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Impact Over Revenue: Toward a Social Entrepreneurship Model for University Technology Transfer

Matthew M. Mars[1]* and Randy Burd[2]

[1]Associate Dean, Outreach College, Affiliated Faculty, McGuire Center for Entrepreneurship, The University of Arizona, Tucson, Arizona, USA
[2]Associate Professor, Department of Nutritional Sciences, The University of Arizona, Tucson, Arizona, USA

Abstract

The institutionalized focus of university technology transfer is on revenue generation. Following a brief exploration of the evolution of the field, the current paper unpacks the assumptions underpinning the institutionalized understanding of technology transfer as a revenue-generating mechanism. Next, an alternative technology transfer model that is based on social entrepreneurship principles is proposed. The alternative model is predicated on the recognition of technology transfer as a mechanism for bettering society through value creation rather than value capture.

Keywords: University technology transfer; Social entrepreneurship; Social and economic impact

Introduction

The enhanced freedom of universities to transfer intellectual properties (IP) to the marketplace through conventional market mechanisms (i.e., licensing) and innovative strategies (i.e., warrants) has resulted in growing expectations that technology transfer will generate increasing amounts of university revenues [1]. However, the performance of mainstream university technology transfer models does not consistently support such expectations. For instance, past performance data has indicated many universities fail to realize any notable financial gains through technology transfer activities [2], while others have come to understand such activities as "loss leaders" that have the promise of creating future opportunities not directly linked to those technologies that have been commercialized (e.g., future increases in industry-sponsored research) [3]. Furthermore, 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, technology, engineering, and mathematics (STEM) fields [4]. In this regard, select research universities with the highest status enjoy greater capacities to generate resources through technology transfer activities compared to a much higher number of less prestigious universities. It has also been argued that established technology transfer models are overall unable to effectively compel faculty to engage in formal commercialization activities [5,6]. The result is knowledge being indirectly provided to industry in ways that offer little to no financial return to universities [7]. In short, this slice of literature presents a mixed perspective on the general performance and overall effectiveness of the dominant university technology transfer model.

The uncertainties in the performance and effectiveness of university technology transfer warrant the exploration of alternative models and approaches. In the current paper, technology transfer as a resource seeking activity is deconstructed and re-conceptualized based on the principles of social entrepreneurship. In doing so, attention is given to the potential merits of a novel set of performance metrics designed to capture the value proposition of technology transfer in terms of social and economic impact achieved (i.e., value creation) as opposed to university revenues generated (i.e., resource capture). The paper first explores the evolution of university technology transfer and how this field has evolved into a perceived source of university revenues. The context that underlies the mainstream structuring of technology transfer and sustains university revenue generation as the primary indicator of performance is framed according to the activities and initiatives of the Association of University Technology Managers (AUTM). Next, the widely adopted assumption that technology transfer should be framed and managed as a set of revenue-generating activities is unpacked and critically explored. The paper concludes by framing and arguing the potential merits of an alternative model of technology transfer that would be grounded in the principles of social entrepreneurship and guided by a set of performance metrics centered on social and economic impact achieved rather than university revenues raised.

Prior to discussing the development and institutionalization of the university technology transfer field, the general concept of technology transfer must be defined. This is somewhat challenging in that there is no single, universally accepted definition of technology transfer. Instead, defining principles and practices vary from one organizational context or environment to another [8]. However, Roessner [9] was able in a simple statement to identify a broad set of practices that adequately capture the overall spirit and intent of technology transfer across all fields. Roessner stated technology transfer is "the movement of know-how, technical knowledge, or technology from one organizational setting to another" (p. 1). Building on this general definition, the paper refers to university technology transfer as the process of moving innovations developed from university discovery out of the academy and into society where value is created and impact is achieved. The primary goal of value creation makes it possible to consider a radically different form of technology transfer that transcends the current model, which is restricted to the narrow task of protecting and managing university-owned IP with the primary goal of capturing value through revenue generation.

The Emergence of Technology Transfer and Mainstream Revenue-Based Performance Metrics

American research universities began to seriously consider the

***Corresponding author:** Matthew M. Mars, Associate Dean, Outreach College, Affiliated Faculty, McGuire Center for Entrepreneurship, The University of Arizona, Tucson, Arizona, USA; E-mail: mmars@email.arizona.edu

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dedication of organizational resources to the development of in-house expertise in the areas of IP protection and management beginning in the 1970's [10]. The primary reason for this early activity was to help relieve the pressures being placed upon an over-subscribed federal patent system [11]. A second reason was that the emergence of new scientific fields created greater opportunities for university-industry partnerships. For example, the emergence of disciplines such as biotechnology spawned the rapid creation of various technologies that readily translated into clinical practice. The resulting potential for novel medical therapies simultaneously created perceived routes to revenue and royalties. However, the development of marketable technologies also required new public-private partnerships, and by necessity more efficient IP strategies.

