioning of the regional economy of Calabria, with the aim to improve innovation policies, which favor the enhancement of Innovation Poles, in light of the EU framework on research, development and innovation. To re-create a place-based dimension within the Calabria region, the integration among S3 and IP strategies has the goal to exploit advantages from proximity to promote economic growth and competitiveness.

In recent years, Italian researchers began to focus on the concept of Innovation Pole as a "natural" evolution of technological districts (Ferrara and Mavilia, 2012). In fact, innovation Poles, intended as models of aggregation for local development, have gained increasing importance in the political strategies for promotion and development of local economies, generating interest for enterprises, Research institutes, Science parks and other actors active in the territory. Furthermore, the available literature and official sources on the matter, still illustrate how the interaction among Academic institutions, Research centers and enterprises turned out to be successful in many European countries, as well as in the U.S.A.

The purpose of the analysis of existing experiences in the European and American context is the recognition of best practices and main critical issues, based on the implementation of Innovation Pole strategies. The study, based on the analysis of some of these experiences in Europe and U.S.A., applies methods of comparison to detect successful cases and established practices replicable and transferable, in a framework of initiatives for practices exchange and local development transfer models. The regional analyzes carried out include Italy (Lazio region, Piedmont region, Emilia Romagna); France (with reference to the system of the Poles of Competitiveness), Austria (the region of Styria, as the case of European best practice), and the Louisiana "Innovation Ecosystem" (as a case of American best practice).

A qualitative comparison among case studies allowed to define a model able to show the logic and strategic objectives, including the peculiarities dependent on specific factor, e.g., socio-political context, geographical location, position in the process of development of the culture of innovation, degree of economic dependence on sources of structural programming, governance model and the architecture of the control model. The reason why we focused on the Louisiana “Innovation Ecosystem” as a successful example of economic development strategy, was due to the fact that Calabria region appears today as an “old version” of Louisiana (presumably as the region appeared 10-15 years ago) while presenting strong similarities (in terms of starting conditions and opportunities) with the same region.

Following the identification of the relevant factors that characterized the European Innovation Pole and the Louisiana "Innovation Ecosystem”, through the analysis of the dynamics and trends in the regions of study, it was possible to trace “potential paths for development” in the short- medium term, with the aim of bringing out the common elements of a "logic of growth". To assess these similarities, a structural equation model was developed for Louisiana, to prove that the Innovation Ecosystem is, in fact, an alternative version of an Innovation Pole. The econometric model, that relates same inputs and outputs for technology transfer of an Innovation Pole, showed a positive correlation between predicted values and actual values of the endogenous variables, showing quite good fits.

In other words, Innovation Pole and Innovation Ecosystem seem to share same objectives and scope. Furthermore, a depiction of the factors that made the Louisiana Innovation Ecosystem successful in the first place, as well as an understanding of the different steps the region is going through to overcome its underdevelopment, sorting investments, promoting projects and monitoring interventions, allowed us to identify, in turn, some useful policy guidelines that, with a suitable model of governance, might be successfully replicated in the Calabria region.

INTRODUCTION

Horizon 2020 and Smart Specialization Strategy

Horizon 2020 is the financial instrument carrying out the Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. Seen as a means to drive economic growth and create jobs, Horizon 2020 has the political backing of Europe's leaders and the Members of the European Parliament. They agreed that research is an investment in our future and so they decided to put it at the core of the EU's blueprint for a Smart, Sustainable and Inclusive growth.
By combining examination and innovation efforts, the program called Horizon 2020 is assisting the achievement of the established purposes by actualizing excellence in science, industrial leadership and resolving societal challenger: the ultimate goal is

1. To provide Europe with high-quality scientific solutions,
2. To remove obstacles on the way to inventions,
3. To simplify the work of both public and private sectors in collaborative distribution of innovations.

Horizon 2020 incorporates a common financial mechanism based on three predecessors (2007-2013) targeted to maintain development in research, innovation and technology management efforts. It includes the basics from the Seventh Framework Programme (7PQ), Competitiveness and Innovation Framework Programme (CIP) as well as the European Institute of Innovation and Technology (EIT).
Horizon 2020 helps to develop a society based on knowledge and innovation and addressed to a smart, sustainable and inclusive growth, under provisions of Europe 2020, the European Union growth strategy for 2010-2020. Seen as a means to drive economic growth and create jobs, Horizon 2020 is the main financing tool to strengthen the European Research Area – an open space where researchers, scientific knowledge and technologies can freely circulate – as well as implement the Innovation Union, the flagship initiative aimed at ensuring Europe's competitiveness in the international context.
The three growth dimensions (smart, inclusive, sustainable) put forward by the Europe 2020 Strategy brought about a new holistic and

place-based understanding of competitiveness: no longer are knowledge and innovation considered as policy silos, but instead, as the lens through which structural economic change becomes visible. Investments should be placed where distinctive regional strengths suggest opportunities to move up in international value chains.
Smart specialization strategy [S3] refers to the priority-setting practices: thus, every region may take advantages from specializing and actualizing in specific fields of science and technology development. Such regional progress would be supported by eagerness for knowledge and innovations, contributing to the essential structural changes.
Strategies of research and innovation grounded on the Smart specialization concept are pragmatically implemented by identifying the most promising fields of a region under comparative analysis. The three-fold dimensions, including Smart, Inclusive, and Sustainable perspectives, are included in the Europe 2020 Strategy to eventually formulate a novel and sophisticated awareness of innovative competitiveness: knowledge and innovation are not viewed as political dimension; instead, they represent an image of the lens that multiply the visibility of structural economic changes.

Innovation Poles in the [S3] perspective

Clusters as phenomena in the regional economic landscape are clearly highly relevant to Smart Specialization Strategies. Clusters are, in fact, quite likely to be the focus of attention for developing Smart Specialization Strategies in many regions. Clusters come close to “smart specialization domains” if they promote new forms of expertise spillovers with a multiplier effect, influencing the economy and its development.
Innovation Poles as clusters (operational groupings of the centers of private and public research, and enterprises, which enable to generate sophisticated mechanisms of exchange for the improvement of the precompetitive relocation, and the applied research) are the holding institutions accountable for the support of the Regional Strategy for Research and Innovation (SRI) throughout regions.
The prototype of the Innovation Pole relates to the larger family of knowledge mediators, and portrays itself as the creator of the innovative operations of ventures, whose purpose is to stimulate a close relationship with the mentioned sources of knowledge (e.g., research centers and universities). The two key functions of the innovation clusters in the frames of SRI are the implementation of all the functions engaged in the system of R&I, which act in a certain technology area, and the mediation and maintenance of the collaboration between research and enterprises.
Innovation Poles maybe defined as the meeting point between demand, which is the entrepreneurial network, and supply, which involves

research organizations and universities, of the innovated system, which is located at the local, or regional level.

The transition to Innovation Poles

Over the past years, Innovation Poles have risen as the pivot of the national economy in Italy. It also should be noted, that the traditional Industrial Poles also existed – concentration of enterprises of small and medium size specialized in various steps in one production process that had the features of a well-identified local culture, as well as a decisive tendency towards the mutual collaboration and partnership with other authorities locally. An Innovation Pole engages the skills connected with the high-tech sectors, which are appropriate within the given territory. The high-tech connotation of the enterprises that function in the Innovation Pole is the main significant difference between the Industrial and Innovation Poles.
Moreover, an Innovation Pole allows for the presence of enterprises, as well as other actors: this means that research centers and universities can provide skills and knowledge, which reflect the raison d'etre of the given Pole. The considerable support from the governance is given towards the promotion of the cooperation of enterprises, research centers and universities concerning the development of technology programs that provide positive benefits for the local economic system. According to the National Plan of Research 2002-2004, Innovation Poles are considered as a Policy tool aimed at the achievement of the three following goals:

1. Stimulation of the cooperation between the parties of the R&I system locally;
2. Allocation of the public support within the strategic areas for the industry and the economy;
3. Unification of several enterprises around the programs that have high technology content and essential economic spillovers.

The National Plan for Research and the 2005 Decree on Competitiveness (2005) affirmed the central role of Innovation Poles. If compared to Innovation Poles, another phenomenon of the "older" reality is called "Science and Technology Park" (STP). The first mentioning of the term STP was about 50 years ago.

Goals and objectives

The primary goal of an Innovation Pole consists in the integration and organization of the actors (e.g., innovative companies, research universities and institutes), which operate in one or several research areas and innovation system within a given territory. The cooperation of the R&I actors contributes to the rationalization of the resources, for instance, when actors utilize the facilities and equipment for the operation of technology production and scientific research once involved in the Pole. It also leads to the minimization of the transaction costs from the system, and mostly simplify s the development of the technology due to the interactions members within the system.

The cooperation also involves research centers, financial institutions, universities, and innovative technology activities. The interaction between these actors generates a synergic effect, contributing to the generation of new ideas, as well as innovation technology, thus, acting as a huge incentive towards the development of new initiatives (Pierre Lafitte, founder of Sophia Antipolis). In the connection between the entrepreneurial system and the scientific system, the Pole takes the intermediary position, facilitating the cooperation between initiatives, which in turn stimulates the innovation of the productive system. For these reasons, Innovation Poles may be the actual solution for the failure of the R&I system, which is a constant feature of some Italian regions, especially the Southern regions.

The Innovation Pole represents an effective solution because of two factors: an unsatisfactory demand (sometimes not existent) of technology and scientific services from the productive network (particularly, the enterprises of small and medium size), and the demand from the academic and public institutions, whose reference market involves public resources (communal, regional, and national), but not the entrepreneurial system. Consequently, the resulting system is a system of “research without innovation”, which means that scientific activity cannot demonstrate considerable results at the economic level. Consequently, the meaning of Innovation Poles is to act as promoters of innovation and catalysts of managerial and scientific know how thanks to the meeting and cooperation between research and enterprise. Until now, this cooperation is not always possible due to the heavily dissipated governance among too many actors, where responsibilities fail to find a clear definition (Ferrara & Mavilia, 2012).

However, we refer today to organizations aimed at the production of technology (e.g. Services, products and industrial processes) and the stimulation of the facilities and enterprises, that produce knowledge through the advancement of the distribution of technologies and flows of ideas among the entrepreneurial system, the scientific system (presented by the universities and research centers), and within the production network. One more basic objective of an Innovation Pole is the stimulation of new entrepreneurial realities, addressing the activities of incubation and spillovers.

The given activities together, because of the unification of enterprises, research centers and universities within a certain physical area (the “park”) make the STP practically similar to an Innovation Pole.

However, the two concepts remain distinct: the Park is the physical area where all the steps that contribute to the marketing of products and services take place, while the Pole is the "virtual" area where the high-tech solutions are performed: the Pole plays its role in the generation and transfer of knowledge to the economy in the form of startups or spin-offs, whose performance is improved because of the location in situ of the high-tech enterprises and R&D university centers (Almeida, Santos and Silva, 2008).

A literature review: Science Parks, Research parks or Innovation Poles?

The literature provides several studies about the effectiveness of Science and Technology Parks and Incubators (Colombo, Delmastro, 2002; Link, Scott, 2007) investigating as well the differences between on-park and off-park companies (Lindelof, Lofsten, 2004; Squicciarini, 2008). Nevertheless, the debate on the effectiveness of these structures remains open (Rothaermel, Thursby, 2005; Schwartz, 2009; Sofouli, Vonortas, 2007; Siegel et al., 2003; Mian, 1996).

The main difference between a Science Park and an Innovation Pole relies in the fact that the former refers to the physical location-agglomeration phenomena of firms, while the latter, the Innovation Pole/Cluster[1], to the "virtual" location.

According to Link and Scott (2003: 1325) and to Link and Link (2003: 81), "the definition of a research or Science Park differs almost as widely as the individual parks themselves". In recent years, some definitions have been suggested for Science Parks, where the main focus would be technology transfer from the university, the knowledge flow and the regional economic growth (Link & Scott, 2006).

A "Science Park[2]" is "*a property based initiative that has formal and working links with a university or other higher education institutions or research center*". A Science Park is a business support and technology transfer initiative that encourages and supports the start-up, incubation and development of innovation led, high growth, knowledge based businesses. In other words, a Science Park is the environment where businesses and centers of knowledge creation may interact for their mutual benefit (Parry, Russell, 2000; Ferguson, Olofsson, 2004).

According to the available data, the first Science Parks were founded in North America in 1950's based on researches by Cesaroni and Gambardella (1999), and Colombo and Delmastro (2002). This tendency affected Italy in 1980's with the emergence of the first Science Parks, such as Area Science Park of Trieste founded in 1982 and Tecnopolis Novus Ortus of Bari established in 1985.

The development of Science Parks continued, and since the end of 1990's, a Science Park can be found in almost every region of Italy (Sancin, 1999). Differences between Science Parks always served to connect research centers and university laboratories to business development that could not happen without research and development departments that relied greatly on efforts made by Science Park staff members (Colombo and Delmastro, 2002; Link and Scott, 2003, 2006, 2007).

The ICT revolution and spread of the internet made the need for innovation apparent in recent years (Benghozi et al., 2009). The physical limitations of a Science Park should be brought to the digital world to enable researchers cooperate and interact without physical restrictions. As suggested by Conicella and Baldi (2012), growth and prosperity of Science Parks and business depending on those need to be backed up in a digital way (p. 4). Attitudes of companies, skills, organization, and training of personnel, and managerial structure of science pars need to be modernized to meet the requirements of the changing technologies, gadgets, and innovative methods. Cooperation and competition should be applied simultaneously to introduce collaboration into Science Parks (Brandenburger and Nalebuff, 1997; Hamel et al., 1989).

According to a study by Moore (1993), this competition would be beneficial for the business and research innovations (p. 76). Traditional clusters may be defined as

Geographic concentrations of interconnected companies, specialized suppliers, services providers, firms in related industries, training institutions and support organizations linked around technologies or end product within a local area or region" (Porter, 1990). At territorial level", through their value networks and proven channels between businesses, research and academics, clusters provide efficient catalysts for innovation policy interventions...possibilities exist to further enhance the quality of cluster activities" and therefore contribute to Europe 2020 strategy (Reiner, Gelzer, 2010: 2)

Clusters[3] form a pivotal element of Europe's economic environment (Commission of the European Communities, 2008). Every year a number of innovative clusters are perceived as a tool of the maintenance and of the support of further growth and development. This attitude toward the innovative measures needs to be underlined.

In recent years, particularly at EU level, attention has been moved from the concept of innovative clusters as a way to stimulate a particular technology field (the so called "technology based clusters") to a different approach that fosters clusters that are regrouping actors synergistic from a market point of view and based on different and complementary assets.

The so- called "Smart Specialization Approach" is a direct consequence of such a vision. Following this approach, it should be understood at the outset that the idea of smart specialization does not call for imposing specialization through some form of top-down industrial policy that is directed in accord with a pre-conceived "grand plan" (Foray et al., 2009)

This approach is different and opposite to the one used to plan, develop, and implement Science Parks that usually are conceived following a "top-down approach".

At the same time Science Parks and industrial associations are in the best position to develop such smart specialization clusters: the reality of Science Parks allows the development of high sensibility towards the final market and the ability to integrate complex "systems", e.g. in technology transfer projects, in launching converging technologies, R&D activities and in supporting the development of innovative start-ups.

This is particularly true in high-tech sectors and in markets that are continuously based on innovations such has health care, energies, new materials and so on. As a consequence, the establishment of Innovation Poles/clusters, fostered by the Science Park-incubator involvement, seems to be an interesting phenomenon that contributes to this aim. From these considerations it can be assumed that Science Parks have frequently now a "double role": manager of the physical science park and coordinator of the local ecosystem" and "they have to build communities of actors also out of the physical boundaries of the Science Park" (Conicella and Baldi, 2012: 8 and 12)

The main focus of the Ministry of Education, University and Research (MIUR) is the incorporation, concentration, and rationalization of the resources, as well as the interference that are provided through the determination of the clearly defined and considerable technology areas, which have been determined as priorities. A considerable progress in the European perspective is highly dependent on the Innovation Union Flagship Initiative and the Europe 2020 Strategy, striving for the achievement of the comprehensive, smart, and viable development through the transverse innovation.

The design of innovation strategies across the region for a "smart" specialization is promoted by the European Commission. These strategies are integrated as a strategic and combined approach to the operation of the opportunity towards the "smart" progress of the economic knowledge throughout the regions of Europe.

There are functional and flexible innovation strategies called the "Smart Specialization" strategies. They are developed at the regional level; however, their assessment and availability to the system is carried at the national level. The economic actors have already located and specialized the sectors and segments of your evident comparative superiority. These sectors are easy to identify due to the results of the competition. Otherwise, it may also occur in the future entrepreneurial activity that should be valued. This activity is also called "entrepreneurial process of discovery".

Smart Specialization requires all the regions to approve their programmatic approach for the unification of a new formation of public policies towards the innovation and research. This approach is useful to prepare for the new programming cycle of 2014-2020 by the improved and integrated utilization of financial resources, and Structural Funds. Smart Specialization has planned the implementation of a policy to introduce certain operational goals. This policy focuses on the allocation of the resources on several Projects of Regional Development of Strategic Value. This is done to improve the regional management capacity, and to define the driving forces of the sectorial and territorial development, providing an opportunity to significantly affect the territory of Calabria.

The Innovation Clusters (operational groupings of the centers of private and public research, and enterprises, which enable to generate sophisticated mechanisms of exchange for the improvement of the precompetitive relocation, and the applied research) are the structures, which bear responsibility for the development of Regional Strategy for Research and Innovation (SRI) throughout strategic regions.

The prototype of the innovation cluster is related to the larger family of knowledge mediators, and portrays itself as the creator of the innovative operations of the ventures, whose purpose is to stimulate a close relationship with the mentioned sources of knowledge (e.g., research centers and universities). The two key functions of the innovation clusters in the frames of SRI are the implementation of the functions engaged in the system of R & I, which act in a certain technology area, and the mediation and maintenance of the collaboration between the research and enterprises, and enterprises.

The region has established certain functional goals through their inclusion: the incentive of the demand towards the innovation of the enterprises, being engaged in the cluster, and more commonly – the incentive of the Calabrian SMEs; the maintenance of the spread and the exchange of research laboratories and facilities, as well as the maintenance by the enterprises of the accessibility to the technology and science knowledge of industrial interest; the maintenance of specialized services, which have high added value to enhance and withstand the dissemination of innovation between the enterprises.

Being highly open to innovation means having the ability to have productive equipment, which has high added value and which contributes to the creation of more profit. This equipment is able to cope with the infrastructural and geographical gap that is experiences our production system, thus giving guarantee of the capability to be highly resistant to the international crisis. The Research and Innovation sector in Calabria is officially proclaimed to have low investment levels, and additionally, to have the public component of the costs on R&D as the most important. The research centers and universities that are placed within the region (in specific research fields) demonstrate great results and have scientific expertise in the international and domestic relations. However, the regional system of innovation supply and research in Calabria that can simplify and maintain the innovation and the increase of the enterprise system has an inappropriate structure.

Taking into account the information presented above, it should be mentioned that the enterprises in the South have their own strategy concerning innovation: they simply change the equipment and the machinery, without using the services of the scientific institutions located in their area. This is the so-called "innovation without research", which is typical for the economy of the South. The Regional Innovation Clusters within the scope of the Regional Strategy that is introduced in Calabria are essentially important for the guarantee of the effective performance of the system, and for the support of the economic development within the region. Their main objectives are to:

- Systematize and implement, thus providing general service standards, the present and future institutions of innovation technology and scientific research in the region, referring to certain use and technology;
- Perform the function of mediators (being the part of the broader Regional Network for Innovation) in innovation and research. Thus, perform to simplify and maintain the connections and the improvement between the entrepreneurial system and the science system, as well as the collaboration between the enterprises to encourage the impetus towards innovation in the production system.

As already mentioned, the strategy of the Calabria region tends to accelerate the transition of the entrepreneurial system to the development, based on technology with the utilization of the distinctive instrumental and intellectual resources, making the research the successful undertakings of enterprises. The action will be simultaneously aimed at the attraction of new intellectual and economic capital, performed through the networking operations and highly innovative valuable spinoff.

Calabria tends to adopt the model towards the maintenance of the development with the aim to increase the phenomenon of "territorial economic intelligence", what means to contribute to the development of a new culture that takes for basis the system operations, which are created for the expansion of the competition beyond a certain territory, and have the entrepreneurial system as the purpose.

It will result in the changes in the "competition / cooperation" relationship in the territorial system, thus increasing the exchange of identity, unity, and knowledge, as well as combination of such objectives, as the economic stability of the innovation process introduction, which is based on the trans-disciplinary research. This research has the ability to systematize the strategic possibilities of the evolution of the production system, being supported by the offer system, which tends to its evolution through the facilitation of the "research that produces innovation".

CHAPTER 1

From Industrial Districts to Technological Districts

Knowledge and innovation technology are now a key competitive asset both for businesses and for the role for the competitiveness of the national system, currently is increasingly recognized his relevance of regional and local scale.

As demonstrated in the famous case of Silicon Valley, the development of the knowledge economy depends crucially on the quality and intensity of the regional branch of the activities with a high technology content. Not only in the advanced countries, but also in emerging markets, is therefore stating the concentration of high-tech activities in spatially defined regions, a phenomenon referred to as "technology district" or "technology cluster".

Storper (1997) is the first author to use the term "technology district", which defines it as a territorial system where relational components and cognitive processes of accumulation of technology co-exist, that is an area where collaboration and learning, which involves research bodies and training, are the foundation of the production process(Florida,1995).

Cooke and Huggins 2001, the technology cluster is a geographically restricted area of interconnected business, horizontally and vertically, which grow in a specific market segment and allow a continuous evolution of technology progress, thanks to the dynamics of competition and cooperation. This element is also identified by Lazzeroni (2010).

Piccaluga (2004) speaks of "geographically well-defined areas, generally at sub-regional scale, particularly rich in activities in science and technology, with a well-defined scientific-industrial vocation, in which you can locate the excellence and specificities in terms of research, but also the industrial sectors in which the research results are used".

More generally, other authors define the technology district as the set of territorial aggregations of activities with high technology content, in which public research bodies, large companies, small businesses and local authorities provide their own contribution with different configurations, to create an environment where the costs and risks of scientific research are supported by businesses.

A role of great importance is also assigned to financial services rooted in the local context, which, especially in the form of venture capital, are able to assess more effectively the investment proposals, of course uncertain and risky (the typical case of biotechnology).

Finally, as emphasized by the industrial districts, culture and social capital are fundamental elements: Saxenian (1994) states that the local culture and the sense of belonging to the district are growth drivers that are triggered by the dynamics of learning by doing all ' domestic firms.

Even Breschi and Lissoni (2001) emphasize the importance of technology and cognitive space, which allows us to better understand and simplify the transmission of knowledge. They also dwell on the importance of investment in R&D that encourage innovation in the production process or product and attract skilled labor from outside (Cohen and Levinthal, 1989; 1990).

There are reasons for the growing interest in these realities. First, there is an increasing tendency to value relationships and relationships at the local level, the will to develop joint projects, committing more 'subjects and help to form a critical mass in R&D and a greater spirit of competition between territorial systems. In addition, a strong need to specialize the supply chains of scientific well-defined to achieve significant results, and the propensity to innovation paths, bottom-up, and considered to be more effective and less expensive than top-down.

Bonavero (1995), to identify local contexts of technology excellence, offers a series of quantitative criteria: variables related to the field of research and innovation, measures the dynamism and innovation capacity for the regional system as a whole.

At the European level, to compare the innovative dynamics of the member countries was created the European innovation Scoreboard EIS, quantitative tool that evaluates the performance of innovations based on structural indicators. In particular, the EIS considers 17 indicated major, divided into four broad categories of "Human Resources", "Knowledge creation", "Transmission and application of knowledge" and "Finance for innovation, output and markets."

Lazzeroni (2004) identifies two variables to define the technology districts specialization in high-tech innovation system. The specialized high-tech concerns the consistency of the high-tech or high tech and is used to measure the location quotient.

The innovation is instead on the availability of qualified human resources, the presence of universities and research centers and the business culture. In this, we consider the percentage of graduates and skilled employees in the disciplines of science, technology on the resident population and the birth rate of enterprises.

From Industrial districts to Technological districts

Industrial districts are characterized by achieving economies of scale internal and external (or agglomeration), which reduce the production costs of the company, mainly due to three factors:

- The presence of indivisibility in the provision of goods and services, which is exceeded only if the district experiences the simultaneous requirement of a minimum threshold of application.
- The presence of a fixed social capital, that is, communication infrastructure, transport and energy, which leads to greater productivity for all businesses in the area;
- The presence of synergy effects, which reduces transaction costs between firms and the possibility of specialization of labor along the production cycle, increasing overall efficiency.

However, these external economies also contain a dynamic component, source of entrepreneurial creativity and innovation.
The spatial concentration also results in an easier flow of information, ideas, scientific and technology knowledge, and easier access to specialized knowledge, while knowledge spillovers arising from the proximity and the mobility of labor, the competitive pressure and social interactions favor the learning.
It is mostly about small and medium organizations, linked by strong horizontal and vertical relationships, with frequent phenomena of spin-offs and a robust innovation system, in which we find businesses that interact with different actors: other companies, educational system, research, financial system, local, and national government. The new economic global order and the resulting increase in competition imply the need to modernize the system of industrial districts leveraging on technology and innovation.
Technology districts are considered then as a natural evolution of industrial districts that, despite numerous actions in support of regional industrial policies at the local level, have been facing, especially in recent years, a decline in competitiveness. The model of incremental innovation proposed by industrial districts, or the mere adoption of technologies developed outside is a strategy no longer sustainable in the medium to long term, and it is indispensable to undertake research and development of radical technologies within the districts themselves.
The current competitive conditions encourage flexible specialization and vertical disintegration, resulting in the agglomeration geographical production activity in areas dominated by small and medium-sized enterprises: in this way, the district gets flexibility and specialization among enterprises interconnected by a network of relations, also informal. This leads to the design and creation of technology districts,

intended as territorial aggregations of activities with high technology content, where small and large companies, public research institutions and local authorities contribute to the creation of an environment in which the costs and risks of research are shared collectively while generating benefits, equally shared.

The urban and regional economics has largely focused on the innovative potential of certain geographical areas, focusing on the one hand, on the innovative environment (institutional, infrastructural and environmental factors), and the other on the presence of structural factors (innovative companies, laboratories R & D and other innovative input): the theory of technology districts are just part of this scene.

Technology districts may be defined as "geographically well-defined areas, usually at sub-regional scale, particularly rich in activities in science and technology, often (but not always) with well-defined scientific-industrial vocation, in which both can identify excellence and specificities in terms of research in science and technology and industrial sectors in which the research results are used "(Piccaluga, 2004).

Technology districts find support from local and central public administration, business, training centers, research and financial institutions. They arise to create innovative poles, specialized for the technology sector, which have the ambition to become centers of excellence at the international level and with strong positive impact on the business of the territory.

The institutions have a central role in the emergence of technology clusters, favoring one side the meeting between demand and supply of knowledge and secondly, by carrying out a series of policies designed to create public-private joint venture, aimed at the application of the processes of R&D for the creation of new technology.

Also crucial is the presence of local institutions of higher education and knowledge production, such as universities and research centers, public and private, capable to generate innovation and qualified human resources, usable in the industrial supply chains, which in turn are a driving force innovation.

Another important component is the geographical proximity, in relation to the innovation process and the properties of technology knowledge. Geographical proximity favors the exchange of advanced scientific and technology knowledge, which is often not an exclusive possession, but can be found also outside. In addition, such knowledge has tacit nature, that is not observable in use, so that the transmission cannot be done by hand or computer, but can only take place through personal interaction, informal exchange of technical knowledge, staff mobility and training on the job. These forms of transfer are much more efficient as the subjects are closer.

At the firm level, the geographical proximity reduces the inherent uncertainty of innovative activities, allows companies to get feedback information about the status and progress in the advancements of technology, allowing them to build a code for communication and exchange of information, greatly reducing the cost of the research. Businesses also benefit from the possibility of using highly qualified human resources that can be easily found on the territory of knowledge spillovers, benefits that research conducted by a person has on the activity of the other subjects.

The spatial concentration of firms varies by operating segment and by technology. The relationships within the district are favored by ad hoc policies, public funding, from a local regulatory framework, designed to promote integration between producers and users of knowledge and by the presence in the area of physical infrastructure and venture capital funds, can support the incubation and development of entrepreneurial high-tech. If located in areas with high density of expertise and different services, enterprises can more easily find answers to their needs and bring forward more smoothly the process of innovation.

Technology clusters and industrial districts. A comparison in the manufacturing sector

The common elements of technology and industrial districts are:

1. Territorial dimension that characterizes them;
2. Fundamental function of enhancement of local conditions, to improve the attractiveness of the area.

The clusters are characterized by a dense system of relationships, intended as tangible, effective input-output exchange and subcontracting relationships, as well as intangible, intangible exchanges between enterprises and territory, and for the presence of externalities. The proximity generates so many advantages, which allow distinguishing between:

1. Industrial districts specialized in the production of traditional goods with standardized technologies;
2. Districts that produce high-tech goods, namely technology clusters (Silicon Valley is a prime example).

The districts that produce mature goods (textiles, ceramics etc.), stable and defined, aim to reduce direct and indirect costs of labor, to offer highly differentiated and customized products, to respond quickly to changes in demand and fashion: here innovation is not the strong point of the district, but is incremental and developed inside.

The district is characterized by a well-defined territoriality: the relationships in the supply chain are well defined and stable, with no hierarchical coordination, and knowledge flows are slow, informal and internal.

The companies belonging to technology districts, however, are specialized in the creation of products subject to rapid obsolescence generate radical innovations and the role of the district is to promote this innovative process: the main necessity is to create new goods, technologically advanced and for whom there is still a market demand. The territory becomes a sort of laboratory for the invention, experimentation and the introduction of innovative products; relations of production chain are less static and rigid, according to a model of territoriality enlarged.

Often, districts arise near university campuses, research centers or other facilities of the public sector, which are the direct purchasers or the main buyers of the products in the trial phase. Later, in the phase of production for the market, location, combined with proximity among small innovative companies, continues to encourage the circulation of ideas, knowledge and creativity, both through spillovers, spin-offs, that is, the creation of new enterprise by workers first employed in another organization.

The flows of knowledge are not limited to the district, but are transversal and retrieval flows of information, and, although expensive, are crucial for technology development, which is the goal of the district. Among the actors, private and public, there is extensive cooperation that takes the form of partnerships or financings. Large capital investments public and private mainly attracted by the potential of the ideas and developed technologies are indispensable.

Finally, it should be specified that, while in the industrial districts operate many small businesses (and sometimes a leader); in the technology districts, actors have very different sizes and not always cooperate or compete with each other.

Industrial districts in Italy are more numerous than technology districts. Given that, what matters is the critical mass of investments and/or specialization. Industrial districts are almost always a bottom-up process result, while technology districts arise mainly from a large investment in public and private research or by the action of the pre-existing company; finally, while in the industrial districts there was no particular public support, for the development of technology clusters is fundamental state intervention (Piccaluga, (2004)).

The importance of Universities and Research centers in Technological districts

Technology districts derive much of their success from the feedback process between the final market and basic research, so it is necessary that creators and users of knowledge are present on the territory.

In the traditional Italian model of "innovation without research" (Piccaluga, 2004), products and processes are developed independently from scientific research. It is clear that in the current

situation it is not sustainable nor effective anymore, so a close collaboration between research and industrial production, especially in some areas of recent development, as ICT and telecommunications is required. Thus, the presence and the role of universities in technology districts is the main difference between technology and industrial districts.
The university, with its core business of high human capital formation and production of scientific knowledge and innovative infrastructure is recognized as a major source of industrial innovation (Pavitt, 1991; Mansfiled and Lee, 1996; Salter and Martin, 2001; Cohen et al., 2002).

Evolution of the mission: the "Entrepreneurial University"

During the past two decades, there has been a change in the mission of the university. The United States were pioneers, since starting in the early eighties, to address the risk of loss of international competitiveness, enacted a series of legislative measures to promote the implementation and commercialization of the results of academic research. Later in Italy, over the years, it has increasingly entrusted to universities the task of creating entrepreneurship and technology development, helping to recover competitiveness of the domestic industry.
Along with its traditional objectives, research and education, the university has a third mission: technology transfer, enhancement of the potential and the creation of new content applications and, therefore, the promotion of innovation based on research, so as to play a central and active role in the economic and social development of the territory.
Therefore, is emerging a model of "entrepreneurial university", which enters into contracts with the local production, generates a growing number of spin-offs and shows a growing number of patents; research is aimed at short-term and greater are the focus on results, the dynamism and competition, especially to win the resources are increasingly limited.
This model "industry-university research" defined as "centric" (Patton and Kenney, 2009), is a local industrial fabric whose production activities are linked closely to the presence of networks with research, which carries out a technology push action, unlike the traditional industrial district, where the paths of growth and development arise purely from competition and collaboration between enterprises.
Relationships between industry and research are based on formal tools, such as technology transfer offices, incubators for the promotion of innovative entrepreneurial activities, spin-offs and licensing contracts, and informal tools, such advisory activities carried out by teachers, joint publications and commercialization of new technologies, derived from a partnership.

Nature and objectives of research are changed intrinsically in recent years, for various reasons, including the increasing importance of Information Communication Technology (ICT) and the biotechnology; the emergence of new disciplines, the result of the combination of pre-existing fields (bioinformatics, computational chemistry, bioengineering, etc.); the influence of the phenomenon of globalization; the desire to rediscover the specificity and local expertise.

Technology districts and territories: interactions with businesses and territories

To simplify the process of innovative business, the key are interactions and relationships created between organizations within the district. First, essential are the interactions between the companies themselves: vertical, e.g. customer-supplier, and horizontal, intended as cooperation-competition. The former are important in the initial stage of the innovation process, characterized by uncertainty where business can benefit from establishing stable relationships with its suppliers to create a common code for the transmission of information and knowledge, which simplify the interaction and reduce transaction costs. The relationship with suppliers leads to a constant comparison, the interactive learning and immediate feedback about the technology advances and the technical feasibility of the new processes, allowing to grasping more easily the market changes and the lock-in that vertical integration of all functions would lead to.
As for the horizontal interaction, it should be noted the importance that business cooperation plays in determining their innovative performance: increasingly popular are becoming the business networks, main input of the innovative activity and, thus, a source of new ideas. The collaboration allows overcoming the lack of resources for research, typical of small businesses, thus providing the minimum equipment needed to perform the research.
Other important relationships are the one created with the educational system which, in the form of universities and public or private research centers, are the source of scientific and technology knowledge to which companies tap. The university has an essential role in determining the innovative capacity for businesses; it forms the general culture, develop tools for reading reality, provides technical and specific scientific expertise, and carries out basic and applied research in its laboratories. Skills development is much more useful when it takes place in close contact with the company itself, then in line with its capabilities.
Another important factor is the financial system, since the innovative companies must face costs at every stage of production, from R&D to commercialization and marketing. A locally private financial sector, active in venture capital and private equity, has both the ability and the

desire to evaluate innovative projects and possible future flows associated.
There are often problems of information asymmetry between the lender and the manager, who, in the phenomena of adverse selection of moral hazard, could lead to failure of the capital market. In financial systems where banks have greater influence (model of continental Europe), it is possible for companies to find financing in the long term at acceptable rates, thanks to the existence of relationships between suppliers and users of capital.
However, in a context of rapid changes in technology and products, in the presence of high risk, this system is no longer adequate. The best solution seems to be that the Anglo-Saxon conducive formation of venture capital: one of the major energy activities of venture capital in fact is just the start-up financing, e.g. the intervention during birth or early development of the company in the work of individuals who combine financial with industrial expertise.
Finally, very important in determining the innovation performance of companies are the government and technology policy. The objectives to be achieved are, on the one hand, the development of a specific technology, and secondly, the creation of infrastructures that promote technology change.
In the first case, the most used tool is R&D funded by the government, while in the second case the state provides the infrastructure, designed not only as individuals but also as entities (e.g. Chambers of commerce) that support international links while promoting, through the creation of associations, the diffusion of new technology through technical advice and financial support.
In Italy, the role of the state and local authorities is crucial for technology districts. The Reform of Title V of the Constitution of 2001 states that the scientific and technology research and innovation support are competing matters between state and regions: the basic principles are determined by the state, but the legislative power lies with the regions.
Technology districts, as an economic development tool according to the "Guidelines for Scientific and Technology Policy", approved April 19, 2002, in the National Research Programme (NRP) 2005-2007, are defined as “territorial aggregations of intensive technology activities in which they provide their own contribution, with different configurations and different realities, research bodies, large companies, small businesses, new or existing, local authorities”.
Unlike industrial districts, now bound by specific regulations, the start of technology districts is based on a process of collaboration between different public bodies (central, regional and local government) and private (businesses, research centers), thanks to the tools of negotiated programming (program agreements and framework agreements Program).

The Ministry of Education, University and Research (MIUR), with the "Guidelines for Scientific and Technology Policy" of 2002 and then by the NRP, the last for the period 2011-2013, has allocated substantial funding to support the creation and development of technology clusters, mainly by promoting memorandums of understanding and planning agreements between the main stakeholders active in the area.

According to the law, the regions can propose a project to create a technology district in response to calls for the Ministry of Education funding. They perform studies of feasibility to assess the competitiveness of a specific technology sector by region to house the district, initiate negotiations between public and private actors of the territory to bring attention and consensus around the project, and finally conclude the program agreement, which allows the operational start of the district.

The initiative for the construction of technology districts lies with regions, presenting a project to the Ministry of Education, which, in turn, after assessing the initial situation of the territory, the feasibility of the project, the potential and the ability to attract investment, ensure official recognition.

The creation of a district is determined by some basic features of the region, such as the presence of local universities and authoritative research centers, of widespread entrepreneurship and highly skilled human resources. The features that a district technology must possess are:

- Consistency with the guidelines of the government's Science and Technology Policy;
- Presence of the leading companies in the sector;
- Presence of the main public actors;
- Presence of a governance structure;
- Definition of a legal entity responsible for the coordination of the initiatives;
- Contribution of expertise and public and private funding and operation of significant actors in the financial system at the regional level;
- Forecast medium- to long-term self-sustainability of the technology district.
- The Ministry, in addition to the selection of proposals for startups, high-techs, sustainability assessment, is called to assess, based on objective criteria and indicators, the results obtained from the districts already operating, to promote improvements and to promote broader collaboration between districts and other organizations involved in the projects.

Technological districts in Italy

Numerous scholars and policy makers agree in bringing the success of industrial districts to the theoretical model of local innovation called the Triple helix.
The idea of the model is that an effective innovation system relies largely on the integration among local government, business sector and public scientific research: they support joint initiatives such as research laboratories shared between universities and industry, new spin-offs from university research, strategic alliances between companies developing new technologies and creating companies thanks to venture capital.
As evidenced by Piccaluga (Piccaluga, 2004), in Italy the idea of technology clusters seems to find strong liking for at least three reasons. First, the Italian economic system has internalized the concept of district: industrial districts are a well-known phenomenon they need transformation and revitalization, which can pass for an openness to innovation and high technology. In particular, industrial districts need to focus on specific scientific sectors to achieve significant results with international visibility and to make critical mass in R&D locally, a need to develop joint projects that span multiple subjects, even after the examples of foreign technology districts and the positive impact that these have had on their respective systems. Secondly, the tendency towards a kind of design of a shared and from the bottom planning is often considered more effective and less expensive than the vertical one, allowing to the exploitation of the potential at local level. Thirdly, the technology district is very attractive, especially at local level, for policy makers, academics, entrepreneurs, financial institutions and communities, as it allows exploiting the relationships in their communities and the spirit of competition among regions and most imitated territorial systems.
The first experiences of Italian technology districts appear to outline different development strategies taken by the government in relation to the specific characteristics of the local context, in particular stands out among development models with the inherent operational structures (Nicolas, 2006):

- The model "acceleration of SMEs' in case the industrial base of the country is very fragmented and requires different skills. In this situation closely represents the benchmark for new knowledge provides real services for SMEs and support for venture capital funds (it is the case for example of the district Torino Wireless).
- The “corporate research center” model, where large companies work together to competitive universities and research centers on projects of common R&D support system and increase its

global competitiveness (emblematic case is that of Imast in Campania).

- The "drive and creation of investment" model in which the district part substantially from one academic competence in the face of an industrial base in the territory development strategies typically incubators and public funds of seed capital, in this case are oriented mainly to attract investment in the area.

Piccaluga (2004) instead focuses on the characteristics of the districts and develops categories.

- ➢ The technology district in which the large high-tech enterprise is able to trigger the interaction with a public research already robust (for example the case of Catania).
- ➢ The technology district in which the strong public research generates not a single company, but a multitude of businesses with an adoption economic predominant in for example the case of Pisa
- ➢ The technology district where industrial research and public gradually integrates in the presence of industrial restructuring processes and scientific technology specialization (e.g. in Turin Genoa and Naples).
- ➢ The technology district in which public research creates the basic conditions and then pushing an entrepreneur "Schumpeterian" triggers the growth and the specific vocation high-tech (e.g. Cagliari);
- ➢ The technology district in which the entrepreneur 'Schumpeterian' start growth and the subsequent entry of industrial subjects outside (Mirandola).
- ➢ The technology district in which the centers of excellence in the public and private activated dynamics of integration, but without a vocation predominant (as in the case of Milan and Rome).
- ➢ The technology district in which government intervention can generate positive discontinuity where there are already good relations between public and private, for example, Trieste and Padua.

In the definition of public intervention is then necessary to distinguish the government assistance, and existing technological, emerging and potential districts.

Public policies in fact, could strengthen the foundations of the district and possibly supporting processes of specialization like Turin, while for the latter could generate and intensify the areas of scientific and technology excellence that already exist, and finally, the third party may select scientific areas technology that show a potential for future growth and to support the launch.

Generative factors

The large technology company decides if to localize in a certain place by considering the provision of infrastructure the presence of skilled labor of qualified suppliers and a scientific system at universities and public research centers or private carriers of technical scientific knowledge.
For small local businesses working with large high-tech companies is an opportunity to access to know-how and expertise and to get a return of image resulting in a legitimacy in the international markets.
All these relations lead to mutual trade, positive for both companies: on the one hand the large company draws on skills of local businesses, increasing the variety of its own, on the other, small businesses are able to access knowledge and to qualified relational network of large. Overall, the innovative capacity is greater. The factors related to the district can be installed on

1. a top down approach where the government intervenes with territorial marketing policies to push the big technology companies through tax breaks and financial bureaucracy reduction,
2. a bottom-up approach, where business initiatives aim to the exploitation of the potential offered by a large high-tech enterprise, or in actions taken to meet strong local demand. In the first case, it is important to set up agencies and associations for the promotion of direct investment or for the creation of space research. The second approach is rather an expression of independent entrepreneurship created to take advantage of the positive externalities also created from the activities of a large company or to design scientific research through spin-offs as happened with Silicon Valley.

Often, technology districts develop in areas without an industrial tradition because, where important business alternatives are lacking, the opportunity cost of investing in new initiatives is smaller, so that, rather than focusing on sectors already launched with high entry costs and barriers to entry, the new high-tech sectors are preferable.
The birth of a technology district assumes that the territory has some essential conditions to attract investment as the existence of a widespread entrepreneurship, highly qualified human resources, university level, an adequate infrastructure network and the presence of services dedicated to technology transfer.

Potentialities and weaknesses of Italian Technological districts

Finally, we should dwell on\ the potentialities and weaknesses of Italian technology districts.

Technology districts are a potentially important instrument, created to enhance the technology level and the competitiveness of the production system of a region.
In this light, the ability to take advantage of the contribution of academics with an entrepreneurial approach and highly qualified human resources at competitive costs it is believed to be a strong point, taken that Italian researchers have on average a lower cost than their colleagues in other European countries.
This process is reinforced by the presence of public research centers of great value even at the international level and some large industrial research centers which are developing a network configuration to increase the skills around the country while maintaining coordination with their headquarters (for example Fiat). In addition, is the ability to create technology transfer offices in universities launch training courses for technology managers and process specific programs for companies' spin-off. This context leads to an increase in the number and quality of graduates in scientific technology filed, which also allows not only to stop the "brain drain", that is bright young graduates trained in Italy, but also who find work abroad, but also to recall talents who have emigrated by providing them with an environment just as exciting and innovative.
To exploit and develop these strengths we need to increase the funding of research centers selected based on objective criteria to find markets outside the district for the products and services hi-tech premises and engage in communication local marketing, and abroad. In view of these potential whose careful management can lead to a positive influence both at the national and local level, we need to consider the existence of critical points in the model of the Italian technology districts to intervene effectively.
Firstly, the scarcity of resources is often a constraint to development: it would be good to combine the activities of the central government of regional than local scale is to create a critical mass of interventions that might actually give districts the resources to operate. Secondly, the crucial point in technology districts is the activity of coordination and address, namely governance. It is essential for the governance to be effective, influential and competent, to handle the dynamism and heterogeneity inherent to districts that often translate into divergent interests and goals or even conflicting.
A further aspect to work on is the internationalization of technology districts, still weak.
In June 2008, the Economic Mission of Milan carried out a research among technology districts and science and technology parks, to identify the collaborations established with other European countries that joined the cluster: 11 adhered; nine of them do not have relationships with foreign clusters, but have formalized relations through a formal agreement.

Italian districts have a tendency to collaborate with foreign partners on specific projects, rather than signing cooperation agreements in the long term, and also encourage their members to internationalize but are not themselves, as an independent entity, to do so.
Finally, as is clear from the Annual Report of Intesa San Paolo in December 2011, it must be considered that the areas most characterized by the phenomenon of technology districts are crossed by different dynamics and therefore need targeted interventions.
In the ICT sector, the performance of companies is contingent upon the manufacturing system as a whole, and therefore to the ability of the latter to recover the losses incurred due to the recent crisis.
In the pharmaceutical sector, fears are related to the competitive drive of generic drug manufacturers and the expiration of patents on products of its supply, so that the actions of some major players in the sector are changing.
There is concern in the biomedical sector and the growing competition from emerging countries and for the payment delays in public administration, phenomenon that deeply undermines the liquidity of the companies; the aeronautics sector is finally rethinking the organization of productive geographical, thus, affecting also the performance of companies in the supply chain.

CHAPTER 2

Innovation and Internationalization of Industrial Districts

Innovation and Internationalization processes in the districts

The increasing globalization opens up new developments of remote interconnection, loosening the relationships with the local market, and, at the same time, multiplying the opportunities for interchange. The result is an increased competitive pressure, which influences the nature of the innovation processes, particularly the technology ones: the pursuit of strategies based on the introduction and development of innovative behavior is not to be considered anymore as an opportunity aimed to gain a competitive advantage, but as an indispensable condition for being part of the market. Italy is characterized by an economy built on a broad base of SMEs, the majority of which are located in industrial districts and concentrated in traditional industries, such as food, textile, leather, wood and furniture. The SMEs belonging to the districts are going through a very troubled period because of a tough competition in terms of price, product quality, innovative performance and a reorganization of the manufacturing processes, which is increasingly based on the use of strategies of outsourcing production.

The role of Innovation

In the light of the new economic scenario at national and international level, the following question, which in many ways is also reflected on the typical elements of competition of the districts, arises: how long the local networks, in the peculiarities of the situations of the districts, which does not uniformly characterize the territory, will be able to support a very modest research system, not only because of its absolute size, but because of its poor links with the production system and its ability to osmosis (De Cecco, 2000)? Even today there is no clear definition of the impact of ICT on the economy world, on enterprises and final consumers: new business organizational models are taking shape and new businesses are springing up with production units located thousands of miles away.

In this new scenario, which exceeds the idea that the size of the company determines much of the success, even the small companies are gaining new consideration, provided that they are hi-tech, open, flexible, network-connected with other business entities and that they produce goods with high added value. For the industrial districts, the region is essential in the innovation process, as claimed by Corò and Micelli (2007), who highlight three factors.

First of all, the proximity fosters the communication of important information related to technology, which usually do not spread in the traditional communication channels. A prime example are the errors relevant to any innovative process: they can teach a lot and allow to economize on the production of knowledge; however, they are not mentioned in the news work articles, press conferences or public notices, nor is it easy to find them through the reverse engineering, since only the best products are marketed, so that the district, with the geographic proximity and the network of relationships that follow, is the best alternative to learn about them and exploit them.

Secondly, we must consider that researchers need continuous contact with universities, research centers and scientific laboratories, which in the case of industrial districts, are concentrated in the same area and are permeated by stable and long-term relationships, facilitating the collaboration and exchange of information. Finally, there are strong positive externalities related to the innovative activity: the productivity of a team of researchers has a decisive impact on the network as a whole, thereby creating an integrated and successful system where collaboration, sharing and even unintended consequences do ensure that everyone will obtain benefits from the proximity of the other.

