CHAPTER 14

The Industry View of Collaborative Research

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INTRODUCTION

Collaborative research is becoming increasingly important. It can lead to more effective generation of new knowledge, based on a complementary division of labor between industry and academia. However, the benefits to industry and academia alike depend on how well this network relationship works. In this chapter, I first suggest a conceptual framework for the accumulation of strategic know-how and, also, for how to conceptualize a network organization for new discovery. How can collaboration between academia and industry enhance this? I then address six specific challenges regarding this collaborative task. Lack of attention to any or all of these issues can lead to potential dysfunctionalities. First, I attempt to identify potential practical problem areas when it comes to collaborative research. Then, I discuss the question of how negative scientific results might be reported or dealt with. This then leads me to examine the question of publication policies more generally. It is logical that general ethical concerns are then reviewed. This is followed by a discussion of the key economic constraints and challenges of financing this research. It is essential to be clear about what the various parties are paying for—and what patterns of obligation this might create.

I have had a chance to discuss the above issues with seven practitioners—who shall remain anonymous—representing leading corporations active in collaborative research. Three of these corporations are from the pharmaceutical area; one is from the software development area; two are from the food and nutrients area; and one represents a chemicals corpora-

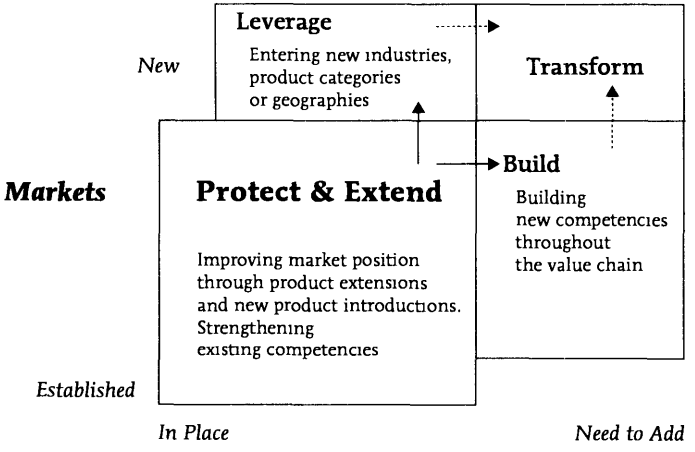
tion. I am most grateful for the inputs from these cutting-edge practitioners. However, the conclusions in this chapter are my own.

A CONCEPTUAL SCHEME FOR KNOWLEDGE GENERATION IN COLLABORATIVE RESEARCH

The modern corporation is typically driven by a knowledge-based strategic approach (Von Krogh *et al.*, 2001). Its success largely depends on whether it has the relevant knowledge to pursue meaningful strategies, above all, based on "seeing" and pursuing new business opportunities before they are obvious to its major competitors.

To push for new knowledge that can expand a firm's strategy is therefore critical. This can perhaps be thought of as taking two directions. One would be to go after new interfaces with customers, through pursuing new market opportunities. Established strengths and proven bases for success could perhaps be "exported" into new markets. The other would be to add new competencies to one's established business bases, thereby further strengthening one's business. These two approaches both build on what already works, either through a *leveraging* of one's present business or a *build-on* to one's present business. Exhibit 1 illustrates this.

Exhibit 1: Build on Established Strengths: Basic Competence-Based Framework for Internally Generated Growth



For executives and scientists heavily committed to scientific discovery, a tempting view might perhaps be that one should look for entirely new com-

