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Progetto di ricerca:

# Hi-tech clusters and University Technology Transfer: theoretical approach and industrial implications

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Il programma di ricerca si inquadrava in una preesistente collaborazione, "Hi-tech clusters and University Technology Transfer: theoretical approach and industrial implications". Questa prevede due obiettivi principali tra loro correlate. Il primo è lo studio dei cluster industriali. Il secondo è lo studio comparativo teorico e sperimentale delle pratiche di trasferimento tecnologico.

In particolare l'obiettivo principale della attività di ricerca collaborativa svolta presso l'Università di Toronto era inserito nel secondo dei due obiettivi. Riguardava infatti lo studio di uno specifico caso di trasferimento tecnologico in ambito Europeo attraverso un framework teorico già valutato.

Il risultato concreto delle attività svolte è contenuto nella bozza di articolo allegata al presente documento.

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# Which are the factors affecting Italian University commercialization?

ABSTRACT: The present article studies the technology transfer and commercialization of relevant European (Italian) universities, framing the determinants in a meaningful framework to determine the most important factors affecting such activities.

KEYWORDS: Technology Transfer; Italian Universities; Internal Factors; External Factors;

## 1. Introduction

Commercialization of research results has become a relevant phenomenon in universities and research institutes. First, Universities need to show a return for publicly funded research. Moreover, exploiting results of research activities for commercial purposes became a relevant instrument to foster regional economies.

Several terms have been coined to describe the activity of commercialization of research results. The most common is probably "Technology Transfer", though some confusion still exists on its usage[1]. The confusion on the terms (as well as on the practices) is even stronger in Countries, like Italy, where the commercialization of research results is minor with respect to other Countries. In fact, following almost two decades of efforts, it is only in the last years that technology transfer has become important among the practices of Italian universities and research institutes. This actually marks a strong difference with the North American and the more general Anglo-Saxon world where "Third mission" is already strongly assessed. In comparison to other countries, the implementation of universities' 3rd mission in Italy is less common. First of all it continues propagating the classical Humboldtian model of teaching-research University. Moreover, the urge for accountability via spreading and exploitation of results is often scarcely felt by University professors.

Thus it might be relevant to underline the peculiarities, the strengths and the weaknesses of the specific Italian "Technology Transfer" model. In order to perform this analysis we chose to exploit a functional interpretive framework of commercialization activities. This framework has been previously assessed (Breznitz, 2011: Breznitz and Ram, 2012) and organizes the factors affecting university technology commercialization to *external* and *internal*. In this way it makes possible to analyze such factors and to devise whether they contribute or not to the performance of the

[1] For an earlier discussion on the topic see for instance Bozeman (2000) who argues "technology transfer is defined in many different ways, according to the discipline of the research, but also according to the purpose of the research" (p. 629)

university in tech Transfer.

This paper focuses on the following research questions: which peculiar factors affect technology transfer and commercialization in Italy? especially for the case of Italy, where previous studies found that universities still exhibit lock-ins in this field. The hypothesis at the base of the analysis is that performance is first of all affected in negative by the mentality and the approach towards commercialization. The other relevant factor is the organizational one, both in terms of public policy and of internal organization of universities.

The analysis is done via case study method, using three technological universities in Italy. These universities are the three Italian *Politecnici*: Politecnico di Torino (PoliTO from now on), Politecnico di Milano (PoliMI) and Politecnico di Bari (PoliBA). Politecnici are specialized technological universities, performing in general teaching and research activities only in engineering and architecture. There are two main reasons directing the choice towards these Universities. These institutions are specifically relevant for the analysis since they are the only engineering technical universities in Italy. Moreover, previous studies show that engineering is one of the disciciplines with the strongest ties to industry and hence to commercialization . Second, from inception these universities were created with a focus on commercialization and hence the quality of their technology transfer activities remains high in comparison to the Italian standard.

The case study analysis will focus on PoliTO using PoliMi and PoliBA as shadow cases. There are several reasons for taking this approach: out of the three, PoliTO has the longest history. In fact, the institute dates back to mid-19$^{th}$ century, it became Politecnico in 1909. PoliMI, though sharing similar origins, became Politecnico in 1927. Finally PoliBA is the youngest of the three, as it dates back to 1990 only. Then, its incubator I3P (which will be described more in detail in the following of the article) is the oldest Italian incubator (having been founded in 1999). It has been nominated in 2004 "Best Science-Based Incubator" by The Technopolicy Network. Then it has been ranked 12$^{th}$ in the world and 4$^{th}$ in Europe in the 2013 UBI Index global benchmark of University Business Incubators. Finally, PoliTO was ranked first among Italian Universities in 2012 by the Italian Education Ministry rankings for accessory funding. Moreover it ranked first of the three Italian Politecnici for three subsequent academic years (2010/2011, 2011/2012, 202/2013) in the National University Survey realized by national newspaper "La Repubblica" together with the research institute CENSIS. Thus most evidence will be presented in this case. The other two will have an ancillary role and be treated rather as shadow cases, mostly showing differences with the principal one.

The present paper is organized as follow. Section 2 presents the theoretical framework: literature on internal and external factors affecting commercialization. Section 3 discusses Technology Transfer in Italy. Prior a literature overview is presented. Then relevant national factors

are presents in the light of the theoretical framework. Section 4 introduces the case studies. The description of each University is followed by the regional external and internal factors affecting commercialization. Finally, section 5 discusses strengths and weaknesses of the case, and presents suggestions and learned lessons.

## 2. Theoretical framework

This theoretical framework reviews the factors affecting university commercialization. When approaching the study of best practices in university technology commercialization a relevant fact must be taken in account: That is, each university or research institution operates in a specific environment. Different legislative, financial, and cultural setting are present. Thus, as Rothaermel et al. (2007) point out, the different environments are the reasons for the conflicting results in technology transfer studies.