Cainelli and De Liso (2005) point out that the district as a unitary entity appears, in terms of performance and innovative activity, stronger than its components taken individually thanks to Marshallian externalities, agglomeration economies, knowledge spillovers and phenomena of learning by doing: this results in an attitude towards the innovation not sought explicitly, but simplify d by the context, called "unintentional innovation", from which a more systematic codification can start. Thus, there are some activities that lead to the creation of new products or processes. Starting from that observation, the authors, using an econometric analysis on a dataset built on data taken from the Community Innovation Survey (CIS), the System of Accounts of Companies (SCI) and from the Archives of the Statistical Active Enterprises (ASIA) show that the success of these realities is not only due to the relations of cooperation-competition among enterprises, the knowledge spillovers and the industrial atmosphere, but rather, in large part, to the innovative performance.

The typical and commonly recognized effect of the districts are confirmed, but this results in an innovative attitude far greater than you might think, that, in the traditional sectors, is realized especially in product innovations. Belussi and Sedita (2007) identify that from mid-nineties the Italian districts have evolved through a prioritization process, which has led to a general intensification of innovative efforts, an increase of the size of firms with the establishment of an operational model called "group of companies" and a relocation / outsourcing of many activities, once guaranteed by local suppliers. In some cases, this evolution has led to an increase in the rate of internationalization of the districts, through direct investment and international sub-contracting (Belussi and Sedita, 2007). As shown by other studies in this field, the districts with little propensity to learning are the most threatened by the internationalization, while the most innovative districts are able to start a process of selective relocation consisting of a substitution of low added value activities with some more attractive in terms of innovation and profitability (Belussi and Samarra, 2006).

Internationalization

The years following the Second World War saw a growing international economic integration, in particular the process which reduced the obstacles that restrict the free movement of goods, services and factors of production, able to break down the barriers, both natural and artificial, that hindered the interaction between different areas of the world, and create markets that go beyond the national boundaries. The strengthening of international ties implies a strong process of internationalization of enterprises which involved in the redefinition, at a global level, of the trade in goods, the movement of factors and the production structure. The district firms have three types of participants abroad: the strategic suppliers, which produce key parts or components for the realization of the final product and are mainly located in Europe, especially in Germany and France; the local sub-contractors, as workshops or small industrial enterprises, especially in the countries of Central and Eastern Europe that offer competitive processes in terms of labor costs; ultimately, the foreign direct investments, mostly concentrated in Central –Eastern Europe which represent an important opportunity for the SMEs to expand their boundaries, based on differentiated and flexible strategies.

With regard to the phenomenon of internationalization, Ferrara and Mavilia (2012) usefully analyzed the data of the TeDIS Observatory from 2001 to 2006, based on a series of quantitative surveys and case studies. The districts surveyed by the observatory are 45 and include the "4 As" of the made in Italy, namely the home furnishing sector, the clothing and textile sector, the automation and machinery sector, and the agro-foodstuffs industry. The companies have an annual turnover of more than EUR 2.5 million, an average turnover of about EUR 16.5 million and an average of 70 employees.

The collected data provide important information about the presence of the district firms abroad. First, we note that the average percentage of the export turnover is around 45 percent and about 40 percent of firms' export more than half of their total turnover. However, the relationship with foreign countries is not limited to the sale, but also

involves a protection of international markets, through subsidiaries, franchise and distribution networks and also the production chain is projected beyond the national borders, as demonstrated by the fact that 30 percent of the companies examined claims to produce thanks to a system of suppliers based on an international scale.
By considering the two dimensions of the internationalization process of the district firms, the degree of internationalization of the production and the degree of supervision of the markets, Ferrara and Mavilia (2012) defined four different strategic options for the positioning of the companies. Almost 50 per cent of the firms examined are more traditional in the sense that they continue to maintain a geography of production concentrated in the region, exporting only through traditional channels. Their weight, in terms of sales, however, is remarkably decreased, coming to represent only 30 percent of the total revenues of the companies examined. About 28 percent of companies have initiated a program of investments abroad, to increase their control in the markets.
A very small percentage of 11 percent is configured as open upstream companies, in other words they start a process of internationalization of the production to regain competitiveness by cutting the cost of the product, in particular by using the subcontracting and foreign direct investments. Finally, although only a small number of companies is involved, about 12 percent of the sample, the open network model results in an impact worthy of mention, which provides an international projection both upstream and downstream of the value chain and produces about one third of the total turnover considered.
The analysis of the Observatory focuses particularly on open network companies: they are mainly concentrated in automation and mechanics rather than in the home furnishing one, with a strong local rooting; they are more present in the district areas of the Northeast, not in those of the South. Furthermore, compared with the traditional district firms, they invest more in brand owners, product innovation, design and R & D, and they have their own patents and a computer equipment of much higher quality.

Learning systems in the Italian districts. Different types of learning

The satisfactory results of the industrial district in terms of innovation do not come from investments in formal R&D by the companies, which, when considered individually, lack the necessary resources and capacity, but rather from the possibility of exploiting the benefits of the collaboration and the belonging to an economic structure able to provide an effective support to the international competition. It is understandable, therefore, that the knowledge transfer is the main driver of innovation in the network of small and medium enterprises, which take advantage of the spatial and relational proximity. The strengthening of the processes of the internal transfer of knowledge

and information can be a necessary impetus to the growth of the districts.
However, the stronger links can lead to a self-referential system closed in on itself, unable to change and innovate its products and services. To understand the origin and meaning of this paradox, it is useful to introduce a distinction in the inter-organizational ties, based on the strength of the relationship among the affiliated entities. In a famous article entitled "The strength of weak ties", Granovetter (1973) proposes a distinction between strong ties and weak ties. The strength of a tie is "a combination, (probably linear) of the amount of time, the emotional intensity emotional, the intimacy (mutual confidence), and the reciprocal services that characterize the tie" (Granovetter, 1973). It seems evident that the ties between the members of the industrial district are of a strong type: the subjects interact with high frequency, share language and objectives, they are deeply connected and highly interdependent.
The success of district forms is historically due to the ability of those links to circulate quickly knowledge and information and to create an environment where collaboration is based on mutual trust: the processes of knowledge transfer are made possible by the density and the depth of the inter-organizational relationships. The advantages of a network of this type, as pointed out by Uzzi (1997), can easily turn into sources of difficulty: when the ties between members become too strong and exclusive, the adaptation to external changes becomes difficult and, moreover, the isomorphism that is created decreases the diversity, the access to non-redundant information and the creativity. The difficulties present in the industrial districts may be brought about by this closure, which prevents the change, the renewal of skills and the introduction of radical innovations.
According to Lipparini and Lorenzoni (1996), it is possible to identify four types of learning within the networks of the SMEs: learning by localizing, learning by specializing, collective learning and learning by interacting. The first three types require reduced efforts because the necessary coordination is provided in a natural way from the same district, while the learning by interacting requires a more structured effort that cannot arise spontaneously and that is the main objective in the current context.

Learning by localizing

The district firms have historically based their success on learning by localizing processes. The belonging to a dynamic environment, composed of other small and medium enterprises, in most cases of the same industry and with similar goals, the mutual understanding and the collaboration enable a fast and efficient circulation of information and represent an important source of competitive advantage.

This model has proved to be effective, since the technology knowledge is often idiosyncratic and heavily dependent on the context in which it developed, and incremental (Kogut and Zander, 1993), since it is often the result of a process of learning by doing: therefore, the technology transfer among companies requires a common basis of knowledge, previous experience of sharing and the understanding of the potential linked to it. As already pointed out by Marshall in Principles of Economics (1920), the district by its nature is therefore a reality able to support inter-organizational processes of knowledge sharing, in which the existence of a subject with special skills or the introduction of an innovation by an enterprise benefit all the other members. Within the industrial district the learning by localizing appears to be a natural phenomenon, which allows you to start a vicious circle in which the competitiveness and the ability of innovation of a subject drive the development of the other, creating the conditions for a further growth; this is particularly important for the smaller companies, which would otherwise have difficulty in introducing innovations.

Learning by specializing

The district firms can also benefit from a form of learning b specializing. In fact, the companies that are part of the industrial districts are specialized by activities, because they focus on specific tasks and limited operations, so that the finished product comes from the performance of processing stages carried out by different subjects, geographically close to each other.
This division of labor, which is spontaneous thanks to the effectiveness of the transactions and the immediate circulation of the information, allows to have highly qualified, diversified and complementary skills. The companies establish relationships of knowledge and mutual trust with each other, which enable a strong partnership and competition whose presence allows to obtain excellent results. The manufacturing specialization also allows to achieve goals of flexibility, meaning the ability to respond to the technology changes and to the requirements of the demand: the district firms therefore appear more "flexible than the mass producers and thus more competitive in unstable environments" (Sabel, 1989).

Learning collectively

Within the district the companies can increase their ability to innovate, thanks to learning processes based on synergies with other subjects: in this regard we talk about collective learning. The collective learning is more structured and deliberate than the previous ones, because it does not focus just on the geographic proximity of the members of the district, but also on the relationships that are established.

Besides the advantages due to the circulation of knowledge, made possible by cooperative ties, the innovative milieu is a tool for reducing uncertainty, since, due to the intensity of the relations established with other members of the district, a company can understand the possibilities of success of an innovation technology, control the strategies of others and increase the codification of technology information. The collective learning is based on the concepts of reciprocal learning and mutual adjustment. These concepts ensure that the interaction between different subjects leads to an increase in the level of knowledge, which concerns the network as a whole. Therefore, the cooperative ties that are established at an inter-organizational level guarantee the survival and the development of the industrial district.

Learning by interacting

The learning by interacting, which will be discussed in detail later, is based on the assumption that the innovation is an interactive process, which involves the integration of different participants, skills and information and that it takes the form of knowledge flows and multilateral relations.

Weak learning systems

The idea of Belussi and Pilotti (2002), however, is that the industrial districts can take three types of structures on the basis of the knowledge and the type of learning on which they are based.
These systems are mainly based on the horizontal extension of a given knowledge accumulated in certain areas, mainly tacit and linked to social practices. The companies within these districts base their strategy on the possession of traditional craft skills and often have to cope with a "stagnation", e.g. an absence of technology opportunities, entrepreneurship and creativity, both for exogenous and endogenous reasons.
The district is characterized by a highly fragmented industrial structure, the presence of external economies and by a reluctance to adopt new technologies by local realities, run by local entrepreneurs, skilled in high quality hand-crafted processes, but reluctant to development and innovation: the production processes tend to remain unchanged, as well as the products, despite the frequent and significant changes in the economic system and the needs of the demand. A particularly clear example in the Italian context is the Murano glass district.
The mode of learning that underlie these realities is the dissemination of practical know-how: the routine activities are learned and reproduced without fully understand the basics. It is useful at this point to distinguish knowledge into explicit and tacit, as done by Polanyi (1966) and then by Nonaka and Takeuchi (1995). Explicit knowledge

is communicable, as it can be coded through a formal language (for example, the sequence of operations necessary to produce a drawn steel); tacit knowledge is, however, personal, and specific to a context and, for these reasons, hardly communicable and transmissible (the optimal execution of operations to produce a drawn steel without defects is a tacit knowledge, being the result of the company and its workers' experience).

So, if the first has to do with the knowledge of "what to do", passively learned through theoretical explanations, the second is the knowledge of "how to do it", developed by the active participation and social relations. It is understandable, then, that in this model the knowledge that spreads in the network in which companies cooperate, is tacit and does not result in the loss of the existing basic craftsmanship. The transfer of knowledge is done either via the transmission of instructions from competent workers to apprentices (intra-enterprise), or through the technical skills transferred along the production chain (inter-enterprise).

Absorptive capacity systems from external knowledge circuits

The companies operating in these districts are characterized by a high level of innovation, since they are able to absorb knowledge from outside, combine it with the information that they already possess and thus innovate products and processes. It is worthy to point out that the accumulation of knowledge from outside is not a mere act of copying or passive reception, but it requires the translation of the knowledge in a language congenial to the district. The knowledge is captured by the population of the district simply by absorption, a graduate and linear proceeding which involves schools, business associations and centers of services: as theorized by the neoclassical economics, there is no distinction between the development of knowledge and the regular business activity of the district.

Therefore, in the case of systems with high absorptive capability, the learning is informal and takes place first with a re-contextualization and decoding of external knowledge and, then, with a new codification within the organization of the district and its operating methods. Various authors have focused on the learning process in the event of a network of this type. According to Cohen and Levinthal (1989), the agents need, as well as the cognitive ability, tacit and informal knowledge, of great importance for the absorption from the outside.

This knowledge is realized in the stages of acceptance, adoption and diffusion to other companies; on the other hand, Choo (1998) breaks down the learning process into three stages: creation of meaning, knowledge development and decision; Noteboom (2000) describes the learning as a “cycle of discoveries”: at the beginning there is a little awareness, then the testing leads to the coding, so that the knowledge can be abstracted from the context and generalized and, finally, a dominant design emerges; Kuhlthau (1993) describes the stages of the recognition of the need for information (initiation), the identification of a topic (selection), the surveys (exploration), the examination of some possible solutions (formulation), the searching for information related to the subject (collection) and finally, the completion of the research process (presentation).

The relationships within the district are essential, as they are realized in co-production, joint research and cooperation with users (Lundvall, 1992), but also the social and cultural environment (Nonaka and Takeuchi, 1995) and the technology interdependencies, which change as the district evolves, represent the basis for the construction of knowledge. The dense and spatially concentrated networks are ideal for the development of learning and the dissemination of tacit knowledge. This type of learning is different from the previously analyzed passive transfer of practical know-how from one agent to another, since it is a creative process: the learning opportunities are affected by the mental models of the people and their representation of the reality, depending on the objectives to be pursued, so that it becomes a problem solving activity, using sources outside the district.

The opening of the industrial districts towards the outside world allows companies to gain access to new information and skills, contributing to the formation of new ideas and allow to overcome the organizational inertia, which could otherwise block the most radical innovation processes, and avoiding the isolation from the dynamics of the market and the new opportunities offered by it. Taking up the theory of Granovetter (1973), the district firms built weak ties with the external participants, to gain access to not redundant information and to create variance in the system, not by abandoning the strong bonds between the members of the district but, on the contrary, exploiting their potential: weak ties with external participants provide an incentive that can be leveraged internally thanks to the network of strong relationships.

In particular, the external subjects to which district firms can open are those who, remembering the distinction made by Malerba (2000), are part of the large scale R&D innovative system: the innovative large and small companies, the universities and the public research centers. For what it may concern the SMEs in the district, such relationships allow to overcome the limited internal knowledge, having access to the vast pool of skills of the academic and public research network. Some examples of this type of system are the textile and clothing district of Carpi and the jewelry one of Vicenza.

Dynamically evolving systems

This kind of organization is typical of districts benefiting from the presence of some highly innovative enterprises. To fully understand the scope of such innovative reality appears useful to introduce the

Abernathy-Clark model. It suggests that innovation requires two types of knowledge: technological, e.g. linked to the components of a product / service and the links between them, which together constitute the offer of the company, and the market, namely the knowledge of the distribution channels, the possible applications of a product and the needs and preferences of customers (Abernathy and Clark, 1985). On the basis of this, the model distinguishes four types of innovations.

A regular innovation, usually indicated by the term incremental, preserves both the technology capabilities and those of the market and focuses on minor marginal changes. The case of Intel, which switched the production from Pentium III chips to Pentium IV chips is emblematic: the new product is in fact based on the same technology knowledge and does not require new market skills of the manufacturing company. A niche innovation maintains the technology skills, but it makes the market obsolete: this is the kind of innovation that Bettini has been able to cope with successfully. He is an Italian manufacturer of tiles, which has used its technology prowess in the manufacturing and processing of ceramic materials, to produce blades for ceramic knives, a product that will appeal to a different market from that of the tiles and that is sold through a different channel.

An innovation can be defined revolutionary if retains the skills of the market and, at the same time, renews the technology ones: in this case, the firm leverages the knowledge of the end customer and of the sales channels, to overcome the difficulties due to the necessity of a technology change.

For example, in virtue of its knowledge of the market, IBM has been able to maintain its leading position in the personal computers market, in the transition from CRT technology to transistor and then integrated circuits. An Architectural innovation, also called radical, ultimately involves the overcoming of market and technology expertise and requires businesses with a strong ability to adapt or foresee the market needs. The transition from the production of CDs to the online selling of songs, for example, is a breakthrough architecture that record companies have not been able to propose and therefore resulted in a significant loss of competitiveness for them. The district firms organized according to the dynamically evolving model are able to exploit and process the information received, generating both incremental and revolutionary innovation, although the one which prevails is the revolutionary innovation, especially by end-user companies, research centers and specialized suppliers. The flows of knowledge are countless: from the outside, so that the ideas are internalized by the district, but also from within the district to the external realities, simple or multinational companies, which in some cases may then decide to take part of the same district.

The clusters with these development districts are typically high-tech, such as the biomedical district of Mirandola, or the districts creators of specific products that require strong technical basis, such as the upholstered furniture one of Altamura, Matera and Santeramo. The type of learning in this more innovative and creative districts, which are able to develop new knowledge, is the generation of innovative capability. As previously mentioned, only a marginal part of the innovations derived from R&D, according to the idea of mainstream economics (Lissoni and Metcalfe, 1994; Edquist, 1997), while the majority of the innovation activity of the enterprises depends on knowledge exchanges, absorption, integration of knowledge and exploitation of the opportunities coming from outside.
We must therefore abandon the linear science-based paradigm of innovation, and switch to an interactive and evolutionary model (Lipparini and Lorenzoni, 1996): we are not facing a mere transfer of techniques, but the development of internal competences and skills to absorb external knowledge. It differs from the Schumpeterian vision, where a heroic entrepreneur generates innovation simply recombining productive resources, to approach a kind of development that comes from daily routines and activities of accumulation and conversion of knowledge. The learning, therefore, is a bottom-up activity, and is stimulated by continuous investments, processes and relationships with customers, users, suppliers, other companies and other public or private participants.

The knowledge brokers

As a consequence of the profound changes in the global economy that have caused difficulties to the industrial districts, two proposals have been put forward to boost competitiveness: a clearer restructuring of internal inter-organizational relationships and a greater openness to external relations with subjects potentially able to develop the SMEs innovation capacity.
It is worth highlighting, however, the industrial district has not, in the first case, the ability to coordinate strategy and vision, and, in the second, the resources and skills for the selection and transformation of the information received. Small enterprises that make up the industrial districts often have neither the necessary means nor the skills to identify and use external sources of scientific and technology knowledge, since the acquisition of know-how from outside is an expensive process, which often exceeds their possibility.
The opportunities offered by research collaborations do not constitute a sufficient condition to increase the innovative capacity for district firms: the latter should be able to learn and internalize the knowledge generated during these collaborations, which can then spread through the mechanisms of learning by interacting. It is believed that this bridging role can be done only by subjects specifically dedicated to the

innovation support to small and medium-sized enterprises, defined "knowledge brokers".

The process of knowledge creation

The creation and dissemination of technology knowledge in the reticular architecture of smaller companies is based on two inextricably linked concepts: the transfer / absorption of the knowledge and the learning by interacting (Boccardelli et al., 2000).

These processes require management skills of research, translation, transfer and combination of technology expertise (Morrison, 2004): while the first three are based more directly on the process of opening to the outside of the district system, the combination recalls the importance of the internal relations planning. In general, these abilities are rarely owned by the individual district companies, and require the intervention of a specialist, described as "a catalyst for knowledge."

The first task of the catalyst for knowledge is to identify, interpret and absorb external expertise which are complementary to those held by the members of the district, through links with various parties, including large enterprises, public research centers and universities; he plays the role of a broker of knowledge, as he makes possible the exchange of knowledge between individuals or different networks, occupying a structural hole, e.g. a position of potential link between groups not previously connected (Burt, 1992).

The catalyst for knowledge thus allows to establish weak bonds between the industrial district and other entities that would otherwise not have the opportunity to work, and to create the necessary conditions for the development of new knowledge, enabling the access to resources developed externally. He must have high technical expertise, a deep familiarity with the business of the district and its needs, a strategic vision able to identify the most promising directions of the technology development and "a level of absorbency above average" (Morrison, 2004).

This concept is developed by Cohen and Levinthal (1990), which define absorptive capacity as "the ability to recognize the value of new information, assimilate and apply it for commercial purposes" (Cohen and Levinthal, 1990), stressing that this depends on the level of basic knowledge possessed by a common language and the most recent scientific and technology discoveries in a given scope. The catalyst for knowledge must ensure that the information taken from outside is adapted to make it appropriated by the receivers, e.g. the district firms, in a quick and effective way.

What is essential is therefore the activity of translation (transcoding) of the acquired knowledge, so that the members of the district can actually benefit from access to it. Knowledge often takes a tacit nature, so that it may be necessary to create opportunities for direct contact between source and receiver and as the importance of the tacit and

contextual component grows, a greater involvement of the participants becomes essential, giving rise to different transfer modes: simple delivery of technology, consulting, joint development, training programs and apprenticeship (Gottardi and Ferretti, 1997). The delivery of technologies requires a low involvement of the stakeholders, given that the knowledge to be transferred may be codified and therefore a simple indirect link between the parties is enough.
It is mediated by the catalyst for knowledge, whose goal is to make the communication possible; other modes require instead a growing involvement of the stakeholders, essential to transfer the not articulated knowledge: in such situations, the role of the catalyst for knowledge is that of a consultant, able to indicate the most appropriate agreement modes. It must be emphasized that the mere access to information and external expertise cannot be a source of competitive advantage, but it is necessary that they are assimilated by the members of the district and used together with those already held: it is referred to as "combination of technology skills".
The role of the catalyst for knowledge is precisely to simplify the learning mechanisms within the district, recombining the know-how possessed by the parties with whom it is in connection. Finally, it is interesting to note that the presence of a catalyst for knowledge modifies the industrial districts orientation towards the innovation. First of all, the innovation generated is not merely of an incremental type; indeed, the integration of knowledge held by subjects not previously connected to each other or its application in areas other than the original one allow you to develop radical innovations. Second, the planning skills allowed by its coordinator role bring about a greater flexibility and responsiveness to market demands, so that district firms take on, in terms of innovation, the features suitable to the current global competitive environment and can have all the requirements to return to the successful levels that have made the Italian district paradigm well-known.

Potential knowledge brokers

Once analyzed the functions that a catalyst for knowledge should carry out, it is important to identify the players that could play this role. Several contributions, including the one of Lipparinil and Lorenzoni (1996), indicate the district leading enterprises as a potential subject able to perform that function. According to Baden-Fuller and Lorenzoni (1995), the leading role is taken by a strategic center or by a central enterprise. These authors consider the birth of medium or large dimensions leading enterprises, and the resulting hierarchy of the industrial district, as the necessary evolution of the district formula and attribute the economic upturn to the ability of these entities to coordinate and run the process of change, exploiting not only the

network internal connections, but also the ones with external participants.
Morrison, however, raises an objection to the identification of the leading companies as knowledge brokers, arguing that “despite the leading enterprises may have the necessary skills to identify external sources and acquire knowledge, they may not be willing to share them with others members of the district” (Morrison, 2004): these companies have in fact the skills necessary to implement the tasks mentioned above, but not necessarily have sufficient incentive to cooperate with other members of the district, as the willingness to cooperate depends on the benefits that the subject expects to get from the relationship.
In the case of the transfer of knowledge between business leaders and smaller companies, the asymmetry of the relationship, due to the different skills and resources owned, means that the first have a low incentive to cooperate with the second, and for this reason, having in mind the specific role that a knowledge broker should play, the larger companies appear to be able to perform the functions of research and translation, but they hardly have an incentive to take care of their transfer, thus preventing an effective combination thereof. Knowledge is in such cases only transferred between the leader company and the restricted network of customers and suppliers with whom it collaborates in a systematic way: in particular, what is missing is the horizontal circulation of information that would benefit all members of the district, initiating a process for further development.
The support to the district firms’ innovative processes could also come from the centers for innovation and technology transfer, in particular public and/or private subjects, including Experimental Stations, Science Parks, Technology Clusters, Industrial Liaison Offices, University Incubators, Business Innovation Centre (BIC), Special Agencies of Chambers of Commerce, Agencies for the development of the area and topic and multi-sectorial centers. In Italy, it is possible to identify at least 300 of these individuals, who are united by the same purpose: "as a response to the demand for innovation of the companies, they provide an articulated set of services, technologies and knowledge that represent the available innovation offer" (Survey IPI, 2005).
The primary purpose of such structures is to connect the different participants that are part of the national innovation system and to provide an interface between the network of R & D on a large scale and that of small and medium enterprises. The centers for innovation and technology transfer current organization enables them to act as knowledge brokers in the best way, since they are well distributed in the area, with a greater concentration in areas with a bigger presence of enterprises, and in 80 percent of the cases they have as a target the small and medium enterprises. For what concerns the concrete actions

to support the enterprises, each center deals with three types of activities: information, training and technical-specialist assistance. The specific services in these macro-areas can be identified as the functions of research, translation, transfer and combination of knowledge, which have been previously identified as necessary to support the innovation activity of the district firms. For all these reasons, the centers for innovation and technology transfer already present in the Italian context, represent the subjects who may give support and orientation to the flow of information within the districts and who enable the companies to get in touch with subjects outside of the network.

Poor cooperation vs research-industry integration

The poor results obtained so far are attributable to several causes. First, it is important to emphasize that the lack of concrete results is at least partly due to the fact that the innovation support system is young, having more than a half of the facilities currently being operating in our country from less than ten years. The biggest problem faced by these centers, however, is the poor cooperation with the other subjects of the national innovation system. This is due to different reasons: the universities and research organizations often operate in response to the needs of the big company and they do not offer a knowledge consistent with the demand of SMEs, mostly unspoken and not systematized; on the other hand, the small companies, and among them the districts ones, have a poor innovation culture, which often makes them disinterested to the offer of technology knowledge and hardly proactive in suggesting specific research projects; the big company and the small innovative companies, also, in many cases do not consider the many benefits that can be derived from the transfer of knowledge to the district companies, which for example may represent interesting markets for their products.

A first step towards a greater effectiveness of the companies support activity should be done by the centers of innovation and technology transfer themselves, through an increased integration of the research system with the productive one and an increase of interaction and mutual support, so as to create a cohesive network of specialized participants. Faced with the service and technology centers lack of specialization, a greater level of focus in this size would require a closer collaboration between the different structures that should be able to combine the synergies arising from their connections and their deep-rooted attachment to the local area in which they are settled, but would increase the level of qualification and personalization of the services offered.

It is hoped that the creation of an Agency for the diffusion of the innovation technology, already indicated by the 2006 Finance Act, fits into this context of strengthening of existing structures. Designed with

the intent to promote the integration between the research and industry worlds and developed on the model of the similar French Agency, the new structure would "enhance the competitiveness of small and medium-sized enterprises and industrial districts, through the dissemination of new technologies and their industrial applications". (Regulation n. 266, Art. 368 d of 23th December 2005). The idea of channeling the complexity of the network of research and technology diffusion in a single agency appears positive, as it creates the conditions for a more effective organization of the existing structures.
Although the path is still long, one can cite some examples that go in the right direction. Emilia Romagna, for example, provides an environment able to support with innovative and targeted services several initiatives: in its districts there are about 40 centers for the technology transfer in different sectors (ceramics, textiles, footwear, mechanical, automation, biomedical) and laboratories working for large international companies in telecommunications and microelectronics, including Nokia, Ericsson and STMicroelectronics. Also the project, co-funded by the Lombardy region, "Optimization of the innovation transfer between centers of district services and regional infrastructures" aims to optimize the infrastructures system for the transfer of innovation technology, to promote the formation of innovation experts in local agencies and to create a stable system of relations between local authorities, research centers, service agencies and innovative companies. It also involves the testing of "nodes of innovation" as stable structures for the promotion of strategic innovation subjects, the upgrading of the existing staff and the promotion of pilot projects to enhance the innovations produced. Also the roles and responsibilities are defined and are local competence, to ensure the reproducibility and the widest dissemination of knowledge.

The “bottom up” Interactive Innovation model and the S-learning

In view of the increased competitive pressure caused by the globalization, the industrial districts have been shown to not be able to resist with their own powers, so that it becomes necessary to change from forms of learning previously defined natural, since they are spontaneously created (we refers to the processes of learning by localizing, by specializing and collective learning pointed out by Lipparini and Lorenzoni), to a more structured form of learning, called "learning by interacting" (Lipparini and Lorenzoni, 1996). The starting point is always the territorial dimension of the innovation, in relation to SMEs belonging to local production systems: the industrialization is considered as a territorial process.
Moreover, it is important to understand the importance of non-economic factors necessary for the development, and to consider the innovation as a socially rooted innovation activity, that is, as an institutionally and culturally contextualized interactive learning

process. This alternative model, suitable for SMEs and the economy of learning, where knowledge is the key resource and learning the most important process (Lundvall and Johnson, 1994), can be referred to as a bottom-up interactive innovation model (Asheim and Isaksen, 1997).
While the forms of learning that arise spontaneously in the districts are primarily due to the environment, the learning by interacting is based on the "ability of a participant to address the behavior and conducts of the system, to speed up the learning process of other spatially localized companies "(Lipparini and Lorenzoni, 1996), thus assuming the deliberate action of some individuals, the knowledge brokers, whom, through the interaction with the members of the district, can leverage their own structures and architectures to push them to grow. The evolution of this form of knowledge transmission does not require a reversal of the industrial district nature, because it is simply the evolution of the previous forms, which have represented the competitive advantage of the industrial districts, but adapted to meet the environment changes: the competitive forces from outside require that there is a greater planning in the circulation of knowledge and information, that continues to be identified as the main base of a successful district. Also the company distinctive skills evolve: they no longer include only the knowledge and skills developed in-house, but include the ability to use the reports to access to knowledge held by other companies, and to promote innovation (Lipparini and Grant, 2002). It is therefore necessary to identify the partners in possession of potentially useful knowledge and establish relationships with them based on trust and cooperation. The more the relationships and the amount of information available increase, the more these actions become simple. (Dyer and Singh, 1998).
We move from a strategy of N-learning, intended to encourage the sharing of knowledge within the company but to defend if from the outside, to a strategy of S-learning (Boisot, 1998; Quagli, 2001), which instead promotes the knowledge exchange with the outside. In this way there is the idea of a network of companies where the inter-organizational relationships are simplified by an external intervention, which determines the manner and purpose of the agreements, and allows to drive the behavior of the various parties to pursue common goals.
The strategic management of the links between the members of the district allow to increase the cooperation, orienting the relationship towards strategic directions.

A Linear model of innovation vs "interactive" innovation process

An important type of intervention for the innovation is the promotion of the interaction between the production structure and the institutional infrastructures. It consists in stimulating the innovation systems, which are generally national, but which in recent years have

established themselves on local and regional basis, creating new possibilities in the planning of innovation policies targeted at the SMEs.
In the interactive innovation process, the learning takes place:

- between the different phases of the innovation process, which includes the mobilization of the different forms of knowledge and information (knowledge based on science, market information, technical skills);
- between the different companies and organizations, such as the inter-company collaborations between suppliers and subcontractors or relationships with clients;
- with different centers and organizations of knowledge production, ranging from the regional, national and international R&D institutions to other sections of the knowledge infrastructure;
- through the interaction between different units of the same company, which implies a collaboration among different groups of employees' holders of different types of knowledge, which can be based on R&D, craftsmanship, or implicit.

In the past, the policies were designed to encourage the research and the introduction of formal innovations in both products and processes, but they were not very effective because the activity of formal R&D is inaccessible for the majority of SMEs, due to the lack of sufficient financial and human resources, with the exception of companies operating in high-tech sectors, which employ many workers with high skills, have intense relations with research institutes and base their competitive strength on adaptability and flexibility.
Compared to the traditional linear model of innovation of formal R&D, which provides a well-defined sequence of different stages whose direction is unambiguous and which is based on research (basic or applied), development, production and marketing, the interactive approach allows a more sociological and linked to the institutional context vision of learning, which sees in the promotion of regional endogenous development an alternative strategy for the realization of the competitiveness in the global economy.
The linear model of innovation, traditionally characterized by long implementation times and high costs, therefore, can be used efficiently only in basic research, and in university laboratories and large science-based enterprises, such as those belonging to the pharmaceutical and Defense industries. However, in many sectors there are companies that can be considered innovative, while not committing time and resources in formal R&D activities: for example, in the production of furniture, the design is a tool for continuous innovation, vital for

competitiveness and for improving the value chain. Currently, however, the SMEs not belonging to the high-tech sectors, but still competitive and innovative, are seen as the result of successful strategies of "regionalization", based on:

- learning as a localized process;
- innovation as a process of interactive learning, opposed to the linear model of innovation, and based upon the assumption that collaboration promotes competitiveness;
- agglomeration as the stage for a more efficient interactive learning.

A successful example of this model and the support it provides for innovation of SMEs comes from the metalworking district of Lecco, who has benefited from the presence of a CNR office, where are carried out researches on not traditional metallic materials. The CNR was established in Lecco in 1994 on the initiative of the CIL (Lecco Innovation Centre), which brings together the chamber of commerce, trade associations, the province and the town of Lecco and which had already promoted the creation of a section of the Polytechnic University of Milan, always with the aim of promoting the link between the worlds of research, education and small and medium enterprises. Thanks to the support provided by the National Research Council, the engineering firms have been able to acquire technology knowledge related to shape memory materials and new metal alloys and leverage the skills and inter-organizational relationships existing at the district level to create products and cutting-edge solutions.

Obstacles to innovation

The growing interest in the role of regional and national innovation systems must be understood in the context of the creation of policy instruments aimed at the systematic promotion of the localized learning to ensure innovative advantage and competitiveness of the economic system.

The concept of the innovation system, defined as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Freeman, 1995), is based on the idea that the innovative performance innovative of an economy depends largely on how many companies, in the innovation processes, are able to take advantage of the experience and knowledge of the other companies, research organizations and public bodies, although the skills and attitudes of entrepreneurs, managers and workers are critical to the innovation capacity.

Within the districts, the division of labor, the high levels of competition and, at the same time, of collaboration, the presence of a pool of specialized knowledge and the sharing of values, standards and codes, promote the innovation, stimulating the learning processes. As already discussed, in fact, the generation of knowledge and innovation, rather than on private investment in R&D, is based on learning by doing, on learning by using, on the imitative observation, on the mobility of workers, on the spin-off company and on the intra-district relationships.

All this promotes the production of incremental innovations and product differentiation, important activities in the district context but hardly identifiable through the indicators normally used to measure the entrepreneurial innovation activity, as the expense for the R&D and the number of patents. The factors that stimulate innovation are therefore determined by the enterprises environmental conditions, designed both in a functional and territorial sense. For what concerns the functional meaning, the companies gain the ideas, know-how and complementary assets of users, suppliers, consumers, universities, training and financial organizations, regardless of their geographical location (Todtling and Kaufmann, 1999); in particular, the SMEs belonging to districts need to be "in touch, not necessarily directly, but through the value chain, with global networks" (Cooke, 1998), to attract the complementary assets necessary to be competitive, when the local expertise in R&D is missing or outdated.

In the territorial sense instead, the stock of knowledge and the ability to learn within the regional industrial fabric can be of great importance in stimulating the firms' innovation capacities: the physical proximity allows direct relationships of sharing and collaboration, instant access to information and lower transaction costs. Thus "the region is increasingly the level at which innovation is produced through regional networks of innovators, local clusters and the cross-fertilizing effects of research institutions" (Lundvall and Borràs, 1997).

Several factors contribute to the local dimension of the companies' innovation processes:

- in many cases the industrial concentrations are localized;
- the training institutions and research organizations are linked to specific regions;
- the interactions between companies and suppliers of knowledge and spin-offs are often located;
- the common technical culture that can develop in support to the collective learning and innovation;
- the local public organizations, which were generally active in supporting innovative activities and technology transfer (Todtling and Kaufmann. 1999).

The SMEs seem to depend particularly on the assets present in the regional industrial fabric to innovate since, by definition, they often have limited internal resources, as well as problems in the management of external collaborations with remote participants. The local organizations efforts in creating “institutional thickness” (Amin and Thrift, 1995) are important in stimulating the collaboration, the learning by interacting and the innovation activities. Nevertheless, for many companies, the innovation is a primarily internal matter, due to greater confidence in their skills rather than in the external participants (Todtling and Kaufmann, 1999). It is noted, however, that companies can successfully innovate without belonging to regional innovation systems, finding the set of skills relevant to them also in national and international innovative systems. Today and in the future, the region is no longer the main and only area in which the competitiveness of SMEs is built, but it must become the fulcrum of a transnational network: therefore, a strategic rethink in individual companies is needed. The specific contextual factors, indeed, do not always constitute a means of promotion of innovative processes, since they could also represent an obstacle to the same reason. If there is no doubt that the presence of an atmosphere focused on progress in the region and the establishment of long lasting partnerships in innovative activities based on mutual trust with other local businesses, knowledge organizations and skilled workers can stimulate the development of innovation processes by companies, is equally certain that the absence or weakness of these factors cause the opposite effect on SMEs. Among the limitations which may curb the innovative activity at the local level there are:

- the difficulties to analyze and understand the role that the innovation technology plays for the improvement of internal and external processes with the resulting increase in productivity and competitiveness;
- the low capacity for finding the skills required, the low propensity to the research and development, a low availability and propensity to collaborate with other companies, with academia and with centers of expertise;
- the lack of monitoring and evaluation of investments in both the start-up and the management phase;
- the fragmentation of the production that may cause failure in dealing with the competition in increasingly globalized markets;
- the passivity of the participants of the district compared to the initiatives of a leading company;
- the specialization of some industrial districts, especially in Italy, in mature sectors faintly interested in developing innovation sectors;
- a lack of knowledge and availability of tools and funding, which results in an inability of the responsible institutions in identifying suitable projects and in the

presence of formal barriers, as sets of forms and bureaucratic issues;

- a lack of clarity in the various tools created (Por, Pon, Tax Credit, FIRB, VII FP, other Community funds, Guarantee Fund).
- We can therefore outline some situations, in which the innovation is hampered by one or more of the reasons listed above.

Firstly, there may be no regional innovation system, due to the lack of relevant regional participants (organizational "thinness"). These regions may still emerge for their ability to form organizations that encourage the enterprises innovation activity, and everything depends on their decision-making power, their financial resources and the orientation of their economic policy (Todtling and Kaufmann, 1999).
Secondly, a regional innovation system cannot exist for a lack of innovative collaboration among the participants of the region, which thus constitute a regional fragmented system. In this case, the relevant subjects are present, but they do not give rise to a regional efficient system, due to lack of joint stock capital , which is critical for the innovation activity and that usually involves forms of quality communication, e.g. interpersonal ties, informal institutions, communication codes, styles of behavior, trust and collaboration methods, to simplify the learning by interacting (Gregersen and Johnson, 1997); such informal institutions allow different types of cooperation between companies without the need for written contracts, because they know each other and they follow the same routine and unwritten rules of behavior.
Third, it is possible that a regional system exists but is too closed, so that the networks appear excessively rigid and create a situation of lock-in: instead of cumulative learning and path dependency that often characterizes the strong innovation systems, there is a "closed" entrepreneurial attitude in terms of institutional, social and cultural rights.
This may be the case of an area that has historically had a strong innovation system based on local R&D institutions and Vocational training organizations with specialized activities and that, once the technology suffers a decline, should update and improve its knowledge base and promote product innovations (Cooke, 1998). To develop incentive mechanisms for innovation, it is necessary to consider its nature, compared to the potential situation of cooperation/competition which could results in the district; there are innovations of public interest, which can easily encourage a cooperation, and innovations of interest for the competitiveness of an individual company, so that the district as a whole will not be willing to cooperate.

The uncompetitive innovations, as those required to respond to changes in products regulations, and the pre-competitive innovations, namely the ones regarding the phase previous to the competition on the market (such as the introduction of a new material in a district, which then is used and adapted by individual companies for the development of their products in competition) are well suited to cooperation. The best tool to promote the development of innovations of this kind is the multi-client project, which allows you to split the cost of R&D between the companies, reducing the financial problems, compensating for the lack of qualified human resources and limiting the time that an entrepreneur should spend.

The public intervention may constitute a direct aid to SMEs for the implementation of their projects, through feasibility studies, plans and designs for products, production processes or new services. The promotion of the competitive innovations, which benefits a single company, however, can be made through financial aid and providing expertise: in particular, the financial aspect is crucial, since the costs of development are imposed on a single firm. It is possible to cooperate with upstream or downstream companies in the value chain (e.g. not in direct competition with the company) or exploit public aids.

Among the public aids, soft loans, which have a low interest rate or no demand for any warranty, are not very useful for SMEs, considering the high risk associated with the development of innovation. On the contrary, the contributions grant that at European and national levels are often 50 percent, are definitely more attractive, although they may be further strengthen considering a higher rate to finance the initial stages of development and relief to the most advanced stages, by connecting the public contribution to the evolution of the project.

There are other actions which have a great impact. First of all, the pre-seed financing, aimed at the development of the results of activities related to the research and testing of products and processes. Furthermore, when the realization of prototypes is needed, it is aimed at testing and marketing activities. Secondly the start-up financing, whose goal is to support the material implementation of industrial projects resulting from R&D activities. It is aimed at funding the development of a product and its marketing and helping to create the conditions for the participation of private investors and other subjects able to support professionally and financially the growth of the enterprise.

Moreover, to solve the problem of improving the innovation ability of the small enterprises making part of the district, it is essential to rely on the capacity for collective construction, in addition to the establishment of centers of real services and local innovation systems, which could systematically provide an assistance to the companies and

help them to keep up with the latest technology developments: concrete steps should be taken to implement a networking strategy between the companies and the private and public entities. To enable the SMEs to produce innovations, especially the radical ones, it is often necessary to combine the informal, implicit and localized know-how with R & D expertise, which typically occurs in the universities and research institutes: in the long term, indeed, the companies cannot focus only on localized learning, but they must also have access to more universal codified knowledge, processed by some participants of the national innovation systems. According to Garofoli (2002), the interaction between the participants, including the external ones, should be simplify d by specific forms of support for innovation, fostering the collaboration between different organizations such as companies, universities and research centers, rather than by putting them in competition for access to the scarce resources offered.
This represents a multi-layered approach to the innovative systems and infrastructure of knowledge, as the firms' innovative activities are based both on the specific experiences of the place, e.g. the implicit knowledge, the craftsman skills and abilities, and on R & D based knowledge. To allow the companies who do not have an intensive R & D to gain the formally codified knowledge, the operation of national and international manufacturers of innovation systems must be encouraged to make them more interactive: in this way, these systems, originally organized according the linear model, would become more accessible and responsive to the collective and individual needs of the international competition of the industrial districts enterprises.
Finally, it must be remembered that a strategy of endogenous development based on learning cannot be universally applied without some forms of government intervention or the collaboration between public and private. In particular, it might be very difficult to achieve in rural and suburban areas, characterized by a little industrial manufacturing fabric and a little tradition of production, as well as in declining industrial regions dominated by transnational corporations, because the trends of regionalization in these places seem structurally subject to strong constraints (Asheim and Isaksen, 1997).

The importance of Innovation

It is common opinion that for the district firms' innovation is not a key issue, since they are SMEs and they have clear financial and dimensional limitations. It is true that innovation technology requires high skills and resources, often not accessible to SMEs. However, it is only one type of innovation, although it is the most famous with its recent implications in ICT and telecommunications, which have fundamentally altered the entire international production system. Innovation is instead a transversal concept, which affects the organization of the factors of production, the selection and training of the human resources, the production range, the marketing, the distribution, the partnerships and which, in fact, is an obligation for the companies that want to meet the challenges of the global market.

Many district enterprises are moving towards the adoption of an articulated paradigm of innovation, not focused exclusively on changes to the product, but on investment in intangible items that can considerably increase the added value of the productions. Obviously, the innovation of products and processes, linked to the technology, is always at the core of the efforts of the district enterprises. However, it becomes necessary to go further, focusing on new distribution and trade strategies, on the rethinking of supply chains and subcontracting relationships and on the investments in control and intelligence systems to ensure quality to raw materials, semi-finished products and information flows.

The focus on improving the product was and certainly remains a cornerstone of the made in Italy success, but many entrepreneurs are struggling to act on wider stimulus, regarding the expansion of the range offered, the raising of the quality of the suppliers, the control of the commercialization steps, the use of ICT technologies and more flexibility and services. Although we do not want to enter into the debate, which began with the works of Schumpeter, on the relationship between firm size and innovative capacity, it must be remembered that some contributions (Rothwell and Dodgson, 1991; Pavitt, 1984) highlight the importance of the roles, albeit different, of both small and large companies.

They consider that there is no optimal size for innovation, and that small and large companies play complementary roles in innovation process. Companies of significant size have greater financial resources, strong managerial skills capable of directing the innovative activity and more opportunities to get in touch with the academic world, features that allow them to have more capacity in basic research and in undertaking innovation projects with higher capital requirements and big risks. Smaller companies instead, thanks to the set of relationships between interdependent participants, have a greater flexibility since they are able to vary the quality and volume of their offer and a quicker response to external opportunities; in addition, the proximity to the market, combined with the advantages of the internal circulation of knowledge, means that the small firms are particularly competitive in the phase of developing innovations.

District firms can benefit from the cooperation with large enterprises, by virtue of the complementarity of reciprocal skills and expertise. For instance, it is on the basis of this cooperation that the relationship between Montecatini, a giant of the Italian chemical industry, and the small and medium enterprises in the district of polymers and fluorinated rubbers, better known as the Valley of Fluorine, has arisen and has gained strength. In the 50's, while Montecatini developed the

first fluorinated polymers, in the area between Bergamo and Brescia some small businesses began to operate in the transformation of the same substances, so that a relationship among the two nascent industries have developed and strengthened over time. The district firms, whose number and importance have grown over time are not only buyers of the chemical, but also the individuals capable of giving the necessary feedback to the ongoing development. This collaboration, which benefits both the Ausimont, a subsidiary of Montedison group (formerly Montecatini) and the transformers of the Valley of Fluorine, has enabled the creation of a market of over 150 million euro per year (Fortis, 2005).
Although innovation occupies an increasingly crucial role in the competitive strategies of the industrial districts, the companies show different profiles and guidelines for this activity. According to Bramanti and Fratesi (2009), the enterprises within the districts can be distinguished into different types: leading companies, with a strong ability to project their own relations beyond the borders of the district and to benefit from the external encoded and complex knowledge; cooperative companies, or subcontractor that do not compete in the external markets, but which cooperate with the leading companies in the production and development of knowledge; follower companies, which simply exploit the local opportunities without contributing to the innovation activity in any way; unlinked companies which do not have the absorptive capacity to establish themselves as a cooperative subcontractors and be part of the value chain, and which often occupy unprofitable segments and with fewer barriers to entry.
These companies may therefore be exposed to competition from other suppliers, especially foreign, with lower labor costs. The key issue is the role of the district leading companies in the creation, dissemination and exploitation of knowledge processes within the same district. They act as gatekeepers of knowledge within the district (Toschi, 2011), sharing with the other district firms' information gained outside. It is difficult to judge their ability to innovate, especially if they are small companies, as demonstrated by a study by Astrid, who highlighted the methodological weaknesses of many charts on international competitiveness, often built with reference to structured large companies and to their typical model of innovation without considering that in the SMEs the innovation processes take on diverse paths, which sometimes do not even appear in the financial statements.

The effects of Globalization and Outsourcing

The investigation of systems of small district firms have helped to undermine the idea that the international presence is a phenomenon only relevant to big enterprises (Becattini, 1998). The novelty of the current internationalization is the overcoming of the stereotype of the large multinational company and the opening of routes that make a large use of the networks, e.g. stable vendor sales, sourcing, licensing, franchising, etc. In all these cases, beyond the legal form chosen, the relationship joins independent companies, located in different countries, and is powered and provided by resources of communication and cooperation, prepared by the stakeholders and reproduced from the practice of business.

The exchange, therefore, does not occur in the free market and between anonymous parts, but in a relationship network that is constructed and confirmed by the operations each time implemented. The global economy is changing the industrial districts from within. To occupy new spaces and maintain its advantage, each district must modify its products and the way they are run, starting from the core on which rests its competitive advantage: the exclusive competence accumulated in a certain field of the "know how”. Only if skills, ideas, variety and flexibility can be reproduced over time, the opening towards the foreign countries and the possible entry of multinationals do not bring about the dismantling or colonization of the district, but, rather, they globally expand the supply and market network, on which the small and medium enterprises located there can rely.

To follow this evolution, the district must finely improve the skills possessed and diversify its scope, pledging to continuously evolve, changing its products and production processes, even if it is difficult to realize the changes needed when they are related to the environment and the collective resources. How to train the new and essential professionals? How to invest in intangible resources? How to manage the outsourcing processes avoiding the risk of including the entire network of subcontracting in a spiral of crisis? The local systems, even when they are highly organized from a technical-productive point of view, are often "headless", without a "head" that can properly design the change and organize the consensus and the resources necessary to invest in training, creating the infrastructure, "putting the practice of doing and the research and higher education knowledge in contact" (Bonomi and Rullani, 2005) and creating a sound financial basis.

