University Technology Enterprise Network in Portugal: A bottom-up approach to Improve Regional Innovation Ecosystems

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Abstract

In the new paradigm of Open Innovation (OI), traditional cooperative research agreements or sponsored research are no longer effective enough to meet the needs of the system and the market. Today, any Innovation Ecosystem has a myriad of players, such as: big and small companies, start-ups, R&D institutions, brokers, and other intermediaries.

The UTEN (University Technology Enterprise Network) Program, launched in March 2007 by The University of Texas at Austin's IC^2 Institute to accelerate the development of a sustainable, globally competitive, professional technology transfer (TT) and commercialization network, was founded with the propose of improving the Portuguese international competitiveness in university–based science/technology commercialization. We argue that initiatives taken place in the project have gotten UTEN network presently run in OI fostered mostly by the TT Offices and their own networks and officers. This paper shows the actions taken to develop UTEN and improve the Portuguese Innovation Ecosystem. The data we offer in support of our argument is a collection of implementation that started with 14 Portuguese Universities and select international partners in a five-year program.

Our indicators show that UTEN has leveraged this growth by stimulating new competencies in international technology transfer and commercialization, and by facilitating industry access to the world's leading markets. This bottom-up approach contributed to building the necessary relationships between all actors within this innovation ecosystem by providing the necessary knowledge to play their roles. This case is evidence that critical mass and regional public policies are very important in the development of "high-tech" regions.

Keywords *Portugal; Technology Commercialization; Open Innovation, University Industry Relationship; Technology Valorization; Technology Transfer Office; Innovation Ecosystems*

Introduction

Open Innovation (OI) is descriptive - it refers to the inbound and outbound of knowledge, ideas, and technologies in a "co-creative" environment that allows innovations to come to fruition and mature. The sources of external inputs and internal outputs are lavish in players, including: customers and suppliers, "coopetitors", university labs and research institutions (and their Technology Transfer Offices (TTOs)), public authorities, patent agents, public funding agencies, and mediating parties (i.e. technology consultants, media, conference organizers and the technology brokers).

Historically, universities have always practiced co-creation as a feature of their projects, and have primarily collaborated with their peers. OI is novel in the sense that the partners could transfer to other organizations outside of the academy, and the university's role is no longer restricted to the knowledge/technology provider.

As non-profit organizations, universities and their respective R&D institutions have different objectives and missions from for-profit companies. This also holds for an OI environment. By their nature, universities contribute to the early stages of an innovation process by producing novel technologies and not converting these technologies into products for sale in the marketplace. This reality underscores the crucial role of their TTOs in an OI environment. They need the TTOs to function as their "boundary spanners" (Rogers 2003) that manage external relationships, matching the appropriate partners in a co-development environment. At the same time, TTOs are responsible for scouting the right "champions" (Rogers 2003) on both sides of the partnership for a project, improving the ability of the R&D unit to be more aware and responsive to the final client goals and requirements.

In the following sections of this chapter we will demonstrate how UTEN (University Technology Enterprise Network) has applied a defined set of procedures to build a globally competitive and sustainable science and technology (S&T) transfer and commercialization network ready for the co-creative OI Ecosystem within its first five years of implementation. UTEN's focus has been the TTOs (a bottom-up approach) in association with universities, as the main agents capable of building and spreading the Portuguese regional innovation ecosystem. Obvious challenges from the start of this Program involved strengthening the existing Portuguese regional and national technology transfer (TT) academic-science-business cooperative networks and abilities in order to achieve needed critical competencies of required expertise to successfully take the best Portuguese S&T and entrepreneurial capabilities to commercial applications and international markets.

The chapter describes the success of the UTEN initiative (the methodology to collect data consisted of documental analysis, surveys, and interviews), and is organized as follows: Introduction; 2. Ecosystem and Actors; 3. Environment and Scenario; 4. Problem characterization; 5. The UTEN network; 6. Research Data and Discussion; 7. Final Notes; 8. Conclusions; and Acknowledges and References.

1. Ecosystem and Actors

Ever since the "competitive forces" of economies were defined (Porter 1985), the global economy has changed with the expansion of strategies to improve those forces. Presently, intellectual capital expands the range of strategic management options so that organizations can play in the knowledge-based economy. OI follows this trend by establishing the adoption of "open" business models as the standard obligation for players. In this scenario, an organization could utilize this more competitive environment more efficiently by taking advantage of open and collaborative networks that can offer new ideas for business and provide resources to extend the development of outstanding opportunities.

One of the most important issues being raised today is that a technology can only offer value to the market when it is commercialized with a certain business model (Chesbrough 2003). The rise and decline of the dot-com era is a useful illustration on this concept. During this period a whirlwind of high-tech innovations without business models were unable to capture the potential value of the new technologies involved. Henry Chesbrough (2003a) states that an organization can capture value from innovations in three ways: using technology within your own existing businesses, licensing the technology to other partners, or launching a new business venture to use the technology. Because of the complexity of the environment, products, and markets in which an organization operates, it is very difficult to have individuals with expertise in all aspects of the organization's processes. The business model serves to connect aspects of business development with the economic output of the business, which provides more control over the risk inherent to technology commercialization. This leads to the conclusion that scientists and technical developers need to have an understanding of the business or join forces with business people, internally or externally.

Despite the variety of literature available on these topics, the human factor still remains unattended (Herzog and Leker 2007). Witzeman et al. (2006) argue that switching to the OI model requires that not only technological systems change. The more external innovation is sourced by organizations, the more systems, processes, values and culture also need to be modified. Witzeman et al. (2006) states that, "harnessing external technology for innovation requires a fundamental change in employee thinking. The «Not Invented Here» (NIH) syndrome is replaced with the «Invented Anywhere» approach." However, many organizations demonstrate their reluctance to change, showing strong path dependency (Menon and Pfeffer 2003). Therefore, the change of culture, attitudes and values in the organization should be implemented for opening up the organization boundaries. The values and attitudes of employees are often the consequence of strong mental models imposed by national culture. In the cultural dimension literature, "cultural values" are considered the most important explanatory variables of behaviour (Kluckhohn 1951). Certain cultural issues of Open Innovation have been mentioned in the literature, such as NIH and Not Sold Here (NSH) syndromes by Henry Chesbrough et al. (2006).

The development of a critical mass of technology transfer professionals (i.e. the human capital factor), occupies a central role in the UTEN project. For this reason, almost all initiatives taken place in the project have lead the UTEN network to adopt an Open Innovation (OI) model fostered mostly by the TTOs and their own networks and officers. The project changed culture, attitudes, and values in the network by applying a bottom-up approach to open up partner boundaries through its human resources. This opens up room to discussion the roles of actors in the ecosystem when they try to engage in a TT partnership.