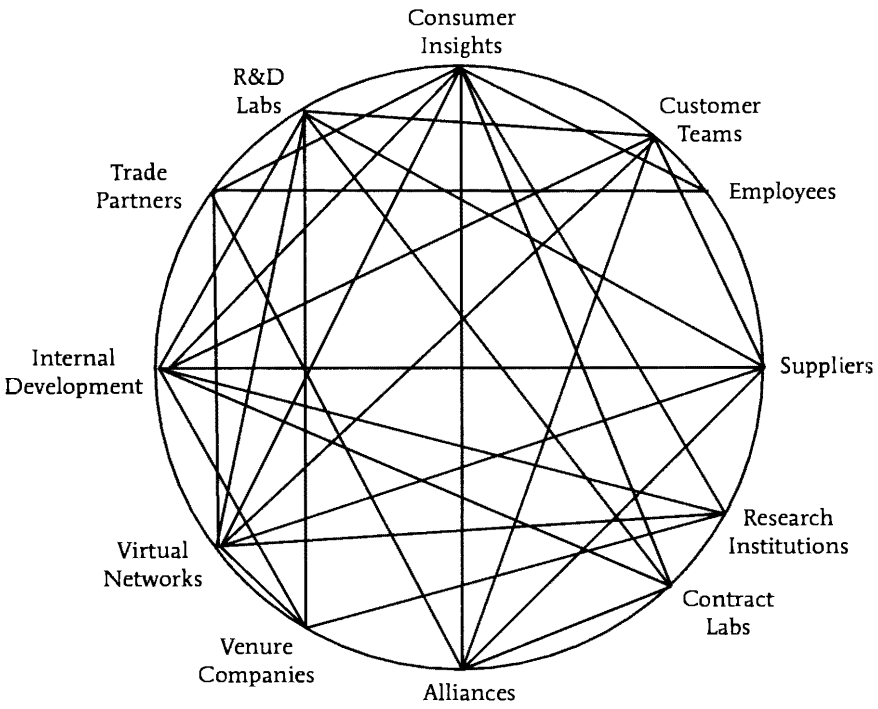
petencies, to be applied to entirely new market situations—what we call *transform* in Exhibit 1. Research indicates, however, that this is typically a less realistic way of strategically building business success for the future. In contrast, it tends to be more effective to build incrementally on one's present strengths by finding new distinctive add-on competencies (a build strategy) and/or by finding new market applications to utilize what already works (leverage strategies). Interestingly, then, when a build—or alternatively a leverage—strategy has been established, one can *subsequently* add a leverage—or build—dimension, so that one might eventually achieve a transform strategy, but through a longer evolutionary path. Thus, this is done via an indirect route, not through direct pursuit of new "cloud nine" ideas based on entirely new competencies and entirely novel market applications.

Collaborative research can of course play an important role in all of this. Most of all, perhaps, it might be effective when it comes to adding new distinctive competencies. The key here is to make sure that the distinctive competencies are such that they lead to a build strategy, and, further, that there is enough of a link with the present strategy of the firm. The collaborative research must lead to value-add-on capabilities to what is already working. At times, however, the collaborative research may be too unguided, perhaps attempting to achieve a transform-type strategy which, as already noted, tends to be less effective. A safe general conclusion can now be made: collaborative research must be based on a clear strategic positioning of what is to be achieved within the firm's growth strategy.

Before discussing the six more specific challenge areas identified, let us observe that the very context for collaborative research has changed due to the emergence of new web-based communications technology. Cooperation today must thus be seen in this new light. The new communications technology embedded in the web is enabling corporations and outside entities, including academic institutions, to collaborate in radically new ways. Virtual networks for research can be established between a firm and others. One can describe this as going from Research and Development to Connect and Develop. Exhibit 2 illustrates this.

Day (2002) reports on this type of cooperative pattern at Procter & Gamble. It involves a lot of outsourcing—reaching out for innovation through a web of connections. Specifically, Procter & Gamble is reported to have 600 websites readily available for access by its researchers and new product developers, all linked up with outside sources containing the latest relevant thinking. Kimberly-Clark, IBM and Eli Lilly are reputed to follow this type of approach too. At Intel these networks are called *lablets*. This trend towards web-based cooperative networks in R & D will certainly become even more common; it will reshape the role(s) of collaborative research.

Exhibit 2: From R & D to Connect & Develop



At this stage, a general caveat should be raised. Most corporations will, of course, primarily make available on the web the type of information that they *wish* to communicate. This could, however, create an information-flow bias, in the sense that the more euphoric, positive tidbits about one's recent projects may set the norm to be communicated. On the other hand, realistic, balanced research inputs may be lacking. This potential source of bias may thus in the end hamper network-based collaborative research between industry and academia.