What is needed are shared decisions, taken by collective participants who have the ability to look at the system as a whole, designing transformations and acting upon the issues that emerge from time to time. The global economy, therefore, putting in competition different local systems that coexist in it, induces a strong need for self-government. They must be able to address the problems generated by the competitive change, respecting the specificity of each place, and acting within the time and in the manner required by the competitive comparison: to compete, in fact, decision-making power must be in direct contact with those who feel the need of research and professionalism, with companies within the district and those from outside, with the infrastructures and services available in each place.

Globalization and Internationalization

In the last years of the twentieth century, the stagnation of the aggregate demand and the absence of identification of long-term favorable prospects blocked the innovative investments by medium and large enterprises, so that they were pushed to delegate the production to smaller companies. The survey conducted by Chiarvesio, Di Maria and Micelli on the Italian SMEs pattern of internationalization shows that, since the early nineties, the supply networks and the organization of production processes have undergone profound changes, mainly due to the impact of the fall of the Berlin Wall on the process of European integration.

The internationalization of the production has experienced a strong growth, resulting in the transfer of labor-intensive activities in countries with abundant low cost manpower. In the Italian SMEs market, many enterprises based in countries with much lower production costs has started to operate and, in parallel, many large companies have started to outsource their activities in areas with low labor costs (e.g. Romania), saving considerably compared to the costs that would have resulted in the production in their home country: the increase of the price competition has represented an issue of considerable importance for Italian companies.

The employment reduction, the research of producing areas with lower costs, the increasing competition from local and national suppliers with foreign suppliers and the impoverishment of the network of local production interdependencies risk to start a transformation without prospects, which has already led some industrial Europeans districts to the deconstruction (Garofoli, 2001). The evolution towards an international orientation, which can be noticed in every industry and economic organization, is clearly more complicated in the district companies, given that the competitive advantage is due to the manufacturing skills rather than to the commercial and strategic skills: this implies an increased complexity in the separation between the "head" and the "arms" of the company, because the generation of the value lies in the process of carrying out the production processes and the place in which they are carried out, so that environment, the factory and the people who work there (strengths hardly transferable outside the district) take much more relevance (Chiarvesio, Di Maria and Micelli, 2003).

Some significant changes are affecting the organization of the district model. First, many outsourcing flows have been started and led by the leading companies, which have sufficient financial resources and which created some satellite districts with the function of subcontractors of the more advanced "Parent District"; secondly, the processes of international outsourcing of some production stages and the foreign direct investments, which result in the replacement of the internal networks of the district with external exchange networks, weakening the relationships and the circulation of strategic information between local enterprises and the mechanisms of knowledge reproduction rooted in the region; finally, the progressive organization of financial and trade groups with significant market shares, which brings about the substitution of the local exchange network with the "international subcontracting" and inserts a progressive standardization of products and processing stages, slowing the production of ideas, novelties and variety. It is interesting to point out, however, the firms that internationalize almost never come out from the local system, nor close the factories operating in it, but they start processes of spatial reconfiguration of the value chain, especially directed towards Eastern Europe and Asia, trying to overcome the negative effects emerged, the risks of which can only be postponed, but not eliminated (Belussi and Sedita, 2007).

The consequences of these changes are (Garofoli 2011): an increase in the attention to the organization of external networks and inattention to the exchange of information and planning cooperation with the district companies; a focus on production costs rather than on innovation, on finding new solutions to problems and on the variety of products; a growing devotion to the control of the market, rather than to the changes and diversification.

The behaviors similar to those experienced by large enterprises, which had opposed the strength of the commercial and financial innovative capacity to the flexibility and diversification of the district companies gain more importance: the aim of the system is not innovation or development, but only the short term management and the maintaining of the leading company cost competitiveness and extra profits. The small subcontractor company is pushed to comply with the terms of the contract (price, product specification and delivery time), increasing the external dependency at the expense of new innovation opportunities.

Besides the exportation and the outsourcing aimed at cost reduction, there are at least two other promising ways of internationalization to explore: the transnational distribution of different activities that make up the value chain, with the aim of being able to take advantage from the national differences specific to each country, and the participation in international networks of labor division, in the production and utilization of knowledge fields. In the first case, because of the particularities of each country, considering the emerging areas, the maximum benefit is obtained by distributing the activities of production and value creation at the international level, working to overcome the barriers that make it difficult for them to invest and operate in distant, uncertain, unfamiliar and sometimes hostile conditions and environments, to exploit the advantages related to each country in specific stages.

Today, the optimization of the production transnational chain today can be undertaken by all the companies, even the SMEs, through the development of international collaboration networks, with limited use of directly controlled subsidiaries. In the second case, the companies are able to use the knowledge, information, research and specializations accessible worldwide, rather than producing them on their own, with high costs and risks. The opportunity of being part of a network allows the company to focus on a specific knowledge, exploitable worldwide, and, for all the other needs, they can rely on partner companies, thanks to a proven trust and communication relationship. If, in their traditional sense, the districts were seen as local supply chains, closed in the upstream stages and strongly internationalized in the final, sales and customer service stages, according to a clearly export-oriented model, there are signs of greater openness along all the value chain and, in particular, in knowledge production, processing and exploitation.

How to cope with Globalization?

Facing the changes brought about by the globalization, the districts clearly need to change their strategic plans. According to Garofoli (2001), the most appropriate strategy is a continuous upgrading of the district, accompanied by the growth of relations with the external world: it consists in the research of new markets, the introduction of new products, the exploitation of the increasingly important external networks and the commitment to cooperative ventures with other enterprises and other areas, to continuously research new market niches in which the local manufacturers become world leader, while avoiding to increase the labor costs.

Another possibility is innovation and high quality production, which implies a progressive enhancement of the external economies and a reproduction of the dynamic competitive advantages of the industrial district. The districts have adopted different orientations. The diversification of production was followed by the districts which chose to invest in high quality and differentiated products to avoid the competition on production costs, e.g. the cost of labor, and the exacerbation of the relations among the enterprises, while maintaining the advantages of the inter-company cooperation. This strategy is usually accompanied by the objective of seeking a greater autonomy, to enter specific market niches or expand the markets, through the use of economies of scope, as the opportunities of entering parallel markets (Garofoli, 1991).

This strategy leads to the growth of the relations with the outside, with other partner firms in the manufacturing process and with the customers, resulting in a “internalization” of knowledge external to the company and to the district, which implies an increase in the "contextual knowledge” (Becattini and Rullavi, 1993). The search for

specific resources and particularly qualified expertise produced by the local system has recently determined the entrance of the large company (often multinational) in the district, which represents a growing interest of large enterprises to the local system external economies.
This penetration involves the introduction of hierarchical relationships instead of district cooperative relationships, which weaken the district system and deprive it of one of its most important constituent parts. With the economies of scale concentration and prevailing research, only the static competitive advantages are incorporated into the financial group, while there are no opportunities to reproduce the dynamic competitive advantages, resulting from the competition and collaboration between local companies (Garofoli). The formation of groups indeed leads to the progressive reduction of the relations (trade, exchange of goods and information) internal to the local system and the introduction of a hierarchical logics, which may prevent the stimulus to the variety and innovation. Two examples of the application of this type of strategy are the Montebelluna district and the packing system in the Bologna area.
The outsourcing is part of the strategy followed by the industrialized countries to cope with the competitive pressure of the low labor costs emerging countries, and it is embodied in the international fragmentation of labor-intensive productions, especially in the textile and clothing and footwear sectors. The erosion of the competitive advantage of the industrialized countries is then faced by carrying out a combined strategy of increased productivity at home and reduction of the cost of labor abroad through the international fragmentation of the production, so as to keep it stable, or at least to prevent its abrupt decline. Graziani (7001), after having analyzed the labor costs structure, comes to the conclusion that the cost savings resulting from this strategy may be quantified in 50 percent for Germany and 40 percent for Italy.

Threats and opportunities

Therefore, there are definitely some decisive advantages in extending the division of labor, the cognitive processes and the manufacturing stages at the transnational level, not only for reasons of scale (the width of the European or global market), but also because, coming across a variety of cultures and lifestyles, companies can expand their range of ideas and resources they have access to, and learn opportunities on which they can rely. To get immediately in touch with the advanced technology, companies must come close to the places where careers in science and technology are concentrated: an example is the area of the Silicon Valley in the United States. Moreover, analyzing the benefits from the point of view of costs, the internationalization gives access to national differentials of cost that can be decisive in the competitive comparison: for example, to obtain cheap manpower it is necessary to draw from the wide basin of the Third World, made available by the internationalization processes (even partial) of the production cycle and immigration in Italy. However, to benefit from public facilities the companies must take into account the incentive policies of some regions, such as in Southern Italy or other countries in Europe, for example the Eastern Europe tax havens.

As already discussed, the concept of "co-opetition", a mix of competition and cooperation (Brandenburger and Nalebuff, 1996), is the basis of the district model.

In this regard, the studies conducted by Brandenburger and Nalebuff point out an important aspect of the internationalization in a district area: the enlargement of the network, expanding outside of the original context, allows an increase in competitive and cooperative relations, with consequent positive effects in terms of comparative advantages for companies that are able to manage relationships in the new structure of the network.

Nevertheless, this is contradicted by the studies by Belussi and Sedita, who affirm that at the root of the "co-opetition" processes there is an important pre-condition: in order that the positive effects of the cooperation-competition combination may occur, the companies need a spatial proximity, that is, the presence of relationships internal to the district. That is linked to the issues of creation-use of the tacit knowledge within the district, of which the outsiders cannot take advantage.

Therefore, it is not clear whether the effects of internationalization are positive or not, given that the increase in terms of competitive advantages due to the higher number of reports of "co-opetition" could be eroded by the loss of tacit knowledge or the lack of training, having negative effects on the district enterprises themselves. Moreover, there are some disadvantages also in the district companies process of internationalization, particularly regarding the stability of the local networks. Faced with lower costs thanks to the exploitation of new forms of supply chains no longer enclosed in the district, the localized knowledge is at risk, threatening the ability to compete and innovate (Chiarvesio, Di Maria and Micelli, 2003). Given the particular characteristics of the district model and considering the unique relationship between knowledge and local participants, the internationalization can compromise the virtuous cycle of creation thereof.

This seems particularly suited to the Italian case, in fact the Italian companies belong to low-tech sectors in which they operates by focusing on the product through the learning by doing, that is by innovating through incremental improvements of manufacturing processes and satisfying the demand thanks to their flexibility and

creativity, in a context in which the region becomes the reference infrastructure of the enterprises, to manage the collaboration and knowledge sharing (Chiarvesio, Di Maria and Micelli, 2003). Regarding the management of knowledge and the consequent competitiveness of the district, then, the internationalization has extremely important implications. In fact, the possible outsourcing of activities outside of the region may result in the gradual renunciation of the knowledge embedded in it, increasing the risk of investment operations (Belussi and Sedita, 2007), but also the risk of relocation of the value chain, since the knowledge needed to compete is incorporated in it and it has a crucial role in the creation of know-how and innovation (Chiarvesio, Di Maria and Micelli, 2003).
Furthermore, we need to pay particular attention to the fact that for the district, the outsourcing may have serious implications in terms of competition, as it is configured as a process of transfer of knowledge and skills related to the core business of the companies, with the risk of exacerbating the competition and losing the advantage gained in the foreign network, following the attainment of productive and strategic independence by the same companies in which the activities are outsourced (Chiarvesio, Di Maria and Micelli, 2003).

A focus on Outsourcing

The phenomenon of outsourcing, which is widespread in the Italian industrial districts, deserves a deeper analysis. The redefinition of the international division of labor as a result of globalization has seen a preponderance of the phenomenon of production outsourcing, especially in high production stages within a given production chain.
The erosion of the comparative advantage of the industrialized countries in the traditional productions is fronted by building a combined strategy of increased productivity and reduction of the labor costs, through the international fragmentation of the production (Crestanello and Tattara.1005). In recent years, in many industrial areas of the Northeast and Central Italy initiatives of outsourcing have proliferated towards the countries of Central and Eastern Europe, through various forms that tend to repeat the kind of relationships that have been built within the district.
There are two main modes of outsourcing: direct investments abroad and relationships of international subcontracting. The first are implemented by large companies that often switch from relationships of almost market, with the use of local subcontractors, to forms of hierarchical control in vertically integrated foreign companies (as in the Geox case); the second realize a form of quasi-integration, because the relation envisages the special execution of an order by an enterprise on behalf of a client, with technical exchanges of people, information of and often semi-finished, so that the district extends its own network of productive relations, to include also production

facilities of foreign countries with lower labor costs. The processes of production outsourcing benefited especially China and Eastern European countries: the latter have expressed, in the past five years, a sharply higher growth trend, mainly related to their proximity to Italy, which allows not only a sufficiently restrained time-to-market, but also the use of Italian products exported duty free.

The patterns of international integration differ according to different geographical-economic areas: the outsourcing, as an international decentralization of the production which allows to maintain the control of logistics operations of supply and distribution, concerns mainly the Balkans and the Mediterranean area; a model of horizontal integration of the production with phenomena of intra-industry global sourcing, local or regional supplies and the development of the demand for investment goods, occurs, however, towards the Eastern Asia developing country.

An example of this phenomenon is the Vicenza textile-clothing district, which, among the Italian provinces, is the one that shows one of the highest degrees of international openness, and where, in relation to the value added created in the province the exports reached a share of 64 percent, growing relentlessly over the past decade. Concerning the sectorial composition, the emphasis on exports of the province remains the traditional textile-clothing-footwear sector (30 percent of exports), particularly in the upstream production, such as the processing of fabrics and leathers.

Europe remains the preferred area, although the trade integration and productive processes have been moved towards east: also the volumes of trade with East Asia has grown, particularly with China, Korea and Japan, especially as regards imports, reflecting the strengthening of the international integration process of the production networks. One wonders now how far these processes of international production integration are widespread and if there are specific patterns and distinct stages in this evolution, referring in particular to the textile-clothing, organized primarily in a district system.

By analyzing the imports and exports flows of textiles and clothing with Romania, there is a correlation between the two series, since the creation of textiles corresponds to a specific specialization of the district (the weaving stage) and the purchase of clothing goods hardly corresponds to a product entirely worked abroad, Vicenza being known as a place of high quality production. It is also noted that exports are lower than imports, which hardly can be connected to imports of finished products from Romania, and such a deviation remains stable. We can therefore deduce that exports of textiles and imports of textiles-clothing indicate a strong productive relationship between Vicenza and Romania and that outsourcing follows the economic trend of the same district and is highly integrated, so not an episodic phenomenon.

In conclusion, it should be noted that the outsourcing brings some threats which, however, are associated with interesting opportunities. Indeed, on the one hand it could: reduce the force of the circuit of local knowledge after the transfer abroad of the strategic processes; weaken the relationship between business leaders and small suppliers, resulting in less local business activity and a depletion of the chain value. On the other hand, we can identify two important opportunities associated with it. First of all, the ability to export the district model in other countries, counterpoising it to the pervasive and poorly sustainable corporations' system.

The district outsourcing process is very different from that adopted by corporations, rather than through the expansion of the organization beyond the national borders, it is implemented through the gradual overseas expansion of the supply networks, and where the direct investment works as leverage for the activation of a network of relations with the new localized contexts, it is often a mix of proprietary strategies and networking. Secondly, the outsourcing also allows to upgrade the competitiveness of the district, promoting a differentiation in specialization and skills to support original solutions linked to production, innovation and knowledge.

Competitive development between Innovation and Internationalization

Innovation and internationalization are among the main themes at the base of a competitive sustainable development, both in an individual viewpoint, e.g. at the level of an individual enterprise, and in an aggregate business system viewpoint. Many authors have shown the positive effect of the opening on the innovative performance, opposed to an attitude towards the isolation, as it results in a company better access to external sources of knowledge (Pavitt, 1987; Lundvall and Johnson, 1994; Malerba and Orsenigo, 1996; Malerba 2000).

As mentioned above, Cohen and Levinthal (1989; 1990) use the concept of absorptive capacity that identifies in enterprises R&D activities the dual ability to generate knowledge useful to innovate and to identify the external sources of knowledge that can satisfy the cognitive deficits. However, we point out the lack of a literary mainstream able to clarify the nature of the relationship between innovation and internationalization and to identify the direction of a possible statistical correlation, as identified by a robust sample survey.

Evidence shows that the internationalization, understood as the attitude to operate in foreign markets, rather than a simple use of these markets as outlet areas, is a key element in pushing companies towards a supported innovation: some companies realize joint ventures or commercial agreements, some build new production sites, some others find new suppliers to be included in their supply chains or lengthen their networks beyond traditional boundaries. The processes of innovation and internationalization are thus an interesting combination that forces companies within a virtuous circle: the more they internationalize, the more they innovate, and vice versa. The industrial district has always been a closed environment and mainly focused on the exploitation of domestic resources.

The companies of the cluster constitute indeed a cohesive social environment, in which proximity is not only territorial but also, and above all, social and cultural, that is, an environment in which the participants share values, rules and languages: this allows a free and quick circulation of knowledge, constituted both by an explicit component and by a tacit component and therefore not fully available to entities outside the district, so that a company outside the district does not have the possibility of access to internal information, given the physical and cultural distance of the environment in which it operates (Morrison, 2004).

Thus, the intense process of sharing knowledge has always been one of the main levers of competitiveness of the district operators: within the district the diffusion of innovation is based on personal interactions and the local mobility of workers. The importance of the role of knowledge within the district is demonstrated by some empirical studies about the links which the knowledge has with the performance of the cluster itself (Morrison, 2004): in this regard, however, they also identify an assimilation process of the scientific knowledge generated outside and internalized by the internal knowledge, which makes the external information understandable and usable by the district operators, forming competitive assets functional to the cluster itself (Rullani Becattini, 1996).

Also Camuffo and Grandinetti (2006) point out that in the last fifteen years, due to the globalization of the economic processes, the competitive scenario has changed, leading to a gradual extension of the global processes of production, circulation and use of knowledge relevant to the competitive advantage of the district firms, so that it imposes a greater openness to the external environment. The internationalization involves the companies both internally (relating to the activities of the value chain), and in relations with other participants, a procedure called "global networking", so that they assimilate, combine and transfer new information on an international basis.

The innovations developed by these realities are more complex than the typical or product and process innovations, and they deeply modify the organizational structure of the company and all its relations, for example, the Total Quality Management system; they often require the control of ICT, the absorption of complex knowledge and their recoding to be adapted to the specific characteristics of the business environment. The introduction of complex innovations by an entity constitutes a challenge to the ability of other firms in the district to absorb knowledge, so that the processes of local spread of innovations

through the imitation, the intra-district relations and the human resources mobility are limited. Innovative processes are dependent from the rising of the human resources quality within the enterprise. As a result, the outgoing mobility of highly skilled workers is reduced, weakening the generative mechanism of new companies through spinoffs from existing realities.
The district company that opens to globalization and the internationalization of activities and relationships must develop a greater ability to find the information, communication and codification of tacit knowledge, to allow investments on an international scale and the interaction with the upstream or downstream companies and other parties involved in the compositions of the global value chain; to conquer and defend the competitive advantage, the company must still maintain its capacity for production and elaboration of tacit knowledge and promote the development through individual and collective learning by doing processes. Analyzing the guidelines of the entrepreneurs towards the international context and the types of strategies pursued, it is possible to identify four profiles of enterprise:

- The “open”, internationalized, innovative company, willing to form alliances;
- The "pioneer", internationalized, innovative company, not available to form alliances;
- The "networking", little innovative company with a local market and willing to form alliances;
- The "closed", not innovative company, with a local market and unavailable to form alliances.

Currently, district firms are classified primarily as “open” firms, able to maintain their own competitiveness, and "closed" firms, which undergo a progressive marginalization. In front of the international competition, in fact, the districts are the object of major transformation processes, so that the systems that functioned in the past according to a logic predominantly closed or open, are no longer sustainable.
They have therefore extended their networks of relationships, both productive and commercial, by moving the processing stages with lower value added abroad and keeping the most important ones in loco. They also changed their relationship with the region, seeking more skilled manpower and new services and increased the investments in networking technologies, given that most of the strategic suppliers are situated out of district areas. Therefore, the processes of internationalization have already transformed the districts, not cancelling the relationship with the territory, but redefining it substantially because, thanks to the new technologies, the resources needed for the development (whether human, innovation,

financial or productive) can be more easily found in other contexts outside of the local base.

It cannot be omitted that a worrying deviation from typical cluster features is possible: the strategies implemented by the global systems do not match the reproduction of the district model, if the evolutionary resources remain concentrated in one or a few dynamic participants, if there is less demand that supports the division of labor and if the mechanisms of diffusion and combination of knowledge stop. An example is the Belluno eyewear district, where we highlight a strengthening of the larger companies and a weakening of the district system (Camuffo, 2003; Nassimbeni, 2003).

In brief, the two most important challenges that today's industrial districts are facing are represented by innovation and internationalization. The SMEs innovative activity, due to their small size and their poor allocation of financial resources, does not derive from formal R & D, but from forms of learning and dissemination of knowledge, made possible by the bond with the region, from the relations of trust and collaboration within the district and the growing number of information flows with external companies.

It is therefore required more attention to the internal circulation of knowledge and openness to potential sources of external innovation, so an organizational change in the industrial district becomes necessary, with the introduction of the new role of the catalyst for knowledge. This entity, identified in the already existing structures of innovation support, especially in Italy, might be able to simplify a change of the district paradigm, promoting a greater coordination between companies that are part of it and offering them support in the interaction with external subjects committed to basic and applied research, such as universities, public research institutions, and other innovative companies.

To overcome the difficulties that have prevented these structures from being an effective support for the SMEs innovative activities, however, every participant, which is part of the national innovation system, must increase its awareness on the importance of its role and create a more cohesive network of knowledge; on the other hand, the centers for innovation and technology transfer should increase their specialization and create stronger mutual relations. In support of the external catalyst for knowledge, able to guide them in innovative activities, the district firms may find the necessary incentives for an economic recovery, based on collaboration and mutual support that have made the district model successful.

The introduction of agents able to encourage the process of creation and dissemination of knowledge is therefore an important opportunity to make the most through interventions by the institutions. The evolution of the competitive environment has not only resulted in an increase in competition, an increase in the importance of rapid

response to market demands and increased importance of the innovative activity, but also in a change in the type of innovation required to the firms, increasingly radical. The territorial dimension has always influenced profoundly the overall competitiveness of the districts: the set of values, skills and entrepreneurship at local level is, in fact, the basis for the operation and development of such a model.
However, due to the international scenarios in the wake of the globalization and the increasing competition that follows, the forms and the relationship between territory and competitiveness has changed. The numerous opportunities offered to the companies by the international markets provide an incentive to adopt new strategies, such as the outsourcing of the production towards emerging countries, the definition of productive and commercial agreements with foreign companies or groups and foreign direct investments, but may undermine the traditional relationships with the local production, causing a depletion of the district system and decreasing the competitive advantages.
Onida (1999) points out that in the context of a growing outsourcing of labor-intensive stages from industrialized countries to emerging ones,

> *the maintain of a mastery over the production process, and in particular of its noble phases (planning, design, ennoblement, finishing), in a context of integrated logistics and quality control, with suppliers no longer located in the same region, is an extremely difficult challenge of organizational-management innovation for a district of small and medium-sized family companies, often grown very rapidly in few years*[4].

It is still difficult, considering the Italian context, to predict whether these processes will lead to a drastic weakening of the importance of the local dimension, or, rather, will result in a new balance between the local and global sphere, although recent strategic decisions taken by some well-known Italian groups, mainly specialized in traditional high quality made in Italy products, seem to confirm the latter option: these companies, in fact, also as a result of strategies of production outsourcing, have decided to consolidate their presence in the district areas, without abandoning the definition of other strategies of greater openness to international markets through the acquisition of commercial networks abroad.

CHAPTER 3

On Technology Transfer

Definition

The following chapter provide a glimpse of the evolution of the situation in Italy and in Europe in terms of transfer results, an issue that becomes increasingly important because of the development of metrics for measurement and evaluation of performance by the entities that usually carry out research and technology transfer.
Technology transfer can be defined as the whole of activities developed by research centers finalized to the evaluation, protection, marketing and commercialization of technologies and, in general, to the management of the intellectual ownership developed in the circle of the projects of research and development conducted by the academic world. The activities connected to technology transfer can be represented synthetically as those initiatives turned to the exploitation, in economic terms, of research results typically developed, through their protection (patenting) and their transfer to the enterprises.
The process of technology transfer includes:

a) Identification of new technologies models, sketches, marks and copyright;
b) Definition and the implementation of an effective strategy of marketing;
c) Transfer of the technology through the transfer of the rights of exploitation of the found to existing firms or the creation of new-based enterprises on the same one.

Technology transfer can be effectively utilized in national and regional policies to promote such activities, with the constitution, in universities and in research centers, of ad-hoc structures (ILO, Industrial liaison this cha offices or rather technology transfer offices), to favor the use of new technologies from the enterprises, promoting the process of innovation and consequently, development and competitive growth.
The exploitation and the transfer of the scientific and technology results developed in research centers covers a fundamental role, more and more remarkable in terms of economic development, and is considered the motor to accompany the transition from a

manufacturing productive fabric to the so-called knowledge society based (knowledge-based economy).
The importance of technology transfer as a tool for promoting enterprises innovation, ensures the scientific structures will cover a prominent role in the process of economic development and become effective partners to support the competitiveness of the industrial system. In this sense, university widens its traditional mission (creation and diffusion of new knowledge) since it can contribute to the improvement of the economic and social conditions.
For this reason, the general concept of transfer of knowledge, always realized through the transmission of competences in explicit and codified forms (as in the case of the patents) or in tacit forms (as in the case of the spins off) with the objective to valorize knowledge in terms of economic return, is even more often associated with technology transfer.
This widens and makes more complex the process of transfer including other strategies and methodologies such as research collaborations, the consultations and the mobility of researchers. The evolution of research centers from structures appointed to the development and the diffusion of new knowledge to organizations able to protect, manage and valorize scientific and technology results, requires efforts from universities and research public corporate bodies, to maintain the quality of the activities of high education and research, while guaranteeing a suitable relapse in terms of application.

Objectives and benefits of technology transfer

Research structures realize activity of transfer of technologies developed in their laboratories to favor its development in industrial terms and the following diffusion and marketing.
In other words, technology transfer widens the role of universities and research centers that, on one side, through scientific publications and participation to conferences, contribute to widen the frontiers of knowledge sharing, and on the other, they can protect and valorize the intellectual ownership through the collaborations with the enterprises, to turn the knowledge into products, methodologies and innovative services.
The universities and research centers welcome, with gradual awareness, the evolution of their role within the global economy and accordingly they open, also with approaches of competitive nature, to actions of collaboration in projects of technology research and development (R&D) with industrial partners.
In this picture, the motivations that push the universities and the scientific institutions to undertake initiatives of transfer of their results are varied:

- To make known the inventions and the innovations produced by the institution;
- To contribute to the economic development and the innovation of the enterprises;
- To produce profits to be reinvested in formative and research activity;
- To answer to precise indications coming from the national or regional politics.

Every institution establishes its own strategies and priorities in comparison to the objectives listed above.
Nevertheless, benefits deriving from the activities of technology transfer are represented by the new products and processes that are introduced on the market through the activities of transfer, and that are able to improve the quality of the life of the citizens as to develop and to consolidate enterprises creating occupation.
The role of the public research centers becomes wealthy and does not turn into an exotic entrepreneurial mission if some fundamental conditions are respected:

a) a clear policy of research center that allows to conjugate complex strategies of diffusion and exploitation of the science (through, for instance, the constitution of offices for technology transfer);
b) slender and effective directives that allow to answer, in brief times, to the demands of researchers to appraise, for example, the degree of patentability of an invention and progress to its possible protection and following diffusion and popularization;
c) Development of evaluation methodologies for researchers, to remind about the importance of scientific productivity and effectiveness in technology transfer.

In this picture, the activities of technology transfer can be conducted with success without weakening the processes that allow developing new knowledge through the sharing of publication and information, results and projects. The protection and the transfer of the consequential results from research activities carried out by the academic institutions means to “enhance” the public investment in R&D that results therefore as more effective as the entrepreneurial system absorbs and implements such innovations creating economic development.
The benefits for research institutions, deriving from initiatives of transfer of knowledge and technologies, are observable also on the long period. It is easily demonstrable that when a firm acquires patents and technologies from the universities, it subsequently continues with

activity of collaborative research that it often conducts to the development of new knowledge and new technology solutions that are transferred, subsequently, from the laboratories to the market.
Very often, we go from single initiatives and specifications of technology transfer to collaborations more structured among research institution and enterprise (joined laboratories, technology districts) that allow researchers involved to participate in continuous way to the new developments. This allows the enterprises to reduce meaningfully the time of industrialization of the technology and to overcome the so-called syndrome of the not invented here (NIH) that seems to slow down the process of acquisition of new technology solutions if not developed inside the same firm.
In this perspective, the problem of technology transfer acquires further dimensions and becomes no longer representable as a linear trial of passage of knowledge from the holder to a recipient.
Rather, it is translated in a two-way trial that asks for a relationship among the actors, where its effectiveness will depend not only on the optimization of the relationships among the subjects directly involved (research centers, enterprises) but also on the context in which the process of technology transfer is realized. Policies to support the collaborations between research and industrial fabric, system of financings and facilitations for experimental development, presence of structures aimed to simplify the passage and the sharing of knowledge (technology incubators, agencies for innovation, scientific and technology parks).
The critical factors of success, and therefore the attainment of the objectives technology transfer (general, type partner-economic, and specific objectives of the university holder of the technologies) cannot be brought back to the solution of the asymmetries of language between researchers and entrepreneurs, but can find a correct position in the political and economic context in which the transfer occurs.
Particularly, in regards with research centers, the problem list related to the individualization of potential recipients of the technologies and to the ability to communicate its applications with the purpose to give the correct value to the same technology must be resolved.
With reference to the enterprises (or to the final users), the effectiveness of technology transfer, which is in wide measure dependent from the ability 'to absorb' new technologies, increases in proportion with the quality of the technology competences possessed from the firm and the ability of the organization to affect the processes of updating and formation. Besides, the effectiveness of the diffusion of the technologies also passes through theirs social 'acceptance' social and the correct awareness of the benefits and the risks of their development (we can think, for instance, about the debate on the OGMs or on the nuclear one): in this sense, a key role develops from the communication and scientific divulgation.

Technology transfer in Europe and in the world

Even if technology transfer and innovation technology remain separate concepts, they strongly become two correlated aspects on which European policies of economic development, at international, national and local level converge. In the last ten years, the European policies on technology transfer and innovation, concentrated on the pursuit of the objectives defined by the Lisbon Strategy and particularly on the necessity to create a European area of knowledge, multiplying the investments in research and knowledge to stimulate the competitiveness and the creation of new jobs.
According to Janez Potocnik (European Commissioner for Science and Research), the strategies that the EU and States members must adopt and implement will have to depart from the consideration that knowledge is an essential factor for the competitiveness, hence, to occupy future avant-garde positions, European enterprises must invest now in knowledge, also thanks to suitable support from governments.
At the same time, it is necessary that public investments in R&S, will not only increase in quantity, but will translate themselves in new technologies to be transferred to the industry. Even if Europe maintains strong performances in qualitative and quantitative terms in regards with the production of new knowledge, from the other side it is distant from the United States as it regards with the ability to transfer and to capitalize such knowledge in products and innovative industrial processes. The increase of investments in R&S (unchanged in Europe since 1990 both from governments and industries), despite being one of the priority objectives to develop new technologies and to bait processes of innovation of the enterprises, does not represent the only critical factor of success.
On the contrary, many researchers demonstrate that the investment in research can be translated into growth and economic development only if accompanied by policies of support to the processes of technology transfer. For instance, nanotechnologies, as it was for ICT in the preceding decades, represent a revolution in terms of advancement of the frontiers of the knowledge and, in consideration of the multiplicity of possible applications, they have a considerable impact on the world economy.
The public investment in the sector of the nanotechnologies at the European level, from half of the 90's up to today has been elevated and superior to that of the United States; nevertheless, despite the 1200 patents deposited (at the world level) by institutions and American firms during 2003, only 400 are the European patents.
Besides, technology startups in nanotechnologies developed in the United States during the last 25 years are meaningfully greater in number in comparison to those in Europe: in fact, the investment of the European enterprises (data for 2006) is just a third of the total one,

while in the United States it represents over the 50% of the total resources.

Policies for technology transfer

The European policies for innovation set as an explicit objective the improvement of the transfer of knowledge and technologies with the purpose to accelerate the exploitation of research and the development of new products and competitive services. The effectiveness or the weakness of technology transfer depends on manifold factors, for instance: the cultural differences among the scientific and entrepreneurial community, the lack of incentives, the legislation barriers and the structure of the industrial fabric. Every of these aspects negatively affects the economic growth and consequently the creation of new occupation.

The translation of new ideas in products or innovative processes is correlated strongly to the initiatives, promoted by the universities and by research centers, which aim to the exploitation in industrial terms of the results of research. Through methodological studies and analysis of the international practices operational tools have been individualized, to be applied at the community level and of single States members, to recover the delay in terms of ability of transfer of the universities and the European research centers.

Following, numerous initiatives directed to favor collaborations between research institutions and enterprises have been launched; in this context, the States members started programs to simplify technology transfer through:

a) incentives to research organisms for the development of professionalism and competences that allow them to effectively collaborate with the industries and to favor the mobility of researchers from the public sector to that private one and vice versa;
b) A system of rules to manage properly the resultant rights of intellectual ownership deriving from research financed with public funds;
c) Mechanisms of evaluation and incentive for the personnel of research that actively participates and promotes initiatives of technology transfer.

In regards with the first point, it is common opinion that the effectiveness of technology transfer strongly depends on the competences and the personnel's qualification devoted to this activity at the scientific institutions. In the United States since 1974 it is active the AUTM (Association of university technology managers) to promote and improve the activity of technology transfer of the universities and to divulge and to spread its benefits through education, communication and networking.

Likewise, ProTon Europe, a net of structures for technology transfer and the Network for the exploitation of the results of the university research (NetVal) in Italy have been founded. In general, the primary mission of these structures for technology transfer working within the universities and the public research centers is to define the most efficient processes of protection and exploitation of the intellectual ownership to conduct research results to an industrial application.
In regards with the legislation, a lot of publications related with the European policies for technology transfer individualize what point of criticality the procedural lacks in the deposit of patents, that is still an extremely complex and onerous operation. The objective, in the short period, should be to found a European system of deposit of patents which is more cost-effective, to guarantee the mutual recognition with the other great systems of patenting in the world and to found a Pan-European system for the controversy resolution.
Besides, to solve specific matters tied up with the R&S of research centers, by introducing in Europe the so-called period of grace (a period within which is possible to get the patenting protection even if the invention has been object of early disclosure).
Finally, in terms of evaluation, it should be underlined that standard procedures for a suitable exploitation do not yet exist (in terms, for instance, of careers inside research organizations) to guarantee the activities of technology transfer conducted by the personnel of research: development of patents, management of contracts and collaborations with the enterprises and so on.

The structures for technology transfer and the operational modalities

The TTOs (Technology transfer office) or ILO are structures adopted by the Italian universities and research corporate body during the last decade. They are expressly devoted to the exploitation of the results of the scientific and technology research, finalized to promote and to favor the transmission of the new knowledge and specialized competences to the productive world.
Within the process of technology transfer, the difficulty to absorb successfully new knowledge and innovation from the research depends, as already underlined, on numerous factors that influence the actors' behavior involved in the trial, having a repercussion on the ability to valorize the consequential potentialities of innovation rising from the meeting between demand and supply of technology.
Within this trial the action of the structures of technology transfer is inserted with the role of ‘facilitators’ of the interactions among the actors involved with the purpose to maximize the consequential opportunities which derive from the dialogue and from the collaboration between research and that industrial world.
In the international scenario, technology transfer is formalized in different ways: sometime it is structured within the universities or

research centers (e.g., Massachusetts Institute Technology, the National institute of Danish Search, the Polytechnic in Milan); in others the management of the actions of protection and exploitation of research results and collaboration with the industry is entrusted to external business constituted on purpose by the same university or center (as the Garching Innovation of the Max-Planck-Institut German, or the Délégation aux Enterprises).
Such structures share objectives on the exploitation of research results, professionalism, suitable tools to valorize scientific results of industrial interest, coordinating the whole process: from the individualization of a need that activates specific paths of scientific research, to the development of projects of applicative nature, to the attainment of innovative results that, opportunely protected, can be transferred in industrial applications.
The role of intermediation, typical of technology transfer, among interests of scientific nature, introduce manifold advantages which translate in valuable research results (protection patenting, economic effects in the form of royalties, consolidation of the collaborations with the outside etc.) as well as to the affairs of the productive and institutional world (increase of the competitiveness, technology progress etc.).
The actions put in effect from the structures for technology transfer, by intervening in circles characterized by different visions, those of the world of research and the industry, ask for an articulated forecasting of tools and solutions to apply, in integrated way, for the formalization and the protection of an effective interaction between supply and demand of innovation technology.
The actions of the process of technology transfer can be separated in two categories: 'codified' forms and ‘tacit’ forms. The first ones include tools tied with the protection and exploitation of the intellectual ownership, therefore to the patenting of research results, with the purpose to increase its potentialities of exploitation. For the management and the exploitation of the intellectual ownership specific competences are required, particularly in relation to the industrial right, as well as to the analysis of the content of the inventions and the support in the phase of writing of the patents application. Among the codified forms of technology transfer we can find licensing activities connected to the marketing of research results.
These activities include the definition of the solutions and the most appropriate contractual tools to guarantee to the structure of research a suitable return both in terms of economics and visibility. Such activities are essential since the products and the technology solutions realized by the scientific research are usually focused on niche markets, characterized from a high specialization and prominent position of the competitors, in which the definition of the market price is often critical.

The tacit forms of technology transfer, concern instead the activities of marketing and promotion of research results, of information and popularization of the scientific competences and the relative sectors of industrial application, with the purpose to attract with great effectiveness potential affairs of the productive world and guarantee visibility to the structure. In this category are also included the actions of monitoring of the state of advancement of the result of research, such as the necessity of intervention of engineering and advanced development, on the base of the market demands, that is translated in the activation of national or international specific channels of financing to support the pre-competitive development phases.
A particularly meaningful impact in terms of technology transfer, within the tacit forms of action, is constituted by the support in starting phase of the so-called spin-off, namely entrepreneurial high-tech realities, whose core business founds itself upon the commercial exploitation of results of the scientific and technology research. To the enterprises spin off is recognized a fundamental function in terms of technology transfer, since they allow to directly inserting research realities in the productive fabric and they possess, in comparison with the traditional enterprises, the ability to absorb the innovations set in research laboratories.
It appears by now overcome the theory according to which the problem of technology transfer can be brought back to an asymmetry of languages and, consequently, to a difficulty of communication among the system of research and the enterprises.
The main hypothesis would be that technology transfer requires a general vision of the various channels to realize itself, and universities must adopt a new role to develop a market culture, building policies and operational tools to allow themselves to locate at the center of the process and to implement all the possible forms of exploitation of its results.
It is important to keep into account that the system of research and innovation has suffered deep changes of organizational, sociological and managerial nature during the last century, particularly in the countries more industrialized.
The institutions that develop research activity are progressively adopting, not always knowingly, organizational models and social roles typical of the entrepreneurial and financial system. On the other side, the industrial system has understood the importance of the connection with the universities, and the need to leverage on innovation as a tool for recovering and consolidate competitiveness. Indeed, this generates a system in which academic and entrepreneurial world converge and need the support of policies aimed to develop forms of effective collaboration. The modalities and the mechanisms with which these three systems (government, enterprise and university) interact, to trigger dynamics of development founded on

innovation and technical progress, have been broadly described and explained through models in literature by Henry Etzkowitz and Loet Leyesdorff, through the metaphor of the 'triple helix.' In the model of the triple helix, in fact, university (and the system of the public research in general) plays again a particular importance and becomes the principal source, through the processes of technology transfer, of diffusion and exploitation of the knowledge, agreement intended as mix of concepts, information, data, technologies, complex problems solution, models.

For this reason, the modalities to promote technology transfer must be necessarily diversified and sufficiently flexible to satisfy the demands of the enterprises, whether large industrial groups or small enterprises, thus requiring an ample, articulated and turned effort in many different directions. In this sense, the initiatives that coordinate and integrate codified forms of transfer (patenting of the results and their exploitation), with tacit forms (for instance, through the creation of spin off and research collaborations) appear to be more profitable.

How to protect Intellectual Property?

The protection of intellectual ownership is the essential element for an effective exploitation of research results conducted in the universities and in research centers. As invention is considered a new and original solution of a particular technical problem in the industrial field.

The legislation distinguishes the concept of invention from the discovery, defining the latter as the result of a direct search to determine the laws and the principles that govern the nature and for this reason not patentable (as a simple understanding of already existing phenomena). The invention, concerns contrarily the technology sphere, whereas the discovery concerns exclusively the understanding of the science.

The inventions that can constitute object of a patent are, for instance, a method or a process of industrial workmanship, a tool or a mechanical device, a product or an industrial result; also the technical application of a scientific principle can be patented, if the inventor proves that is new, ingenious and leads to original industrial applications.

Patents are titles that transfer on the holder a temporary monopoly of commercial exploitation of the founding, which consists in the exclusive right to realize it, to dispose of it or to commercialize it as well as to forbid to third to produce it, to use it, to put it in commerce, to sell it or to import it.

To be susceptible of valid patenting, an invention must satisfy some fundamental requisites:

a. **Novelty**: the invention must not be already included in the prior art (prior art is anything that has been made accessible to the public, in Italy or abroad, before the date of filing of the patent application through written or oral description).

b. **Originality** (highly inventive): the invention must not be obvious to the eyes of an experienced technician of the sector.
c. **Industrial applicability**: the invention must be susceptible of industrial application or used in some kind of industry.
d. **Legitimacy**: the invention must not be contrary to public policy and morality; (and) sufficiency of disclosure: a patent application discloses a claimed invention in sufficient detail for the notional person skilled in the art to carry out that claimed invention.

The patentability of the results represents the principal form of intellectual property protection for universities and research centers; through the patent we protect the results that can be transferred to business through transfer agreements or licensing (whether exclusive or not exclusive). The patenting activity of the universities is not a recent phenomenon. In the United States, the academic institutions have intensely been developing such activity for some decades, even if only at the end of the eighties a meaningful increase of the number of recorded patents has been deposited from research public laboratories.
In 1965 only 30 American universities had obtained at least a patent, while in 1991 have become 150 and more than 400 in the 1997. This increase in interest from American universities towards patenting has also been induced from the legislation changes introduced in the early eighties from the Bayh-Dole Act, which has since then granted to universities and research institutions property rights of the inventions sprung by research activity financed with public funds, as well as to collect revenues from concessions of such rights. Following the introduction of the Bayh-Dole Act American universities have modified their organizational structure, creating offices for technology transfer and strengthening existing ones, with the aim to make the process technology assessment more efficient, and the licensing of patented technologies more effective.
In recent years, the push towards the adoption of codified forms of transfer has also required to universities and public research institutions in Europe for a meaningful effort to overcome two main issues: proper incentives to stimulate adequately researchers to patent the inventions; (b) to effectively implement policies of the exploitation of the existing patents.
Here, the public research institutions face new challenges to consolidate the role of research in the innovation process of enterprises, deploying security policies, tools and skills to protect intellectual property, as a necessary step for the transfer of knowledge and the exploitation of research results, both through patent licensing

and the aforementioned tacit transfer, typical of the academic spin-offs.

The academic spin- off

The academic spin- off are enterprises that valorize and commercially exploit the results of the scientific research bringing on the market technologies, new processes, innovative services and so on.
The birth of these enterprises is countersigned, in comparison to the modalities of start of traditional entrepreneurial realities, from the fact that the spinoffs often use the commercial advantage offered by the use of the rights on the intellectual property and/or, in general, the expertise developed inside the research reality from which they derive.
The core business of the spin- off is based, therefore, on the direct exploitation of research results (whether patented or not). As already pointed out, the spin-off is classified as part of the tacit forms of technology transfer, which represent the most effective and direct channel of implementation, outlining a situation of coincidence among scientific and entrepreneurial vision, in which the transmission of the knowledge from the university or research organizations to the enterprises is practically automatic.
Policies that promote spinoffs, showed strengths, with respect to the followings issues: (a) cancellation criticalities related to informative asymmetry: the direct exploitation of the results of the scientific and technology research through the tool of the spin off allows to overcome the problem of interaction, which typically occur between research structures and business at the time when the knowledge produced from the first should be transferred to the latter.
The scientist / researcher, in fact, is at the same time inventor and user of this knowledge and therefore ho does not find obstacles in entirely absorbing the tacit component of the transfer. Besides, starting of a spinoff allows matching both researchers and entrepreneurs' motivations, with respect to the use of the technology and its potential in the best way.
We can overcome an additional constraint, related to the effectiveness of transfer or rather to the motivations for the commercial exploitation of the results:

a) Economic advantages: the promotion of spin-offs participated from universities or from research organizations guarantees an additional flow of financial resources comparable to that resulting from licensing of patents and, in general, from intellectual property;
b) Economic and social impact: the start of spin- offs can generate direct benefits not only to the local entrepreneurial system and beyond. In fact, it favors and strengthens the innovation process, creating new opportunities for job

creation, consolidating the social role of universities and public research institutions.

However, opposed to these advantages, some criticalities inherent to the typology of actions oriented to the industrial exploitation of research results, may directly involve researchers from universities and public research institutions. Such criticalities can be identified, for instance, with the conflict of interests that may arise from promiscuity, especially during the startup phase, among spin-offs and scientific community of origin, and with lacks in terms of ability of researchers to successfully manage the business.
For this reason, the start and the consolidation of spin-offs passes through clear policies for their promotion providing suitable systems for the evaluation of business ideas, articulated programs on how to choose the market and, in general, for the economic / entrepreneurial support in business matters.
The management and the solution of such criticalities can be possible if rules and programs for the spin off are defined, making sure that these mechanisms do not result in sources of stiffening processes of business creation, but in systems with a perfect balance between legal protection and flexibility of the technology in a product or service for the market. The Italian and foreign experiences clearly show that it is often more efficient for the universities and research institutions to try to overcome the issues related to the start of spin-offs rather than to bind their action of technology transfer exclusively to opportunities arising from the patenting activity of the results and the subsequent commercial exploitation of the patented technologies.

CHAPTER 4

Competences in Technology Transfer

Actors and interests involved

Technology transfer involves three possible levels of interest and actors:

- universities and public research institutions whose mission is the creation of knowledge, technology and progressively intellectual property;
- universities and public research bodies, those that generate knowledge and technology, provide protection and manage their intellectual property rights in the portfolio, also performing all activities of transfer;
- Those who should acquire and use knowledge and technology, e.g. business.

The institutions that generate knowledge and technology

For the Institutions that generate knowledge, the problem of competences is to ensure an adequate level of literacy within the research staff on issues of intellectual property protection and technology transfer, and to affect mainly, but not exclusively, those human resources on training (such as PhD students) who are going to become professional researchers, in the public or private sector.

It should be also reported the initiative Cert-TTT-M ("Certified Transnational Technology Transfer Manager"), a research program financed by the Sixth Programme Framework, which seeks to create a framework just for those professional figures that should manage the process of technology transfer at a Pan-European level. The program moves exactly from the assumptions that without specific skills the Common Research Area becomes a goal only partially achieved. The Cert-TTT-M is followed by the initiative EuKTS, for the creation of a structure to give credit to those who are now defined as KT professionals, e.g. experts in the knowledge transfer, waiting for an official career recognition (Autio and Renko, 1998).

As for the Italian situation, some public research institutions (EPR) have promoted the organization of courses on technology transfer on scientific and technology matters within their doctoral schools; they have also promoted the organization of courses for its administrative staff or have encouraged participation in courses specifically organized. In general, however, the extent and duration of these initiatives in our country is still significantly insufficient when compared to the often-declared ambitions and objectives with regard to the exploitation of the public research results. This, not to naively chasing the myth of Silicon Valley and the high-tech entrepreneurship "at any cost", but to put each graduate researcher in the position to know how to "take care" of research results, as it should be in the presence of public funding.

The institutions that must transfer knowledge and technology

On the side the institutions that transfer knowledge to the market, the need for competencies binds immediately, with the new mission (the third) to which the European Union is directing universities: generating innovation, ensuring positive effects (also at the regional level) in terms of the creation of skilled jobs, new business models and new businesses with high knowledge content.

Technology transfer is in some ways an innovation and a challenge. If, in fact, training and research have always been carried out by researchers and professors, the profession of innovation requires, however, a strong cooperation between research (without which knowledge and technology cannot be created) and specialized staff of the technical and administrative structure. In addition, if classrooms and laboratories are enough to training and research, technology transfer requires a different type of dedicated intangible infrastructure, as systems of knowledge management, specialized databases, and specific programs. It requires, therefore, especially those complementary skills and competitors without which it becomes virtually impossible to manage the process that from the knowledge creation leads to its use on the market, through a series of complex activities.