The roles of the actors in technology transfer

Technologies are transferred through interpersonal networks (Rogers 2002), which can offer a partial explanation for the presence of both effective and problematic cases. Everett Rogers (2002) discusses the reasons why the diffusion of innovations and TT types of communication are particularly difficult. For instance, TT involves heterophilous groups since technologies shift between different environments. It is useful to illustrate how the processes of TT can be analyzed from the point of view of the actor's individual roles in interpersonal networks within or between organizations. Rogers considers three types of roles of importance: "champions," "gatekeepers," and "boundary spanners." The champions are individuals in an organization who enthusiastically support new ideas (Rogers 2003). Within his work, Rogers describes the fundamental role of champions in introducing technological innovations. A champion can easily connect an innovation with an organizational problem and identify the needs of financial and human resources to implement and adopt the new idea. Champions act as great enthusiasts for technological innovations and their adoption. Robin Steele is a good example of a champion in TT: he was a young engineer from one of the companies of the corporate consortium MCC[1] in Austin (note that MCC had twenty-two company members). For over a year, one week per month, Robin traveled from his office in Colorado Springs to the MCC in Austin, where he worked with a team of researchers to develop a computer program. Steele integrated this technology in a software product to be commercialized by his company, NCR Corporation. This young engineer showed great determination even in the face of numerous difficulties in bringing technology from the MCC to his company and commercializing the new product (Gibson and Rogers 1994). "Gatekeepers" are individuals who control the flow of messages in a communication channel (Rogers 2003). A gatekeeper can be someone on the top of the organization hierarchy (or near the top), such as a president or director who travels frequently and has a large social network, or someone at the operational level, such as a helpdesk employee that deals with customer service and complaints. Gatekeepers may play important roles in the TT processes. According with Gibson and Rogers (1994) each of the twenty-two electronics companies belonging to the MCC identified a key employee who travelled to Austin for monthly briefings on research findings. Some of these liaisons were more effective than others at applying technologies from the MCC to the relevant units in their corporation and reflecting their company's needs to guide the MCC research program (Gibson and Rogers 1994). The "boundary spanners", according to Everett Rogers (2002) (who cites various authors to illustrate this third type of role), are a particular type of gatekeeper whose function is to control the inflow and outflow of information across their system's boundary. They are individuals who link an organization with its environment. Thus, a boundary spanner provides openness across the boundaries of an organization by facilitating an information exchange, which alerts the system to new developments (both problems and solutions). Champions, gatekeepers, and boundary spanners are roles that some individuals on both sides of a TT relationship may have in their organization and whose importance in the process of technology transfer can be decisive. Nowadays, there are multiple cases of units/offices or organizations that are established to enhance the links between R&D units and other actors in the innovation ecosystem. The UTEN initiative has been actively involved in the improvement of these units/offices in Portugal.

In the United States, the offices of technology transfer that have been established in most research universities since the 1980's are boundary-spanning units. These organizational units help research universities become more actively involved in the technology transfer process (Rogers et al. 2000).

A particular skill set and information resources are required to efficiently manage co-creative projects, ideas, and innovations within the open innovation paradigm. Innovation brokers emerged in recent years in response to requests from companies who view co-creative projects in OI environment as a definite commitment to improve R&D efficiency and effectiveness. In this scenario, these innovation brokers have committed their most important resources on smart platforms of information systems to manage their customers' innovation projects (e.g. applications that enable the partner organizations to release and request internal and external information). Currently, these organizations act as services providers, or intermediaries that help other companies in their innovation processes. These companies are nodes of new networks that improve the global open innovation environments that intend to host the global scientific knowledge marketplaces of the future. Although these brokers maintain their business on the principles of open innovation, they differ in the approaches and adopted

[1] Microelectronics and Computer Technology Corporation (Microelectronics and Computer Consortium - MCC) was the first, and - at one time - one of the largest, computer industry research and development consortia in the United States. In late 1982, several major computer and semiconductor manufacturers in the United States banded together and founded MCC under the leadership of Admiral Bobby Ray Inman, whose previous positions had been Director of the National Security Agency and Deputy Director of the Central Intelligence Agency as an American answer to Japan's Fifth Generation Project, a large Japanese research project aimed at producing a new kind of computer by 1991 (Gibson and Rogers 1994).

features. A good example is the Processes and structures of InnoCentive, Inc.[2] whose business model is centered on broadcasting science problems, connecting a global network of seekers (companies) and solvers (experts). This arrangement enables other companies to identify and hire the necessary skills to deal with their technical challenges.

2. Environment and Scenario

Economic and cultural progress will be accelerated if advances in science and technology are adopted by companies and institutions through technology transfer (Novozhilov 1991). Technology transfer is complex: technological innovation is fast and continuous, companies are at a loss on how best to innovate and work with universities/R&D institutions, and the institutions themselves lack a full understanding of what companies need and when they need it (Rogers at al. 2001). Therefore, while there is agreement that innovation will maintain and promote the competitiveness of companies, there are real hurdles in achieving such innovation (Etzkowitz et al. 2000). TTOs are integral to these processes, yet they have received scant attention from policymakers and institutional leaders. They are the boundary spanners of their organizations and deserve significantly more attention now and in the future as important players in the OI ecosystems.

UTEN was launched in March 2007 with the mission of building a globally competitive and sustainable science and technology (S&T) transfer and commercialization network within five years. The vision of UTEN was that Portuguese companies, managed by highly trained TT professionals in close international collaboration, could benefit from a co-creative environment through the empowered links of the network. To fulfill this vision, UTEN has worked to create a critical mass of highly skilled professionals able to accelerate the international commercialization of Portuguese science and technology companies through the development of skills and professional competence and the leveraging of UTEN partnerships to foster international technology-based entrepreneurship and business development throughout the country.

When UTEN was initiated, Portugal had recently achieved an average OECD level in terms of the number of researchers per thousand workforce (Heitor and Bravo 2010), and witnessed its highest increase in R&D expenditure: for the first time, expenditure represented more than 1.2% of its GDP (GERD reached 1,71% of GDP in 2009[3]), equaling or surpassing levels reached by Spain, Ireland, and Italy. The rise in R&D expenditure was matched overall by the business sector, which doubled such expenses in that period (having reached more than half of the R&D total expenditure).

This increase in R&D expenditure also reflected the policy priority for science and technology development, and was followed by a rapid increase in the number of researchers within the labor force from 3.8% in 2005 to 5% in 2007, (nearing the EU average) a ratio of one researcher per 200 employees.

The priority given to this rapid scientific and technological development was accompanied by a strong mobilization within the scientific community with visible results at an international level. Portugal's increasingly international scientific community is young and equally comprised of male and female researchers. This represented a highly productive period of clear growth. The national scientific output rose by 18% in a span of two years, measured in terms of the number of scientific publications in recognized journals. Among the five most cited scientific articles in the EU, two included collaboration with Portuguese authors.

At the same time, science- and technology-based entrepreneurship was increasingly seen as a key element of Portugal's ability to grow and prosper. Together with industrial liaison programs, research universities worked to foster a range of technology transfer and commercialization activities and offices, mostly devoted to fostering entrepreneurial environments, launching technology-based start-ups, and bringing ideas from the laboratory to the market. As part of this effort, UTEN was created to synergize the growth from research and stimulate new competencies in international technology transfer and commercialization with the aim of facilitating industry access to leading markets worldwide.

From Everrett Rogers's point of view (Rogers 2002) together with the above discussion, we justify the procedures employed by UTEN. Rogers cites the following five strategies, "potentially the most important strategies" to the TT process:

1. Create a boundary-spanning unit in an organizational structure that is responsible for technology transfer;
2. Transfer personnel in order to transfer their technology;

[2] InnoCentive is a Massachusetts-based open innovation company that accepts by commission research and development problems in a broad range of domains such as engineering, computer science, math, chemistry, life sciences, physical sciences and business and frames them as "challenge problems" for anyone to solve. It gives cash awards for the best solutions to solvers who meet the challenge criteria (Prizes for Solutions to Problems Play Valuable Role in Innovation. Wall Street Journal, 25 January 2007. Retrieved Sep 17, 2013).

