

Inside the Black Box: Assessing TTO Performance

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ABSTRACT

This article uses an original three-phase approach for empirical assessment and comparative evaluation of the efficiency of university technology transfer. It is based on analysis of inputs and outputs of a disclosure phase followed by a value-add phase and a final license phase, using a multidimensional framework. The objective is to find university Technology Transfer Office (TTO) efficiency and effectiveness patterns for each phase as well as overall TT processes. A network Data Envelopment Analysis (DEA) model was used to analyze and describe the complicated TT operational processes using Association of University Technology Managers data collected from 90 US university TTOs for the period 2007-2013. It was concluded that the sampled TTOs were most inefficient in their value-add (2nd) phase and that the average overall efficiency as well as the efficiency of disclosure (1st) and license (3rd) phases decreased during the last five years of data analyzed. In addition, in line with other studies, analysis supports the contention that the presence of medical school does not increase TT efficiency or effectiveness. The present research's contributions focus on three areas: (1) Analysing and modelling TTO valorization and commercialization process with a UML activity diagram to provide a clear picture of TT procedures and processes; (2) Proposing a three-phase DEA framework showing input/output indicators closely related to each phase of processes rather than a black box or separated activities; (3) Offering a strategy to conduct empirical studies on TTO's operational efficiency thereby helping to better understand future research operational problems.

KEYWORDS

Data Envelopment Analysis (DEA), Technology Transfer, Technology Transfer Office, Technology Valorization

INTRODUCTION

According to AUTM (2005) the central mission of a university Technology Transfer Office (TTO) is to manage and operate TT activities. Accordingly, it is important to know how efficiently and effectively a TTO conducts its operations. Some TTO activities are quantifiable and can be identified and measured at least to some degree of clarity such as number of start-up firms established, number of industry relationships formed, number of patent applications filed, and licensing income (Arundel & Bordoy 2007). However, in reality such metrics may not accurately measure TTO performance. For example, concerning licensing income "top performers" commonly reflect the outcomes of one or two blockbuster IP assets rather than overall consistent TTO performance or efficiency (Thomas 2007). Additionally, many TTO tasks based on interpersonal contacts and such tacit knowledge

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exchange activities are difficult to observe and measure. Other tasks such as developing strategies and processes for transferring technology are difficult to assess at any one point in time as they require longitudinal analyses. Clearly such issues make it difficult to effectively evaluate TTO performance. To address these considerable and complex challenges we propose the multidimensional input-output framework of Data Envelopment Analysis (DEA) as a quantitative approach to assess efficiency and effectiveness dimensions in terms of TTO inputs and outputs (Resende, Gibson, & Jarrett, 2013). The objectives are to use DEA analyses to:

- Determine the overall relative efficiency of TTOs as well as the efficiency of critical processes in each of three phases,
- Identify critical characteristics of TTOs efficiency and effectiveness based on the literature and experts in order to measure key variables as they influence TTO's efficiency in each of three phases of the valorization and commercialization process, and
- Open the "black box" of TTO operations by better defining three sub phases showing input and output variables and metrics for each phase while highlighting their relationships.

This paper is organized as follows: identifying and describing TTO's main processes in each of three phases; Overview of our research methodology; Data analyses; and Presenting empirical results followed by conclusions and policy implications.

DESCRIBING TTO'S MAIN PROCESS

Some researchers consider TTOs' operational process as a single phase (Anderson, Daim & Lavoire, 2007; Chapple, Lockett, Siegel, & Wright, 2005; Thursby & Kemp 2002). In such studies, the input-to-output process of TTOs is seen as a "black box" with little consideration of the intervening steps with select inputs and outputs to different phases of technology transfer processes. Such an approach provides little insight regarding determining sources of inefficiency (Lewis & Sexton 2004) and also provides limited process-specific guidance to help improve the effectiveness of TTO operations. Additionally, if sub-phases of TT processes are identified and evaluated, the separate phases approach does not account for the continuity of links between adjacent phases (Tone & Tsutsui 2009).

Siegel, Waldman, Atwater, & Link, (2004) built a list of the most common output indicators for university/industry technology transfer from the point of view of three groups of actors: scientists, TT Officers, and entrepreneurs/managers. The most frequently mentioned outputs by TT Officers were licenses 86.7%, royalties 66.7%, patents 46.7%, Sponsored Research Agreements (SRAs) 46.7%, startups 33.3% and disclosures 33.3%. While we used these outputs in our DEA model, we also include input and output indicators based on the variables used by AUTM's survey of TTOs. Table 1 (all tables are in the Appendix) provides an overview of TTO efficiency indicators used or cited in the literature and which we also use in our DEA analysis. The table also indicates in which sub-phase these indicators are applied.

Figure 1 (all figures are in the Appendix) depicts a generic TTO activity diagram describing key procedures and processes to commercialize knowledge/technology from research to return on investment. This diagram is the model to the Three-Phase Network DEA Inputs and Outputs Framework for TTO's generic technology commercialization main process (Figure 2). Each phase has a set of indicators based on AUTM (Association of University Technology Managers) and ASTP (Association of European Science and Technology Transfer Professionals) research reports, which are used to evaluate TTO's performance in a three-phase analysis in which key outputs of the previous phase are inputs for the following phase.

Empirical studies generally use two methods of frontier analysis: Stochastic Frontier Analysis/ Estimation (SFA or SFE) and DEA. Using the Network DEA methodology, we can assess each

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