The institutions that purchase knowledge and technology

The point of view of those who use generated knowledge and technology is, necessarily, the entrepreneurial one. The presence in the company of competencies of technology transfer is crucial from many points of view. Even companies - typically larger ones, with higher financial capacity and adequate level of internal structuring - perform research activities (industrial) as a condition to ensure innovation (and, therefore, competitive advantage). These companies have similar needs of universities and public research institutions with regard to the generation and protection of knowledge and technology (and with respect to their competencies), with regard to a business function known as intellectual asset management.

However, these institutions have needs diametrically opposed, if compared to the technology transfer done by the public, because they represent those who buy, e.g. the demand.
This need for external supply - become more strong and complex in the perspective of the open innovation – is typical of all the companies, but becomes sometimes the only option for small-medium business that does not reach the minimum optimum size to integrate internally such an expensive and risky activity as the R&D. For this reason, the discourse on competencies becomes crucial because of the existence of small and micro enterprises that are the backbone of the European manufacturing base in general, and of Italy in particular.
It has been observed - albeit with reference to technology transfer between rich states and less developed countries - which the acquisition of technology is function of the capacity to absorb the technology itself by the recipients of transfer (Amendola, 1992).
In other words, for technology transfer to be successful, we need the person who wants to acquire the technology to perceive its usefulness, to identify a certain requirement, to determine the strategic value of the technology itself (as a factor to reduce production costs or to differentiate from competitors), and to transform the technology into products or new services.
In fact, some of the difficulties normally encountered by public institutions and universities in conveying to the market the innovation produced also depends on a superficial knowledge of the business world and, in more specifically, of the complexity of the process to acquire the technology with productive purposes.
In Italy, four types of businesses show behaviors and strategies differentiable with respect to the process of open innovation and technology transfer.
First, a small group of large companies, with a few major high-tech companies. Undoubtedly, they have good opportunities to be exploited by interacting with EPR, but also responsibilities towards the “Country”, since, in compliance with boundaries dictated by strategies and budget constraints; they have to monitor and exploit results from public research, rather than ignore or "freeze" inventions, as sometimes the static large companies do.
A second group is made up of medium-sized companies, operating not only in in the high-tech sectors, which have clearly identified strategies based on innovation as the only possibility to compete in international markets. Many of these already work in partnership with the EPR and the intensity of such relations is expected to increase.
A third area involve small and medium enterprises (SMEs) of the so-called traditional sectors, whose difficulties to dialogue and interact with public research are well known. For these companies, access to public innovative products and services could be mediated by service centers, Science Parks and private companies specialized in

technology transfer. Only in rare cases, SMEs can endow themselves of sufficient capacity for scouting and absorption of promising research results but in need of further investment.
Finally, a very promising group is represented by university spin-offs and small and very small high-tech companies, which work as suppliers of larger groups. These firms, often set up by the research staff of the EPR, have not only the possibility to continue to interact with the bodies of origin, but also to bring innovation not only beyond the national boundaries, but also in other Italian companies where the actual internal production of innovation is not sufficient for the current levels of competition.

Definition of the field of investigation: the meaning of technology transfer

The National Academy of Sciences in the United States has identified eight different ways through which technology transfer takes place:

1. the mobility of students with high qualification;
2. the scientific publications;
3. personal interactions between creators and users of new knowledge;
4. research programs sponsored by private individuals;
5. multi-level agreements, such as those for the creation of joint laboratories;
6. counseling of students and professors in favor of private;
7. the external business activities of professors and students;
8. licenses to existing companies or newly established (Grandi and Grimaldi, 2005)

In technology, transfer is referred often to the US universities as champions in bringing the technology to market and achieve remarkable returns especially in terms of royalties and equity holdings in spin-off. Still makes sense to know that Stanford has grossed $ 336 million from the IPO of Google, Inc. (Rasmussen, Mosey and Wright, 2011)
The fortune of American universities is often credited to the Bayh-Dole Act. On the Bayh-Dole Act we had an incredible scientific production and empirical studies have been conducted to assess its impact, even in negative terms, as impairment of values of public research performed in front of the change of universities in "commercial" or "entrepreneurial" entities.
Recent analysis seems to confirm the merits of the law, and minimize the risks associated with the involvement of universities in technology transfer: there was no appreciable spread of secrecy, nor uncooperative outcomes, or ran to the individual profit at the expense of the quality of scientific research. Obviously, no system is perfect,

and even the US system is perfectible, while a recent study by the National Academy of Sciences (2010) points out the risks, the vices and lacking virtue of the Bayh-Dole Act.

However, compared to Europe, the United States have more than three decades of advantage and experience. The reality is that our system is terribly young and has a lot to learn yet. The data we have are encouraging, especially if we look at the progressions; the absolute values are still far apart not only if we look at the results, but also the levels of investment in R&D.

To reconstruct the overall picture of the Italian reality, in light of European developments, it should be noted that the Italian universities have begun to use suitable technology transfer offices (the OTT) especially since 2001, when the Italian legislature has deprived universities and public research institutions to be owners of the inventive results achieved by employees.

The altered legislative framework produced certain reaction from the universities, which, in unanimous disagreement with the provision mentioned, begun to gear up to provide researchers with the services to simplify the industrial exploitation of inventions, avoiding this way, the pursue of individual practices of technology transfer, independent from their university of origin (Muller, 2010).

In spite of the reasons given by the legislature to justify this change (poor production patent of Italian universities in relation to the quality of scientific research staff and poor capacity to exploit), some studies show that the increase in the number of patents of Italian universities had already begun in previous years. In particular, the determinant key of the increased capacity for universities to enable technology transfer processes would be reconnected, according to the literature, to the attainment of university autonomy in 1989 (Baum and Silverman, 2004). Others have shown a significant "submerged" patent production, characterized by patents where researchers and professors of universities are inventors, but whose ownership is held by firms (Amendola, 1992, Conti, 2004 and for a review of the situation in other countries, Muller, 2010).

The reaction of universities, in fact, reinforced a trend already in place (Moore, 1991). We might say that the legal measure has produced side effects (increased patenting activity of the University) but in a positive way, if compared to what it was supposed to happen on the basis of reasons that have inspired the adoption (the alleged inability of universities to enhance the research results). Concretely, as already mentioned, since 2001, in part as a reaction to the new law and in part as a well-established trend toward greater attention to the exploitation of research results, universities have begun to structure their dedicated internal offices (variously named, and functionally similar) and to invest in human resources training (Grandi and Grimaldi, 2003).

In support of the organizational transformation public policies intervened with the extent to support industrial liaison offices (also known as ILO) contained in the National Plan of Research 2004-2006, by which have been made available initial resources and possibility of cooperation between universities. National initiatives followed sometimes along with the regional ones, given that the regions, according to Article. 117 of the Constitution have now also competencies with respect to the scientific and technology research and innovation support for productive sectors. However, the lack of continuity in the central and regional policies is not conducive to the preservation and improvement of results.

Furthermore, the path of the Italian technology transfer was accompanied by the establishment of the Italian Network for the Promotion of Research (NETVAL, 2002), originally conceived as a spontaneous coordination and, from 2006, as a proper association among universities, bringing together 49 members (49.5% Italian universities) with 71.3% of enrolled students and 73.9% of teachers in the Country. The most relevant aspect, however, is that the universities participating in NETVAL boast 76.3% of professors in scientific and technology disciplines, 88.3% of businesses university spin-offs identified in Italy to date, as well as 94.9% of the patents in the portfolio assets owned by Italian universities (Lazzeroni, 2004).

What briefly described above is a path already known in other countries and which has seen in the US the first and most analyzed example, since the introduction of the Bayh-Dole Act (Piccaluga, 1991, Gartner and Shane, 1995, pp. 102, 782, Iacobucci, Iacopini, Micozzi and Orsini, 2010).

Even the contributions of policy from the Lisbon Agenda (CE, 2009) follow, in reality, the North American debate on technology transfer and, more particularly, on the involvement of public research in activities related to the industrial exploitation of research results. However, there is criticism and invitations to rethink the policy on technology transfer (TT) between public and private sectors (Iacobucci, Iacopini, Micozzi and Orsini, 2010, Compagno and Pittino, 2006).

With the gradual rise of Knowledge economy, national competitiveness for innovation is even more influenced by the characteristics and the performance of public research and the capacity for the research system to enhance its performance, managing the intellectual property and fostering the creation and growth of high-tech companies, as well as the consolidation of the existing ones.

We believe that the end of the financial crisis will increase the role of innovation and the so-called outsourced innovation, e.g., the acquisition of technology from the outside, for the revival of manufacturing activities and differentiation of strategies, in line with the paradigm of open innovation (Bellini and Zollo, 1997).

The progressive involvement of universities and public research institutions in the economic exploitation of the results is complex, crossed by an intense debate, which involved both scholars and policy makers, in progress between the proponents of the so-called "Open Science" on one side (Cooper, Gimeno-Gascon and Woo, 1994), and the "entrepreneurial universities" on the other (Piccaluga and Balderi, 2006, Bax,2008), where the changes occurred in the system of scientific research are subject to different interpretations.
Some scholars agree with a growing industrial finalization of the research activities promoted by public research institutions and, in general, to a greater involvement with external parties (Cesaroni, Moscara and Piccaluga, 2005). According to this view, the greater integration between the world of research and the industrial world is not a threat to the institutional academic activities (education and research), but favors, on the contrary, the transfer of scientific and technology knowledge, the creation of new qualified employment, as well as an increase in financial resources to be invested in academic research. The consequences resulting from a greater commitment to the enhancement of research results would be positive for both for the companies that use it, and for the regions in which the research institutions are located.

The Technology Transfer Office

It is widely accepted that in recent years the universities are taking a third mission, in addition to the educational and research ones: contributing to economic development, turning into "entrepreneurial universities". A similar situation can be seen in the public research (EPR) that have made efforts and resources in technology transfer. The reasons for this change are to be found in a number of institutional factors and context, including:

- the decrease and change of the nature of financing for research that are becoming more mission-oriented and performance-based;
- the increase in demand for research that is industrial and economic relevant, e.g. it can contribute more directly to the development of the national economy;
- the internationalization of research that increases the pressure on universities and EPR to compete and supports to address a greater specialization;
- the increase of the phenomenon of outsourcing of research activities, both for large companies, including multinationals, and small and medium enterprises (SMEs) through the creation of clusters and / or industrial districts;

- Increasing importance of the opportunities for commercial exploitation (arising from the birth of disciplines related to the theme of bio and nanotechnologies).

This model of "entrepreneurial universities" has placed at the center of the problem of industrial and commercial exploitation of technologies produced by the research activity of the university, to achieve benefits both in terms of economics and image.
The universities are part of the economic environment as active players in the market of knowledge creation, and to fulfill this role, they must develop dedicated structures to the management of technology transfer: The Technology Transfer Offices (TTO).
The literature largely developed on the organization of the of technology takes into account the American model which is characterized by homogeneity in the role and activities / processes carried out by TTO to simplify the transfer of knowledge and technology from universities / EPR businesses.
Without necessarily taking as reference model the American situation, too distant from our national situation, because of too many different exogenous variables or context (legislation, industrial fabric and financial system of public funding, research management and properties intellectual etc.). It is important to emphasize the commonality of the strategic approach and methodology of technology transfer in the university, as well as we understood and practiced:
The exploitation of the results of public research possibly protected from various forms of deprivation, from the inside outside through the processes of licensing and/ or creation of new business. (Colombo M D, Adda and Piva, 2010)
Consequently, the transfer processes performed by these offices are focused on activities of protection of industrial properties, licensing and spin-offs, which are seen as the most appropriate activities to promote the industrial and commercial exploitation of the research results conducted within the universities. The TTO has been therefore the structure mainly engaged in the management and transfer of intellectual property belonging to the University or EPR where or for whom it works. The TTO plays a fundamental role in the relations between public research and the market.
To quote a professor of the University of California, John C. Baez: the TTO is indeed labeled as the social structure that can ensure a constant flow of new inventions, preparing the ground for the management of all activities aimed at protecting and enhancing the research result. Having clarified the specific position of a TTO in the complex process of technology transfer, is not just as easy to simply define a unique name or label that each EPR or universities attaches to its TTO. From a simple search on the net has been possible to identify several names

given to structures identical or similar to the prototype of TTO we are going to define:

- Technology Transfer Office;
- (Industrial) Liaison Office;
- Knowledge Transfer Office;
- University Industry Linkage;
- Contract Office;
- Office of sponsored research;
- Patenting and Licensing Office;
- Business Development Office;
- Office of Technology Licensing.

Life cycle and stages of a Technology Transfer Office

In reality, many of these structures have the same objectives and perform the same processes, and by the simple name has been already possible to sense the emphasis in terms of strategic direction and operational activities of the TTO.

It is possible to speak of a true lifecycle of TTO in Italy only since the end of the nineties in conjunction with the establishment of the model or the push towards the entrepreneurial universities and the emergence of the Triple Helix Model. These five periods include all the steps that led the TTO and technology transfer from a pioneering and exploratory position to an experimental and learning one to get to maturity. This last period, the current one, has been rich of various models, which will be mentioned in the subsequent paragraphs, among which we mention:

- Outsourcing of the function of out licensing through spin-off investments (for example, MiTo Technology);
- Management of incubators within or in close collaboration with the TTO;
- Evolution from very centralized management to the "antennas in the departments."

In general, the fundamental logic of a winning approach is collaboration preferred to centralization, in particular collaboration between professionalism in the technical and administrative area and researchers, cooperation between competencies and complementary experiences, etc. From the strategic and systemic point of view, there has been a strong acceleration confirmed in the last five years by some indicators, plus a quantitative survey of the Network for the Promotion of University Research (NETVAL) 2009. The trend is certainly positive, but it should be considered carefully some indicators of weak signals that certainly deserve full consideration: the number and professionalism of the staff of the TTO who have seen in the last ten years, a qualitative and quantitative growth, although it is to be reported to a halt last year. From the operating point of view of programming processes, we can distinguish some phases or potential lines of development in the activities managed by the TTO:

- Phase I: culture of the patent;
- Phase II: selection of the patents and the creation of new business;
- Phase III: monitoring research agreements with industry, exploitation through licensing;
- Phase IV: management of intellectual property in various forms of cooperative research;
- Phase V: growth of spin-off society and access to venture capital;
- Phase VI: diversification of services, new forms of organization of the TTO, new business models for the management of intellectual property.

The role of the TTO in the process of technology transfer

After giving a definition of a TTO and its life cycle, a question arises: how we can see the role of the TTO in the process of technology transfer? It is really useful and necessary?
According to Alessandro Ovi, the TTO is not, nor can be the solution to the problem of innovation: “A TTO creates primarily licenses towards an innovative industrial system, today weak” (Bax, 2008). Therefore, it is clear that the role of a link between the research world and industries must find the correct declination in function of the stakeholders’ system. In general, the strategy approach of the TTO depends on the regulatory, industrial and financial environment of every nation, but today even more of each region. The TTO can and must be only a catalyst, which should intervene to speed up the process without changing it, must be a trainer, translator and facilitator of the process.
We need to emphasize on the production of technology transfer from research to the use of results, but also on the active role towards the third actor of technology transfer (Autio and Renko, 1998), e.g. the public and private stakeholders that support, not only with purely financial initiatives. The three worlds express different needs and goals, and even though they are potentially functional and complementary to each other, while speaking different languages.
Therefore, the TTO manager must know the different worlds or at least know how to recognize them. He must interpret the various prompts or the specific expectations of the parties involved. He must be able to communicate with all the actors of the process and to do this

he must be able to understand the different objectives and tasks, various preparatory activities. After several years of experience, analysis of quantitative data (Baum and Silverman, 2004), observation and reconstruction of case studies, it is still difficult to identify a unique role of the TTO. The universities, and consequently the TTO, are always more required to clarify the logic of technology transfer to support the territory, seen as the industrial system. Moreover, even the stimuli towards employment of graduates and Doctoral School will encourage the creation of structures and actions of financing for the creation of new business (that, on the contrary, does not come exclusively from innovation generated from research results). A stronger focus on the exploitation of research (arrow from left to right) could lead instead to greater efficiency of results and increased efficiency in the management of the main processes of technology transfer. First, to enhance the research and its results we need to understand, if not the technical aspects, at least the applicative-industrial outcomes and the value attached to them.

On the one hand, the relationship with the researcher is fundamental and must be based on respect and mutual trust. In any case, the first value to recognize and not to question along with other parameters of evaluation is the scientific one, which is the starting point for building the evaluation on the technical-legal but also industrial and commercial invention.

The binomial researcher- TTO manager is a sine qua non condition for the attainment of any objective of technology transfer. This relationship must be built over time, on the basis of experience and expertise that accrues on the field, not in the short term, based on the ability to listen and learn from the smaller aspects of industrial interest. Especially in the first phase of setting up the TTO it is extremely important that the staff is internal to university, knowledgeable about the system, research and researchers.

The provision of ongoing support is the first element of success in establishing a relationship of trust with the researcher. Willingness, competence, spirit of collaboration support can make a difference and help lay the foundation for a partnership that we can see a necessary condition for internal technology transfer. Furthermore, the TTO can and must also be the gateway to the demand for matching skills and needs of industrial innovation. Typically, this activity is not primary (except in the case of special needs and links with the territory), but it comes from a good activity to promote the results and/or patents. In fact, the knowledge of a patent in a certain area with a certain application generates interest on expertise and underlying skills, and may simplify the contracting of further research activities.

One factor that often justifies the adoption of a position or model rather than another is represented by the characteristics of the environment in which the university or the EPR is operating. In a very

economically developed environment, characterized by the presence of a strong entrepreneurial and financial system as in the Silicon Valley or Boston, the creation of spin-off is often driven by demand (demand-pull) and can benefit of external economies already present locally. In contrast, in a weaker environment, the EPR has to play a more active role in promoting new businesses as mentioned above. In this case, the process of creation is seen as the consequence of a push that originates in the dimension technology (technology push). The universities take on a role of animation and selection, supporting new business initiatives through all stages of the development process. Depending on the model of support chosen, each EPR will have to promote a set of activities and adopt a set of resources skills.
Among the activities are the following:

- research of the technology opportunities within the organization;
- evaluation and protection of inventions;
- selection of projects for spin-off;
- development of the business plan;
- provision of financial resources and the identification of financial external sources;
- management support to start-up;
- Any enterprise incubation. Among those resources appear:
- organizational resources (articulation of the technology transfer office);
- human resources (number and skills of people employed);
- technology (laboratories and ability to chair one or more areas of technology);
- physical resources (spaces infrastructure);
- Financial resources (operating for both the financing of start-up and the operation of the technology transfer office).

The main mission of a TTO

The main mission of a TTO is the exploitation the results of research. In particular, the emphasis is given, always depending on the role and positioning previously defined, on the protection, promotion and transfer of research results to be protected by special industrial property.
One factor, a necessary condition for the management of a TTO (or better for the long-term survival of the same structure), is the clear definition of the mission. Not only the mission should be clear and communicated with the utmost transparency, but also it must stem mostly from an agreement, a real pact with the political and

administrative leadership. Even better if this consultation process will involve decision-makers and key stakeholders. One of the major mistakes, especially in Italy, is the definition of mission and unattainable goals that will inevitably lead to the birth of expectations not in line with the process and results of technology transfer.

Structures and organizational forms

From the organizational point of view, different forms of structures are active or used already. Empirically, but also in the literature, it is not possible to detect the best organizational form, in an absolute sense. It is however possible to note some prevailing trends related to two macro factors. The first related to the lifetime of the TTO (or in general of the activities of technology transfer in a research institution or university). The second dependent on the specific process or activity to implement. It is in fact possible to find a trend, at European level, of outsourcing of functions more linked to the exploitation or marketing of research results or patents. On the other hand, it seems necessary to create a central core, preferably internal to the research, to cover the activities of technology transfer as close to the research and researchers (such as scouting selection of inventions and technologies protection).

A reference driver for the classification in terms of organizational model is represented by the ownership structure of the TTO and consequently from the relationship with the universities.

Solutions at European level are heterogeneous. Some TTO are characterized as internal offices of university, which hierarchically respond to a Deputy Rector for research or for the transfer of technology from the point of view of the strategic guidelines policies, by a head of department/ sector/ office or directly from an executive. Rarely, and only in the case of small universities, some TTO staff are incardinated in the administration department.

Other structures configured instead as capital societies external to the university but wholly or partly owned by a university, governed by an Administrative Board generally composed of board members of the academic staff and representatives of the industrial world.

Finally, in other cases, some activities of technology transfer are attributed to intermediaries in the form of associations, consortia and external consultants.

As a typical Italian phenomenon in possible expansion, the birth and development of the university foundations that gradually are working on activities related to the research financing and technology transfer. This new phenomenon or model, however, should balance the various meanings and activities of technology transfer to promote synergies and avoid overlaps.

Thus, there might be a possibility of structuring the activities of technology transfer according to different approaches: the TTO are not necessarily units or offices within the university but they can also be placed on the outside and have legal personality separated from that of the university.

From the point of view of the different types of TTO we can take as a reference a classification of different organizational forms developed by the Public Research Organizations Technology Transfer Office Network (PROTON), which illustrates the existence of the following four main forms:

- internal structures to university;
- External companies controlled by the university, which holds more than 51% of the share capital. This category includes companies which are wholly owned by the university, but also hybrid companies, where the majority of the share capital is owned by a university, but there is also the possibility for the entry of other actors, both public and private;
- external companies, consortia with minor participation from universities;
- External companies, with no participation from universities.
- It is important, during both the start and growth of a TTO, to grasp the differences between internal and external solutions; the latter categories may merge into one, and placed in juxtaposition with the internal structures of the university.
- In this way, we could get only two categories:
- Wholly Owned Internal category (WOI) which coincides with the structures within the university;
- "Other" category, which coincides with the sum of external TTO controlled or participated and external TTO not participated.
- Based on this differentiation, some quantitative surveys conducted in recent years at European level (Proton Europe, ASTP) show some general data, useful to understand the context and outline the phenomenon of TTO:
- Most of the TTO are internal to university, making the type WOI the most widespread and accepted, especially in Spain and Italy.
- As for the type "Other", which is a minority, the largest contribution comes from Germany.
- The most widespread solution provides an exclusive relationship between TTO and universities of reference, special prerogative of TTO WOI.

- A net minority sees the TTO to service more universities, as a typical TTO "Other", which constitute the majority of non-dedicated TTO.

CHAPTER 5

Innovation Poles. Impact on Economic Growth

Innovation and economic growth

The relation between innovation and economic growth has been widely investigated and described in literature. Regardless of the theoretical approach we wish to take, innovation is a powerful stimulus both to economic, ad more broadly, social growth. The Italian economy has been characterized by a binomial nature: on one side large private companies (Fiat at all) or semi-public (Italian Post Office, Enel, etc.), while on the other, a myriad of small and medium businesses. The latter, when belonging to the same sector and locally close to each other, have often resulted in new forms of collaboration known as "industrial district".

More formally, the industrial district is a local system characterized by the activity of a human group and main industry made up of small independent companies that specialize in different stages of the production process, connected by networks of transactions and coordinated by specialized forms of cooperation more or less explicit. Industrial districts have been for many years, and will probably continue to be, one of the pillars of Italian economic development.

A special attention is given to the role of innovation and research within the districts, as well as instruments through which a reality “territorially circumscribed” can promote and support innovation.

The Innovation Pole is a recent innovative territorial tool, whose role in the support of territorial competitiveness is still yet to be properly clarified. The archetype of the innovation cluster, belonging to the wider family of intermediaries of knowledge, born in more recent times compared to the district, acts as a means to catalyze the activity of innovative enterprises favoring a closer contact with sources of knowledge, such as universities and research centers. In this activity it is sometimes supported, sometimes replaced by another instrument: the Scientific and Technology Park (or Science Park), which operates as an aggregator of geographic innovative reality, based on the correlation between physical proximity and knowledge exchange.

The definition of the Innovation Pole as an archetype is not accidental. The scenery of Italian innovation clusters is colored by a plethora of realities very different from each other, with highly heterogeneous structural and functional features.

Thus, next to the Pole and the Science Park which act typically as incubators for start-up or spin-off, we can find more complex entities, which house internal research programs, managing workshops and projects aimed at the development of the associated (or not associated) companies.
Similarly, where some specialize in certain productive sectors or technology families, others are characterized by a more or less programmatically intersectional activity to exploit synergies that otherwise will not find expression. Still, if the Pole is placed in some cases in direct descent relation with an industrial district, showing a natural vocation, in other cases it acts clearly as an instrument of territorial development imposed by the local administration to re-specialize the production system by following directions specifically defined.
Since the Poles are conceived as tools of the administrative policy at the regional level, it might be also necessary to question about the actual impact of this tool on regional economic development. The production, which currently characterizes the different Italian regions, is a combination of very different stories of territorial specialization, thus the local government should provide different uses of the Poles according to different specializations.

Innovation Poles. Nature

Innovation Poles mean

"groupings of independent undertakings — innovative start-ups, small, medium and large undertakings as well as research organizations — operating in a particular sector and region and designed to stimulate innovative activity by promoting intensive interactions, sharing of facilities and exchange of knowledge and expertise and by contributing effectively to technology transfer, networking and information dissemination among the undertakings in the Pole" (Ministry of Economic Development Decree 27/3/2008 no. 87).

Moving from this definition, Innovation Poles can be seen as a meeting place between demand (the entrepreneurial network) and supply (not only research organizations but also universities) of the local innovation system (e.g. regional).
Originally aimed at expanding the local technology base by stimulating the creation of start-ups and attracting existing businesses in situ, in the last years Innovation Poles have been constituted – in most cases – by the local public administrations and fit within the broader framework of policies based on the innovation and the development of a knowledge-based economy, under the Lisbon strategy.
The Innovation Pole can be considered as a new form of economic organization, which brings about a new productive logic, made

possible by the research of links between innovative undertakings, public and private research and university.
From the operative point of view, the Poles are structured as groups of industrial and research organizations, which realize all the steps of the scientific and technology development, from the laboratory tests to the production and marketing.

The Role of Innovation Poles

The original purpose of the Innovation Poles was to integrate and organize the R&I players (innovative companies, research institutes and universities). They operate in one or many sectors of research and innovation in a given territory: hence, the distinction between "General Poles", which attract companies and activities from different technology sectors, and "Specialist Poles", born to put companies and activities from different technology sectors together.
R&I players 'aggregation promotes the rationalization of resources (e.g. mutual use of equipment and facilities for the activity of scientific research and technology production), minimizes the transaction costs from the system, and, most of all, promotes the creation of technology thanks to the synergies that arise among the parts involved in the system.
Innovative technology activities, research centers, undertakings, universities and financial institutions aggregate in the same place, while contacts among the players are promoted in a way that generates a synergic effect, which may in turn generate new ideas and innovation technology, thus stimulating the creation of new undertakings (Pierre Lafitte, founder of Sophia Antipolis).
The Pole plays an intermediary role between the scientific system and the entrepreneurial system and promotes the collaboration among undertaking, fostering the innovation of the productive system.
Furthermore, Innovation Poles represent a valid solution to the failure of the R&I system of some Italian regions (especially the Southern regions), due to

1. The unsatisfactory or not existent demand of scientific and technology services from enterprises),
2. The demand from public and academic bodies, whose reference market is consisting of public resources (regional, national and communal) rather than the entrepreneurial system ("research without innovation", e.g. the scientific activity is not capable to produce economic result).

Therefore, the importance of Innovation Poles is given by their role of catalysts of scientific and managerial know-how and promoters of innovation thanks to the interaction among enterprise and research, otherwise scattered between too many players, without a clear identification of responsibilities (Ferrara, 2012).

From Industrial Poles to Innovation Poles

During the last years, beside the traditional Industrial Poles (concentration of small and medium-sized enterprises specialized in different stages of the same production process, characterized by a well-defined local culture and a strong inclination towards a cooperation and collaboration with other local authorities), we assisted to the rise of so-called Technological Poles.

A Technological Pole groups the skills related to high-tech sectors, considered to be relevant in a given territory. A substantial difference with Industrial Poles, is the high-tech connotation of the enterprises operating in the Pole.

Furthermore, a Technological Pole involves the presence of other players beside the enterprises, e.g. universities and research centers which are able to provide knowledge and skills which represent the *raison d'etre* of the Pole. Moreover, a governance structure must promote the mutual collaboration of enterprises, universities and research centers to develop technology programs which have positive spillovers on the local economic system.

Outlined by the National Plan of Research 2002-2004, the Technological Poles have been conceived as an instrument of policy aimed at achieving three objectives:

- Promote the collaboration between the subjects of the R&I system at a local level;
- Address the public support to strategic sectors for the economy and the industry;
- Aggregate several enterprises around programs with a high technology content and with important economic spin-offs.
- The centrality of Technological Poles was also confirmed later in the 2005 Decree on Competitiveness (turned into Law no. 80/2005) and in the National Plan for Research.

A Science and Technology Park (STP) represents an "older" reality compared to the Technological Pole.

The meaning of STP, used for the first time about 50 years ago, changed during the decade, and now is used to define an organization whose primary is to produce technology (products, services, industrial processes) encouraging enterprises and academic institutions to promote the circulation of ideas and technologies between scientific system (research centers and universities) and enterprises, flowing through production; another fundamental goal is to promote the birth of new entrepreneurial realities through the incubation and spin-off activities.

These activities as well as the grouping of research centers, enterprises and sometimes universities in a defined *physical space* (the "park") make the STP almost entirely similar to the more recent Innovation Pole (this is why the terms "Park" and "Pole" are used indiscriminately). All the steps which lead to the marketing of goods, services and high-tech solutions are carried out within the park: research and development, production and marketing. A STP works as a platform for the production of knowledge and its transfer to the economy in the form of spin-offs or simple knowledge spillovers, enhanced by the in situ placement of R&D university centers and high-tech enterprises (Almeida, Santos and Silva, 2008).

The stakeholders

The placement (localization) of an Innovation Pole varies according to three factors:

1. The different types of available inputs from which it can benefit within the local economy;
2. The different absorption potential of the results of the Pole, arising from specific needs and different historical conditions;
3. The different role and involvement of the stakeholders (public and private) in the steps of planning and implementation of the project.

Concerning the stakeholders, they are essentially four:

- The national, local and regional institutions: they play a crucial role in the formation of the partnerships and in the definition and diffusion of the funding programs; they pursue their goal of developing by increasing the number of the undertakings and through the growth of the ones already existing;
- The universities and the institutes of management and dissemination of the knowledge: they cannot participate as financing partners. They can contribute making available lands, facilities and equipment, technology results etc. The purposes of their involvement are the technology transfer and the achievement of profits through research contracts and specialized consultancy activities;
- The research centers: if their dimensions are considerable, they can found an Innovation Pole to increase their commercial and operative autonomy; the

Pole aggregation is aimed at bringing the scientific basis financed by the government to the industrial system.

- The enterprises (mostly small and medium-sized): the more are the enterprises aggregated to the Pole, the bigger is its reputation; the enterprises proximity to universities and research centers and the belonging to a thematic community promote the local and non-local enterprises association to the Pole; the goal is to access to technology transfer and problem solving services, gaining a competitive advantage.

To sum up, an innovation Pole represents the meeting place between the parts involved in the research and innovation system: research centers, undertakings, universities. This "meeting", far from being the final goal, is primarily aimed at integrating and structuring the system (in some region completely unstructured) through the cooperation and the coordination of the parts involved in the R&I.

The Pole, besides being an interface among different production realities linked by a relation based on proximity, provides greater chances of developing at the national and global level, promoting a harmonious growth of the innovation system.

Furthermore, the Pole not only enhances the realities (local and non-local) operating in different scientific and technology sectors through the technology transfer and the definition of ambitious projects in innovation, but it also stimulates the local entrepreneurship through the incubation activity: in this way it promotes the creation of innovation, minimizing the transaction costs from the system, thanks to the collaboration among the scientific and the productive worlds.

Innovation Poles are an instrument of economic development policies whose goals are to:

1. Organize and integrate, guaranteeing standards of mutual services, the current and the future scientific research and innovation technology facilities operating on a regional basis with reference to a specific technologic and application sector;
2. Perform the role of specialized intermediary of the research and innovation, by providing high-tech services, operate to promote and support both the reinforcement of the links between scientific and entrepreneurial systems and the collaboration among enterprises to increase the inclination to the productive system innovation.

Sponsor & stakeholders	Features	Potential targets of involvement	Financial features
Institutional bodies national, regional and local authorities	• Can play a key role in the formation of partnerships and the organization and dissemination of support programs. • Partner essential to meaningful participation in funding programs by central governments.	• Economic development by increasing the number of enterprises (enterprise incubation and mentoring processes) or the size of the existing ones. • The Poles of innovation are a key for economic development and marketing tools.	• Involvement in the phase of feasibility and design • A long-term involvement is required for infrastructure investments • The legislative and financial framework can stimulate investment by private operators
Universities and institutes of management and dissemination of knowledge	• Organizations stable with a great wealth of skills, ideas and knowledge • They cannot participate as financing partners • They can help in kind with the provision of land, technology results, equipment • Large public research centers can charter a Pole as part of a process of growth that the commercial and operational autonomy	• Technology transfer; • Move the technology results in the value chain through the creation of spin-out; • Profits from research contracts or activities of specialist advice through the creation of spin-out; • Profits from research contracts or activities of specialist advice • Technology transfer can approach the scientific basis for government-funded system of industry • Out-sourcing of business to business spin-out created as part of a process of industrial restructuring	Major source of impetus for the creation of spin - off; The national networks are useless for building collaborative projects.
Research centers	Large public research centers can establish a Pole as part of a process of growth of the commercial and operational autonomy	Technology transfer can bring the scientific basis government-funded system of industry Out - sourcing activities for spin-out companies created as part of a process of industrial restructuring.	Need for a model of revenue generation for internal and external customers; Key players in the creation and identification of collaborative projects; Needs funds for activities of engineering an prototyping.
Enterprises	• Increase the image and reputation of the Pole; • Membership of a thematic community with common goals; • Proximity to universities or research centers; • Possibility of personalized development	• Gaining commercial advantage; • Address resource needs; • Direct access to technology transfer services and problem solving	• The need for seed capital; • Strong demand for take-up services; • Business model; • Services of coaching; • Support IPR

fig.1. The Stakeholders. Features of the actors associated with an Innovation Pole.

Innovation Poles: different names, different aims?

The term "Innovation Pole", defined and discussed so far, however, is not used in a unique way, neither by literature nor by institutional bodies. To avoid confusion, it is therefore necessary to briefly describe those structures, which, although having a different name than innovation Pole, are similar for both socio-economic function and

regional and\or supported activities. Further, we should distinguish those structures that, despite their name, cannot be considered as Innovation Poles.
Specifically, we define Scientific Technology Parks (or Science Park) those organizations managed by specialized professionals, whose main objective is to increase the wealth of the communities in which they are located, through the promotion of a culture of innovation and entrepreneurial competitiveness and the institutions 'knowledge based' that belong to the park.
To achieve this objective, a Science and Technology Park manages the flow of knowledge and technology between universities, research institutions and development, companies and markets; the park also simplifies the creation and growth of 'innovation based' companies, through incubation activities and spin-off processes; finally, the park provides value added services, as well as space and quality facilities (IASP International Board 6 February 2002).
The research park (Research Park, whose definition is widely used in Canada and the US rather than Europe) differs from the Science Park because it does not carry out production activities, except for prototypes. The Research Park has numerous partnerships with universities (or other higher education institutions) and research centers, which supports the research activities and enterprise development; also provides assistance for the creation of technology start-ups and business between science and entrepreneurial world.
"Innovation and Technology Centre", in Germany, refers both to a technology center for the promotion of innovative start-ups, and a science and technology park. The main activities of this organization are:

- Advice and support to start-ups and assistance in the development stages
- Differentiated infrastructure supply and equipment of various types
- Development of innovation activities and cooperation between research and industry and between enterprises at the local level.

An "Innovation technology Centre", to be defined as such, does not necessarily need to have operational links with universities: therefore, it is not necessarily a PST.
The BIC (Business and Innovation Centre) is an organization that ensures support to innovative SMEs and entrepreneurs. With its business incubation, it contributes to local and regional development through the creation of new innovative SMEs and the development of innovative projects for existing SMEs. BICs are grouped within the EBN (European BIC Network, there are about 165 in 21 countries) an

association from which they benefit in terms of common services and different kind of tools.
The Incubator ("Business Incubator") defined as a generator of new start-up, provides support for the development phase to ensure that they are competitive in the market. Besides, having infrastructure for the creation of start-ups, incubators offer comprehensive services to innovative companies that already exist; Incubators are often the core center for the birth of new PST.
A Business Park, finally is, an organization that provides spaces (high quality accommodation) in which take place production activities, "showroom", distribution and so on. Similarly, to the "Innovation Center", a "Business Park" does not necessarily have creative ties with institutions of higher education and universities, and for this reason cannot be considered a PST.
The European Commission, through the Economic and Social Committee, its governing body, established the following rules. The designations to identify an innovation Pole are variable: the most common terms in terminology and legal formulations are "industrial park," "Science Park", "Technology Park", "Techno-polis", "Research Park," "commercial package", "innovation center" and " technology incubator". The content, however, remains almost the same: the park is the place of the relationship between science and technology and economic development. It concentrates the synergies, which arise from the cooperation between institutions and enterprises, to simplify market access and centralizes the specialized services that favor the exploitation, paying particular attention to business incubation, spin-off activities and the creation of networks of contacts (2006/C 65/11).
In light of the existence of all these types of structure appears necessary to present the criteria explicitly used to select the structures under study. In this sense, there are three characteristics required for an Innovation Pole or STP to be included in the analysis, and none of these can remain unsatisfied:

1. The existence of Pole as a stand-alone structure, subordinated to other public or private entities, which, in accordance with local institutions is likely to promote innovation and economic development in a certain geographical area;
2. The presence of incubated or associated companies, which can use common or specialist facilities that are offered by Pole;
3. The presence of facilities devoted to research, self-owned or in joint participation with institutions external to the Pole, such as universities or research centers.

Vocational -Endogenous and Political-Exogenous Poles

When we consider an innovation or Scientific-Technological Pole is crucial to evaluate its features, in addition to the bond and dependence with the territory, to understand the reasons and purpose of its existence.

Based on its features, a Pole can be defined as Vocational - Endogenous Pole or Political - Exogenous Pole. Hybrid solutions are also taken into consideration, because we may find Poles consisting of elements typical of both Vocational and Political poles.

The Vocational Poles also known as natural or motivational Poles, born in specific areas, on the basis and as a natural consequence of a specific territorial and entrepreneurship fabric that characterizes the reference area.

The Vocational Poles find their *raison d'eitre* within stable and long-term technology districts, and generally take shape in contexts with strong and long-term entrepreneurship; consequently, without extremely generalize, there is a deep-rooted presence of Vocational Poles in regions and economically well-off areas.

Specifically, the natural Poles capture the vocations and peculiarities of the territory, as they seek to exploit as much as possible the potential of the activities that businesses and traders have significantly developed at the national level over the years.

Therefore, these Poles do not just develop because of an external or government will, but as a direct consequence of the endogenous push, which depends on the presence of a rooted, strong and efficient technology district, in the regional fabric.

Unlike natural Poles, Political Poles, crafted in an artificial manner are known as Exogenous Poles.

These Poles are established in particular contexts, generally characterized by a certain entrepreneurial and economic backwardness, as the result of a development strategy and innovation planned by the local ruling class.

Places with Political Poles are subject to infrastructure and more generic investments to stimulate the creation of business; both the State and more rarely, the European Community, decided to allocate substantial funds to allow the most backward areas to reach the levels of the richest ones, most historically accustomed and focused on entrepreneurship and trade.

The allocation of these funds ex lege replaces the internal push of the technology districts as a driver for the constitution of Scientific-Technological Poles. In these places, which lack of technology districts, the allocation of huge state funds is the fastest way to compensate the lack of features that allow the most innovatively forefront areas to develop, almost automatically, a scientific Pole.

Technological Innovation Poles. A lever for the economic and productive system

Outline models, policies and instruments in relation to the promotion of activities of aggregation and cooperation between innovative companies with a strong technology is one of the main challenges that the regions face in an overall economic and social change.
The policy for managing active and integrated innovation is now considered essential to leverage the competitive repositioning of the economic system through actions aimed at improving innovation policies in favor of the enhancement of the Innovative Technological Poles in light of the European discipline for research, development and innovation.

Innovation Poles can be defined as

Groups of independent companies, start-up, innovative, small, medium and large enterprises, as well as research organizations, operating in a particular sector or region and designed to stimulate innovative activity by promoting intensive interactions, shared use of facilities and exchange of knowledge and experience, as well as by contributing effectively to technology transfer, the networking and information dissemination among the firms that make up the Pole (Decreto M.I.S.E. 27/03/2008 n.87)

The sustainability of an Innovation Pole is based on three main sources:

1. The sale of services arising from the use of the infrastructure of the Pole: use of spaces and locations, rental of equipment and equipment, maintenance, use of facilities, common areas and organizing conferences / events participatory;
2. The sale of value-added services resulting from the transformation of knowledge and research results: (i) products and processes commercialized and exploited by local industry, (ii) the generation of new business models "technology-based" (start-up) and the continuous flow of new collaborative projects, transfer of knowledge and technologies among small-medium and large enterprises, industrial organizations and research system for providing services and manufacturing system, (iii) the enhancement of physical assets through the sale and the rent and (iv) the sale of services to support innovation.
3. Innovation Poles, finally, can be defined as combinations that create value and economic growth through a very structured value chain, ranging from

the creation of innovative marketing and distribution, in one or more technology markets.

Innovation in Italy

Of the total resources devoted to the support of companies in Italy, approximately 20% is allocated to innovation policy and research. The breakdown of spending on regional innovation and research shows that all southern regions showing a portion of amounts paid much lower, with the exception of Abruzzo (18.7%) the national average (20.5%); only Basilicata, Sicily and Puglia showed a more than 10%.
Excluding the Trentino Alto Adige, all regions of the north-central feature a proportion of total expenditure to innovation and research higher than the overall average. In particular, reach a particularly high Emilia Romagna with a percentage of 66%, Veneto and Liguria (over 50%) and Tuscany (41%).
The comparison between the policy and the level of research activity provides some interesting results. We considerate the degree of intensity of the policy for RTDI (Research, Technology Development and Innovation) of companies through a simple indicator that compares the disbursements made by the research activities of enterprises.
The three regions with the lowest values or regions with the higher business spending on research (total of the two regions account for nearly 50% of national expenditure) are Piedmont, Lombardy and Lazio, which is at the fourth place at the national level between the regions with a high level of spending in business research. At the other extreme, all southern regions recorded positive indicators with low or almost irrelevant levels of business research (in the case of Calabria and Molise, for example).
Emilia Romagna and Veneto, however, despite being among the regions with increased research firms relative to the rest of Italy, have a higher-level unit index (albeit slightly), as well as Tuscany and l 'Umbria (with an index close to 2). Campania and Sicily, with an enterprise research activity relatively high in the southern regions, recorded the worst indices of regional support intensity area. If we try to compare the relative orientation of the enterprise policy (approximated by the share of total resources for RTDI of the total) with the intensity of the research of the regional companies (ISTAT survey) the picture is very different.

Indicators for evaluation

Italian regions are evaluated according to two indicators: the index of "research intensity" of production, (the ratio of spending on research value added (national average in 1)) and the index is the ratio between the spending policies for RTDI and the total expenditure for enterprises in region, standardized for the distribution of the same sizes nationwide. The policy is oriented according to the demand of businesses. A greater relative share of expenditure on research per unit of value added is a larger demand from the production system supports specific to RTDI, as well as to higher values 'unit of the index in policy means, for the same resources, a greater specific orientation of the attention of policy makers to the interventions in question.

Policy makers tend to orient their own costs largely based on demand with some aspects of interest. We have regions with strong research firms and a modest policy guidance in this type of intervention, while regions with intensive research and wide diffusion of policies RTDI see the presence of Lazio, Liguria, Piedmont, Lombardy and Emilia Romagna.

Furthermore, we have regions with a relatively low intensity of research, but with a significant effort of RTDI policy: stand Veneto, Tuscany and Val d'Aosta and, albeit with less intensity, Marche and Umbria. The remaining regions present production systems with a low intensity of research and the relative levels of policy are not TDI oriented.

Of note, in this large group are present all southern regions and major administrations with special status. These are the regions that provide the major resources in absolute value in support of business and that allocate a relatively small portion of the same to the support of research and innovation. In this case, in particular, the policy does not seem to create special incentives to change the production systems to be more- intensive research. The higher the total resources of industrial policy (southern regions and special status regions), the lower this incentive.

The aggregation of enterprises: a necessary step

In some European countries and beyond, the stimulus to investment in sectors with higher-held innovation technology also involves the development of certain niches or "centers of excellence", with the impulse, at least in the initial stages of policy interventions territorial.

In Italy, in addition to industrial districts "traditional" for some years it also speaks of "technology districts". The triggering factor of technology districts is represented by a considerable investment of public research or initiative of a large local company (top-down development). The common element in the two categories of districts is the territorial dimension that simplify s the exploitation of local conditions, the exploitation of economies resulting agglomeration and the attractiveness of the area.

The promotion and support to technology districts in Italy is not an isolated experience, other countries have indeed experienced similar policy initiatives. In Europe (France, Germany and Sweden) but also in non-European countries such as Japan, the launch of programs to promote locally the interaction between research centers, universities and industries, specifically intended for the most innovative technologies, has allowed the birth of the Poles of "excellence" deeply rooted in the business of the territory.

Innovation Technological Poles: a key to Regional competitiveness

The industrial district is a limited geographical area with the presence of a set of small and medium-sized specialized in the phases of the same production process, with a well-defined local culture, and presenting a network of local institutions conducive to interaction, competitive and cooperative, and between different enterprises, and between enterprises and skills of the territory.
Innovation Poles, initiatives implemented by local governments with economic development strategies, are intended to stimulate the growth of technology-based local, through the creation of new businesses (especially start-ups and spin-off technology), and / or the attraction in situ of existing undertakings. The projects of the Poles are based on the theory of cross-fertilization.
"The merger, in the same place, of innovative technology activities, research centers, enterprises, universities and financial institutions. The contacts between these subjects are promoted, so as to produce a synergistic effect from which new ideas can emerge and innovation technology, and thus stimulate the creation of new businesses."
- Pierre Lafitte, founder of Sophia Antipolis -
Operationally, the Poles are a group of industrial and research organizations that share a common interest in all aspects of scientific development, from the laboratory to the production and commercialization. Their physical representation can be an industrial area, mostly made up of small and medium sized, which includes offices, laboratories and production units, all located in areas with a strong territorial value.

Peculiarities of Poles

- The Pole is an image, which is the framework perceived economic dynamics, thus constituting the production space of the twenty first century. The Pole creates space for a new form of economic organization. The establishment of a new production logic is favored by the search for links between innovative industries, public and private research, and higher education. Technology transfer is an essential function for the techno Poles.
- The Pole offers a particular form of localization. The forms of design, architecture and animation established in techno Poles are all designed to promote the establishment of a new philosophy socio-productive. The Pole provides an interface between the productive relations based on proximity and a broader global

perspective, thus stimulating a harmonious development of the system.

- The Pole increases the technology creation, minimizing the related transaction costs, with the cooperation of economic forces and industrial.

The components of the Innovation Pole are

1. A research infrastructure, usually public, linked to universities and centers of public R & D;
2. An expertise and an infrastructure of advanced university education and postgraduate also
3. Characteristics of persons associated with an innovation center coordinated with the University;
4. A business incubator;
5. An area of production which also includes specific areas for R & D;
6. A center for testing and demonstration supporting businesses and universities and their collaborative projects.
7. Each positioning process of an innovation center is different because:

I. Every Innovation Pole takes advantage of the different inputs available in the local economy;
II. Each environment has a specific absorption potential of the results of the Pole caused by different historical traditions and specific needs;
III. The changing role of public and private stakeholders can influence the path implementations.

CHAPTER 6

Innovation Poles in Italy and Europe

A glimpse of Italy and Europe

Since the Innovation Pole is one of the main drivers for growth and competitiveness of the regional economic context, this chapter will analyze some Italian and European cases of successful "Innovation Poles" Policies such as the French Poles because, even if characterized by a strong national coordination and investments, they can still provide important insights. It is also important to mention the case of Styria, as the winning model for Austria and its success, based on the policy implemented by the creation of networks and clusters. Moreover, in the European Project "Creative Trainer II", Umbria Innovation, Italian region of Umbria, is a partner of the Styrian Business Promotion Agency (SFG), the agency at the center of the governance of the Poles for Styria.