[3] Eurostat 2010. Portugal: GPEARI / MCTES.

3. Form network relationships linking R&D organizations and receptor organizations;
4. Encourage the formation of high-tech spin-offs;
5. Organize consensus-developing conferences to create shared practice guidelines concerning a technology (commonly accepted strategy in healthcare).

UTEN strategies follow the same rubric. In the following sections as support for the application of these strategies, we offer results from the evaluation phase.

3. Problem characterization

Capacity Building

While it is clear that Portugal is climbing the charts in PhDs granted and R&D funding, IP protection, and licensing of technology to industry, it is also clear that these advancements are not sufficient alone (as witnessed in Portugal's current position in the global economy). In short, the significant challenges Portugal is currently facing center on 1) retaining the country's educated talent by developing high value jobs and careers, by 2) commercializing Portuguese S&T in global markets to the create new jobs for high talented nationals and on their own foster regional wealth across Portugal. Since its inception, UTEN's goal has been to enhance training and network building on an international scale, together with Portugal's technology transfer managers and staff and technology entrepreneurs, this effort is initiated under FCT's funding and leadership from the IC² Institute at The University of Texas at Austin.

UTEN's network includes 14 Portuguese universities and select technology parks and research centers. The Program focuses on capacity building for the accelerated commercialization of Portuguese S&T. UTEN is tightly linked with Portugal's program of international partnerships that focus on enhancing education and research excellence in targeted sectors at Portugal's leading research universities. Taken as a whole, these programs have been a substantial investment in financial and human resources devoted to enhancing Portugal's competitiveness in the knowledge-based global economy of the 21st century. The following are active programs furthering this goal:

- The International Collaboratory for Emerging Technologies, CoLab (www.utaustinportugal.org) with The University of Texas at Austin
- The MIT|Portugal Program in Engineering Systems, with the Massachusetts Institute of Technology (www.mitportugal.org)
- The Information & Communication Technologies Institute, ICTI, with Carnegie Mellon University (www.cmu.edu/portugal)
- The Harvard Medical School–Portugal Program in Translational Research and Information, (www.hmsportugal.org)
- Fraunhofer Research Portugal (www.fraunhofer.pt) through FhP AICOS, the Research Center for Assistive Information and Communication Solutions.

Portugal has a unique worldwide in conceiving, launching, and continually assessing UTEN as an international program for capacity building with a focus on commercializing of academic S&T via business development and venture creation. These challenging tasks are key to wealth and job creation in emerging, developing, and developed economies, especially during the current global financial challenges. If it were easy to launch and build globally competitive national and international technology-based companies, then all nations would be doing it. It is not easy, and while Portugal has select examples of such successes, more needs to be done. The following pages demonstrate UTEN's unique proposal to address these challenges and to produce significant results.

UTEN has been in continuous development from 2007 through 2012 to provide much-needed training in technology transfer and commercialization and increase access to international networks. This is done in order to increase capacity building to bolster Portuguese academic-industry linkages, increase technology-based entrepreneurship, and accelerate firm growth nationally and globally. These capacity-building programs and activities over five years are reviewed and summarized in this working paper.

Taking the Last Mile

In networked systems that support many of today's critical services – roads, energy grids, telecommunication infrastructures, etc. – there is a well-known difficulty referred to as "the last mile problem." The [common] difficulty is bridging the gap from a local high-throughput distribution center to every single consumer home, equipment or individual, so that the service delivery point can actually (physically) meet the consumers, satisfying their needs and thereby producing value. The challenge is to feed the network with valuable content while providing it with the required capillarity to bridge the gap and avoid connectivity problems.

UTEN was born as a concept or a vision of a cooperative network aggregating entities and individuals in Portugal concerned with technology transfer, with a single major goal: improving and accelerating the transformation of science and knowledge into economically valuable, innovative solutions and addressing societal problems in a global context. With UTEN support such a network is being built on increasingly larger and more effective knowledge-producing nodes (laboratories, university research groups, tech-based companies) and on the new delivery links created through the technology transfer offices and professionals associated with those labs and universities – the "boundary-spanners".

In the OI environment, a boundary-spanner links the desired actors of an innovative project. The links (inbound or outbound links) with partners, brokers or any kind of organization or company participating in a project require management; this is the need boundary-spanners fulfill.

Because these links were initially created to interconnect the knowledge-producing nodes, they have trouble in effectively connecting with the knowledge-consuming nodes (the end-user companies and other licensees aiming at transforming and/or selling technology and technology-based products and services). This difficulty in effectively connecting to potential clients is the "last mile problem" of the technology transfer network.

With the application of all the capacity-building programs and activities over five years, the "last mile problems" of UTEN Portugal demonstrate their relevance through results presented in the next sections. We intend to show that the practices taken place in the UTEN program can improve and accelerate the transformation of science and knowledge of a region/country ecosystem into economically valuable innovative solutions as well as address their societal problems are adequate.

There is widely accepted (standard) method to systematically verify the performance of an innovation ecosystem—we do not know what an "adequate" performance by a player looks like, if it can be improved, and if improvements are possible. Furthermore, it is challenging to understand how to intervene to improve efficacy. Chapple at al. (2005), Debackere and Veugelers (2005), and Siegel at al. (2003) show many organizational practices that improve performance. Those practices are the same as those cited by Everett Rogers (2002). We argue that in addition to the use of this information to improve individual institutions, thus information needs to be systematically normalized for the use of regional and national programs that utilize incentives and grants to enhance performances. In a time of reduced public expenditure, it is important to determine the best rate of return for every investment made (Resende et al. 2013).

In this chapter, we aim to achieve this last objective; however it is very important to analyze other success cases like UTEN in the future to further validate our conclusions. UTEN is a network; an OI Network; acting as a facilitator in the innovation ecosystem where it interplays.

The questions driving this analysis relating to the UTEN project are:

- There is a huge collection of variables conditioning the TT relationships, can we confirm that all processes, procedures, and structures in the UTEN network improved and accelerated, with relevant results, the transformation of science and knowledge of UTEN partners into economically valuable innovative solutions?
- Is it possible to characterize processes, procedures, and structures in the network and to identify their weight in the results?
- Is it possible to point out processes and critical procedures that are still weakly implemented?
- If we find and improve these weakly implemented processes and mechanisms, what performance increases (both efficiency and effectiveness) can we expect to achieve from intervening and rectifying existing problems?

Several other research projects have addressed issues of TT relationships - both cases in open innovation (Chesbrough et al. 2006; Carvalho 2009) as driven by the triple helix (Etzkowitz et al. 2000; Fundación Cotec 2003). However, not all could be applied to the various scenarios and regions due to social, economic, and cultural specificities. In the following sections, we identify the steps necessary in our ultimate quest to improve technology transfer operations in an OI environment.

Research Methodology

The scientific domain of this research is the Management of Innovation and Knowledge and Technology Transfer, with a central subject of the relationships between the TTO, its host institution, companies, and other agents of innovation (who make Technology transfer one of its activities in an ecosystem under the OI paradigm.)

The research approach of this study is action research. According to Coughlan and Coghlan (2002) action research uses a scientific approach to study important social or organizational issues together with those who experience these issues directly. Action research has two goals: making the action happen and reflecting on what happens in order to contribute to the theory. This process involves collaboration between researchers and

members of the organizational system. Action researchers are not just observing change, they are actively working to make it happen (Coughlan and Coghlan 2002). Action research is also self-evaluative. Researchers have to be aware of the impact they have on the situation (Remenyi et al. 1998).