The emergence of technology transfer as an institutionalized field in American higher education primarily took place beginning in the early 1980's following the passing of the Bayh-Dole Act of 1980. The direct intent of Bayh-Dole is to enhance university capacities to transfer technologies from campus laboratories to society in ways more efficient and effective than the previously centralized federal licensing system. The Act provides universities with the ability to retain the rights to IP developed through the support of federal funds, as well as the right to either exclusively or non-exclusively license out any resulting inventions. At the time when Bayh-Dole was passed there were only 25 American universities with technology transfer offices [10]. This number has nearly grown four-fold over the past three decades.

It remains unclear as to whether or not the Bayh-Dole Act was the direct cause of the over three decades of exponential growth of technology transfer across the research sector of American higher education [12]. Regardless, this act is very often pointed to as the justification for university efforts to leverage technology transfer as source of revenue generation. Indeed, Bayh-Dole created a mechanism for universities to engage in revenue generating activities. However, this was not the underlying aim of the legislation. In a 2012 report authored for the U.S. Congress, Schacht [13] described the intent of the act is to expand the commercialization of technologies developed through government funding "by employing the patent system to augment collaboration between universities (as well as other nonprofit organizations) and the business community to ensure that inventions are brought to market". The key role of universities in this innovation to market process is to develop novel technologies and processes that stand to benefit society. Furthermore, the obligation of universities is to create effective and efficient mechanisms for which to make such technologies available to society. Irrespective of the underlying goals of Bayh-Dole to create efficiencies and maximize the benefits to society from federally funded research, university technology transfer is firmly anchored in a model of revenue generation.

The preceding revenue generation-based model is directly reflected in the widely adopted performance metrics that shape the university technology transfer field. Internal measures of technology transfer performance vary from university to university. However, the field of technology transfer is captured in a trustworthy manner through the activities and positions of the Association of University Technology Managers (AUTM). AUTM facilitates the most prominent annual global conference for university technology managers and directors and hosts the Journal of Technology Transfer. Most relevant to the current paper is AUTM's role in designing, distributing, analyzing and publishing the results of annual university technology transfer performance assessments. The gold standard assessment instrument is the Annual AUTM Licensing Survey. This survey focuses on the amounts of licensing revenue generated and the underlying factors that feed into such revenue generation (e.g., invention disclosures, filed patent applications, awarded patents, start-up companies). The opportunity to generate licensing revenues through technology transfer activities has been celebrated by university administrators and public policy makers as a mechanism to decrease resource dependencies and counter consistent declines in state funding [14]. The field-wide importance placed on the Annual AUTM Licensing Survey points to the centrality of revenue generation in the organizational framing and the underlying practices of university technology transfer.

AUTM has recently begun to explore potential ways of capturing field-wide performance beyond the scope of licensing and licensing-related activities. One example is the AUTM Annual Transaction Survey, which was first implemented in 2009. This instrument is designed to assess the capacities of university technology transfer offices (TTOs) to contribute to local and regional economic development activities, the expansion of industry-sponsored research, and other various external relationship building opportunities. While this recently established survey is not focused on licensing activities, the variables measured are strongly market-oriented. Currently, AUTM is designing an Institutional Engagement Survey with the intent of enhancing the capacity to recognize the various contributions university technology transfer activities make to local communities and economies. The early description of the instrument indicates the involved measures of engagement are overwhelmingly linked to economic benefits and viewed as contributions secondary to licensing outputs. Lastly, AUTM maintains an ongoing campaign known as the Better World Project, which is designed to publicize the diverse benefits of academic research and technology transfer to communities and society as a whole.

The attention that AUTM is now directing toward assessing and illustrating the implications and performance of university technology transfer using measures and indicators that transcend licensing activities and outputs holds promise for influencing how universities practice technology transfer. However, this promise is limited to the potential for modest incremental change. Specifically, all three of the AUTM efforts are based on the understanding that the contributions of technology transfer activities to communities and society are secondary outputs with priority remaining placed on revenue generation. Regardless, these efforts provide an initial field-based platform from which to propose the development of alternative technology transfer models, such as that which is proposed in the current paper. Such alternative models should be directly guided by a diverse set of performance metrics that are capable of capturing impacts that extend beyond university revenue generation. The development and adoption of such alternative models would encourage universities to redirect efforts and resources away from revenue generation and toward the creation of more holistic outcomes that benefit communities and society. Equally important, \ technology transfer models aimed at value creation over value capture would benefit smaller regional universities and softer disciplines (e.g., humanities, fine arts, etc.) that create IP that is harder to translate into financial gain.