Lazio

The system of the Technology Centers in the Region is a reality that is realized through large pro-jets like the Tecnopolo Tiburtino, which is characterized by productive activities and industrial high-tech, and the Tecnopolo Castel Romano, oriented to the study and research in environmental biotechnology and technology transfer. Lazio can count on other centers of excellence, active in advanced fields of research such as biomedical technology and agribusiness. The business model generally applied by the subjects in the innovation system Lazio can be traced to three main lines of action:

1. Management of the Structural Funds
2. Business combinations for the co-construction of collaborative projects
3. Supply of services, infrastructure, equipment specifications for the development and industrialization of innovative

The Lazio Region has allocated over 100 million euro to fund research and innovation, to be used in the 2009-2011 period.
85 million to fund universities, research centers and Science Parks of Lazio, as required by the 2009 Budget and an increase in the fund economic development, research and innovation. The remaining 22 million, however, to promote the integration of young researchers.

Among the sectors identified as strategic and priority are the Aerospace, bio-technology, cultural heritage (conservation and use), alternative and renewable energy, ICT and multimedia. The logic of intervention against businesses, based on the model applied by regional Poles of the Lazio Region, is as follows:
Direct aid, for activities related to research and innovation, which mainly concern the acquisition of services. The combined enterprises can access on a preferential basis:

- funding on the chapters of regional programming dedicated to priority areas in innovation;
- to specific lines of credit under future regional calls in support of research projects and the industry-experimental development;
- Indirect aid, granted to the manager of the Pole for the construction of infrastructure necessary for the functioning of the Polo and the entertainment activities of Pole;
- Investment aid for the creation and expansion of the Polo (local training and research laboratories and test center; infrastructure of broadband network);
- Operating aid for the animation of the Polo (marketing expenses to attract new businesses, infrastructure management of the Polo Open access, organization of programs, knowledge transfer and technical and professional skills, seminars and conferences to simplify knowledge sharing and networking among the members of the Polo).

Some Regulatory References

"The Lazio Region has published on its official bulletin of 14 August 2008, the regional Law 13/2008 on the theme of "Promoting research and development of innovation and technology transfer". The Law aims to support the regional system of research and innovation, thereby enhancing the competitiveness of the entire local production. This will be achieved through a series of actions of networking between the world of research and business and between the world of SMEs and that of large companies, specialized consulting services to companies for supporting projects of industrial research and pre-competitive development or to start patenting processes. In particular, will be funded:

• research and development, presented jointly by SMEs and research centers, public or private, regarding improvement of conditions of production and the cost-sharing by private entities;

• technology transfer activities that allow SMEs to acquire innovation technology by those holders of the same, favoring forms of cooperation with the system of Poles and technology parks with large companies and regional supply chain.

Analysis and studies conducted both by some regional agencies for economic development, both by specialized structures, and reported in numerous documents approved and disseminated by the Lazio Region, have identified as priorities for the development of Lazio, in the programming for the next 4-6 years, the following sectors of innovation:

1. Advanced technology districts (DTA, DTB, DTC)
2. Technologies for Environmental Sustainability
3. ICT Technologies and Multimedia
4. Lazio is characterized by the presence of 3 technology districts:
5. DTA (Aerospace Technology District)
6. DTB (Technology District of Biosciences)
7. DTC (Technology District of Culture)

These are the Districts selected as priorities by the Region of Lazio as the subject of specific measures and conventions and agreements with national authorities. Each district presents some topics of technology frontier, including, for instance those considered as more functional to regional development and the most adherent to the drawings and to the strategies of the economic actors belonging to the chain. The frontiers of technology related to the aspects that need to be addressed for the definition of appropriate development paths of these chains of innovation have been defined in the framework of regional programming of the POR ERDF 2007-2013.

Piedmont

The activities of the Piedmont Region in innovation policies have been systematized in an organic law complete in January 2006, with the approval of the Law. 4/ 06, establishing the "Regional System for Research and Innovation".
The law defines the Triennial Program of Research: a programmatic document that spells out the intentions of the regional government with respect to: i) areas and sectors; ii) actions and objectives considered strategic; iii) how to achieve the purposes of the law, iv) criteria for the evaluation of projects; v) allocation of resources available for macro-intervention.
Currently two types of interventions of the Piedmont Region can be traced back to the sphere of technology Poles, in a broad sense. These initiatives are:
- Technology Poles of innovation;
- Technology platforms.

The Technology Poles of Innovation are identified and governed directly by regional regulations and are made in the form of aggregations of individuals who have specifically requested to be part of it and are coordinated by a management entity. The Piedmont Region has currently operating 12 centers of innovation technology.

The platforms are an instrument of coordination that combines diver-you stakeholders around a common vision and a strategy of development of new applications. The Piedmont Region has identified the platforms as the basic unit of funding for complex and large scale. Nevertheless, the Piedmont Region has indirectly recognized in 2007 the aerospace cluster, as an aggregation of stakeholders already established by allocating a dedicated intervention to fund major research projects (Call L.7 / 2007).
However, it should be noted that, unlike the technology centers of innovation, technology platforms are not organized in institutional form. Funding related to this area are only those mentioned for major research projects.

Regional policies and Regulatory Framework

As for the establishment and classification of technology Poles, the most relevant pieces of legislation are:
1. Community guidelines on state aid for research, development and innovation adopted by the transmission of the European Commission 2006 / C 323/01, in force from 1 January 2007.
This legislation sets out in particular the type and extent of subsidies that can be delivered to companies for research and innovation.
2. Regional Law no. 4/2006.
This legislation, cited above, defines the criteria and the general lines to organize, promote and coordinate the regional system of research and innovation inwardly of the European Research Area. Constitutes the regulatory reference regarding the areas of intervention, the strategic objectives and the resources assigned.
3. Regional Operational Programme ("POR") 2007/2013, financed by the ERDF Objective 'competitiveness and employment'
This program makes it possible for the budget. Provides as voice financed Innovation Poles, Axis 1 "Innovation and Production Transition" provides an asset (I.1.2 Activities: Poles of Innovation) aims to support "... networks and structures to organize and disseminate innovation in SMEs "with actions that" focus on promoting the transfer of technology, knowledge and the supply of services to businesses."
4. Resolutions of the Regional Government n. 25-8735 of 5 May 2008, n. 11-9281 and n. 12-9282 dated 28 July 2008 and n. 37-9622 of 15 September 2008. With these resolutions, the council has identified the technology domains of competence of the Poles and the related areas of reference and defined the general contents for the establishment, expansion and operation of Innovation Poles.
As for the aerospace cluster, in December 2005, the Piedmont Region, together with the Province of Turin, Turin City, Chamber of Commerce, Finpiemonte SpA, Industrial Union and API Torino, gave birth to the Piedmont Aerospace District Committee. The idea of

establishing a national aerospace district has never reached, however, the operational phase. Currently, the committee is responsible for coordinating and promoting the initiatives in aerospace, on an informal basis.

Types of facilitators

There are two parties to a regional issue that act as regulators and facilitators subjects concerning Technology Poles. The main competence belongs to the Department of Research, Innovation and Industry of the Piedmont Region, which operates in this area primarily through the Directorate of Productive Activities and the Directorate of Research. This subject has primarily the task of defining the general orientation of research and regulate the typologies of eligible expenditures. The second party involved is Finpiemonte spa, the regional finance company, which acts as a regulator of the contributions made, as well as a monitoring body of the Poles.

The Technology Poles recognized by the Piedmont Region

1. Polo Agribusiness, the areas of Asti and Cuneo
2. Polo Biotechnology and Biomedical, areas of Canavese and Vercelli
3. Polo Sustainable Chemistry, area of Novara
4. Polo New materials, area of the Alexandria
5. Polo Digital Creativity and Multimedia, area of Turin
6. Polo Sustainable architecture and hydrogen, area of Turin
7. Polo Renewable energy and biofuels, area of Tortona
8. Polo Systems and components for renewable energy, area of verbanocu-sio-ossola
9. Polo Renewable energy and mini hydro, area of Vercelli
10. Polo Information & Communication Technology, areas of Turin and the Canavese

Currently the 12 Poles recognized by the Piedmont Region are in the phase of operation goodwill, in other words are still: i) completing their legal formalization, ii) formalizing the effective participation of businesses (at the application stage they had only expressed an interest) and iii) have started to organize approved activities.

Governance

The Technology Poles of Innovation were organized or in the form of Temporary Associations of Purpose (ATS) or in the form of the consortium (including the form of consortium companies was permitted, in addition to the earlier mentioned).

All the managers of Innovation Poles have taken the legal form of ATS or consortium of companies, even if the subject manager could also be identified in a company that participated the Polo, provided under the direct or indirect public control, or by a company that did not benefit in any way of contributions and services provided by the Polo itself (this possibility was expressly precluded to Research institutions).
Those managers, when operational, will act as catalysts of research proposals received from participants and contributors of the Pole. Their function is to operate as true organizers and coordinators among the participants and between them and the region, which will provide the funds. There is also expected that these will act as real entry-filters, to increase the level of robustness of research proposals actually forwarded to the Region.
The degree of access to companies in the consortium must be maintained wide, to avoid that participation takes discriminatory or lobbying valence.
The governance of the Aerospace District is, instead, of advisory and bottom-up type. The organization of the Steering Committee of the Aerospace District, which performs coordination and promotion for the stakeholders of the platform, consists of seven institutional members (Piedmont Region, Province of Turin, Turin City, Finpiemonte, Turin Chamber of Commerce, Industrial Union Turin, Torino API). Are instead part of a Steering Committee, with consultative purposes, the following institutions: Politecnico di Torino, Turin University, University of Eastern Piedmont, ITIS Grassi, Astronomical Observatory TO, COREP, Order Engineers - prov. Turin, AIAD, Alenia Aeronautica, Avio, SELEX Galileo, Thales Alenia Space, AMMA, Unionmec-canioca, Aerospace Unions.

Emilia Romagna

For a long time, the Emilia-Romagna region has been committed to developing a policy to measure the development of the local version of Innovation Poles (here also called Industrial Research Laboratories and Technology Transfer and Innovation Centers). Although the technology areas of interest at the regional territory are defined, however, the approach of Emilia-Romagna differs in some elements: there is no unique managing entity for each Pole, because in relation with the territory, it is possible to have different experiences, but consistent in terms of organization; the governance is unique for the entire system and is operated, with the specific mandate of regional administration, by Aster S. Cons. Agency Regional Consortium of Emilia-Romagna, universities, research institutions operating in the national territory - CNR, ENEA, INAF, the Regional Union of Chambers of Commerce and Business Associations regional.

Among the main tasks, the Institutional Consortium is engaged in the development and coordination of the High Technology Network of Emilia-Romagna. The Poles do not have a defined geographical concentration, but are distributed according to a network structure which, while referring to localized physical facilities (departments, laboratories, equipment, ...), combines skills "at a distance, creating a "Virtual network ".

The Poles are mainly driven by research subjects, with the necessary and qualifying business presence. This is because the measures in support of the Poles are part of a comprehensive program of support for applied research and innovation, in which there are specific actions for businesses, which are then stimulated to resort to the Poles by other means, with respect to the direct participation to their team.

The situation of Emilia-Romagna was in line with international developments in local production systems. In particular, the academic reflection has also its focus on the trends of change of the so-called "industrial districts", which traditionally insist on the regional territory.

The districts are delineated as dynamic systems of small businesses, where the technical specialization, networking and exchange of information generates a high capacity for problem solving at the individual and collective level, continuous learning and continuous improvements, improvements in products and incremental innovations that, in the long run, result in products and technologies to market excellence.

This approach defines a innovation driven by demand based on a high degree of specialization and adaptability of "tacit knowledge", accumulated experience directly in the field: undoubtedly, this kind of dynamic, has allowed the local and regional economy of Emilia Romagna, to achieve levels of competitiveness and success beyond all expectations.

However, the experience of "contact" between traditional districts and processes of globalization, has shown that the production systems of small businesses, if not constantly invigorated by the introduction of new knowledge, are likely to end up trapped in trajectories of hyper-specialization in (mostly) traditional sectors, where will be forced to convert and integrate the accumulated knowledge with new knowledge (given its extreme specificity), when they are pushed by strong drivers of change.

The study of the evolution of industrial districts has highlighted the need, on the side of the policies, to achieve more integrated schemes for the development of innovation strategies, taking as reference the "innovation systems", where complex individuals act, with different roles, to create an environment conducive to innovation.

This new approach, not rigidly systematized in the form of a single model, but in its progressive definition takes into account the following elements:

- permeability between the system of higher education and research, academic and not, with the industry and production;
- the role of intermediary parties, public and private, that can act as a link between the two spheres (applied research, industrial research, technology transfer, technology brokerage, technical and scientific information, technical assistance, project finance and support for the startup of new businesses, etc.).
- the importance of involving small businesses in the dynamics of innovation technology;
- the role of the territory as an arena in which skills are developed, exchanges of information and relationships are built, favorable environment conducive to the development of enterprises and innovative businesses, thanks to the combined action of divers public, private and social actors;
- The centrality of the people, as the main custodians of knowledge and entrepreneurial initiatives.
- In essence, this approach seeks to combine the advantages of the ability to produce new knowledge by structured research centers, and the benefits of adaptive capacity, development and customization, typical of small business innovative systems and dynamic local small business (the traditional districts).

The new strategy for regional innovation policy

Summarizing, on the development of local production systems, the Emilia-Romagna has launched a new phase in 2000, altering its industrial policy towards the development and consolidation of a regional economy of knowledge and innovation: the principle behind this new strategy is to promote the economic development of the territory by leveraging businesses, universities, research institutes, centers for technology transfer, which operate for innovation and interact to exchange and develop new knowledge.
The ultimate goal is to achieve a real Regional Network for Industrial Research, Innovation and Technology Transfer, made of Poles, where the relationship between producers of knowledge (research institutes) and users of knowledge (business) is stable and oriented in a dynamic way to the production of innovation.

In summary, the structural aspects that the region takes into account for the definition of its policy strategy are:

- more innovative levels of specialist knowledge already acquired by the regional production system in the supply chains;
- high spontaneous dynamism of businesses, with an innovation demand even more product and new management techniques-oriented, and less-oriented to the production process;
- growing activism of the University in technology transfer, the academic spin-off and research on commission;
- Presence of a set of subjects already active for innovation support, but not always operatively coordinated.

Governance

The legislative path started in 2001, with the signing of a memorandum of understanding between the Region of Emilia-Romagna, the regional public universities and research bodies, which have agreed to co-participate in the consortium ASTER, with the attributing of the task of "Agency for industrial research, innovation and technology transfer in Emilia Romagna". ASTER makes operating those common actions identified by the protocol to give support to the activities of the universities and research centers, and to the collaboration with these companies.
Subsequently, the definition of the LR 7/02 - Promotion of regional system of industrial research, innovation and technology transfer, determined the legislative framework for the implementation of the network, which was actually designed in 2003, through the Regional Program for Industrial Research, Innovation and Technology Transfer (PRRIITT), whose articulation contains a set of measures aimed at the consistent development of the regional economy, focusing on the knowledge economy as the core of the system.
As for the integration with the national legislation, however, the region has taken the opportunity provided by the Ministry of Education, University and Research (MIUR), to create high-tech districts organized on a regional basis, with the ability to use the Incentive Fund for Research (FAR).

The High Technology Network of Emilia Romagna

The aggregation of industrial research laboratories and centers for innovation consolidates the High Technology Network of Emilia-Romagna. Open to the national and international dimension, but firmly

rooted in the region and to the productive fabric, is already able to respond effectively and professionally to the needs of businesses.
The network aggregates skills, very qualified instrumental and human resources, and operates in harmony with the needs of the regional entrepreneurial system, through an accreditation program, addressed to attest the market's ability to effectively collaborate and support innovation programs and business research. The network consists of 14 industrial research laboratories and 8 innovation centers, located throughout the region, and working on six thematic areas:

- High Mechanical Technology (5 laboratories and 1 center)
- Environment, Energy, and Sustainable Development (4 laboratories and 1 center)
- Agribusiness (1 laboratory and 1 center)
- Construction and building materials (3 laboratories)
- Life Sciences and Health (1 Laboratory)
- Organizational innovation (5 centers)

Centers for innovation
• specially promoted and created by universities or research institutions, or local authorities or experiences of business services;
• committed to developing a program of technology transfer activities with initiatives to update and specialized training of technicians;
• aimed at strengthening the processes of transmission of knowledge and technology expertise to the production system and the territory.

Laboratories for industrial research and technology transfer
• specially constituted new independent operating units composed of universities and research centers, participated or endorsed by businesses and other public and private organizations;
• oriented to the development of applied research activities of industrial interest on specific issues of regional interest, on the basis of a program of activities;
• aimed at increasing the wealth of knowledge of industrial application and production, and its economic value;
• working with the commitment of researchers, specifically dedicated to these new applied research and technology transfer, and collaboration with the technicians of enterprises in adjacent box.

The start of the PRRIITT projects allowed to bring other initiatives – on a smaller scale and/or with sectorial approach - around the new Regional Network of Research and Technology Transfer, giving a unified configuration and recognition to the subjects who act in applied territorial research.
Previous programs to PRRIITT resulted in structures similar to the new laboratories and centers, differ essentially n the origin of the funds available (ERDF-Ob. 2, Triennial Program for Productive

Activities, ICT Plan) and, in some cases, for the thematic destination of the projects (ICT Plan, ICT oriented). The basic rules of the different calls deviate, for certain operational aspects, from those used for the PRRIITT, but the essence of the project activities projects is comparable and, the Region has also pushed initiatives born outside the PRRIITT, to align as much as possible with the mechanics provided. In this way, interventions focused on the development of Poles dedicated to applied research and TT were put in place, allowing a comprehensive management of institutional communication and promotion of the network towards businesses and national and international stakeholders.
Following this grouping, the Regional Network for Research and TT (briefly called the High Technology Network) is made up as follows:

EMILIA- ROMAGNA HIGH TECHNOLOGY NETWORK
55 Structures dedicated to Industrial research, Innovation and Technology Transfer.
PRRIITT= 22 laboratories, 20 research centers
FESR- Ob.2= 3 laboratories, 2 research centers, 2 Innovation parks
ICT Plan= 2 laboratories
AA. PP Program= 4 Innovation parks, 2 laboratories

The coordination of this Network, also for the aspects of international promotion, service contracts and initiatives with a wider scope (e.g. Technology Platforms within the FP7), is taken by ASTER, in implementation of the provisions of Measure 3.4 of PRRIITT. The originality of this Research Network lies essentially in its being "virtual": the effort of aggregation required by the Regional research bodies of the territory has focused on the availability of skills, not so much on capital equipment or physical structures, and this has led to the identification of "Poles of Knowledge" organized around business plans articulated on specific research issues and technology transfer actions towards businesses.
The nodes of the Network lead back the nodes priority issues for the region Emilia-Romagna:

- High mechanical technology
- Environment, sustainable development, energy
- Agribusiness
- Building and construction materials
- ICT
- Organizational innovation
- Life Sciences and Health

The Network is a dynamic aggregation, where new subjects with technical-scientific skills, similar to those of laboratories and centers currently present, will be able to operate, expanding the range of subject areas covered, and specializations. Within the laboratories and centers of the Network 402 young researchers, working together with 600 teachers and researchers already present in universities and research institutes and centers for innovation will operate 140 units.
Since 2005, thanks to PRRIITT operates the High Technology Network of Emilia-Romagna that, in its initial form, was made up of 27 industrial research laboratories and 24 innovation centers, operating in the following sectors: advanced mechanics, life sciences and health; energy, environment and sustainable development; ICT; agribusiness; building and construction materials; organizational innovation.
The results of the first regional program 2004-2007 that gave birth to 27 projects of research laboratories and 24 innovation centers demonstrate that the meeting between science and business has really started. From the beginning, laboratories and centers have produced 115 new innovative prototypes, 20 patents, over 500 studies and research for new products or new methods and processing protocols; 239 cooperation agreements with companies. The investment of the region for 28 million euro was followed by the participation of laboratories to 267 research projects (77 in Europe) for an activity of 20 million euro and trade with businesses of 9 million euro.
The Network has worked with the coordination and support of ASTER Science Technology Business - the Consortium of Emilia-Romagna, the universities in the area, major national research institutes such as CNR, ENEA, INAF, the Union Regional Chambers of Commerce and regional business associations - born to support, coordinate and enhance the network of research and technology transfer in Emilia-Romagna. ASTER will work for the coordination of the network, creating the Association of laboratories accredited by the Region and thus to promote, in unified way, the relationship with business.
The Region has invested 15 million euro in this second program, between 2008 and to 2009. It is already looking at the next target to consolidate and further develop the Network for High Technology in Emilia-Romagna, which will lead to the birth of Techno-Poles, e.g. of the new areas in the different cities that will host the research laboratories with further investments for scientific structures, which can also be used by business.
A further development will also include a material structuring of the laboratories, through the creation of a network of sites dedicated to industrial research, placed infrastructure areas ("techno-Poles"), with their own spaces and offices, research groups and scientific equipment, close to the facilities needed to develop their business relationships, their projects of scientific and technology transfer,

accompaniment to spin-off companies and hi-tech enterprises, collaboration with laboratories.
For the organization of the network, a dedicated association has been planned to promote the coordinated development of the work programs of laboratories and centers, which are part of the network; the Association of laboratories will join ASTER- Science Technology Business, and will take the name of "Science and Technology Association of Emilia-Romagna," then, still ASTER.

A glimpse of Europe. Styria Region, Austria. Regional policies and general scenario on innovation processes

The Styria is an economy inserted within an international network and based on research and innovation. Today a third of high-tech products come from this area; in other words, this region has become the economic model area for Austria. This success is based on the formation of networks and clusters.
The challenge that the region faces today include factors such as the continued development and assured potential for innovation, the continuous expansion of innovative regional basis, the discovery and development of areas with potential for future growth, as well as the conversion of existing research capacity, the conversion of research and ideas into products and services to the market (marketable) at national and international level.
To address these challenges, the Styria has developed seven guidelines ("The strengths of Styria"), which are having great application at the other actors on an international scale, in the long run:

1. Innovation
2. Cross Management (site management) and internationalization
3. Cluster, network, areas of strength
4. Self-employment and entrepreneurial spirit
5. Managerial qualifications
6. Regions and infrastructure
7. Models of innovative financing

With a rate of R&D by 3.5% in 2007, the region of Styria is considered among the top regions in Europe. Innovation processes are stimulated at the political level; plans and strategies are developed in the form of policy documents, guidelines and legislation.
To create a region-based sustainable innovation in the long term, the Styria have implemented a series of policies to support innovation, entrepreneurship and business cluster. The list shown below gives an overview on the most important among those taken.

The Operational Program "Styria, regional competitiveness 2007-2013"

- The program has been developed based on the seven identified guidelines ("The strengths of Styria").
- The program includes the support of the European Commission as part of the objective "Regional competitiveness and employment".
- The total public budget allocated to the program is around € 310.1 million, and the assistance from the European Commission through the ERDF amounts to EUR 155.1 million (approximately 10.61% of the total EU money invested in Austria on the basis of cohesion policy 2007-2013).
- The authority appointed to administer the program, the regional government of Styria.
- Exhaustion / interruption of Finance according to the axis of priorities:
- Objectives of the program: with a GDP per capita of 110.8% compared to the EU, the Styria belongs to the strip of the highest regions of the European Union with a good standard of living and a good quality of the environment. In any case, to meet the challenges of the globalized world and the significant changes in the internal European market due to expansion of the Union towards Eastern Europe, it is essential to support well-targeted areas, to strengthen the economy.

To increase competitiveness and ensure long-term growth of the economy is essential for the Styria to play an important role in the European context. The networking activities with neighboring regions and the European centers should contribute to achieving those objectives. The development of marketable products and services as well as innovation of the regions should focus on specific strengths, to allow a balanced regional development.

The program will promote an economy based on knowledge and innovation and the creation of permanent jobs to increase research and development (R&D = Research & Development), which substantially contributes to achieving the Lisbon strategy goals.

The goal of sustainability of Gothenburg, as well as the principle of equal opportunities has received a special status of horizontal objectives in the program.

The program will ensure creation of 1,800 new jobs, 250 of which in R&D, and will trigger a total investment of 944 million € (six times the subsidy paid by the European Commission), by installing an additional capacity for renewable energy of 11 MW and decrease the greenhouse gas emissions of 110,000 tons per year.

Cluster Policies

Clusters can provide a framework for action in the context of long-term policies. First, this is especially true in three key areas: innovation and technology policy, regional economic development policy, policy of entrepreneurship for SMEs. At the regional level, the policy on clusters is carried out in an ad-hoc manner, rather than through formal programs. Nevertheless, the regional ad-hoc strategy, cluster might resort to the use of national programs in development of individual clusters.

Guidelines for policy on technology in Styria

There are three lines of action, within which clusters play an important role with regard to the policy on technology:

Support to the top innovation and diffusion of innovation bases
The main objectives are to maintain open markets through training / formation of business, expansion of innovative regional basis, renewal of regional clusters, strengthening of new fields of technology and continued marketing of new technologies. These objectives are to be achieved with the help of cluster organizations and the establishment of networks of supply chains in the world of organizations of regional clusters.

Sectorial specialization- Sectors of strength
This action promotes the continuation of a policy of differentiated cluster, supporting essential topics on cluster policy through repeated programs, intensified involvement of clusters on public issues, understanding the importance of clusters, such as access points for companies and their use for internationalization, qualification and technology

Internationalization and inter-regionalism
Based on the Research Strategy, Styria wants to develop networks of R & D across the border, and establish centers of innovation and product development. The development of technology clusters across the border and the strategic cooperation is going to be made by the national programs of the

Entrepreneurship and SMEs Policy

In the region, as well as throughout Austria, most of the companies are SMEs. For this reason, entrepreneurship and the policy on SMEs is incorporated in any kind of policy. The main objective of this policy is to improve the conditions of the general landscape for companies to enhance their competitiveness. All this presupposes measures such as:

- Since SMEs generally have to cope with high administrative costs, measures are implemented to reduce these costs.
- As part of the landscape of enterprise horizontal policy, appropriate subsidies are reserved to SMEs. They are used as compensation for the disadvantages caused by the size of SMEs, for example with regard to access to financial resources (loans, equity capital), in conducting the research, the training of employees or the use of consulting services.

Strategy 2010
Perspectives for Research, Technology and Innovation in Austria

Strategy 2010 is a strategic national policy promoted by the Austrian Federal Government and the Council for Research and Technology Development Austrian (RTD) between 2005 and 2010 and beyond.

The RTD is only an advisory body for all matters concerning research, technology and innovation policies, which has designed a long-term research and a technology strategy for Austria.
The purpose of this policy is to position Austria among the members of Europe's leading technical development and research, to strengthen the competitiveness and the dynamics of the Austrian economy to achieve the target of Barcelona, and to further improve the conditions in research and innovation in the Austrian nation.
The main objectives are: to encourage the achievement of quality in all areas of research as a basis for achieving excellence, improve networking and cooperation between science and economy, increase the efficiency and effectiveness of the financing system.
These are the fields of action, divided and implemented according to priorities: universities, business enterprises, cooperative sector, excellence strategy, international orientation, regional dimension and human resources, the State as a driving force, financial portfolio and use of funding.

Infrastructure and systems in the areas of technical centers SFG

The Styria has a good education system and training departments. The region has five universities, two of applied sciences with more than 45,000 students and 23 graduate programs. In addition, the region has 18 centers of competence, which aim at improving the competitiveness of companies through strategic cooperation between science and industry. Within the University shows a considerable recent growth and a potential for spin-off, in materials and synthetic. It was finally given birth to a number of technology centers and establishment of new companies as part of an effort of regional renewal, offering a range of services ranging from administrative support to technology transfer and consulting.

The SFG Model- Strategy and Mission

The Styrian Business Promotion Agency (SFG) was founded in 1991. The Agency shall ensure the provision of subsidies / grants (loans and grants) and aims to improve the local conditions of the overall regional industries and to contribute to the structural improvement and economic growth of business activity, which have their corporate headquarters in Styria, as well as to the economic growth of poor regions.
To date, 70 employees work at the agency. Until 2007, the SFG has supported 1,871 projects with a total budget of € 80 million, 92.7% of which in support of SME projects.
The SFG offers a variety of services to its customers, who are mainly in their early stages, as well as business already underway and cooperation of business. In any case, the services are also offered to public entities, individuals and legal entities as well as other legal

entities whose assets are used as they provide a valuable contribution to the achievement of economic objectives in the region. The services offered correspond to the seven strategic areas identified as strengths of Styria.

Governance

The SFG is an independent service, for the most part-owned by the province of Styria and directly connected to the "Landesrat" (the highest official of an administrative district) the business of business. The agency works as a one-stop-shop to implement the strategic guidelines of the economic policy of Styria. It is responsible for strengthening the business of Styria, regions and places of business in commercial and industrial production, as well as services related to crafts, trade and business.

Business model and main sources of funding

The business model SFG is organized around the seven regional strengths already identified

1. Innovation,
2. Cross Management (site management) and internationalization,
3. Cluster, network, areas of strength,
4. Work in own and entrepreneurial spirit,
5. Qualification managerial,
6. Regions and infrastructure,
7. Models of innovative financing.

The agency is mostly focused on the high-tech sector and hence on innovation, but also supporting the founders and regions. The incentives available to regional actors are both monetary base and not. The main sources of funding come from regional funds (province of Styria), the Federal Government and by the EU. As concerned the implementation of projects, funds and grants are made available in the following fields:

- Human resources;
- Research and development;
- Transfer of knowledge and technology;
- Network;
- Internationalization;
- Creation of Equity;
- Implementation of business;
- Development of business basis;
- Services related to the business;
- Innovative investment;

Half of the funding of the Structural Funds, Objective 2 area, for measures related to the qualification to undertake business activities, is co-financed by subsidies from the European Social Fund (ESF). Support tools and funding provided come to € 1.25 million for each activity.
Regarding the "innovative financing models" for technology-oriented companies with high growth potential, the SFG provides financial support and usually holds 51% of the shares of the companies, while the banking structures of Styria hold the remaining 49%.
In terms of "partnership" SFG holds 24 partnerships unstructured and 3 partnership of Venture Capital (for a total budget of about 14 million €). To date, have been accepted also 11 guarantees for new markets.
Services / products (particularly relating to start-ups and spin-offs)
Half of the funding of the Structural Funds, Objective 2 area, for measures related to the qualification to undertake business activities, is co-financed by subsidies from the European Social Fund (ESF). Support tools and funding provided come to € 1.25 million for each activity.
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In terms of "partnership" SFG holds 24 partnerships unstructured and 3 partnership of Venture Capital (for a total budget of about € 14 million). To date, have been accepted also 11 guarantees for new markets.
Regardless of the type of business and the industrial sector, the SFG offers its customers extensive advice on funding opportunities, gathering information, possibility of contacts and cooperation based on the type of business and the industrial branch. In particular, the services offered are:

- Financial targeted support to companies of Styria that allocate funds provided by the province, the federal government and by the EU.
- The provision of comprehensive advice and information services on markets and market opportunities for potential investors.
- A link between companies, between science and business, among opinion leaders and decision makers.
- Encouraging cooperation between companies, based on projects and the formation of clusters.
- Development of a region of knowledge and encouragement to the strengthening of the best technology sectors of the region.

Overview on cluster and network

The purpose of the SFG is to make the Styria region able to support innovation and, in this sense, the ongoing global changes are seen as an opportunity for innovation through the cooperation between large and small / medium businesses and the scientific community. In this sense, Styria has introduced extraordinary economic programs, especially regarding the creation of clusters to stimulate the regional economy.

The "path of the cluster" has been fairly successful: clusters in Styria are now seen as the engine of the economy.

The first cluster created in Syria was the Automotive Cluster (AC Styria). The AC Styria can be conceived as an example of best practice for all clusters in the region. The automotive has become the most important sector for the economy of Styria. Given the many positive results obtained by the AC Styria, the government has decided to follow the policy of the cluster. After the automotive, four new clusters were created in the following areas: wood, materials, human technology and eco-technology.

The SFG, as an institution contracted to outside companies and for the 100% owned by the Federal Government of Styria, is generally conceived as an institution responsible for the formation of clusters. As a representative of the government of Styria, the SFG owns approximately 25% of the shares of each cluster.

Centers of Expertise

The competence centers are integrated into regional clusters. Today in the region there 18 centers of competence. These are an essential element of regional innovation system, forming a link between research and application of research results. Universities, research institutes and companies create joint working team in promising areas. In detail, competence centers are facilitators of research and transfer dedicated to a particular economic sector in which companies and scientific institutions working together (for example in the automotive industry, in materials and wood, etc.).

The emphasis is on basic research as well as on industrial research and experimental development. The program began in 1998 and is now one of the most important events dedicated to technology development. At an international level. The program was defined as a best practice. In addition, in 2006, based on experience, was given life to a new program: COMET - Competence centers for technology excellence. This program is intended to support particular research activities of high technology excellence, extremely promising for the future at the international level. COMET directs its activities towards competence centers and networks, as well as to new research consortia and the industries themselves. The program, implemented by the Federal Ministry for Transport, Innovation and Technology and the

Federal Ministry for Economic Affairs, Family and Youth, is supported by the province of Styria through its own funds.

Centers on impulse

Frontier favorable conditions reduce the risks inherent in the business, providing a perfect breeding ground for start-ups, technology transfer and cooperation, as well as for innovation and development of new products.
The program of impulse centers has created a whole network of technology parks, incubators and innovation centers that provide an excellent environment for start-ups and companies in their early stage of development. The impulse centers, through their focus on different technology oriented industries, lend to businesses and regions an important impetus for a successful future.
Today, the program impulse centers of Styria support companies in technology in 29 centers with technology focus, of which 15 are fully owned by the enterprise.
Here some traits, indicative of the effectiveness of the centers on impulse:

- Centers: 29
- Investment: € 198,892,891
- Surface rented: 148,121.6 m2
- Average use: 94.96%
- Enterprises: 460
- Staff members: 3893

The impulse centers provide the following key benefits to start-up:
> Ideal infrastructure and financial support
Through the provision of premises with modern equipment at affordable prices. In addition, infra-shared facilities, such as the lobby, rooms for meetings and seminars, video projectors, office services, etc. provide additional financial benefits that help reduce the risk of starting new businesses.
> Contacts and cooperation
The allocation of furniture industry in a location and the networking of all the centers of Styria pulse generates multiple effects for contacts with customers, suppliers, financial institutions, administrative, as well as institutions for research and teaching.
> Design, promotion and advertising
The impulse centers, as protected trademarks, generate image. Effective measures of marketing, aimed at a specific target such as trade shows, web presence, printing, support the marketing activities of individual companies.
> Information and advice

Exchanges of information and consultancy services provided by the center management allow saving time and helping to identify problems and find solutions.
> Qualification, innovation and motivation
Seminars and events such as meetings between companies and the Fast Forward Award (annual prize awarded by the province of Styria to the most innovative project in the region) increases the level of innovation and skills of the participants and, at the same time, motivates employees and owners to provide facilities with modern equipment at affordable prices. Here, the sharing of a common infrastructure generates financial benefits and minimize the risk of launching new business.
The SFG is the main promoter of regional development in the region of Styria. Owned by the Federal Government of Styria, the SFG is generally referred as the entity responsible for the creation of clusters, strongly supporting innovation and economic development of the region.

Pôles de Compétitivité in France

Over 40 years, a central institution has been in charge of the territorial policies of France: by the end of 2005 this institution changed its name from DATAR (Delegation to spatial planning and the regional policy- Délégation à l'aménagement du territoire et à l'action régionale) to DIACT (Interministerial Delegation to planning and territorial competitiveness, Délégation Interministérielle à l'aménagement et à la compétitivité des territoires).
This transformation has been perceived as a shift of the political focus and an expansion of the mission of the institution: in addition to the traditional tasks of preparing, stimulate and coordinate the policy decisions of regional planning conducted by the State, the emphasis has been shifted particularly towards the objective of competitiveness. In this context, central was the launch of the "Poles of competitiveness".
In February 2004, France, through the DATAR, presented the new industrial policy strategy by launching the initiative of "Poles of competitiveness", defined as "the combination, on a given geographic space, of companies, training centers and research units, public or private."
The activity in favor of competitiveness clusters is based on eight principles of action:

1. Identify and exploit existing Poles through a process of "labeling" ("Labelisation"),
2. Encourage business networks,
3. Investing in human resources,

4. Tighten the bonds industry-research and industrial world of education,
5. Support the creation and development of innovative enterprises
6. Support the development of the Poles with the infrastructure (rail, air, road),
7. Promote a policy "network" at the European level,
8. Conduct the project in close partnership with the regions.

In November 2004, along the lines of what had been done to identify the Local Production Systems (Systèmes Productifs Locaux, SPL), was launched a 'appel à projet' to identify businesses, research centers, training organizations, etc. eager to be a "Pole of competitiveness".
These subjects, even with the help of national services, public bodies, regions and regional development agencies, have developed and presented to the regions some projects, subsequently examined by an inter-ministerial working group composed of the DATAR and the General Direction of Companies Ministry of Economy, Finance and Industry, with the participation of representatives of the ministries of research, agriculture, defense and labor.
The selection process resulted in a threefold analysis: the first conducted at the ministerial level, the second by personalities from the business world, research and higher education, and the third at the local level by the regional authorities. The Inter-Ministerial Committee for the planning and development of the territory (Comité d'Aménagement et de Développement Interministériel du Territoire, CIADT), following the selection briefly described above, has decided to establish with a decree 66 Poles of competitiveness.
In May 2006 the second "appel à projet", which provides financing for 68 other research projects and development presented by 39 Poles of competitiveness, has co e to an end. The two “appel à projet” of 2005 and 2006 have supported 165 research and development projects, presented by the Poles of competitiveness, recognized so far.
An analysis of the projects shows a focusing in some particularly innovative sectors: information technology and communication, energy, biotechnology, aerospace and transportation.
The budget established for the Poles of competitiveness amounts to a figure of around 600 million euro a year from 2006 to 2008. After a year were committed funding to 540 million euro.
Along with the DIAC, three public agencies have been created to stimulate research and innovation technology in the country, by intervening in the financing of the Poles together with the Deposits and Loans Fund (Caisse des Dépôts et Consignations). The Agency National Research (ANR), the Agency of industrial innovation (AII) and the Group Oséo granted aid or financial support to SMEs.

One of the problems that can arise is therefore to define the boundaries of the interaction between the different existing bodies. Although France supports actions for local stakeholders (companies, research centers, universities and local institutions offer to build themselves a "Pole of competitiveness" on the territory), according to the administrative tradition of the country, the final decision for the candidates to obtain the status of Pole for competitiveness belongs exclusively to the central government. There is also a single entity, DIACT, formerly DATAR, traditionally (for over 40 years) responsible for the coordination, the design, the development of territorial policies, as well as representative of France by the EU in the early stages of negotiation for allocation of structural Funds.

The French policy of the *Pôles de Compétitivité*

In an increasingly competitive world, France launched in 2004 a new industrial policy that mobilizes the key factors of competitiveness, the first of which is the "ability to innovate".
A Pole of competitiveness originates on a given territory, the association of undertakings, research centers and educational institutions, engaged in cooperative action (common development strategy) is designed to reveal synergies around innovative projects brought forward in common to a given market.
This policy tends to give birth and then to support initiatives from economic and academic protagonists present on a territory.
Four main elements are the key to success of the Pole:

1. The creation of a common strategy for economic development consistent with the overall strategy of the territory,
2. Depth collaborations between actors around projects,
3. The concentration of technologies aimed at markets with high growth potential,
4. Sufficient critical mass to acquire and develop international visibility.

This networking of innovation actors, according to the policy of the Poles, has the following objectives:

- developing the competitiveness of the French economy by increasing the effort of innovation,
- strengthening of the areas of activity, especially industrial, technology-driven or creation,
- increase the attractiveness of France, thanks to an enhanced international visibility,
- promote growth and employment.

Operating Principles

- A competitive Pole is a vector of collective projects between companies, research centers and training bodies.
- R&D projects are the core of the Poles and the main factor of competitiveness;
- Projects of innovation platforms are infrastructure tip to simplify business innovation through the creation of resources and services;
- Projects "outsider" R&D (education, property investment, ICT infrastructure, waking and economic intelligence, promotion of the territory, to the international development ...) are an essential complement to business competitiveness Pole and for the economic development of the territories.

Governance

Each Pole is represented and animated by a legal entity of its own, most of the time an association. This governance structure is required to grant a predominant place in the industrial, scientific and academic protagonists, allowing even the representation of the local authorities concerned.
The association has a permanent group that has a key role to simplify the composition of the projects between the different protagonists of the Poles. The state and local authorities contribute to the funding of these structures. The main missions of the association in charge of the animation of a Pole are:

- the development and implementation of the overall strategy of the Pole,
- coordination and selection of research projects that seek support from public funding allocated specifically to the policy of the Poles,
- communication of the Pole, especially towards internationalization,
- the creation of partnerships with other clusters, French and foreign,
- projects evaluation.
- a framework agreement governing relations between the Poles, the State and the local authorities involved.

Policy animation:
Inter-Ministerial working group and clusters

The CIADT of 12 July 2005 awarded the periodic monitoring of the policy of competitiveness clusters to an inter-ministerial working group (GTI) whose animation is co-chaired by:

- the "délégation interministérielle à l'aménagement et à la compétitivité des territoires" (DIACT) (Interministerial Delegation to the planning and competitiveness of territories)
- the "Ministère de l'Economie, des Finances et de l'Emploi (Direction Générale des Entreprises)" (Ministry of Economy, Finance and Employment - General Management Company).

The GTI combines the ministries and public bodies involved in supporting Poles: the ministries in charge of planning, industry, research, agricolture, defense, health, transport, the interior, the budget and work, OSEO innovation, "Agence Nationale de la Recherche "(ANR) - (National Research Agency), the "Caisse des Dépôts et Consignations" (CDC) - (Deposits and Loans Fund), the High Representative for the economic security and the group of qualified personalities. Below, a map showing the location and specialization for competitiveness clusters recognized by the French government.
The meeting of CIAD in 2005 has attributed the definition of Poles of Competitiveness to 67 initiatives, out of a total of 105 participants. Later, up to the total current of 71 have been recognized new Poles. Currently, the possibility of carrying out a simplification/ rationalization, which would imply a significant reduction in the total number of Poles, is under assessment. Among these, it is possible to identify two families of special Pole:

- 7 international competitive Poles;
- 10 Poles of competitiveness on a worldwide scale

CHAPTER 7

Impact of Technology Transfer in Economy. The Innovation Ecosystem of Louisiana

The economic impact of research and innovation in Louisiana. U.S.A.

Innovation is a key driver of economic growth in Louisiana. In this region, a technology-based strategy, combined with universities and research centers innovation-oriented, has offered the community for businesses and entrepreneurs to develop, foster, and enhance development utilizing a vast network of resources. Louisiana leaders increasingly embraced innovation-based economic development goals as high social and political priorities. Evidence shows that high job growth occurred in areas where innovation is a driving focus of regional and state economies. The development and promotion of the Louisiana strategy is oriented on economy's innovation- development, while its successful outcomes depended formally on the intense involvement of all significant parties and strategic stakeholders. The list of stakeholders includes state government, regional and county economic development organizations, universities and their academic leaders, the business communities and ambitious entrepreneurs, venture capitalists, angel investors, and workforce. Louisiana has developed an impressive portfolio of research infrastructure assets that span computer science, biotechnology, medical research, and physics. This set of research infrastructure assets have attracted significant interest from academia. These research infrastructure assets, as a whole, developed a consistent track-record of attracting interest from industry for research and development purposes. Louisiana felt its duty to reap the fruits of their expertise and share them with the public good through commercial channels of distribution. Commercialization activities, including technology licenses, patents, and start-ups founded to develop university innovations into products have become the primary vehicles for transferring technology and taking two –fold benefits: thus, they share university innovations with the public in the applicable and usable forms; and they promote economic development activities that benefit citizens through job creation opportunities and increased wages.

The aim of this research is to analyze the strategic role of intermediaries of knowledge to the promotion of technology transfer and the development of the territory, with particular reference to the impact produced by the interaction between academic institutions and enterprises on the regional economy. In the case of Louisiana, the success of Innovation Ecosystem has been the meeting point between the actors that partake in the research and innovation system: universities, research centers, and initiatives. Such a "meeting" is not a goal of the strategy, and has had the implementation and structure of the system (which in some regions may have no structure at all) as the primary purpose, performed through the coordination and collaboration of the members involved in the research and innovation process. The Innovation Ecosystem is still an interface between various productive realities, which are connected by the interrelation, which takes for basis the closeness. The case of Louisiana is a clear example of how the *Ecosystem* for innovation has moved towards national and global development, thus facilitating the harmonious development of a strong innovation system. Louisiana region improved both local and non-local realities that functioned in various technology and scientific areas by means of the technology transfer, and the determination of successful projects within the innovation sector. Additionally, the region continues to promote the entrepreneurial activities locally through the incubation operation. In such a way, it is able to contribute to the development of innovation with minimal transaction expenditures from the system due to the cooperation among the members of the productive and scientific worlds. Overall, the *Innovation Ecosystem* strategy has proved to be a great tool of policy for economic development, aiming at the:

1. Implementation and organization of the present and the future innovation technology institutions and scientific research which function within the region;
2. Role of a specialized mediator in innovation and research through the provision of the high-tech services, operation on the stimulation and support of the connection among the entrepreneurial and scientific systems.

In the regions of southern Italy extensive research and innovation are likely to be the key to boost the competitiveness of the territory. In particular, among the regions of southern Italy, Calabria could represent the main research hub of southern Italy region in terms of investment in research and higher education, devoting the largest amount of public resources to research and development, and qualifying itself as one of Italy's premier productive Poles.
Over the past years, Calabria has directed lot of resources on foundation and maintenance of infrastructure network, which could be strong enough to support innovative practices, and reinforce the cooperation between regional entrepreneurs and researchers from innovation industry. To accomplish the goal and foster innovation

technology, the region should support the creation of a Regional Agency to promote research and innovation. The main task of the Agency should be to stablish a solid network between researchers and industry participants to encourage the development of resourceful and effective business in the fields of venture finance, innovation, and technology transfer. It should also aim at supporting the participation efforts in European programs and global initiatives on innovative development.

The identification of the main factors that have contributed to the success of innovation clusters in Louisiana could be useful to understand which dynamics were proven as crucial not only to achieve objectives, but also to generate long-lasting and effective results in terms of economic growth and development. The analysis of the variables that determines the success of innovation ecosystems in Louisiana might be interpreted as a guideline to support a winning strategy, taking into account the intrinsic characteristics of the territory, including its social and economic background, and investigating the weaknesses (in terms of strategy) and strengths and opportunities (in terms of territory) in which action is needed to stimulate economic growth within our regions.

Innovation: why it matters

Innovation is a pivotal matter for Louisiana region, because involves two crucial elements: the intellectual property asset within the universities and the mechanisms of knowledge transfer to the economy. Scientific research, focused on the public and private R&D activity and main trends in the state has contributed to review the laws, policies, and resources in place to simplify innovation. This section identifies the areas of excellence and the best practices in the nation, including a potential research model that to be taken as a successful reference to be replicated, but also suggestions for improvement in the areas of higher education, business and industry.

The economy of United States has been giving noteworthy importance to technology, knowledge, and innovation during the last decades. The employment of human capital in health care, professional and educational services and other areas "human capital driven" are progressively conquering a larger portion of the U.S. labor market[5]. 9

If we want to use the words of one economist:

Globalization and technology progress have turned physical goods into cheap commodities but have raised the economic return on human capital and innovation. For the first time in history, the factor that is scarce, is not physical capital but creativity. (Moretti, 2012).

The innovation process involves specific industry sectors, including information technology, life sciences and manufacturing, but it may sometimes consist of the ability to use creativity, or achieve efficiency in business by developing new practices and processes, which contribute to enhance productivity and competition. The U.S. Chamber of Commerce reveals that innovation is responsible for more than 40 percent of U.S. economic growth and employment. Across the United States, nations and communities are perceiving the necessity to extend knowledge-driven industry sectors while promoting innovation and technology advancements in traditional sectors at the same time. Albeit hard to measure, innovation is frequently measured by the input (expenditures) and outputs (results) of Research & Development. The long-term growth of an economy is connected to "research intensity," which measures the global R&D investments as a percentage of GDP[6].

R&D is the key to an innovation treasure chest that contains new ideas, new products, new technologies and new ways of doing business. In advanced economies, it is the tried and true route to prosperity[7]

As indicated by Innovation America, a research study promoted by the National Governors Association. Even more as a rule, research has the tendency to deliver new technologies, which likewise has a tendency to goad economic development. Traditionally, R&D is perceived as a pillar of the U.S. worldwide competitive edge, yet China's global financing resources for R&D is expected to exceed that of the United States in 10 years. Last year, China surprisingly topped the position for filings to secure innovation in all four categories: patents, utility models, trademarks and industrial designs[8]. Almost 2.7 million people over the U.S. have a job in the R&D area, in both public and private sectors, and an extra 6 million jobs support them. Louisiana estimates almost 225,429 jobs related to direct intellectual property. These jobs include positions for intellectual-property-intensive companies with accentuated R&D expenditures both in manufacturing and non-manufacturing sectors, application of registered trademarks to consumer goods, and businesses in copyright-concentrated industries.

