CHAPTER

Developing ongoing Research and Learning Relationships between Business Firms and Academic Institutions

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INTRODUCTION

We have looked at a dozen relationships between business firms and academic institutions when it comes to ways of cooperating on research and learning. Our primary focus, which is reflected in this chapter, is to examine learning from the company's viewpoint. Thus we have not examined this phenomenon from the academic institution's viewpoint. By implication several such views will, however, become apparent. Firms may typically see academic institutions as attractive, brain-driven organizations that thus might possess relevant knowledge for them. A key question will be how to get access to this in a cost- and learning-efficient way. How does one find efficient, appropriate organizational ways to achieve this today? What are new trends in such learning collaborations? How can this be contrasted with more traditional ways?

Traditionally, many academic institutions have been predominantly supply-oriented. They have focused on what might be seen as axiomatic teaching and research reflecting many academicians' conventional disciplinary focus and interests (Lorange, 2002). This has often also led to a rather "top-down", or "in-out" mode for conceiving cooperation with business, mainly as a supplier of the more-or-less finished research outcuts. While individual researchers have been sporadically engaged in more interactive consulting, the academic institutions have typically provided final research findings more as a one-way delivery.

Today however, a more demand-oriented direction seems to be becoming more of a norm — and offer a clear contrast to the "old way". This involves "listening" more effectively to the customers, regarding what *they* find to be relevant — both in research and in teaching. This would, in the end, open up for a more realistic learning agenda based on more of a two-way collaboration — with inputs from firms and academia alike. We shall not exclusively review the literature in this field, but also report on our empirical research and related emerging research reports (Harryson & Lorange, 2005; Harryson, 2006). As far as we can see, there is an increased orientation toward the "business dimension" of publicly funded research, with increased industry collaboration based on factors like: rapidly growing costs of conducting fundamental science; decline in the costs of travel and communication; a much more widespread spreading of formal as well as informal collaboration links; increasing need for specialization within certain scientific fields; and the growing importance of interdisciplinary fields of cooperation. Thus, collaboration on research and learning seems much more widely adapted than ever, while taking fundamentally new forms. Above all, our findings strongly suggest that new forms of co-location and job-rotation are driving better effectiveness of industry-university collaboration, which therefore still remains a global business. Let us discuss this further.

KEY-LEARNINGS FROM OUR OBSERVATION

Based on in-depth research with 12 companies representing best practice in university collaboration, we shall articulate the following observations regarding how effective learning challenges in the academic-business context now might look.

First, it seems key to emphasize that one might devote relatively more attention to the development of personal contacts as a means to establish mutual trust. This personal chemistry seems key. Effective cooperation thus seems to be based relatively more on personal chemistry than on abstract rational logic! This also means that one might devote more attention to selecting the right individuals (professors and students), say, by applying a more professional recruiting process. A related issue, to be discussed later, would also mean that one should try to always keep the students within one's own company.

Second, we find that every external cooperative project needs to have an internal fund- and time-budget allocated for steering the project towards business needs and supporting internalization of the results. This might at times be further enhanced by actually establishing a separate company, with its own resource-based budget and its own milestones to more easily secure systematic selection and development of corporate university-based ideas for cooperation — before the results are transferred into the mother-company. It should be clear, however, whether an independent unit is established or not, that one should have clear and mutually understood definitions of milestone-focused success when establishing a cooperative project.

Third, one should be careful when trying to understand the geographic dimension. It appears that a partner's geographical closeness is key — physical proximity still seems to be a major advantage for smooth learning, despite all the progress that is being reported regarding the virtues of virtual organizational forms (Beise & Stahl, 1999; Katz & Martin, 1997; Lindelöf & Löfsten, 2004; Mansfield & Lee, 1996; Harryson, 2006).

