Collaborative Knowledge Networks for Physicians

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Agenda

► Knowledge characteristics of physicians as independent inventors having an impact on technological development

► Leveraging technological specialization of knowledge in knowledge communities / networks

► Collaborative knowledge networks: two examples in the field of surgery
Innovation is becoming increasingly open and democratized. (Chesbrough, 2003; von Hippel, 2005)

Independent inventors appear to be an important source of breakthroughs and commercially attractive innovations in many industries (Amesse et al., 1991; Åstebro, 2003; Baldwin et al., 2006; Fleming, 2007; Lettl et al., 2006; Riggs and von Hippel, 1994; Spear, 2006).

- Capability: independent inventors’ ability to think outside the box
- Motivation: independent inventors’ benefits from inventing
Independent inventors’ motivation for voluntarily engaging in creative processes is typically a combination of the following motives:

- First, the inventors may simply enjoy the intellectual challenge of developing a novel solution to a problem (Harhoff et al., 2003a; Lakhani and Wolf, 2005).
- Second, they may be compelled by a need for a better solution (von Hippel, 2005).
- Third, they may be motivated by the prospect of gaining recognition from peers or signalling technical excellence to venture capitalists or potential employers (Lerner and Tirole, 2002).
- Fourth, they may see an incentive in the monetary rewards which may arise from patent licensing, consultancy or entrepreneurship (Åstebro and Dahlin, 2005; Spear, 2006).
The opportunity to borrow from many disparate fields, i.e. to reassemble knowledge from diverse technological fields in a novel fashion, is said to put independent inventors in an advantageous position to develop breakthroughs (Fleming, 2007; Shane, 2001; von Hippel, 2005).

The freedom to think 'outside of the box' allows independent inventors to experiment with previously unattempted combinations of technologies and components.

Reasons for independent inventors’ ability to think outside the box:

- They do not have an explicit obligation to innovate and thus enjoy a high degree of autonomy in their inventive practice.
- They are often industry outsiders and therefore less entrenched in the existing assumptions, mental models and problem-solving paradigms of an industry.
- They are less prone to organizational inertia, and their solution space is less fettered by corporate policies, core competencies and core rigidities.
But does that also hold true for rather high-tech areas like medical equipment technologies?

- Who are the independent inventors in that particular technology field?

- Do they contribute to technological progress?

- And, do they profit from knowledge diversity, i.e. ‘assembling’ different knowledge areas?
Lettl et al. 2008 investigate the role of independent inventors’ prior knowledge characteristics on the technological impact of their patented inventions in the medical equipment industry.

- Technological impact: How often does the patented technology serve as a foundation for later inventions? → patent citation measure (citations received)

- Knowledge characteristics:
  - Diversity: Technological diversity, or the breadth of technological knowledge, allows creativity and generates new perspectives and insights by a blending of prior knowledge from different fields. → patent citation measure (direct citations made)
  - Specialization: Cumulativeness relates to specialization, or depth of knowledge within a given field. → patent citation measure (direct and indirect citations made)

- Independent inventors are identified by matching assignee and inventor fields on patent documents. Manual check: More than 90% of the independent inventors are physicians.
1681 patent families in the field A61B17 published between 1980 and 2005 and primarily assigned to IPC patent subclass A61B17 ('surgical instruments, devices or methods')

Manual coding:

- **Independent inventors**: 205 patent families belonging to 174 independent inventors
- **Corporate inventors**: 1476 patent families belonging to 496 companies

Source: Lettl et al., 2008
Physicians as independent inventors (7)

Research Framework

Prior Knowledge Base applied to Invention

<table>
<thead>
<tr>
<th>Diversity</th>
<th>Specialization</th>
</tr>
</thead>
</table>

H1/H2 Marginal Returns

Source of Invention

Independent / Corporate Inventors

Technological Impact of Invention

Source: Lettl et al., 2008
Physicians as independent inventors (8)

Quantile plots of the technological impact of corporate and independent inventors

Source: Lettl et al., 2008
Interaction effect of the source of invention and technological specialization/diversity on technological impact

Source: Lettl et al., 2008
Overall, our results indicate that on average independent inventors generate inventions of lower technological impact than their corporate counterparts.

Independent inventors apply a significantly more diversified base of prior knowledge to inventions than corporate inventors.

There are no significant differences in the degree of specialization between independent inventors and corporate inventors.

High-impact independent inventors apply high degrees of specialization and low degrees of diversity, while low-impact independent inventors apply low degrees of specialization and high degrees of diversity.

To sum up, the more independent inventors apply a high degree of specialization and a low degree of diversity, the more capable they are of reaching the same level as or even outperforming corporate inventors.