Tharenou et al. (2007) argue that action research studies iteratively cycle through diagnosis and intervention until there is an understanding of the situation investigated. In this study, the action research is used to develop practice-based innovation processes in cooperation with the employees of case organizations.

The empirical research is based on various case studies. In fact, these case studies are all related to each other since the intention is to create a powerful network in the Portuguese innovation ecosystem. "Case study is a comprehensive inquiry, conduced in the field, into a single instance, event or setting" (Tharenou et al. 2007). Case studies allow for the concentration on specific instances in order to provide a multidimensional view of the situation (Remenyi & al. 1998). Although the results of a case study are difficult to generalize to other cases, the generalizability can be improved by using more than one case (Tharenou et al. 2007).

Action research always requires prior understanding of the organization's environment, conditions of the business, as well as the structure and dynamics of the operating systems (Coughlan and Coghlan 2002). Therefore, a baseline data collection and metrics have been gathered in the first research phase.

The primary purpose of this first research phase has been to provide baseline data for key metrics on UTEN programs and activities as they relate to the performance of government programs, universities, and technology parks. In the Year 1 pilot program, national and EU comparative data was compiled from published research articles and combined with various studies and reports of the European statistics and economic agencies (this initial research report, "Select Baseline National Metrics Affecting Technology Commercialization in Portugal" in Jarrett and Ferreira 2007, contains data from the European Innovation Scorecard, OECD S&T and Industry Scorecard, and World Bank Indicators). In Jarrett and Teixeira (2011) additional data at the level of specific universities, incubators, and research parks was collected in cooperation with these Portuguese organizations.

4. The UTEN network – A case study

UTEN´s mission is to cultivate entrepreneurial attitudes and competitiveness of Portuguese science and technology assets in order to facilitate access to the OI market opportunities worldwide. UTEN strives to present new business opportunities to Portuguese scientific communities while also exploring opportunities for research projects with long-term industrial growth potential. Key UTEN activities include:

- Strengthening and sustaining technology transfer networks and collaboration within Portugal and with international partners building the Portuguese Open Innovation Ecosystem;
- Training Portuguese technology transfer managers and staff through value-added workshops and internships in select and diverse centers of expertise for "on-the-job" international competence building and enhanced network development;
- Promoting both active support and mentoring for select and globally-competitive Portuguese business ventures as well as the national and international promotion of technology portfolios from Portuguese research centers and universities;
- Enabling stakeholders to support leading-edge S&T commercialization practices including international patenting and globally networked entrepreneurship.

UTEN VISION

The vision of the University Technology Enterprise Network was to build a network of highly trained professionals in science and technology (S&T) transfer and commercialization. The effort had already been taking place to establish TTOs in major universities across Portugal - UTEN was tasked with mobilizing this new resource. The UTEN network was to span Portugal and to intersect the globe; it was to become self-sustaining within five years. In pursuit of this vision, UTEN provided immersive training events to develop skills and professional competence at home, while introducing participants to international subject matter experts and industry contacts. The skills and the relationships that would result were to ground the UTEN network to, in turn, foster international technology-based entrepreneurship and business development throughout Portugal.

While most of its theoretical foundation consists of an understanding of entrepreneurial education, business incubation, regional development, and the power of positive policies to contribute to a knowledge economy – the UTEN program was of unique design, and introduced a "new angle of approach" for a program able to impact a nation's capacity for technology commercialization, and help launch technologies from university laboratories to global markets. This new trajectory has been agile in nature, with proactive response to program feedback. Thus, the program has evolved continually to meet new audiences with new events.

UTEN STRATEGY

UTEN's strategy has been to leverage programs and activities in a bottom-up approach that builds sustainable partnerships and networks among technology transfer and commercialization experts and centers across Portugal (UTEN Portugal), as well as with globally competitive international experts and offices of technology commercialization in order to:

- Strengthen Portuguese industry-science relations, intellectual property management, and technology transfer and commercialization competence for international markets,
- Foster entrepreneurial vision and competence in Portuguese academia and business, and in civic organizations in a cooperative co-creative environment,
- Provide productive international networking opportunities for Portuguese technology transfer managers and staff, technology-based companies, and start-ups,
- Deepen Portugal's understanding of the challenges and opportunities of university-based technology transfer and commercialization nationally and globally,
- Benefit from national and international experience and case studies which demonstrate how to promote regionally-based, globally-networked technology development and commercialization, and
- Brand Portugal as a creative, innovative nation that successfully attracts, educates, and retains world-class research and entrepreneurial talent.

UTEN was conceived as a cooperative network aggregating entities and individuals in Portugal concerned with technology transfer, with a single major goal: improving and accelerating the transformation of Portugal's science and knowledge into economically valuable innovative solutions as well as addressing societal problems in a global context.

Programs and Activities

Since its inception, UTEN programs and activities have catalyzed sustainable, value-added partnerships and networks with key international partners while continually increasing its network reach within Portugal:

- Expanding the UTEN network by adding Portuguese institutional partners,
- Expanding programs and activities to new international audiences, and
- Training an increasing number of Portuguese TTOs and associated entrepreneurs and professionals.

UTEN established new creative learning mechanisms with a focus on capacity building through innovative technology transfer practices, related know-how, commercialization skills, and development of both formal and informal national and international networks. UTEN programs and activities include:

- International Internships,
- Specialized Training and Networking,
- Technology Commercialization,
- Observation and Assessment, and
- Institutional Building.

This chapter presents part of the Observation and Assessment. The central focus of UTEN's assessment effort is the continued observation and dissemination of lessons learned relating to challenges and successful projects and ventures to help assess and improve the performance of technology transfer and commercialization across Portuguese institutions. These efforts further the larger goal of the continued professionalization of Portuguese TT managers and staff. To this purpose UTEN conducts:

- In-depth program evaluations of international internships, international workshops, training weeks, in-situ training, and roundtables of leaders.
- Annual reports of the main activities and results of the Program with feedback from the stakeholders involved.
- Annual surveys of national TTOs, performed cooperatively with Portuguese and UT Austin researchers.
- Annual surveys administered to all UTEN partner institutions to help monitor the challenges and best practices of technology transfer and commercialization in Portugal.
- Case study development associated with Portuguese startups and university spin-offs.

5. Discussions and conclusions

The next discussion is a transcription of selected parts of the empirical research (UTEN 2012) by James Jarrett, Senior Research Scientist, IC^2 Institute, The University of Texas at Austin, and Aurora Teixeira, Assistant

Professor with Habilitation, School of Economy, University of Porto; Associate researcher of CEF.UP, INESC Porto & OBEGEF.

According to Coughlan and Coghlan (2002), the general phases of an action research process are: Planning, Taking action, Evaluating the action, and Further planning. This section explains the latter two phases with UTEN Program.

Context

The central mission of a TTO is to manage and operate TT activities (AUTM 2005). TTOs have been established to assure professional commercialization of the knowledge generated within the universities. These developments have received extensive attention worldwide with researchers initially focusing those efforts on the direct implications of licensing and patenting (Rothaermel et al. 2007). Recognizing that TTOs are only a part (though an important one) of university knowledge spillover, (Shane 2004) the growing emphasis has been placed on university or Academic Spin Offs (ASOs) (Lockett et al. 2005; Wennberga et al. 2011; Lazzeretti and Tavoletti 2005). ASOs are firms whose products or services are based on scientific/technical knowledge generated within a university setting, where the founding members may (or may not) include the academic inventor (Steffensen et al. 1999). In short, ASOs are firms created to exploit technological knowledge that originated within universities (Fini et al. 2011).

