University Technology Transfer Office Business Models: One Size does NOT Fit All

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Abstract
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ABSTRACT

Technology transfer processes expose universities to a competing logic which challenges the public nature of science and creates conflicts among faculty. By analyzing licensing performance of a sample of 144 U.S. universities drawn upon the AUTM database (Association of University Technology Managers), this paper suggests a framework to understand alternative business models which reflect how universities combine conflicting logics and organizational mechanisms. We propose that the variety of business models fosters change within Technology Transfer Offices (TTOs) and triggers sense-making as they seek to define success and failure of technology transfer in terms of value creation for society, instead of value capture for university.
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1. Introduction

It is widely recognized that the Bayh-Dole Act of 1980 led to an explosion in the growth of technology transfer offices in U.S. universities, as well as a substantial increase in the commercialization of university inventions and academic spawning of new innovative firms (Feldman, 2003). This is consistent with the “Triple Helix” model that refers to a long and evolutionary process that defines relationships among industry players, universities, public research organizations (PROs), and governmental institutions to boost local economic growth (Etzkowitz and Leydesdorff, 2000; Etzkowitz, 2010) As a result, universities have become hybrid organizations incorporating competing institutional logics (Battilana and Dorado, 2010; Greenwood et al., 2010; Haveman and Rao, 2006): the “disinterested” pursuit of science (Merton, 1968) and engagement with market. Despite the open science view, the Bayh-Dole Act gave US universities the privilege to retain the property rights to inventions deriving from the state-funded research and hence relaxed government control over the commercial use of the results of publicly-funded research.

Accordingly, between 2002 and 2009, the number of invention disclosures grew 44% (National Science Board, 2012), the revenue flow increase of almost 75% since 2002 (AUTM 2012), although only 65 of the 2,821 licenses issued in 2011 yielded more than $1 million in revenues (AUTM 2012). Despite this gold rush, anecdotal evidence shows only a few U.S. universities, such as the Massachusetts Institute of Technology (M.I.T.), University of California System, and Stanford, have both coupled market practices with institutional knowledge dissemination (Laredo, 2007). Although most US universities exhibit a high number of active licensing agreements, only few universities profit from high licensing income. This is consistent with findings from several European TTOs, which differ in terms of licensing revenue, but not in terms of number of licenses (Conti and Gaulé, 2011). Taken together, these findings highlight a sort of paradox that calls for attention on how actors configure different “business models” in terms of processes, tools, and engagement with stakeholders. Accordingly, we ask: What are the alternative metrics or goals for TTO performance, and do universities with higher revenue generation from TTO activity actually have the “highest performing” (most successful) TTOs?
These questions pose interesting conceptual issues for business model research because hybrid organizations challenge the idea of reproducing a single coherent business model (Markides and Charitou, 2004; Markides and Oyon, 2010). In other words, what it is seen as failure because it does not draw revenue can be seen as success because it advances the other goals. We contend these mixed performances are the outcome of different university business models as “models” (Baden-Fuller and Morgan, 2010; Baden-Fuller and Mangematin, 2013; Massa and Tucci, 2014) since they articulate causal relationship configuration within university technology transfer activities. By adopting a micro-level analysis, it is possible to identify alternative university business models, which reflect different organizational mechanisms to achieve commercial goals and/or stimulate engagement with society.

The main argument is that universities can adopt different business models according to their viable strategies to reconcile competing goals in terms of local impact and faculty engagement (Etzkowitz, 2014; McAdam et al. 2012; Landry et al., 2013), and, at the same time, they can use the business model concept to promote change and trigger sense-making as they seek to define success and failure of technology transfer processes.

Evidence is drawn from the analysis of a panel dataset on U.S. universities created by combining data from a number of sources, including the AUTM database (Association of University Technology Managers, http://www.autm.net/), that shows licensing data collected by survey over the last 20 years. Using the AUTM database, we first identified U.S. universities involved in technology commercialization and tracked their strategies over time, and then focused our attention to “outliers” indicating different configuration of technology transfer activities.

Our goal in this paper is to contribute to university technology transfer as follows. First, we propose that the “metrics paradox” within university technology transfer reflects alternative implicit business models. Second, instead of attributing performance heterogeneity to initial environmental conditions, we seek to unpack sources of technology transfer heterogeneity by first tracing differences in university expectations and then by examining to what extent configurations of key activities may create fruitful conditions for entrepreneurship and revenue generation. Third, we analyze business model innovations in technology transfer and how universities promote changes in their activities by adopting new mechanisms and practices that reflect their balance between conflicting goals.

