

# A new technology transfer paradigm: how state universities can collaborate with industry in the USA

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**Abstract:** *In some US states, policy makers, pressed by local and regional industrial interests, are debating how to 'reform' technology transfer at public universities. 'Reform' in this context is generally understood to mean redirecting university technology transfer activities to increase the benefits of state-funded research to local industries. Progress towards this goal is often constrained by federally mandated laws applicable to technology transfer at universities (such as the Bayh–Dole Act) and by university policies that have been placed by state legislatures outside the purview of policy making state officials. Calls for change have also been countered by the view of many universities that the system is not broken. Suggested reforms range from the abolition of the Bayh–Dole Act, which gives universities the flexibility to transfer ownership of federally funded inventions to local industries, to structural or management changes in universities that will promote innovation and/or expedite the licensing of new ideas. This article proposes a new paradigm: instead of measuring the success of technology transfer by counting numbers of patents and licensing deals, the authors suggest measuring knowledge flows between state universities and their localities. This approach should produce a more accurate picture of the full impact of universities on their regions.*

**Keywords:** *technology transfer; innovation; performance measurement; regional development; US state universities*

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Technology transfer offices at US universities are under increasing scrutiny. Industry representatives, when asked about how universities could or should become

more involved in local or regional economic development, often cite the need for better quality results from university technology transfer. Local, state

and regional economic developers express a similar concern. A recent technology-based economic development conference included one session subtitled 'Our Bipolar Relationship with Universities'.<sup>1</sup> Industry complains about the time required to get a deal done and the difficulties of negotiating with universities. State and regional economic developers are troubled by state universities auctioning their technologies to the highest bidders to the detriment of local companies. They also express concern as to why professors are not more willing to collaborate with the companies around them.

Many academic studies of university technology transfer, as well as reports from the Association of University Technology Managers (AUTM), refute the notion that the system is not effective (Thursby and Thursby, 2003). However, historically the focus for most universities has not necessarily been regional. Despite the data showing, for instance, that in 2005 more than 3,200 patents were issued to US universities, more than 4,900 licences were granted to commercial companies and 628 new start-ups were created (AUTM, 2007), the din from industry and economic developers strongly suggests that these accomplishments alone are not always considered sufficient. In this paper we discuss several reforms in the public discourse and suggest an alternative paradigm for changing the approaches of university technology transfer offices (TTOs) to shore up the interface between the university, the local and regional business community and economic developers.

Our intention is not to be prescriptive but to emphasize that organizations respond to metrics – the actions of organizations and people are driven in part by how they are measured. We advocate that metrics should be broadened to support universities in shifting towards managing their intellectual assets for the benefit of economic development. RTI International (with which two of the authors are associated) works with a wide range of clients and recognizes that varied solutions are needed to benefit different organizations and their missions. We believe that a shift is possible without a one-size-fits-all mentality, but we advocate that organizations consider knowledge flow as the basis for measuring success.

## **Built-in barriers**

Most universities subscribe to the notion that their central mission is the open and free dissemination of knowledge for the greater benefit of society. The university fulfils this mission through teaching, research and public service. Historically, many academic institutions and their faculty members have viewed

innovation for profit and entrepreneurial activities as not only outside, but potentially contrary to an educational mission. Nevertheless, with the increasingly knowledge-based economy of the twenty-first century, universities are being called upon to play an expanded role in society – and for the most part they are.

Universities today are collaborating with industry and generating ventures on a scale and in ways previously unthinkable.<sup>2</sup> Industry-sponsored research, intellectual property (IP) licensing, corporate internships, business incubators and start-up companies are providing great educational and revenue-generating opportunities for students and universities. These activities are leading to new products and services that benefit the public. They also create new industries and jobs for the national, as well as the local, economy.

However, to make this work, both academia and the for-profit sectors have had to reach some accommodation with one another. Those endeavouring to reshape university structures or forms of IP management will need to start with the institution's core values and principles, and consider how best to make sure they are reflected in changes to IP management policies and practices.

Transferring technology out of a university typically involves consideration of intellectual property rights that may apply to it. Here, US law, beginning with the Constitution,<sup>3</sup> is virtually pre-emptive of state laws in defining what those rights are and who has the authority to exercise them.<sup>4</sup> Another federal law critical to university technology transfer at both federal and state levels is the Bayh–Dole Act.<sup>5</sup> This law requires universities and non-profit research institutions receiving federal financial assistance for research (basically federal research grants, contracts or cooperative agreements) to disclose, protect and commercialize for the public benefit any patentable inventions discovered during the funded research programme. Since research funded by federal agencies involves use of US taxpayer dollars, this controlling legislation does not recognize preferences for local industries as the beneficiaries of university research. In fact, language in the introductory portions of the Act can be read as contrary to establishing this kind of preference.<sup>6</sup>

On the other hand, a workaround may be found in the one preference that is established under the Act that favours licensing to small businesses.<sup>7</sup> Other federal laws and regulations setting limits for university research and technology transfer practices can be found in US tax law, including certain limitations on the use of facilities and equipment financed by tax-exempt bonds,<sup>8</sup> antitrust considerations and export control regulations that define fundamental research.