Companies, which apply intensively intellectual property, provide 41 percent higher wages than other companies in Louisiana[9]. Studies have demonstrated that innovation is a driver of higher per-capita income and prompts many advantages, including the recruitment of brilliant students who potentially represent new workforce, entrepreneurial opportunities, new infrastructure and a spillover to higher wages in other job sectors[10]. To quote the words of Economist and innovation expert Enrico Moretti:

The innovation sector generates a disproportionate number of additional local jobs and therefore profoundly shapes the local *economy… For each new high-tech job in a metropolitan area, five additional local jobs are created outside of high tech in the long run… These five jobs benefit a diverse set of workers both professional and non-professional* (Moretti, 2012).

The Small Business Innovation Research (SBIR) program provides incentives for American small businesses and encourages them to invest in R&D to market their products; almost $2 billion received award recognition in 2013. The Small Business Technology Transfer (STTR) program represent the instrument through which the federal government stimulates innovation through collaborative R&D between academic world and small businesses; globally $200 million was the award for 2013. Federal agencies with an exceeding R&D budget of more than $1 billion, such as the Department of Defense, are obliged to direct 0.3% of that budget for STTR awards to small businesses, which in turn will pledge intellectual property agreements with the research institution to guarantee commercialization. Furthermore, to support SBIRs in the state while leveraging federal research dollars, Louisiana launched a research tax incentive for SBIRs within the state's Research and Development Tax Credit. The incentive provides an additional 40 percent cash boost to the cash value of SBIR awards. The global value of the 353 SBIR/STTR awarded to Louisiana is settled around $76 million.
However, the first step is to channel these investments in areas that have a "monetary value" for the state. In fact, the amount of state R&D funds remains secondary to how it is spent. Studies from the 2014 State New Economy Index showed that *"it is not the amount of capital, but the effectiveness with which it is used that accounts for as much as 90 percent of the variation in growth of income per worker"*[11].

Innovation occurs in a variety of places — from universities to non-profits to start-up companies and public-private partnerships. Some states are trying to prioritize some specific economic development sectors, and providing incentives to encourage university and industry partnerships. Figure 1 shows how "*this investment is targeted toward making advancements across various elements of the economy*".

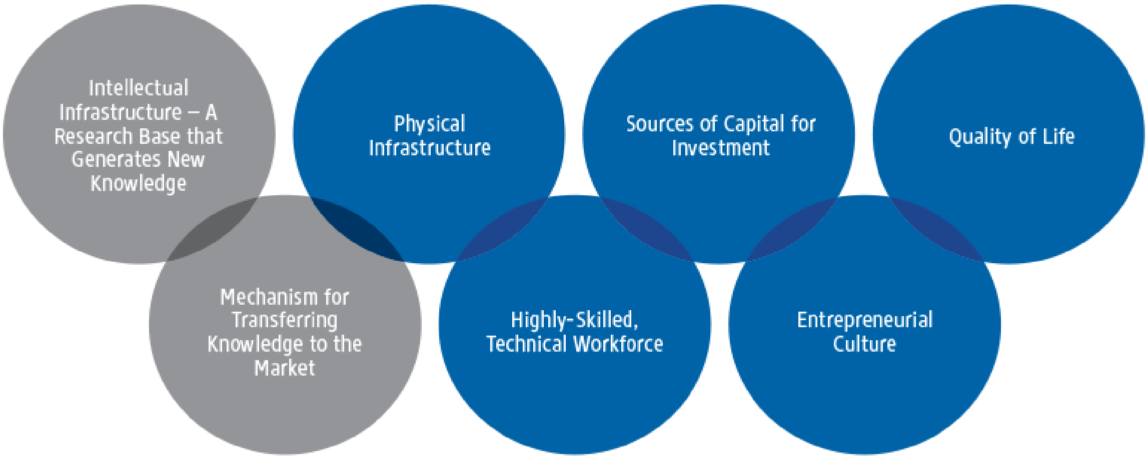


fig. 1. Elements of a Technology-Based Economy. The State of Science and Technology Institute (Conaway& Scott, 2015)

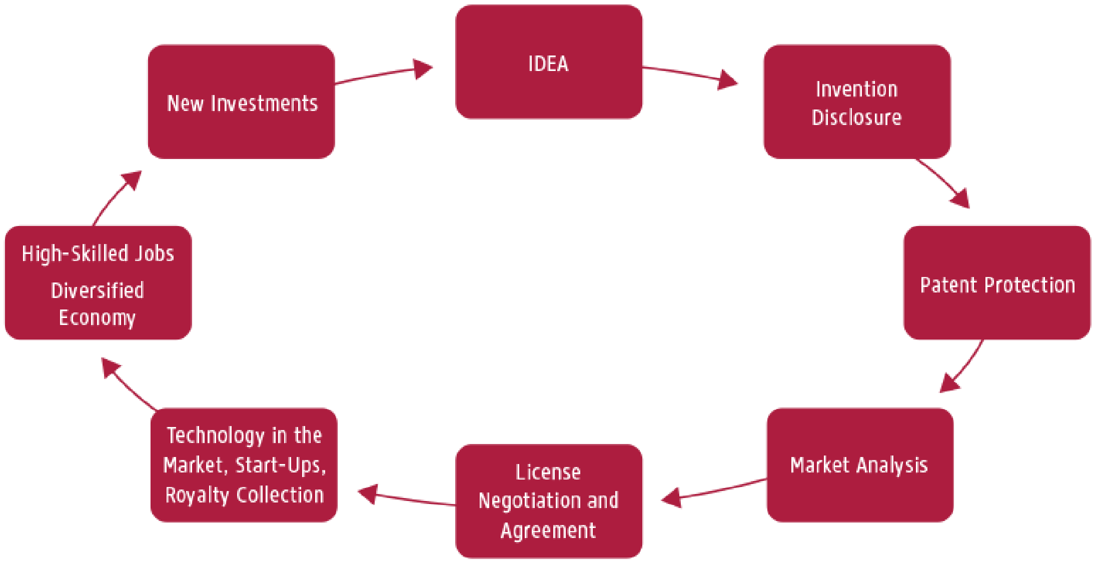
As previously mentioned, the aim of this research is to focus on two of the main assets of the flourishing technology-driven economy in Louisiana: the intellectual infrastructure and the mechanisms through which knowledge is transferred to the market. The Universities in Louisiana are, in most of the cases, the cradle of the intellectual infrastructure of the nation. For this reason, the commercialization of disclosures and new products for the greater benefit of the public has been an enduring challenge for Louisiana.

Universities: Intellectual Infrastructure for Innovation

In spite of the fact that the vast majority of R&D in the United States and around the world is funded and performed by industry, the academic world (including universities and college) directs more than $60 billion in research every year[12]. As the traditional epicenter of knowledge and innovation, universities deliver both basic and applied research, and share support by different sources—including federal and state governments, industry and non-profit entities and so on. Federal government funded more than half of U.S. university research in 2012, with an additional $5 billion for federal research centers at universities[13]. The approach of doing research and innovation has changed over the past decades. Traditionally, R&D was conducted by industry within large internal labs, with the aim to develop and protect knowledge, which in turn would have been released only if/when "completed" or ready to be profitable commercialized. Lately, instead, the approach of industry and academia have shifted to the preferred "open innovation." The growing awareness of the true cost of creating new knowledge led to the idea sharing ideas would be the best option both for business and academia, and for society as well. Thus, large internal labs leave space to outsourcing research, with a propensity to collaborate with universities, start-ups and other companies, to fill specific targets for each company. Therefore, once the technology is discovered and commercialized, companies and researchers can move to the next chapter[14].

Furthermore, many universities across the U.S. abandoned their "ivory towers of knowledge" attitude. Today, universities have oriented their "cutting-edge" research within specialized labs with specific offices and subject-matter experts that companies can saddle for specific needs. Quoting a think tank: "*The drive to keep research secret is declining in favor of sharing information among multiple players… The 'upstairs-downstairs' relationship between the academy and industry is over…The early adopters of a collaborative approach are likely to gain a competitive advantage*[15]*".*

An impetus for more prominent academic contribution to innovation and technology transfer was the Bayh-Dole Act of 1980, which played the role of a catalyst for universities, small businesses and non-profit entities, encouraging them to patent, control and market their federally funded research and inventions. Enclosed in the Bayh-Dole Act is a federal mandate *"that taxpayer-funded innovations be brought to the market".*[16]30 According to the Association of University Technology Managers, in fiscal year 2012, $63.7 billion was invested for university sponsored research, with a 4 percent increase over the prior fiscal year. More than 5,000 licenses executed, 5,100 patents issued, nearly 600 commercial products and more than 700 start-up companies launched during the same year, as a result of research at U.S. universities (AUTM FY12 Licensing Activity Survey) American universities continue to maintain their prolific international position in patent filing 32. Furthermore, 27 out of 50 higher education institutions seeking international patent protection were based in the United States.[17]



The process of creation is long and with numerous steps along the *innovation continuum* at which to gage achievement. Chart 3 illustrates how patents are simply one measurement in the innovation cycle, which in turn is complex and constantly in progress. For this reason, it is important to concentrate on the metrics at the different stages of the innovation cycle to assess the status and advancement of Louisiana's academic institutions. The following are brief portrayals of the various steps of an innovation cycle, just as they regularly occur within a university.

fig. 2. Within the University- From Idea to Market. Measuring Innovation (Conaway& Scott, 2015)

1. ***Idea or concept***: basic or applied research is usually the input to innovation. An input may also consist of a specific lab, created by a specific industry for a specific aim. Mandatory requirements are also financial capital and talent.
2. ***Invention and disclosure***: There is a linear relationship between the "amount" of research performed and "deal flow," that how many inventions the researcher can generate and disclose to the university (Innovation U: New University Roles in a Knowledge Economy). A federal research prerequisite is that the faculty disclose potential "marketable" inventions to the university. A benchmark widely recognized is one disclosure per $2.5 million of research (Nicole Honoree).
3. ***Technology transfer***: in most universities, technology transfer research is shared between "in-house" officers who collaborate with specialists to disclose the invention and guarantee that the various policies operating at the federal, state and university level, are complied. These officers usually help during the phase of assessment of the product and market analysis to verify its essence, the commercial value, the potential partners and next phases. The officers collaborate with the faculty staff to file a patent application and arrange a license agreement with private sector. Royalties arising from academic licensing have a wide range and rely on the technology, albeit studies conducted at a national level indicate rates typically fall between 2% and 5%.37. As showed in chart 4, compatible to federal law, universities usually share with inventors the income generated from intellectual property, including the inventor's department and the university, after the coverage of expenses (for instance, unreimbursed patent and legal fees[18]).
4. ***Entrepreneurship and economic impact***: when the technology enters the market, it encloses a "potential" for economic development, job creation and new investment, sometimes assuming the form of a start-up company. Government reports show that job creation coming "newly formed" can

reach extremely high level, making up 3% of global U.S. employment but in change of 20 percent of job creation[19]39. Since the innovation is original, breakthrough or too risky – and frequently without a defined commercial application – the licensee might require further investment and risk. In this phase, the university and inventor may begin to receive royalties, however in a very small percentage. Apparently, some universities gain licensing income equal to 1 or 2% of the university's research budget[20]. Royalties from licensed innovation usually generate a few thousand per invention. A study published by the Brookings Institute showed that, for 130 of 155 universities that took part in a national survey, the licensing income generated every year was not sufficient to cover the salaries of technology transfer staff and the attorney's fees for intellectual property[21].

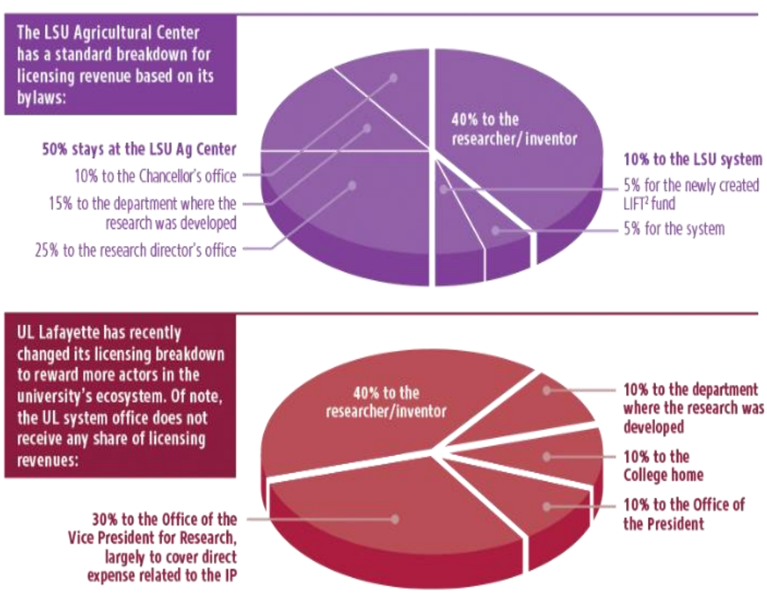


fig. 3. Samples of Academic Licensing Revenue distribution (Conaway& Scott, 2015)

A variety of studies have recognized the common attributes for universities that most adequately contribute to support initiate and fuel national and regional knowledge[22].

The right stuff

- Strong leadership that treasures industry and government partnerships to foster economic development
- World-class research in fields important to industry clusters relevant for the region
- Outstanding faculty staff, globally recognized in their own field, oriented both to basic and applied research

- Physical capital, including spaces where industry and academic world can interact between each other
- Tools, programs and resources to transpose profitably research and inventions into the market.

In general, the institutions *"economic development and open innovation"* oriented are driving the growth. Even though the leadership and academic culture is not easy to measure, they undoubtedly have a strong impact on innovation— regardless we are dealing with scientific results or industrial partnerships, patents or start-up companies. The institutions that recognize the importance of *"economic development and open innovation"*, that "*research funding and add real-world content to classrooms are likely to be more successful at bringing ideas into the public space*" (Shaffer and Wright, 2010). According to analysts at the Rockefeller Institute of Government: *"those places where knowledge is the lead incentive that states offer businesses they want to attract or grow will have a competitive advantage in a global economy*" (Shaffer and Wright, 2010).

Louisiana R&D Status

Regardless the fact that Louisiana has moved toward knowledge-driven economy decades ago, only recently the State agencies have adopted concrete actions in terms of resources and policies. Additionally, Louisiana's universities did not have traditionally grasped the mission to foster economic development, and for this reason, a lack of commitment and responsibility in technology transfer and commercialization of research were reflected in the weak academic productivity. Only recently, Louisiana started to experience a revitalized manufacturing sector with the launch of multi-millionaire projects and a growing demand for a high-tech workforce. According to a national study, Louisiana ranks at number 6 for the average yearly growth of high-tech industries[23]. Simultaneously, companies specialized in software and digital technology announced thousands of jobs in New Orleans, Baton Rouge, Lafayette and Shreveport/Bossier City. This is the perfect timing for partnerships between industry and academic institutions and the commercialization of research.

Positioning Louisiana among the States

The R&D formula of Louisiana in terms of input and output involved is intriguing. The total R&D expenditures in the state reached more than \$1.5 billion every year, positioning the state 35th at the national level[24]. Additionally, national figures in R&D expenditures at universities and colleges, ranking Louisiana 26th, even higher for specific areas of focus. For instance, the ranks for agricultural and environmental sciences are 16th and 19th respectively, while in math and computer sciences the state ranks 21st in terms of R&D investment among the states[25]. In fiscal year 2011, $729 million of R&D investment, nearly half of global R&D expenditures in Louisiana have been directed to universities. This figure clearly demonstrates that, compared to the overall R&D national investment, the largest part of R&D performance occurs within the universities. Consequently, the industry R&D expenditures in Louisiana (30%) is well beneath that of the state in general (69%)[26].

The federal government is the main source for universities R&D funds, since nearly half of $729 million academic research dollars is expended at the academic level. This is probably due to the effort of the Board of Regents within the Louisiana's *Experimental Program to Stimulate Competitive Research (*EPSCoR), an initiative designed by the National Science Foundation with the aim to promote science and engineering research skills, in states historically penalized in terms of federal R&D grants.

It is also important to recognize that Louisiana present some challenges not easy to overcome, including the medium-sized population base, the absence of a major federal research facility, and low levels of private investment in industry-based R&D. However, this does not imply the possibility for the state to achieve positive results, both quantitative and qualitative.

For instance, focusing on performance metrics in relation to the commercialization of research, Louisiana Tech and the LSU-Health Sciences Center in New Orleans perform very well after this adjustment in terms of invention disclosures, compared to all the campuses in the Southern region.

Source	Louisiana	United States
Federal	$320 million (21%)[59]	$53 billion (12%)
Industry	$459 million (30%)	$294 billion (69%)
Universities and colleges	$729 million (48%)	$62 billion (15%)
Non-profits	$7 million (0.5%)	$6 billion (2%)
State, Other Governments	$7 million (0.5%)	n/a
TOTAL	$1.5 billion	$428 billion

fig. 4. R&D comparisons between U.S. and Louisiana. Most R&D is performed at Universities. Nationally most R&D is performed by Industry (AUTM, Conaway& Scott, 2015)

Institutions	FY13 Invention Disclosures (AUTM)	Institutions	FY13 Invention Disclosures Per $10M (AUTM)
University of Florida	335	Clemson University	13.3
Georgia Tech	296	University of Alabama (main)	8.7
North Carolina State	238	Louisiana Tech	7.2
Duke University	218	LSU – HSC (New Orleans)	6.7
Vanderbilt University	178	University of Florida	6.2
Virginia Tech IP Inc.	174	North Carolina State	5.7
Univ. of Virginia Patent Fdn.	162	University of Louisville	5.6
University of Tennessee	145	Wake Forest University	5.1
University of Georgia	140	Auburn University	4.4
UNC Chapel Hill	138	University of Tennessee	4.3
University of Louisville	105	Tulane University	4.2
Wake Forest University	102	Univ. of Virginia Patent Fdn.	4.2
Clemson University	102	University of Georgia	4.0
UAB Research Foundation	101	Georgia Tech	3.5
University of Miami	75	Virginia Tech IP Inc.	3.5
University of South Carolina	68	University of Arkansas	3.5
Auburn University	65	Oklahoma State University	3.5
Florida State University	58	LSU-Ag Center	3.4
Univ. of Kentucky Res. Fdn.	58	University of South Carolina	3.3
Tulane University	57	Vanderbilt University	3.2
Oklahoma State	50	University of Delaware	3.2
University of Alabama (main)	58	Florida State University	3.0
University of Delaware	45	LSU – HCSD (Shreveport)	2.7
University of Arkansas	44	Duke University	2.7
Mississippi State	35	Univ. of Kentucky Research Fdn.	2.4
LSU – HSC (New Orleans)	33	UAB Research Foundation	2.3
West Virginia University	31	UL Lafayette	2.3
LSU A&M	31	UNO	2.2
LSU Ag Center	30	University of Miami	2.2
Louisiana Tech	18	LSU A&M	2.1
UL Lafayette	14	West Virginia University	2.0
Pennington	10	Pennington	2.0
LSU – HCSD (Shreveport)	8	UNC Chapel Hill	1.8
UNO	5	Mississippi State	1.7
University of Mississippi	1	University of Mississippi	0.2

fig. 5. Invention Disclosures among Southern Universities. SREB direct comparisons of Invention disclosures among Louisiana Institutions. Variance adjusted for research dollars expended (AUTM, Conaway& Scott, 2015)

How Louisiana Universities compare to each other

Tables below show the R&D inputs and outputs of Louisiana academic institutions to fiscal year 2012 performance as measured by accepted metrics and compiled by national experts. This study includes only Louisiana's Tier One and Two four-year academic institutions, as designated by the Southern Regional Education Board (SREB). As noted, within the state Tulane University spends slightly more than LSU's main campus in Baton Rouge. Louisiana Tech expends approximately $26 million annually, nearly tying the University of New Orleans.

Louisiana Institutions	FY12 Research Expenditures (AUTM)	National Rank By Institution/System (AUTM)	In-State Rank
Tulane University	$152,053,048	#103	#1
Louisiana State University (LSU) A&M	$149,885,000	#104	#2
LSU Agricultural Center	$88,866,000	#129	#3
University of Louisiana at Lafayette	$65,000,000	#147	#4
LSU Health Sciences Center-New Orleans	$53,712,000	#153	#5
LSU Pennington Biomedical Center**	$46,644,000	#157	#6
LSU Health Sciences Center-Shreveport	$29,365,000	#175	#7
University of New Orleans	$27,238,849	#179	#8
Louisiana Tech University	$26,546,000	#180	#9

*Although the FY2013 data was used for the regional comparison above, full data tables for all universities were not available from AUTM at the time of publication. In order to show national rank, PAR chose to utilize FY2012 data for the tables in this section.

**Of note, the R&D expenditure for Pennington could be considered inflated because it includes dollars spent on clinical trials. While trials are a necessary step in the development of new drugs, it is not the type of research activity that leads to innovation as defined in the following metrics.

fig. 6. Invention R&D Expenditures in Louisiana, FY 2012* R&D Expenditures for Tier One and Tier Two Four Year Louisiana Institutions (AUTM, Conaway& Scott, 2015)

When we move from research inputs to outputs to about academic performance, we clearly appreciate a dramatic change as showed in the table below. It is important to remember that all the comparisons are made after adjusting for levels of research funding, consistent with the suggestion of Louisiana's university technology transfer experts. In this comparison, Louisiana Tech dominates the top, not only within the state of Louisiana, but also at the national level, positioning ninth in the Top 10 institutions in the country with a total of 10.5 invention disclosures per $10 million expended. The second-highest ranking entity in 2012 was University of Tulane at position 98 in the national rank, with 3.6 invention disclosures. In the bottom line, the University of New Orleans and the LSU Pennington Biomedical Center. Furthermore, it is important to specify that Pennington is disadvantaged with this particular variable because the center the fact that the center conducts many clinical trials does not mean that these trials will lead to innovative outputs.

Louisiana Institutions	FY12 Invention Disclosures Per $10M R&D (AUTM)	National Rank By Institution/System (AUTM)	In-State Rank
Louisiana Tech University	10.5(28 actual)	#9	#1
Tulane University	3.6 (55 actual)	#98	#2
LSU Agricultural Center	3.0 (27 actual)	#120	#3
Louisiana State University (LSU) A&M	2.5 (38 actual)	#145	#4
LSU Health Sciences Center-New Orleans**	2.2 (12 actual)	#162	#5
LSU Health Sciences Center-Shreveport	2.0 (6 actual)	#166	#6
University of Louisiana at Lafayette	1.2 (8 actual)	#181	#7
University of New Orleans	1.1 (3 actual)	#187	#8
LSU Pennington Biomedical Center	1.1 (5 actual)	#188	#9

*Of note, all institutions in Louisiana did improve the number of invention disclosures in FY2013 over FY2012 with the exception of Louisiana Tech and LSU A&M.

**As discussed later in this report, LSU-Health Sciences Center in New Orleans demonstrated dramatic recent progress. FY2013 data would like place the institution in the Top 25 in the country for invention disclosures per $10 million.

The analysis in the table below shows a similar scenario when we examine US patents issued to each institution per $10 million in research expenditures. Louisiana Tech is again at the top, ranking in the Top 25 nationally for maximizing its dollars. The LSU Health Sciences Center in New Orleans ranks 2nd in the state, while all other institutions drift in the bottom quartile nationally on AUTM's survey. Finally, only two institutions in Louisiana received zero patents in fiscal year 2012. (The number of institutions with zero patents increased to three in fiscal year 2013 including LSU-HCSD in Shreveport, UNO, and Pennington).

fig. 7. Invention Disclosures in Louisiana Institutions, FY 2012* Invention Disclosures per $ 10 Million at Tier One and Tier Two Four Year Louisiana Institutions give rise to an outlier, a top 10 University. (AUTM, Conaway& Scott, 2015)

Louisiana Institutions	FY12 Patents Per $10M R&D (AUTM)	National Rank By Institution/ System (AUTM)	In-State Rank
Louisiana Tech University	2.6 (7 actual)	#22	#1
LSU Health Sciences Center-New Orleans	.9 (5 actual)	#74	#2
LSU Health Sciences Center-Shreveport	.3 (1 actual)	#149	#3
LSU Agricultural Center	.3 (3 actual)	#150	#4
Louisiana State University (LSU) A&M	.3 (4 actual)	#160	#5
LSU Pennington Biomedical Center	.2 (1 actual)	#173	#6
Tulane University	.1 (2 actual)	#177	#7
University of Louisiana at Lafayette	0 (0 actual)	n/a	n/a
University of New Orleans	0 (0 actual)	n/a	n/a

*Of all Louisiana institutions, LSU A&M saw the most progress in patents issued in FY2013 over FY2012, increasing from 4 to 10.

For FY 2012 Louisiana Tech out-performs again other universities in the state in terms of license agreements or options (See table below). Louisiana Tech proved a strong capability in maximize research funds to foster economic development and accentuate commercialization among faculty and staff. LSU Agricultural Center ranked second when adjusted for research dollars, but it has actually executed the highest number of licenses in Louisiana with a total of nine in the same fiscal year. However, Louisiana research institutions that did not produce any license agreements or options in 2012 are University of Lafayette and UNO.

fig. 8. Patent Issued- U.S. and Louisiana, FY 2012* Patents issued per $ 10 Million at Tier One and Tier Two Four Year Louisiana Institutions (AUTM, Conaway& Scott, 2015)

Louisiana Institutions	FY12 Licenses Per $10M R&D (AUTM)	National Rank By Institution/ System (AUTM)	In-State Rank
Louisiana Tech University	1.88 (5 actual)	#30	#1
LSU Agricultural Center	1.01 (9 actual)	#70	#2
LSU Health Sciences Center-Shreveport	.68 (2 actual)	#113	#3
Tulane University	.52 (8 actual)	#130	#4
LSU Pennington Biomedical Center	.43 (2 actual)	#146	#5
Louisiana State University (LSU) A&M	.33 (5 actual)	#156	#6
LSU Health Sciences Center-New Orleans	.17 (1 actual)	#173	#7
University of Louisiana at Lafayette	0 (0 actual)	n/a	n/a
University of New Orleans	0 (0 actual)	n/a	n/a

*FY2013 saw several shifts with regard to in-state rank, although most institutions would likely have remained in the bottom tier nationally. LSU A&M actually dropped further, only executing two licenses in FY2013, while LSU-HCSD in Shreveport executed none. At the same time, the LSU Ag Center jumped to 15 licenses and would replace Louisiana Tech for most licenses executed in the state in a direct comparison or when adjusted for the amount of research dollars invested. Also of note, UL Lafayette executed four licenses in FY13, up from zero.

The success of Louisiana Tech may be attributed, among the variables delineated above, to the peculiarity of its research focus – that is, the field of applied science, technology, and engineering. These areas of research are more likely to be commercialized if compared, for instance, to basic research or social science research. Simultaneously, Louisiana Tech has neither medical schools nor agricultural programs, which can drive research productivity and commercialization on college campuses. That is because licensing revenue is usually highest in the pharmaceutical/medical and agricultural fields, whereas engineering, computer science and digital media frequently involve strong private partnerships, so that the benefits cannot be always translated in revenue, but more significantly in the workforce and the community. This trend seems to be truthful in Louisiana, where Tulane University is at the top of the list with its hospitals and medical research in fiscal year 2012. (See Table below). In the same year, the LSU Agricultural Center ranks 2nd with a global $9 million in licensing revenue for new products moved into the market[27]. To date,

fig. 9. FY 2012* Licenses Executed per $ 10 Million at Tier One and Tier Two Four Year Louisiana Institutions (AUTM, Conaway& Scott, 2015)

the Ag Center brought in the State more than $ 20 million thanks to a very well-known exclusive licensing agreement signed with BASF and Clearfield Rice in 2003, to produce a new herbicide-resistant rice varietal. (The fiscal year 2013 list ranked the Ag Center No. 1 and Tulane No. 2.)[28]

Louisiana Institutions	FY12 Licensing Revenue	National Rank by Institution/ System	In-State Rank
Tulane University	$10,629,051	#37	#1
LSU Agricultural Center	$9,582,731	#47	#2
Louisiana State University (LSU) A&M	$447,892	#133	#3
LSU Health Sciences Center-Shreveport	$170,440	#151	#4
LSU Health Sciences Center-New Orleans	$96,124	#157	#5
University of Louisiana at Lafayette	$43,000	#168	#6
Louisiana Tech University	$31,500	#174	#7
University of New Orleans	$28,836	#176	#8
LSU Pennington Biomedical Center	$25,618	#177	#9

*In FY2013, Tulane's licensing revenue dropped to $3.8 million, leaving LSU Ag Center in the clear lead on licensing revenues within the state.

fig. 10. FY 2012* License Revenue per $ 10 Million at Tier One and Tier Two Four Year Louisiana Institutions (AUTM, Conaway& Scott, 2015)

As showed in the table, Louisiana Tech registered lower licensing revenues during the year, compared to the previous year or the years after. This result might be a consequence of the fact that the main goal of the institution was to market its research rather than simply "make money" for the university. According to the Center for Innovation technology at the Brookings Institute, *universities "compete for prestige, and prestige is measured in terms of high-value contracts and licensing income. Aggressive negotiations for higher royalties can lead industry to turn in-house or simply look elsewhere"*[29].

If the goal of university technology transfer were to sell its product, then protecting the university and generating income for the business would eventually be of lower priority. In fact, some universities may sometimes reduce licensing fees on industry-sponsored research, deciding that *"the small payoffs it has seen to date aren't as valuable as building strong industry relationships for faculty and students*[30]*"*.
At the State level, $2.6 billion out of $63.7 billion in research investment at universities has generated licensing revenue annually with more than 10,000 products sold (FY12 AUTM US Licensing Activity Survey). However, if making revenues is important and beneficial, this variable is not particularly useful to estimate the global value and performance of the research effort. Another important variable to measure technology transfer is the percentage of research investment provided by industry to the academic institution, even if it

is not easy to find complete data at the campus level for the last years. During fiscal year 2011, University of Lafayette positioned at No. 10 with 19% total national university R&D expenditures funded by business, against a less than 5% nationwide. The University attributed this success to the efficient institutionalization of partnerships with industry and the regular interaction between business representatives and faculty and students on campus: this periodic “exchange” allowed easy transactions on licenses and revenue sharing. Following the national debate around the best measure of the outcomes of academic research, this research analyzes the most common variables collected by the Association of University Technology Managers (AUTM), including, to name a few, the quantification of relationships with industry, the support for student entrepreneurship, and the capital raised by alumni for new companies. This information will give us a better understanding of successful university R&D programs. Consequently, this research will rely on traditional comparable metrics such as research expenditures, invention disclosures, patents, licenses, licensing revenues, and startups.

Louisiana Tech Advantage

Although other universities persevered on taking Louisiana Tech as an example, a comparison of results cannot be so obvious then. Louisiana Tech shows real levels of high performance results thanks to a concrete application of the investments made and policies adopted. The first is leadership and culture that supports and recognize the value of a knowledge-based economy. According to the university’ executives this is a primary driver to achieve positive results, and so they have consistently aligned their activities accordingly. By analyzing the objectives of the various academic institutions in Louisiana, we realize that "job creation" is not the *raison d'etre* of the academic R&D. However, Louisiana Tech repeatedly reminds us of this goal. According to Louisiana Tech’s president and senior staff, driving economic prosperity in north Louisiana is their mission, and commercializing research is a critical piece of that mission. Similarly, LSU Agricultural Center experts suggested that the number of companies created is the main result of their campus research technology. The long-term success of the research attempt at the Ag Center is the consequence of years of successful leadership that made of result commercialization; highly qualified staff and maximization of Louisiana’s competitive grants program its priority. Louisiana Tech identified very specific areas identified for R&D funds. According to its officials, the University requires a national quality program to generate a strong economic impact at the regional level. For instance, cybersecurity, advanced manufacturing and trenchless technology are crucial sectors. These research “areas of excellence” have been in place for many years. Louisiana Tech has put these areas of excellence at the center of its research focus for years, leading to the creation of major research infrastructure such as the Center for Secure Cyberspace, which in turn is attracting and retaining new companies. In the last years, universities are experiencing a decline in federal funding and for this reason industry' partnerships are critical to ensure long-term success of the research efforts. Research funding important to make effective, innovative research. If the university is unable to attract funds and support faculty in the research, "the ultimate mission fails."

Thus, Louisiana Tech has revealed its "philosophy to get the deal done" to find quick, original ways to secure funds for both research and commercialization. Louisiana Tech intentionally chose to *"not to engage in lengthy negotiations with industry and to not hold out for a huge payout*[31]*."* Instead, they sought for market-based royalty rates negotiations, as well as streamlined approval processes efficiencies. It is clear that Louisiana Tech's company partnerships, research marketability and benefits to the north community of Louisiana are valued more than the short-term revenue gains for the university. The partnerships also a result of the joint efforts with individual companies in to implement curricula and programs in specific areas where workforce is required, including, for instance, a telecommunications certificate with CenturyLink. The policy of Louisiana Tech is to favor on-campus licensing agreements where the University of Louisiana system office is not involved. Additionally, Louisiana Tech developed express license agreements to employ as

Templates to expedite agreements with faculty spinout companies and utilized option agreements with companies to allow them to validate the technology in-house at a reduced cost to finalize the deal[32].

Since most of the small and medium-sized companies have poor experience in partnerships with universities (unlike large corporation), and they do not have enough funds to engage technology scouts, Louisiana Tech has developed "ad-hoc" guidelines to help the private sector manage R&D agreements, licensing, and contracts. The College of Engineering and Science provides valid and effective indicators of the efficient faculty administration and promotion policies including patents, externally funded research, technology licensing and the creation of start-up companies. In 2011, Louisiana Tech has received a grant from the federal Economic Development Administration to build a Louisiana Tech "i6 Proof of Concept Center" to promote the marketability of green innovation technology[33]. The aim of the annual federal competition is to simplify entrepreneurship across the country in high-growth sectors, involving the Departments of Agriculture, Commerce, Defense, Energy, including the National Science Foundation. Industry is also massively involved in the project, spreading the I-20 corridor from northeast Texas to west-central Mississippi, merging with the Enterprise Campus. Thanks to a NSF grant, Louisiana Tech also launched its Venture Enhancement Teams to commercialize university Intellectual Property via *a "comprehensive package to licenses to significantly reduce the risk[34]"*. These are multi-disciplinary teams and the projects selected can take advantage from prototypes creation, business planning, and cooperation on Intellectual Property. The federal grant is coordinated by the university, the Research Foundation, local angel network or private companies. The university manages its State Support Fund dollars strategically. For instance, thanks to pre-existing partnerships with industry, they can benefit from the Industrial Ties program. Equivalently, they took advantage of enhanced grants to create competitive labs and OPT-In funds to favorite partnerships between faculty inventors and companies. Louisiana Tech is also trying to employ Support Fund resources to obtain considerable grants from the federal government. According to the University officials, the *ecosystem approach* may be also the main reason for the success of Louisiana Tech: in this ecosystem the university *"as a whole, is pulling in the direction of marketable research including faculty and student entrepreneurs[35]"*.

Louisiana R&D achievements

During the past decades, the state of Louisiana has made visible efforts to foster regional economies through academic innovation. Outstanding programs have flourished in many areas. The state has organized a solid infrastructure made of ambitious tax incentives, benign legal conditions and favorable funding resources; ultimately, leadership is even more conforming to innovation strategies. The successful stories within the state show themselves new lessons to enhance and positively conform the university management system. Different studies through the years have enforced state and higher education leaders to think and act more dynamically, and clear examples of this new attitude are visible today even more. This trend confirmed that the innovative and policy actions undertaken by some academic institutions are working well. Specifically, the endeavors to empower industry partnerships and perceive the importance of the economic development mission within the university are the crucial factors of academic research, especially if we think that federal funds are diminishing overtime.

"Silicon Bayou" at UL Lafayette's

Almost 3 years ago, the University of Louisiana at Lafayette collaborated with Drexel University in Pennsylvania to create the Center for Visual and Decision Informatics (CVDI), the first such

National Science Foundation center in Louisiana. This NSF Industry / University Cooperative Research Center is one of 66 across the country supported by industry and NSF grants. In 2013, NSF positioned UL Lafayette within the Top 10 American universities with a very high percentage of industry-based funding for R&D. Over 19% of Lafayette's $70 million R&D budget is provided by private companies, while average at the federal and national average reaches a weak 5% 80. The massive industry involvement is not by accident. UL Lafayette leaders are deliberately encouraging the involvement and collaboration of private companies to enlarge their research program, setting eager goals to maximize R&D investment. Leadership is focusing on expanding research in areas aligned with projected needs and regional growth, including, for instance, healthcare: the aim would be the involvement in inter-disciplinary research to support the healthcare industry relying on strengths in computing. Lafayette's mission to become a "Living Lab for Health Innovation" has also been recognized by the White House, which defined the attempt as "*a community-scale testbed for healthcare innovators to test their technologies in real-world settings. Lafayette will be an active partner in developing the future of healthcare through the power of gigabit networks and software defined networking, addressing such complex societal challenges as childhood obesity, aging in place, emergency medicine, and workplace health*[36]".

According to UL Lafayette, this latest achievement was also credited - to the efforts by the Center for Business and Information Technologies (CBIT) at the university, whose goal is to transfer technology-driven innovations into the market. During the inaugural event of CajunCodeFest, the CBIT's signature event that attracts thousands of participants from different states which are involved in health care coding competition, the U.S. Chief Technology Officer defined the "Silicon Bayou – aka Lafayette, Louisiana – as the best kept secret reservoir of innovation mojo in America[37]".

Year 2014 was a prolific year for University at Lafayette: three intentional partnerships with industry for R&D generated 1,000 direct IT jobs in the area. The first arrangement involved the IT and management consulting firm Perficient, which was planning to open a center in Lafayette with 245 full-time jobs, relying on computer science graduates from UL Lafayette. The Silicon Valley-based software development company Enquero engaged with the LITE Center with plans to create a 350-job technology center. Simultaneously was announced that the world's fifth largest independent IT services firm, CGI, was choosing the UL Lafayette Research Park for the launch of a 400-job U.S. technology center. As a major incentive, the partnership will generate a ten- year fund ($4.5 million) to triple the number of bachelor's degrees at UL Lafayette's School of Computing and Informatics. Unmistakably, the partnerships between business and academic world is making a difference in Lafayette.

Innovation Cluster: Louisiana Tech prioritizes Cybersecurity

The deliberate effort of Louisiana Tech and north Louisiana to invest on university leadership and selected industry partnerships have contribute to reinforce its reputation as "one of the fastest growing cybersecurity clusters in the nation[38]". This diverse flourishing innovation ecosystem includes physical infrastructure, partnerships and widely recognized efforts in a niche area of technology. This innovation ecosystem originated with the creation of the cyber-research park, the non-profit Cyber Innovation Center located in Bossier City. Many years ago, economic development state and local began to collaborate with public and private partners, a collaboration that is now carrying positive results with academic programs and trained graduates cyber-job market-oriented.

In 2012, Louisiana Tech became the first university in the United States to offer a four-year cyber-engineering degree. Student enrolled passed from 23 of 2012 to 76 in 2013, and almost double in 2014. Students have already received national recognition with internships at the National Security Agency (NSA), which has also considered new potential partnerships with Louisiana Tech[39]. The university has been recognized as National Center of Academic Excellence in Information Assurance Research and Education from the NSA and the Department of Homeland Security (DHS) – the one and only university in Louisiana and among 35 throughout the country. The aim of the federal program is to *"reduce vulnerability in the national information infrastructure" by promoting research and growing the number of professionals with this expertise[40]".* Located in Ruston, the new Enterprise Campus is the physical space where Louisiana Tech encourages industry and government collaborations. The research park supports the recruitment and retention of faculty staff and students who want to "convert" their research into products appealing for the market economy. The first facility of the Enterprise Campus, Tech Pointe, is the residency of the Cyberspace Research Lab funded by the Air Force Office of Scientific Research with advanced computing, visualization, and networking facilities. Down the interstate in Bossier City, the Cyber Research Park houses Boeing, the Computer Sciences Corporation (CSC), Huntington Ingalls, Northrop Grumman, Lockheed Martin, and Venyu among other large companies. Of note, the direct partnership between CSC and Louisiana Tech on a specific graduate curriculum which is going to cover new 800-jobs technology center in Bossier City. The CSC's executive vice president defined the decision to locate in north Louisiana as "compelling" because of the cyber engineering program offered by Tech[41]. During the spring of 2014, a new partnership between Louisiana Tech and the Cyber

Innovation Center was launched through the Louisiana Cyber and Data Consortium, to promote and simplify the exchange of operational and technical concepts, technologies and protection of cyber assets. The consortium houses members from Fortune 500 companies, small businesses and higher education, which work together to raise awareness about risks, best solutions from cyber security and data centers[42]. The National Integrated Cyber Education Research Center (NICERC), targeted on curriculum design and teacher training in K-12 schools is another partnership between Louisiana Tech, Bossier Parish Community College supported by the Cyber Innovation Center.

LSU Engineering and IBM: integrating workforce solutions and tech research

The LSU College of Engineering is a clear example of how a voluntary and systematic effort can attract industry and provide successful workforce solutions, and curriculum and research at the same time. Two years ago, the LSU College of Engineering, which also include computer sciences, launched a brand new partnership with IBM Corp. and Louisiana state agencies to implement efficient workforce solutions and innovative research through the new Baton Rouge-based IBM Services Center. The contribution of the private Baton Rouge Area Foundation was also crucial to launch the project. It has been estimated that IBM will employ at least 800 people by 2016, and most of them will be computer science specialists. A discriminating element of Louisiana's economic incentive package for IBM is slated to fund the extension of LSU's computer science program and is already producing results. During fall 2013, the percentage of new student enrolled in computer science went up to 60 percent[43]. Consequently, LSU has collaborated with IBM to re-arrange the curriculum and include cloud technology and data analytics as main programs[44]. The university's main goal is to double the faculty members and triple the number of graduations in computer sciences in no more than 5 years since the partnership with IBM, thanks to the financial support of Louisiana's economic development funds. However, this partnership was not accidental: economic development is, in fact, one of eight strategic goals of the College, precisely "Improving and Diversifying Louisiana's Economy." With a five-year strategic plan, the university confirms that "innovation through academia and the business world will spawn a rich environment for companies and businesses to grow locally, paving the way for future diversification of our state's economy[45]". IBM staff created and utilized a scorecard to assess progress both at the college and department levels. The scorecard contains R&D variables such as research expenditures, new research funding, patents awarded, start-up companies and invention disclosures. The metrics related to Industry are used to record numbers for corporate interactions in the College of Engineering, companies involved in research, industrial research investment and roundtables with regional economic development actors. A for Louisiana Tech, LSU staff confirmed that firm leadership and high accountable faculty staff has generated better results.

The future of LSU's school of engineering relies upon innovation and industry proximity. The school is going to expand its faculty panel by adding 50 new faculty positions "in areas that matter". Students enrollment has dramatically increased. In 2014, the College began a $110 million infrastructure renovation, using both public and private dollars, which will provide the largest academic area in Louisiana in a couple of years. If the state and the private sector will continue to support LSU College of Engineering, it might achieve a privileged position at the national level. Over the years, there has been no shortage of plans and strategies from universities and the State of Louisiana to increase research and development and grow the economy. We can provide many examples:

- *The Fostering Innovation through Research in Science and Technology (FIRST)* is a plan developed by universities and collectively authorized by the Louisiana Board of Regents to feed into the Master Plan and the 2010 GRAD Act provisions[46]. According to the documents provided, the vision of the Plan is to address "near- and long-term employment needs and economic growth[47]."
- *The Board of Regents Master Plan*, which has three main goals including fostering innovation and research, support also "strategic collaborations among higher education, government, and Louisiana's existing and prospective high-growth industry sectors[48]."
- *The Strategic Inventory of Louisiana Research and Innovation Assets by Battelle Technology Practice,* commissioned by Louisiana Economic Development (LED) in 2013, aimed to diagnose strengths and opportunities, supporting emerging growth sector and cross-sector cooperation initiatives[49].
- *The Research Advisory Committee of the Board of Regents Master Plan (MPRAC)* provided guidelines to the Louisianan Innovation Council (2014) based on a series of working groups and other attempts, including the urgency for industry-university liaisons, coordinated support for research centers, and proof-of-concept funds.
- *The Council of Technology Transfer Officers* partially reestablished by LED and assembled during the spring of 2014.

Incubator and Venture capital

Louisiana has genuinely solid incubator to support newborn businesses, some of which work inside colleges and others that are

subsidized by state agencies or private holdings. A national study positioned Louisiana No. 1 for the quantity of business incubators every 10,000 business establishments[50]. The Louisiana Business and Technology Center (LBTC) located in Baton Rouge is a great example, with over 30 incubators tenants and expected availability of 2,278 occupations since its creation in 1989[51]. 110 tenants out of 140 graduated tenants are still fully operating (with a success rate of 78%)[52]. The Center manages the LSU Student Incubator and the technology transfer office from different stations located at the LSU Innovation Park and NASA's Space Center in Mississippi, providing assistance for more than 2,500 Louisiana businesses in winning important innovation research awards such as SBIR/STTR, estimated in $77 million since the office opening in 1999[53].
The New Orleans Bio Innovation Center (NOBIC) is an incubator created in 2011 with state funds, whose main target are health and bioscience start-up companies. Become fully operating, NOBIC has supported the creation of 66 companies – with 34 tenants still active — raising over $24 million 96. NOBIC leaders have collaborated with academic technology transfer offices to the creation of approximately 90% of start-up companies[54]. The aggressively recruiting of start-up companies along with the premature sale of businesses, even before the commercialization of the product, is becoming a very common trend according to NOBIC officials. The increase of venture capital is also the result of the successful effort of Louisiana Fund I, initiative of the Louisiana Emerging Technology Center in Baton Rouge. The provision of early-stage funds allowed the creation of more than a dozen Louisiana-based companies. Following the same successful formula, the Center is launching Louisiana Fund II[55]. A similar initiative is supported by BVM Capital in Shreveport, which has invested in major projects developed at Louisiana universities and incubators. According to the Milken Institute Louisiana, "reached No. 1 on the 2012 Science and Technology Index for the increase in the number of companies receiving venture capital investment and No. 8 for the number of business starts per capita[56]".

The LSU LIFT2 Fund

Hosted by the LSU Research and Technology Foundation, the Leverage Innovation for Technology Transfer Fund was created at the beginning of 2014 as direct answer to the recommendations of the LSU transition advisory council and the President's Committee on Technology Transfer. The fund is available to all entities across the system and intended as a support for researchers across the "valley of death", that is the "space" between the invention disclosure and its validation. The goal is to "*increase the number of inventions which are licensed to a corporate partner. The grants are competitive, externally scored, and will be made twice annually in amounts up to $50,000.*

Funding for the grants was re-directed from licensing revenues previously dedicated to the Office of the President. Fifteen awards were made in July 2014 totaling $500,000[57]".

Louisiana Innovation Council

Louisiana Department of Education LED and the Louisiana Workforce Commission, among other public agencies, share the responsibility for encouraging innovation in the state. The Louisianan innovation Council (LIC) was created in 2009 with the ambition to stimulate cooperation and "shape the Louisianan innovation agenda[58]". The committee lumps 31 representatives, including national agencies, academic institutions, entrepreneurs and specialists in economic development. Although completely financed by LED, the Council has the statutory power to develop and prioritize recommendations on regular basis. The first report published by LIC right after the first year from its launch analyzed the possible creation of a Louisiana Research Alliance, following the successful initiative promoted by Georgia. LIC recommendations focused on the recruitment of illustrious faculty and the creation of centers for excellent science, technology, engineering and mathematics (STEM) jobs, through balanced public and private funds. According to LIC, these funding sources *"are currently used to support other high-priority programs… In the absence of an identified funding source, the LIC will continue to explore options to achieve the desired outcomes[59]"* In 2012 Battelle Technology Practice developed, on behalf of LIC, an inventory of Louisiana R&D assets, to identify the strengths and potential opportunities for national economic competitiveness. The emerging sectors identified included digital media, coastal and water management and advanced manufacturing. Recommendations prioritized also on cooperation on technology transfer and commercialization, creation of national pre-commercialization fund, a catalog on the policies adopted by universities on matters of intellectual property, as well as the possibility to include commercialization activities in the governance.