The paper is organized as follows. Section 2 offers an accurate portrait of the proposed theoretical framework. In particular, first it explains how multi-sided business models
influence technology transfer processes and affect the emergence of “metric paradox.” Section 3 gives details on the empirical settings and proposes a theoretical framework based upon illustrative cases of U.S. university technology transfer offices. Section 4 discusses the findings, highlights implications for university and policy makers, and suggests a few avenues and strands for future research.

2. Theoretical framework

Tech transfer offices can be seen to have business models themselves. In some sense, they should be considered intermediaries who must mediate between different epistemic worlds or communities, such as academic science / research and markets / private enterprise.

Universities are traditionally the most important knowledge source nurturing technological innovation. Technological innovation is a dynamic process that, over the last decade, has become much more based upon a complex and multidisciplinary knowledge base. Accordingly, universities have been required to put more effort into coordinating different disciplines and creating industry linkages in order to shorten time to prototyping and identifying market needs. Until 1980, these relationships were based on partners’ complementarities: university quest for publications and industry’s quest for patents. The Bayh-Dole Act dramatically changed partners’ incentives since universities may pursue patent ownership and foster entrepreneurial technology transfer. The key consequence of this normative change is that institutional and normative boundaries between the two epistemic communities blurred. Therefore, after the Bayh-Dole Act, universities not only create, conserve, and transmit knowledge, but they must increasingly cope with technology commercialization in order to put in action their entrepreneurial orientation.

As a result, universities have become hybrid organizations where the logics of science and of business are both in play although they prescribe different behaviors - such as open publication and the pursuit of knowledge versus the proprietary retention and commercial exploitation of research outcomes. Put differently, the former resembles the open regime serving the whole of a community, the latter focuses on the closed regime profiting from science and rewarding all parties (i.e., researchers, departments, schools, and TTOs).

From one point of view, this marriage is useful as it has the potential to improve society. Prior work demonstrated that uniting public and business logics have accelerated medical discovery in biotechnology firms (Murray, 2010), life sciences (McMillan et al., 2000), but also in areas such as computational chemistry (Mahdi and Pavitt, 1997).
From another point of view, simultaneously pursuing these competing goals may create a sort of “sense of dissonance” (Stark, 2009) due to the fact that organizations can experience conflicting demands as they seek to conform to diverse norms and expectations. Recent stream of research recognizes that the availability of multiple institutional models of action creates opportunities for hybrid organizations to draw from the broader repertoire of behaviors prescribed by competing logics. These studies suggest that hybrid organizations may reconcile competing logics by enacting a combination of activities drawn from each logic in an attempt to secure endorsement from a wide range of field-level actors (Greenwood et al., 2011).

In line with this reasoning, universities may want to balance scientific and commercial goals. Further, they are expected to respect the norms of community logics, both in their relationships with students and with local communities in which they are located. More generally, universities have an institutional identity that prescribes that they should use selectively technology transfer activities in order to avoid organizational struggle and preserve their institutional identity. On the other hand, universities that decide to selectively couple competing logics are more likely to experience a performance paradox (Smith & Lewis, 2011) because what it is seen as failure within the business logic can be seen as a success within the community logic.

These competing goals may lead to different “business models” for the TTOs, depending on dominant models in effect at different universities, the universities’ strategies, and the composition and organization of the TTOs themselves. Here we use business model to describe “the rationale of how an organization creates, delivers, and captures value (economic, social, or other forms of value) in relationship with a network of exchange partners” (Zott et al. 2011). Part of the business model is the articulation of the value proposition, or what the stakeholders find of value in the offerings of the organization (Afuah and Tucci, 2003), in this case the TTO’s offering. Designing the value proposition is one of the key roles that management of an organization can take (Osterwalder et al., 2014). Even within a market logic, there could be differences between the goals of universities with regard to their technology transfer activities, which could influence the TTO’s business model development. Some universities may be very concerned with development of a local ecosystem or local economic development (McAdam et al. 2012), whereas other ones could be more concerned with global impact or global community engagement (Audretsch et al., 2014). Some universities could be more oriented toward life sciences, whereas others could
be more oriented toward engineering, for example. Finally, some TTOs may be more proactively involved in screening or selecting, or providing incentives to faculty members to participate in technology transfer activities. We will discuss these different orientations and their implications in the next sections.