### *2.1 External University Factors*

Under a general point of view there are several external factors that may influence how commercialization is performed, its process and consequently its outcome. These must be found in the conditions of economy, as well as in the legislation (Rahm *et al.*, 2000, O'Shea *et al.*, 2005, Lawton Smith, 2006). This is true at both national and regional levels. Such factors, besides legislation (a relevant example is the Bayh-Dole act in the US, see Mowery and Sampat, 2001) can be related for instance to the role of regional development agencies (Lawton Smith and Bagchi-Sen, 2012). In the section of the present work dedicated to case study such factors – both at National Italian and Regional level – will be pointed out.

As also the literature review on the Italian case shows, a relevant external factor is the industrial context surrounding the University. In particular, the most relevant role for (successful) Technology Transfer must be ascribed to the relationship existing between industry and University. Relevant interpretive frameworks to put in context such relations are the theories of National and Regional Innovation Systems, and of the Triple Helix (Nelson, 1993, Etzkowitz, 1995). Such theories help understanding the importance of the operational environment of the University and of the relations existing with firms and institutions. These are factors that might strongly affect the modalities and skilfullness in innovating and bringing products to market.

For the case in object the most relevant external factors will probably be the surrounding industrial context and the local incentives to university industrial collaboration. This is due to the Italian industrial context, scarcely devoted to innovation and high technology.

### *2.1 Internal University Factors*

Internal factors play a relevant part in university commercialization. In past literature the three

main factors can be identified as follows: entrepreneurial activity and culture, Technology Transfer organization, Technology Transfer policy (Clark, 1998, Etzkowitz, 1998, Bercovitz *et al.*, 2001, Shane, 2004, Link and Scott, 2005, O'Shea *et al.*, 2005, Breznitz, 2011, Breznitz and Ram 2012)

University commercialization culture was identified in several studies as crucial to the ability of universities to bring technology to the market. Clark (1998) emphasized the cultural atmosphere of an entire university. Moreover he asserts that a vital role in promoting entrepreneurial activity is that deriving not only by the leadership of a university, but from all departments, schools, research centers etc. Under this point of view also the results obtained by Rolfo and Finardi (2014) show the importance of a diffuse culture of collaboration.

Also Kenney and Goe (2004) assert that "professional entrepreneurship and corporate involvement" (p. 204) can be directed by the University of residence of a scientist. Thus authors find that there is an effect on the entrepreneurial spirit of a scientist from the culture of a department, and also from individual colleagues. Also Bercovitz and Feldman (2007) affirm that the university of residence can influence one's ability in terms of technology transfer. They assert in fact the importance of an atmosphere supporting and encouraging entrepreneurship. Thus a department where peers file inventions will help scientist take part in activities of technology transfer. The importance of the mission statement of a university might offer in many cases an insight into its commercialization culture and organization. The university's mission statement indicates its commitment towards economic development and, more in particular, towards commercialization of research results and technology transfer (Breznitz, 2011).

Internal bodies and local management of technology transfer play another relevant part. University Technology Transfer Office (TTO) or Industrial Liaison Office (ILO) are indicated by several studies to influence the spinoff creation activity at their specific location (see Bercovitz et al., 2001; Owen-Smith and Powell, 2001; Shane, 2004; Chapple et al., 2005; Lockett and Wright, 2005; O'Shea et al., 2005).

The topic of historical background and past success in commercialization is stressed by O'Shea et al. (2005). Their study shows that such features can predict the future ability and options regarding the creation of Spinoffs. Also the quality and number of personnel involved in the TTO is relevant. This obviously reflects its resources, its influence, as well as the university structure is flexible and trusted. Moreover, if the staff is highly reliable and knowledgeable, it is more likely that internal inventors and external investors will be willing to collaborate with them (Shane, 2004; Lockett and Wright, 2005; O'Shea et al., 2005; Muscio, 2010; Balderi *et al.*; 2012). A further, positive effect towards the creation of Spin-offs is that of the ability in business development of a TTO (Clarysse *et al.* 2005; and Lockett and Wright (2005). Also organizational facts of TTOs play their part. Facts like concentration of all Technology Transfer activities in one single unit, the

clarity of policy, the competence of staff are described by Breznitz (2011) as relevant factors promoting technology commercialization.

Naturally it is not only the TTO that influences the performance in commercialization. In fact also the importance of academic policies (in particular of those affecting the relations between university and firms) has been shown to impact the ability of universities to commercialize technology. IPR policies refer to copyright of scientific publications (like journal articles or books). Nevertheless in the specific topic it is more relevant the policy a university has towards patents for invention filed within the university as results of research. In particular ownership of inventions is the relevant point in the analysis of IPR policies. There are differences in definitions, as well as those existing in culture, history and organization of TTOs. In general, ownership might be wholly of the university, or depending on the source of funding (Siegal and Phan, 2005). In the specific case of Italy, as the next section will show, national regulations on IPR have influence on ownership of inventions produced inside universities. Among the factors enhancing and encouraging licensing of technologies from research is assigning a higher share of royalties to the inventors (see for instance Link and Seigel, 2005). On the other side, there is always a chance to improve patenting contributing equity for expenses of patenting and licensing. This can be devised for instance from the study of Di Gregorio and Shane (2003), who state that universities that take on these expenses spin out companies at a higher rate than those who do not. Again Shane (2004) did show that the policies of a university have a marked influence on its spinouts. He lists a series of factors that can determine the rate or creation of spinout companies: allowing exclusive licensing; allowing a leave of absence; permitting the use of university resources; the size of the share of royalties allocated to inventors; providing access to pre-seed-stage capital

## 3. Technology Transfer in Italy

### *3.1 Technology Transfer in Italy*

Existing studies on technology commercialization indicate that Italian universities are slow to adopt the new models of the entrepreneurial university. Moreover, examination of university-industry relationships show low absorptive capacity for university R&D. Chiesa and Piccaluga (2000) have been among the first ones to study Technology Transfer in Italy. They performed in fact an empirical study on the creation of academic Spin-offs. Their conclusions were that in Italy existed "an Italian (and perhaps partly European) model for research spin-off companies, which is different from the American (and perhaps Anglo-Saxon) one. The Italian model is characterized by low risk levels, together with modest growth rates" (p. 338). Authors ascribe these facts to a lesser readiness towards acceptance of failures, hence the minor likelihood in engaging in commercial

activities. But another relevant fact pointed out in the article is the "greater stability offered by the university system in terms of long life employment" (p. 338). These conclusions add evidence to the idea of an Italian University environment rather resilient – under a general point of view – towards innovation.

