NIST Technology Transfer Brief 2

Filing Rate and Transfer Rate at NIST: An examination of invention disclosures, patent applications, and invention licenses

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Abstract

In this work, we apply new technology-transfer measures—filing rate (i.e., proportion of invention disclosures that result in a patent application) and transfer rate (i.e., proportion of patent applications that result in an invention license)—proposed in the academic literature on technology transfer, to data on invention disclosures, patents, and invention licenses from the National Institute of Standards and Technology (NIST). We calculate these measures for NIST and compare these calculated values of these measures reported for the Naval Medical Research and Development Enterprise (NMR&D) and for universities. For fiscal years 2010 through 2014, NIST had a filing rate of 67 % and a transfer rate of 15.3 % on reported inventions. During that same time period, NMR&D had an 84.5 % filing rate and 9.4 % transfer rate. Compared to the university mean filing rate of 60 % and transfer rate of 42 %, NIST and NMR&D invention disclosures appear to be prosecuted for patenting at a higher rate and result in licensing at a lower rate. We caveat analysis of these measures by noting that these values are influenced by many factors unobserved in this work, including the nature of research conducted, the organization's mission, and the organization's policies towards intellectual property.

Key words

Filing rate; licensing rate; invention disclosure; license; patent; technology transfer; ORTA; federal laboratory

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1. INTRODUCTION

The modernization of the measurement of federal technology transfer was a stated objective of previous Presidential administrations [1-2]. Their objective is echoed by NIST's Return on Investment Initiative's Green Paper [3], which found improving understanding of science and technology trends, through improved metrics, as one of its cross-agency priority goal strategies. The Green Paper stated "metrics can be an important source of information used by organizations" to better understand their operations. In this report, we further those objectives and build upon previous analysis by applying newly proposed measures of technology transfer to data on the National Institute of Standards and Technology's (NIST) technology transfer activities.

NIST, under statutory requirements [4], reports an array of measures of federal technology transfer activities in an annual report of federal laboratory technology transfer activities. The most recently published report at the time of this writing is the *Summary Report on Federal Laboratory Technology Transfer – Fiscal Year 2016* [5]. The reported measures include, among others, the number of invention disclosures, the number of patents, and the number of invention licenses. While these measures provide valuable information on technology transfer activity of federal agencies, there are limitations to the insight those measures provide. This work is a step towards addressing that limitation.

Researchers contributing to the broader technology transfer literature have proposed several measures of technology transfer activities. Choudhry and Ponzio [6], two researchers affiliated with the Naval Medical Research and Development Enterprise (NMR&D), proposed the application of more advanced measures of federal technology transfer activities, which they suggest may prove useful for assessing the resource usage at federal ORTAs.[1] This work applies two of those measures, filing rate—the proportion of invention disclosures that are prosecuted for patenting—and transfer rate—the proportion of patent applications filed that result in invention licenses—to data on NIST invention disclosures, patent applications, and invention licenses.

One benefit of measuring filing rate and transfer rate in comparison to the currently reported measures is that these newly proposed measures provide relative measures that are unrelated to the size of the federal laboratory or agency in question. Researchers, including Link, Morris, and van Hasselt [8], have found that inputs such as expenditures and labor are positively correlated with innovation outputs. This means that one may expect federal laboratories with more resources to have more innovation outputs. Using ratio measures, such as filing rate and transfer rate, one can more clearly understand the

[1] ORTAs operate under various names, such as Technology Transfer Offices (TTOs) or Offices of Technology Transactions (OTTs). For consistency, this work refers to any group within an organization whose primary tole is the external transfer of technology as an ORTA. A broader discussion of these is in Link and Oliver [7].

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similarities and differences between federal laboratories and agencies that have significantly different resources.

We caution that readers should interpret the measures calculated in this work with the understanding that many unobservable factors may influence their calculated values. As discussed by Gingrich et al. [9], ORTAs at federal laboratories and agencies vary greatly in their organizational and operational characteristics. Further, federal laboratories and agencies vary greatly on their mission, their fields of research, and the technology readiness levels of their research outputs. These factors may influence the invention disclosures, patent applications, invention licenses, and the measures of filing rate and transfer rate that we report in this work.

With the stated caution in mind, this report is descriptive in nature and does not provide insight into these factors or other reasons why the measures calculated herein may vary across organizations. Additional research on this topic is necessary to provide information to understand the relationship of the filing rate and transfer rate, the function of ORTAs, the research characteristics of federal laboratories and agencies, and downstream outcomes such as licensing revenues and commercialized products. Further, research on the appropriate interpretation of filing rate and transfer rate is necessary to understand if they do indeed assess the resource usage of ORTAs as proposed by Choudhry and Ponzio [6].