Source: Lettl et al., 2008
Knowledge characteristics of physicians as independent inventors having an impact on technological development

Leveraging technological specialization of knowledge in knowledge communities / networks

Collaborative knowledge networks: two examples in the field of surgery
Independent inventors who specialize in a certain technological field have a higher likelihood of becoming embedded and being awarded legitimacy in communities of peer specialists.

Independent inventors have often been stereotyped as lone 'garage' inventors (Fleming, 2007).

Recent work indicates that many independent inventors are embedded in social networks of individuals who share an interest in a specific topic or field (Antorini, 2005; Baldwin et al., 2006; Franke and Shah, 2003; Jeppesen and Frederiksen, 2006; Lettl et al., 2006; Luethje et al., 2005).
► Knowledge communities are partly informal networks of individuals who share an interest in a certain topic or field.
► Communities therefore center on a specific field and both attract and generate specialists (peers) in that field.
► Within peer communities, individuals voluntarily share experience and knowledge, exchange ideas and innovative artefacts, and provide feedback on posted ideas or solutions.

(Brown and Duguid, 2001; Hienerth and Lettl, 2008; Perry-Smith and Shalley, 2003; von Hippel, 2007).
Independent inventors who participate in communities are able to leverage resources and processes to add to the value of their personal expertise:

- They acquire state-of-the-art knowledge and learn about trends and important issues in the field.
- Their ideas and solutions are given feedback from the community (peer review).
- Collaborative filtering and rigorous selection for promising ideas: Community-embedded independent inventors are thus able to make better choices as to which ideas and novel combinations are worth advancing (Hienerth and Lettl, 2008; Fleming, 2007; von Hippel, 2007).
- Stronger and faster dissemination of ideas and solutions increases the likelihood that their inventions will be cited in future work (Fleming, 2007).

Source: Lettl et al., 2008
Knowledge communities / networks (4)

In sum, community embeddedness as a cause and/or effect of technological specialization enables independent inventors to gain access to processes and resources which corporate inventors typically find in the corporate context.
Knowledge networks advance professional practice and inventive progress in technology fields that are based on and apply the knowledge practiced in the knowledge community.

They therefore fulfill an important function as a driver for future relevant professional knowledge.

How can they be implemented?
Agenda

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- Leveraging technological specialization of knowledge in knowledge communities / networks
- Collaborative knowledge networks: two examples in the field of surgery
Example – AO foundation (1)

► The AO is a Swiss-based non-profit organization based on a network of surgeons who are committed to the study, practice, and teaching of AO (surgical) principles and their advancement in the field of trauma and musculoskeletal surgery.

► In 1958, thirteen surgeons came together to promote what was at the time a revolutionary idea—internal fracture fixation. The AO (Arbeitsgemeinschaft für Osteosynthesesfragen) was founded in 1958 by a group of Swiss surgeons—Maurice E Müller, Robert Schneider, Hans Willenegger, and Martin Allgöwer who were conducting research into bone healing, with particular reference to the influence of the mechanical environment of the fracture upon its healing pattern.

When AO commenced in the 1950s, non-operative treatment was the unquestioned standard in fracture care. Early attempts at operative treatment had been made but usually produced unsatisfactory results.

The founders of AO realized that this was due to unsuitable techniques and the poor quality of the available implants. In its early days, AO therefore focused on the mechanics of fixation, i.e. developing suitable implants and tools for rigid fixation.

Soon, educational activities were started as a means for spreading this concept and teaching the necessary surgical techniques: From around 1960, the AO promoted and organized the treatment of fractures with its own industrially produced and marketed plates, screws, and instruments.

Example – AO foundation (3)

► This early work laid the foundation for the current knowledge of the direct and indirect healing of fractures, as well as the influence of rigid fixation upon the healing of non-unions.

► The AO’s classical landmark experiments are known to fracture surgeons throughout the world.

► The aims of the AO pioneers were not to popularize the indiscriminate use of surgical fixation, but rather to evaluate scientifically its place in the care of the injured and, where appropriate, to refine surgical practice so that the outcome for the victim of injury could be optimized.
In 1984 the AO Foundation was formerly constituted to take responsibility for the various commissions of: research, development, education, documentation, and international affairs.

1992 the entire Foundation moved to a custom built AO Center on the outskirts of Davos, where it remains till today.

Nowadays the AO represents a “Gold Standard”, delivering a win-win merger of surgical practitioners, researchers, and industry to the benefit of patients.

The AO today represents the world’s leading knowledge organization in osteosynthesis with more than 5,000 surgeons, including an international faculty of over 3,000 in more than 100 countries.

The AO organization works together with industry in the areas of research, development, education, and quality assurance in fracture treatment for the benefit of fracture patients.

In 2006 AO started the project „knowledge services“. Although the project suffered initial difficulties it turned out to be a highly successful endeavour: according to oral information by the AO CEO, Mr. Strasser, currently 20‘000 visitors a month make use of the codified knowledge offered by the platform in order to enhance their surgical practice.