Spin-offs have been studied more than ten years later also by Salvador and Rolfo (2011), who work on a sample of firms with a linear regression model. Results show at regional level the dependence of the number of spin-offs by the number of incubating structures. Nevertheless, as authors point out, "The research spin-off scenario in Italy is complex, confused and difficult to qualify. [...]the spin-off phenomenon is a new reality for a country like Italy and it has acquired increasing levels of importance in recent years [...]lack of clarity and information characterize the Italian research spin-off context" (p. 179). Results support the idea that attention has been directed towards creation, rather than long-term sustainability, of spin-offs.

Among the most recent works studying Spin-off creation in Italy, Iacobucci *et al.* (2013) analyze a complete database of Italian spin-offs created inside public research institutes between 2000 and 2012. Their results show a generalized low capital intensity, low levels of growth, as well as low sales performance. Also investments in innovation are low, and spin-offs tend to perform consulting and R&D activities, rather than engaging in other fields. Authors conclude ascribing these fact to the Italian industrial environment, unfavorable towards hi-tech companies. Also the generalized model of ownership and governance of Spin-offs plays its part. Notwithstanding these results, authors also deem positive the engagement of academics in entrepreneurial activities. First, because more than 3,500 professors have been involved into entrepreneurial initiatives, thus stimulating universities towards "third mission". Second, because spin-offs are in any case (also if there is a majority of consulting enterprises) a medium able to appraise university's skills. Finally, because they are anyway an instrument able to obtain a relevant outcome, that is, support and promotion of the diversification of Italian industrial system.

A more general approach is that of Balderi *et al.* (2007), who study strategies and actions of Italian TTOs, analyzing data of a 2002-2005 survey. Their picture of this early stage of development shows "a relevant increase in the volume of TTOs' activities. [...] TTOs' growth is both intense and somehow 'wise'. In other words, in the majority of TTOs we don't observe an excessive growth of the patent portfolio and IP expenditures." (p. 29).

Herafter Muscio (2010) tests hypotheses on the use of TTOs by Italian academics according to their confidence towards, and the competence of, staff. The results, based on a wide set of data and a survey, show that "in the case of Italy, TTOs' contributions to university-industry collaborations are marginal. [...] "Research performance, business-oriented management of TTOs [...] positively affect the probability of the TTO being involved in university-industry collaborations. [...] research

performance affects scientists' use of TTOs" (p. 199).

More recently Algieri *et al.* (2013) also study Italian TTOs. Their analysis shows the importance of the economic context where TTOs operate. There are in fact strong differences in the probability of success between TTOs operating in the North (more successful), in the Centre and in the South (less successful) of Italy. A similar study is that performed by Balderi *et al.* (2012). Their analysis shows an evolution of the general Italian TTO panorama. The advance is mainly due to the growth in competence of TTOs staff, as well as in quality of research and of relations with firms. The weaknesses are mostly depending on a lack of positioning of TTOs in the structure of Universities in terms of decision chain, and to insufficient human resources.

Finally, co-patenting between firms and Universities in Italy has been studied by Cerrato *et al* (2012). Their analysis shows evidence that co-patenting is driven by the demand of innovation present in the local (regional) industry. The greater the innovative ability of the Regional industrial system, the more significant is the contribution of Universities to the Regional development. Nevertheless enterprises remain indifferent to the absolute value of research according to academic evaluation (p. 276).

A peculiar case is instead studied by Finardi and Rolfo (2014) who address the topic of Spin-off creation in the CNR, National Research Council of Italy. Their analysis does not distance itself from previous results, in that CNR Spin-offs are mainly performing with low turnover, and tend to be involved in research and development rather than in productive activities.

The learned lessons from this literature overview are those of a system that has slowly evolved in the last 15 years. The evolution proved problematic; nevertheless signals show a slow but steady growth in the performance of university commercialization.

*3.2 Technology Transfer in Italy: External factors at National level*

Italian State policies on university and research have undergone a long series of reformations since the last decades of the 20$^{th}$ Century. According to Reale and Potì (2009) the "classical" – Humboldtian, theoretical-culture-driven – model of university existed in Italy up to 1980s. While the rest of Europe the 1960s marked a dimensional expansion, and a growth in terms of number of students and Universities. Nevertheless the National Government reacted with basically no organizational changes. Thus no differentiation in terms of mission and territorial embedding happened. In the 1980s, notwithstanding a further increase in the number of professors, "the compromise between central bureaucracy and the academic guilds composed by professors did not end" (p. 83).

Reformations in the 1990s began when 168/1989 Act passed (1989). Again Reale and Potì (2009) affirm that "Law 168/1989 passed, introducing important structural changes in the higher

education sector in terms of the distribution of authority, the degree of autonomy of the institutions and mechanisms of co-ordination" (p. 84). Subsequently to 168/1989 further acts set instruments for financial autonomy, and then for the application of the Bologna model[2]. The rationale for reformations was influenced by the theory of New Public Management, nonetheless adapted to the specific Italian context.

During the 2000s two subsequent performance evaluation exercises of university and research institutions were performed, though no significant reallocation of funding according to performance of universities happened. In the meanwhile two different administrative orders were issued by university and education ministry (1999 and 2004). The two ministerial acts performed two subsequent reformations of university autonomy, there comprised teaching and educational activities.

The final reformation of Italian University took place at the end of 2010, when Act 240/2010 was promulgated. The Act performs radical changes. In particular the system of hiring of new professors has been completely changed, with the introduction of a preliminary examination ("Abilitazione") in order to set minimum requirements for accessing the system of selections for hiring. These policy change must also be considered in the context of a dramatic decrease in the number of professors, also due to National restriction in hiring of public personnel.