As these barriers indicate, very little inducement is found in prevailing federal law to ease the transfer of innovation to industry or to support local and regional economic development. Since the states themselves can do little to improve the situation in the face of countervailing federal laws, the universities must become creative in finding ways to ratchet up their contributions to local economies and societies.

## Existing reform agenda

The public discourse seeking to encourage universities to form closer relationships with industry and to place greater emphasis on local and regional needs has produced numerous recommendations for change. Several of these are discussed briefly below. A distinction is made between proposals dealing with university policies that can be implemented internally and those seeking to amend the federal and state legal environment in which universities operate and which require the intercession of outside authorities.

This paper presents four major university policies and procedures and two reforms in discussion outside the university realm that may be relevant to improving relationships between universities and local businesses and economic developers.

### *Proposals for change in state universities*

*Change promotion and tenure considerations.* Recent discussions on many campuses have addressed the possible benefits that would accrue if campus cultures and attitudes were changed to become more accepting and encouraging of entrepreneurial activities among students and faculty members. One recommendation is to expand promotion and tenure policies to reward entrepreneurial behaviours (see, for example, Siegel *et al.*, 2003; Renault, 2006). Counting patents as publications, measuring interaction with corporate partners (using metrics such as industry-sponsored research and consulting with industry) and valuing licensing and start-up activity as positive measures of achievement in promotion and tenure considerations would support and advance cultural change.

*Standardize university–industry agreements.* This approach is promoted repeatedly among economic developers and industry alike as a way of streamlining university-sponsored research and licensing processes (Government–University–Industry Research Roundtable, 1988). Introducing the use of standard templates for collaborative research, technology licences and other technology transfer-related agreements between universities and industry should reduce the timeframe for negotiations. Since these agreements are

two-sided, to be effective they must be developed in collaboration with industrial partners.

*Change royalty structures.* The royalty structures commonly applied by universities often do not meet the needs of industry and, because they are perceived as a barrier, impede economic development. There is pressure in the community for universities to offer fixed-rate royalties, fixed fees or no fees when licensing university-developed technology. A major part of the argument for more accommodating royalty structures comes from claims by local taxpaying industries that they have already paid for the infrastructure and means by which an innovation has been developed. While local industry's perception of entitlements may be self-serving and not a valid basis for selection, state universities, in making decisions as to priorities, do have the capability to adjust the relative values they place on supporting local economies versus generating royalty revenues.

*Use different metrics.* The traditional technology transfer metrics in current use (such as invention disclosures, patents filed and issued, licences executed and start-ups formed) have become widely accepted, predominantly as a result of the *AUTM Licensing Survey*<sup>TM</sup>. AUTM itself recognizes that these metrics do not always convey the full impact of technology transfer activities, such as public benefit and quality-of-life improvements, and has embarked on two initiatives to paint a clearer picture of the impact of technology transfer. Its *Better World Project*<sup>9</sup> speaks to the quality-of-life improvements made by university technologies. State universities, together with state economic development organizations, might consider adopting a 'Better State Project' to showcase the local and regional contributions of state universities. AUTM has also formed a Metrics Task Force to propose new metrics that could be included in the annual *AUTM Licensing Survey*. Perhaps state and/or regional economic development organizations should be given a seat at the table in helping to develop measurements that would more accurately take into account states' interests in the performance of their public universities.

### *Reforms outside universities*

*Repeal or reform of the Bayh–Dole Act.* The last few years have produced several recommendations for the repeal or reform of Bayh–Dole. Many of these suggestions have been rather tightly focused on issues surrounding the patenting of research tools such as DNA segments and protein structures (Eisenberg and Rai, 2003). Some repeal recommendations are suggested by the biomedical ethics community, concerned that large companies are getting too much benefit from ideas nurtured largely by federal funding

(Heller and Eisenberg, 1998).<sup>17</sup> It is debatable whether ‘fixing’ Bayh–Dole in a way that reduces patenting (as some articles suggest) will help states that are seeking to build new businesses. States would most likely not be in a position to champion changes in Bayh–Dole, even if there were a consensus as to what the changes should be. The focus for state universities should be on finding ways to work within Bayh–Dole, such as locally exploiting the small business preference, and explaining to state policy makers how Bayh–Dole works to ensure timely and effective use of university innovations.