RELATIONSHIP MANAGEMENT APPROACH

Taking the above considerations into account, we will now outline a more comprehensive framework and decision-making scheme to propose how business firms can articulate and manage their university relations in more systematic and efficient ways. Based mainly on discussions with leading practitioners, in particular the CTOs and University Collaboration Officers of a dozen companies actively working with universities, we can define and propose six dimensions that seem particularly critical to manage carefully for immediate innovation impact of university collaboration:

- **Scanning:** Identification of the most relevant opportunities for R & D cooperation with universities. How can strategic intelligence help to find all possible opportunities — especially in research areas beyond the well mastered core business?
- **Screening:** Selection of the "best" external units in terms of universities and their leading faculties. What evaluation and selection-criteria to apply (e.g., Citation index of the leading professors, patents awarded, research budgets, business-rankings)?
- **Involvement for Knowledge Transfer:** How to become sufficiently involved in the joint programme and build the required relationships to acquire, transfer and utilize the results back home?
- **Steering Towards Business Objectives:** How to secure appropriate steering of direction if any?
- **Exclusivity and IPR:** How to manage possible competition for results in non-exclusive programmes, in particular, how to share IPR and other intellectual assets?
- **Globalization:** How to manage across distance without losing control?

In order to explore new knowledge in the area of I-U collaborations, we established research partnerships with Stora Enso and SCA from the world of pulp and paper. From the wireless world, we have the three leading mobile operators in Sweden, Switzerland and Poland — as well as the recent Born Global Anoto in Lund. In food processing and medical equipment, Alfa Laval and Gambro are other well-known Born Globals from Lund. Porsche in automotive, Hilti in fastening equipment and SIG Combibloc in packaging offer unique examples of networked innovation in advanced engineering and mechanics. Finally, Bang & Olufsen in Denmark offers a compelling example in consumer electronics of how to spin out a core technology and turn this into a new platform for university collaboration to accelerate innovation-driven growth. We also found that Porsche has developed an equally unique and distinct model for university collaboration, which deserves particular attention.

Although all 12 companies held the six dimensions as the most critical ones to manage successfully for immediate impact on their innovation activities, these dimensions have only been presented in fractions in previous research. The main contributions are reviewed below:

Scanning: Fritsch & Schwirten (1999) suggest that scanning for innovation-related I-U relationships is primarily based on existing personal contacts between companies and research institution employees (39% of responses referred to this factor). Other frequently mentioned answers were specific temporary search initiatives conducted by companies (29%) and conferences and fairs (14%).

Screening: According to Burnham (1997), companies should consider a series of criteria before entering a collaboration agreement with an academic institution, such as IPR policy; overhead charges; calibre of the graduate students; supervision/interaction time with faculty members and dissertation committees. Research by Mansfield & Lee (1996) regarding factors determining which universities major U.S. firms in various industries support find that "second-tier" universities and departments more often act as a valuable and frequently used source of research findings for industry than the first-tier players. Their main explanation is that much of the applied R & D supported by industry can be done satisfactorily at less prestigious departments as these are more prone to focus immediately on industry problems than highly ranked universities are.

Interestingly, a study of the German market by Beise & Stahl (1999) reveals that the top four German research institutions received almost 30% and the top ten got 43% of the citations as the most important institutions involved in business-academic collaboration. Similarly, a study of the Japanese market by Wen & Kobayashi (2001) suggests that highly ranked universities are the most active participants in joint research with companies, and play the more significant role in the formation of collaborative R & D networks for the country as a whole.

At first glance and based on only a few studies, it would seem that a broader range of universities — including the top-tier players — are active partners of corporate innovation in the German and Japanese markets. Conversely, it would seem that U.S. companies are limiting their collaboration to second-tier universities as these are claimed to be more prone to focus immediately on industry problems than highly ranked universities are. In this context, Audretsch & Stephan (1996) found that the status of being a scientific "star" reduces the need and incentive to commute outside the region in which the scientist is located and thereby also reduces the degree of collaborative links with industry.