Reale and Potì (2009) conclude their analysis affirming that "in Italy reforms were driven more by ideological than by changes in the constellation of power of the protagonists. The effects of reforms were not as important as they were intended to be, because the state did not cede power and responsibilities linked to key aspects of the higher education system, but adopted an "in-between" solution in applying new public management principles that, on the one hand, impeded the creation of a quasi-market environment, and on the other allowed professionals in higher education to maintain most of their privileges and sphere of influence. [...] More generally we see only slow adaptation to comply with the new rules which leave, almost intact, the existing system of idea, practices and habits." (pp. 91-92, passim).

The constant higher education policy changes created a confusion in regards to the technology commercialization policy. In particular, the transfer of power from the state to universities is still partly unaccomplished.

A further relevant policy external factor to be taken in account is the Italian regulation on intellectual property. In particular it is relevant to note the existence of the so-called "Professor's Privilege". This is basically the possibility for university professors to retain the IPR of inventions made while at the workplace. Italy has introduced it in 2001 in the novel regulations on intellectual

[2] For a wide description of the financing system of Italian University see also Geuna and Sylos Labini (2013)

property. The most recent act discussing the topic is the Decreto Legislativo No. 30, February 10th, 2005. Thus, while other european universities have chosen to cancel the inventor IP rights, in Italy university professors retain the intellectual property rights of their inventions. This is true except the case in which the research has been performed in the context of a research partly or totally financed by private business or by other public research bodies different from the researcher's employer. Notwithstanding the introduction of the privilege the analysis of Lissoni et al. (2013) shows a decrease of the share of academic patenting over total EPO patenting in the years between 1996 and 2006.

At a National level, besides policies, a relevant external factor affecting how Universities tackle commercialization are structures for technology transfer. In particular it is the case of the most relevant of such bodies, Netval, Network per la valorizzazione della ricerca universitaria (Network for the valorization of University research). Netval is an association of Italian Universities and public research bodies with the aim of the valorization of research results via commercialization and Third mission activities. Its mission is the appraisal of research results, through the network of technology transfer offices.

This mission is fostered in collaboration with the industrial and finance environment, associations of enterprises and venture capitalists. The aim is to strategically bridge between research in Universities and Public Research Bodies, and enterprises aiming at innovation. The final target is the obvious growth in market competitiveness. It must be pointed out that every year Netval is publishing a survey reporting the state-of-the art of Technology Transfer in Italy[3].

## 4. The Case study

### *4.1 Politecnico di Torino*

The first origins of PoliTO are found in 1859. In that year the so called "Legge Casati" (Casati Act, from the name of the then Education Minister) was declared. This Act reformed completely the schooling of the Sardinian Kingdom (to which Turin was at that time the Capital Town)[4]. Following its implementation the "Scuola di applicazione per gli Ingegneri" (Application School for Engineers) was founded. The school was set in the ancient Castle of Valentino in Turin, dating back to the 17th Century and now included in the list of UNESCO World Heritage Sites. Until that time the education of engineers was entrusted to the University of Torino, and had a strongly theoretical character. The promoters of the new school, instead, were mainly oriented to an experimental, strongly practical approach.

Establishment of Politecnico di Torino in its present form came finally in 1906, after the fusion

[3] See http://www.netval.it/pagine/Netval-Survey.aspx (accessed May 2014).
[4] See Mele (2006) (in Italian) for an historical overview of the origins of PoliTO.

with the "Regio Museo Industriale Italiano di Torino" (Royal Turin Italian Industrial Museum). This museum, established in 1862, was also conceived as an education institute for industrial subjects, with the presence of several technical schools. Thus, from its origins, the main character of PoliTO is that of an educational institution having strongly practical orientation, more directed towards practically exploitable technological knowledge rather than towards a deeply theoretical approach.

After World War I the F aculty of Engineering moved to a new building in the center of town. After being severely damaged by World War II bombings, this building was abandoned and a new location was instead planned. The debate on the new location started immediately after the end of the war, when the Allies initially offered a sum for repairing the building.

Once this offer expired, the decision on the location for the new location was largely dependent on the offer of 300 Million Liras by the "Unione Industriale" (Turin Association of Industrial Employers) to buy the area where now PoliTO is. Initially both the Municipality and the public opinion were against setting the Politecnico in this location. According to newspaper articles building of this location has been a complex process[5]. This was mainly due to the yet existing chronic lack of funding, which in turn caused severe slowing down of building procedures. Eventually further financing arrived from several sources, together with further funding of 600 Million Liras from National Administration. The Municipality of Torino offered 500 Million, the Province of Torino 200 Million, the "Unione Industriale" further 100 Million, the Commerce Chamber 40 Million. The main sponsor has been nevertheless FIAT. The (then) Turin-based car production company offered 700 Million Liras. This amount financed the construction of the main, central building of the new building. In this building takes place the main lecture hall, dedicated to the founder of FIAT Giovanni Agnelli,. Finally the new location was inaugurated on November 5$^{th}$, 1958. Thus PoliTO moved, in 1958, to the new building, hosting the Faculty of Engineering. The Faculty of Architecture remained at the Valentino Castle, as the new building was yet insufficient to host both the Faculties.

These facts explain the strong ties between PoliTO and the local industrial environment existing since after World War II. Private actors and in particular FIAT have been in the 1950s the main financing bodies of the building of its new location. It is easy to devise that, in the strong economic expansion happening after the war, the need for a deeply specialized workforce of engineers has probably been the driving force of their involvement..

Minelli and Turri (2009) present evidence on the last decades of history of PoliTO, with particular attention to the years from 1996 to 2007. According to their study the period of time up to

[5] Reference on the topic have been retrieved on the online historical archive of national newspaper "La Stampa", published in Turin, http://www.archiviolastampa.it/ (in Italian, accessed May 2014).

the end of the 1980s has been for PoliTO rather static under a general point of view. No particular changes occur. Key figures of university rectors adopted a managerial-entrepreneurial approach, leading PoliTO – together with the academic senate to several achievements. Some of these achievements are: the creation of the institute for electronics "Mario Boella", in a partnership with Compagnia di S. Paolo, Motorola, SKF and STMicroelectronics; a new Centre for automotive technologies (realized with the support of FIAT); participation to foundations; a multimedia project for long-distance education; further partnerships with Motorola and FIAT. Moreover these years changed the environment of PoliTO, from a self-referential attitude – typical of traditional University – to the capability of relations with strong economic and social actors. Moreover, in the context of a phase of reformation of Italian University (see below) reformations at the level of teaching structures (Faculties and Schools) and of research structures happened. In the meanwhile the building of an extension, doubling the volume of its structures, began.

