How'd We Do?: Establishing Useful Technology Transfer Metrics

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As evidenced by the available market research, metrics continue to be a significant topic among technology transfer offices (TTOs) charged with licensing out their organization's intellectual property (IP). Despite the voluminous inventory of possible metrics, selecting success metrics is a subjective process that is highly individualized for each organization.

At the request of the TTO at NASA's Marshall Space Flight Center, Fuentek conducted market research in the fall of 2009 to identify best practices in metrics collection and success measurement within TTOs in the government, academic, and commercial sectors. This paper presents Fuentek's analysis of that research, including recommendations for metrics that TTOs—particularly those for government or academic organizations, but perhaps also in the corporate sector—can use to effectively evaluate their technology transfer function.

Trends in Tech Transfer Metrics

Fuentek identified several recurring themes within the available research data regarding best practices in metrics used by TTOs:

- **Need for clearly defined goals:** High-performing TTOs have clearly defined goals and establish their metrics in support of achieving those goals.
- **Need for definitions:** Clear definitions for all terms are needed to avoid misinterpretation and invalid comparisons. Well-defined metrics are easier to capture than vague metrics.
- **Need for normalization:** Normalized metrics are needed for any meaningful comparison, whether to determine year-over-year performance within the TTO or to compare across organizations.
- **Need for qualitative measures:** Numbers alone are insufficient to demonstrate the value that technology transfer brings to the larger research and development (R&D) organization, the regional or national economy, and the public. High-performing TTOs augment their quantitative metrics reporting with success stories and anecdotes.

Trends by Sector

Although the objectives of government R&D agencies (such as the laboratories of the U.S. Department of Energy) and academic research institutions differ in some respects, both place a heavy emphasis on the public benefits to be gained from their research, and both see technology transfer as a means of serving the public. Licensing revenue is important, but it is balanced against serving the public good.

In contrast, corporate research is product-focused and profit-motivated, even in cases where it is directed at solving fundamental scientific problems. Technology transfer is used very

differently by various commercial entities, depending on their business models and corporate philosophies. Most companies use their patent portfolios for defensive purposes (i.e., to build and maintain monopolies for their own proprietary products), and many companies license out their technologies in certain circumstances, as for example to settle an infringement suit or to find a productive outlet for a technology that would otherwise go unexploited. However, it is unusual for a company to build a major component of its business plan around the profits to be obtained from licensing revenues.

Because they are profit-driven, companies must be cost-efficient in their acquisition and maintenance of IP protection. Therefore, some of their best practices can benefit government and academic organizations.

Building a Better Metric

The purpose of performance metrics is to measure how well a given program meets its goals. Without a clear mapping of the metrics to the goals, the metrics activities become measurement for measurement's sake. Therefore, before establishing performance metrics, a TTO must start with a clear understanding of its program's goals. Doing so ensures that the metrics support achieving those goals.

A listing of the tech transfer program's goals, as in Exhibit 1, is a useful starting point. Such goals should be SMART: specific, measureable, attainable, relevant, and time-bound.

Exhibit 1: Sample Technology Transfer Program Goals

Impact	***Humanitarian and Economic Benefits:*** Leverage technology development for humanitarian and economic benefits ***Financial Stewardship:*** Spend donor, grant, taxpayer, or investor dollars responsibly
Strategic Benefit	***Technology Leveraging:*** Leverage technology development throughout the organization to increase return on R&D investments ***Minimize Cost of Innovation:*** Find cost-effective solutions to difficult problems, improve the make-vs.-buy decision process, and reduce the financial burden of innovation ***Enhance Recognition and Prestige:*** Improve rankings and recruit professors or other researchers, leading to more research dollars
Innovation Stewardship	***IP Protection:*** Capture and protect IP innovations ***Innovation Spirit:*** Foster the innovative spirit in order to maximize innovation

Using its own goals, a TTO can identify a list of metrics to determine whether progress is being made toward each goal. At the same time, the TTO should be able to avoid metrics that are irrelevant to its program.

Based on our research, Fuentek recommends that the qualities described below be used when setting performance metrics—regardless of whether the TTO is a government lab, a university, or a for-profit company. As in any analysis and reporting effort, it is important to clearly define all of the parameters and equations used in each metric.

Normalized: To provide an apples-to-apples comparison of the TTO's performance both against itself (in year-over-year analysis) and other organizations, normalize the metrics against appropriate standards. For example:

- Normalize the volume of invention disclosures against research expenditures.
- Normalize cycle-time metrics against labor resources.
- Normalize metrics related to royalties, license volume, product launches, and the like against research expenditures and patent volume.

