PERFORMANCE EFFECTS OF UNIVERSITY INDUSTRY COLLABORATION

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University Industry Collaboration (UIC)

Potential benefits (generating knowledge, solving problems, attracting students)

vs.

Costs (high investments, cultural differences, knowledge leakage)
Starting point:
Personal experience with the Siemens Center for Knowledge Interchange
Without support collaboration with universities is loosing relevance

1. Portfolio management, transparency of goals and competences,
2. Controlling of divergent interests, personal interaction and intensive project initiating
Initial Research Questions:

Which collaboration strategies with universities do companies pursue?

Which collaboration instruments and organizational approaches have been proven to be successful?
Method and Data

- 20 Semi-structured, 60-120 min., personal interviews with senior managers responsible for the university collaboration processes
- 18 medium to large, technology oriented companies from different industries

> Interview guidelines with 31 open questions grouped into “UIC Strategy”, “Institutionalization of UIC”, “UIC Portfolio”, “Talent Orientation of UIC”, and “Formalization of UIC Projects”

→ 30+ hours of recorded interview, 700+ pages of transcribed interviews and notes, 550 codes to describe the data using ATLAS.ti QDA software
Functions and Types of University Collaboration Portfolio Management

Dedicated University Collaboration Function

Portfolio Management Tasks
- Monitoring and coordination of the portfolio
- Knowledge management
- Implementation of portfolio strategy
- Interface management

Collaboration Management Tasks
- Support for and controlling of individual collaborations in all project phases
- Formalization of core collaboration processes
- Alliance performance assessment
Successful collaboration approaches

1. Align UIC activities to technology strategy to archive holistic solutions rather than solve isolated problems.

2. Establish some standardization and centralized coordination of the portfolio; choose the right mix of collaboration forms; foster a collaboration-friendly organization.

3. Adjust the extent of portfolio management to the collaboration impact.

Universities as knowledge vendors vs. Universities as partners in the generation of new knowledge

“Do-It-Yourself Store” [Wright, 2008]
Remaining Questions:
Does university collaboration pay off for firms?
If yes, how may firms maximize the benefits of university industry collaboration?
## Mixed Results of UIC on Firm Performance

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIC</td>
<td>University Industry Collaboration faces several barriers (Bruneel et al. 2010, Decter et al. 2007, etc.)</td>
</tr>
<tr>
<td>... as an open innovation approach (Perkmann and Walsh 2007)</td>
<td>Universities and firms have different cultures</td>
</tr>
<tr>
<td>... as a source of new competencies and innovative ideas (Balconi and Laboranti 2006, Belderbos et al. 2004)</td>
<td>different preferences</td>
</tr>
<tr>
<td>... reduces time horizon between NPD and market launch (Mansfield 1991)</td>
<td>different project targets</td>
</tr>
</tbody>
</table>

### Previous Empirical Results

**Positive effects** (Belderbos et al. 2004, Mansfield 1998)

Unable to show an association with firm performance (Berman 1990, George et al. 2002)

Previous studies concentrate on single industries (George et al. 2002, Demirkan und Demirkan 2011)

Scarcity of long-term studies and no consideration of time lags (Bozeman et al. 2013)
Basic Hypothesis

University Industry Collaboration will equip firms with external knowledge, necessary resources and capabilities.

\[ \text{H1a: A firm’s university collaboration intensity will enhance its firm performance.} \]

- high costs in the short run and returns only in the long run
- indirect effects: access to knowledge, technology, market partners, image, people
- focus on the early stages of the innovation process
- focus on substantial innovation with high barriers and resource requirements
- “valley of death”

\[ \text{H1b: The effect of university collaboration intensity on firm performance will be lagged in time.} \]
Determinants of the success of University Industry Collaboration on three levels

- Network level (How do you structure your alliance portfolio?)
- Partner level (With which partners you should work together?)
- Project level (What kind of research is most promising?)
Network Level: Strong Ties between Partners

- Creating new knowledge depends on the strength of direct relationships
- Concentration on few partners allows the stabilization of routines
- Transfer of tacit and complex knowledge increases

H2: A firm’s university collaboration intensity will have a higher effect on firm performance if concentration of collaboration is high as compared to low concentration of collaboration.
Partner Level: High Quality Universities ...

- attract star scientists
- have excellent resources and facilities
- have better networks
- have more experience with University Industry Collaboration

H3: A firm’s university collaboration intensity will have a stronger effect on firm performance if they collaborate with high quality universities.
Project Level: Basic Research Orientation of UIC

- Different incentives, cultures, and processes between basic research and application cause collaboration barriers.
- Basic research results cannot be assimilated and implemented as simply and fast as knowledge of applied research.
- Intra-firm diffusion of theoretical knowledge is complex.