Practical problems of cooperation

Several key areas can be identified. First, the question of intellectual property may be a central source of conflict. It is thus particularly important that this issue is well understood. The expectation equation between the two sides needs to be clear in terms of who finally owns the results of the common research efforts. It further has to do with a clear understanding of the costs of the project, meeting deadlines and ensuring correct reporting. A clear understanding when it comes to reconciling possible time scale differences is also key. Academia, for instance, may take a longer-term viewpoint, with a more

basic research focus, whereas the business side may take a shorter view and be more application oriented. This may have profound effects on how to interpret the intellectual property rights. Thus, who will finally own the results of the common research effort? The answer to this should, however, be absolutely clear, stemming from comprehensive contract documentation that takes all the above issues into account.

Second, as already touched on, the time horizon for this research typically differs. The opposite argument to the one outlined above can, however, also be made, in the sense that academia, faced with a "publish or perish" pressure, might indeed have a more short-term focus, whereas business might take a longer-term view. Business might have the resources to take such a long-term viewpoint, which may no longer be the case in academia, one might argue. The "right" answer to this controversy will of course depend on the specific situation. It will therefore be important to establish a good understanding of what the time horizon differences actually are in each case.

A third area of potential conflict may be whether academia will in fact be able to be truly independent, doing *bona fide* freestanding research, and being fully accountable for its research output in a scientific sense. There is controversy here. Take, for example, the pharmaceutical industry. Several people have argued that there is "growing interference by pharmaceutical companies in the conduct of clinical trials and the publication of their results ... The reliability of clinical trials, essential for the development of new drugs, is increasingly imperiled by conflicts of interest, inappropriate involvement of sponsors in trial design and management, and biased in publishing the results. In a highly competitive world, the pressures may be simply too great for individual researchers, universities, medical journals or public agencies to stem the tide of commercial influence." (*Financial Times*, 2001). Thus, the whole area of academic independence is at the heart of a healthy cooperative equation. Premature dissemination of results, for instance, without the full academic rigor behind them, may be part of this problem, since such results may not then stand up to scientific quality principles. The toxicity issue in the pharmaceutical area, for example, absolutely must be addressed when it comes to defining quality. It is the patient's safety that should unquestionably be at the center when defining quality, not the urge to publish "interesting findings" before scientific results are absolutely clear.

A fourth issue may have to do with the "silo cultures" in academic and industry-based organizations alike. It may be hard to work collaboratively across such kingdoms. The resulting fragmentation—leading to isolated atmospheres and non-eclectic realities—can clearly hamper the quality of collaborative research. This implies that a certain level of maturity is required when it comes to organizational culture. There must be a minimum degree of openness. The "not invented here" attitude must be substituted by

a "now improved here" approach. The key is "to borrow with pride," as said at one of the firms interviewed.

A final source of potential conflict may have to do with changes in the portfolio strategy of the firm and adjustments in overall risk taking, with the implications that these will have for various academic research projects. At the heart of this is a realization that risk must be balanced—this is critical for all scientific work. The firm must manage its portfolio of research projects from a risk-taking perspective. This means that academic work on specific projects in the portfolio will have different risk profiles—some will be more risky and some less risky. If the direction of the overall portfolio changes, this might lead to shifts in specific projects, redefining specific risk profiles. Similarly, the geographical mix of the firm's overall portfolio strategy may change, so that relatively more projects are run in the United States, for instance, while relatively fewer are run in Europe. The split between basic scientific approaches to be pursued may also be adjusted—relatively more emphasis on chemical components research versus biochemistry research for the portfolio strategy of pharmaceutical firms, for instance.

The key is to come up with an overall *balance*, which is meaningful when it comes to risk exposure, geographic split, types of focus areas, such as biochemistry versus chemical components, etc. To manage this portfolio when it comes to risk, geography, scientific component focus, etc. is critical, particularly if one is going after major innovations. In one of the pharmaceutical companies we examined, it was argued that biochemistry had been relatively too dominant in the portfolio relative to chemicals, and that too much of the research had been focused on the U.S. versus Europe. Further there was a silo mentality issue in the organization of this firm which tended to contribute to an imbalance in the reality of its portfolio. Top management clearly needs to drive all of this. It is when this portfolio balance is being shifted—a key prerogative of top management in any science-driven firm—that potential problems might arise when it comes to cooperation with academia. Specific collaboration projects may have to be dramatically adjusted—and it may be hard for the academic research teams involved to understand this without having access to the firm's (now revised) portfolio strategy.

Disappointing research results?

