



Aalborg Universitet

AALBORG UNIVERSITY
DENMARK

Highways of Knowledge

Cappelen, Katja Strøm; Højmark, Jeppe; Nielsen, Christian

Publication date:
2012

Document Version
Early version, also known as pre-print

[Link to publication from Aalborg University](#)

Citation for published version (APA):
Cappelen, K. S., Højmark, J., & Nielsen, C. (2012). *Highways of Knowledge*. SSRN.
<http://ssrn.com/abstract=2192407>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

Take down policy

If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Highways of Knowledge

Authors

Katja Cappelen, Jeppe Højmark and Christian Nielsen

Abstract

The objective of this paper is to discuss mechanisms, enablers and barriers for knowledge transfer in university - industry collaboration projects. The underlying question is how to acquire the right kind of knowledge to stay innovative and competitive in today's fast changing society. The study is conducted with a qualitative research design. Data is collected through 35 qualitative interviews with Danish and Norwegian representatives from three main categories: Business, research and university students. All respondents have been involved in collaborative projects within recent time, such as student-industry cooperation or collaboration projects between researchers and businesses. This research shows that to secure real value adding through knowledge transfer in university - industry collaboration projects, it is important that the involved parties view each other as equal partners. Allowing for curiosity, mutual sharing and experimentation might lead to unforeseeable, valuable knowledge creation in contrast to secrecy and holding back information. Another key finding in this paper is that the level of reciprocal knowledge transfer is perceived as lower in student - business collaboration projects than in projects involving researchers and businesses. It is argued that creating a better understanding of roles and competences of the involved parties can help diminish the problem. A third significant conclusion is that continuous knowledge sharing throughout the project seems more highly valued by the involved parties than a final report does. This result could have implications for the framing of future collaboration projects in this field.

Key words

University-industry collaboration, project management, project success

Introduction

In the current economy where the only certainty is uncertainty, you can be sure of one thing: You need knowledge. Businesses as well as universities need knowledge to succeed and to stay ahead of competitors. There is a tendency moving towards a society with continuously shifting technology, a growing number of competitors and products becoming obsolete overnight. In this reality companies and their employees need to be at the forefront of the knowledge available to them in pursuit of the competitive advantage. Knowledge creation is vital to organizations of all kinds. Therefore organizations must show a corresponding amount of effort in helping to ensure that it happens (Edwards 2009). The key questions are how to acquire the right kind of knowledge, how do we know what the right kind of knowledge is in a given situation and what kind of barriers and enablers are the most common to come across?

Knowledge in a company and university perspective and the understanding of collaboration

In the following section, the theory regarding knowledge transfer will be addressed, and why it is of such importance for universities as well as companies to transfer knowledge will be discussed. Today knowledge is of even greater importance to companies than it was a few decades ago (Quinn *et al.*, 1996). Therefore the potential of university- and industry collaborations will become more and more attractive in the near future. Businesses show a growing interest in research results discovered by universities, and many universities are eager to pass on knowledge to companies as a way to commercialize their research results (Knockaert *et al.*, 2011).

What is knowledge? There are different types of knowledge, and in relation to research the value of knowledge also differ. Quinn *et al.* (2005) address that the value of knowledge increases from cognitive skills to motivate creativity. This leads to a paradox, because companies spend more resources improving the employees' cognitive skills instead of skills that generate more value.

The theoretically understanding of the term knowledge can vary depending on the difference in perspective from companies and universities. From a company's point of view knowledge is a term that can generate or conserve competitive advantages (Knockaert *et al.*, 2011). Therefore knowledge and intellectual capital become more important capabilities and value drivers than phys-

ical assets (Quinn *et al.*, 2005). The competitive advantages depend on how well a company enhances its own knowledge base, integrate knowledge and procure knowledge to either develop or improve products (Knockaert *et al.*, 2011). According to these value drivers, Kessler *et al.* (2000) address that there are some contingencies that will have an effect before companies can get advantages of a certain piece of knowledge. These results indicate that there are lower competitive advantages when companies use external sourcing in early stage knowledge development (Kessler *et al.* 2000). A possible explanation could be that knowledge from a university perspective often is knowledge at an early development stage, which can be difficult for companies to relate to (Knockaert *et al.*, 2011). Before a company can absorb this kind of knowledge it needs to have some basic skills or a shared language. In addition to that, businesses need the ability to recognize the value of new knowledge and information at the right time (Cohen & Levinthal, 1990). At this early stage, knowledge leads to some issues around attracting financing from the universities point of view. This is because companies in many cases have difficulties imagining the final results of university cooperation (Knockaert *et al.*, 2011).

Markman *et al.* (2008) states that studies on research and technology commercialization have so far been neglected. If researchers bring this problem into focus, it could maybe solve some of the problems around early stage knowledge and if companies find a way to commercialize early stage knowledge, there might be more possibilities for future collaborations.