Appropriately timed: Because of the vagaries of timing in the patent filing and approval process, some metrics may be most useful when examined over a long time, perhaps from program inception or over multi-year period. Regardless, use a consistent and clearly defined time period across related metrics.

Consistent: In order to facilitate trend analysis, use the same metrics from year to year. Granted, metrics may need to be modified from time to time to accommodate new objectives, but they should not be shifting each year. Consistency is critical for measuring year-over-year performance.

Augmented with success stories: As noted earlier, numbers alone will not tell the full story of the program's performance. Therefore, augment quantitative metrics with anecdotes demonstrating advantages of the new products, cost savings, health and/or safety benefits, human impact, economic impact, etc.

Differentiated by audience: Different audiences care about different metrics. For example, measurements that demonstrate progress and excellence to members of Congress and the general public may be insufficient for internal goal setting and progress tracking. Therefore, ensure the list of metrics is sufficiently comprehensive for communicating to the various stakeholders without being onerous.

Captured and reported automatically: Develop and implement a process to consistently capture the data needed to drive the metrics as well as automatic reporting capabilities. Such a process is best when integrated with other databases and/or information management software for tracking progress through the technology transfer pipeline.

Frequently Used Metrics

This section documents Fuentek's findings related to existing metrics systems, based on information in secondary market research reports. Information is grouped by sector: government laboratories, academic institutions, and commercial entities.

Government laboratories

The National Institute of Standards and Technology (NIST) and the U.S. Department of Commerce publish a summary of reports prepared by agencies that have significant federal laboratory operations. The most recent such summary includes information from 11 agencies, which collect the following metrics:[1]

- **Collaborative relationships for R&D executed**, which includes Cooperative Research & Development Agreements (CRADAs) and other collaborative arrangements, such as the Space Act Agreements (SAAs) typically used by NASA
- **Invention disclosures received**
- **Patent applications filed**
- **Patents issued**
- **Licenses**, including active licenses, newly executed licenses, and/or income-bearing licenses
- **Earned royalty income and other royalty statistics**
- **Disposition of royalty income**
- **Licenses terminated for cause**

Several government agencies also tracked other uniquely relevant parameters, and the report included success stories and anecdotes highlighting successful outcomes, illustrating the importance of such "soft" qualitative metrics. NASA also publishes its technology transfer successes in the annual publication *Spinoff*.[2]

Academic institutions

Since 1991, the Association of University Technology Managers® (AUTM®) has published an annual survey documenting results of the implementation of the Government Patent Policy Act of 1980, also known as the Bayh-Dole Act (Public Law 96-517). The most recent edition contains statistics on U.S. research institutions and hospitals for fiscal year 2008:[3]

- **Licensing full-time equivalents (FTEs)**
- **Research expenditures of the institution**, tracked because the number of inventions is expected to be roughly proportional to the number of research dollars spent
- **Licenses and options executed**, broken out by exclusivity and by licensee type/size (startup, small business, large company)
- **Active licenses and options**
- **Startup companies formed**, which is an indicator of economic impact

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[1] *Federal Laboratory Technology Transfer Fiscal Year 2008: Summary Report to the President and the Congress*, prepared by NIST and the U.S. Department of Commerce, March 2010

[2] Visit http://spinoff.nasa.gov for more information.

[3] *AUTM U.S. Licensing Activity Survey: FY2008*, published by the Association of University Technology Managers®, February 2010

- **Invention disclosures received**
- **Invention disclosure disposition** (i.e., how many invention disclosures are dealt with either by licensing or by closure), providing a rough measure of the ability of the TTO to keep up with the stream of disclosures being received
- **Patents issued**
- **Patent applications filed**, including a breakout of provisionals and derivative applications (i.e., divisionals, continuations, continuations-in-part, and foreign equivalents)
- **License income**, broken out by running royalties, cashed-in equity from startups, and other sources (e.g., one-time payments)
- **Products released by licensees**
- **New research funding derived from licenses and options**, which documents an institutional benefit not reflected in license income
- **Legal fees expended and reimbursed**, which indicates the institution's success in managing the cost of its patent portfolio – ***Note:*** One way to gauge overall cost-effectiveness is to seek a positive ratio of income from license fees, royalties, reimbursed legal fees, and license-related research funding to expenditures on legal fees, FTEs, and other office expenses.

Several of the tables in the AUTM report include a column showing whether each institution has a medical school. This information improves the relevance of comparisons between institutions, as those with medical schools are likely to have substantially higher licensing royalties than other institutions.