The remainder of this report is structured as follows. Section 2 defines the proposed measures of technology transfer and presents some of their limitations and features. Section 3 describes the data used in the analysis. Section 4 shows the results of applying the measures to the data and offers some limited interpretation. Section 5 concludes the work with an overview of the results and suggestions for future research.

2. MEASURES

Choudhry and Ponzio [6] review the literature on measuring technology transfer and the operations of ORTAs. They note that many measures proposed in the literature are difficult to calculate for federal laboratories and agencies due to the limited technology transfer data available. From the available literature, they identify "licensing success rate" (LSR) from Stevens and Kosuke [10] as a tractable "metric to assess technology transfer operations." They state that LSR, or a permutation thereof, is a good choice to "evaluate and analyze the activities of federal laboratories," because it "aligns well with both congressional and executive guidance."

Stevens and Kosuke [10] define the LSR as:

$$Licensing\ Success\ Rate = \frac{\#\ of\ New\ Invention\ Licenses}{\#\ of\ New\ Invention\ Disclosures} \quad (1)$$

Explicitly, LSR measures the ratio of invention licenses to invention disclosures at an organization. Stevens and Kosuke [10] suggest that LSR is "one of the fundamental

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measures of efficiency and effectiveness of [an ORTA]." However, they continue by stating other factors such as the organizational and operational characteristics of the ORTA and the technology readiness level of the inventions may influence the LSR.

Choudhry and Ponzio [6] propose two measures, based on the LSR, that may be applied to federal ORTAs' data: filing rate and transfer rate. These measures are defined as:

$$Filing\ Rate = \frac{\#\ of\ New\ Patent\ Applications}{\#\ of\ New\ Invention\ Disclosures} \tag{2}$$

$$Transfer\ Rate = \frac{\#\ of\ New\ Invention\ Licenses}{\#\ of\ New\ Patent\ Applications} \tag{3}$$

Filing rate (2) is the ratio of new patent applications relative to new invention disclosures for a given time period. This means that the rate is the proportion of invention disclosures that the federal laboratory or agency chooses to prosecute for patenting. Choudhry and Ponzio [6] state that the filing rate "provides insight into how discriminate an agency is and whether or not invention disclosures are judiciously evaluated prior to filing a patent application." This interpretation may be incomplete as factors external to the ORTA may influence the decision to file patent applications such as laboratory or agency policies.

Transfer rate (3) is the proportion of new invention licenses relative to new patent applications. This means that the rate is proportion of patent applications that result in an invention license. Choudhry and Ponzio [6] suggest that transfer rate may provide information on the commercial applicability of the technologies that ORTAs choose to patent. Again, this interpretation may be incomplete as factors external to the ORTA may influence the decision to file patents or issue licenses of patented technologies.

Combined, these measures may directly provide information on the proportion of invention disclosures prosecuted as patents and the portion of patent applications that result in licenses. As stated, one feature of using these metrics over traditional activity metrics (e.g., number of new patent applications) is that they are not directly influenced by the size of an organization (i.e., we would expect that larger organizations would have higher levels of technology transfer activities ceteris paribus) and therefore may provide previously unavailable information on the operations of ORTAs relative to each other.

Despite the potential benefits of using filing rates and transfer rates as measures of ORTA efficiency, it is important to reiterate some limitations in its interpretation. Choudhry and Ponzio state that Stevens and Kosuke [10] "observe that in general, academic universities engaged in fundamental research have significantly lower than average" transfer rates. This is likely to hold true for federal agencies as well—that is, factors such as the nature of the research, mission of the laboratory or agency, and organizational characteristics may influence the observed filing rate and transfer rate.

3. Data

The calculation of filing rate and transfer rate requires information on invention disclosures, patent applications, and invention licenses. We conduct these calculations for invention disclosures at NIST. For each invention disclosure, the analysis needs information on their year of submission, whether they resulted in a patent application, whether they resulted in an issued patent, and whether they resulted in a license. For this work, we obtain these data for NIST invention disclosures filed in fiscal years 2010 through 2014.

From NIST's records, we obtain the necessary information on individual invention disclosures. For each individual invention disclosure, we identify the fiscal year it was submitted to NIST, whether an associated provisional patent application was filed, whether an associated non-provisional patent application was filed, whether that patent application resulted in an issued patent, and whether the invention disclosure resulted in an invention license.

This work differs from other, previously published works in how it views the year of patent applications, patent issuances, and invention licenses. Previously published data on this information reported invention licenses in the year of the license and did not consider the year the invention was disclosed [11]. That is, an invention license issued would be reported for the year that agreement was signed and not the year the invention was disclosed. In this work, we take an alternative approach and track individual invention disclosures, provisional and non-provisional patent applications, patents issued, and invention licenses based on the year of the disclosure.