According to Polanyi (1966) all knowledge is either tacit or rooted in tacit knowledge. Transferring explicit knowledge may not result in successful values for the company, because of the tacit knowledge that lies beneath (Barney, 1991). Before knowledge transfer can be successful, it involves moving knowledge from one group to another (Argote, 1999). Before this transfer can be successful, Roberts (2000) addresses a term called *show how*, which is an interaction of communication between the two parties. The key word regarding knowledge transfer is therefore collaboration. A conclusion shared with Quinn *et al.* (2005), who also recognize the benefits of collaboration. Quinn *et al.* (2005) also address the fact that through communication and dialog, both parties gain value through shared knowledge. There are some risks in this process concerning which knowledge is to be shared. Quinn *et al.*, (2005) therefore suggest that the company should be in control of the process. Otherwise they could lose their competitive advantages. Disadvantages and risks for a company related to university collaboration are also addressed by Carayol (2003). The problem occurs in relation to research results being published because it can be difficult to determine the

license or patent holder. To make sure that uncertainty does not occur, it is important that the two parties have a common understanding of the project goals and a shared agreement of expectations. Case studies show that it is important to define mutually agreed objectives (Barnes *et al.*, 2006). These are key factors to be aware of in a university - industry cooperation.

The importance of knowledge and main drivers for collaboration from a university point of view

Lee (2000) addresses certain incentives for universities to collaborate with companies and other external stakeholders such as:

- To supplement funds for university driven research
- To test practical application
- To gain insights in the area of a certain research question
- To further the universities outreach mission
- To gain knowledge about practical problems
- To create student opportunities

The essences of these incentives for a researcher to collaborate with companies are primarily driven by the need to advance their own research agenda. Creating student opportunities or looking for business opportunities through research commercialization is in most cases not the main driver for researchers. Lee (2000) indicates that the researcher gets the most substantial benefits from their own agenda and that most probably there is a link between incentives and research output in this matter.

The importance of knowledge and drivers for collaboration from a company's point of view

Lee (2000) lists certain incentives for companies to enter collaboration with one or more universities and/or researchers:

- To develop new products and processes
- To gain access to new research
- To maintain an on going relationship with a university
- To recruit university graduates
- To solve specific technical or design related problems/challenges

Like researchers, companies are also primarily driven by their own agenda in search of university cooperation partners. Secondly businesses are eager to recruit top talent graduates to access relevant university knowledge.

Comparing the incentives and motivation for universities and businesses to collaborate, they are remarkably similar. According to Lee (2000) the parties have more or less the same expectations to the outputs from collaboration, which is positive regarding possibilities for further future university – industry collaborations. Meyer-Kramer & Schmoch (1998) argue that there is a certain danger for a mismatch between the incentives to collaborate since most companies have a much shorter time frame for projects than scientists and researchers do (Meyer-Kramer & Schmoch, 1998). Carayol (2003) addresses that some expectations of such collaborations are not in accordance with the incentives. This is caused by businesses expectations to positive impact on economic performances. Carayol's (2003) view is opposite of Lee's (2000) findings, because the company respondents in Lee's (2000) research cannot identify a clear monetary benefit of such a collaboration. Economic calculations do of course represent an important factor for collaborative projects, but as it will involve much intangible information it is also a highly complex calculation to undertake. This is why it is difficult to say something concrete about the economic output of university - industry collaboration. Even though in most cases there will be some economic expectations, Carayol (2003) highlights that companies also tend to having some non financial incentives for collaboration. Companies are interested in this kind of collaboration because it can complement their own research and in this way they can generate a greater synergy of knowledge (Carayol, 2003).

Tacit and explicit knowledge

To understand the nature of knowledge one has to understand the difference between tacit and explicit knowledge. Polanyi (1966) addresses the fact that people know more than they are able to communicate, this can for an example be expressed in people's ability to recognize different faces. Most of us have the ability to remember a face in a large crowd of people, but it is hard for us to put into words what it is that exactly makes us remember one specific face (Polanyi, 1966). The difference between knowledge that one is able to express and knowledge that is harder to articulate is what Polanyi (1966) describes as tacit versus explicit knowledge. Explicit knowledge is a type of knowledge that is collectable, storable and possible to distribute, while tacit knowledge is more experience based (Nielsen & Nielsen 2009). Howells (1996) defines tacit knowledge as non-

codified, disembodied knowledge that people acquire by means of informal procedures. According to Spender (1996) tacit knowledge is often referred to “as things are done around here”.