In what follows, we present summarized data of the main traits and dynamics of TTOs and ASOs in Portugal over the last decade. We argue that such trends, depicting TTOs and ASOs as key university related technology transfer mechanisms, might in large part be connected with the institutional changes observed in Portugal in this period, together with the creation of transnational programs, namely the University Technology Enterprise Network (Gibson and Naquin 2011).

UTEN Survey of TTOs

In 2012 the third annual UTEN network survey of technology transfer offices was conducted to develop a more comprehensive view of technology transfer in Portugal. A short summary of key findings follows[4].

- The primary functions of TTO employees continue to be: writing grants and fund-raising (27%), assisting with the protection of intellectual property (18%), and supporting entrepreneurship/spin-outs (14%) with smaller amounts of time devoted to coordination, licensing, and industrial liaison;
- On average, approximately half of the revenues received by TTOs are from grants, with another 20% from external fees and services; only one fourth of TTO revenues are provided by their institution.
- Compared to last year, there was a substantial increase (42%) in the number of invention disclosures reported by the TTOs.
- There are no clear trends with patent applications, while there has been an upward or stable trend over time for the three main types of patents granted. In the last two years, the impact of the economic crises in the use of patents seems clear.
- Licenses, option agreements, and assignments in 2011 matched the strong number in 2010, and the trend over time continues to be positive.
- Total license income increased once again in 2011, by about 6% over the prior year.
- Research and development agreements were 38% higher in 2011 than in 2010.
- TTOs reported a large number of new companies established: 141 in 2011 compared to 95 in 2010.

Twenty offices were contacted, and responses were received from 18 TTOs as of late October. TTO directors were promised that only aggregate results would be released and that no responses from individual TTOs would be disseminated. Unlike the prior two years, this year UTEN Portugal implemented the survey with MERIT of Maastricht University, under the European Commission's Recommendation on Knowledge Transfer and supported by the European Council's Resolution on Knowledge Transfer. UTEN and MERIT surveys were merged to decrease the response burden on Portuguese TTOs and to overcome the lack of international comparable data. TTOs were contacted initially in late September 2012, and responses were tabulated in October 2012. A second survey was sent to a larger group of Portuguese institutions including polytechnic institutes, associated labs and private research centers, to access their technology transfer results for the year of 2011. The

[4] The source of data is mainly from UTEN 2012 report. But it is important mention the following publications: Performance of Portuguese Academic Spin-offs: Main Determinants is the work of Aurora A. C. Teixeira with the research assistance of Marlene Grande. Previous related studies appear in the 2009-2010 UTEN annual report, Technology transfer and commercialization activities in Portugal: A quantitative overview, p. 52-55 and Portuguese Academic Spin-offs and the Role of Science and Technology Transfer Organizations, p. 55-61; and the 2011 UTEN annual report, Characters and Trends of Academic Spin Offs (ASOs) associated to UTEN partners, p.74.

responses received are included in the results provided to MERIT integrating the sample for the technology transfer study commissioned by the European Commission.

Basic organizational structure

Basic organizational structure: most TTO respondents are an integral part of their institutions. Two TTOs are external organizations that provide technology transfer services to multiple institutions. Besides performing services for their universities, four TTOs serve government or non-profit research institutes, two serve incubators or a research institute, and two serve research parks.

MATURITY OF TTOS: Many of the TTOs are recently established with only two TTOs having been established for at least a decade. Others are more recent with one started in 2010 and another in 2012.

EMPLOYEE DUTIES: The number of full-time technical/professional employees ranges from 1 to 14 per office. Twelve of the 18 TTOs have five or fewer technical/professional employees. The offices that responded have a total of 81 technical/professional employees. Across the different TTOs, on average employees allocate their time to several key functions (Figure 1).

BUDGET EXPENDITURES: Expenditures vary considerably across the TTOs. At least four TTOs spent more than €200,000 and four others spent more than €100,000. Of the TTOs providing expenditure information, approximately 70% of funds were devoted to human resources, with nearly 20% allocated to patenting and the remaining funds spent on entrepreneurship.

EMPLOYEES' BACKGROUNDS: More than half of the TTOs have employees with university qualifications in Management/Business Administration and Engineering/Natural Sciences. About one-fourth of the TTOs have employees with a background in Law. About one-fifth of the TTOs have employees with qualifications in Finance, and three TTOs (one-sixth) have staff with biomedical backgrounds.

SOURCES OF REVENUES: As shown in Figure 1, grants and fund-raising are an important task for TTOs. Only one TTO in 2011 received all of its revenue from its home university. TTOs are in fact quite dependent on grants to perform their functions as nearly half of their revenues, on average, come from grants. In 2011, ten of the TTOs secured at least half of their revenue from grants, with three TTOs above 70%. Two other TTOs were entirely funded from external fees and services. On average in 2011, the TTOs received their revenues from sources as shown in Figure 1. Compared to the prior year, TTOs increasingly relied on external fees and services and grants, receiving a smaller proportion from their home institution.

SERVICES PROVIDED: Despite the diversity among TTOs in their budget expenditures and revenue sources, there is considerable similarity in what services are being provided:

- Create or support start-up companies based on their institution's inventions.
- Raise awareness/disseminate information on intellectual property rights and entrepreneurship.
- Assess the patentability of inventions.
- Manage material transfer or confidentiality agreements.
- Apply for patents.
- Negotiate or arrange licenses.
- Scout for new intellectual property and new technology.

(> 66% of TTOs)

- Prepare grant proposals.
- Provide training to faculty, researchers, or students.
- Negotiate government-sponsored research contracts/grants.
- Coordinate with business angel networks.

(>50% of TTOs)

In contrast, about one-third manage or coordinate an incubator facility and one in five manage a research/science and technology park. Other services noted by TTOs include: providing consultancy services, drafting non-disclosure agreements, business idea competitions, searching research and developing competencies, and acting as a liaison to industry.

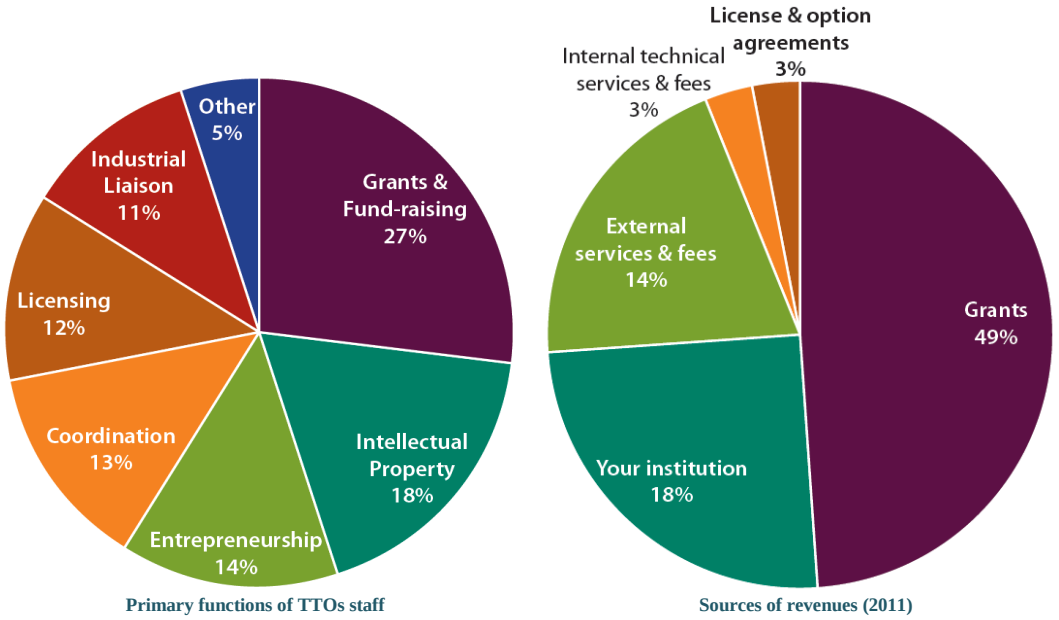

Figure 1: Core functions and sources of revenues of the responders TTOs (UTEN 2012)