**Proposition 1:** Competing goals in university technology transfer shape business model configurations for TTOs.

To reconcile this paradox, technology transfer managers may use in their managerial thinking different business models. Here business models are not conceived as a meta-concept to give a systemic view of firm strategy, but they are seen as a cognitive tool (Baden Fuller and Mangematin, 2013) which helps technology transfer managers think about causal relationships within technology commercialization. In this respect, it provides an alternative approach able to explore possible paths to meet multiple, divergent demands. Although selecting few technology transfer activities might aid revenue generation, a business model perspective argues that long-term sustainability requires continuous efforts to engage multiple customers (i.e. established firms, new ventures, local agencies, students). Performing paradoxes stem from the plurality of stakeholders require financial and social approaches to understand to what extent technology transfer activities are matching goals and expectations of internal and external stakeholders (Donaldson and Preston, 1995). These goals and expectations are dynamic and evolve over time. As a consequence, some goals can become easily obsolete and may not fit the university’s strategies for technology transfer. Therefore, universities need to continuously adjust the degree of engagement of internal and external stakeholders and find the right balance between the relevant contingencies in the business environment and the university’s internal strategies and resources. Hence, the combination of internal and external stakeholders and the continuous transformations of their engagement and incentives may contribute to more valuable reconfiguration of business model, and lead to business model innovation. This led us to propose the following proposition:

**Proposition 2:** Metric paradox in the short run leads to searching for business model innovation.
3. Methods

To start addressing these questions, we first used a panel dataset on U.S. technology transfer offices by combining data from a number of sources, including the Association of University Technology Managers (AUTM) database which contains information from an annual survey about university technology transfer performance in the US over the last 20 years. We identified 144 U.S. universities involved in technology commercialization and tracked their strategies over the period 2002-2012. All data have been compared and verified with the data reported on the respective TTOs’ websites or from direct communication with the TTOs. We dropped all universities from the AUTM dataset that do not have at least two years worth of observations. We also excluded the University of California System to ensure consistency with the other single universities. First, we analyzed data drawn from the 2012 AUTM Licensing survey that confirmed the U.S. universities’ propensity to filing patents (+11.3% over the prior year), to promote spinoffs (+16.1%) and startups (+5.1%), and increase licensing income (6.8%).

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<th>Table 1 - U.S. technology commercialization key indicators in 2012</th>
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<td>Total US disclosures</td>
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<td>Total US patent applications filed</td>
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<td>Issued U.S. patents</td>
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<td>Total license income:</td>
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<td>Startup companies formed</td>
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<td>Startups still operating as of the end of 2012</td>
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Source: AUTM Licensing survey 2012

Then, we calculated for each university of our sample the compound annual growth rate (CAGR) of patents issued and startups launched in the period 2002-2012, in order to detect which universities are more oriented toward patenting or new venture creation. We also analyzed the licensing income over time and the ratio of exclusive/not exclusive licensing agreements to understand to what extent U.S. universities reap financial return from their licensing activity and how they balance the conflicting goals included in exclusive licensing agreements. As known, exclusive licensing agreements are conceived as an incentive to encourage early investment in new university findings to translate these findings into products. By granting restriction of the commercial use of the patent to only one company, they support firms’ willingness to take on the risk of developing an early stage technology,
and address their request to obtain more protection from their potential competitors via the exclusive use of the patent. This is especially widespread in the life science field, where clinical trials, require very large investments. On the other hand, exclusive licensing agreements may prevent local companies from producing innovative products at affordable prices, thus affecting the social value of scientific research. Therefore, looking at the TTO’s orientation toward exclusive vs. non-exclusive licensing agreements is relevant to gauge which practices they deploy to cope with this criticism. Taken together, all these performance metrics help develop a categorization of university TTO business models by evaluating how, and to what extent, TTOs devote their efforts in promoting economic development and, at the same time, providing faculty members incentives to be involved in technology transfer activities. Figure 1 shows that few U.S. university TTOs got more than one million dollars of licensing income (i.e. New York University and M.I.T.) while the majority of the sampled universities exhibits poor financial returns. It is worth noting that the large part of US universities has been involved in launching new ventures, with an annual growth rate ranged between 5% and 15% (see the red points) while only few universities show an positive annual growth rate related to patents (i.e. University of Florida, see the blue points).