To understand how tacit and explicit knowledge is transferred between people and/or institutions one can look to Nonaka (2007). When an individual has to learn tacit knowledge from another individual, it is often through observations, imitations and practice. The observations or imitations hereafter becomes part of the person’s own tacit knowledge. According to Nonaka (2007), there are challenges concerning communicating tacit knowledge between individuals. These challenges relate to the fact that even though an individual gain tacit skills through tacit knowledge, the person might still lack insight about *how and why*. There is no automatic in tacit knowledge becoming explicit knowledge through knowledge transfer and it might therefore be challenging for an organization to draw direct benefits from it. Furthermore Nonaka (2007) underlines that there are challenges connected to explicit knowledge being transferred. The problem with explicit knowledge is that it often does not add any new knowledge to the organization. Instead it relies on assembling data and/or knowledge from different places within the organization and organizing the information into a combined report. According to Nonaka (2007) the real knowledge value adding happens when one is able to transfer tacit knowledge of an organization into explicit knowledge. In this way the organization as a whole will be able to create a mutual understanding of the hidden knowledge embedded in the organization. This means that instead of knowledge being restricted to the different individuals or departments, the entire organization can draw benefit from it’s knowledge base. In addition, shared explicit knowledge will create new tacit knowledge in the organization which employees then can take advantage of to reform and expand their own tacit knowledge.

What is Knowledge Sharing?

Knowledge sharing is an important source for learning and development in all organizations and it is closely connected to knowledge management as well as tacit and explicit knowledge. Knowledge sharing is about getting better at utilizing already existing knowledge. Shared knowledge equals extended knowledge and generates ownership and motivation within an organization (Hampden-Turner 2009).

In their research, Argote & Ingram (2000) address best practices when it comes to knowledge sharing. Some research results show that moving employees is generally seen as a powerful mechanism

for facilitating knowledge transfer, because individuals are able to transfer both tacit and explicit knowledge (Argote & Ingram, 2000).

When speaking about technology transfer the effect comes from moving tools from one site to another (Zhao & Reisman, 1992). Although transferring knowledge through moving technology can be effective, the success highly depends on the complexity of the technology and the accompanying effects of moving employees (Argote & Ingram, 2000). To succeed regarding knowledge transfer or knowledge sharing there are some important factors. Argote & Ingram (2000) address various difficulties in the initiation phase of a knowledge-sharing project that can cause negative impact on knowledge sharing later on in the process, especially in the implementation phase.

A positive side effect of knowledge sharing is network creation because network members can benefit from each other's experiences and extended knowledge base. Network theory is central in understanding the development and diffusion of knowledge. Cross et al. (2003) argue that strong networks are the key to success for individuals as well as organizations. Well functional networks depend on factors such as diversity, knowledge management, communication and incentive systems. Diversity among network members is absolutely crucial for learning and innovation (Bruder et al. 2010; Nooteboom 2004).

What is knowledge transfer?

Inkpen & Tsang (2005) define the transfer of knowledge on individual level as "how knowledge acquired in one situation applies or fails to apply to another situation". Organizational knowledge creation on the other hand is the process of making available and amplifying knowledge created by individuals as well as crystallizing and connecting it to an organization's knowledge system (Nonaka & Krogh 2009). According to Argote & Ingram (2000) the problem with knowledge transfer in organizations is the fact that people tend to have a wide range of approaches to how things are done in the best way. In many cases this leads to an organization with a lot of different methods on how to handle the same procedures. In addition to that, Argote & Ingram (2000) mention that knowledge transfer manifests itself through changes in the knowledge base meaning that if one wants to measure knowledge transferred within an organization one has to measure the changes in knowledge and changes in performance (Argote & Ingram, 2000) which is obviously a challenging task.

Darr *et al.* (1995) illustrate this performance-based approach by showing the extent to which fast-food restaurants are affected by transferred knowledge or experience from other restaurants in their franchise. Likewise Baum & Ingram (1998) analyzed the hotel industry in search of hotels ability to survive when drawing on the experience of others. A well known problem in assessing knowledge transfer through measuring alterations in the performance is controlling the fact that performance does not become influenced by other factors than the experience of others (Argote, 1999). As mentioned earlier, knowledge transferred can be measured by changes in the knowledge of the recipient. It is though important to acknowledge that this does not come without its own set of problems. The main problem concerning measuring the outreach of transferred knowledge is the fact that people's knowledge often consists of both explicit and tacit knowledge (Nonaka, 2007). The problem is that tacit knowledge is difficult to articulate, and thereby hard to measure (Argote & Ingram, 2000). This challenge is also addressed by Berry & Broadbent (1984) who showed that individuals are able to transfer their experience from one management simulation to another, and even though the performance is enhanced the participants were not able to articulate why the performance was improved. In Berry & Broadbent's (1984) study, participants were asked to fill in questionnaires with regard to their knowledge. The results showed that they were not able to measure the verbal interaction that had happened and therefore increased the performance of the experienced participants.

A further challenge addressed by Argote & Ingram (2000) is that it can be very difficult to measure increased levels of knowledge because of the fact that an organization consists of multiple repositories. The problem with measuring changes in knowledge is that you need to register every change in the different repositories that the organization consists of in both a before and after situation.