On the question of negative results, one could perhaps say that there might be two fundamentally different reasons for this: bad craftsmanship of the researcher, based on a sloppy design; or a well-prepared scientific design, which turns out to give a disappointing result.

There was a clear consensus from industry that the latter case represents no problem when it comes to publishing. This is, after all, central to the nature of research. The issue of sloppy research design is more troublesome,

however. A quality culture is therefore important when it comes to cooperative research. Good science leads to good quality output—and there is no problem in publishing it then, whether it is positive or negative. Quality must drive the process.

To ensure such quality, perhaps sponsors should be contractually bound to respect the intellectual independence of researchers. This could be done by establishing a registry for "filing" details of all trials, by prohibiting sponsors from taking legal action against researchers except in the case of fraud, and by protecting whistle-blowers who report unscientific and unethical research practices. Dealing with disappointing results thus may have a lot to do with developing a healthy organizational culture with a minimum of organizational politics, allowing truth to be the ruling principle.

Negative results typically need to lead to "stop decisions" on particular research programs. Again, when human lives are involved, the patient's needs have to be key; safety is everything. Beyond this, however, there can clearly be differences of judgment regarding when to stop a project. Here, the organizational culture and reality should be strong enough to counteract any tendency for wishful thinking and entrapment (Brockner *et al.*, 1981).

Should all experiments be hypothesis-driven, the way we have learned to know about it from Popper (1963)? Some argue that we need *both* hypothesis testing-driven research *and* more open-ended experimental research design. Trying the latter is important to arrive at unexpected answers, which one would rarely reach via classical hypothesis testing. Hypothesis testing is typically associated with quantitative research based on precise measurements. It could be that more anecdotal research might be more effective in some settings, however (Brunner, 1986). In the area of human genetics, for instance, some felt that a Popperian approach would be relatively less effective.

Publication of scientific results

One key approach seems to be that there might be a *coordinated* process of granting patents and releasing publications, ensuring that both are generated in parallel. This is meant to ensure good protection of each project and research platform. At the same time, one would be able to keep a current date for publication without having to insist on delays for this. The issue is thus *both* to get adequate patent protection *and* have the data disseminated fast. Still, it seems to be generally acknowledged that the publication process needs to recognize the strong sensitivity for protecting proprietary findings, at least until the research is fully ready. Academia may want to report on short-term results through early publications, whereas industry may want longer-term protection through a thorough patent application process. A well thought out procedure of parallel patent and publication coordination is therefore key.

The issue of too early publication may still be significant. A sign-off procedure, whereby the parties would agree on any article *before* publication and be sure that no trade secrets were revealed, may be normal to avoid too early publication. This "right to agree" on any article's content before publication may thus be critical. Although industry seems to appreciate publication, they may still want to make sure that potential trade secrets are being protected (Stern & Simes, 1997). Obviously, there is a fundamental disconnect here between the interests of the two sides—only good faith and mutual trust can resolve this.

The issue of competitiveness will thus of course play a major role when it comes to the publication side of collaborative research. On the one hand, a given corporation will typically not want to engage in a cooperative research project with an academic institution if the knowledge generated might freely benefit other firms, particularly its competitors; hence, the importance of intellectual property rights and delayed publishing. Still, a firm may want to cooperate on more basic research, in which other corporations might also be involved, to enhance the general boundary of useful knowledge within a more basic field. This sharing of resources among several players—to pursue the basics—can clearly be beneficial. We can perhaps label this pre-competitive research. Cooperation between industry and academia might be particularly fruitful here. But this assumes that participating firms will not impose stringent patent protection requirements or publication constraints. The patent policy—and publication policy as well—will thus have to be more flexible and applied differently in the case of pre-competitive research than in cases where there will be a clear threat of competition. Within the pharmaceutical field, the area of genomics is now generally treated as pre-competitive, with no patents and few publication constraints. Similarly, in chemicals, consumer electronics and in several other industries, one can find significant areas of pre-competitive research. Particularly, with the emergence of web-based research networks for Connect and Develop (see Exhibit 2), a key challenge for the participating entities will perhaps be to "move up the barriers" for pre-competitive research, to allow more "space" for this. This should significantly open up for a more straightforward approach to the publishing of results in these areas.