How Louisiana maximizes innovation resources. State funds for R&D

An examination of Louisiana expended resources show that the state has been capable to generate through the years, a range of successful stories of R&D implementation and jobs creation in the technology field. The focus, in fact, is how to spend money for strategic purposes. The operating budget of Louisiana includes R&D expenditures for academic institutions, including colleges and universities. The total funds for higher education during 2014 was approximately $1.1 billion. Over $181 million of the total budget, from globally available resources, has been invested in academic research as reported by the Board of Regents, with a considerable increase over the prior fiscal year[60]. During 2014, the Workforce and Innovation for a Stronger Economy (WISE) Fund, a dedicated and targeted research oriented fund was created by the Louisiana Legislature. According to the legislative leadership, the main goal for the government for this fund was to support the demand for specialized degrees and prioritize high-demand marketable research to satisfy the needs of the state in terms of workforce and innovation. Following the new law, the Board of Regents will acquire a $40 million annual deposit, which will be assigned to two- and four-year institutions, accordingly with the national workforce demand and gap scientific report conducted by the WISE Council. The council is composed of four system presidents, a higher education commissioner and several representatives of different state agencies. The 80% of the fund is based on the percentage of degrees and certification in high-demand research areas, while the remaining 20% is on federally funded research investment. A minimum 20% private match is required to be eligible for funds, while funds are available in different forms, such as cash, materials, infrastructure, scholarships or endowments.

The approach to combine degree production incentives and high-demand field research as well as the binding industry involvement turned out to be very successful, proving significant progress in every field, in terms of innovation. In recent years, pursue of alternative funds for research and innovation has been one of the main concern for Louisiana Legislature. During fiscal year 2013, the support from regional economic development partners allowed Louisiana to establish MediFund with the ambition to create centers of excellence in biosciences and biomedicine, support research and improve health outcomes. Similarly, Medifund receives support grant through the U.S. Economic Development Administration and the Baton Rouge Area Chamber, which provides staff support for the identification funding sources.

The Support Fund

The traditional source for academic research funds in Louisiana is still the constitutionally designated Board of Regents Support Fund. In 1986, the recently renamed Kevin P. Reilly Sr. Louisiana Education Quality Trust Fund (LEQTF) was created by an amendment to the Louisiana Constitution. This Fund, which started with an original investment of $540 million, has now reached more than $1.2 billion. The LEQTF relies on two components:

a. The Louisiana Education Quality Support Fund, which earns 75% of global expenditures and royalty income from the LEQTF and 25% of the earnings from net capital gains/losses;

b. The Permanent Fund, which gets the reverse[61]. The overall sources of income (expenditures, royalties, and capital gains) are equally distributed between the Board of Elementary and Secondary Education (the 8g fund) and to the Board of Regents (the Support Fund)[62]. A further distribution of funds follows a competitive grant process to boost academic achievement and educational outcomes.

Institution	FY13-14 Allocation	Institution	FY13-14 Allocation
Baton Rouge CC	$199,000	McNeese	$0
Bossier Parish CC	$75,879	Nicholls	$840,493
Centenary	Did not apply	Northshore TC	$45,000
Delgado	$0	Northwestern	$196,754
Dillard	$116,290	Nunez CC	$97,632
Grambling	Did not apply	OLHC	$120,445
Fletcher	Did not apply	OLOL	$44,250
Louisiana College	$172,162	River Parishes CC	Did not apply
Delta CC	$0	St. Joseph	Did not apply
LSU Ag Center	$121,000	SLCC	$0
LSU Alexandria	$490,085	Southeastern	$191,662
LSU Main Campus	$3,803,245	Southern BR	$0
LSU Eunice	$62,500	Southern N.O.	$315,785
LSU Law	Did not apply	SU Shreveport	$254,635
LSU Pennington	$148,639	SOWELA	$31,633
LSU Shreveport	$118,335	Tulane	$2,263,349
LSUHSC N.O.	$112,000	Tulane HSC	$987,148
LSUHSC Shreveport	$0	UL Lafayette	$1,569,588
Louisiana Tech	$1,414,469	UL Monroe	$91,000
Loyola University	$76,466	UNO	$441,426
LUMCON	Did not apply	Xavier	$136,030

fig. 11. Regents Support Fund recipients' FY 2014. The Board of Regents allocated $ 14.5 million in New Grants from the Support Fund to 32 Public and Private Institutions last year (AUTM, Conaway& Scott, 2015)

During 1986 Louisiana invested over $700 million in higher education through the Board of Regents Support Fund, with more than half of expenditures to enhance academics and research ($363 million) 118: the return on investment was about $1.61 for each dollar invested in all projects funded since 1987. Achieved results are:

- 3,060 external research awards, $1.2 billion in external funding from federal, private, and other sources, which have in turn generated an estimated $2.5 billion in new revenues to Louisiana firms and almost 45,000 new jobs
- 314 endowed chairs for Eminent Scholars at 26 campuses
- 2,262 endowed professorships at 39 campuses
- 1,514 superior graduate fellowships at 16 campuses[63]

Between 2014 and 2015 the estimated budget was approximately $23.5 million, while since then, the Louisiana Legislature acquired $27.2 million; the excess was conferred to endowed professorships. The budget of $23.5 million estimated by the Board of Regents was divided as follow[64]:

- $12.4 million for the enhancement of academics and research,
- $4.6 million for "carefully designed research efforts",
- $3.6 million to recruit superior graduate fellows,
- $2 million to endow chairs,
- $842,000 in administrative expenses.

These categories are identified in the Louisiana Constitution and in statute. Since then, the Board of Regents has lunched 13 programs and subprograms divided in different categories, with the ambition to satisfy different goals and purposes:

1. The ***R&D Program*** for "carefully defined research efforts[65]", with three sub-programs, with $2.2 million required to fund prior commitments during last fiscal year:
   a. The *Research Competitiveness subprogram* ($1.4 million in new first-year funding) "designed to assist competitive researchers in targeted fields to abate the final obstacles to compete for federal R&D dollars".
   b. The *Industrial Ties Research subprogram* ($585,000 in new first-year funding) "to support proposals with significant near-term potential for contributing to the development and diversification of the Louisiana economy."
   c. According to LED[66], nearly half of completed projects within this program were successfully commercialized or in the process of commercialization, and the Board of Regents estimates a direct return of $11 for every dollar invested".
   d. The *Awards to Louisiana Artists and Scholars subprogram* ($450,000 in new first-year funding) was "created in fiscal year 2002 to provide support for productions with a potential for broad impact on a regional or national level. The subprogram's justification within the carefully defined research efforts, according to the Board of Regents, was a result of the Board's strategic plan to improve educational quality at all levels in all disciplines[67]"

2. The *Endowed Chairs Program* ($2 million) was "created to recruit and retain distinguished faculty with 314 funded chairs in 26 institutions and a total endowment of $362 million[68]".

3. The *Graduate Fellows Program* ($3.6 million) was "created to attract and retain high-quality graduate students into particular departments. Nearly all of the current year funds simply go toward prior obligations".

   a. The *Traditional Graduate Fellows subprogram* "primarily supports doctoral-level fellows".

b. The *Graduate Fellowships for Teachers subprogram* "supports pre- and in-service teachers seeking master's degrees in science and math, requiring a commitment to teach in the Louisiana school system for at least one year[69]".

c. The *Board of Regents/Southern Regional Education Board Doctoral Scholars subprogram* "provides fellowships to build diversity in graduate programs".

d. The *Enhancement Program for "academic, research, or agricultural departments or units within community college, college, or university,* is the largest component of the Support Fund, three times the amount of the R&D program – despite the stated constitutional goal of the Support Fund for "higher educational purposes to enhance economic development[70]"

Much of the annual appropriation funds prior obligations". According to the Board of Regents, six grants for six different programs are available to all Support Fund-eligible colleges in Louisiana:

I. The *Traditional Enhancement program* ($4 million), to acquire instructional and research equipment, classified as "the area of greatest need in the Enhancement category". Recently new funds are available for curriculum revision projects, service learning, projects etc.

II. The *Undergraduate Enhancement program* ($1.6 million) specifically designed for universities without extensive graduate programs.

III. The *Enhancement Program for Two-Year Institutions* ($1.1 million) created in 2002 to guarantee support funds dollars to the community and technical colleges.

IV. The *Federal Matching Grants Program* ($1.6 million) adopted as a coordinating tool for federal grants including NASA and EPSCoR.

V. The *Endowed Professorships program* ($2.8 million), similar to the endowed chairs previously mentioned. An investment of $60,000 from non-state sources is required to be meet the $40,000 coming from the Support Fund, with at least $100,000 professorship. Campuses can use federal funds to acquire one professorship per year.

VI. The *Endowed Undergraduate Scholarships Program for First-Generation College Students* ($1 million) ensures a $40,000 endowed scholarship each four-year institution to gain a private or institutional contribution of $60,000 "to permanently endow a scholarship fund for first-generation students. Two-year schools are guaranteed $20,000 with a $30,000 private match. Students must receive a minimum of $1,000 annually along with structured support from the university and campus employment".

Regents Support Fund Category	FY 2014-15 Budget
Enhancement	$12,403,706
Research and Development	$4,620,000
Graduate Fellows	$3,614,000
Endowed Chairs	$2,020,000
Administartive Costs	$842,294
TOTAL	$23.5 million

fig. 12. Regents Support Fund allocations by Category. FY 2014-15 Budget (AUTM, Conaway& Scott, 2015)

The Board of Regents has complete responsibility over the sub-programs and funding distribution between each of the four main programs established by the Louisiana Constitution establishes the four programs, with the exception for multi-year awards previously funded, which can reach a considerable amount. The Support Fund budget has recently imposed to the Board of Regents the condition “that the quality of the applications and demand for funding is continuously on the rise[71]”. The Board of Regents Support Fund supports also the Louisiana’s Experimental Program to Stimulate Competitive Research (EPSCoR), a federal initiative supported by the National Science Foundation. At the present stage, the Support Fund contributes with $2 million to match the $4 million of NSF for a five years’ program, with a total $30 million, where one-third is state funded, and two-thirds federally funded. The EPSCoR program was designed to encourage science and engineering research potentials especially for states have not been historically awarded with consistent federal R&D grants. Since Louisiana ranks 26 in the national list for academic R&D expenditures, the Program seems to have satisfied its goal to stimulate research competitiveness. According to the Board of Regents, the direct return on investment is $4.19 for every dollar awarded in NSF grants. The decision to match targeted federal grants and opportunities have “enabled the State to progress from receiving minimal support from NSF for research collaboration in the 1980s, to the current environment, in which Louisiana is among the elite of EPSCoR states in successful research-related grants and activities[72]”.

Leveraging to improve outcomes

To sum up, the Louisiana’s Constitution supports more than 20 programs, funded with Support Fund dollars, intrinsically dedicated to boost economic development of both public and private universities in Louisiana. EPSCoR main goal to intensify federal R&D in Louisiana has been achieved, while research commercialization and technology transfer academic results have significantly improved: each sub-program allows to match a specific target, leveraging the national and constitutional purpose of enhancing economic development through investment.

Louisiana Tax Credit Incentives

Louisiana national laws provide a variety of incentives that encourage innovation, R&D, and investment. During 2013, LED in association with the Louisiana Department of Revenue conferred more than $25 million to businesses eligible for the tax credits:

- The R&D Tax Credit incentive ($24.3 million, FY 2013, which is going to expire in 2019) – defined by the Tax Foundation as "the third most generous R&D credit in America", provided up to a "40% tax credit on qualified research expenditures incurred" in state of Louisiana. The national law specifies that the credit has no minimum requirement or cap, has been conceived for research that is "technology in nature" excluding the involvement of research conducted in other fields, such as social sciences.

- The Technology Commercialization Credit and Jobs Program ($105,000, FY 2013-2017) – with a cap of $250,000 per application, is a "40% refundable tax credit incentive for businesses that are going to invest in the commercialization of technology created by a Louisiana business and researched by a Louisiana college or university. Qualifying costs include machinery, equipment, licenses, patents, copyrights, and payments to the schools or third-party research centers in Louisiana".
- The Angel Investor Tax Credit incentive ($1.8 million, FY 2013-2015) – with an annual cap of $5 million, favors with a 35% tax credit all the investments made by investors funding companies certified by the Louisiana Department of Economic Development as "Louisiana Entrepreneurial Businesses". These companies "must totalize at least $10 million annually or present a business net worth of less than $2 million. Qualifying funds include capital improvements, equipment, R&D, and working capital".

Recommendations to meet Louisiana's challenge

From the point of view of the opportunities, three assets seem to differentiate the successful formula for innovation in Louisiana:

I. The role of leadership and institutional culture,
II. A new re-discovered interest from academic institutions in acting as partners in economic development through commercialization and technology transfer; and
III. The prioritization of financial capital and talent, as main resources behind economic development.

The Role of Academic leadership and institutional culture

Louisiana is working hard to boost its intellectual infrastructure for innovation, as its leaders have largely recognized the need of prioritizing the economic development mission of the university and commercialization of academic research. National administrations, along with state economic development agencies and higher education enterprise share the responsibility for creating and improving *Louisiana's innovation ecosystem,* as in the past this ecosystem was not efficiently coordinated or accomplished on a national level. While the private sector has begun to embrace the "open innovation" model, some Louisiana universities have learned how to find new ways to influence regional economic development by pushing innovation out promptly and efficiently while shaping their connection with the private sector to spur the economy. According to latest research, universities are progressively learning how to find alternative solutions for technology transfer, trying to overcome "informational and cultural barriers" such as university-industry conflicts, excessive bureaucracy, and issues with the private sector "interfering with academic freedom[73]", among others. A change that is starting from the top, with a change of attitudes and culture, as well as policies, resources, supportive culture and leadership, both in the public sector and in higher education. The priority is moving from the top to the bottom, with academic research shifting from labs and academic journals to the society through multi-institutional, public-private campaigns to support innovation. Universities with strong track records in technology transfer do not have the same protective approach. There are different ways to reach the goal – some institutions may emphasize commercialization, while others will carefully balance time and investments to launch new technologies into the market. Other universities, for instance, will support the creation of spin-off companies to "bypass" the financial risk. Regardless of the mechanisms and approach, it is the leadership and culture of expectations that can make the difference – that research will be commercialized, that an impact on the economy of the state is important, and that each institution has unique niches and areas of expertise that should shape their role in that process. The most frequently pointed out reason why Louisiana continually ranked low on the outputs from applied research was "resources". This because without sufficient funds, without enough expenditures on R&D, the university "cannot be expected to produce more[74]". The constitutionally dedicated Support Fund gave Louisiana the opportunity to fund additional and more targeted R&D, with an average annual budget of approximately $20 million during the past ten years. As noted by many experts "focused spending is critical to ensuring state investments have the desired outcome[75]". For instance, to implement recommendations effectively, various campus in Louisiana are stressing the importance and the urgency for "pre-angel seed funding" as a tool to "double-check" research projects commercialization. That because venture capital is not accessible at early stages of research, and angel capital would represent a high-risk option that implies some basic recognition prior to investment.

"*Louisiana is fortunate to have a dedicated funding stream for R&D already approved by the people in the Louisiana Constitution and enacted by the Legislature — with the flexibility in the law for the Board of Regents to approve policies to keep the Fund relevant and effective. Prioritization and directing resources accordingly can solve some of the challenges to bringing research to market. The Board of Regents dashboard for the Master Plan indicates hundreds of millions of dollars are already being used for aligned investment of State and campus resources in areas of high potential for research commercialization*[76].

That statement clearly reconciles with the selective priorities, better targeting and leveraging of resources Louisiana has been promoting through the years. The best practices promoted by the nation also support the idea that innovation and research "for the market" should prioritize the proper allocation of resources. Basic research is not the final goal for research funds, but applied research and inventions are crucial for economic growth and economic development within the region. Even though the academic system "cannot control some factors that enhance technology transfer, such as proximity to numerous and concentrated high-tech firms", however, the state of Louisiana started to use existing resources to replicate best practices and successful models", where motivating and strongly committed leaders can make decisions to maximize existing resources and spur a successful knowledge-driven economy.

Fiscal Year	Allocation (*Budgeted)
FY2015	$23.5 million*
FY2014	$23 million*
FY2013	$29.2 million
FY2012	$23.9 million
FY2011	$23.7 million
FY2010	$25.4 million
FY2009	$34.6 million
FY2008	$34.0 million
FY2007	$32.7 million
FY2006	$29.7 million
FY2005	$34.4 million

fig. 13. Support Fund allocations over the last ten years (AUTM, Conaway& Scott, 2015)

Looking back to State economy, as it was 10 years ago, Louisiana has turned out to be a "captivating, attractive Pole" for new business investment and new jobs due to a mixture of policies and smart resource allocation decisions, ranking the highest position for progress in economic development. "Louisiana took first-in-the-nation honors for Business Climate by Business Facilities magazine and ranked in the Top 10 in three other national rankings from Area Development, Chief Executive, and Site Selection[77]". Therefore, it was not difficult to predict that the same scenario would have occurred within Louisiana's R&D community – investing on new policies, re-allocation of resources, leadership committed in state government, higher education and private sector.

Select and enable a Leader to spur regional development

As well as coordination, commitment is vital to achieve great research performance and results. For instance, we can think about an Executive Director within an innovation Council who is able to lead and manage an articulated strategy, which focuses on the same targets highlighted by the Board of Regents, the higher education system, the Louisiana Department of Economic Development, and business and industry. These actions would strictly resemble those recognized by

the Louisiana FastStart program, which is today considered as the best program in the country for customized workforce– whose identify with innovation its priority and focus.
In recent years, the Louisiana Economic Development Department partnership with the higher education system has been a crucial step in the creation of the "innovation ecosystem" model for Louisiana, simplifying the evaluation of the benefits for the region, but even more allowing for business recruitment, designing workforce solutions, boosting jobs creation. The financial incentive package provided to business companies such as IBM and CGI has been a determinant component of the economic development plan as an opportunity to spur the economy through academic programs and new graduates to support business projects within the region. At the same time, the recent news that LED is going to support LSU cyber engineering ambition to become a “top-notch national expert” is a great example of what the agency can do to advance university-based innovation.

Favor high-tech business recruitment with R&D potential

Year 2014 was the most successful year for new partnerships between firms and universities in Louisiana, where technology transfer from academia has played the major role within the economic development plan. This trend is contributing in the diversification of Louisiana economy, functioning also both as an incentive for research transfer between university and industry and workforce partnerships. The new innovative model implies that both economic development offices and the high growth job and workforce training programs are located in the same place, along with incubators, university/ foundation, TTOs. Since private businesses usually locate nearby, this interaction generate a “physical ecosystem” were the main actors collaborate simply because of they are very close and interact with each other. An incentive to spur also new financial opportunities from philanthropic and private sponsorship might be also to give recognize the most successful partnerships between university and private sector through ad hoc awards.

Legislature

Since bureaucratic controls suffocate the beneficial opportunities both for the state in terms of innovation and for the university in terms of revenues, the re-authorization of consistent and flexible innovation tax credits and rebates with a return on investment may incentivize the right behaviors by companies and universities. For instance, since the angel investor credit precludes partnerships and is only recognized for individuals who may not always have the right competence to identify the most proficient investment on their own, the authorization for credits to be transferred to investors and partners (for instance, within start-ups), can have better probabilities to generate more considerable funds for researchers and entrepreneurs. Federal laws now simplify actions for "crowd funding" and "non-accredited investors" to make equity investments. The new combined approach of the WISE Fund allows for a combination of goals and intents between workforce programs and applied research: on one hand, incentivizing degree production and research in high-demand fields and, on the other, imperative industry engagement.

The Board of Regents

The institutionalization of economic development is crucial for the Louisiana academic enterprise. The recruitment of leaders to take dynamic actions and intensify the partnerships between industry and universities across the state allow greater valued products starts at the top, while at the same time products are brought out the lab and commercialized. The Board of Regents Fund is important for technology transfer offices in terms of ability to tie industrial programs and research competitiveness, emphasizing the interaction across institutions, the adoption of peer reviews, and rigorous conflict-of-interest prearrangements[78]. From this analysis, we can also draw some recommendations on the importance of funding major areas of research, as Louisiana is doing embodying the Support Fund's mission "higher education for economic development purposes." First, the State might support the creation of incentives such as a proper "Eminent Scholars" program to select and attract faculty teams with credibility and prestige in their own research fields, committed with the public authorities in the achievement of economic development goals. Second, the funds might provide new equipment to make the research process smoother and the targeted innovation pleasing for the market. Finally, the enduring partnership between the EPSCoR program and National Science Foundation is the proof that funds need to be targeted and leveraged to have greater impact.

The closeness and alignment between public, academic and business private goals is also imperative to spur economic development. Investments must focus and target specific industry clusters, relevant to the Nation's economy and growth. Thus, the adoption of a "resource strategy" seems to be the best choice: supporting resource strategies and selecting targeted research areas, allow us to better understand what results we expect to achieve and how we can contribute to economic development. Of note, a study published by the Board of Regents in 2009 showed that "the administrators requested additional clarification and guidance in how to describe, deliver, and assess the economic development contributions[79]". The definition of the desired outcome and benchmarks for "economic development" is an imperative to match successful research and funds recipients. The

Board of Regents confirmed that more than 90 percent of Support Fund resources have been allocated to science, technology, engineering, and math initiatives (STEM), to set clear goals for outcomes, measure progress to better gauge performance and promote accountability to the intended purpose. The LSU College of Engineering scorecard is an example of such a tool.
The adoption of a "competitive, mission-driven approach" without spreading resources is also important. In Louisiana, each institution in Louisiana has its own scope and mission. This means that every institution has a different purpose rather than just addressing R&D to build a knowledge-driven economy. Others institutions may prefer to focus on alternative issues, such as political interests, while devoting resources only where they can produce outstanding results: leveraging funds more strategically where the outcomes of commercialization and economic development can materialize would be a more realistic goal.
To sum up, *"the enhancement of economic development"* is a multiple stage process, which starts with the assessment of funds devoted to each program and the decrease or elimination of areas if they do not significantly contribute to the Constitutional goal of the Support Fund. On this purpose, the Board of Regents is planning to re-direct the unused funds from other Support Fund programs, including funds available for professorships scholars that endowed chairs, to follow some of the elements that made the Georgia Research Alliance Eminent Scholars model successful through the years. Besides, the Board of Regents, along with the Louisiana Innovation Council and universities is urging for prolific partnerships with private contributors to fill the vacant endowments, with the ambition to attract renowned specialized researchers at the national level. The goal would be to reassure private investors on the liability and the quality of the research groups, which would attract other private investments in return, with a consequent enhancement of Louisiana's development.

Higher Education Systems and Management Boards

The economic development and regional growth is becoming a priority within universities and on campus. This interaction favors economic development and industry partnerships as well as a more direct connection between academic curricula, degrees and regional workforce. That is of particular matter because the mission and vision of the academic system in Louisiana is to incorporate the goal of economic development and job creation. The primary objectives of academic "commercialization, economic development and public benefit" are progressively moving away from traditional idea of "university protection". Besides, in 2014 the LSU system has decided to abandon the approval of the intellectual property requirement from the Board of Supervisors: that because such high-level approvals were not necessary to guarantee the effectiveness of academic research within the country. Furthermore, a simplification of the rules will simplify the engagement between companies and research centers with a "priority for commercialization". The endorsement of a "bureaucracy-free system" and a "flexible process" through the creation (or empowerment) of research foundations. They provide useful services to support academic and its technology transfer mission, is helping Louisiana's universities to find support for transferring the intellectual property and research into the market. The foundation (e.g. the LSU System Research and Technology Foundation, 2002) can act also as a business incubator on campus, turning the traditional academic model into a "shared services mode[80]".

The idea of the research foundation as a facilitator for academic licensing and patenting actually helps to remove some of the legal and bureaucratic obstacles for commercialization while bringing research straight into the marketplace. Since a foundation can approve licensing and patenting by working directly with the technology transfer offices from each campus, centralizing the development of licensing templates and instituting a single process for protecting intellectual property, it is more likely to encourage the support of industry, cut across campuses, and elevate the level of sponsored research. Louisiana is progressively adopting the research foundation model as a means to accelerate and simplify commercialization. Good examples include the Louisiana Tech research foundation, which actually owns the intellectual property developed on campus. The University of New Orleans is choosing the same path, thanks to the Research and Technology Foundation Inc., which acts as a facilitator for financing, acquisition and management functions, and even more for technology transfer or commercialization support. These benefits combine with the purpose to balance philanthropic orientation of the foundation itself. "*The Baton Rouge Area Chamber's analysis recently found that research universities with foundation models generate 176% more licenses and 101% more patent applications[81]"*. Thus, the admirable decision of LSU to adopt a "hybrid model with shared services" is proving that the foundation model is successful. The Louisiana's *innovation ecosystem* is still under development. The success of this model will be the result of a long-term performance based on "a multi-year, financial commitment of donors, philanthropists and industry partners".[82] The business community and the university leaders must be committed to make research commercialization as a top priority – focusing on key areas of strength for Louisiana. The partnership between the business community and the WISE Fund is strong, and thanks to the Louisianan Innovation Council, which will serve as a pivotal connection with the industry, the partnership with universities and future outcomes will be a tangible result for the state. Since the philanthropic partnerships with universities are the most traditional form of engagement for industry in Louisiana, these private institutions and their donors are becoming even more involved in the process of how the funds will be used, as well as targeted. The model for innovation is mold around industry and inputs, most of all because universities need also the input of successful businesses in their field, to create successful curricula, research and products.

CHAPTER 8

R&D, Technology Parks and Research Centers in the Innovation Ecosystem of Louisiana

Section1

Scientific and Technology Parks

For more than ten years, Louisiana has showed huge strides towards the improvement of its R&D sector, with the ultimate ambition to empower the country system's competitiveness. The high quality of research occurring in the American infrastructure as well as the strength of Louisiana's scientific community, the increasing volume of innovative initiatives and the support measures adopted in favor of investments in innovative ventures, have been fundamental features of the national system that have risen the attention of global investments in the country. Louisiana has sustained a Cluster leveraging policy throughout the country to valorize the "areas of technology excellence and boost cooperation and synergies between public and private systems" at the national level, involving scientific and technology parks, technology districts and national clusters, as part of an innovation ecosystem. As widely recognized, one of the main key driver for a long-term growth of a nation is the ability of universities, research centers and private business to innovate by carrying out scientific knowledge and research inputs.

The analysis of the Research & Development (R&D) performance of the region allows researchers to evaluate the capability to generate new scientific findings, as well as to assess the overall environment in which research and innovation are both carried out. The translation of ideas into scientific results and ultimately into innovative applications implies the need for scientists and researchers to properly exploit the environment and support services – such as equipment, support measures, funding, etc. - to refine and materialize their research. Furthermore, it is extremely important to include several aspects of a country R&D system within the general assessment as well as its context, so we will be able to picture a clear overview of the performance in various areas.

The analysis of the most interesting aspects of the Louisiana R&D system and its ability to produce scientific excellence, spread innovation, and attract foreign investment are the main are intended as guidelines to show and highlight innovative areas and support initiatives that may deserve the attention of foreign ventures for investment attraction. Louisiana is making strides for improvement thanks to the implementation of fundamental policy changes and newly designed programs whose aim is to ambitiously attract and increase foreign investment and bring change to Louisiana.

The aim of Scientific and Technology Parks is to act as a attractor for companies, venture capitalists, universities, laboratories and research centers, with the ambition to increase the wealth of the local communities by fostering the culture of innovation and the competitiveness of private companies, generating a fertile and collaborative working environment while offering a wide range of support services and activities. Louisiana Technology Park has established itself as the hub for technology development in Louisiana. It was designed to spur economic development and job creation by supporting high-tech startups with the resources to market their products and services faster and more effectively.

Created in 2001, Louisiana Technology Park (LTP) has accelerated the growth of the high-tech sector in Louisiana through the years, and it is considered as the result of then Governor Mike Foster's Vision 2020 plan, whose goal was to create a better and competitive Louisiana and as a driver for the economic renewal and diversification for the state.

It championed the importance of Louisiana's existing industries, while actively seeking diversification into emerging technology areas, and also creating an environment where entrepreneurs can thrive

It is a flourishing, synergetic home to almost 20 startups and innovative companies at different stages. These new businesses provide new technology, as well as job creation and a gradually financial expanding influence that goes all through the state. While new plans may have risen, the way to deal with economic development and the support for entrepreneurship and innovation advancement is still the same. The Louisiana Technology Park still generates new companies in the Baton Rouge Area. These companies selected Baton Rouge because of the appealing offerings of the LSP, including shared infrastructure, proficient collaborations, cooperative synergy that happens when working between organizations with shared vision and mission.

The LTP is one of the South's premier business incubators providing resources for high-tech start-up companies to bring their products and services to market faster and more effectively.
It's not just entrepreneurs and local businesses that are thriving because of the Tech Park. According to LSU economist James Richardson, the overall impact of LTP companies has produced exponential effects throughout Baton Rouge and the state, including:

$92.2 million in additional business transactions
$26.8 million in additional household earnings
614 new jobs

The direct and indirect economic impact has returned $9 for every dollar invested.

The Louisiana Innovation Park and the LBTC Business Incubator

The goal of LBTC Business Incubator is to enhance the development and growth of new established businesses by assisting entrepreneurs with company operations and supplying resources fundamental for their success. Established 26 years ago, the incubator continued to stimulate the growth of new businesses, spur economic diversification to expand Louisiana's economy. The LBTC has global recognition as one of most successful technology business incubators in the nation, housing over 30 businesses as tenants. Many programs are available, including the LSU Student Incubator to support young entrepreneurs who want to start their business while still in school. The incubator handles administrative details and overhead issues, so that the tenants can focus on operations, production, and marketing, as main factors that directly affect success. The LBTC's collaboration with small businesses and entrepreneurs has attracted more than $177 million in loans, equity investments and SBIR grants, creating more than 10,000 jobs for Louisiana.

Impact

1. LBTC Impact (October 1, 2013-December 2014)
2. 242 businesses and entrepreneurs assisted
3. 9 businesses started
4. 32 prototypes built in the first 60 days of ProtoStripes
5. $5,277,000 in loans, equity, and grants secured
6. Technology Transfer Office (1999-2014)
7. 2,750 Louisiana companies receiving SBIR/Technology support
8. $79,500,000 SBIR/STTR Awards won by Louisiana businesses
9. 282 Phase 0 Awards
10. $2,400,000 in Phase III government contracts secured from SBIR awards (2013-2014)
11. LSU Student Incubator (2010-2014)
12. 122 students and 103 businesses have been assisted
13. 31 student businesses currently in operation
14. 78 new jobs created
15. $2,865,000 capital raised
16. $70,000 start-up capital given to 13 student businesses since the Venture Challenge Inception in 2012

Louisiana Technology Transfer Office (LTTO)
LBTC's mission is:

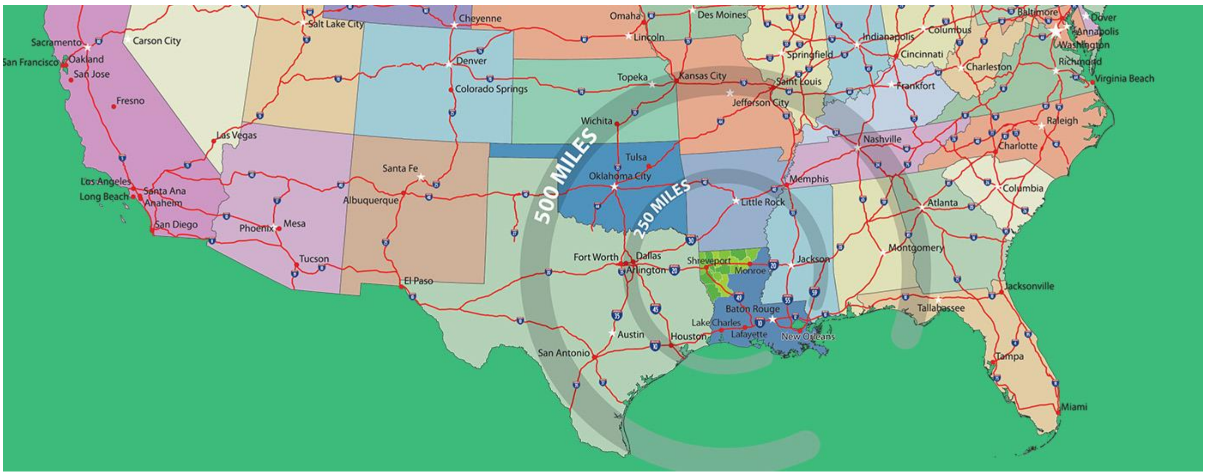
- To complement resources and expertise for Louisiana businesses within the federal laboratory system.
- To evaluate technical needs and to potential solutions to offer to Louisiana companies
- To promote the federal Small Business Innovation Research Program (SBIR) and the Small Business Technology Transfer Program (STTR) to Louisiana companies.
- To Assist Louisiana businesses in applying for and winning grants and contracts.
- To access information from networks of technology resources such as NASA, SERTTC, the Federal Laboratory Consortium for Technology Transfer.
- To ease transfer of technologies between federal agencies and Louisiana industries, emphasizing on procurement, licensing and problem solving.
- To develop business projects, marketing and other business strategies including the raising of seed and venture capital and debt financing.

In addition, the Louisiana's Research & Development Tax Credit rewards innovation by offering a tax credit up to 40% to businesses that choose Louisiana, to establish or continue research and development activities, to foster not only environment for innovation, but also financially competitive solutions. In this way, businesses take advantage of Louisiana's wealth of business opportunities.

The North Louisiana Innovation Corridor

Over the past years, North Louisiana has nurtured an emerging technology sector known as the *"North Louisiana Innovation Corridor."* The Innovation Corridor is a combination of different technology assets and innovative R&D programs, supported by the region's 12 colleges and universities. The Innovation Corridor collaborates also with forward-thinking nonprofit organizations and foundations to support and cultivate a knowledge economy in North Louisiana. North Louisiana helps sustain and grow technology companies through a system built on a flourishing network of venture capital funds and angel investors, plus technical and infrastructure assistance from nonprofits and foundations. The picture below shows how the technology clusters throughout the I-20 and I-49 corridors connect in the region: connected the multimodal transportation infrastructure connects companies at a national and global level companies, so the companies that are looking for transportation and logistical advantages will find real savings and accessibility in North

Louisiana. Furthermore, the central location system of North Louisiana provides a system of interstates and federal highways, first class rail, airports and four ports to make the region a leader in logistics.



Source: http://www.nlep.org)

The emerging biotech and life science sectors benefit from North Louisiana's innovative programs, dedicated to the promotion of a knowledge economy, such as the Biomedical Research Foundation and its related initiatives.

The **InterTech Science Park,** an urban science and technology park, balances extensive research, education and facility resources of nine universities and colleges and thirteen community and technical colleges in North Louisiana, with the goal to seek and support businesses that operate in the technology clusters of biomedical and biotechnology, information, communications, digital and sound media, environment and energy.

Biomedical Research Foundation and its Inter Tech Park aim to be leaders in knowledge-based regional economy by cultivating and attracting digital media, film, life science enterprises and related technologies. Therefore, Inter Tech Park operates as a technology incubator.

Louisiana Tech University's Institute for Micro-manufacturing tackles intellectual capital of teachers and students works on interdisciplinary research to develop radical innovation and inventions. Louisiana Tech's research output is five times the national average in terms of report of inventions (ROI) per expenditures, with an average 20 ROI per $10 million spent. License/option activity at Louisiana Tech quadrupled over the past five years. The University collaborates with private industry to support technology transfer and commercialization, and Tech's two business incubators and the newest Enterprise Campus, a 30-50-acre research park modeled after Research Triangle Park in North Carolina.

Companies that support job creation and invest to commercialize Louisiana technology can benefit from tax credit thanks to the Technology Commercialization Credit and Jobs program. Investments in commercialization of Louisiana technology may also benefit qualifying individuals or businesses through a refundable tax credit on any income or corporation, franchise tax liability, and earn a refundable tax credit based on new jobs created. Furthermore, such credits are granted for a period of no less than five years. In this way, businesses in Louisiana can access a competitive, comprehensive portfolio of incentives, both at the national and federal level, and this can make a profound impact on a company's bottom line.

1) Federal Incentives

a. New Markets Tax Credits. Is a federal incentive that allows individuals and corporate investors to receive a tax credit against their Federal income tax return in exchange for making equity investments in specialized financial institutions called Community Development Entities (CDEs). The credit totals 39 percent of the original investment amount and is claimed over a period of seven years (five percent for each of the first three years, and six percent for each of the remaining four years). The investment in the CDE cannot be redeemed before the end of the seven-year period.

b. Work Opportunity Tax Credits. This incentive allows businesses to earn up to $2,400 in federal tax credits if they hire persons within certain targeted groups. Furthermore, businesses may earn up to $4,800 for hiring disabled veterans and up to $9,000 over a two years' period for hiring long- term welfare recipients. (U.S. Department of Labor website or the Louisiana Workforce Commission website).

c. Workforce Investment Act – WIA. The aim of this incentive program is to fund local and regional workforce training programs through local Workforce Investment Boards (WIB).

d. Foreign Trade Zones. Foreign Trade Zones (FTZ) allow US companies to engage in value added activities thanks to delayed or reduced duty payments on foreign merchandise, so that the companies can effectively compete with foreign alternatives.

e. Research and Development Tax Credit. Companies that carry out R&D activities may claim a federal income tax credit, which can be combined with Louisiana R&D credits.

2) State Incentives

Louisiana has a variety of incentives programs available to both new and existing businesses.

a. Louisiana's Quality Jobs Program. This program allows eligible companies to receive a cash rebate of up to 6% of annual payroll expenses for up to ten years and either a 4% sales/use tax rebate on capital expenditures or an investment tax credit equal to 1.5% of qualifying expenses. A rebate of a portion of local sales/use tax may be available in some areas.

b. Enterprise Zone. Application for the Enterprise Zone program allows eligible companies to claim a one-time tax credit of $2,500 for each net new permanent job created during the first five years of the project. The incentive also provides a 4% sales tax rebate on taxable expenditures or a 1.5% refundable Investment tax credit.

c. The **Louisiana FastStart** is the nation's best workforce training program, thanks to innovative, customized employee training to companies that create at least 15 new, permanent manufacturing jobs, or at least 50 new, permanent service-related jobs.

d. Competitive Projects Payroll Incentive Program. The Competitive Projects Payroll Incentive Program provides an incentive rebate of up to 15 percent of a participating company's new payroll for up to 10 years.

e. Research & Development Tax Credit. This incentive provides to existing businesses with operating facilities in Louisiana a tax credit up to 40% of the expenses necessary to establish or continue research and development activities within the state.

3) Local Incentives

a. Industrial Property Tax Exemption. This incentive program grants new and expanding manufacturing operations an exemption from local property taxes on new construction, additions to existing buildings, or permanently fixed equipment and machinery purchases. Business can take advantage of this program for a period of 5 years with the option of a second five-year exemption.

b. Restoration Tax Abatement. This incentive program, administered by the local parish tax assessor, grants a 5-year deferred assessment of the ad valorem property taxes assessed on renovations and improvements with an option for a second 5-year exemption. Commercial property owners and homeowners who expand, restore, improve, or develop an existing structure in a qualifying district are eligible.

Section 2

How to accelerate Economic Development through Technology Transfer and Innovation? Policy Guidelines from Louisiana

The role of Academic research

Views of the role of academic research have evolved over time. Among economists, support for public funding for a university role in basic research has a longstanding basis in the public goods argument that the benefits of basic research are too diverse for a single firm to capture, and therefore a system of private markets will supply less basic research than is socially desirable. More recently, Aghion, Dewatripont and Stein (2005) have indicated that even if perfect property rights protection were available, the university setting is well-suited to basic research. They argue that an academic researcher's freedom to pursue projects of their choice implies a higher, compensating wage for private sector researchers (whose research interests and projects are imposed) that flips the sign of expected payoffs from research projects with high but risky potential payoffs from positive in an academic setting to negative in a private sector setting. Their conclusion is especially powerful when commercial application of research is at the end of a sequence of research projects, with success at later stages depending on success at earlier stages, because after successes in early stages the remaining research becomes less risky and hence profitable for private sector businesses. Arora and Ceccagnoli (2006) provide a rationale for university licensing of patents at the later stages of research by observing that production is more profitable relative to licensing when the knowledge-holder holds complementary assets, namely marketing and production expertise, which universities frequently lack.[83]

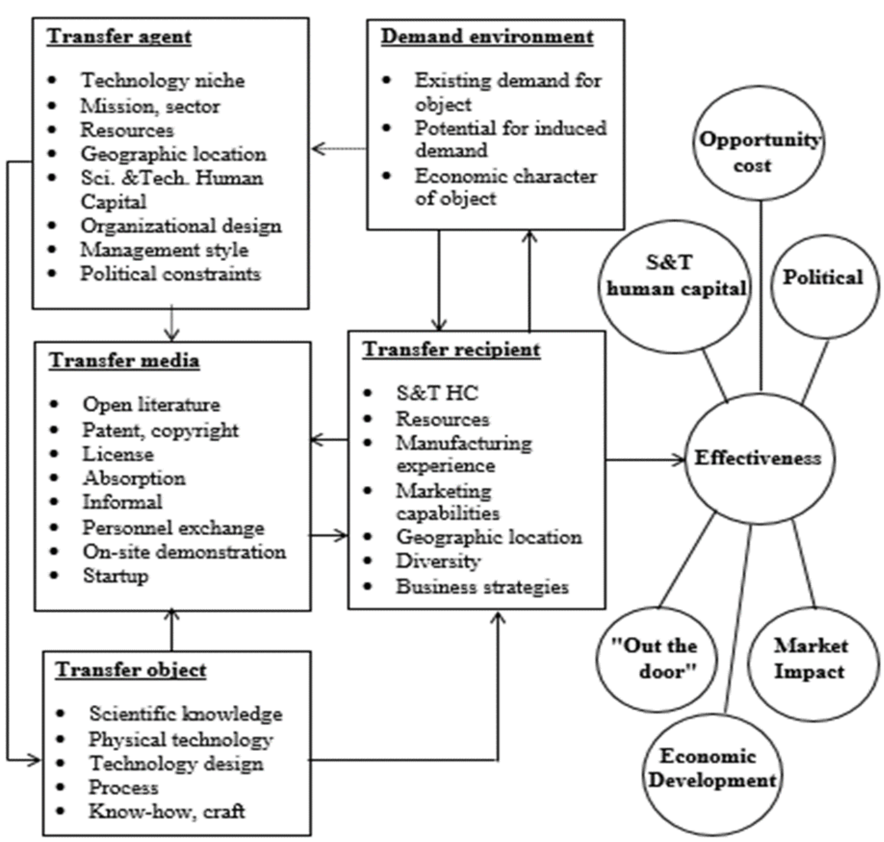
In the policy arena, the Bayh-Dole Act of 1980 has encouraged a greater degree of collaboration between universities and business firms in transferring technology from academic institutions to the private sector. Prior to passage of the Bayh-Dole Act, patents for inventions that were developed as the result of federal grants were assigned to the federal government. Under the Bayh-Dole Act, small businesses and non-profit organizations such as universities are permitted to retain patent rights from inventions developed with federal funds. Armed with patents or even without patents but at least holding intellectual property rights that are not subordinate to the government's, universities are free to license new technologies they have developed to private businesses. According to an annual survey undertaken by the Association of University Technolohgy Managers (AUTM), universities in the State of Louisiana earned more than $24 million in licenses fees alone in 2013. But not only has the Bayh-Dole Act been profitable for universities through license agreements, but O'Shea, et al. (2005) report AUTM estimates that startup companies from academic institutions were responsible for 280,000 jobs in the US economy from 1980 through 1999, and that as of 1997, annual sales of startups orginating from MIT alone were $232 billion annually. Indeed, O'Shea, et al. (2005) suggest an evolving "third role" for universities in generating startups and developing commercially useful inventions and thereby developing regional economies, in addition to the traditional missions of research and knowledge dissemination to academic and student communities and prepation of students to contribute to firms and society.

In this work, data from annual AUTM surveys of universities in Louisiana is used to develop a simultaneous equations model of research outputs in those universities. Specifically, outputs of inventions, patents, licenses, license revenues and startups are modeled as functions of several different inputs tracked in the data set. The work is organized as follows: Section II provides an overview of the literature on university technology transfer and draws implications from that literature; Section III discusses the data and econometric model; Section IV discusses results of estimation and Section V briefly summarizes and discusses results.

Background Literature

To organize a discussion of the literature on the effectiveness of technology transfer, Bozeman (2000) provides the conceptual diagram recreated below as Figure 1, which details five important dimensions of the technology transfer process, Transfer agent, Transfer recipient, Demand environment, Transfer media and Transfer object, or as Bozeman describes them "who is doing the transfer, how they are doing it, what is being transferred, and to whom" (p. 637).

fig.1. Contingent effectiveness model of technology transfer



(Source: Bozeman, 2000

The transfer agent is taken as the university, including its technology transfer office (TTO), and research community which of course includes additional agents. Within the transfer agent are embedded a host of important factors including the university's mission, geographic location, any scientific and technical expertise specific to the university such as inclusion of a medical school or special centers associated with regional economic components (fisheries, agriculture and so forth). Design elements include whether the technology transfer office is decentralized, with different units for different departments or centralized into a single unit. Management style and Political constraints include such factors as the emphasis placed by various academic departments and/or the university on publishing versus patenting, licensing and technology transfer in the tenure process.

The other agent in Figure 1 is the transfer recipient, typically a private sector business. The transfer recipent has its own scientific and technical human capital. From surveys of 355 firms that participated in National Science Foundation academic institutions designated as Engineering Research Centers Feller, Feller, Ailes and Roessner (2002) find that the most important function the university serves is the combination of keeping local firms plugged-in to a cutting edge network of research techniques and knowledgeable students (corresponding to the absorption, informal, personnel exchange and on-site modes in the Transfer media category) rather than specific products and processes. From the Transfer agent's perspective, key characteristics of the Transfer recipient are its business strategy, production facilities and marketing capabilities, skills and expertise that are not usually resident among university research faculties or Technology Transfer Offices. Several measures of effectiveness result from the interplay of Transfer agent, Transfer recipient, Transfer media, Transfer object and Demand environment. In evaluating outcomes and measuring effectiveness, one should remember that universities are not profit maximizing enterprises; rather, within the management literature, they are often viewed as bureaucracies.

Opportunity cost, in this context, measures the lab director's and scientists' preference that technology transfer, which from their perspective is often not as important as scholarly research and output, not be unduly costly to these more important outputs. Although perhaps not directly measurable as an output, Bozeman asserts that opportunity cost remains an important internal measure of effectiveness that can usefully organize thought. The simplest measure of effectiveness is "Out the door," which refers to perfunctory action in response to a mandate to make technology available to the private sector in pursuit of simple but easily measured results such as licenses and patents.[84] The political measure of effectiveness has arisen in surveys and paints technology transfer activities as a means to an end, namely increased political support that is later manifested in renewed or increased funding from public sources or in favorable mentions of the university to policy makers.

The development of scientific and technical human capital refers to the two way transfers of knowledge that occur between the university and private partners through research networks that may involve collaboration, demonstrations of technology and technology transfer through employment of university graduates. Of course, Market Impact and Economic Development are the primary aims of the Bayh-Dole Act, but they generally require detailed case studies to evaluate, with the leading empirical examples being centered on Silicon Valley-Stanford-Berkeley and Boston-Harvard-MIT. Given the data available from the AUTM surveys, we focus on counting measures of effectiveness, specifically patents, licenses, startups and university revenues from licenses and turn to several relevant, more focused empirical works.

Link and Siegel (2005) combine their own informal surveys with AUTM data to develop a stochastic frontier model of relative efficiency in producing licenses and license revenue. Their informal surveys provide three stylized facts. First, although university researchers working under federal grants are required under the Bayh-Dole Act to disclose inventions to the university TTO, they typically do not do so and universities frequently do not enforce these rules.[85] For this reason, labor input from the TTO unearthing and documenting new inventions is critical. Second, licensing of inventions typically occurs long before patenting, if patenting occurs at all. Finally, property rights lawyers are important inputs purchased by the university both to protect intellectual property and to negotiate and re-negotiate licenses.

Findings include the following: 1, both the number of licenses and license revenues are positively related to the number of invention disclosures, 2, additional TTO staff generates more license agreements, but not additional license revenue, 3, additional spending on lawyers generates more license revenue, but not more license agreements. Macho-Stadler, Perez-Castrillo and Veugelers (2007) use a game-theoretic model of reputation to suggest that the latter finding may be the result of the university technology seller (or lawyers acting as their agents) needing to "shelve" some potentially licensable but lower quality inventions to maintain a repuation for quality when firms cannot diectly assess the quality of the invention as well as the university.[86] O'Shea, et al. (2005) construct a random effects negative binomial model of the count of startups, using the AUTM surveys from 1980 to 1991 as a source of data. Of relevance to the present investigation, they find the number of startups to be increasing in the number of employees in the university's TTO as well as in the proportion of total research funding comprised of industrial sources.

Arora and Ceccagnoli (2006) investigate the decision of whether to monetize an invention via patent and license or patent alone. Although they use data from private firms rather than universities, their findings should still be relevant. They argue that the strength of patent protection, in the sense of how readily rivals can produce competing products without licensing from the patent holder, influences the decision to patent. However, stronger patent protection raises the value of patents more for firms that hold assets complementary to the patent and also raises the value of patents for own production relative to patents for licensing. In a university setting, we might expect their results to imply, for example, that the patentable products of an agricultural center will be licensed because the university lacks the scale of production to extract as much value from the patent from own production as from licensing. In contrast, new inventions from computer science departments, such as programs that provide various services, might be more likely to be the source of startups because the complementary assets related to their use (e.g., Internet access for distribution and "buzz" about their existence from social networks) is more readily available.