Figure 1- A map of U.S. University Technology Transfer Offices performance
4. Discussion

Data reveal that U.S. universities usually transfer their technologies via both licensing and new ventures creation. Some ventures are academic spinoffs, while others are launched by independent entrepreneurs who signed a licensing agreement with the university. Technology licensing and startups play different but often complementary roles that position them to exploit particular areas of the university technology transfer, a process that further promotes the creation and the development of vibrant ecosystems, which in turn enriches the variety of entrepreneurial opportunities.

Accordingly, universities often engage themselves in thinking strategically about their technology transfer processes that they deploy, and how to develop and cultivate relationships with the scientific community (i.e., inventors) and industry as well. Specifically, researchers represent the key actors in the value proposition creation process which, in turn, can be shaped by organizational variables (e.g. departments and colleges), while established firms and new ventures play a crucial role in value exploitation. In addition, U.S. universities differ in terms of their preferences for working with large vs. small firms, how much they promote internal disclosure by faculty members, and, in some cases, the propensity to adopt non-exclusive licensing agreements vs. exclusive ones. Taken together, these findings highlight the emergence of alternative business models universities may use in their technology transfer activities. Since technology transfer is a process involving key actors in value exploration (researchers) and value exploitation (incumbent firms, new ventures, and potential entrepreneurs), universities often seek the right alignment between internal and external stakeholders. Engaging local stakeholders reveals the aim of universities to promote and create a munificent ecosystem through relationships with established firms, potential entrepreneurs, financial companies and local institutions. Engaging global stakeholders reveals the intent to boost impact and visibility through innovation and market access. This distinction between global and local outlook with regard to stakeholders shapes organizational practices that universities may use to provide incentives to motivate researchers. These mechanisms can be devoted indistinctly to all departments or focused only on exceptional researchers who are often Principal Investigators in several research projects and are familiar with managerial issues related to industry collaboration and their lab’s network configuration (Mangematin et al., 2014). Organizational practices targeting these two types of scientists may shape revenue generation patterns and consequently affect future technology transfer activities. The dynamic interplay between the above can be translated into a framework of
university technology transfer that consists of four different quadrants that result from different configurations of key elements representing business models. Figure 2 provides an overview of these various modes and corresponding challenges related to strategic thinking that universities face in each of these.

Mode 1: Technology Transfer as Traditional Shop

In mode 1, universities conceive technology transfer as a process to drive research outputs that already exist into the marketplace through formal linkages. This is consistent with the private view that the Bayh-Dole Act brought up and, therefore, universities falling into this mode are more likely to promote patenting and, in general, intellectual property rights culture indistinctively among all departments, without any targeted mechanisms. Interestingly, they strive to obtain maximum productivity—often the count of patents in the portfolio—but they leverage academic logic or discourse to motivate researchers, as the number of patents is subject to departments’ evaluation and this affects future financial resources for research. It is oriented toward bibliometrics and academic “performance.” The main activities that Technology Transfer Offices (TTOs) carry out are dissemination of patents and tactical mechanisms as well, to preserve the possibility of patenting (e.g., postponing publication until after patent application, sanitizing data for publication, etc.). They also generally, at a
minimum, require that the university take title to sponsored inventions, including those inventions made using university facilities, in accordance to their patent policy.

With regard to technology transfer revenues, universities in this quadrant show a limited interested in licensing income and this suggests that technology transfer is seen as a cost center and not as a revenue center. An illustrative example is the University of South Florida. The Technology Transfer Office was established in 1990 to facilitate the commercialization of university intellectual property, including patents and copyrights. Accordingly, in 2012, the University of South Florida ranked ninth in terms of U.S. patents issued (n. 98) within the top 10 Universities worldwide, confirming the efforts devoted over the last decade (see Fig. 3). At the same time, an increasing number of inventions have been disclosed, as well the number of license agreements (Fig. 4).

Regarding licensing income, the University of South Florida registrered low revenue flow, demonstrating that the technology transfer office may be considered a cost center and its activities respond to a regulative orientation, in accordance with the Bayh-Dole Act. Except 2010, licensing income is consistently below the historical average of all universities in the sample, while the number of patents issued increases dramatically over the last four years (see Fig. 5).
Overall, this business model refers to universities that respond to competing goals through a strategy according to which they promote formal linkages of technology transfer, mainly based on licensing agreements. The strategic focus is mainly internal and it is devoted to promote patents within departments by leveraging an academic and regulatory compliance logic.