Stevens and Kosuke [10] discuss timing considerations when studying LSR for university ORTAs. They note that only a small fraction of inventions are licensed in the year that they are disclosed and that only half of invention licenses occur within four years from disclosure. This means that calculating LSR, filing rate, or transfer rate with annually aggregated data—common practice in the literature due to data limitations—results in incorrect measures. As previously stated, we avoid this problem by tracking individual invention disclosures; however, our abbreviated time frame potentially underestimates licensing activity.

One feature of this data is that we report patent applications and invention licenses resulting from an invention disclosure for the year of the invention disclosure and not the year in which the application or license occurred. This directly links observations and accounts for a latency problem that is not controlled for in some other studies on invention disclosures, patent applications, patent issuances, and invention licenses. This latency problem occurs when data on invention disclosures, patent applications, and invention licenses are aggregated by year. It is not necessarily the case that each event that occurs each year is the result of an invention disclosure from that year and calculating LSR, filing rate, and transfer rate with yearly data may miscalculate these measures. Our data addresses this problem by observing invention disclosure individually.

4. Application

The analysis below shows the calculated filing rate and transfer rate for NIST invention disclosures submitted during the period of fiscal year 2010 to fiscal year 2014. As described in the previous section, this work calculates these measures for each fiscal year by tracking the individual invention disclosures from the stages of disclosure, patent application, and invention licensing. For comparison, we show the reported filing rate and transfer rate of NMR&D and university ORTAs as reported by Choudhry and Ponzio [6].

Table 1 shows the data on invention disclosures, patent applications, patents issued, licenses, filing rate and transfer rate from the NIST patent portfolio database. The first column indicates the fiscal year the invention disclosures were reported. The second column lists the number of invention disclosures. The third column lists the number of provisional patent applications. The fourth column lists the number of "full patent applications," which includes all non-provisional, divisional, continuation, and continuation in part applications. The fifth column lists the number of patents issued. The sixth column lists the number of invention licenses. The seventh column lists the calculated filing rate. The eighth column lists the calculated transfer rate.

Table 1. *NIST Invention Disclosures, Filing Rate, and Transfer Rate from FY2010 to FY2014.*

Fiscal Year	Invention Disclosures	Provisional Applications	Non-Provisional Applications	Patents Issued	Licenses	Filing Rate	Transfer Rate[a]
2010	30	12	13	9	2	43.3 %	15.4 %
2011	30	24	24	19	3	80.0 %	12.5 %
2012	59	43	35	26	7	59.3 %	16.3 %
2013	33	22	18	13	4	54.5 %	18.2 %
2014	42	29	30	25	3	71.4 %	10.0 %
Total	194	130	120	92	19	67 %	15.3 %

[a] Not all applications were filed with a provisional application prior to their full application. As such, Transfer Rate is calculated using the larger value of provisional and full patent applications.

For the time period in consideration, NIST had 194 invention disclosures, of which 67 % were prosecuted via either a provisional or non-provisional patent application. From these, 92 patents were issued, and 19 received invention licenses. NIST's annual filing rate for this time period ranged from 43.3 % to 80.0 %, with an overall rate of 67 %.[2]

[2] This work calculates the overall rates using the total number of invention disclosures, patent applications, and licenses for the time period in lieu of averaging across the rates for each year. This is done to account for the differences in the number of invention disclosures from year to year and avoid over-weighting years with fewer invention disclosures.

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NIST's annual transfer rate for this time period ranged from 10.0 % to 18.2 %, with an overall rate of 15.3 %.

Choudhry and Ponzio [6] use NRM&D patent portfolio data to construct Table 2, reproduced here for comparison to NIST data. For the period in consideration, NMR&D's annual filing rate ranged from 71.4 % to 87.5 % with an overall rate of 84.5 %. NMR&D's annual transfer rate for this time period ranged from 0 % to 20 % with an overall rate of 9.4 %.

Table 2. *NMR&D Invention Disclosures, Filing Rate, and Transfer Rate from FY2010 to FY2014, reproduced for comparison.*

Fiscal Year	Invention Disclosures	Provisional Applications	Non-Provisional Applications	Patents Issued	Licenses	Filing Rate	Transfer Rate[a]
2010	17	15	10	5	1	88.2 %	6.7 %
2011	18	15	16	3	1	83.3 %	6.7 %
2012	7	5	3	1	1	71.4 %	20 %
2013	16	14	11	3	0	87.5 %	0 %
2014	[a]	15	6	-	3	[a]	20 %
Total[a]	58[a]	64	46	12	6	84.5 %[a]	9.4 %

[a] Invention disclosures were not listed for FY2014, the totals for these columns are calculated using data from FY10-FY13.

The data in tables 1 and 2 illustrate the potential benefit of applying filing rate and transfer rate to data from federal laboratories and agencies. That is, currently reported measures of federal technology transfer activities report the level of activity, but do not provide information that allows one to place these measures in context. Filing rate and transfer rate provide additional context and information about the technology transfer outputs and, with additional research, may provide insight into the resource usage of ORTAs.