Finally, at the end of the 2000s, the implementation of a strategic plan begun. This plan was developed under four main axes: research university, strong internationalization, strict relations with surrounding environment and the economic system, quality of university life.

It must be noted that, in these decades, the ability to attract funding – both via competitive research project and industrial commissions –grew. The relevance of this plan is pointed out by Cuttica (2012) who also describes a growing trend of technology transfer results, as well as a strict collaboration between the different structures for TTO.

The analysis of Minelli and Turri (2009) shows a relevant attitude of PoliTO "internal environment" towards change and modernization, though consistent "grey areas" of resistance to change exist. These facts must always be interpreted in the framework of Italian University, which tends to be resilient both to change and to collaborations outside the "Ivory Tower" of culture. Nevertheless PoliTO leadership has been able to overcome the internal "organizational intertia".

By 2012, PoliTO counted almost 30,000 students according to government's official statistics office) and 811 Professors (Full, Associate and Assistant). It is thus considered among the medium-large Italian Universities (Macro Universities are those with more than 40,000 students, small Universities those with less than 10,000).

The number of scientific publications produced by PoliTO has been growing steadily in the last 15 years, as reported in Table 1a. Moreover, table 1b reports the total funding of students per year. In the first (2001-2003) Evaluation Exercise of Italian Research, PoliTO ranked above the national average in Engineering.

Table 1a – Number of PoliTO scientific products (Source: Scopus, http://www.scopus.com, accessed October, 2013);

| YEAR | SCIENTIFIC PRODUCTS |
|---|---|
| 1998 | 478 |
| 1999 | 518 |
| 2000 | 572 |
| 2001 | 642 |

| | |
|---|---|
| 2002 | 717 |
| 2003 | 787 |
| 2004 | 951 |
| 2005 | 1,108 |
| 2006 | 1,218 |
| 2007 | 1,367 |
| 2008 | 1,467 |
| 2009 | 1,759 |
| 2010 | 1,792 |
| 2011 | 1,926 |
| 2012 | 1,938 |

Table 1b: total funding (source: ISTAT)

| YEAR | TOTAL FUNDING |
|---|---|
| 2000 | 146,525 |
| 2001 | 223,919 |
| 2002 | 240,073 |
| 2003 | 248,614 |
| 2004 | 249,867 |
| 2005 | 275,998 |
| 2006 | 312,455 |
| 2007 | 317,434 |
| 2008 | 384,677 |
| 2009 | 413,175 |

External University Factors

Coming to a more specific, local level, an initiative set by the Regional government (via EU funding) to foster "Third mission", should be pointed out (see also Piccaluga, 2001, pp. 267-269). This is the project "DIADI" ("Diffusione dell'Innovazione nelle Aree a Declino Industriale della Regione Piemonte", diffusion of innovation in the industrially declining areas in piedmont region). Performed from 1996 to 2006, DIADI encompassed several initiatives. Among these ones was the creation of a database of research projects, carried on in Universities and Public Research Institutions, set to foster collaboration with enterprises.

A further regional element is the project ILO-Piemonte, that is, a regional industrial liaison office (Cuttica, 2012). This public financed office joined PoliTO and the other two Universities of Piedmont (Università degli Studi di Torino and Università degli Studi del Piemonte Orientale), together with regional government and other local bodies. The project lasted two years (2008-2010) and has been only partly successful in its outcome, not fully creating bonds between the participants for enhancing Technology Transfer.

Turin has been all along 20th Century the home to the most important Italian firm, car-makers FIAT, which absorbed from the 1960s to the 1990s other relevant Italian car-making companies (such as Lancia and Milan-based Alfa-Romeo). In consequence, absorptive capacity of employment for engineers in the local industrial context has always been very high. So it has been the chance for engineering departments of PoliTO (University of Turin has no schools of engineering) to collaborate, mainly in terms of problem-solving and, more in general, of applied research.

Technology Transfer is considered at PoliTO a relevant issue to be promoted. The Statute of Politecnico di Torino (2011) begins declaring its nature (Section 1) and mission ("Finalità Istituzionali", Section 2). Paragraph 7 of Section 2 is dedicated to technology transfer: "Politechnic sets between its goals technology transfer, transfer of innovation and of knowledge to the economic and production system [...]"[6]. This fact shows the cultural relevance of the relation with

[6] Il Politecnico pone fra le proprie finalità il trasferimento tecnologico, dell'innovazione e delle conoscenze al sistema

entrepreneurial environment in PoliTO, as Technology Transfer is considered a relevant part of its mission.

Besides this institutional fact, also the general attitude of personnel towards Technology Transfer should be taken in account. The analysis Rolfo and Finardi (2014) show the presence, in PoliTO, of a rather generalized and pervasive culture of relations with enterprises. Data, collected via the database of the above described DIADI initiative, show that all 18 PoliTO departments were involved in research projects. Nevertheless participation of professors to this initiative was regardless of the structure of departments. That is, Professors at any level were personally involved, rather than delegating directors or personnel at decisional level.

In fact ties with local industrial environment, as also above described in the historical overview of PoliTO, have always been strong. This in turn might strongly depend on the intrinsic nature of PoliTO, that is, its character of specialized university, devoted solely to engineering and architecture. The sole presence of such – strongly related to production activities – topics in research and education is probably naturally fostering an entrepreneurial mind setting of researchers.