Critical Assessment of Financial Performance Metrics

In this section, the implications of the institutionalization of university technology transfer as an anticipated mechanism for revenue generation are unpacked and more fully considered in the context of university capacities to make innovations accessible to society. This unpacking leads to the following four critical observations specific to the problematic nature of the current university technology transfer

paradigm and ultimately the undermining of the best interests of both the academy and societal stakeholders: (1) universities functioning as private firms; (2) conflicts resulting from a public-private dynamic; (3) universities signaling to public policymakers the capacity to independently generate revenues; and (4) universities positioning technology transfer in conflict with the culture of higher education.

The university in the role of private firm

Colleges and universities are not organizationally structured to operate as profit-driven businesses. In particular, universities are governed by bureaucratic structures that create operational conditions that lack the fluidity and flexibility that is required to be competitive in private market environments. In particular, regulatory policies set by state governing bodies (public universities) and boards of trustees (private universities) can discourage and sometimes prevent the execution of competitive strategies. For example, public colleges and universities are generally prohibited from accepting ownership shares in start-up companies that are profiting from the commercialization of university-developed technologies. It should be noted that a limited number of universities have gained the capacities to accept warrants on and/or a minority amount of shares in spin-off companies [1,15]. Nonetheless, external governing controls overall continue to promote university accountability to society through research, teaching and service, as opposed to corporate and executive boards that focus on earnings growth as a measure of firm accountability to shareholders and investors. In this regard, there is a fundamental disconnect between the philosophies and rulings of governing boards and university efforts to seek revenues through technology transfer activities.

Internally, universities operate under a model of shared governance. This operational structure delegates leadership to and across academic units and departments, which dilutes and redirects executive authority. This bottom-up model of leadership, which is deeply rooted in tradition, can at times counter organizational directives to adapt and change. This condition of organizational confinement is the antithesis of private firm environments where top down oversight is able to drive responsive progress. In other words, corporate strategies are likely to be blocked by faculty who resist market models that enable the effective pursuit of commercial activities.

A particularly powerful attribute of shared governance exists in the form of promotion and tenure. Tenure has historically been framed as the mechanism through which the merit of individual faculty scholarship, instructional activities and service is determined. Strict academic guidelines and expectations guide the pre-tenure experiences of faculty with overall merit being determined at the disciplinary level through a peer-to-peer review and evaluation model. This longstanding model has very little, if any alignment with organizational goals and priorities that are specific to revenue generation. Once earned, tenure works to protect the academic freedoms, intellectual autonomy and professional security of professors. Given the disciplinary base of the tenure process, post-tenure also provides shelter from administrative direction and authority. This isolation allows professors the ability to pursue their own intellectual interests irrespective of organizational goals and priorities. Thus, the tenure and promotion system marks a sharp difference between research universities and private sector organizations where the performance of employees is directly subject to shifts in firm-level priorities and strategic directions.

The initiation of university start-up companies is reliant on faculty ideas and innovations [16]. However, the dominant tenure and promotion structure does not directly reward this form of academic entrepreneurship. This disconnect likely contributes to an underwhelming number of university start-ups. For example, the 2011 Annual AUTM Licensing Survey indicates that the mean number of start-ups created by 179 universities was only four and the median was 2 with a range of 0 at the lowest to 58 at the highest (Table 1). This is especially low given the mean and median annual amount of research expenditures for the same 179 universities equaled $339,702,195 and $190,925,888 respectively. The range was $48,501 at the lowest and $5,418,601,941 at the highest [17]. Considering research productivity is identified as a direct input into the formation of university start-ups, a reasonable expectation is that the mean and median numbers of start-ups would be notably higher. The salient point here is that the entrepreneurial behaviors that are celebrated by private firms become relegated to a moonlighting-type of activity that could become detrimental to the careers of academics.

The preceding observation is also consistent with the mean and median figures in the areas of annual licensing revenues, invention disclosures, patent applications, and patents awarded. As illustrated in Table 2, the mean and median figures reflective of licensing and IP protection activities are relatively low compared to the mean and median annual research expenditures. For instance, universities generated on average only $1,000,000 in licensing revenue for every $25,000,000 in research expenditures. Similarly, there was on average only one active license for every $1,544,101 in annual research expenditures. Among the indicators of IP protection, there was on average only one patent awarded for every in $12,581,563 in annual research expenditures. Furthermore, the average number of patents awarded was 27 compared to an average of 3,921 patent applications filed. This data is consistent with previous findings that indicate sporadic and often low performance levels across the university technology transfer field [2].

Another internal characteristic that makes universities unlike private firms is the organizational willingness to sustain financially challenged units. Normative pressures linked to prestige and legitimacy [18] and community needs and demands motivate universities to retain academic departments that are otherwise financially insolvent. This subsidization model is based on the conventional understanding that fund development and resource generation are sets of activities aimed

	Annual Research Expenditures	Annual University Start-ups Created
Mean	$339,702,195	4
Median	$190,925,888	2
Lowest	$48,501	0
Highest	$5,418,601,941	58

Table 1: Annual Research Expenditures Compared to University Start-Ups.