*State initiatives.* At least four state legislatures have attempted to enter the debate. In 2006, the North Dakota legislature commissioned a study on IP policies and procedures, responding to concerns expressed by the business community.<sup>10</sup> In the same year, the Virginia legislature amended its legislation<sup>11</sup> regarding the adoption of patent and copyright policies by state universities to allow for the assignment of interests in IP developed in state universities. Interpreted by some to mean that Virginia corporations sponsoring research at the state universities may have resulting IP assigned (as opposed to licensed) to them, this is a variant of the flat-fee proposals. New York is in the formative stages of studying its options with respect to IP developed at its public universities. A bipartisan Roundtable on Intellectual Property Policy<sup>12</sup> is working towards the goal of developing a comprehensive state-wide policy. In the 2007 session, the Maine legislature considered a bill to mandate ‘favourable’ pricing of intellectual property and to assert the state’s ownership position of IP arising from state funding.<sup>13</sup>

## **Suggestions for a new paradigm**

Many of these recommendations are worthy of consideration and some should be implemented. However, another solution would be to rethink the measurement systems currently used to assess outcomes. The current paradigm in many US universities (public and private) rests on the twin objectives of encouraging faculty members to disclose innovation and maximizing revenues. Some TTOs do add economic development to their goals, but there is little evidence that these are other than a small minority. Below we describe some ways for universities to broaden their management practices to encourage relationships with industry with a positive impact on economic development.

### *Measure spillover and knowledge transfer*

Assuming that organizations and their staffs act in ways consistent with how they are managed and measured,

the twin objectives mentioned above may lead offices to fixate on patenting for the sake of counting patents and licensing technology to the highest bidder, who may or may not be local. This approach is unlikely to increase the interaction of state universities with their surrounding localities. The outcome, then, will continue to be dissatisfaction from some industrial and economic development sectors.

We propose an alternative – a new paradigm for university technology transfer, based on outcomes that will benefit economic growth as well as outcomes that have traditionally been seen as desirable for the university. These outcomes are more closely aligned than is generally believed. The paradigm considers the role universities play in developing new knowledge and innovation that spill over into local and regional economies (Jaffe, 1989). Many observers fail to grasp that this spillover happens in numerous ways outside the TTO. Goldstein and Luger (1997) characterize the university as a multi-product entity that effects regional economic development in eight ways, including formal technology transfer, but also the training of students, the informal transfer of know-how, the building of a knowledge infrastructure and supporting a creative regional milieu.

Others have characterized the appropriate role of the university as increasing knowledge flows. Siegel’s (2006) presentation at the National Science Foundation Workshop on Advancing Measures of Innovation suggests several new proxies for knowledge generation. In Table 1, Siegel’s measures are aligned with Goldstein and Luger’s modalities of university regional roles.

This analysis shows that some measures are still missing, such as the number of graduates, including those in science and engineering, who remain in the region after graduation; the amount of sponsored research from regional partners (industry and/or non-profit research institutions); and measures of the creative community, such as Richard Florida’s (2003) composite diversity index.

With these added, Table 2 suggests a new set of measures<sup>14</sup> that more fully capture the university’s multidimensional role in a region, thus broadening the narrow focus on the formal technology transfer role. Note that these metrics do not include a number of widely used indicators, such as number of patents filed and issued and the amount of revenue generated from licences, because these are by-products of the activities that should be encouraged. These ‘old’ indicators have caused the dysfunctional behaviour ascribed to university TTOs, and should therefore be downplayed to change results for the better.

Using new metrics will enable universities to refocus on the two things they see as fundamental to their

**Table 1. Comparison of modalities and measures for universities roles in regional growth.**

Modalities of university roles	New measures
Formal technology transfer	Numbers of disclosures, licences and start-ups
Informal transfer of know-how	Citations of patents and articles Co-authoring Firm retention in university research joint ventures Firm survival New products commercialized Growth in employment and sales of firms
Training of students	Job mobility among students Hiring of engineering and science graduates
Building of knowledge infrastructure	Productivity of TTOs
Supporting a creative milieu	

mission: the education of students and the performance of research. The metrics will encourage universities to seek curricula and educational partnerships that are meaningful and useful to regional clusters so that they can maximize local hiring of their graduates. The metrics also encourage universities to seek research funding from

regional industry and non-profit research institutions in addition to federal sources. These joint research projects will result in the transfer of informal know-how, especially of tacit knowledge, but will also stimulate the production of innovation that can be licensed in the region. Further, locally funded research projects result in full-time or part-time employment opportunities for students who then also acquire practical knowledge to supplement their classroom teaching.