**Mode 2: Technology Transfer as Orchestrator of Local Buzz**

Mode 2 refers to universities that act entrepreneurially in order to accomplish the “third mission” (Etzkowitz and Leydesdorff, 2000), in addition to teaching and research. The entrepreneurial orientation stems from the importance of exploiting new scientific and technological opportunities to boost local economic development. This leads universities to broaden the range of university-industry relationships, favoring social interactions with local actors. In other words, an increasing number of universities have recognized that traditional technology transfer programs were inadequate to serve their objectives, and needed to go beyond patents and licensing agreements or the negotiation of more equitable contracts of sponsored research to participate as active partners in more entrepreneurial programs.

In line with this reasoning, the role of universities goes beyond the mere impact they have on the economic environment through direct licensing or contract research. Universities also have an indirect impact on the local economy through different linkages that they have with industry. Direct and indirect forms of knowledge transfer tend to be associated with the
dichotomy between tacit and explicit knowledge as developed by Polanyi (1967). Tacit knowledge cannot be codified, and is hard to formalize and communicate (Nonaka, 1991). The transfer of tacit knowledge requires close social interaction between people and is difficult to manage. In contrast, explicit knowledge can be more easily articulated and universities increasingly have developed various sorts of IP policies to protect this form of knowledge and capture its value. The underlying premise of this policy is that, although most of the knowledge at a university is explicit, the development of emerging technologies requires the involvement of inventors, beyond licensing agreements. In some cases, academic researchers decide to pursue the development of their inventions by spinning out a new venture. Overall, universities may generate and orchestrate several types of collaboration with the local community, shaping the development of a munificent ecosystem. To facilitate the interaction between the university and its industrial environment, technology transfer managers leverage students, consulting arrangements, research collaborations, and publications. A particular attention is devoted to start-up companies and their role in the local ecosystem. Accordingly, universities are often willing to manage physical spaces (i.e. incubators, contamination labs, accelerators) to promote entrepreneurship. A case in point is the New York University since it devoted from its inception an increasing attention both to financial and social results. Almost 60% of NYU patents have been licensed to companies for development and commercialization. Over the past five years, NYU has ranked first among all U.S. universities in income from technology licensing, and actively promoted entrepreneurship with more than 70 companies. In fact, NYU created 87% more new start-up companies per research dollar expended than the national average (see Fig. 6).

![Figure 6 - New York University- License Income and License Income per patent issued (2002-2012)](image-url)
In this perspective, technology transfer activities are conceived as a source of revenues that can be split along financial and social lines. Revenue streams are relevant for universities because they can overcome financial constraints and further support research. It is important to “break even” with respect to operating expenses at the minimum and, ideally, to be able to return some income to the inventors and to the university for research and education.

Overall, the adoption of a wide range of technology transfer mechanisms, both formal and informal, may be seen as part of a trend in which universities are becoming more entrepreneurial in light of new opportunities and changing expectations (Etzkowitz, 2014).

**Mode 3: Technology Transfer as Catalyst**

Over the last decades, a handful of universities emerged as catalyst and global players in the university-industry collaboration to develop disruptive innovations able to solve societal problems. According with this view, the most successful technology transfer offices were those that pushed for the highest payment and made the most money on deals.

Most of the inventions generating over $100,000 were at least 10 years old, with the basic DNA cloning patents generating $37 million. These universities with strong patent policies generally also have royalty sharing policies to provide an incentive to the researcher to participate in the technology transfer process. For example, at Stanford, for each invention, 15 percent of the gross royalty income is deducted for administrative expenses. After any direct expenses (typically patent costs) are deducted, net royalties are divided: one-third to the inventor(s), one-third to the department, and one-third to the school. Other universities have a 50-50 sharing, or a sharing whose percentage changes, depending on the royalty income level. These universities are also more likely to grant exclusive licenses since exclusivity is needed to encourage firms’ investment and development. University technologies that have been the most lucrative for industry have often been technologies that never existed before, thus the markets were not easily identifiable or quantifiable at an early stage. Some of Stanford’s technologies that have been commercialized include: FM Music Synthesizer licensed to Yamaha, Fluorescent Activated Cell Sorter licensed to Becton Dickinson, the Acoustic Microscope licensed to Olympus, and Computer-Aided Tomography technologies licensed to General Electric.