It has been suggested that a *code of practice* governing the relationship between researchers and sponsors should be established, to guide publishing practices, safeguard scientific independence and ensure impartial handling and assessment of the results. For instance, "the editors of thirteen leading medical journals made an unprecedented joint statement saying they would refuse to publish studies where researchers did not appear to have professional independence." (*Financial Times*, 2001). It was further pointed out that often editors of scientific journals might be biased towards publishing prima-

rily hypothesis-driven experiments, in the Popperian tradition. But, what about publications involving the more pre-paradigmatic type of studies? These should of course also be expected to appear. Will industry allow this type of research to be published—perhaps revealing what might be closer to their strategic thinking, and will the scientific community open up for this? Obviously there might be biases here. And what about publication of negative results? These clearly need to be published as well. Here, several have pointed out that there might be an editorial bias against this—such findings are less "catchy!" Some say that it may primarily be the less prestigious journals that in the end might publish negative results (Easterbrook *et al.*, 1991).

Issues of potential ethical concern

These issues of potential publication biases raise ethical concerns too. The implementation of a good collaborative research project might be seen to have at least four ethical aspects. How might these be handled? There seems to be a rather common practice to have an ethical board, both at the university and the corporation level. Key issues regarding potential ethical conflicts seem to be handled through interactions between such boards.

- First, there is the issue of premature publication. It may be particularly important that the so-called Helsinki agreement is not violated here (*World Medical Association*, 2000). Again, a well laid out contract should safeguard the practice of good ethics when it comes to concluding research with adequate scientific design, worthy of publication. An ethics board may also play a constructive role in the timing of publication decisions.
- Second, the documentation around a project raises ethical questions. The issue of having accessible protocols so that other researchers can verify the results, clear guidelines regarding how to collect, analyze and store data, etc. are all aspects of good research practice. As already noted, the establishment of an independent registry for "filing" ongoing results may also be useful. Again, the contract can do a lot here. An ethics board can also be proactive.
- Third, funding may have an ethical side. If the funding is too closely linked to performance, there might be a temptation to take shortcuts that might violate ethics with respect to how a project is run, with respect to how the publication policy is approached, even perhaps with respect to aspects of safety. This may be particularly dangerous when young, less experienced researchers, such as doctoral students, are involved. Some of the companies responding provide independent funding to doctoral projects, with less pressing performance requirements attached, and/or provide independent

donations—say from their own research foundations—to support basic doctoral research. These firms are sensitive to the fact that the funding should not lead to such pressures that ethical principles are potentially violated. Potential misunderstandings regarding funding may always exist. These should not be of an ethical nature, however. If ethical dysfunctionalities are involved, then they must be resolved—or the project should be dropped!

- The fourth and final issue deals with the fact that in both business organizations and academia there are often internal organizational kingdoms, highly compartmentalized structures, strong but isolationalist academic departments or research groups. Potentially, this can lead to unethical practices too. The potential challenge is the fact that "homemade" norms and practices might develop within such silos, which may stretch what one would normally find as ethical. It is thus important that top management—and top academic leadership as well—pay attention to the enforcement of standard ethical norms and requirements. They must not allow questionable insular ethical practices or interpretations to take hold.

A specific potential ethical conflict might stem from the fact that a university may already be carrying out cooperative research with competitors of a firm newly approaching it. Here, it seems critical that all trade secrets are indeed kept secret. To create procedures with "Chinese walls" must be key. This probably involves using entirely separate research teams on potentially competitive tasks—to mix the people might lead to working accidents. Clear human resource policies are therefore essential. The university in question should see its own reputation as a very critical asset here and it would probably not want to enter into any activities that might jeopardize such a "Chinese walls" approach. There does, in fact, seem to be a reputational safeguarding of potential ethical conflicts. Contracts typically spell out noncompetitive clauses. The potential for strategic leaks to a competitor must be minimal. However, if the sensitivity of a particular project is too high for the company, then it may be that entering into a cooperative research arrangement at all is seen as unattractive.

Finally, there seem to be diverse practice on whether to have a specific ethical board or not. Some have, but often companies do not have this. Such boards may be called for, above all, regarding the issue of ethics and judgment when it comes to safety. This is critical, perhaps particularly in pharmaceutical research. Here, concerns for the patient's safety will be absolutely paramount. Several firms have pointed out that if there are more fundamental ethical problems, then the project might actually be dropped.