Knowledge Transfer: Owen-Smith & Powell (2003) hold that successful technology transfer relies on access to evaluations provided by commercial contacts. These evaluations enable universities to assess their invention transferability and act accordingly. One of the most effective methods of collaborative research and knowledge exchange between academic and industrial researchers resides in a temporary secondment of university-based researchers to industry (Schmoch, 1999) — ideally involving joint supervision of Ph.D. and Master theses (Schartinger *et al.*, 2001).

Steering: Numerous authors [1] propose to establish a high degree of engagement and trust through frequent face-to-face communication, thus mitigating the risk of conflict. Several authors (Goldfarb & Henrekson, 2003; Friedman & Silberman, 2003; Siegel *et al.*, 2003), mainly related to the German market, hold that perhaps the most critical steering mechanism is a reward system for faculty involvement in technology transfer — issued as clear compensation and staffing practices by the technology transfer office of the university in question. Our observations suggest that this practice is as common in the German-speaking world as it is uncommon in Scandinavia.

IPR and Exclusivity: The output of a university can be licence agreements which permit the use of university IP by private firms, usually combined with royalty payments received by universities in exchange for the use of IP (Thursby & Kemp, 2002). Santoro & Chakrabarti (1999) and Thursby *et al.* (2001) agree that many universities prefer not to grant exclusive licenses to their industrial partners, since exclusive licensing to one firm restricts the dis-

1 See, for example, Bloedon & Stokes (1994); Davenport *et al.* (1999); Kogut & Zander (1992); Rappert *et al.* (1999); Rogers *et al.* (1998); Santoro and Chakrabarti (1999); Santoro and Gopalakrishnan (2001); Schartinger *et al*, (2002); Zander and Kogut (1995).

semination of knowledge to the general public. Surprisingly, in a cross-sectoral analysis conducted by Rappert *et al.* (1999), only very few companies considered formal protection of IP to be essential — mainly technology-driven firms in the material sectors. Similar findings are proposed by Thursby & Kemp (2002) and Harabi (1995). In contrast, all of the companies in our sample put strong emphasis on IP ownership in the context of university collaboration.

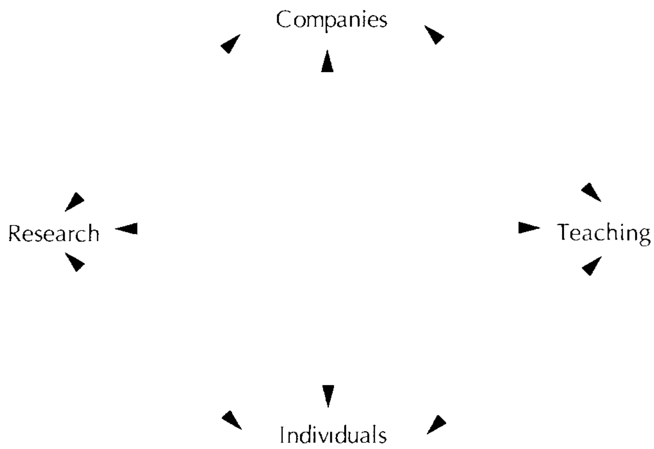
Globalization: Sporadic meetings between disparate teams are not enough to effectively share tacit knowledge (Nonaka & Reinmoeller, 2002). Trust and mutual understanding can only be developed through frequent and long-lasting cooperation, which necessarily involves geographical proximity (Leonard-Barton, 1995; Davenport & Prusak, 1998). It is true that advanced ICT tools can facilitate global industry-university collaboration. Still, such collaboration will only give mediocre results if attempts to build a common foundation for trust and understanding among all global R & D team members are neglected. In line with the dogmatisms of knowledge-creation, organizational learning and knowledge transfer theories (Kogut & Zander, 1992; Nonaka, 1994; Von Krogh *et al.* 2000), a large number of authors [2] on I-U collaborations find geographic proximity to be a crucial factor in the knowledge transfer process. For example, in a study of three German regions, Fritsch & Schwirten (1999) found that geographic proximity constitutes a clear advantage for establishing or maintaining cooperative relationships, and that a disproportionate share of I-U cooperation partners come from within the same region. Our own sample of 12 companies fully confirms a strong focus on proximity to the university collaboration partner. In fact, most companies in our survey limit their main academic interaction to those universities that can be reached within two hours of travelling.