Internal University Factors: Commercialization Organization at PoliTO

The main PoliTO branch dedicated to Technology Transfer and commercialization is officially named SARTT (Supporto alla Ricerca e al Trasferimento Tecnologico, Support to Research and Technology Transfer). SARRT is one of the 11 Divisions of central administration. Its target is to manage all activities that are related to research in two main areas: the first one is competitive research projects (at international, European, national and regional level); the second is technology transfer and commercialization activities. SARTT has (according to PoliTO website) a staff of 30 as of May 2014.Inside SARTT the specific office for Technology Transfer is "TT&IL - Technology Transfer Division and Industrial Liaison", founded in 2000. TT&IL counts as of 2012 a staff of 10 people.

As previous studies show, the strength of a technology transfer office can be viewed through its reporting level within the organization (Feldman and bercovits XXX) in the case of Polito, the director of SARTT reports directly to the general director of the university whom, being the head of the administrative body of the university, reports directly to the rector of PoliTO. In turn the director of TT&IL reports directly SARTT Director. Hence, this level of reporting implies that....

Other structures of PoliTO Knowledge/Technology Transfer structure encompass a business contact point (Innovation Front End), a venture capital hub, and the Business Research Centre (Fassio *et al.*, 2014). This last unit, launched in 2008, has led several foreign/multinational

economico e produttivo, anche con riferimento all'ambito delle professioni.

companies to set a research unit at PoliTO. Nevertheless it must be taken in account that some of the companies subsequently withdrew their participation.

According to Della Malva *et al.* (2007) PoliTO ranked at that time 11$^{th}$ in Italy for number of patents, and it was 14$^{th}$ for its index of University Patenting intensity. The patent list retrieved on PoliTO website[7] contains 358 patent applications as of January 2014. Further data on patents have been retrieved on the European Patent Office online database "Espacenet"[8]. A search for "Politecnico Torino" in the search field "Applicant" rendered 219 single patents (not inventions) having PoliTO as applicant under different denominations (mostly "TORINO POLITECNICO"). Figure 1 and Table 1 show data on the evolution of patenting at PoliTO. Fassio *et al.* (2014) report a portfolio of 172 patents as of 2012: this figure does not consider abandoned papers, as well as those issued in 2013 and 2014.

According to received information, as of December 2012 9 patents had been licensed. The total income from licensing was less than 9,000 Euros.

[7] http://www.swas.polito.it/_library/downloadfile.asp?id=103051, accessed May 2014
[8] http://www.epo.org/searching/free/espacenet.html, accessed May 2014

Figure 1 – Trends of Patenting at PoliTO

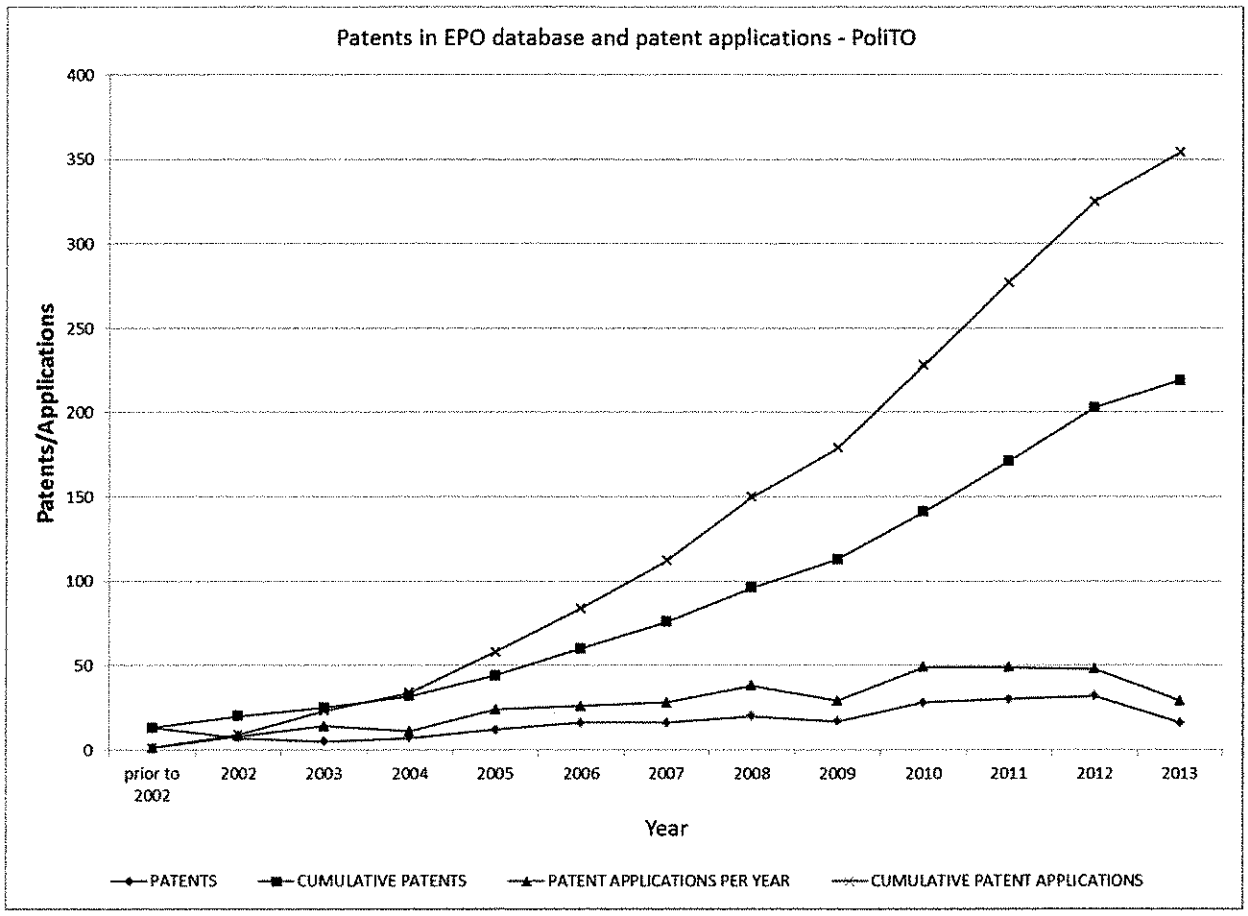


Table 2a – PoliTO Patent Applications per year

| YEAR | PATENT APPLICATIONS PER YEAR |
|---|---|
| 2001 | 1 |
| 2002 | 8 |
| 2003 | 14 |
| 2004 | 11 |
| 2005 | 24 |
| 2006 | 26 |
| 2007 | 28 |
| 2008 | 38 |
| 2009 | 29 |
| 2010 | 49 |
| 2011 | 49 |
| 2012 | 48 |
| 2013 | 29 |
| 2014 | 4 |