It should be noted that AUTM collects yearly data by sending each member institution a comprehensive questionnaire that includes a concise definition of every metric used in the survey. This attention to detail helps to ensure accurate and consistent comparisons across institutions and over time. Furthermore, the number of metrics tracked by AUTM indicates the complexity of the problem of measuring technology transfer effectiveness.

As discussed elsewhere in this paper, numbers alone do not tell the whole story. For this reason, the AUTM survey includes a section entitled "Technology Transfer Success Stories" in which respondents highlight specific technologies that represent apparent breakthroughs in their areas. In order to more fully describe the benefits of technology transfer, AUTM publishes an annual *Better World Report* with an extensive list of success stories relating to a particular focus area, which changes each year.[4]

Commercial entities

Unlike government and academic institutions, where new discoveries may be unexpected by-products of basic research and where public benefits may be at least as important to the

[4] Visit http://www.betterworldproject.net/reports.cfm for more information.

mission of the organization as profits, companies are in the business of making money for their owners or shareholders. Therefore, their patent strategies usually are built primarily around the need to protect their products against competition. Other than a few exceptions, such as IBM®, which is known for its aggressive licensing program, and 3M, whose corporate culture encourages employees to initiate entrepreneurial new ventures, companies typically do not file patent applications far outside their own relatively well defined fields of interest.

Corporate technology transfer metrics have been the subject of some recent publications, and some of the conclusions may be helpful for government labs and universities as well.

For example, an article based on interviews with experts at Booz Allen, Boston Consulting Group (BCG), Jump Associates, and Kaiser Associates found that "measuring the innovation process" can be confusing:[5]

- "The common mistakes are putting in too many metrics, measuring the wrong things, misaligning metrics within organizations, and counting what can be counted, not what counts."
- "Looking solely at the number of ideas in a pipeline without measuring successful outcomes in terms of revenue and margins won't help."
- "It doesn't do much good to measure spending levels if you don't ultimately track them against final outcomes. It's the organic growth and profit margins that count in the end."
- "Companies should look carefully at the screening mechanism they have for sifting the gold from the thousands of suggestions they may get."
- "Speed is everything. In a recent BCG survey of 269 companies, time to market was the [metric] that [innovation] companies reported to be most valuable."

A 2009 article by the global management consulting firm McKinsey & Company suggests that typical innovation metrics based on inputs (e.g., R&D spending) or outputs (e.g., number of patent applications filed) are too narrow to provide useful comparisons of innovation potential. Instead, the company reported that it is developing a new metrics model based on its own proprietary "granularity of growth" database. By applying its method, McKinsey generates "an innovation performance score (IPS), expressed as a percentage, that shows the compound annual growth rate of a company for a specified period that can be attributed to innovation." The method is still being studied, but early observations suggest:[6]

- "IPS is strongly correlated with overall company performance."
- "Strong innovators achieve their success in large part by outperforming markets they are already in rather than by entering or creating new segments."
- "A significant degree of business model innovation seems to be necessary for superior innovation impact."

[5] J. Hempel, "Metrics Madness," *Business Week*, September 25, 2006

[6] J-O. Berwig et al., "Innovation: What's Your Score?" published as a What Matters online essay, September 4, 2009

- "There may be an optimum level of innovation…. Players that have the very highest IPS aren't always rewarded proportionally in terms of higher TRS [total return to shareholders]."

Recommendations for a Cross-Functional System of Metrics

Recommended metrics

Based on the market research gathered and our knowledge of technology transfer programs and goals at numerous government and academic institutions, Fuentek has developed an exhaustive list of possible metrics, each of which supports one or more of the program goals. Presented in Exhibit 2, this list provides a "toolbox" from which a TTO can select those metrics that are most appropriate to its technology transfer program. Priority might be given to areas that have been highly successful (and thus enable the TTO to quantify its success) and/or to areas that need improvement (allowing the TTO to more closely monitor its progress).