According to Walsh & Ungson (1991) there are five different storage possibilities for knowledge in organizations:

- Individual members
- Roles and organizational structures
- The organization's standard operating procedures and practices
- Organizational culture
- Physical structure of the workplace

All of these possess a challenge around registering knowledge transferred between them. In this aspect, organizational knowledge creation integrates context, knowledge assets, and knowledge

creation processes throughout the organization as a whole (Krogh et al. 2012). To measure changes through organizational knowledge transfer, one must measure changes at all the above listed storage levels.

Factors affecting knowledge transfer

Szulanski (2000) analyzes how distinctiveness of the source of knowledge, the recipient, the specific context and the knowledge itself affects the knowledge transfer process. In a study Szulanski (2000) found that it varied how important these factors were over the stages of the transfer process. It was found that factors which had an effect on the perception of an opportunity to transfer knowledge, such as the reliability of the specific source, predicted difficulty of knowledge transfer during the early initiation stage, where factors which influenced the execution of the transferred knowledge. For instance the recipient's specific ability to take on knowledge, affected the difficulties during the implementation phases (Szulanski, 2000).

Research has also been done on how characteristics of individual members, such as abilities and motivation for certain tasks, have an effect on the transfer of knowledge from training level to transfer context (Baldwin & Ford, 1988).

What kinds of barriers exist in the field?

According to Sun & Scott (2005) the barriers connected to knowledge transfer can be divided into different categories with regard to the kind of level it concerns. Sun & Scott (2005) divide the levels in i) individual, ii) team, iii) organizational and iv) inter-organizational barriers. With regard to the barriers at individual level Sun & Scott (2005) underline that many people are afraid of the unknown and want to keep things as they are, so that they can stay in their comfort zone. This means that their economic well being, psychological comfort zone and social status are all tied to the current context of the organization (Seo, 2003). This causes a possible emotional barrier, hindering unique information or knowledge to be transferred within the organization (Sun & Scott, 2005). Furthermore Sun & Scott (2005) found that fear of loss of ownership and control of knowledge represents a significant barrier to knowledge transfer.

At a team level knowledge transfer is often withheld when the team members find that their comfort zone is being potentially destabilized. Furthermore when looking at knowledge transfer at team level, one of the barriers is that teams need to justify sharing information with the rest of the organi-

zation and therefore they will tend to consider the rewards for sharing information or knowledge before doing so.

Other barriers connected to knowledge sharing at team level are external influences of the organizational climate on a team interaction as well as the influence of systems and organizational structures. The climate of an organization can influence power struggles that might occur in team interaction. This is especially the case when the team is newly formed. Problems might occur because the team members do not know each other yet and therefore hesitate to share information that potentially can benefit other members of the team without them giving anything back (Sun & Scott, 2005). A key quality of leadership is to encourage and stimulate such kinds of teams from within, to bring their most creative ideas and best knowledge to the organization (Krogh et al. 2012).

In addition to the above-mentioned barriers, systems and structures of an organization can represent a significant barrier in the sense that accuracy, timeliness and difficulties with acquiring the necessary information from the organization can affect team interaction one or another way. Finally Sun & Scott (2005) found competences to be a significant source of barrier at team level. The perceived competences of an individual member by the other team members, plays a role in determination to what extent unique information will be transferred from the team to the individual team member.

Methodology

This study was carried out as part of KASK:VIE (Kattegat-Skagerrak: Vidensamarbejde, Innovation - Entreprenørskab), an Interreg EU-funded project with project partners in Denmark and Norway. As part of KASK:VIE work package one “Knowledge transfer and matchmaking”, the aim of this study has been to take a closer look at the mechanisms of knowledge transfer and knowledge sharing between stakeholders in university – industry cooperation projects. This study is based on a qualitative research approach building on 72 semi-structured interviews. This specific research design was chosen because the main goal of the study is to explore, describe and understand a complex set of problems connected to the research topic.

Data Collection

When selecting relevant respondents to the data collection process the aim has been to identify individuals that have been involved in recent university-industry collaborations either between companies and researcher and/or companies and students. The respondents represent different catego-

ries such as researchers, company representatives and students. They were all thoroughly chosen based on their involvement in collaboration projects. This selection method is what Johannessen *et al.* (2009) refer to as tactic selection. During 2011 and 2012, 35 interviews have been conducted among actors in research-industry cooperation projects. In all cases the respondents were chosen because they were the main point of contact for either university or industry in a collaboration project.

Out of the 72 interviews this study is based upon, 19 interviews have been conducted with company representatives, 11 with university-employed researchers and five interviews were done with students that have been engaged in university-industry collaboration projects. The study counts for a total of 33 interviews with Danish respondents and five Norwegian respondents. All interviews were done face-to-face, on the respondent's own language and each interview lasted for approximately one hour. Most interviews took place at the respondent's office. The interviewer followed a semi-structured interview guide divided into sections covering the various project phases from the initial contact, throughout the actual project work and termination.

Analyzing the dataset

After finalizing the interviewing process in both countries, all interviews were transcribed and codified. When analyzing the empiric data concerning this specific paper, generated through 35 qualitative interviews, it has been important to reduce the information load to a manageable dataset (Johannessen et al. 2009). Besides empiric data generated through qualitative interviews, earlier studies and reports as well as topic specific literature and the theoretical framework for this paper creates the analytic foundation for this study.