From table 1 we can observe that NIST recorded 19 inventions licensed from inventions disclosed in FY2010 to FY2014. From table 2 one can see that NMR&D reported 6 invention licenses from inventions disclosed in FY2010 to FY2014. These values are analogous to measures of licensing reported in by NIST in the annual federal technology transfer report [5]. One can observe that NIST reported more than three times the number of invention licenses as NMR&D during this time period. However, this comparison lacks context on factors such as the inputs to R&D at these laboratories, which has been shown to be correlated with innovation outcomes [7].

An application of filing rate and transfer rate to these data provides information that is more comparable between these two entities. From tables 1 and 2, one can observe that over the entire FY2010 to FY2014 time period, NMR&D had a higher filing rate than NIST—84.5 % compared to 67 %. Conversely, over this time period NMR&D had a lower transfer rate than NIST—9.4 % compared to 15.3 %.

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To facilitate external comparison, Choudhry and Ponzio [6] suggest using the average filing rate and transfer rate of universities as a benchmark. An important caveat with comparisons between organizational types (e.g., federal laboratories, university TTOs, industry) is that these organizations operate under very different mechanisms with very different guiding principles and limitations. The general assumption is that universities and industries are seeking to maximize licensing profits for their organization while federal laboratories emphasize other factors when licensing their inventions.

With those caveats in mind, Choudhry and Ponzio [6] calculate the filing rate and transfer rate for universities using data from the AUTM [12] database. They report that for university ORTAs[3], the average filing rate is 60 % and the average transfer rate is 42 %. These values were calculated using annualized data on invention disclosures, patent applications, and invention licenses. As these were aggregated annual data, it is possible that an invention may be licensed multiple times and upwardly bias the calculated transfer rate for universities.

Both NIST and NMR&D had filing rates greater than the university ORTA average of 60 % and transfer ratios below the university ORTA average of 42 %. Choudhry and Ponzio [6] suggested that this would imply that the ORTAs in NIST and NMR&D are less judicious with their resources than the ORTAs in universities in the AUTM database. Their suggested interpretation implies that universities are more judicious in their resource usage. We propose an alternative interpretation, this difference may be explained by differences in objectives for ORTAs in universities—generally, the maximization of profits for the university—relative to those in federal laboratories and agencies—generally, the maximization of technology transfer for public use. These alternative objectives may drive the differences we observe in filing rate and transfer rate at universities and federal laboratories and agencies.

5. Conclusions

This work applies technology transfer measures that had previously been proposed in the literature to data on invention disclosures, patents, and licenses at NIST. This application furthers the modernization of the measurement of federal technology transfer, a stated objective of previous Presidential administrations [1-2] and NIST's Return on Investment Initiative's Green Paper [3].

We find that for the period of fiscal years 2010 through 2014, NIST had a filing rate of 67% and a transfer rate of 15.3%. For comparison, Choudhry and Ponzio [6] found that NMR&D had a filing rate of 84.5% and a transfer rate of 9.4%. They also found that university ORTAs averaged a filing rate of 60% and a transfer rate of 42%. A simple examination of these values show that NMR&D and NIST file patent applications at a

[3] The term ORTA is used exclusively by the federal government. For consistency, this work maintains the use of ORTA as described in foot note 1.

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higher rate than university ORTAs and convert inventions for which they have filed patent applications to invention licenses at a lower rate.

While these comparisons provide a useful frame of reference, a naïve comparison ignores the differences in mission, research focus, and other factors that might influence these measures for an ORTA. As previously noted, researchers have observed differences in these measures that may be related to organizational characteristics such as the type of research conducted, the organization's mission, and the organizational policy towards intellectual property. These differences likely hold true for federal agencies as well—for example, agencies whose mission-focused research is more applied may have higher transfer rates as disclosed inventions have higher technology readiness levels.

We offer some suggestions on how future researchers may expand upon this study. Researchers may consider exploring the determinants of filing rate and transfer rate. This exploration may include studying the relationship between these measures and laboratory and agency mission, the stage of research, ORTA organizational and operational characteristics, and other factors. Additionally, researchers may consider exploring the relationship between filing rate, transfer rate, and down-stream effects such as licensing revenues or patent citations. Information on these relationships may provide information on the interpretation of filing rate and transfer rate as measures of the level of discernment by an ORTA as suggested by Choudhry and Ponzio [6].

We conclude by noting that in NIST's Return on Investment Initiative [3] they state, "metrics should not become the goal itself, but, rather, used to understand aspects of a system." This study provides information on the activities of ORTAs at federal laboratories and agencies. However, there are important caveats about what we can learn from this information and its interpretations. This information is a part of a larger picture that is best understood in the specific context of the federal laboratory and agency.

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