Exhibit 2: Recommended Metrics "Toolbox" for TTOs

Metric (Normalizing)	Measures/Demonstrates
Invention disclosure activity	
# of disclosures (per $10M R&D)	Innovation volume Reporting compliance
# of first-time submitters (per $10M R&D)	Effectiveness of outreach
Time to arrive at (per licensing FTE): Strategy decision Inventor notification of disposition Agreement execution	Process efficiency
Patent activity	
# of non-provisional applications filed (per disclosure)	Innovation volume
# of non-provisional patents issued (as a ratio of disclosures)	Innovation quality
# of patent applications rejected	Caliber of patent applications Financial stewardship
Expenditure on legal support for patenting process (per issued patent)	Return on investment
Patent filing fees (per issued patent)	Return on investment
Patent maintenance fees (per issued patent)	Return on investment Patent burden

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Exhibit 2: Recommended Metrics "Toolbox" for TTOs *(continued)*

Metric (Normalizing)	Measures/Demonstrates
Licensing activity*	
# of licenses (per patent)**	Patent application quality
% of licenses to small, medium, large business	Small business economic impact Balance of economic activity
% of continuing active licenses	Technology longevity
% of terminated licenses	Technology longevity
Total royalty $ (per $10M R&D)	Market value of technology portfolio
Median royalty $ (per license)	Return on investment
Product data (per license and/or per R&D $): Sales of license-related products/services # of products currently on the market # of new product launches # of new startup companies	Economic impact Humanitarian impact Technology longevity
Collaborative R&D activity†	
# of non-disclosure agreements (NDAs) signed	Frequency of information exchanges
# of new agreements executed	Partnering capabilities Perceived expertise
# of active agreements	Partnering longevity and sustainability
Median duration of active agreements	Partnering longevity and sustainability
# and extent of technology advances (e.g., technology readiness level [TRL])	Quality of collaboration
$ generated from and/or in-kind value of agreements (per agreement and/or R&D $)	Value of partnering Reduced financial burden of technology development by cost sharing
Outreach	
# of press releases related to tech transfer	Communication of organization's value to society
# of public outreach events supported	Communication of organization's value to society
# of external presentations given	Communication of organization's value to society
# of internal presentations given	Communication of tech transfer's value to organization
# of website hits	Public attention Effectiveness of website expenditures

* Consider tracking software usage agreements separately.

** The goal should be for the number of licenses to equal or exceed the number of patents.

† Consider tracking collaborations intended to lead to licensing/spin-out separately from collaborations intended to address internal needs/spin-in.

Recommended reporting of metrics

When reporting the metrics, Fuentek recommends a user-friendly, balanced scorecard format that shows the metric, the currently reported value, the benchmark (target), a visual indicator of whether the metric is on target or not, and a visual indicator of how the metric is trending: up, down, or flat. This sample format shown in Exhibit 3 provides an excellent example.

Exhibit 3: Sample Format for Reporting Metrics

Fiscal Year 2010

Technology Transfer Scorecard

#	Perspective/Metric	Results	Goal	On Target	Trend
	Impact				
1	Metric 1	17	24	☹	↓
2	Metric 2	37	36	☺	→
3	Metric 3	5	12	☹	↓
4	Metric 4	3	2	☺	↑
5	Metric 5	4	6	😐	→
	Strategic Benefit				
6	Metric 6	$5,985	$6,000	😐	↑
7	Metric 7	162	150	☺	→
8	Metric 8	18	25	☹	→
9	Metric 9	27	35	😐	→
10	Metric 10	$525,000	$500,000	☺	↑
	Innovation Stewardship				
11	Metric 11	92	100	😐	↑
12	Metric 12	3	4	😐	→
13	Metric 13	91	125	😐	→
14	Metric 14	3.38	3.50	😐	↑
15	Metric 15	8.82	3.75	☺	↑
16	Metric 16	15	12	☺	↑
17	Metric 17	110	75	☹	↓
18	Metric 18	512	365	☹	↓
19	Metric 19	$836	$875	☺	→
20	Metric 20	$1,898	$2,000	☺	→
21	Metric 21	$376	$500	☹	→
22	Metric 22	$2,500	$2,000	☺	↑
23	Metric 23	$24	$25	😐	↑

Going Forward with a New Metrics System

Once a TTO is ready to undertake a more sophisticated and more useful approach to metrics, Fuentek recommends the following steps:

- Interview key technology transfer players to discuss achievable benchmarks for key metrics and obtain insights into the implementation process.
- Define the specific list of metrics.
- Define and document the terms used in each metric.
- Normalize each metric against an appropriate standard (e.g., disclosures per $10M in research expenditures).
- Collect historical data for the established metrics to aid in establishing a baseline or benchmark for each metric.
- Establish a reporting frequency, which may vary by metric according to its volatility.
- Identify the data source(s) for each metric and a process for capturing the necessary data and reporting it.
- Develop a plan for rolling out the metrics program, including streamlined data collection; user-friendly, automated reporting; and internal training and communications.

By implementing a sound metrics system based on best practices, TTOs can know where they have been and where they are going.

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