Empirical analysis

Analysis of the empirical dataset will be presented and discussed in the following chapter. The purpose is to discuss the content of the conducted interviews in relation to the papers theoretical framework as well as previous research findings. This discussion will create a foundation for a closing over all evaluation to conclude upon. The empirical data collection through 72 qualitative interviews has been codified and categorized according to the key research questions for this paper. This was done to clarify upon the papers main research question the best way. Key research questions that the following analysis aims at giving an answer to:

- When does knowledge transfer happen in a university-industry collaboration project?
- Who is the beneficiary (beneficiaries) in a university-industry collaboration project?
- What are the main barriers and enablers to knowledge transfer in university-industry collaboration projects?

Analysis and discussion of empirical data

In the following the collected data material will be presented, analyzed and discussed. When analyzing the data, the aim has been to present the respondents meaning and statements as objectively as possible. To maintain the informants confidentiality and secure research ethics, are all statements and quotes from the interviews kept anonymous. Respondents' statements are highlighted with italic letters.

Research Question 1: When does knowledge transfer happen in a university-industry collaboration project?

Knowledge was earlier viewed as a linear process where universities produced knowledge which in the following was commercialized by the private sector (Lundvall 2006). The current view on knowledge development is that it is a much more integrated process where universities and businesses co-create new knowledge as well as collaborating around utilization for commercial purposes. The theoretical understanding of the term "knowledge" can vary depending on different stakeholders' different point of view. This makes it somewhat challenging to compare statements about knowledge transfer and the value of knowledge from such different actors as academic staff and business representatives.

Researcher: "It is difficult to talk about knowledge moving around. I don't really believe much in moving knowledge around. You can tell someone something he or she didn't all ready know, but you can't move knowledge as such around".

The statement above underlines the difficulties when talking about such abstract sizes as *knowledge*. The challenge is to define what new knowledge is, and how to measure whether new knowledge has entered an organization or a specific project or not. When we speak about transferring knowledge it is often misinterpreted as one piece of knowledge being transferred from one corner to the next in form of a report, textbook, a programming code etc. More accurately when we speak about knowledge transfer is to understand that moving people around can be a powerful mechanism for facilitating knowledge transfer (Argote & Ingram 2000). This is because people are

able to transfer explicit as well as tacit knowledge when the context allows for it. The data clearly shows that all parties, businesses, researchers and students acknowledge the value of continuous communication and dialog throughout the collaboration process. This is in line with Quinn *et. al* (2005)'s view about all parties gaining value through shared knowledge.

According to the dataset, knowledge sharing happens in various ways in university – industry collaboration projects. While a number of respondents preferred frequent meetings to review the latest developments and progress, others said a phone call now and then to check in on status quo was more than enough. A finding that seems to be of importance to a successful collaboration process, is for the parties to arrange for regular meetings where issues such as “where are we in the project”, “what are our present needs”, “what do we wish for” as well as critical points can be discussed. Such a procedure can for some at first glance seem unnecessary time consuming, but the data material indicates that this is a crucial step for real value adding. By allowing the process time and space, real knowledge sharing between project partners can take place. A further benefit for the project work itself and the project members is that knowledge sharing equals extended knowledge and generates ownership and motivation for the involved partners (Hampden-Turner 2009).

Taking into account the variety of collaboration project and actors this study builds upon, from large to small businesses, technical to service- and knowledge based companies, different geographical locations, structures and collaboration motivation, it is remarkable how all respondents refer to continuous knowledge transfer as more useful than a final report after a finished collaboration. This result is especially present in the datasets from respondents representing the corporate world.

Business representative: “To us, the important thing has been the interaction and the continuous learning process with our collaboration partner. Not the heavy, final report produced by a Ph.D. student”.

Researcher: “We had frequently meetings where those who had solved a project specific task would report on their work and show what their results. It was a running process with continuous knowledge sharing”.

The above quoted statements highlight a couple of important factors to take into account for future collaboration projects. Regular meeting arenas to allow for planned as well as unintended knowledge sharing seems to be a worthwhile investment. Secondly, the final report that is often taken as given in a university-industry collaboration (in most cases written by academics), might not be the best

way to secure long-term knowledge transfer and development. In many cases such reports are written in a language or style that does not add value to the business partner. This finding is in line with what Nonaka (2007) refers to regarding explicit knowledge. The problem with explicit knowledge is that it often does not add any new value to the organization. A project report will often have more of the characteristics of assembled data gathered from different places within and around the organization and finally put into a combined report. Real value adding at organizational level, both in academic institutions and businesses happens when tacit knowledge is transferred to explicit knowledge and this is most likely to happen through continuous exchange and learning (Nonaka 2007).