	Annual Research Expenditures	Annual Licensing Revenue	Active Number of Licenses	Invention Disclosures	Patent Applications Filed	Patents Issued
Mean	$339,702,195	$13,542,920	220	121	3921	27
Median	$190,925,888	$1,513,592	126	68	43	14
Lowest	$48,501	$0	0	2	1	0
Highest	$5,418,601,941	$200,390,266	2,213	1,581	677,204	343

Table 2: Annual Research Expenditures Compared to Licensing and IP Protection Activities.

at supporting research and instruction. Accordingly, scholarship and student learning are considered the critical outputs that positively impact communities and society and thus warrant financial support in cases when revenue generation and financial solvency are not possible. The market logic underpinning the current technology transfer model conflicts with the just described subsidy logic. Specifically, the technology transfer logic frames scholarship as an input into the capacities of universities to generate revenues. In general, the inventor and/or the inventor's home laboratory and department are the beneficiaries of any allocations of revenues accrued through technology transfer transactions [19,20]. In other words, any revenues generated through technology transfer are not commonly applied to cross-subsidization efforts. Also, universities not only often fail to generate significant revenues through commercialization efforts [2], but TTOs commonly operate at a loss [21]. Accordingly, it is not feasible to view TTOs as a reliable source of funds for cross-subsidization. Thus, there exists a fundamental conflict between the operating principles and logics of technology transfer and those of the broader academy.

Conflicts in public-private dynamic

The established technology transfer model complicates how universities as public organizations engage and interact with the private sector. In particular, there exists the potential for unfair competition to emerge when universities engage in private market activities (i.e., start-up activities, aggressive licensing pursuits) that are in part made possible through various forms government support (i.e., direct subsidies, grant awards). Specifically, universities have the option of either creating start-ups that will compete with existing businesses that subsidize higher education through taxes paid or licensing out technologies to firms that will then gain a competitive advantage over other companies operating within the same market. In the either case, a portion of private market stakeholders face some degree of unfair competition through the commercialization practices of universities.

The public-private dynamic is also disrupted when universities engage in "hold-up practices" aimed at exclusively licensing patents at premium rates. According to Lemley [22], these powerful firms obtain exclusive licenses from universities with the specific goal of preventing competition. One result of such practices is some technologies never being fully developed, which prevents societal impact from being achieved. The organizational strategy of licensing technologies to top bidders also disadvantages small- to medium-sized companies that cannot afford premium rates. These more modest companies, which are often locally or regionally-owned, are consequently at risk of being closed out of high value licensing deals. This is in direct conflict with university commitments to local and regional development interests, which in part involves supporting small- to medium-sized businesses. This condition is especially unfortunate considering university technology transfer activities that do occur locally and regionally have been shown to have significant positive "spill over" effects on surrounding communities [23]. Furthermore, strategic hold-up practices counter the spirit of public policy designed to promote innovation. This spirit is reflected in the goals of the Bayh-Dole Act, which in part is aimed at promoting "increased participation of small firms in the national R&D enterprise under the assumption that these companies tend to be more innovative than larger companies" [13]. In short, the choice of universities to pursue revenues over impact conflicts with its public charter.

Hold-up practices also occur not through purposeful strategy, but through issues that arise from the problematic nature of the conventional TTO model. In a study of academic patenting rates on knowledge transfer, Crespi et al. [24] 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. 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. According to Kenney and Patton [25], under-staffed and risk adverse TTOs often revert to hesitation when facing uncertainties that comes at "no direct cost, though there may be enormous (but never known) opportunity costs" Regardless of whether the result of purposeful strategy or a consequence of a flawed model, hold-up practices are counter-productive and detrimental to the capacity of universities to benefit society through technology transfer practices.

Signals of revenue-making capacities to public policymakers

Steady reductions in state funding to higher education over the past three decades have pushed colleges and universities to engage in market and market-like activities [14,26]. Such market-facing activities include increasing tuition, creating instructional efficiencies through economies of scale (e.g., increased course sizes), and decreasing instructional costs through adjunct faculty hires. Technology transfer is included in this array of university activities centered on revenue generation and maximization. The current metrics that are exclusively based on levels of IP protection activity and licensing productivity reinforces the primary understanding of technology transfer as a source of university revenue.