Table 2b – PoliTO Patents per year

| YEAR | PATENTS |
|---|---|
| prior to 2002 | 13 |
| 2002 | 7 |
| 2003 | 5 |
| 2004 | 7 |
| 2005 | 12 |
| 2006 | 16 |
| 2007 | 16 |
| 2008 | 20 |
| 2009 | 17 |
| 2010 | 28 |
| 2011 | 30 |
| 2012 | 32 |
| 2013 | 16 |

Table 3 reports the average number of priorities *presented* by the Italian Universities member of Netval (Neval 2014) as well as granted patents per year. Both global average data and average of the top-5 Universities are presented. Data show that PoliTO lies at the top of Italian patenting Universities.

Table 3 – Average priorities and patents per University (source: Netval 2014)

| YEAR | 2004 | 2006 | 2008 | 2010 | 2012 |
|---|---|---|---|---|---|
| Average priorities per University | 3.2 | 5.4 | 5.4 | 5.2 | 5.7 |
| Average priorities per top-5 University | 13.2 | 21.8 | 20.2 | 24.6 | 23.8 |
| Average patents per University | 1.6 | 1.8 | 2.3 | 6.8 | 3.9 |
| Average patents per top-5 University | 8.0 | 8.8 | 11.4 | 37.8 | 18.2 |

The most important strength is probably PoliTO incubator, I3P ("Incubatore di Imprese Innovative del Politecnico di Torino", Turin Politechnic's Innovative Enterprises' Incubator). I3P was founded in 1999 and is thus the oldest Italian academic enterprise incubator. I3P is a joint-stock company, and its partners are – besides PoliTO – several public actors: the administration of the Province of Torino, the Commerce Chamber of Torino, Finpiemonte (Regione Piemonte's Financial Institution), the City of Torino. This fact shows involvement of local bodies at different level towards PoliTO Technology Transfer and commercialization activities. The performance of I3P is relevant both at a national and international level. As above described I3P won in 2004 the "Best Science Based Incubator" Award of the Technopolicy Network[9]; in the 2013 University Business Incubator ranking, it ranked 12$^{th}$ in the world and 4$^{th}$ in Europe[10].

As of October, 2013 the number of incubated companies was 149. Table 4 resumes the features of the firms: number of companies entering/exiting I3P per year, societal status (active, sold off, acquired by another company/entrepreneur). These companies have been founded by professor facult, a Post-doc, or Ph.D. student, either active or having left PoliTO within three years.

Out of the 149 incubated spin-offs, about one third (50) are official PoliTO Spin-offs. The status of "official spinoff" depends on the regulations on creation of Spinoffs. After granting the status of Official Spin-off companies undergo continuous scouting and assessment of their performance by PoliTO Spin-off commission. The remaining incubated spin-offs, though having a relation with PoliTO as above described, have not been granted to adopt official logo of "PoliTO spin-off". Finardi and Rolfo (2014) analyze data for 32 of the official PoliTO Spin-offs. Data on industrial sector indicate that the 40% of spin-offs focus on consulting activities[11]. Average turnover for the 13 "production" spin-offs are positive (from about 450'000 Euros in 2010 to about 750'000 Euros in 2012). EBITDA in the same years are negative or slightly positive; nevertheless this data suffer from the presence of two, strongly negative, outliers. Once eliminated the outliers, turnovers of "Production" Spin-offs grow and EBITDA become positive, though not very high (the maximum average EBITDA is about 48'000 Euros in 2012). Data show that, as of December 2012, 60 % of the total I3P Spinoffs are either active on the market or have been acquired. This fraction is even

[9] See http://www.technopolicy.net/index.php/events/sbi-awards (accessed October, 2013);MAKE ALL OF THESE INTO CITATIONS

[10] See http://ubiindex.com/global-top-list-2013/ (accessed October, 2013);

[11] ATECO, Italian Industrial classification, adopted adopted by Italian National Statistics Institute ISTAT, follows in its last revision EU industrial classification NACE rev. 2.

higher if we do not consider those Spinoffs that are still incubated: 77 %.This high fraction of companies successful in the short term ????.

Table 4a – I3P Spin-offs entering/exiting incubation

| Year | Entering I3P | Exiting I3P |
|---|---|---|
| 1999 | 4 | - |
| 2000 | 7 | - |
| 2001 | 10 | - |
| 2002 | 6 | 7 |
| 2003 | 12 | 7 |
| 2004 | 10 | 11 |
| 2005 | 14 | 4 |
| 2006 | 15 | 11 |
| 2007 | 13 | 11 |
| 2008 | 10 | 15 |
| 2009 | 12 | 10 |
| 2010 | 14 | 11 |
| 2011 | 9 | 12 |
| 2012 | 7 | 14 |
| 2013 | 6 | 12* |
| 2014 | | 12* |
| 2015 | | 6* |
| 2016 | | 6* |
| * Foreseen | | |

Table 4b – Tech field and status of Spin-offs

| Technological field | Spin-offs |
|---|---|
| BIOMEDICAL | 10 |
| CLEAN TECHNOLOGIES | 25 |
| ELECTRONICS & AUTOMATION | 29 |
| ICT | 58 |
| INDUSTRIAL | 27 |
| **Status (as of 12/31/2012)** | |
| Acquired by another company | 9 |
| Closed/closing | 27 |
| Incubated | 33 |
| Active/on the market | 81 |

Internal University Factors: Commercialization Policies at PoliTO

The first IPR policy at PoliTO was created in 2001 with the latest update in 2007 (Fassio *et al.*, 2014). Article 2 of IPR regulations contains a series of statements describe the importance for PoliTO of valorization of research results via patrimonial exploitation, of fostering of patenting, of supporting the transfer of research results to enterprise. It is noteworthy that this statement also explicitly says that PoiTO manages all contractual relations, there comprising those relative to IPR and technology transfer. This fact entails obviously a policy of strong institutional control of the administration of PoliTO towards personnel of the University.