In all three groups of respondents there seems to be a shared opinion about knowledge transfer taking place during the collaboration, but less so after the collaboration project is ended. This is likely to be a source of untapped potential to be further investigated.

Research Question 2: Who is the beneficiary (beneficiaries) in a university-industry collaboration project?

When it comes to measuring knowledge transfer in a long-term perspective it is difficult to predict who the beneficiaries of a collaboration project are. As described in the theoretical framework of this paper, organizational knowledge creation is an integrated process of context, knowledge assets and distribution throughout the organization. In this perspective, possible changes through knowledge transfer must be measured as changes in knowledge and performance at all organizational levels over time, not only with those individuals initially involved in the knowledge sharing process (Argote & Ingram 2000). In a shorter-term perspective, most of the respondents considered the collaboration project, with either a university or industry partner, to be of value to themselves and/or their institution.

Business representative: “We got some knowledge and we got a network that we still make use of. There has been initiated a cooperation around a different technology project that didn’t have any direct connection to this specific project. The good thing is that we have tried some things together and thereby have an informal knowledge about each other. I think that creates a feeling of trust for further collaboration”.

Business representative: “What was really interesting in this project was the network connections we got access to at the university. In a way it is like we bought us access to this experiences and knowledge”.

The above statements confirm that knowledge sharing can lead to network creation, which again can have positive effect on further knowledge sharing (Cross et al. 2003). This because network members can benefit from each other’s experiences and competencies.

The dataset indicates that there are less mutual benefits from knowledge sharing in student – business collaboration projects as it was found to be in other constellations.

Business representative: “If there were some basic questions to be answered then we would speak on the phone. But our general contact to the student group was over e-mail. That is the easiest way for all parties”.

Business representative: “They (the student group) initially got an introduction to our company and the problem they were to work with and then they came back at the end of the project and presented their results. That was a really good way to do it”.

It seems that the respondents among the business representatives perceived student interaction being less of a knowledge sharing process and more about the business providing information and helping a group of students answering their questions. The following quote confirms this from a student perspective:

Student: “Most of our communication was actually via e-mail. We also got a phone number to call in case we needed something. But besides our initial meeting with the business, all communication was over e-mail”.

The explanation for less perceived knowledge transfer in collaboration projects that include students and businesses might be found by the way students act. If a group of students behave as if they are to write a school paper instead of acting as professional knowledge workers towards the business, chances are they will be perceived less serious by the business. But the opposite might as well be true. If the businesses partner does not take students and their ability to create valuable knowledge seriously, students will most likely be taking on the role given them and thereby act accordingly.

Further findings with regard of student – business collaborations show that students receive little or no feedback from their business partner after the project is finished. In most cases projects are closed down by the students giving a presentation of their results and handing over a project report followed by a discussion. The student respondents in this research value this final meeting with their business partner highly, but do miss feedback to follow up on their work afterwards.

Research Question 3: What are the main barriers and enablers to knowledge transfer in university-industry collaboration projects?

Looking at the collected data, there are some bottlenecks to effective knowledge transfer processes that are being brought up by all three groups of respondents. Time, or lack of time stands out as a critical barrier to knowledge transfer. On one hand, respondents' demand distinct goals, clarification on intentions and a common understanding of the project collaboration. On the other hand there seems to be an aversion against engaging in processes that have no immediate return on investment regarding knowledge creation. From the universities' point of view, one problem is that businesses often find it difficult to imagine what a final result of a university – business cooperation might look like (Knockaert *et al.* 2011). Business representatives on their side claim researchers tend to be unclear in their communication, which creates a gap of understanding.

Business representative: “We don't have the best experiences with those final reports. But we have good experiences with dialog during the project. I must admit that students ask the most irritating questions now and then and they keep asking about some things that we feel we have control of. And then it turns out that they challenge us on some of our procedures based on their theoretical knowledge and that is really healthy for a company like ours”.

It is crucial, as the above quote illustrates, that the business partner has the ability to recognize the value new knowledge generated through a university collaboration project can add to the business (Cohen & Levinthal, 1990). The data material shows that those who went into a collaboration project with openness and curiosity were more satisfied with the end result and over all process than those who started out with clear expectations. In the latter cases less knowledge sharing took place. This finding reflects how successful university-industry collaboration projects differ from cases where one party is consulting or delivering specific services to another party.

Challenges around confidentiality and intellectual property rights are a returning problem when talking about university - industry collaborations.

Researcher: “(...) It was really a requirement for us to be part of the project. We are supported by public money and therefore it is obvious that things we do within this project cannot be confidential. We write about and communicate our research, so it was important to us that they knew that from the beginning”.

Only a few respondents in this study brought patents and intellectual property rights up as a barrier to knowledge transfer. This might be a result of most respondents emphasising the importance of mutual trust and common motivation to collaborate.