The unsubstantiated celebration of technology transfer as an institutional revenue generation mechanism signals to legislatures that research universities can sustain further cuts in funding. This legislative assumption is further reinforced by the recognition that other state-funded agencies lack similar, albeit perceived revenue-generating capacities. Evidence of poor performance across the university technology transfer field illustrates the problematic nature of delivering such a message to public policymakers [2,21]. Furthermore, the unrealistic legislative perceptions that are reinforced by university rhetoric and practices specific to technology transfer overshadow the impact being achieved in the areas of research, instruction and service.

Conflicts with academic culture

The traditional structure of universities is directly grounded in and guided by academic productivity, which is assessed through established metrics that include research output, grant dollars awarded, students graduated and service performed. These metrics are the guidepost for tenure and promotion and squarely align with the core academic norms and values of higher education. It is widely accepted that faculty activities and priorities are motivated by Mertonian norms of science, which do not acknowledge the potential value of revenue-seeking behaviors [27]. Of course, some university researchers are motivated by the potential to personally profit from technology transfer activities. However, for those academics motivated by monetary incentives, the lure comes most often in the promise of increased revenue flows to support ongoing research agendas [28].

The mainstream market-based model of technology transfer does align with the goal of securing revenues to support research. However, the poor performance of most university TTOs fails to support such goals. This failure leaves those professors who are willing to engage in mainstream technology transfer activities disappointed and less

motivated to continue the pursuit of entrepreneurial initiatives that involves the protection and management of university IP [21]. Also, technology transfer continues to be a peripheral field in most universities, which is due in large part to the distance between it as a revenue-driven field and higher education in general as an institution committed to the unbiased pursuit of knowledge and the betterment of society and the human condition.

Constructing a Social Entrepreneurship Model of Technology Transfer

Principles of social entrepreneurship

The development of a university technology transfer model based on the core principles of social entrepreneurship represents an opportunity to establish an alternative process that is directly aligned with the core values and organizational structures of the academy. The meaning of social entrepreneurship is a point of ongoing debate in the literature [29]. For example, a 2009 literature reviewed conducted by Zahra, et al. [30] revealed no less than 20 different definitions of social entrepreneurship, while in 2010 Dacin [31] identified 37 definitions. In the current paper, social entrepreneurship is reflective of the activities and initiatives of actors and organizations that are committed to value creation over value capture. According to Santos [32], in the case of value creation "the aggregate utility of society's members increases after accounting for the opportunity cost of all the resources used in that activity while with value capture "the focal actor is able to appropriate a portion of the value created by the activity after accounting for the cost of resources he/she mobilized". On the one hand, value creation involves innovative activities and initiatives that benefit stakeholders beyond the individual and/or organizational level. On the other hand, value capture involves benefits that are realized by specific individuals and/or organizations (i.e., profits, revenue generation). As argued by Santos, value creation is the central and defining characteristic of social entrepreneurship. Value creation is also central to the core mission of higher education, which has long been identified as a public good. Thus, the emphasis on value creation directly ties the practice of social entrepreneurship to the outreach activities of colleges and universities, which includes technology transfer.

A technology transfer model based on the principles and practices of social entrepreneurship would directly emphasize and promote the creation of meaningful and sustainable impact (i.e., value) through the movement of university-born innovations. This emphasis would cast a shadow over the pursuit of university revenues, which is currently at the core of the mainstream technology transfer model. It is, however, important to note that value creation and value capture can co-occur. In particular, value capture may ne required to help fund the continuation and expansion of TTOs. However, the integrity of a technology transfer model grounded in social entrepreneurship would have to strategically ensure that the scales remain tipped toward value creation. The preservation of commitment to value creation marks a departure from the notion of double- and triple-bottom line models, which imply an *equal* emphasis on value creation and value capture (i.e., blended value) [33]. As Santos indicated when describing the evolution of Compartamos from a Mexican bank focused on microfinance to a more conventional profit-driven model, the risk of value capture overriding a commitment to value creation is very real. The steady commitment to the primary goal of value creation would be the hallmark of an alternative model of technology transfer that is anchored in the principles and practices of social entrepreneurship.

While the current mainstream technology transfer model does include a mix of value capture and value creation, the greatest emphasis is placed on value capture as represented through the perceived revenue generation capacities associated with technology commercialization. The integration of value creation is being more directly integrated into technology transfer agendas as indicated by the previously described AUTM initiatives to illustrate the various impacts of technology transfer on communities and society. However, the recent efforts of AUTM do not place enough emphasis on broader impact with priority remaining squarely on revenue generation (i.e., wealth creation). In particular, AUTM implicitly frames broader impact as a secondary outcome of an otherwise revenue-generating enterprise. The social entrepreneurship model for technology transfer that is proposed next calls for a profound, field-wide shift in how universities engage in and measure the performance of technology transfer activities. This alternative model echoes Dees's [34] argument that social entrepreneurship represents a remedy to the general inabilities of societal institutions, which includes colleges and universities, to respond to the problems of the world in efficient and effective ways.