From another perspective, universities that are catalysts are able to engage both small and large companies, and promote entrepreneurship as well, especially to develop early stage inventions. Through these mechanisms, universities pursue the generation of royalty income
for research and education. In this manner, they align commercial logic in the academic setting, where the core mission of the institution is education, research, and community service. For example, the M.I.T. declares that the mission of the MIT Technology Licensing Office is to solve societal needs through a “process which is consistent with academic principles, demonstrating a concern for the welfare of students and faculty, and conforms to the highest ethical standards”. Accordingly, technology transfer is mainly devoted to turn early-stage technology into commercially successful products. Figure 7 illustrates key performance of M.I.T. technology transfer which mainly focuses on start-up creation, substantially above the average, licensing of blockbuster products (more than one million of dollars), and signing of exclusive agreements. This needs an effort to strategically selecting key internal and external actors to involve in this endeavor in order to enhance both market needs and private incentives.

![Figure 7 – Key Performance M.I.T. (2002-2012)](image)

**Mode 4: Technology transfer as smart bazaar**

Mode 4 refers to universities that intend to generate and transmit knowledge, both to students and society at large since they perceive their responsibility to respond to human needs, with particular emphasis on those of underserved populations, and in general to engage society in knowledge production and dissemination. The premise of this shift is twofold. First, it is worth noting that up-stream patents may fail to spur innovation due to the emergence of
anti-commons. Heller and Eisenberg (1998) pointed out that privatizing basic research may prevent further development and this is socially inefficient, especially with regard to medicine and biotechnology. Second, most universities have experienced consistent declines in revenues. Consequently, over the last decade, universities are more conscious that the drive to generate revenues should not distract from the ultimate importance of moving innovation to society where intended impact can be achieved. Accordingly, they exhibit an increased awareness about the relevance to engage more deeply faculty participation in disclosure of inventions and to make licensing agreements more flexible in terms of deals structure, by preferring non-exclusive terms instead of exclusive ones. In this regard, the Johns Hopkins University is a case in point. During the last years, the Johns Hopkins University has promoted disclosure among faculty and non-exclusive licensing agreements as well (fig.8). As the Director of Technology Transfer Office said, “At Johns Hopkins Technology Transfer we have been remaking the way we do business in order to respond to these changes. We are now the business concierge for Johns Hopkins”.

![Figure 8 – Disclosures and non-exclusive licensing at Johns Hopkins (2002-2012)](image)

Taken together, our findings reveal that universities are trying to become less compelled to seek financial interests and revenue generation and lay the foundation of a more open-sourced model of technology transfer. In this view, technology transfer office is seen as a ‘smart bazaar’ which makes university discoveries accessible to society and incentives value creation over revenue generation and value capture. In addition, big data and crowd-funding help the
emergence of an alternative technology transfer business model based on the principles that societal engagement and openness would alleviate the need to measure revenue-based performance. In line with this shift, the most influential U.S. universities are becoming to launch their online crowdfunding platform aimed at providing critical fundraising support for innovative projects by faculty and student organizations. One of the first U.S. universities that implemented this online platform is the University of Virginia that uses philanthropic crowdfunding to advance university research. “It’s our hope that this innovative initiative will build on the success of the University’s proof-of-concept research programs and establish a new model for funding promising, early-stage research. Through this crowdfunding initiative, we’re creating opportunities for members of the community to be a part of advancing these exciting discoveries” said W. Mark Crowell, executive director of UVa Innovation. Other examples includes UCLA, George Tech University, and in Europe University of York. Open data are also influencing science, with particular emphasis on biotechnology area. Providing free access to materials and database that are intermediate scientific outcome, open data promote a larger involvement of the global scientific community and enhance creativity and problem solving. This poses some challenging questions regarding university-industry collaboration and new practices of revealing are emerging.

Overall, our analysis demonstrates the universities utilize a variety of approaches to shape their technology transfer processes and this affects business model configuration. Table 2 summarizes the key components of the four university technology transfer business models.