Intellectual Property and Commercialization

SCOPE OF PATENTING: In 2011, all but three of the 16 TTOs responding to this question performed at least 90% of the patent applications through their offices. One reported handling less than half of the applications, and two others do not undertake any patent applications.

OWNERSHIP OF IP RIGHTS: The universities own IP rights in nearly all cases. In three, inventors own some rights depending on contract negotiations; in one, IP rights are owned by the schools.

ROYALTIES: Seventeen TTOs provided information about royalties, and 15 reported that royalties are split between their institutions and the inventors in varying proportions. In eight of the institutions, royalties are split 50%-50%. In another seven institutions, the inventors receive 55% or more, this includes two institutions that provide 80% to inventors. One university alters the allocation depending on the total amount of royalties received—for smaller amounts, the inventor receives a higher percentage; for larger amounts, the university receives more and the organizational unit receives some proportion. Compared to last year, inventors now are receiving a larger share at a number of institutions.

INVENTION DISCLOSURES: During the UTEN program period, there was a substantial increase (42%) in the number of invention disclosures reported by the TTOs. As shown in Figure 2, invention disclosures in 2011 reached 282.

PATENT APPLICATIONS (PRIORITY FILINGS): The trend is less clear on patent applications as shown in Table 1. In one category (provisional), the trend is clearly upward, while in the other four categories there are no clear trends. In 2011, there was one application in Spain and another in India.

PATENT APPLICATIONS BY SUBJECT AREA: More than half of the TTOs applied for some type of a biomedical (diagnostic, devices, pharmaceutical etc.) patent in 2011. Six of the TTOs applied for a patent related to computers or communication equipment, while four applied in the area of nanotechnology/new materials, and two in low or zero carbon energy technologies. Other areas in which TTOs applied for patents were agricultural sciences, life sciences, mechanics & electromechanics, and the food industry.

PATENTS GRANTED: The trends has been upward or stable over time for the three categories. In 2011, two TTOs reported receiving Canadian patents.

ACTIVE PATENTS: Compared to the year before, in 2011 there were more EPO patents (6%) and USPTO patents (26%) filed. PCT active patents declined by 5%. Because of changes in the data collection methodologies, the increase in the number of active Portuguese patents could not be determined precisely. The increase was a minimum of 56% and possibly as high as 85%. TTOs reported having active patents in Canada, France, Russia, Norway, Brazil, Japan, China, Australia, and South Africa.

Table 1: TTOs patents and applications, 2007-2011 (UTEN 2012)

TTOs	**Patent Applications (Priority Filings)**					***Patents Granted:* The trends has been upward or stable over time for the three categories**				
	2007	***2008***	***2009***	***2010***	***2011***	***2007***	***2008***	***2009***	***2010***	***2011***
Provisional Filings	***4***	***23***	***66***	***80***	***100***					
Portuguese	***71***	***88***	***76***	***78***	***69***	***24***	***32***	***38***	***56***	***52***
EPO	12	13	12	4	6	4	5	5	7	8
USPTO	11	17	5	11	7	5	3	5	4	2
PCT	29	30	74	43	17					

LICENSES, OPTION AGREEMENTS, AND ASSIGNMENTS: As in prior years, the large majority of the licenses, agreements, and assignments have been executed with Portuguese partners as shown in Figure 2. The total in 2011 nearly matched the very strong number in 2010, and the trend over the past five years continues to be positive. About an equal number of licenses and options were granted to start-up companies and firms with fewer than 250 employees. The remaining licenses and options, about 20%, were granted to companies with more than 250 employees.

LICENSE INCOME: following the dramatic increase in 2010, the total amount of license income increased once again in 2011. Seven of the TTOs reported license income, with three TTOs reporting license income of at least €100,000 in 2011. Therefore the aggregate amount of nearly €650,000 is not due to a single transaction or single TTO. Three TTOs reported international license income.

COMMERCIALLY PROFITABLE PRODUCTS: Eleven TTOs indicated that their institution's licensed technology or knowledge had resulted in commercially profitable products or processes in the past three years.

RESEARCH AND DEVELOPMENT AGREEMENTS: TTOs reported a dramatic increase in the number of executed agreements in 2011 (up 38% from the prior year). The number in 2011 essentially matches the strong performance in 2009 and surpasses the levels in 2007 and 2008 as shown in Figure 2.

INSTITUTIONAL RESEARCH RESOURCES: For the first time in this series of surveys, TTOs were asked questions about their institution's research resources. The total number of research personnel (researchers, technicians, and administrative support personnel) at 14 institutions in 2011 was 22,377. Six TTOs reported more than 1,000 researchers each. The aggregate research budgets at nine institutions were €112,908,866, with two institutions accounting for three-quarters of the total. Privately funded research at institutions varied considerably. One TTO said 35% of total research expenditures came from private companies, a second TTO said that figure was 24% at their institution, and a third TTO reported 19%. One TTO each reported 12%, 11%, 10%, and 9%, while three TTOs reported 5%. Other TTOs did not provide a response.

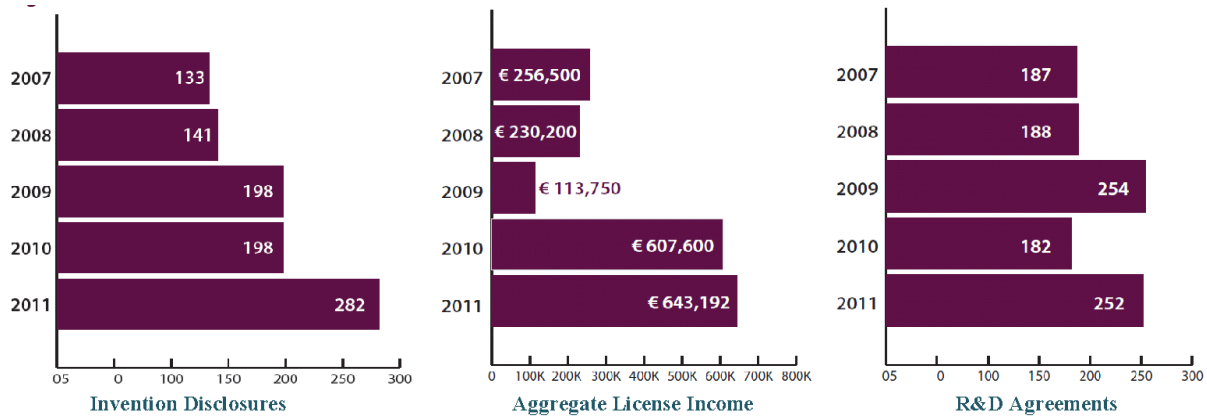

Figure 2: Indicators – 2007 to 2011 (UTEN 2012)

SPIN-OFF & START-UP COMPANIES: Data from the TTOs show that a large number of new companies are being established. In 2011, TTOs reported 141 new companies were established, while nine companies from prior years ceased operations. The total number of new companies and the total number of active spin off and start-up companies until 2010 is shown in Figure 3.

