



A COCHRANE METHOD SYSTEMATIC REVIEW OF UNIVERSITY TECH COMMERCIALIZATION RESEARCH

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BACKGROUND MOTIVATION FOR THIS STUDY

- Former USPTO patent examiner
- Registered Patent attorney
- JD Atlanta's John Marshall Law School
- LLM, Master of Laws in Intellectual Property Law, University of Illinois at Urbana Champaign
- MBA
- PhD in Industrial & Systems Engineering with an Engineering Management concentration
 - University of TN Knoxville
- I've counseled small businesses in government contracting
- I've taught business law and ethics for 10 years
- I've served as a university/ federal lab technology transfer specialist

BAYH DOLE ACT 1980

- Allows American universities to own and commercialize inventions made by their faculty and students using federal government resources
- This commercialization process is called “technology transfer” or “**technology management**”
 - Thus, it is very relevant to engineering management
- Faculty created inventions get patented and the patents get licensed to companies that seek to develop and sell products based on the patented technology

UNIVERSITY TECHNOLOGY TRANSFER PROBLEMS

- Some universities are good at technology commercialization and some are not
- So, over the past 30 years, numerous fragmented university tech transfer studies have been conducted
- Many studies have been published in the Journal of Technology Transfer which was founded in 1978
- There's no agreed upon common theory
- There are differences in findings that conflict

SUGGESTED THEORETICAL FRAMEWORK

- Since there's no agreed upon common theory to explain the university technology transfer performance phenomenon, the Burning Question is:
 - How should we approach the study of what drives university technology transfer performance successes and failures?
- The combination of two existing theories was used:
 - **The Resource Based View** (Barney, 1991)
 - **Theory of environmental munificence** (Castrogiovanni, 1991, 2002)

SUGGESTED THEORETICAL FRAMEWORK

- **The Resource Based View** (Barney, 1991)
 - The view that when resources are hard to imitate, and are valuable and rare, such as patented inventions, then they provide an organization with a competitive advantage
- **Theory of environmental munificence** (Castrogiovanni, 1991, 2002)
 - The view that the environment external to an organization is an important source of resources, and when environments are more munificent, it makes it easier for an organization to survive and prosper

RESOURCE BASED VIEW/ ENVIRONMENTAL MUNIFICENCE CONSTRUCTS

- Study the INPUT resources related to university technology transfer performance
 - **Human resources**
 - TTO staff size, age, legal expenditures
 - **Organizational resources**
 - Invention disclosures, patent applications filed, patents owned
 - **Physical resources**
 - Presence of an incubator and/or medical school
 - **External environmental resources**
 - Regional GDP, Regional R&D intensity, total research funding, industry funding

RESOURCE BASED VIEW CONSTRUCTS

- Study the university technology transfer **performance OUTPUTs**
 - Overall Performance
 - Licenses
 - Licenses Executed, licensing revenues
 - Startup business formations

COCHRANE METHOD SYSTEMATIC REVIEW

- Again, there have been numerous studies related to all of these inputs and outputs over 30 years
- The goal is the systematically review the existing studies and decide what over-arching meaning can be gleaned
- The Cochrane Method of Systematic Reviews is commonly used to make sense of conflicting medical clinical trial research
- **Step 1**: Develop a protocol
 - How to search for data sources?
 - Define inclusion and exclusion criteria based on key words

COCHRANE METHOD SYSTEMATIC REVIEW

Cochrane PICO strategy

Break the research question down into concepts including:

- **P**opulation
- **I**nterventions, medical
- **C**omparisons
- **O**utcomes, research

Modified strategy called PRO

Break the research question down into concepts including:

- **P**opulation (TTO staffing population)
- **R**esources (inputs)
- **O**utcomes, research (outputs)

COCHRANE METHOD SYSTEMATIC REVIEWS

- **Step 2:** Need well formulated research questions (and accompanying hypotheses):
 1. Are **human resources** positively related to TTO performance in the areas of patenting, licensing, and generating startups?
 2. Are **organizational resources** positively related to TTO performance in the areas of patenting, licensing and generating startups?
 3. Are **physical resources** positively related to TTO performance in the areas of patenting, licensing, and generating startups?
 4. Are external **environmental resources** positively related to TTO performance in the areas of patenting, licensing, and generating startups?

COCHRANE METHOD SYSTEMATIC REVIEWS

- **Step 3:** Translated the research questions into Boolean format for the systematic review search strategy to find data sources
- List population, resource and outcome concepts
 - List the essential Few
 - The goal is to obtain a manageable set of results
 - But be thorough
- (Population OR synonym1 OR synonym2) AND (Resource OR synonym1 OR synonym2) AND (Outcome OR synonym1 OR synonym2)

COCHRANE METHOD SYSTEMATIC REVIEWS

- **Step 4:** Establish inclusion and exclusion criteria
 - The **meta analysis** is a technique which may or may not be done in systematic reviews
 - A meta analysis was conducted to get a **weighted average effect size of relationships** between constructs
 - Thus to be included in the meta-analysis, each study had to contain a **correlation** among the resource inputs and outputs selected for this study

COCHRANE METHOD SYSTEMATIC REVIEWS

- **Step 5:** Systematically go through all reputable data sources seeking studies that meet the inclusion criteria
 - Cochrane method requires completing the **PRISMA information flow chart**
 - A secondary reviewer was also used to verify results
 - This research began with 10,105 records and 18 studies were selected that met the search criteria Systematic process of elimination
 - The data collection began in 2014

COCHRANE METHOD SYSTEMATIC REVIEWS

- **Step 6:** Use software to run the meta analysis
 - CMA, Comprehensive Meta Analysis software was used (Borenstein, 2005)
 - Study effect sizes of weighted average correlations, r
 - Look for strong effect sizes for inputs to outputs; i.e. $r > 0.5$
 - Human resources to startup formed, licensing activities, overall performance
 - Organizational resources to “ “ “
 - Physical resources to “ “ “
 - External environmental resources to “ “ “

COCHRANE METHOD SYSTEMATIC REVIEWS

- Strong Effects were found among the following relationships:
 - Human resources to startup formation
 - Organizational resources to startup formation, licensing activities and overall performance
 - Physical resources – none
 - External resources to startup formation

STUDY RESULTS

HYPOTHESES TESTING

- I. human resources are positively related to TTO performance in the areas of patenting, licensing, and generating startups
 - Not supported with respect to all three(3)
 - But supported with regard to generating startups

STUDY RESULTS

2. organizational resources are positively related to TTO performance in the areas of patenting, licensing and generating startups?
 - Org resources were defined as including invention disclosures, patent applications and university owned patents
 - This hypothesis was supported for all three(3)

STUDY RESULTS

3. physical resources are positively related to TTO performance in the areas of patenting, licensing, and generating startups?
 - The physical resources were defined as the presence of business incubators and/or medical schools
 - Hypotheses 3 was not supported

STUDY RESULTS

4. external environmental resources are positively related to TTO performance in the areas of patenting, licensing, and generating startups?
 - There was a positive relationship between the external environment and start up business formation

STUDY RESULTS

- The **human, organizational and external environmental resources** are significant relative to **start up business formations**
- Physical resources are not significant to overall performance, licensing activities or startup business formations
 - This is significant because tech managers need to rethink the belief that a university TTO cannot produce outputs unless they invest heavily in business incubators and medical schools
- **Organizational resources** are significant related to licensing activities and overall performance
 - Again, these are defined as invention disclosures, patent applications filed, and patents owned
 - TTOs need to focus on supporting the foundation of university technology transfer:
 - The inventions and patent protection