[Insert table 2 here]

Overall, our analysis on U.S. university TTOs performance revealed several expectations and different business model configurations. Understanding the linkages between organizational mechanisms and business and societal communities sets the stage for exploring how universities exploit new opportunities for technology transfer. University expectations about the role of technology transfer inspire new opportunities and promote business model innovation. While there are things about the technology transfer that should be taken as ‘givens’ - for instance, its role in boosting the economic growth -, there is considerable room for framing, revising, and transforming the traditional model of technology transfer.
The entrepreneurial function of universities can stimulate the emergence of growth and evolution by revising assumptions about boundaries and resources, which sets the stage for redefining the balance between public and private logics. It also requires the building of new relationships and linkages within the local ecosystem, revising organizational mechanisms and dynamics of new business models competition. In this context, the business model innovation becomes a knowledge creating activity where the outcomes are thoughts, models, and new ways of organizing the university technology transfer.

These changes alter the role of technology transfer office - seen as cost center, revenue center or profit/value center – which in turn impact universities’ strategic choices and how they position themselves in their institutional ranking and marketplace. The use of business model as a cognitive tool suggests that new roles of technology transfer can be discovered by engaging in scenario generation and flexible thinking in order to capture white spaces and cross-activities benefits. For example, universities that intend to transform their technology transfer business model from ‘cost center’ (mode 1) to ‘profit center’ (mode 2) have to become more selectively both in patenting and licensing agreements (fig.9). The efforts should be addressed towards increasing the patents quality in order to attract global partners. This is consistent with prior research (Crespi et al., 2011) that provided evidence that the productivity of knowledge transfer actually decreases once universities hit a certain rate of academic patenting. In other words, there is a tipping point where the amount of protected IP universities control becomes inversely related to knowledge transfer rates.

![Figure 9](Image)

*Figure 9 – The transforming role of University TTOs*
Also, TTOs often suffer from an organizational paralysis that is symptomatic of not having the legal and financial expertise to make nimble decisions during the negotiation of licensing agreements. As a result, further personnel with business background and organizational mechanisms have to be introduced and, more in general, a selective coupling strategy should be implemented in order to increase financial performance and become a profit center. This is the case of the University of Florida that from 2000, started to spawning new startups, and this led it to rank in the first roster of top players, together with California Institute of Technology, the University of California system, M.I.T. While these schools are in high-tech communities brimming with scientific inventors and risk-taking investors, the University of Florida is involved in a local ecosystem that is not so beneficial for entrepreneurship. Until 2000, the university focused on signing blockbuster licensing with large corporations (see the Gatorade licensing). The changed strategic expectations led the University of Florida to triple the staff of its tech licensing office and hired a director with private-sector experience to absorb new competences and help activities reconfiguration through a better use of two underutilized business incubators at Gainesville.

Another mechanism that enables the local community of students and regional economic activity to be much more engaged in university collaboration is the creation of living labs which refer to physical space where user-driven innovation can be experimented and co-created. The University of British Columbia in Canada is proving that students, academics and staff have been working to reduce greenhouse gas emissions by 33% from 2007 levels by 2015, and by 67% by 2020, and to eliminate fossil fuel usage entirely by 2050. Strategies have included the incorporation of courses that are either sustainability related or sustainability focused in their programs. In this respect, the University of British Columbia is conceived as a living lab devoted to the sustainability which intends “to commit, integrate, demonstrate and inspire”. UBC is also a recognized leader for its technology transfer and commercialization activities. 158 spin-off companies have been formed around UBC technologies, and UBC research discoveries have been at the heart of technologies, therapies and products that have generated well over $5 billion in sales. As a greater focus is placed on open innovation and collaboration, the UILO is supporting the free sharing of research outputs through data and material repositories or open source where these channels provide the greatest opportunities for research tools, data, discoveries and code to have a meaningful impact and to develop research communities working towards shared goals (from mode 3 to mode 4). In addition, the emergence of proprietary platforms of crowdfunding enables technology transfer managers to engage in identifying alternative options as to how to
commercialize emerging technologies through the involvement of a large and global community (from mode 3 to mode 4). Therefore, university contributions to local and regional economic activity are a productivity measure of technology transfer that is more compelling than revenue generation figures. Also, smaller universities that are mostly focused on student instruction and nontraditional forms of technology transfer would have the opportunity to develop a more relevant and legitimate set of performance metrics.