We argue that UTEN program has improved not only the OI ecosystem but, more deeply, the co-creative relationships. The indicator is the number of ASOs that started selling earlier in the last years (Figure 4). In this case, one could state that the ecosystem "boot up" the user-driven innovation with some network actors.

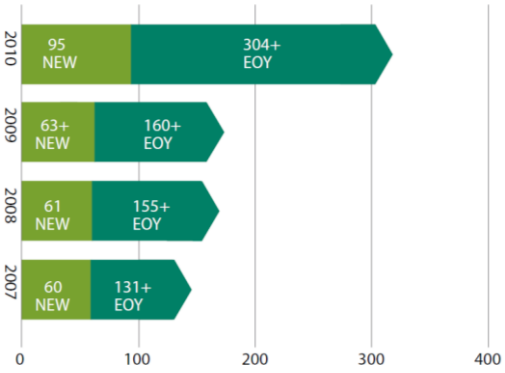

Figure 3: New and total Academic Spin Offs at end of years (UTEN 2012)

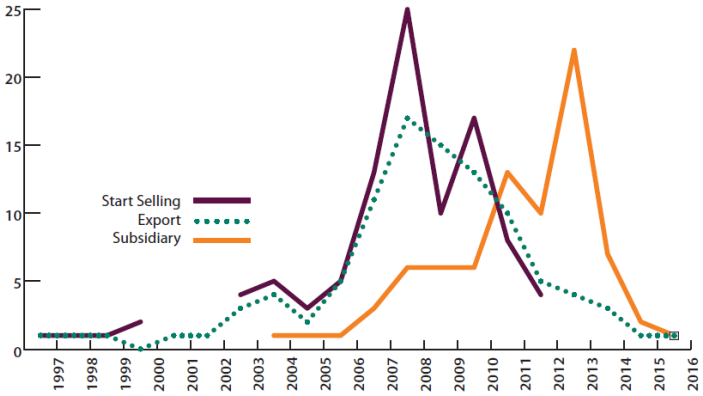

Figure 4: Beginning of the activity/sales/exports/subsidiary of ASOs. (Teixeira 2012; UTEN 2012)

In Portugal, national patent applications from universities have continuously increased between 2006 and 2009, with growth rates above 20% per year, as seen in Table 2. In 2010, it is possible to observe a slight decrease, partly recovered in 2011. The effects of the financial restrictions, resulting from the economic crisis, are visible in the in number of patents applied for, in these last years, namely after 2010.

Table 2: University National Patent Applications, 2006-June 2012 (UTEN 2012)

	2006	2007	2008	2009	2010	2011	June 2012
University of Aveiro	12	5	19	21	17	12	9
University of Minho	8	12	13	12	14	12	11
University of Évora	3	4	1	5	2	1	1
University of Porto	12	8	12	11	3	10	9
University of Coimbra	2	1	1	9	7	9	4
University of Algarve	3	2	5	13	14	5	4
University Nova of Lisboa	3	13	13	11	3	2	0
University of Beira Interior	1	2	1	6	16	17	2
University of Trás-os-Montes and Alto Douro	1	8	6	7	7	13	5
Instituto Superior Técnico	35	43	54	38	9	15	6
Other	4	10	14	36	30	42	17
TOTAL	**84**	**108**	**139**	**169**	**122**	**138**	**68**

Source: Portuguese Institute of Industrial Property (INPI)

In general, the main applicant universities increased the number of patent applications over the last six years (Table 2). On an individual level, between 2006 and 2011, University of Beira Interior (UBI) and University of Trás-os-Montes-and-Alto-Douro (UTAD) showed the most distinct growth. In 2006, these universities had the lowest number of patent applications. However, in 2011, UBI had the lead and the UTAD had the third highest number of patent applications. While Instituto Superior Técnico (IST), the country's largest Engineering school, has significantly decreased the number of patent applications in the last two years, it remains the university with the highest number of accumulated applications (194) in the period 2006-2011.

As shown in **Erro! A origem da referência não foi encontrada.**Table 3, except for the United States, the national and international (WIPO and EPO) patent applications have risen until 2009. In the last two years, the impact of the economic crises in the use of patents seems clear. There was a decline in the number of patent

applications in all routes of protection. It was at national level that this effect was less visible; to a certain extent this can be explained by the fact that the protection in Portugal is the one which requires the lowest investment.

The number of patents applied for directly in the United States increased in 2007, but in the following years the level of applications has been more or less maintained. Moreover, it is interesting to observe that in 2010 there was even a rise in the applications in the United States contrary to the behavior in other routes/territories.

In 2011, EPO published 89 patents applications and WIPO published 185 applications in several technology areas, belonging to Portuguese enterprises, higher education and R&D institutions, and independent inventors. The majority of these applications came from enterprises, followed by universities and then by individuals. The U.S. Patent and Trademark Office (USPTO), in 2011, published 27 patents submitted by Portuguese entities while enterprises filed 23 of those patents, and universities filed the remaining 4.

Table 3: National and international patent applications, 2006 – 2011 [UTEN 2012]

	2006	2007	2008	2009	2010	2011
Portuguese Institute of Industrial Property (INPI)	219	283	405	600	527	598
World Intellectual Patent Organization (WIPO)	68	93	100	163	117	96
European Patent Office (EPO)	78	70	84	112	81	77
United States Patent and Trademark Office (USPTO)	23	35	39	36	43	–

Source: Portuguese Institute of Industrial Property (INPI)

Policy Implications

More opportunities for science and technology within increasingly globalized and specialized markets of OI have brought new challenges and opportunities to international technology transfer and commercialization. Our study shows improved indicators that lead to the conclusion that UTEN is a success case. This new network has worked the last five years with national and international partners to leverage existing professional technology transfer and commercialization know-how, to generate new knowledge for successful S&T co-creation and commercialization, and to promote Portuguese economic development in the global economy.

In recent years, public policies in Portugal have promoted a systematic development increase in competencies to manage TT and commercialization. UTEN was born as a top-down project that has been working with TTOs as a success case of a practical bottom-up approach.

Talent is everywhere, whether in large or small countries, or developed or developing economies. The pathway to success in which science meets the market to create economic impact is to uncover local talent and provide a country-wide ecosystem that is open to the world and promotes innovation and collaboration. One can conclude based on the evidence presented in this paper that for small countries such as Portugal to be competitive knowledge-generating moguls it is imperative to develop critical masses within the research community. We argue that an effective way to do this is through the establishment of partnerships like the UTEN program with leading international institutions with vast experience in the field will provide expertise and prestige to the local research entities. This principle also holds true for the technology commercialization process. The participation of formal global networks will trigger internal (informal) collaborative processes between local institutions that would otherwise not occur. If kept long enough, results will be generated as relationships evolve and confidence between peers solidifies. The role of federal governments is key for this transformation to occur. Not only through funding mechanisms (although crucial), public authorities should set the tone and develop policy that simulates excellence in research and development activities and the commercialization of scientific results. In doing so, these authorities function as a bridge between the research community and the private sector. By funding basic and applied research, keeping a culture of merit, and empowering the most promising institutions and individuals these organizations can cultivate the secret sauce for success.