*Broaden the guiding principles of technology transfer offices*

The question remains of how change can be effected at the working level of the technology transfer office. A group of public and private institutions has recently suggested that guiding principles should be introduced which TTOs might follow in their licensing practices.<sup>15</sup> Slight changes to these guiding principles can help to balance the inherent difficulty in working with industry at a national or local level. TTOs at state universities might consider adapting the idea of guiding principles as a means of strengthening their relationships with local and regional interests. We offer the following variations from a few of the recommended guiding principles. Our additions are in italics:

- (1) Universities should reserve the right to practise licensed inventions *and to find ways for other non-profit and state and regional public-interest organizations to benefit.*

**Table 2. Suggested metrics of university's contribution to economic development (authors' additions in italics).**

Modalities of university roles	New measures
Formal technology transfer	Numbers of disclosures, licences and start-ups <i>New jobs created, new products introduced, new revenues and investments received by licensees</i> <i>Amount of sponsored research from regional partners (industry and/or non-profit research institutions)</i>
Informal transfer of know-how	<i>Amount of sponsored research or research joint ventures with regional partners</i> Citations of patents and articles <i>from university researchers</i> Co-authoring <i>between university and industry or non-profit researchers</i> Firm <i>participation and</i> retention in university research joint ventures Firm survival <i>after collaboration with university</i> New products commercialized <i>after collaboration with university</i> Growth in employment and sales of firms <i>after collaboration with university</i>
Training of students	Job mobility among students Hiring of engineering and science graduates <i>Number and percentage of students who remain in the region</i>
Building of knowledge infrastructure	Productivity of TTOs <i>Jobs created through university incubator or science park</i>
Supporting a creative milieu	<i>Composite diversity index</i>

- (2) Exclusive licences should be structured in a manner that encourages technology development, use *and regional impact*.
- (3) State universities should anticipate and help to manage technology transfer-related conflicts *and be prepared to help local and regional actors overcome them*.
- (4) Ensure broad access to research tools *and strive to provide a bridge to regional users with access and training*.
- (5) Consider including licensing provisions that address unmet needs, such as those of a state's neglected patient populations or geographical areas, giving particular attention to improved therapeutics, diagnostics and agricultural technologies for *regional benefit* and the developing world.

## Conclusion

This new paradigm, then, refocuses the measurement of technology transfer activity from a narrow set of metrics to a broader list of indicators of knowledge flows that benefit local and regional economic development and broadens the responsibility for university participation from the TTO to the wider university community. Because the broader measures encompass the traditional missions of universities – education and research – they will align more closely with the activities desired by industry and economic developers. This new paradigm will do much to quell the dissatisfaction currently felt by local industries, economic developers and universities themselves with the current state of affairs.

## Notes

- <sup>1</sup>State Science and Technology Institute, 10th Annual Conference, 31 October–2 November 2006, Oklahoma City, OK.
- <sup>2</sup>For example, the Berkeley–Novartis five-year, \$25 million plant genomics research agreement (1998).
- <sup>3</sup>Article 1, Section 8, Clause 8 of the *US Constitution*.
- <sup>4</sup>15 U.S.C. 1051–1127, 15 U.S.C. 1511, 35 U.S.C. and 44 U.S.C. 1337–1338.
- <sup>5</sup>35 U.S.C. 200–212.
- <sup>6</sup>35 U.S.C. 200.
- <sup>7</sup>35 U.S.C. 202(c)(7)(D).
- <sup>8</sup>IRS Rev. Proc. 97–14.
- <sup>9</sup>Association of University Technology Managers, 'Better World Project', [www.autm.net/betterworldproject.cfm](http://www.autm.net/betterworldproject.cfm).
- <sup>10</sup>North Dakota, incidentally, is an example of state in which the legislature has placed university policies outside the purview of policy making state officials. It grants broad exclusive authority to the State Board of Higher Education to develop regulations and policies for governing state universities (N.D.C.C. Ch. 15–10–17 §7).

<sup>11</sup>Code of Virginia, §23–4.3 and 23–4.4, amended by HB 134, 11 March 2006.

<sup>12</sup>New York State Assembly Task Force on University–Industry Cooperation, *A Special Report*, <http://assembly.state.ny.us/comm/UnivIndCoop/20060817> (accessed 13 December 2006).

<sup>13</sup>State of Maine Legislature, *Summary of LD 1802*, <http://janus.state.me.us/legis/LawMakerWeb/summary.asp?ID=280024754>.

<sup>14</sup>Some of these metrics come from Ken Swartzel and Jeff Cope (2003).

<sup>15</sup>The document, *In the Public Interest: Nine Points to Consider in Licensing University Technology*, is publicly available on the AUTM Website and can be downloaded at [www.autm.net/aboutTT/Points\\_to\\_Consider\\_letter.pdf](http://www.autm.net/aboutTT/Points_to_Consider_letter.pdf).

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