Taken together, these moves underline the relevance of two distinctive paths. The first – *towards relational approach* – puts emphasis on the increasing embeddedness in local ecosystem and the growing expectations that technology transfer is a source of university revenues. However, our analysis has demonstrated that the performance of large number of university technology transfer does not always support such expectations. Although technology transfer performance has been shown to vary widely and dramatically based on such organizational characteristics as faculty quality, university size, and amounts of research funding in the science, we argue that this paradox stems from the organizational responses to reconcile competing logics that, in turn, shape business model configuration.

On the other hand, new phenomena as open data, crowdfunding for students or faculty projects are reshaping the scientific opportunities for transfer technology and constantly shift the focus on value creation. As a result, the path *towards distributed approach* would be reassigned to the task of brokering relationships between researchers and industry sponsors as opposed to brokering deals between universities and private firms.

Other paths emerge if we look to vertical movements (fig. 10). In particular, we can identify the first one – *from local to global approach* – highlights challenges that TTOs face to enhance their visibility in the international markets. This requires both branding and leveraging strategies to exploit the entrepreneurial orientation of exceptional Principal Investigators in founding several new ventures (Baglieri and Lorenzoni, 2014) and attracting research funds. Technology transfer performance mainly depends from the presence of boundary spanner organizations like public-private labs and research centers led by star scientists able to navigate the dynamics of triple-helix model (industry-university-institutions).

The second one – *from closed to open approach* – underlines the challenges of digital economy and the potential of big data in co-creation and co-innovation and raises new questions to universities: How can the global challenges to the digital sphere, healthcare, the natural environment and other areas facing disruptive forces be turned into growth opportunities? How can universities’ identity, prepare and coach the group of digital leaders?
5. Conclusions

Our analysis highlights that universities may adopt the so-called third mission by putting in action several business models spanning from patenting and licensing agreements to serving society and innovation. Accordingly, the second academic revolution (Etzkowitz, 2004) and entrepreneurial universities may vary according to their different views on the role of university in that context and how this role could be fulfilled. Entrepreneurial orientation is driving university relations with the regional government as well as with industry and shaping, at the same time, university TTO business models. Our study identified four types of university TTO business models which emphasize the increasing role of university in solving societal needs, in addition to optimizing research commercialization. Consequently, the traditional metrics used to measure TTOs performance are inadequate and call for more scholarly attention. Overall, we provide ‘food for thoughts’ to move from a bureaucratic view of TTOs to conceptualize technology transfer business models that call for new leaders, beyond *bricoleurs* (Baker and Nelson, 2005). This more complex view of the linear model of technology transfer process is also of great relevance for policy-makers who attempt to create enabling conditions for Triple Helix model. Despite several works argue that technology transfer model currently practiced at nearly every U.S. university is ineffective for entrepreneurship due to the ownership-model of patents (Colyvas et al., 2002; Owen-Smith, 2005, Kenney and Patton, 2009), we suggest that policy makers should rethink performance metrics and take a broad approach that emphasizes relational and distributed views by taking into account jobs created and employees trained, open data issue and, more in general, the
challenges of digital economy. Since U.S. technology transfer mechanisms have played a role model in Europe and in Asia Pacific region policies, this would be a first step towards rethinking the sustainability of traditional business models, and shaping technology policies in developing countries as well. Accordingly, since policy makers are increasingly seeking to understand how universities can contribute to enhance regional or national competitiveness, our framework should aid university TTO managers and, in general, universities to understand to what extent their “bad” performance are the effects of their organizational policies, practices and structures. In this respect, our framework might lead to the development of organizational interventions that facilitate technology transfer and business model innovation. It is worth noting that our analysis adopts a supply side perspective that should be complemented with the demand side perspective focusing on the faculty members’ involvement in technology transfer activities. For example, an analysis on incentive structure system might be beneficial in order to assess why many faculty members are circumventing the technology transfer office and patenting outside university (Lawson, 2013) and to what extent this academic engagement is valuable for universities and society (Perkmman et al., 2013). It is also worth noting that our findings reflect peculiarities of the U.S. university system that could not be generalize to other countries. These limitations apart, we believe our study will open new avenue on university TTOs business models and, more in general, in the technology transfer micro-foundations which have been largely neglected, despite their role in shaping societal performance. Accordingly, business model research will benefit from a broad consideration of the multiple stakeholders view which calls for further exploration in our future work, and shed new light on stakeholders’ power and influence in shaping business model innovation.

References


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