The UTEN has considerably strengthened this movement. The UTEN network engages with scientific and academic institutions throughout Portugal to emphasize technology transfer and commercialization on an international scale. UTEN efforts have been made possible by the work of the IC^2 Institute at The University of Texas at Austin, the promotion and support of the Foundation for Science and Technology (FCT), working in close collaboration with the Portuguese Institute of Industrial Property (INPI), and since 2010, with the Council of Rectors of Portuguese Universities (CRUP).

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References

AUTM – Association of University Technology Managers, 2005. U.S. Licensing Survey, FY 2004. AUTM, Deerfield.

Carvalho, V., 2009. Open Innovation: novo paradigma de Inovação. CEISE/STI ,Porto.

Chapple, W., Lockett, A., Siegel, D. and Wright, M., 2005. Assessing the relative performance of U.K. university technology transfer offices: parametric and non-parametric evidence. *Research Policy* 34 (3), 369–384.

Chesbrough, H., 2003. *Open innovation: the new imperative for creating and profiting from technology*. Boston MA, Harvard Business School Press.

Chesbrough, H., 2006. *Open business models: How to thrive in the new innovation Landscape*. Harvard Business Press, Boston.

Chesbrough, Henry, Vanhaverbeke, Wim, and West, Joel (Eds.), 2006. *Open Innovation: Researching a New Paradigm*. Oxford: Oxford University Press.

Coughlan, P. and Coghlan, D., 2002. Action research for operations management. *International Journal of Operations & Production Management*, 22 (2), 220-240.

Debackere, K. and Veugelers, R., 2005. The role of academic technology transfer organizations in improving industry-science links. *Research Policy* 34 (3), 321–342.

Etzkowitz, H., Webster, A., Gebhardt, C., and Terra, B. R. C., 2000. The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Research Policy 29*, 313-330.

Fini, R., Grimaldi, R., Santoni, S. and Sobrero, M., 2011. Complements or substitutes? The role of universities and local context supporting the creation of academic spin offs. *Research Policy*, Vol. 40, pp. 1113-1127.

Fundación Cotec para la Innovación Tecnológica, 2003. *Nuevos mecanismos de transferencia de tecnología: Debilidades y oportunidades del Sistema Español de Transferencia de Tecnología: Encuentros Empresariales* Cotec. 2003. Gijón: COTEC.

Gibson, D., and Rogers, E., 1994. *R&D collaboration on trial: The Microelectronics and Computer Technology Corporation.* Boston: Harvard Business School Press.

Gibson, D. and Naquin, H., 2011. Investing in innovation to enable global competitiveness: The case of Portugal. *Technological Forecasting and Social Change*, Vol. 78, Issue 8, pp. 1299-1309.

Heitor, M. and Bravo, M., 2010. Portugal at the crossroads of change, facing the shock of the new: People, knowledge and ideas fostering the social fabric to facilitate the concentration of knowledge integrated. *Technological Forecasting and Social Change*, Vol. 77, Issue 2, pp. 218-247

Herzog, P. and Leker, J., 2007. Open vs Closed innovation – different cultures for different strategies. *ISPIM 2007 conference.* Warsaw, Poland, 17-20 June.

Jarrett, J. and Ferreira, F., 2007. Select Baseline National Metrics Affecting Technology Commercialization in Portugal. UTEN-Portugal, IC^2 Institute.

Jarrett, J. and Teixeira, A., 2011. A Survey of Technology Transfer Offices in Portugal - *excerpted from the UTEN|Portugal 2009-2010 Annual Report*.

Kluckhohn, C. 1951. Values and Value Orientations in the Theory of Action. Toward a General Theory of Action. T. Parsons and E. A. Shils (Eds.). *Harvard University Press*. Cambridge, MA.

Lazzeretti, L. and Tavoletti, E., 2005. Higher education excellence and local economic development: the case of the Entrepreneurial University of Twente. *European Planning Studies*, Vol. 13, n. 3, pp. 475-493.

Lockett, A., Siegel, D., Wright, D. and Ensley, M., 2005. The creation of spin off firms at public research institutions: managerial and policy implications. *Research Policy* Vol. 34, pp. 981–993.

McAdam, R., Miller, K., McAdam, M. and Teague, S., 2012. The development of University Technology Transfer stakeholder relationships at a regional level: Lessons for the future. *Technovation* 32 (1), 57-67.

Menon T., and Pfeffer J., 2003. Valuing internal vs. external knowledge: Explaining the preference for outsiders, *Management Science*, Vol.49, No.4, pp.497–513.

Novozhilov, Y., 1991. University-Industry Cooperation in Eastern Europe: The experience of some advanced Universities in the USSR. *International Journal of Technology Management*, 6 (5/6) 469-477.

Porter, E. M., 1985. *Competitive Advantage. Creating and Sustaining Superior Performance.* The Free Press – New York.

Remenyi, D., Williams, B., Money, A. and Swartz, E., 1998. *Doing research in business and management: an introduction to process and method.* London: Sage Publications, 309p.

Resende, D., Gibson, D. and Jarrett, J., 2013. BTP—Best Transfer Practices. A tool for qualitative analysis of tech-transfer offices: A cross cultural analysis, *Technovation*, Volume 33, Issue 1, January 2013, Pages 2-12.

Rogers, E., Yin, J. and Hoffmann, J., 2000. Assessing the effectiveness of technology transfer offices at U.S. research universities. *Journal of the Association for University Technology Managers,* 12, 42-80.

Rogers, E. M., Takegami, S. and Yin, J., 2001. Lessons learned about technology transfer. *Technovation* 21 (4), 253-261.

Rogers, E., 2002. The Nature of Technology Transfer. *Sage Science Communication*, 23, 323.

Rogers, E., 2003. *Diffusion of innovations.* New York Free Press. 5th edition.

Rothaermel, F., Agung, S. and Jiang, L., 2007. University entrepreneurship: a taxonomy of the literature. *Industrial and Corporate Change*, Vol. 16 (4), pp. 691–791.

Shane, S., 2004. Academic Entrepreneurship: University Spin offs and Wealth Creation. *Edward Elgar Publishing.*

Siegel, D., Waldman, D. and Link, A., 2003. Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. *Research Policy* 32 (1), 27–48.

Steffensen, M., Rogers, E., and Speakman, K., 1999. Spin offs from research centers at a research university. Journal of Business Venturing Vol. 15, pp. 93-111.

Teixeira, A.A.C. and Grande, M. 2012. Determinants of the performance of Portuguese Academic Spin-offs: an empirical investigation, in http://utenportugal.org/assessment/

Tharenou, P., Donohue, R. and Cooper, B., 2007. Management research methods. Cambridge. *Cambridge University Press*, 338p.

UTEN Portugal, 2012. *2007 – 2012: A ProgressReport*. Austin.

Wennberga, K., Wiklund, J., and Wright, M., 2011. The effectiveness of university knowledge spillovers: Performance differences between university spin offs and corporate spin offs. *Research Policy*, Vol. 40, pp. 1128-1143.

Witzeman, S., Slowinski, G., Dirkx, R., Gollob, L., Tao, J., Ward, S., and Miraglia, S., 2006. Harnessing external technology for innovation. *Research-Technology Management*, Vol. 49, No.3, pp. 19-27.