H4: A firm’s university collaboration intensity will have a lower effect on firm performance if a firm focuses on basic research projects within its collaboration portfolio.
Overview of Hypotheses

H1 (+, but lagged)

Collaboration Intensity

Partner Quality

Partner Concentration

Basic Research Orientation

Firm Performance

H2 (+)

H3 (+)

H4 (-)
Data Collection and Sample

95 public-traded companies (S&P 500), randomly selected from 6 technology oriented industries

Company data
- Data extraction from THOMSON REUTERS database
- Company data: 2001 – 2010
- Industry (SIC Codes)
- Financial key figures (Revenue, EBITDA, market cap, etc.)
- Names of all subsidiaries from each company

Publication data
- Joint publications
- Extraction from Web of Science database
- Publication data: 1990 – 2009
- Title, author, address, journal, category, citations, etc.

University data
- Ranking data of 400 Universities (Times Higher Education Ranking)
Measurement

**Firm Performance**: Tobin’s Q (stock exchange performance)

**Collaboration intensity**: Joint publications relative to the firm’s total cost scaled in $1.000.000.

**Partner Concentration**: Herfindahl-Hirschman-Index (HHI) within collaboration network.

**Partner Quality**: proportion of universities from THE Ranking in the total numbers of collaborative universities.

**Basic Research Orientation**: 5-year average impact factor of the journals, where the publications have been published.
## Results for direct effect

<table>
<thead>
<tr>
<th>Collaboration Intensity</th>
<th>Firm Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged (t =-1)</td>
<td>-4.14†</td>
</tr>
<tr>
<td>Lagged (t =-2)</td>
<td>2.58*</td>
</tr>
<tr>
<td>Lagged (t =-3)</td>
<td>5.15**</td>
</tr>
<tr>
<td>Lagged (t =-4)</td>
<td>10.23**</td>
</tr>
<tr>
<td>Lagged (t =-5)</td>
<td>1.61†</td>
</tr>
<tr>
<td>Lagged (t =-6)</td>
<td>1.11</td>
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</table>

<table>
<thead>
<tr>
<th>Time</th>
<th>Firm Performance</th>
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</thead>
<tbody>
<tr>
<td>2002</td>
<td>-.43**</td>
</tr>
<tr>
<td>2003</td>
<td>-.19†</td>
</tr>
<tr>
<td>2004</td>
<td>-.12</td>
</tr>
<tr>
<td>2005</td>
<td>-.19†</td>
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<tr>
<td>2006</td>
<td>-.24*</td>
</tr>
<tr>
<td>2007</td>
<td>-.23*</td>
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<tr>
<td>2008</td>
<td>-.80**</td>
</tr>
<tr>
<td>2009</td>
<td>-.59**</td>
</tr>
<tr>
<td>2010</td>
<td>-.53**</td>
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<p>| | |</p>
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<tbody>
<tr>
<td>R² within</td>
<td>.34</td>
</tr>
<tr>
<td>F</td>
<td>28.74**</td>
</tr>
</tbody>
</table>

Fixed-effects regression; unstandardized coefficients with std. errors in parentheses. two-sided; † = p < 0.10; * = p < 0.05; ** = p < 0.01; n = 95.
Long-term collaboration effect on firm performance

Lagged effects of UIC

Performance effects (Tobin’s Q)

Time after collaboration (in years)
## Results for moderation effects

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
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</thead>
<tbody>
<tr>
<td><strong>Direct effects</strong></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Collaboration Intensity°</td>
<td>11.68**</td>
<td>-17.03**</td>
<td>5.30**</td>
<td>14.96**</td>
<td>-6.60</td>
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<tr>
<td>Partner Quality°</td>
<td>.06</td>
<td>-.07</td>
<td>.08</td>
<td>.05</td>
<td>-.03</td>
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<tr>
<td>Partner Concentration°</td>
<td>.21</td>
<td>.13</td>
<td>.07</td>
<td>.20</td>
<td>.08</td>
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<tr>
<td>Basic Research Orientation°</td>
<td>.01</td>
<td>.01</td>
<td>.01</td>
<td>.02</td>
<td>.02</td>
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<td><strong>Interaction effects</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partner Quality°</td>
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<td>31.91**</td>
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<td></td>
<td>21.17*</td>
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<tr>
<td>Partner Concentration°</td>
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<td></td>
<td>19.58**</td>
<td></td>
<td>9.79†</td>
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<tr>
<td>Basic Research Orientation°</td>
<td></td>
<td></td>
<td></td>
<td>-1.82*</td>
<td>-2.20*</td>
</tr>
<tr>
<td><strong>R² within</strong></td>
<td>.38</td>
<td>.41</td>
<td>.40</td>
<td>.38</td>
<td>.41</td>
</tr>
<tr>
<td><strong>F</strong></td>
<td>29.87**</td>
<td>31.20**</td>
<td>30.76**</td>
<td>28.15**</td>
<td>28.08**</td>
</tr>
</tbody>
</table>

Fixed-effects regression; unstandardized coefficients. Time dummies included. ° = lagged variables (t= -4).
† = p < 0.10; * = p < 0.05; ** = p < 0.01; n = 95.
Illustration of Moderating Effects

- **Firm Performance**
  - Low
  - High

- **Collaboration Intensity**
  - Low
  - High

- **Partner Concentration**
  - Low Partner Concentration
  - High Partner Concentration
Illustration of Moderating Effects

The diagram illustrates the moderating effects of collaboration intensity on firm performance, with partner quality as the moderator. The x-axis represents collaboration intensity, ranging from low to high. The y-axis represents firm performance, ranging from low to high.