The six steps outlined above may seem rather self-evident. Let us now, however, attempt to fame them into a more general scheme for positive learning enforcement, see Figure 1.

The model is based on our strong conviction that there is a need to have a purposeful network when it comes to a firm/university learning relationship. The proposed purposeful network can have four different distinctive roles/tasks, with interaction along all six management dimensions. The key is that this network encompasses both the firm and the academic institution together, as if they were one entity! Only by having cooperative activities involving all positional aspects — including also interaction along each of the

2 Beise & Stahl (1999); Fritsch & Schwirten (1999); Katz & Martin (1997); Lindelof & Lofsten (2004); Mansfield & Lee (1996); Santoro & Gopalakrishnan (2001); Schartinger *et al.* (2001).

Figure 1: Research and Teaching: A positive reinforcement Cycle



six dimensions, will there be full benefits from the cooperation. Speed of interaction will of course be key also. The appropriate formation process is therefore critical — with the right people focusing on appropriate tasks. And, clear delineation of resource — and time-line budgets must be behind it.

TWO EMERGING COOPERATIVE OPTIONS

Based on our case study analysis, we distinguish two basic options for cooperation between business firms and academic institutions — and both seem to be workable! One is what we shall call *The In-Sourced Model*. An example of this, to be discussed, is Porsche (Harryson & Lorange, 2005). The other is what we shall call *The Spin-Off Model* and exemplify through a brief case on Bang & Olufsen.

The In-Sourced Porsche Model

Porsche's in-sourced model seems primarily to be driven by cost-efficiency considerations, but also with a clear view of achieving even more creative technical approaches. The approximately 2,000 internal engineers at Porsche are augmented by about 600 Master students, who are temporarily "insourced" each year. On average each of these students is dedicated for 4-6 months to very specialized research tasks. Indeed, many of the tasks are so focused and narrowly defined that it would be hard to motivate an employee to do them. How about devoting six months to searching for new raw material sources for magnesium? Would an employee have embraced this task with such passion that the possibility of buying old submarines from Russia would have been identified? The main benefits might be: on the cost, eight Master students cost approximately as much as one engineer! Clearly a lot more can thus be achieved, even though the student can never be substituted for good, permanently employed engineers! On the focus side, this is typically driven by the high speed and motivation by the students. It is seen as a great honour to be recruited to Porsche. To be a member of this prestigious high-technology group induces extraordinary inspirational efforts!

There are also negatives, of course: the major one seems to be the potential risk of leakage, particularly when the Master students leave Porsche. It is hard to avoid this, even though Porsche is putting a lot of effort into creating solutions and approaches that are broader than what individual students would work on, i.e. "black boxes". Much in contrast to what we seem to find at Porsche, most peer car manufacturers have developed a strong internal infrastructure, and employed resources that typically cover most or the whole range of R & D process. Porsche, on the other hand, employs only a small group of specialists in the research area, who seem to be given broader freedom to cooperate with individual external providers of expertise — other industrial companies to some extent, but even more with academic institutions. They clearly seem more open to going outside, sometimes in unconventional ways, whenever they require additional brainpower and new solutions. Porsche seems to build more of a broad collaborative network among professionals and academics than the more typical company-to-company research project cooperation one tends to find in the traditional automotive industry.