Financial contributions

The general principles of the financial side of collaborative research seem to be rather straightforward: that a clear project orientation is established, and that full-fledged negotiations are being entered into when it comes to how the project is going to be financed. Competitive issues will be key here. If too costly, then other university sources might be approached to provide the service. A budget must be established. Funds must be managed on a real-time basis, only to be released when clear milestones are being met. Specifically appointed project leaders seem to be critical in all of this. The control of the financials would be part of the project leaders' follow-up. In summary, key words would be "projects," "defined budgets," "clear control," "clear negotiations of specific cost items if things get out of hand" and "clear gradual release of funds against a project's progress." There would thus be norms regarding how costs are incurred and how to handle misunderstandings. Also, the link between the financial dimension and the contractual dimension must be clear. This must also make it clear who owns the research (DeAngelis, Fontanarosa & Flanagin, 2001). In short, good project management practices must be followed (Vollmann & Whybark, 1997).

Other unforeseen conflicts

As pointed out, the contract should provide guidance on how to handle potential conflicts, how to settle, even terminate them. A good contract is therefore essential. The legal department may play an important role in the handling of contractual conflicts. There might also be some procedures for handling escalating conflict here. For instance, the *Chief Technology Officer* may end up being involved if a conflict is particularly difficult. The prestige and perceived importance of the academic institution may also play a role regarding the way conflicts are handled. There may be more tolerance towards settling conflicts in ways that are relatively more favorable to the academic institution if this is seen as a particularly prominent research team from a reputable university.

A frequently recurring potential source of conflict is intellectual property rights. Intellectual property rights typically must belong to the industry side; if this is not clearly understood, there could be potentially nasty conflicts, according to the conventional point of view of industry. This is of course related to such issues as publications, including establishing guidelines for publications that respect the intellectual property rights. We have already discussed this. Again it should be stressed, however, that on the industry side an open attitude is called for—not a dogmatic one. With the latter there would probably be little or no collaborative research at all!

In general, as long as the legal framework typically seems to work well, there might be few practical problems with the procedures for handling conflicts. The rights of the parties will then be clear and respected by all. In the case of escalation of conflicts, the more senior officers that are then involved, both from the industry side and the university side, typically seem to be able to handle this in an amicable way. The mutual will to succeed—jointly—is key! Both parties must be mature enough to live by "when in doubt—do the right thing" (Schwarzkopf & Petre, 1992) when it comes to making collaborative research happen.

CONCLUSION

The phenomenon of collaborative research between industry and academia seems to be growing rapidly. This is not surprising, given the dramatic increase in the general emphasis on relevant knowledge. The winners will be the organizations that "see" business opportunities early, before they are obvious to everyone else, i.e. those organizational entities that have the knowledge to create novel business opportunities.

Clearly, more innovative research, undertaken at an even higher speed than before, is key to this. To achieve it, the need to draw on eclectic groupings to obtain new knowledge creation will be more acute than ever. The emergence of web-based communications technology and the establishment of networks for collaboration on R & D will speed up the process. This should lead to even more collaborative research efforts.

In this chapter, I have pointed out several practical challenges when it comes to how this collaborative process might actually take place. The trends when it comes to all of this are indeed encouraging. Collaborative research can successfully take place provided that:

- there is a positive willingness—a sense of maturity—on both sides
- there is a clear commitment to quality, ethical behavior and respect for fundamental values
- there is a clear understanding of how to dismantle dysfunctional pressures and enhance ethical norms. There must be a positive view of the need to settle disputes pragmatically—one must see opportunities, not problems!
- there is a willingness to adhere to a clearly drawn legal contract, including constraints on publishing due to patents—but also to be active in the pre-competitive collaborative research area, where there would be no patents and few publication constraints.

All in all, the issues at hand relating to collaborative research seem to be manageable. One would thus expect that collaborative research will expand

even more in the future, and that industry will be ready to contribute to such growth. One would similarly expect that academia will be even more prepared to deal with the industry side in the future. This may be particularly significant when it comes to attempting to develop a more open culture, with fewer silos or kingdoms, and more understanding of the need to see industry as a partner. It will be all about bringing the best brains from both sides together.

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