Two lines are plotted, one for low partner quality (dashed blue line) and one for high partner quality (solid red line). The line for high partner quality shows a stronger positive relationship between collaboration intensity and firm performance compared to the line for low partner quality.

This suggests that high partner quality moderates the relationship between collaboration intensity and firm performance, making the positive effect more pronounced.
Illustration of Moderating Effects

Firm Performance

Collaboration Intensity

Low Basic Res. Orientation

High Basic Res. Orientation
Summary of empirical results

- University Industry Collaboration (UIC) has a significant positive impact on firm performance, but this effect appears with a certain time lag.
  - Passing the “valley of death” and overcoming short term incentive systems

- We show that quality of collaboration partners enhance UIC success.
  - Solving the trade off between the positive role of local strong ties vs. integration the global best universities

- At the network level, a high concentration on a few key partners enhances the effect of University Industry Collaboration.
  - Systematic configuration of portfolios

- Too much focus on basic research projects may weaken the performance of University Industry Collaboration
  - Motivation of universities to engage in applied research projects despite less scientific reputation
What does it mean for the university?
Complement the university portfolio management of firms with professional technology transfer approaches!
Analysis of current improvements of technology transfer offices

Data & Method

- Interviews conducted at 22 universities and research institutions in Europe and the United States
- Semi-structured, 90+ minute, personal interviews with technology transfer officers
- Analysis of secondary data (presentations, websites, reports, internal documents)
- Qualitative data analysis (Eisenhardt, 1989; Miles & Huberman, 1994; Yin, 2009)
The Role of Technology Transfer Offices
Institutionalizing Industry Relationship Management (1)

Matchmaking/ first point of contact
Coordination of Relationships

Managing Strategic Partnerships
Key Account Management

Penn State University: Industrial Relations Office
- 150 mill US$ contract research vs. 2 mill US$ licensing revenue
- 10 employees, 15 years of experience
- Concentration on the development of long-term relationships
- Microsoft CRM tool
- Online project and portfolio management
- Intensive internal and external networking and match making
- So far more than 50 framework agreements
- Ca. 200 meetings of industry partners, TTO and faculty per year

“They are responsible for matchmaking, listening to companies, understanding trends, and then: bringing researchers from different fields together to solve those problems.”

“We follow a sales-structure where we have tier 1 and tier 2 accounts. Those are managed on a very regular basis with monthly calls to follow up. We do not go after master agreements with everybody. It’s a select group of companies that match our research expertise, show commitment of time and money.”
The Role of Technology Transfer Offices
Institutionalizing Industry Relationship Management (2)

Formal Matchmaking Programs

- Companies get special treatment for an annual fee (KIT Business Club 8,000€, MIT ILP 60,000 US$)
- Key-account managers handle all interaction

“For a membership fee you can meet more students, find out what research we’re doing, and have a closer relationship.”

“Once you’ve established the relationships, it becomes a less valuable service.”

Internal Networking

- Trainings covering patenting, collaboration models etc.
- Regular consulting hours (at the departments)
- Databases containing information about available competences

“We have to built a relationship with our internal customers, which is the faculty, so that they know us and can bring us in when there is a company wanting to talk with them about research.”

Technology Marketing

“It may not just go to a company who wants to license that IP, but in a way it tells a company what your capabilities are and the research that is tied to it. That’s really what I’m selling.”

“Fostering long-term relationships is also very useful in the marketing of intellectual property. That’s one of the reasons why we were able to transfer 120 technologies last year. Most of those didn’t go to new companies, they went to people we had existing relationships with.”
The Technology Transfer Office (TTO)

**Initiation**
- Fostering Technology Transfer
  - Competence marketing
  - Awareness creation
  - Cluster activities
  - Special programs for SMEs
- Establishing Relationships
  - Matchmaking (inward & outward)
  - Formal Program
- Contracting
- Research Grant Support

**Knowledge Creation**
- Relationship Management
  - E.g. key account mgmt.
- Portfolio Management
  - Strategic alignment
  - Performance evaluation
- Project Management
  - Controlling
  - Evaluation

**Knowledge Diffusion**
- Intellectual Property Mgmt.
  - Patenting/ licensing
  - Technology marketing
- Entrepreneurship
  - Start-Up consultancy
  - Entrepreneurial education
  - Supply of venture capital
  - Infrastructural support
- Knowledge Transfer
  - Post Completion Activities
  - Executive Education
  - Consulting/ Tech. Services
  - Career Services

University Technology Transfer

- Industrial Relations Office
- Technology Licensing Office
- Center for Entrepreneurship

Schneider, Schultz, Svoboda (2010)
Not the end of the story .... The end of the science superpowers (Hollingsworth et al., 2008)