In line with earlier research, findings show that trust and mutual interest is an important enabler to successful collaboration. As referred by Sun & Scott (2005), fear of loss of ownership and control of knowledge represent a significant barrier to knowledge transfer. This represents a threat to newly formed collaborations where too little time and effort is invested in team building processes. Poor levels of trust will typically lead to team members hesitating to share knowledge (Sun & Scott 2005). The data show great benefits for collaborations where there was mutual trust between the involved partners.

Conclusion

In this final chapter there will be concluded on the research questions based on the discussion and analysis presented under the previous chapter. The concluding points will be framed as hypothesis about knowledge transfer and knowledge sharing in university – industry collaborations.

Environment influences knowledge transfer

This study shows that placing people in surroundings that are new to them can be a powerful mechanism for facilitating knowledge transfer. For student - industry collaborations it is valuable to both parties having students spending time with the business, questioning routines and procedures and thereby testing out their own theoretical skills in praxis. Researchers on their side can gain great benefits of getting out of their academic comfort zone to be confronted with different questions and challenges when meeting the corporate world.

Continuous knowledge sharing versus final report

A significant result of this study is that continuous knowledge sharing is valued as more useful than a final project report. Continuous knowledge sharing requires regular meetings between the involved partners where time and space is given to share and develop new knowledge.

This result could be transferable to other areas of knowledge sharing where a final report is viewed as a standard unit of measure. Maybe there are more effective ways of sharing knowledge that should be taken into account when designing knowledge sharing processes for the future.

Long-term consequences of knowledge transfer

The study shows that knowledge transfer happens at various levels and through different channels throughout a collaboration project. But the study also shows that there is an untapped potential of long-term knowledge development caused by poor knowledge sharing after an ended cooperation. At organizational level, real value adding through knowledge transfer manifests itself through changes in the knowledge base. To investigate the deeper consequences of knowledge transfer through university - industry collaboration over time, it is recommended to conduct a longitudinal study measuring changes in variables over time.

What is argued in this paper, is that individual and team level knowledge transfer has positive effects for those involved, which again can lead to increased motivation and thereby benefit the overall organization.

Less mutual knowledge transfer in student - industry collaborations

Findings from this research state that the level of mutual knowledge transfer is perceived as less present in student - industry collaboration projects than in projects involving researchers and businesses. In this paper it is argued that creating a better understanding of the role and competences of the involved parties can diminish the problem.

Absence of feedback from the business side after an ended project period, is a further challenge in student - industry collaboration projects. To secure long-term benefits and knowledge creation for all parties it might be necessary to rethink collaboration procedures.

Unpredictable synergy effects

It can be challenging for an organization to decide which knowledge is to be shared and which is not. Protecting competitive advantages through confidentiality around intellectual property rights is of course important, but by holding back one might also lose out on the unpredictable assets of knowledge sharing. This study shows that to secure real value adding through knowledge transfer it is important that the involved parties view each other as equal partners which will allow for curiosity and experimentation in the collaboration.

Trust and mutual interest

An important question to be answered for both companies and universities is how to acquire the right knowledge for a specific task, project or development process. In this paper it is argued that the complex nature of knowledge acquisition is assisted in the best way by collaborations based on trust and mutual interest for common knowledge development.

Final reflection

Speaking about knowledge transfer is a rather delicate task. Based on the results of this study, there are reasons to believe that there is some confusion around what knowledge really is and how and when this complex size is being transferred. According to the literature on the topic, knowledge transfer comprehends more than exchanging documents and reports, but still it is hard to articulate when knowledge transfer takes place, - and even harder to define what it takes.