To make this work, the selected candidates tend to be fully based within the Porsche premises throughout the duration of the collaboration. We observe that they typically work hard — often spending 60 or more hours per week on the assignment! Half the students typically write their master theses in close collaboration with the R & D department staff, who thus act as coaches, also for the academic part of their thesis work. The other half of the 600 students also perform a highly focused R & D task, but without writing their thesis in parallel. From Porsche's viewpoint this helps create a certain degree of protection — the company maintains the overall focus, while each thesis is focused on the specifics. Accordingly, Porsche currently "produces" around 300 diploma theses per year in their R & D department. Non-disclosure considerations can be relatively easily handled when it comes to the specific themes of diploma projects and/or Master's theses. In contrast, this is harder when it comes to Ph.D. theses — they tend to be broader! Porsche thus "has" less than 10 Ph.D. theses per year! Intellectual property rights and non-disclosure aspects are thus the main reasons for not cooperating to the same extent with Ph.D. students. Above all, it is typically harder for Porsche to create a "black box" protection when it comes to the broader Ph.D. theses, which typically cannot be phrased to focus on their specific issue — as is the case for the Masters theses. In this latter case it is Porsche that keeps the overall integrative view!

The Bang & Olufsen Spin-off Model, driven by innovation flexibility

The spin-off model is adapted by several firms including Bang & Olufsen. It seems to be primarily driven by striving towards more innovation flexibility. Bang & Olufsen, headquartered in Struer, Denmark, has spun off a separate organizational R & D unit — located in Copenhagen (which is also close to the university-city of Lund). There are 35 internal employees, as well as 25 Masters — and Ph.D. students from universities working as fully co-located "temporary unpaid employees" in this unit. The benefits primarily seem to be again, in part on the cost side — relatively low or even no salary to the students. Regarding the scope of innovations, however, it is interesting to see that the students explore ideas that might have been killed if they have been part of the internal R & D, above all due to internal risk resource considerations. In line with this, B & O has also become known for establishing a new breakthrough standard through proactive teaching at selected universities, bringing the research "back to the classroom" at the cooperative institutions.

Here too, of course, there are negatives. Students who do not join the company will walk away with a lot of valuable knowledge at the end of the thesis project. However, B & O is highly proficient at patent-protecting the knowledge as soon as it starts to get business-relevant. However, due to the new patent legislation in Denmark, patent results generated by Ph.D. students in Denmark will now belong to the university partner. As a consequence, B & O has been forced to limit its collaboration to the Bachelor and Master levels in Denmark. In Sweden, these "new" IPR regulations seem to be less restrictive, at least for now. In the longer run some countries may gain an advantage due to less restrictive IPR rules, when it comes to providing a basis for graduate students — having a context for more cooperative R & D networks. Sweden and Finland still seem to fall into this category. This would be important for the present cooperative model to work, since the "black box" protection of the firm will be largely based on owning the IPRs that emerge out of the collaboration.

In the case of B & O, hence, it holds the rights to the patent results (IPRs) — perhaps above all to secure its own stream of recurring royalties. But, as partly attended to, due to the new patent result rules in Denmark which were issued in 2000, universities have became more aggressive in pursuing their own patent strategies. Thus, employees of Danish university now have to file their patents at the university, and that university will own the patent. If the university is not interested in commercializing the patent, then the student might be free to start a business, but the university will even then get one third of the company stock for free.

As a consequence of this, B & O is now looking more proactively for university partners in countries with less rigid legal constraints, such as Sweden, which is only a few miles away right across the bridge!

SOME TENTATIVE CONCLUSIONS REGARDING INDUSTRY-UNIVERSITY COLLABORATION

The perhaps most cited challenge of I-U collaboration is that scientific knowledge produced by companies is short- and medium-term oriented, aiming at appropriating research results as much as possible, whereas the strength of public research is claimed to prevail in basic research, providing important new theoretical findings with high spillovers, but seldom coming up with specific inventions or products ready for commercialization. Our empirical research is revealing how two emerging management models help to bridge the time and appropriability gap.