What makes it different from a simple, or even sophisticated, database is the fact that the knowledge ‘assets‘ are offered in an evidence based way.

Surgeons can make use of the advice, i.e. actionable knowledge that a colleague provided for a similar ‘case‘ and that was enriched by the webteam based in Davos by providing additional (multimedia) content. More than fifty of the world’s most renowned surgeons from 20 countries are contributing to this project, making sure that the AO principles are followed while keeping in mind local realities.

Source: www.aosurgery.org
To understand the AO Surgery Reference, think of a huge online library where you can find quick answers to clinical questions and where hundreds of surgical procedures are described in text and images.

Approaches and patient positionings are shown, and decision making is supported with a huge evidence base containing the literature of the last decade. AO Surgery Reference helps you make the right decisions.

On the Start page of the AO Surgery Reference you’ll see a skeleton.

The anatomical areas available now are highlighted. New anatomical areas are being added continuously at 2-month intervals.

A click on the anatomical area of your interest will take you directly to a website dedicated exclusively to that anatomical region.

Source: www.aosurgery.org
### Example – AO foundation (7)

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Indication</th>
<th>Preparation</th>
<th>Approach</th>
<th>Reduction &amp; Fixation</th>
<th>Aftercare</th>
</tr>
</thead>
</table>

**Surgical management process**
Go step by step through the process.

**The page layout**
For better use and understanding the information on each page is structured similarly:

**Quickfinder**
If you have chosen to go step by step and would like to change the diagnosis, treatment method, or the fixation device while in the process, use the Quickfinder to quickly change your settings without going through the whole process again.

**Information**
Here, in the middle and largest section of the page, you’ll find what is most relevant to know in a particular clinical situation.

**Support**
On the right-hand side of each screen there are boxes containing links to relevant videos, studies, journal articles and book chapters.

Much of this information can be used in a clinical situation (videos, decision making support). The links collected under “Further reading” lead to more academic material with generally longer texts.

Source: www.aosurgery.org

I. von Wartburg, based on Lett/Rost/von Wartburg 2008
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Leveraging technological specialization of knowledge in knowledge communities / networks

Collaborative knowledge networks: two examples in the field of surgery
Syndicom was founded to enable communities and companies to seamlessly collaborate and share knowledge, ultimately delivering innovative solutions to market in a more timely, creative and efficient way.

In October 2005, the company launched its flagship product, the Syndicom SpineConnect platform, to enable spine surgeons to collaborate on difficult and unusual cases. In 2006 Syndicom delivered two new products built on its widely embraced SpineConnect platform, ProductEdge and ResearchEdge Private Networks, and in 2007 launched TrialEdge and Technology Fellowships.

Syndicom’s collaborative process is built on over 30 years of research by professors Raymond Miles (University of California, Berkeley), Charles Snow (Pennsylvania State University), and Grant Miles (University of North Texas).

Source: http://syndicom.com/
Example – syndicom spineconnect (2)

- The Syndicom SpineConnect platform enables surgeons to collaborate on difficult and unusual cases, develop novel approaches to treatment, address the top challenges in spine healthcare, and create technological solutions that address voids in the current product market.

<table>
<thead>
<tr>
<th>Products</th>
<th>Purpose</th>
<th>Audience</th>
</tr>
</thead>
<tbody>
<tr>
<td>SpineConnect Platform</td>
<td>Case collaboration</td>
<td>Surgeons</td>
</tr>
<tr>
<td>ResearchEdge PN</td>
<td>Case-based research</td>
<td>Surgeons/Industry</td>
</tr>
<tr>
<td>ProductEdge PN</td>
<td>Product training and support</td>
<td>Industry</td>
</tr>
<tr>
<td>TrialEdge PN</td>
<td>Clinical Trials</td>
<td>Industry</td>
</tr>
<tr>
<td>Technology Fellowship</td>
<td>Focused training and support</td>
<td>Industry</td>
</tr>
</tbody>
</table>

Source: http://syndicom.com/
Everyday, spineconnect’s members are logging on to collaborate on cases, educate themselves, and make connections with their colleagues. Syndicom’s SpineConnect community has:

- **800+** cases and **3800+** reviews posted
- **200,000+** visits
- Over **1000** members
- Over **30** different countries represented
- **100+** groups formed

Source: http://syndicom.com/
Thank you very much for your attention!
Referenced Literature (1)


Physicians as independent inventors (10)

Prior Knowledge

Base of Invention

Manufacturer

Trajectory Riding

„Expert Mode“

User

Excellence in Problem Solving

„Professional Mode“

Frontier Bridging

„Expert Mode“

Trajectory Riding

„Hobbyist Mode“

Additional Technological Specialization

Additional Technological Diversity

Source: Lettl et al., 2008

I. von Wartburg, based on Lett/Rost/von Wartburg 2008