References

- Argote, L. (1999). *Organizational learning: Creating, retaining, and transferring knowledge*. Norwell, MA: Kluwer.
- Argote, L., and P. Ingram (2000) "Knowledge transfer: A basis for competitive advantage in firms." *Organizational Behavior and Human Decision Processing*, 82: 150-169.
- Baldwin, T. T., & Ford, J. K. (1988). Transfer of training: A review and direction for future research. *Personnel Psychology*, 41, 63–105.
- Barnes, T. A., I.R. Pashby & A.M. Gibbons. (2006). Managing collaborative R&D projects development of a practical management tool. *International Journal of Project Management*, Vol. 24, P. 395-404.
- Barney, J.B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*. Vol. 17(1), 99–120.
- Baum, J. A. C., & Ingram, P. (1998). Survival-enhancing learning in the Manhattan hotel industry, 1898–1980, *Management Science*, 44, 996–1016.
- Berry, D. C., & Broadbent, D. E. (1984). On the relationship between task performance and associated verbalizable knowledge. *The Quarterly Journal of Experimental Psychology*, 36A, 209–231.
- Bruder, R., Engelmann, T., Helbig, R., Helfert, M., Kuhndt, M., Lange, F., Lemken, T., Merten, T., Philipps, S., Scmitt, M., et al. (2010). Strategische Allianzen für nachhaltige Entwicklung, Innovationen in Unternehmen durch Kooperationen mit NPOs. I: Lemken, T. (red.). Wuppertal: Wuppertal Institut für Klima, Umwelt, Energie GmbH.
- Carayol, N. (2003). Objectives, agreements and matching in science-industry collaborations: reassembling the pieces of the puzzle. *Research Policy*. Vol. 32, P. 887-908.
- Cohen, W.M. & D. Levinthal. (1990). Absorptive capacity: A new perspective of learning and innovation. *Administrative Science Quarterly*, 35(1), P. 128–152.
- Cross, R., Parker, A. & Sasson, L. (2003). *Networks in the Knowledge Economy*.
- Edwards, J. S. (2009). Managing flow: a process theory of the knowledge-based firm. *Knowledge Management Research & Practice*, 7: 113-115.
- Darr, E., Argote, L., & Eppler, D. (1995). The acquisition, transfer and depreciation of knowledge in service organizations: Productivity in franchises. *Management Science*, 41, 1750–1762.
- Hampden-Turner, C. (2009). *Teaching Innovation and Entrepreneurship, Building on the Singapore Experiment*. Cambridge University Press.
- Howells, J. (1996) Tacit knowledge, innovation and technology transfer, *Technology Analysis & Strategic Management*, 8, pp. 91–106.
- Inkpen, A. C., & Tsang, E. W. K. 2005. Social capital, networks, and knowledge transfer. *Academy of Management Review*, 30(1): 146–165.
- Johannessen, A., Kristoffersen, L. & Tufte, P. A. (2009). *Forskningsmetode for økonomisk-administrative fag*. 2 utg. Oslo: Abstrakt forlag AS.
- Kessler, E., P.E. Bierly & S. Gopalakrishnan. (2000). Internal vs. external learning in new product development: Effects of speed, costs and competitive advantage. *R&D Management*, 30(3), P. 213–223.

- Knockaert, M., D. Ucbasaran, M. Wright & B. Clarysse. (2011). The Relationship Between Knowledge, Top Management Team Composition, and Performance: The Case of Science-Based Entrepreneurial Firms. *Entrepreneurship Theory and Practice*. July, P. 777-803.
- Krogh, G., Nonaka, I. & Rechsteiner, L. (2012). Leadership in Organizational Knowledge Creation: A Review and Framework. *Journal of Management Studies*, 49 (240-277).
- Lee, Y.S. (2000). The sustainability of university–industry research collaboration: an empirical assessment. *Journal of Technology Transfer*. Vol. 25, P. 111–133.
- Lundvall, B.-Å. (2006). *Knowledge Management in the Learning Economy* Danish Research Unit for Industrial Dynamics.
- Markman, G., Siegel, D., & Wright, M. (2008). Research and technology commercialization. *Journal of Management Studies*, 45(8), P. 1401–1423.
- Meyer-Krahmer, F. & U. Schmoch. (1998). Science-based technologies university–industry interactions in four fields. *Research Policy*. Vol. 27, P. 835–852.
- Nielsen, B. & Nielsen, S. (2009). Learning and innovation in international strategic alliances: an empirical test of the role of trust and tacitness. *Journal of Management Studies*, 46 (6): 1031-1056.
- Nonaka, I. (2007) The knowledge-creating company. *Harvard Business Review*, 85, 162–171.
- Nonaka, I. & Krogh, G. (2009). Tacit Knowledge and Knowledge Conversion: Controversy and Advancement in Organizational Knowledge Creation Theory. *Organization Science*, 20 (3): 635-652.
- Nooteboom, B. (2004). *Inter-Firm Collaboration, Learning & Networks, An integrated approach*. London: Routledge.
- Polanyi, M., 1966. The Tacit Dimension. Routledge & Kegan Paul, London.
- Quinn, J.B., P. Anderson & S. Finkelstein. (1996). Managing Professional Intellect: Making the Most of the Best. *Harvard Business Review*. March-April, P. 71-80.
- Quinn, J.B., P. Anderson & S. Finkelstein. (2005). Leveraging Intellect. *Academy of Management Executive*. Vol. 19, No. 4, P. 78-94.
- Roberts, J. (2000). From know-how to show-how? Questioning the role of information and communication technologies in knowledge transfer. *Technology Analysis and Strategic Management*. Vol. 12(4), P. 442–443.
- Spender, J.C., 1996. Making knowledge the basis of a dynamic theory of the firm. *Strategic Management Journal* 17 (special issue), 45–62.
- Sun, P.Y.-T. and Scott, J.L. (2005), “An investigation of barriers to knowledge transfer”, *Journal of Knowledge Management*, Vol. 9 No. 2, pp. 75-90.
- Szulanski, G. (2000). The process of knowledge transfer: A diachronic analysis of stickiness. *Organizational Behavior and Human Decision Processes*, 82, 9–27.
- Walsh, J. P., & Ungson, G. R. (1991). Organizational memory. *Academy of Management Review*, 16, 57–91.
- Zhao, L. & A. Reisman. (1992). Toward meta research on technology transfer. *IEEE Transactions on engineering management*. Vol. 39, P. 13–21.