IPR regulations, while assigning in any case the title of inventor to the researcher (either tenured or temporary) retains all patrimonial rights to PoliTO. In case a commercial exploitation of the patent occurs, net (after payment of expenses) proceeds are equally – 50/50 – divided between the inventor and PoliTO The fraction assigned to PoliTO is shared between Central administration (40 %) and the inventor's home department (10 %).

The present issue of spin-off regulations date back to May 2009, with a modification on March 2012. Nevertheless the first version dates to 2003. PoliTO spin-off must derive from research activities performed inside the University. A commission to manage Spin-off creation is set, and foundation must be approved by the Administrative Council. In case of direct participation of PoliTO to the new society, the fraction of social capita must be in between 5 and 40 %. PoliTO

Intellectual property rights can be made available to the Spin-off according to specific contracts. Intellectual property rights of research results obtained inside the Spin-off are the property of the same, though PoliTO can access them freely for educational or research purpose, for a period of 5 years from the Spin-off foundation.

What comes immediately to the eye, in discussing this regulation, is the fact that it has been first approved 4 years after the incubator was created. This might indicate a rather practical, target-oriented behavior by part of PoliTO governing bodies, rather than one more cautious, policy-oriented one. That is, it is evident that Spin-off creation has begun earlier than the setting up of an appropriate internal regulation.

*4.2 Politecnico di Milano*

PoliMI was founded in 1863 Istituto Tecnico Superiore ("Higher Technical Institute") in similar circumstances to that of PoliTO, but became Politecnico di Milano only in 1927, when moving to its new (and main present) location.

It is the largest among the three, counting about 40,000 students and 1,300; this could be considered as a consequence of being located in a region – Lombardia – with more than double the population of Piemonte, where PoliTO is situated (more than 9 millions inhabitants vs. more than 4 millions).

*External and Internal University Factors at PoliMI*

Regional government of Lombardia created in 1974 the Regional Research Institute (IReR), performing studies on institutional, economic, territorial and social assets and processes. IReR became in 2011 Éupolis Lombardia. Éupolis performs also activities in education (offering improver courses)

In order to foster collaboration between research centers and enterprises a system of crediting, QuESTIO (Quality Evaluation in Science and Technology for Innovation Opportunity) has been established. Centers (both private and public) can be credited and recognized as CRTT-Centro Ricerca e Trasferimento Tecnologico (Research and Technology Transfer Centre). QuESTIO is a relay point between research research and industry. Regional government has also provided financing for firms to be spent inside CRTTs.

A relevant difference with PoliTO about commercialization culture is in the Mission of University. The Statute of PoliMI, in fact, in its "Mission" section (section 2) does not cite Technology Transfer as a relevant part of its mission.

Coming to commercialization organization, Conti and Bianchi (2012) tell the story of the organization for Technology Transfer at PoliMI. After some experiences in patenting by PoliMI researches, a TTO was established in 1999 in a department. It then became part of the Central

Administration in 2001. Its director is a delegate of the Rector for intellectual property and enterprise creation affairs. In this way governance looks even more direct than at PoliTO.

The first Spin-off was created in 2000, while in 2001 the university incubator "Acceleratore d'Impresa" (literally "Enterprise accelerator") did open. As of May, 2014 PoliTO website lists 22 Spin-offs[12]. Data for 19 of them have been retrieved on the above described AIDA database. Of the 19 Spin-offs, 8 are involved in production of goods, 3 in editing, 3 in consulting and 5 in R&D. Average data on Turnover and EBIDTA for the 4 groups do not differ substantially from those of PoliTO, although values are slightly higher. Consulting companies nevertheless present, in principle, very high values, with turnovers above 5 million Euros. A closer look shows that this is due basically to a very positive outlier: once this is withdrawn, values return low or even negative.

The first PoliMI patent has been filed in 1999. Conti and Bianchi (2012) report more than 200 patented invention. Out of these more than half is reported as currently exploited. What is interesting is the policy adopted by the TTO in terms of patenting and collaboration with enterprises. That is, TTO seeks to minimize unsuccessful transfer of patents, anticipating a phase of scouting of industrial interest towards the invention prior to eventually deposit the patent. Moreover TTO has been working extensively in the last decade in order to negotiate contracts with enterprises, as well as framework convention, on intellectual and industrial property. Moreover it has been working *inside* PoliMI to help diffusion of culture of intellectual property protection.

PoliMI has obviously issued policies for both intellectual property and Spin-off creation.

### *4.3 Politecnico di Bari*

PoliBA is the youngest and the smallest among the three. It was founded in fact in 1990. As of 2013 it counted slightly more than 11,000 students, and 300 professors.

#### *External and Internal University Factors at PoliBA*

The most relevant external factor for PoliBA is probably the establishment of a regional Industrial Liasion Office network in 2006. Agrimi *et al.* (2012) point out the importance of this network.

## 5. Conclusions and learned lessons

The studied case studies show that the most relevant factors affecting in negative technology transfer and commercialization in Italy are those related to blurred and inconsistent policy and the "Ivory Tower" mentality. In fact, the Politecnici stand out for their relevance in commercialization also due to the entrepreneurial mentality of researchers and profesors. Moreover the creation of

[12] http://www.polimi.it/ricerca-scientifica/brevetti/spin-off/elenco-spin-off/, accessed May 2014

Spin-offs in the Italian context is often connected to extra-entrepreneurial motivations (e.g. supporting research activities). Thus both mentality at local level and policy organization at external level act as a powerful lock-ins towards obtaining better results in commercialization.

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