Openness and transparency

An alternative technology transfer model based on the principles of social entrepreneurship would alleviate the need to measure performance according to revenue-based variables and metrics. In this regard, universities would be less compelled to overly-protect financial interests through behaviors such as "hold-up practices," which in turn would lay the foundation for a more open-sourced model of technology transfer [35]. An open-sourced model would create the opportunity for the market to determine the economic value of specific technologies. Technology transfer managers would be relieved of the burdens of forecasting the monetary worth of technologies, while the risk assumed by private firms would be dramatically reduced based on not having to negotiate licensing agreements that are based on potentially inflated values. This reduction of risk would encourage private firms to be more liberal in acting on potential opportunities involving university-owned IP, which would in turn promote the more efficient transfer of technologies to the market. Most importantly, university impact on society would be achieved at higher and more rapid rates.

Refining the mainstream technology transfer model to include at its center social entrepreneurship would incentivize universities, and more specifically technology managers, to seek the best opportunities to achieve the greatest impact irrespective of revenue generation. Universities would also no longer have to overly-protect the novel features of discovery so as not to compromise expected market values. Accordingly, the underlying details of early stage research and emergent innovations could be more freely and fully disclosed, thereby fueling a more productive technology transfer enterprise. Technology transfer officers would be reassigned to the task of brokering relationships between researchers and industry sponsors as opposed to brokering deals between universities and private firms.

A more open approach to technology transfer would also provide outside companies with more direct and specific access to early stage research. Specifically, universities would become less secretive about cutting-edge research as the burden of protecting financial interests in potentially high-market value discoveries would be removed. In turn, industry would be further incentivized to invest in early stage research. Such investments would contribute positively to the research expenditure metric, which is far more relevant to overall university productivity compared to the current revenue-driven technology transfer measures.

University engagement in technology transfer has been shown to positively influence local and regional economic activity [23]. Increases in the rates of technology transfer that would be made possible through an open-sourced model would further increase contributions to the development of local and regional economies. University contributions to local and regional economic activity are a productivity measure of technology transfer that is more compelling than revenue generation figures and more relevant to the overarching public charter. Also, smaller universities that are mostly focused on student instruction and non-traditional forms of technology transfer would have the opportunity to develop a more relevant and legitimate set of performance metrics.

The groundwork for an alternative metric

One advantage of conventional market metrics is that the outcomes of technology transfer activities are able to be assessed using concrete, quantitative measures. However, concrete measures are just that – rigid variables that restrict the freedom to consider softer measures that focus on impact rather revenues generated and number of technologies protected. In other words, this rigidity is highly problematic in that it restricts the capacity of universities to fully capture the potential range of non-conventional impact that could potentially be achieved through technology transfer activities. Moreover, the narrow confines constructed through conventional measures prevent the movement of university innovation and ultimately the impact of research on economies and society as a whole.

Measurable forms of impact vary widely between universities and measuring their impact using terms that transcend current IP protection and revenue-based variables is a difficult task [36]. In fact, the difficulties associated with illustrating impact are a challenge that confronts all social entrepreneurs [37]. Thus, no one rubric could account for all the potential ways in which university technologies may impact society. Capturing the true impact of individual technologies requires the flexibility to account for distinct qualities of value [36]. Accordingly, any attempt to develop a universal set of metrics for determining the performance of university technology transfer would result in limitations and rigid restrictions similar to the current mainstream range of metrics.

While somewhat counter-intuitive, the insurmountable challenges of developing a structured impact rubric create an opportunity for the university technology transfer field to more fully and appropriately illustrate performance, while not creating an illusion of self-sufficiency through licensing activities. The lack of a structured set of measurements would afford universities the latitude to craft a unique story for each transferred technology that qualifies the distinct impacts made on communities, economies and society. For example, a modest innovation with little to no market value that is able to increase access to potable water in developing regions and thereby save lives is no less compelling of a technology transfer case compared to a patented software that generates some (or even a large amount of) revenue. Unfortunately, the current revenue-based rubric suggests otherwise. Accordingly, an enhanced storytelling capacity based on impacted-centered metrics that are unique to the characteristics and activities of individual universities would radically transform the field of university technology transfer [37]. Such metrics would capture value in a wide spectrum of areas including academic, social, economic and financial. Academic outputs, for example, would capture value from publications and students trained, while social metrics would measure outputs related to the environment or health [37]. Furthermore, economic metrics would capture impact and outputs in the employment sector, such as jobs created and employees trained, and the more traditional financial metrics would account for any revenues generated.