The two models also represent excellent recruiting mechanisms. The companies get a chance to "test" out the graduate candidates before they might get actually hired — often exposed to situations of "intensive stress" to perform extremely focused tasks that would be hard to motivate internal employees to do.

Limiting Scanning to Existing Social Networks: Our empirical research largely confirms previous findings that scanning is primarily based on existing personal contacts between companies and research institution employees, sometimes complemented by temporary search initiatives and conferences and fairs.

Most of our case-companies rely on their existing network of trusted colleagues as a human search-tool to scan for new collaboration partners. We also find that our case companies rarely look for a new university as such, but rather for the actual researchers within an already selected university or institute to reach the required expertise.

Screening – Reversing the Benefit of Being a Star: The literature review suggested that, especially in the U.S., companies are limiting their collaboration to second-tier universities as these are claimed to be more prone to focus immediately on industry problems than highly ranked universities are. It is also quite intuitive that the status of being a scientific "star" reduces the need and incentive to commute outside the region in which the scientist is located and thereby also reduces the degree of collaborative links with industry. Indeed, most of our benchmarking partners view high numbers of patents and publications of a professor more as a reason to avoid collaboration than the opposite. Perhaps the most critical screening criterion can be summarized by the term "reliationshipability" — or, the ability and natural willingness to participate in a collaborative network. Relationshipability is critical for partners to rapidly understand the company needs — ideally based on prior experience in industry cooperations.

Knowledge Transfer Only Through Co-Location: Most literature argues that proper involvement for knowledge transfer requires a joint laboratory operating on a clear framework agreement with complementary research relationships. A method with similar effect is the temporary secondment of university-based researchers to industry — ideally involving joint supervision of Ph.D. and Master theses. Another critical mechanism is a reward system for faculty involvement in technology transfer — issued as clear compensation and staffing practices by the technology transfer office of the university in question, or paid directly by the sponsoring company.

Our empirical cases highlight the importance of having a clearly dedicated knowledge "receiver" with a strong personal reason and interest to obtain and integrate the knowledge by bridging the two worlds of science and practice.

Steering Through Co-Location or Financial Incentives: The obvious advice from literature is to establish a high degree of engagement and trust through frequent face-to-face communication and on-site demonstrations. Gambro illustrates in several ways that the steering of "external" Ph.D. projects may sometimes be quite challenging — in particular if the Ph.D. student is not based in the corporate-lab. In such situations, close and frequent interaction with the researchers who actually do the work is required. Relying on the Professor of Liaison Officer rarely guarantees good steering Rather, it seems essential to have a transparent university team structure to clearly see who is doing what and have direct contact with the knowledge contributors. It is also important to keep the areas of investigation well defined in an area of specialization that is fully mastered and understood by the selected institute or specialist.

Personal financial incentives as steering mechanisms to get the desired results were as rare in the Nordic countries as they were common in Central Europe. This mechanism may spread more widely in years to come. It is also reasonable to assume a continued focus on exclusive collaborations — away from multi-member projects, or consortia research.

Destructive IPR Laws: Collaboration with Ph.D. students seems to be problematic in many countries. This includes issues in IP ownership; the difficulty in keeping the thesis confidential; and longer lead-times from problem-definition to completion of the results. However, in some increasingly rare exceptions, such as Sweden and Finland, it is still possible for companies to work with Ph.D. students while maintaining full ownership of the IPR.

It also seems to be an important learning-point that I-U collaborations do not yet tend to be globalized. These seem to work well in geographically close co-locations, enriching both for the companies (financially) and for the students (intellectually). Above all, this seems to be an impressive innovation choice.

Let us now conclude with one major point of concern. We know that for creativity to thrive we cannot apply too strict mechanisms of control. However, much literature and many observations in practice relate to steering and control. Are we possibly in danger of strangling the dog by pulling too hard? Can we identify further approaches and models to strike a better balance between exploration and exploitation? Clearly, more research is required in this exciting area!

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