In a university setting that used case study research, Harmon, et al. (1997) emphasize the importance of relationships between the university and the firms that would reap commercial benefit from inventions. They find that only four of 23 firms that commercialized inventions developed at the University of Minnesota from 1983 to 1993 had had no prior relationship with the University and more than half of the technologies that were transferred either upgraded existing products or extended existing product lines.

One of their important conclusions is that TTO personnel do not typically act as "middlemen" between private firms shopping for technology solutions and the researchers at their institution who have those solutions at hand, which is consistent with the findings of Link and Siegel (2005). More recent research discussed by Phan and Siegel (2006) emphasizes the role of university-specific factors such as the emphasis (or lack thereof) placed on technology transfer in the tenure process, varying incentives for faculty provided by various license fee sharing percentages, the presence of "star" researchers and so on.

From the literature, it is clear that a variety of factors influence universities' success at technology transfer. Several factors that determine performance are university-specific. Because data on these factors is lacking, a set of binary indicator variables for universities is used in the structural model below. In addition to university-specific factors that are not observable, technology transfer depends on several variables that are included in the AUTM data including research spending by the university, the number of employees in the TTO office, and spending on legal fees to carry out patenting, licensing and new firm creation processes.

Data and Econometric Model

The data are from an annual series of surveys of university Technology Transfer Offices (TTO) undertaken by AUTM that were administered from 1991 to 2013. Broadly speaking, the survey covers a variety of inputs the university uses to produce new technology that can be transferred (research expenditures, TTO staffing levels, legal fees) and outputs (numbers of patent applications, license/option agreements, new startup companies, and revenues from license agreements).

The target population for the surveys is all universities in North America that conduct significant technology transfer activities. AUTM desires these surveys to be completed by all university technology transfer offices in North America, but survey response is voluntary. To encourage survey response, AUTM allows university TTOs to indicate that they would prefer that their response be anonymous, and in our sample limited to Louisiana, universities that responded anonymously account for about 30 percent (26 of 87) of all survey responses.[87]

In the data set, universities that respond anonymously also have the year of their response eliminated as well as whether they have a medical school or not. Therefore although the surveys are intended to form a panel of data over time, the anonymity that universities have availed themselves of and the focus on Louisiana limits the econometric techniques available.

Additionally, lack of an identifying year for some of the data means that nominal variables cannot be converted to real variables by use of a price deflator, which increased by a factor of 2.67 from 1991 to 2013. The variables that are used are listed and described in Table 1 below.

Table 1 *Variable names and definitions*

Variable	Definition
TotFTEs	Total FTEs in TTO
TotResExp	Total research expenditures, millions of current dollars
IndResExp	Industry funded research expenditures, millions of current dollars
LicGenInc	Number of licenses generating income in the survey year
LegFees	Total legal fees in survey year, millions of current dollars
InvDisRec	Disclosures of inventions received by the TTO in the survey year
GrossLicInc	Gross income from licenses
StUpsFormed	Startups formed
TotPatAppFld	Total patent applications filed
LicIss	Licenses/options issued in the survey year

Of the 87 surveys available for 1991 to 2013, 64 surveys have all of the data in Table 1. Descriptive statistics for the sample are provided in Table 2 below.

Table 2 *Descriptive statistics, annual data*

	N	Mean	Std. Dev.	Min	Max	Q1	Q2	Q3
TotFTE	64	5.63	5.17	0.03	19.4	2	3.50	8.50
TotResExp	64	179.50	173.84	14.17	615.66	50.27	124.31	209.18
IndResExp	64	15.52	12.69	0.25	57.81	5.22	13.78	20.05
LegFees	64	0.63	0.79	0	4.29	0.16	0.32	0.95
LicGenInc	64	35.28	32.67	2	132	13.5	21	47
InvDisRec	64	59.27	53.21	3	196	21	36.5	86.5
GrossLicInc	64	6.19	5.13	0	20.98	0.97	6.49	9.86
StUpsFormed	64	1.88	2.19	0	8	0	1	3
TotPatAppFld	64	37.06	36.72	0	132	13	21	49
LicIss	64	8.59	8.62	0	34	1.5	6	13.5

For most of the variables in Table 2, the mean is greater than the median (Q2), which implies the distributions are positively skewed. Frequency histograms for two of the variables, *GrossLicInc* (annual gross license income in millions of dollars) and *InvDisRec* (annual invention disclosures) are depicted in Figure 1 and illustrate the skew for those variables. Looking at resources consumed, 5.63 FTEs were employed in the TTO and total research expenditures per year averaged $179.5, of which an average of $15.52 million came from industry.

a. Histogram of gross license income *b. Istogram of invention disclosures*

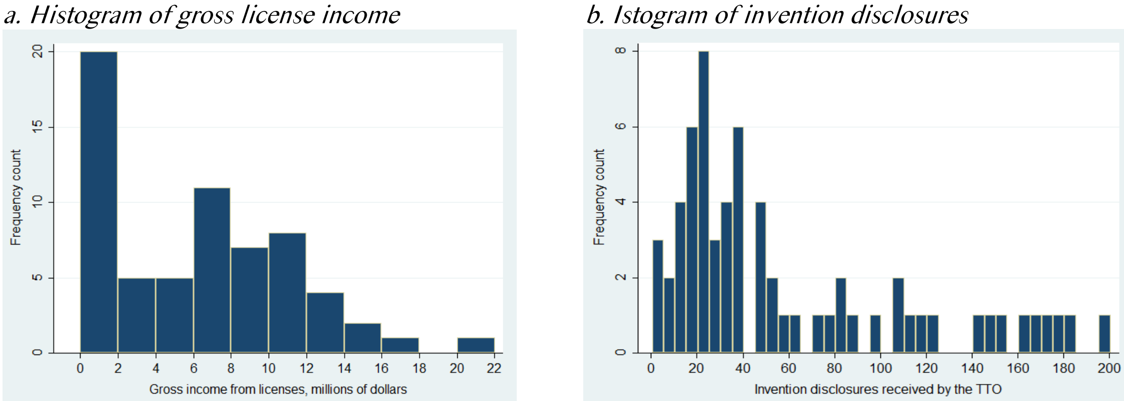


fig.2. Frequency histograms of license income and invention disclosures

Additionally, universities spent an average of $630 thousand per year on legal fees associated with technology transfer (e.g., patent filings, negotiating and writing license agreements and agreements with startups). The number of licenses generating income in the year of the survey averaged 35.28. Turning to the outputs of technology transfer, an average of 59.27 inventions were disclosed each year, average gross license income was $6.19 million per year, and on average 1.88 startups formed, 37.06 patent applications were filed and 8.59 new licenses were issued. Note that more than a quarter of the observations involve no new startups created at a university in a year. Researchers have occasionally used single equation models to predict patents, licenses or licensing revenues, but the input variables are highly collinear with the consequence that single equation models yield imprecise estimates. Table 3 below provides pairwise correlations between fulltime TTO employees, total research expenditures, legal fees and, for example, invention disclosures received at the TTO. All of the inputs *TotResExp*, *TotFTE* and *LegFees* have pairwise correlations greater than 0.7, and all are correlated with *InvDisRec* with correlations greater than 0.73.

Table 3 *Correlations between invention disclosures, research expenditures, FTE employees and legal fees*

	InvDis	TotResExp	TotFTE	LegFees
InvDisRec	1.0			
Significance	---			
N	64			
TotResExp	0.951	1.0		
Significance	0.0000	---		
N	64	64		
TotFTE	0.973	0.971	1.0	
Significance	0.0000	0.0000	---	
N	64	64	64	
LegFees	0.735	0.751	0.702	1.0
Significance	0.0000	0.0000	0.0000	---
N	64	64	64	64

The correlations in Table 3 are part of the motivation for the simultaneous equations approach adopted here. Specifically, in the model estimated below, the resource inputs to the technology development and transfer process are research expenditures (*TotResExp*), TTO personnel (*TotFTE*), and legal fees (*LegFees*). Disclosures of inventions to the TTO (*InvDisRec*) are an intermediate product that results from research expenditures and TTO labor in obtaining information on new inventions from faculty members. The intermediate product of invention disclosures along with legal fees are related to new startups (*StUpsFormed*), patent filings (*TotPatAppFld*) and new licenses (*LicIss*). Finally, both new licenses issued which generate income and previously issued licenses that currently generate income (*LicGenInc*) are related to the gross license income

(*GrossLicInc*) the university receives. Thus, as a set of simultaneous equations, we have the following system:

$$InvDisRec_{i,t} = \alpha_0 + \alpha_1 TotFTE_{i,t} + TotResExp_{i,t} + \varepsilon_{1,i,t}$$
$$LicIss_{i,t} = \beta_0 + \beta_1 InvDisRec_{i,t} + \beta_2 LegFees_{i,t} + \varepsilon_{2,i,t}$$
$$StUpsFormed_{i,t} = \gamma_0 + \gamma_1 InvDisRec_{i,t} + \gamma_2 LegFees_{i,t} + \varepsilon_{3,i,t}$$
$$TotPatAppFld_{i,t} = \delta_0 + \delta_1 InvDisRec_{i,t} + \delta_2 LegFees_{i,t} + \varepsilon_{4,i,t}$$
$$GrossLicInc_{i,t} = \theta_1 + \theta_2 LicGenInc_{i,t} + \varepsilon_{5,i,t}$$

The vector of errors $(\varepsilon_1,\ \varepsilon_2,\ \epsilon_3,\ \epsilon_4,\ \epsilon_5)$ is assumed to have a zero mean for each observation *i* at all times *t*. Observe that the first four equations form a recursive system, in that new inventions disclosed, an endogenous variable, is included as a determinant of licenses, startups, and patents, but new inventions disclosed is not itself a function of any endogenous (e.g., left hand side) variables. Therefore if $(\varepsilon_1,\ \varepsilon_2,\ \epsilon_3,\ \epsilon_4)$ were independent across all periods *t* as well as within each period for each *i*, then the first four equations could be estimated using OLS equation by equation. However, it is very likely that there are omitted variables that would lead to contemporaneous correlation among $(\varepsilon_1,\ \varepsilon_2,\ \epsilon_3,\ \epsilon_4)$.

Additionally, since current gross license income depends in part on past licensing decisions through licenses that currently generate income, there is necessarily serial correlation in gross license income and cross equation serial correlation between past licenses issued and current gross license income. Moreover, any omitted variables that are serially correlated in any equation will impart serial correlation into each of these equations.

Because the data do not contain the time dimension, serial correlation cannot be treated directly. Instead, two features of the estimation represent crude attempts to minimize the problems imparted by serial correlation. First, a binary indicator variable for each identified university is created and included in each equation in the system. Under this parameterization, all of the universities that do not identify themselves are treated as a single university and the intercept in each equation is an intercept for this group. For each university that identifies itself, the estimated coefficients on its indicator variable in each equation is an estimate of the difference between it and the group of unidentified universities.

One advantage of this dummy variable treatment is that any unobservable variables that are university-specific and do not change over time are incorporated into the estimated intercept.

Second, the system of equations is estimated using a two-step General Method of Moments (GMM) estimator that leads to robust covariance estimation at the second stage. In the first stage estimation, all of the exogenous variables in the system, *TotResExp, LegFees, TotFTE,* and the university indicator variables, are used to obtain estimates for each

of the structural equation parameters using the orthogonality condition between the residuals for each equation and the instruments.
The estimated parameters from this first step are unbiased estimates of the population parameters if the structural equations themselves are correct specifications for the expected values of the endogenous variables. At the second stage, the errors from the first stage are combined with the instruments to produce a weight matrix for second stage estimation that allows for heteroskedastic errors for each equation. Therefore along with the equations given above and the implied exogeneity of *LegFees*, *TotFTE*, and *TotResExp*, the econometric model is specified by assuming that the vector of disturbances $(\varepsilon_1,\ \varepsilon_2,\ \epsilon_3,\ \epsilon_4,\ \epsilon_5)$ are independent, have zero mean.

Model Estimates

Table 4 provides estimated coefficients, robust standard errors, z statistics, p values and 95 percent confidence interval estimates for the structural equations of the model. Although Table 4 reports university- or research center-specific intercept estimates, these are not the focus of interest. Nonetheless, the correct interpretation is provided. For example, in the equation for disclosures of inventions to the TTO, the estimated constant, 10.159, is an estimate of the intercept for the group of universities that reported anonymously.
The coefficient of -9.079 for LSU_AG (the LSU Agriculture Center) is an estimate of the difference between the intercept for the unknown group of universities (10.159) and the LSU Agriculture Center. Therefore the hypothesis being tested by the z statistic is whether there is a difference between the intercept of the labeled university and the intercept of the unknown group of universities and this estimated difference is not significant at the 0.05 level of significance (p value = 0.082). The point estimate of the intercept for the LSU Agricultural Center 1.08, found by adding the Intercept in the equation with the estimated difference for LSU_AG (e.g., 1.08=10.159-9.079). Estimates of the intercepts for other institutions and in other equations may be obtained similarly.

Table 4 *Structural model estimates*

	Coefficient	Robust Std. Err.	z	P>|z|	95% LCL	95% UCL
InvDisRec						
Constant	10.159	4.398	2.310	0.021	1.538	18.779
LSU_AG	-9.079	5.222	-1.740	0.082	-19.313	1.155
LATECH	2.206	4.383	0.500	0.615	-6.384	10.797
TULANE	-12.766	4.238	-3.010	0.003	-21.072	-4.460
UNO	-7.512	4.614	-1.630	0.103	-16.555	1.531
LSU	-6.379	4.432	-1.440	0.150	-15.066	2.309
TotResExp	0.053	0.029	1.800	0.071	-0.005	0.110
TotFTE	8.167	1.163	7.020	0.000	5.888	10.446
LicIss						
Constant	0.319	2.859	0.110	0.911	-5.285	5.923
LSU_AG	0.857	2.673	0.320	0.748	-4.382	6.097
LATECH	-0.487	2.488	-0.200	0.845	-5.363	4.389
TULANE	0.064	2.485	0.030	0.979	-4.806	4.934
UNO	-0.515	2.780	-0.190	0.853	-5.964	4.934
LSU	0.674	2.547	0.260	0.791	-4.319	5.667
LegFees	2.123	0.820	2.590	0.010	0.515	3.731
InvDisRec	0.113	0.021	5.480	0.000	0.073	0.154
StUpsFormed						
Constant	-0.848	2.317	-0.370	0.714	-5.389	3.693
LSU_AG	1.078	2.013	0.540	0.592	-2.867	5.023
LATECH	0.918	4.587	0.200	0.841	-8.073	9.908
TULANE	0.105	1.958	0.050	0.957	-3.733	3.942
UNO	1.560	2.288	0.680	0.495	-2.925	6.045
LSU	1.267	1.306	0.970	0.332	-1.292	3.825
InvDisRec	0.023	0.017	1.330	0.184	-0.011	0.057
LegFees	1.321	0.289	4.570	0.000	0.754	1.887
TotPatAppFld						
Constant	-4.848	6.739	-0.720	0.472	-18.055	8.360
LSU_AG	7.153	5.705	1.250	0.210	-4.028	18.335
LATECH	5.605	5.475	1.020	0.306	-5.125	16.336
TULANE	3.679	5.657	0.650	0.515	-7.408	14.767
UNO	5.229	6.500	0.800	0.421	-7.512	17.969
LSU	13.008	4.265	3.050	0.002	4.650	21.367
InvDisRec	0.492	0.076	6.470	0.000	0.343	0.642
LegFees	11.023	2.972	3.710	0.000	5.197	16.849

(continued)

	Coefficient	Robust Std. Err.	z	P>|z|	95% LCL	95% UCL
GrossLicInc						
Constant	3.516	0.798	4.410	0.000	1.952	5.079
LSU_AG	-3.435	0.786	-4.370	0.000	-4.976	-1.895
LATECH	-4.264	0.751	-5.680	0.000	-5.736	-2.792
TULANE	0.784	0.875	0.900	0.371	-0.932	2.500
UNO	-3.843	0.778	-4.940	0.000	-5.368	-2.317
LSU	-3.672	0.801	-4.590	0.000	-5.241	-2.102
LicGenInc	0.114	0.011	10.250	0.000	0.092	0.136

Turning to the structural equation estimates of parameters of interest in each equation, the equation for *InvDisRec*, the average number of inventions disclosed by the TTO, increases by 8.167 for each additional FTE at the TTO, which is statistically significant at less than the 0.001 level of significance. For total research expenditures by the university, the point estimate in TotResExp suggests an additional 0.053 inventions for each additional million dollars of research expenditure, with the p value of 0.071 implying weaker evidence that this coefficient is different than zero. The model's lack of detailed information for each university presumably explains the lack of precision of this estimate. Nonetheless, recalling that the standard deviation of research expenditures in the is 173.84 (Table 2), a one standard deviation increase in research expenditures leads to approximately nine more inventions per year.

For the structural equation for licenses issued in the survey year, *LicIss*, each additional million dollars of legal fees is associated with an increase of 2.123 licenses issued and each additional invention is associated with 0.113 additional licenses, with both of these estimates significantly different than zero at the 0.01 level of significance. Inverting 0.113 suggests that nearly 9 additional inventions are required to generate one additional license. For the structural equation for the number of startups formed, *StUpsFormed*, each additional invention increases the average number of startups formed by an estimated 0.023, implying 44 new inventions are required for a new startup.. However, the p value of the estimate, 0.184, suggests there is not strong evidence that the estimated coefficient for inventions is different than zero. Each additional million dollars in legal fees is associated with 1.321 new startups, and we can reject the null hypothesis that the population parameter is zero at the less than the 0.001 level of significance.[88]

For the structural equation on total number of patent applications files, the average number of patent applications filed increases by 0.492 for each invention disclosed, which is significantly different than zero at less than the 0.001 level of significance and implies that roughly half of new inventions are patented. Each additional one million dollars in legal fees is associated with an average of 11.023 new patents, which is significant at less than the 0.001 level of significance. For the structural equation for annual license income, *GrossLicInc*, the estimated coefficient on licenses that are generating incomes, *LicGenInc*, is 0.114, implying that each license adds $114,000 per year to gross license income, and the estimated coefficient is statistically significantly different than zero at less than the 0.001 level of significance.

An indicator of the goodness of fit can be had by substituting sample values into the structural equations to obtain predictions and then investigating the sample correlations between the predicted values and the actual variables. The sample correlations between actual values of the endogenous variables and their predicted values from the structural equations are given in Table 5. The square of the sample correlation is R squared, which is a measure of how much variation in the endogenous variables is explained by the predicted values, and is also given in Table 5. Observe that all of the sample correlations are statistically significant at the 0.05 level of significance and the values of R square indicate quite good fits for each equation, ranging from 0.68 for licenses issued to 0.96 for inventions disclosed.

Table 5 ***Correlations between predicted and actual values for endogenous variables***

Variables	Sample correlation coefficient	R squared
InvDisRec, predicted *InvDisRec*	0.98	0.96
LicIss, predicted *LicIss*	0.82	0.68
StUpsFormed, predicted *StUpsFormed*	0.86	0.74
TotPatAppFld, predicted *TotPatAppFld*	0.87	0.76
GrossLicInc, predicted *GrossLicInc*	0.91	0.82

One diagnostic test for the GMM system estimator is provided by Hansen's *J* test. Hansen's *J* test tests the null hypothesis that the instruments that were used (*LegFees*, *TotFTE*, *LicGenInc, TotResExp*) are indeed orthogonal to the population disturbances in each equation in the structural model. The test statistic follows a chi square distribution with (l-k) degrees of freedom, where l is the number of moment restrictions and k is the number of parameters. The model above implies 50 moment restrictions and has 39 parameters, and the value of the *J* statistic is 17.58 with an associated p value of 0.09. Therefore there is some evidence that our instruments are not orthogonal to the population structural disturbances. It is also possible that the evidence against the null hypothesis is due to unmolded serial correlation.[89]

Caveats and Policy Recommendations

This research estimates a structural equation model that relates inputs to the technology transfer process, TTO staff levels, university research expenditures and legal fees and licenses that generate income (many from previous years) to outputs of the technology transfer process, current inventions, current license agreements, current startups, current patents and gross license revenues. Despite the data set's lack of identifying information for a large portion of the sample, sample correlations between predicted values and actual values of the endogenous variables range from 0.68 to 0.98 and indicate quite good fits.

The model can be used for several purposes because it provides fairly reliable estimates related to the economics of technology transfer. For example, our estimates imply that the average license generates \$114,000 in revenue annually and that a patent filing costs roughly \$90,000 in legal fees.[90] They also provide some indication of the productivity of TTO personnel. Previous research focused on efficiency indicates that TTO personnel do not enhance university efficiency in generating either licenses or license revenues (Link and Siegel 2005). But the broader, system approach taken here clarifies that TTO personnel play a critical role upstream from the generation of licenses and license revenues in simple invention disclosure.

There is some evidence that the orthogonality conditions required by the GMM estimator used do not hold in the population, or equivalently, that some of the models that we have treated as exogenous are in fact endogenous. In practice, it is likely that legal expenditures and perhaps TTO staffing levels are chosen by university administrators who have knowledge of their institution, such as the culture and the extent to which it and financial incentives supports collaboration with private industry and the presence of "star" researchers or unique centers of excellence that these choices are conditioned on. A second possible explanation for the evidence that the orthogonality conditions do not hold is serial correlation in the endogenous variables which was only imperfectly modeled here with dummy variables and a robust covariance estimator. However, these shortcomings provide guidance for better models that incorporate more data.

Today, a wide range of activities in universities and related technology and entrepreneurial initiatives by state and local governments and intermediary organizations feature technology transfer and commercialization activities. As a rule, these initiatives aim to leverage university inventions to attain such economic development goals as growth, diversification, and facilitation of competitiveness. Transfer and commercialization of university technology are complicated processes, which act as a part of the cultural and environmental context within the university, often being a part of the larger external environment. Many diverse factors influence the university's capacity to transfer and commercialize its research. Internal factors include strength and focus of the university research base, leadership, incentives, and rewards, as well as history and power of corporate relations with other research units within a particular entrepreneurial climate. External factors include availability of angel and seed capital, management capacity building resources, laboratory and incubation space, legal assistance, and networking opportunities that form the infrastructure, supporting technology transfer efforts.

Why Universities are the pipeline for technology- based economies?

Universities serve as the pipeline for technology- based economies, since many publicly supported universities consider technology transfer and commercialization as part of that economic development mission based on university mission to disseminate knowledge. Private universities often have a more tenuous link to economic development goals, in spite of being actively engaged in technology transfer. Some institutions in Louisiana mediate between achieving academic excellence and pursuing technology transfer and commercialization goals. In other words, they reached such results by licensing and spinning off new technology enterprises, which has enriched their environments, making them more attractive for "star" faculty and innovative-minded faculty and students. Because of the younger generation of faculty being in continuous search for increasing entrepreneurial opportunities, universities have to be more open. This strategy benefits the universities and the economies surrounding them.

Why do we need the State Government to support technology-based infrastructure?

The State Government is needed to support technology-based infrastructure, as most states have implemented technology-based economic development programs to fill the gaps in federal programs and to capitalize on their state's technology resources, mainly research universities. Such states as Louisiana implement programs and incentives to replace old industrial jobs with high-wage employment in emerging fields. Louisiana also develops comprehensive, technology-based strategies for catalyzing specific clusters, most frequently in life sciences and information technology/software clusters. State initiatives particularly focus on building life science clusters and improving the research capacities of universities

Policy Guidelines

Policy guidelines drawn from the study of Louisiana Innovation Ecosystem concern academia and technology. For academic leaders, the guidelines enhance technology transfer and commercialization activities and simplify an entrepreneurial culture. For business leaders, the guidelines increase their understanding of university technology transfer and demonstrate the corporate role in supporting university R&D and commercializing results. For government leaders and public decision makers, the guidelines offer guidance on developing an infrastructure that leverages university research for economic goals. These guidelines demonstrate the importance of federal government funding for university research, being the pipeline for inventions that are transferred to and commercialized by the private sector. Collaboration of academic, business, and government decision makers simplify s stimulation and sustaining of science- and technology-based economies.

Guidelines for Government and Business Leaders

The success of technology transfer efforts seems questionable to champions who are critical to it.

Many communities that have successful technology transfer and commercialization from universities also have their own champions. As a rule, they hold high administrative positions in universities. In other words, presidents or chancellors in universities have been champions in technology, which led them to success as entrepreneurs or corporate heads.

It is important to have seed capital funds for launching university start-ups.

In every case study with significant numbers of start-ups, one can trace sufficient private and/or public seed capital funds, and angel networks. State governments, and the private sector had to fill the gap by creating seed and venture capital funds in states and communities with little traditional risk capital. The forms of these funds varied, and communities and states usually established several types of funds that addressed different stages of business development. In some states, funds were directed to specific clusters such as life sciences. The period of early 2000's was marked with increased access to early-stage funds, becoming increasingly important, when private sources of risk capital decreased, being a great challenge.

Angel capital networks appeared to play important roles in many communities.

A network of "angels" can provide "side-by-side" or follow-on funding, adding value to other early-stage investments. Entrepreneurs can access a local chapter of a statewide angel capital network. Universities can also fill the seed capital gap for academic-based entrepreneurs with their own pre-seed and seed funds.

State technology initiatives can leverage major private investments.

Along the strong leadership from the University's President, state policies and programs have provided critical support to the University and regional technology efforts. Some initiatives seeded by state funds have substantially leveraged the state's original investment.

Innovation centers serve as a focus for technology-based activities.
In other words, technology transfer and commercialization or innovation centers serve as focal points for technology-based activities in many communities and states. As a rule, these innovation centers connect to universities, involving corporate participation, and providing a variety of services and linkages for technology start-ups. Funding, size, and complexity of innovation centers vary. Innovation centers aim to bridge the difficult "valley of death" gap between university R&D and the commercial world by adding multiple elements to simplify maturation of early-stage innovations. The strong side of major innovation centers concerns key technology transfer services and linkages offered, including seed capital investments and management assistance. In addition, they serve as focal points, from which other activities can grow and revolve around.

Private industries and foundations in some states and communities have played a major role in promoting and funding science and technology initiatives.

Corporations can play an important role in funding research projects at top-level universities. R&D and technology transfer benefit from corporate managers, successful entrepreneurs, and venture capitalists who contribute by sitting on university advisory boards and participating in entrepreneurial activities. Mentors help entrepreneurs develop business plans, prepare for venture capital forums, and participate in similar activities, providing invaluable support to start-ups. At the same time, business leaders participate as CEO's-in-Residence and make a difference in the survival of a new start-up. Although not normally viewed in a technology transfer context, corporate sponsorship of academic interns is another means of technology transfer. It simplifies s a two-way flow of academic knowledge and real-world experience, and creates a bond between the corporation and the university that simplify s other technology transfer linkages.

Networking is a critical element in an entrepreneurial culture in all university-based exemplary practices.

Most of that networking is informal involving "get-togethers" often sponsored by venture capitalists and law firms. Regardless of the form, technology transfer experts in regions known for technology, point to networking opportunities and active engagement from venture capitalists, serial entrepreneurs, service providers, and technology leaders as critical to the region's ability to create and retain start-enterprises.

A strong, strategically-focused research base promotes technology transfer.

A strong, research base with effective strategic orientation simplify s development and promotion of the technology transfer and commercialization, creating an easy access for technology transfer activities. A number of the educational institutions of the higher level apply strategic planning to find out any fields of technology and related competencies that could contribute to development of a strong research base. Based on the findings received in the course of this planning, universities take measures to capitalize their own advantages and appearing tendencies. Federal R&D is often attracted to the universities according to the results of the abovementioned capitalization with the identification of potential strengths. Universities' research portfolio and strategic direction have the same importance for their success.

University culture is the key to success of technology transfer.

The "culture" of a university is perhaps the strongest and most pervasive influence on its technology transfer and commercialization performance. The beliefs, values, myths, rewards, and incentives come here under a label of culture, influencing behavior within the organization. For instance, universities are successful in transferring technologies, and they provide rewards and incentives for faculty who participate in technology transfer and commercialization activities. As a rule, this process involves credit toward tenure provided to the faculty if they file a patent application and some credit for filing invention disclosures. Other incentives include publicizing faculty and student successes through articles in the university newsworks, department or university award ceremonies, and giving similar recognition. Mission statements, vision statements, and goals of the university become a clear map for those who want to succeed, adopting particular culture, following a positive internal message. When university and academic unit heads support promotion of the positive role of the institution in building the state economy, encouraging entrepreneurial behavior or technology transfer, it offers an academic culture, promoting an environment conducive to technology transfer and commercialization.

Technology transfer linkages to researchers feeding the pipeline.

Effective university technology transfer offices often have close linkages to R&D schools and departments. As a rule, approaches are informal but effective. Technology transfer staff is an integral part of the key centers or institutes meeting star faculty, and encouraging faculty to consider filing disclosures and patent applications. Successful technology transfer offices have linkages to seed, venture capital firms, and pro-actively interact with those sources. In addition, universities in regions lacking venture capital have been pro-active in seeking venture capital from major centers elsewhere.

Universities that serve as examples for others are known for creating their own seed capital funds.

Universities that serve as examples for others are known for creating their own seed capital funds along with having connections to private seed and venture capital firms, which is achieved through early-stage funds for university researchers created by the university. Investments receive additional value from many university seed funds by enhancing the process of building management capacity in the university start-ups to investors. Other university driving forces of financial assistance concerns university inventions, venture capital forums, business plan competitions, and networking opportunities.

When launching university start-ups, entrepreneurial assistance is required.

When launching university start-ups, entrepreneurial assistance is required, since scientists and engineers are not very good in managing business in spite of being good in technology. Technology transfer in exemplary universities involves business plan competitions. As a rule, these competitions are useful for entrepreneurs in meeting each other and studying the rivals, and provide deal flow for university technology transfer offices. Many of such universities and affiliated programs utilize capacities and skills of business students to assist promising entrepreneurs in such activities as writing a business plan, conduct a market research, assessing potential customers, and for other business functions.

Technology transfer takes place through diverse channels.

Technology transfer takes place through diverse channels, including corporate sponsored research, technical aid, and consulting. Some universities use interaction and value of its corporate sponsored research and number of industry-endowed chairs to simplify the completion of successful programs. One of the essential drivers of such an activity is limited to having an office, through which all forms of contacts and collaboration are supported. Since industries face a number of problems, they attempt to identify the maze that a large research university presents to the external world. When one is fully familiar with the ways of how the universities operate, it becomes less difficult to find key researchers and opportunities for collaboration.

Research parks, Science Parks, Technology Parks, Incubators contribute to an entrepreneurial culture and provide a visible "technology presence" at universities.

Research parks are not only places but phenomena that characterize the university's ability to develop and promote its culture of technology transfer and provide benefits and different forms of incentives to those who contribute positively to the university's efforts. Rural areas enable universities to develop a rather strong culture with powerful influence on behaviors. In this respect, such universities acquire attractive incubation opportunities that connect universities through pipelines of technology, enabling them to capitalize their competencies and build relations to skillful managers and talented researchers. In addition, culture of research parks encourages entrepreneurs to interact effectively with researchers and other parties concerned, driving their messages forward.

Cross-Cutting Guidelines

Most technology start-ups are a product of the private sector.

Research universities have been recognized as the most influential party in the development of technology-based economic projects, where universities served as the pipeline for technology start-ups. However, a major source of the new enterprises includes present and former employees of companies that deal with technology.

University-based entrepreneurs and those who come from private sector are almost equal as they benefit from many of the same services, including available investment capital. For instance, seed, "pre-seed," and angel capital can be granted to both university-based and corporation-driven entrepreneurs. At the same time, both types of entrepreneurships have access to potential investors, business planning and management assistance, multiple opportunities for networking with other entrepreneurs and other stakeholders, as well as mentoring by experienced entrepreneurs and investors.

The industry must recognize the role of smaller universities and community colleges in the innovation process.

Smaller universities and colleges are often forgotten, offering unique opportunities in the context of developing technology infrastructure in a state. In addition, innovations and entrepreneurs come from various sources, including smaller universities and colleges, which makes their role more important than expected. In other words, some smaller educational institutions of higher level appear rather effective through focusing on a few areas of science and technology, building national class expertise, and adding to industry partnerships in those areas.

No fast changes or results are expected.

It takes time to complete technology transfer and commercialization programs. Majority of such programs become successful only in a decade, requiring continuous financing and development. In addition, communities related to aforementioned universities gain no benefit from the technology transfer activities when programs stay unsuccessful. Directors of technology transfer and commercialization programs insist that all stakeholders must be patient waiting for the results. Political expectancy plays an important role in this process, since many programs that do not show results in the set timeframes are labeled as failures. Investments in technology development are associated with the future rather than present. Many states invest substantially in technology, bearing all risks, including the risk of total failure.

CONCLUSIONS

This work, focused on the analysis of the agglomeration phenomena of firms inside the "virtual" location of an Innovation Pole, with the ambition to assess the impact of technology transfer in regional economic development.
More specifically, the research aimed to investigate the pivotal motivations and patterns driving these agglomeration phenomena, the main similarities and differences between the "physical" locations (science parks, incubators etc.) and a "virtual" location inside an Innovation Pole (or innovation ecosystem, in the U.S. experience), taking account of issues and obstacles firms face in their growth process.
The literature provides several studies on the effectiveness of science parks and incubators (Colombo, Delmastro, 2002; Link, Scott, 2007). Several definitions of a science park have been proffered in recent years (Link, Scott, 2006), but they all emphasize academic technology transfer, knowledge flow and regional economic growth.
The "science park" identifies a property-based initiative with formal and working links with academic or higher education institutions or research centers. Therefore, it acts as a technology transfer initiative to encourage and support startup, incubation and development of innovation led, high growth, knowledge based businesses, creating a place for developing businesses and favor close interactions with a particular center of knowledge creation, for mutual benefit (Parry, Russell, 2000; Ferguson, Olofsson, 2004).
Notwithstanding their dimension and heterogeneity, the rationale for the creation of science parks has traditionally been considered proximity to university laboratories and research centers, the presence of an incubator, the creation of networking opportunities, the role as bridging institution providing tenant firms with suitable accommodations and technical and business services (Colombo, Delmastro, 2002; Link, Scott, 2003, 2006, 2007). However, the ICT revolution and the diffusion of the Internet (Benghozi et al., 2009) impose businesses to develop new strategies, since the "physical" dimension of a science park seems to be not enough to explain the dynamics of the globalized world. In other words, "quantitative

dimension and physical concentration of assets alone are not enough to assure growth and prosperity" (Conicella, Baldi, 2012: 4).
With the internationalization and globalization phenomena, networks, open innovation, communities, clustering, business ecosystems, innovation poles, emerged as key words and enabling factors of a new science park strategy. This new approach requires a change not only in the managerial structure of the park, but also on the side of company attitudes, including skills and organization. According to Brandenburger and Nalebuff, a co-opetition approach (Brandenburger, Nalebuff, 1997), intended as cooperation and competition, is experiencing several challenges, and that is also because "collaboration is competition in a different form" (Hamel et al., 1989: 134).
"It is a competition among business ecosystems, not individual companies, that's largely fueling today's industrial transformation" (Moore, 1993: 76).

The ecological analysis conducted by Moore (1993) showed that a relatively small company might decide to discard its original isolation to benefit from the creation of a pole, intended as a more complex business ecosystem.
Traditionally, clusters may be defined as *"geographic concentrations of interconnected companies, specialized suppliers, services providers, firms in related industries, training institutions and support organizations linked around technologies or end product within a local area or region"* (Porter, 1990).
At territorial level, *"through their value networks and proven channels between businesses, research and academics, clusters provide efficient catalysts for innovation policy interventions...possibilities exist to further enhance the quality of cluster activities",*
thus, their contribution to Europe 2020 strategy is evident (Reiner, Gelzer, 2010: 2).

In the economic scenario clusters play a pivotal role: many successful clusters are market-driven and are a spontaneous factor, while in recent years, an increasing number of clusters is the result of ad hoc public policies (Commission of the European Communities, 2008). Innovation clusters are conceived as a tool both to ensure the "regional economic welfare" while empowering innovative sectors.

During the last few years, European Government has shifted the attention from a traditional definition of innovative cluster, where the cluster is a "technology based" tool to stimulate a specific technological field, to a different synergistic approach, where clusters may regroup actors connected on the market because of potential, complementary assets. This approach, known as "smart specialization strategy", is a result of such a vision. According to this approach, *"it should be understood at the outset that the idea of smart specialization does not call for imposing specialization through some form of top-down industrial policy that is directed in accord with a pre-conceived "grand plan" (*Foray et al., 2009).

This approach differs from a "top-down approach", where science parks are planned and developed on purpose. However, science parks and incubators can still play an essential role to support innovation poles/clusters based on a smart specialization strategy: this is the case of high-tech sectors, where science parks and incubators favor a higher sensibility towards the final market and a stronger integration of complex "systems" (e.g. technology transfer projects), development of converging technologies, support of R&D activities and innovative start-ups.

Therefore, the creation of an Innovation Pole/cluster, with the involvement of a science park-incubator involvement, may not only accomplish this mission but also confer to science parks a "double role" of managers of a physical place and coordinator of a local ecosystem" where to build communities of actors also out of the physical boundaries of the park (Conicella, Baldi, 2012: 8 and 12).

Furthermore, the idea of an Innovation Pole, which is more than a physical agglomeration of companies within a science park or an incubator, finds its strength also in the internet and the ICT technologies. The idea of a business ecosystem is still emerging behind the traditional cluster

Clusters are defined by the co-location of producers, services providers, educational and research institutions, financial institutions and other private and government institutions related through linkages of different types. There is huge diversity among clusters: they differ in terms of their stage of development along the cluster life cycle; some are networks of SMEs, some are organized around key anchor firms, and yet others have developed around universities (European Commission, 2007: 3).

An ecosystem is a geographic concentration of businesses and research centers in a particular field of activity known as "area cluster". An Innovation Pole (or innovation ecosystem) would be more like a "power cluster", a partnership between enterprises and research centers coordinated by a management team, with the specific purpose to set up an innovation value chain (White Paper, 2010: 5).

Consequently, "their specific nature, including their spatial coverage, differs according to technology, market conditions, and other factors that influence the geographic extent and relative strength of linkages" (European Commission, 2007: 4), while the internet and ICT play a key role because " the development and use of advanced ICT tools

would be expected also to facilitate the interactions between partners within a cluster as well as between clusters across Europe" (European Commission, 2007: 12).
The bottom up approach of a "smart specialization strategy" would allow, more than a "traditional" technology sector approach, the involvement of businesses operating in a variety of technological fields, since the quality of solutions delivered matters more than the technology used.

To sum up, the joint analysis of industrial and technological districts and innovation poles is helpful to understand the relationships among the agglomeration phenomena that characterize the production system in Italy. Increasingly, the innovation pole is not just a direct result of the technological district. The pole is intended as versatile development policy tool regional administrations use both as a catalyst for innovation in traditional sectors, which are the essence of the districts, and as a means to specialize territorial production as well.
We named the former "Vocational pole" and the latter "Political pole". In both cases, the result can be a widening of the technological context of production, if the poles are embedded in an organic and long-term regional development policy.

In Italy, the improvement of innovation within the Italian firms seems to be a direct result of the "district tradition": in fact, where agglomeration occurs, change occurs. If we share knowledge, we achieve mutual benefit, particularly in definite areas known as "sticky knowledge".
Based on these arguments, we can say that the analysis of the poles appeared rather heterogeneous, as evidence that the phenomenon is still in its pioneering phase. The poles, as tools for aggregation and catalysts for innovation at the regional level, do not develop in a specific way, but they follow different paths, through a model that may be an empirical model: a linear sequence of trials and errors through which regional governments would test and understand the potential of the territory.
The use of an empirical model should culminate in the convergence towards those best practices, since the emerging centers should be encouraged to emulate the successful cases previously observed. In this way, we would achieve homogeneity among fragmented realities (at national level) and avoid wasting of public resources. To do this, we need to identify measures and performance indicators that may be shared by all the actors of the process, including the territorial administrations, which are essential to verify the effectiveness of the poles, as well as a transparent and efficient use of funds and public resources.

A fair assessment of the performance of the intermediaries of knowledge would be useful both for managers and for administrations. The former, in fact, hold the keys to self-evaluate the success of their performance, thus recognizing any deficiencies in the internal management (for instance, an inequitable distribution of resources) and preventing small issues that would cause the project to be unsustainable in the long term. The latter may have an objective tool to allocate resources to finance the poles.

A step towards the creation of indicators and evaluation techniques was made in 2012 by the Agency for the diffusion of innovation technology, that published a table of indicators government and managers might use for assessments (Notebooks Innovation 10 and 11).

Shifting the focus from Italy to Europe and the United States, we have noticed our country is still lagging behind other geo-economies. The reasons for this delay is the fragmentation of production and the shortage of drivers of innovation, both endogenous and exogenous to the territory.

Hence, we need to reorganize paths of catching up, to strengthen human capital and spread the absorption capacity, to promote skills of creating endogenous innovation.

This requires local entities to absorb the global flows of knowledge, and local knowledge to merge with the knowledge provided by the most advanced poles, at the international level, since internationalization and innovation are interdependent (Ferrara and Mavilia, 2012).

The regional policy must therefore

1. Promote measures to support innovation in an internationalized context,
2. Open to the global market to gain knowledge codified and stimulate competition,
3. Invest public resources to build regional innovation systems based on different drivers of innovation.

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ENDNOTES

[1] "Innovation Clusters are pools of enterprises – from innovating start-ups to large multinationals – and research organizations, coordinated by a managing body and focused on specific sectors and geographical areas", (Conicella, Baldi, 2011: 10). See also Conicella, Bassi (2011).

[2] The term "Science Park" is more prevalent in Europe, while the term "research park" is more prevalent in the United States and the term "technology park" is more prevalent in Asia (Link, Scott, 2007: 661).

[3] Traditionally, "a cluster can be broadly defined a s a group of firms, related economic actors, and institutions that are located near each other and have reached a sufficient scale to develop specialised expertise, services, resources, suppliers and skills", (Commission of the European Communities, 2008: 2).

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[51] Louisiana Business and Technology Center handout from interview with Charlie D'Agostino

[52] Louisiana Business and Technology Center handout from interview with Charlie D'Agostino

[53] https://sites01.lsu.edu/wp/innovationpark/about-lbtc/impact/

[54] Miscenich.

[55] Lovett interview.

[56]http://statetechandscience.org/statetech.taf?page=state&state=LA&sub=rcic&year=1

[57]https://sites01.lsu.edu/wp/ored/files/2013/10/FirstLABrochure_final.pdf

[58] RS 51:2401. Baton Rouge, LA: Louisiana Legislature, 2009 http://www.legis.state.la.us/lss/lss.asp?doc=104388

[59] Report on the Development of the Proposed "Louisiana Research Alliance" Concept: A Response to Act 82 of the 2009 Regular Session. Baton Rouge, LA: Louisianan innovation Council, 2010.

[60] Board of Regents Form BOR-1 Revenue/Expenditure Data, Higher Education Summary. Baton Rouge, LA: Louisiana Board of Regents, 2013http://regents.louisiana.gov/wpcontent/uploads/2013/10/Summary_BOR1_Actual.xls

[61] When the Permanent Fund reaches $2 billion, the recurring royalty income will revert to the State General Fund

[62]In 2001, the Louisiana Legislature passed Act 698, which specifies that "the Treasurer shall account for earnings attributable to Support Fund balances due the boards of education separately and allocate such earnings to the credit of each board respectively." The result is that specific dollar amounts allocated to BESE and the Board of Regents are not equal.

[63] FY 2014-15 Plan and Budget for the Expenditure of Revenues Available from the Board of Regents Support Fund with an Overview of Results Obtained, Adopted by the Board of Regents, 5 December 2013. Baton Rouge, LA: Louisiana Board of Regents, 2013 https://web.laregents.org/wp-content/uploads/2011/02/BoRSF_FY14-15_PlanBudget_FINAL.pdf

[64] Act 14 (2013). Baton Rouge, LA: Louisiana Legislature, 2013 http://www.legis.la.gov/legis/ViewDocument.aspx?d=860417&n=HB1%20Act%2014

[65] LA. Constitution 7 10.1
[66] LED Magazine "Higher Education Partnerships Attract Major Tech Companies", 8 July 2014 http://opportunitylouisiana.com/index.cfm/newsroom/detail/5
[67] FY 2014-15 Plan and Budget for the Expenditure of Revenues Available from the Board of Regents Support Fund with an Overview of Results Obtained, Adopted by the Board of Regents, 5 December 2013. Baton Rouge, LA: Louisiana Board of Regents, 2013
[68] FY 2014-15 Plan and Budget for the Expenditure of Revenues Available from the Board of Regents Support Fund with an Overview of Results Obtained, Adopted by the Board of Regents, 5 December 2013. Baton Rouge, LA: Louisiana Board of Regents, 2013
[69] FY 2014-15 Plan and Budget for the Expenditure of Revenues Available from the Board of Regents Support Fund with an Overview of Results Obtained, Adopted by the Board of Regents, 5 December 2013. Baton Rouge, LA: Louisiana Board of Regents, 2013
[70] Louisiana Constitution Article 7, Section 10.1 http://senate.legis.state.la.us/documents/constitution/Article7.htm
[71] FY 2014-15 Plan and Budget for the Expenditure of Revenues Available from the Board of Regents Support Fund with an Overview of Results Obtained, Adopted by the Board of Regents, 5 December 2013. Baton Rouge, LA: Louisiana Board of Regents, 2013 https://web.laregents.org/wp-content/uploads/2011/02/BoRSF_FY14-15_PlanBudget_FINAL.pdf
[72] FY 2014-15 Plan and Budget for the Expenditure of Revenues Available from the Board of Regents Support Fund with an Overview of Results Obtained, Adopted by the Board of Regents, 5 December 2013. Baton Rouge, LA: Louisiana Board of Regents, 2013 https://web.laregents.org/wp-content/uploads/2011/02/BoRSF_FY14-15_PlanBudget_FINAL.pdf
[73] See http://bae.uncg.edu/assets/research/econwp/2013/13-10.pdf
[74] Innovation America: Investing in Innovation. Washington, DC: The National Governor's Association and the Pew Center on the States, 2007
[75] Innovation America: Investing in Innovation. Washington, DC: The National Governor's Association and the Pew Center on the States, 2007
[76] See Objective 2.3 on the Master Plan Dashboard.
[77]http://www.opportunitylouisiana.com/index.cfm/newsroom/detail/588
[78] FY2014-2015 Plan and Budget for the Expenditure of Revenues Available from the Board of Regents Support Fund with an Overview of Results Obtained, Adopted December 5, 2013.
[79] Review of the Endowed Chairs for Eminent Scholars Program. Board of Regents Support Fund January 2009.
[80] Review of the Endowed Chairs for Eminent Scholars Program. Board of Regents Support Fund January 2009.
[81] Internal analysis provided by BRAC
[82] Louisiana Tech University College of Engineering and Science Tenure and Promotion Guidelines July 2014
[83] The simple observation that research performed at a university is less expensive than research performed in the private sector motivates industrial funding of university research, and the AUTM survey reports that Louisiana universities received more than $56 million in research funds from industry in 2013. But it also raises the question of why private companies simply don't fund all research through universities. Aghion, Dewatripont and Stein (2005) answer this by noting that the reason for the lower wages received by academics is freedom from an imposed research agenda. Arora and Ceccagnoli (2006) supplement this rationale with the observation that final commercialization of research is more valuable in a setting in which complementary marketing and production assets reside.
[84] Bozeman (2000, p. 644) reports that in surveys undertaken in the 1980s and early '90s a common response to the question "what motivates your technology transfer activity" was "we were told to."
[85] One explanation is that university faculties are not provided with much incentive to pursue licensing. Most universities' promotion and tenure policies view commercial activity as less important than scholarly publication. Additionally, financial rewards to faculty from licensing are frequently under 30 percent of the license royalties generated, although this varies across universities (Link and Siegel 2005).
[86] In the absence of a patent, one problem for technology sellers is how to describe the technology completely enough to convince a buyer that it is both viable and commercially significant without also providing details that would allow a buyer to imitate rather than purchase the technology.
[87]Louisiana universities or centers of universities that identified themselves include Louisiana State University (LSU), LSU Agricultural Center, LSU Health Sciences Center (New Orleans), Tulane University, the University of New Orleans and Louisiana Tech University.
[88] A model with proportion of research expenditures funded by industry in this equation was also estimated but the op value on this variable was 0.92, so the variable was omitted from the reported model.
[89] A discussion of the test is contained in Stata Corp (2011, p. 695)

[90] Note that legal fees also include patent infringement suits and intellectual property protection activities of lawyers, and that the data also include reimbursed legal fees, which presumably includes awards from these infringement suits. Legal fees were used as a variable rather than legal fees net of reimbursements because reimbursements seem like to be speculative at the time the fees are incurred.