Alternative metrics would allow the transfer of technology on a regional level, which is particularly important given the mission of universities to contribute to the development and vibrancy of local and regional communities. The communities that surround each university are unique and involve distinct sets of social and economic challenges and opportunities. Accordingly, specific projects are likely to generate community-centric impacts that cannot be captured by static or standard measurements. Within the current technology transfer model, universities have no incentive to report impacts that do not involve activities that promote and reflect revenue generation. Financial incentives to faculty and TTOs have been proposed to boost licensing dollars, but these methods are rarely employed or shown effective in public universities [36]. Using a dynamic model would provide TTOs with a means to demonstrate effectiveness on a per-project basis and would decrease the pressure on TTOs to demonstrate value based only on licensing dollars accrued. A challenge associated with this alternative model is that it would be difficult to demonstrate or monitor progress over time. Thus, universities would be encouraged to develop some quantifiable impacts important to internal and external stakeholders. In other words, the success of the alternative model would partially depend on the input and buy-in of internal actors (faculty, administrators, executive leadership) and external stakeholders. For example, impact could be translated into faculty metrics through the crafting of context-specific stories of impact that are more familiar to performance review committees. By being able to clearly and concisely demonstrate impact, more professors would be incentivized to engage in technology transfer activities. Faculty members are the key to developing university IP and thus must be recognized for their contributions. Accordingly, impact metrics should directly consider the tenure and promotion process, which includes establishing field-wide recognition of value creation through technology transfer that would be reflected in external review letters.

Conclusion

The reconceptualization of university technology transfer through the application of a social entrepreneurship framework must be constructed in such a way that flexibility and fluidity are ensured. Indeed, technology transfer is not an "all or nothing" set of activities. In other words, performance models should follow a continuum that is anchored on one end by value creation (i.e., impact) and on the other by university revenue generation. Universities should retain the capacity and the drive to generate revenues in a higher education environment that is marked by consistent declines in state funding and increased expectations of academic entrepreneurship. However, as just argued, the drive for revenue should not distract from the ultimate importance of moving innovation to society where intended impact can be achieved. By developing a performance model that incentivizes value creation over revenue generation, the true intent of technology transfer to more efficiently make university discoveries accessible to society can be better achieved.

A performance continuum that favors value creation over value capture would also incentivize and reward a diverse range of technology transfer activities across an equally diverse disciplinary and organizational landscape. In particular, disciplinary fields that are positioned at a notable distance from the private marketplace, such as the humanities and fine arts, would be more directly folded into the technology transfer enterprise. For example, a hypothetical

speech therapy protocol based on a novel poetry methodology would be vigorously promoted as a transferable technology under a model centered on value creation. Under the current revenue-based paradigm, such a technology would likely be devalued, if not dismissed all together due to having little to no potential for revenue generation. At the organizational level, smaller, more regional universities that have fewer capacities for complex scientific and technological research compared to powerhouse flagship schools would also be better positioned under a technology transfer model grounded in the principles of social entrepreneurship. Such universities, which are currently disadvantaged under the current technology transfer model, would be evaluated on an alternative set of metrics that emphasizes value creation over value capture [38].

In closing, this paper has called for a significant transformation in how university technology transfer is framed and its performance is evaluated. Specifically, the merits of a meaningful shift from a performance model that is based on university revenue generation to one that is oriented more toward social entrepreneurship has been argued. The merits of such a profound shift have been framed according to the primary, but commonly overlooked goal of university technology transfer as a mechanism for bettering society through the efficient movement of innovations from the academy to society.

References

1. Michael JB, James NL (2000) University revenues from technology transfer: Licensing fees vs. equity positions. Journal of Business Venturing 15: 385-392.
2. Joshua BP (2003) Commercializing academic research: Resource effects on performance of university technology transfer. The Journal of Higher Education 74: 26-50.
3. Irvin F (1996) Technology transfer from universities. In John C. Smart (Ed.) Higher education: Handbook of theory and practice. Agathon, New York: 1-43.
4. Rory P O'Shea, Thomas JA, Amaud C, Frank R (2005) Entrepreneurial orientation, technology transfer and spinoff performance of U.S. universities. Research Policy 34: 994-1009.
5. Christopher G, Heidi F (2010) Informal university technology transfer: A comparison between the United States and Germany. The Journal of Technology Transfer 35: 637-650.
6. Markus P, Valentina T, Maureen M, Eskko A, Anders B et al.., (2012) Academic engagement and commercialization: A review of the literature on university-industry relations. Research Policy 42: 423-442.
7. Taylor AT, David A (2011) The Bayh-Dole Act and scientist entrepreneurship. Research Policy 40: 1058-1067.
8. Bozeman B (2000) Technology transfer and public policy: A review of research and theory. Research Policy 29: 627-655.
9. David R (2000) Technology transfer. In Christopher Hill (Ed.) Science and technology policy in the U.S.: A time of change. Longman, London.
10. Bhaven NS, Richard RN (2002) The evolution of university patenting and licensing procedures: An empirical study of institutional change. In Paul Ingram and Brian S. Silverman (Eds.). The new institutionalism in strategic management. Emerald Group Publishing Limited, Bingley, UK. 135-164.
11. Donald SS, David W, Albert L (2003) Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: An exploratory study. Research Policy 32: 27-48.
12. David CM, Richard RN, Bhaven NS, Arvids AZ (2011) The growth of patenting and licensing by U.S. universities: An assessment of the effects of the Bayh-Dole Act of 1980. Research Policy 30: 99-119.
13. Wendy HS (2012) The Bayh-Dole Act: Selected issues in patent policy and the commercialization of technology. Congression Research Service Report for Congress.
14. Sheila S, Gary R (2004) Academic capitalism and the new economy. Johns Hopkins University, Baltimore, MD.
15. Koenraad D, Rheinhilde V, (2005) The role of academic technology transfer organizations in improving industry science links. Research Policy 34: 321-342.
16. Celestine C, Richard J (2005) University invention, entrepreneurship and start-ups. NBER Working Paper 11475.
17. Jerry T, Marie T (2007) Knowledge creation and diffusion of public science with intellectual property rights. In Keith E. Maskus (Ed.) Intellectual Property Rights and Technical Changes: Frontiers in Economics Series, Vol. 2, Amsterdam, Elsevier Ltd.
18. Walter WP, Paul DiMaggio (1983) The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review 48: 147-160.
19. Irene A, Grace L, Ashley JS (2009) How are U.S. technology transfer offices tasked and motivated: Is it all about the money? Research Management Journal 17: 1-15.
20. Fabio M (2009) Intellectual property rights and knowledge transfer from public research to industry in the US and Europe: Which lessons for innovation systems in developing countries? In The Economics of Intellectual Property: Suggestions for Further Research in Developing Countries and Countries with Economies in Transition, Geneva: World Intellectual Property Organization.
21. Paul MS, Venubabu V (2009) Why university inventions rarely produce income? Bottlenecks in university technology transfer. Journal of Technology Transfer 34: 343-363.
22. Lemley M (2008) Are universities patent trolls? Fordham Intellectual Property, Media and Entertainment Law Journal 18: 611-631.
23. Maryann F, Desrochers P (2003) Research universities and local economic development: Lessons from the history of Johns Hopkins University. Industry and Innovation 10: 5-24.
24. Gustavo C, Pablo D'Este, Roberto F, Aldo G (2011) The impact of academic patenting on university research and its transfer. Research Policy 40: 55-68.
25. Martin K, Donald P (2009) Reconsidering the Bayh-Dole Act and the current university ownership model. Research Policy 38: 1407-1422.
26. Sheila S, Larry LL (1997) Academic capitalism: Politics, policies, and the entrepreneurial university. Johns Hopkins University Press, Baltimore, MD.
27. Merton RK (1957) Priorities in scientific discovery: A chapter in the sociology of science. American Sociological Review 22: 635-659.
28. Lach S, Mark Schankerman (2008) Incentives and invention in universities. RAND J Econ 39: 403-433.
29. Tina MD, Peter AD (2011) Social entrepreneurship: A critique and future directions. Organization Science 22: 1203-1213.
30. Shaker AZ, Hans NR, Nachiket B, Donald ON, James CH et al. (2008) Globalization of social entrepreneurship opportunities. J Strat Ent 2: 117-131.
31. Peter AD, Tina D, Margaret M (2010) Social entrepreneurship: Why we don't need a new theory and how we move forward from here. Academy of Management Perspectives 24: 37.
32. Santos FM (2012) A positive theory of social entrepreneurship. Journal of Business Ethics 111: 335-351.
33. Emerson J (2003) The blended value proposition: Integrating social and financial returns. California Management Review 45: 35-51.
34. Gregory JD (2001) The meaning of social entrepreneurship. Comments and suggestions contributed from the Social Entrepreneurship Founders Working Group. Durham, NC: Center for the Advancement of Social Entrepreneurship, Fuqua School of Business, Duke University.
35. Michael L, Christopher K, Cafer TY, Vicki LC (2009) Towards open source nano: Arsenic Removal and alternative models of technology transfer. Advances in the Study of Entrepreneurship, Innovation, and Economic Growth, 19: 51-78.
36. Darrell MW (2012) Improving university technology transfer and commercialization. Issues in Technology Innovation 20: 1-15.
37. Seelos C, Mair J (2005) Entrepreneurs in service of the poor – Models for business contributions to sustainable development. Business Horizons 48: 247-252.
38. Rebecca G, Emily M, Rachel M, Ed L (2010) Alternative Intellectual Property for Genomics and the Activity of Technology Transfer Offices: Emerging Directions in Research. Boston University. J Sci Tech Law 16: 194-230.