CHAPTER

University-Industry Collaborations: a Source of Continuous Mutual Stimulation and Inspiration

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INTRODUCTION

In a small country like Switzerland, close contacts and collaborations between industry and academia have a long tradition. They have been and continue to be essential for research-based healthcare companies like Roche. With increasing globalization such collaborations are considered with groups all over the world. They are always sought on the basis of clear win-win situations with groups of best technological competence and scientific excellence. Roche has a particular impressive record of many very successful collaborations of mutual benefit to both Roche and the academic groups.

Close contacts, cooperations and collaborations with academic groups have been a constant source of mutual stimulation in science and technology, new discoveries and joint learning, and ultimately creation of true innovations by transforming novel ideas into successful solutions.

In order to ensure mutually beneficial collaborations with academia, there are a number of critical issues to be carefully observed on both sides, which will be discussed below. Interestingly, even with all the positive experiences over long periods of time, there are occasional misconceptions, some recurrent, others of more recent origin due to changing politics or modes of operation. They tend to counteract good collaborations and need to be addressed accordingly.

DIFFERENT AGENDAS

Due to their different missions and mode of operation, academia and industry are subject to intrinsically different agendas (Figure):

Table 1: Some key differences between industrial and academic research due to intrinsically different agendas and focus.

Academia	Industry
novelty/curiosity-driven	Goal/target-driven
novelty, publication	Impact in Drug Discovery
Satisfaction of curiosity	Decision-critical data
Education on projects	Experts in charge
Volatile expertise	Continuity of expertise
Struggling for funds	Struggling of approval
Long project approval times	Prompt start on needs
Continuity/project life cycle	Flexibility to change or stop
Research alone	Research in teams
Teaching to next generation	Peer knowledge exchange

While academic groups may be largely curiosity-driven, industry is primarily focused on preset tangible targets. This does not necessarily imply that basic research is performed solely in academia, while industry is the place for applied research or engineering only; nor does it mean that basic research, applied research and engineering always follow in a linear sequence from an idea to a practical solution. These are recurrent misconceptions, particularly regarding research and development in the Life Sciences and Medicine, where much fluctuation between fundamental, applied research and development is the rule and indeed mandatory for success. It goes without saying that purely curiosity-driven approaches can be perfectly legitimate for academia, while a tightly target-focused attitude without lateral explorations may have to be imposed during certain phases of industrial research in order to ensure success.

New discoveries, advanced knowledge, improved understanding and publication thereof, as well as education on frontier research, are the primary goals of academia. This should not preclude the possibility and often desirability for academic groups to explore opportunities to convert their discoveries into novel practical applications or technology developments Depending on the nature and the actual stage of a discovery, this can often be best done in collaboration with a suitable industrial partner who can offer a broad technology base, experience and application environment in order to perform the necessary evaluations and required feasibility studies quickly, thus guiding successful further developments. For the healthcare industry, on the other hand, the leading principle must be sustained significant innovation in health care; scientific publishing is not the primary goal, although it is a regular, essential and desired activity of industry that can contribute much to the advancement of science and strengthening of contacts to academia. Accordingly, an industrial group will always strive for research activities that promote the project towards its set goals and provide validation- and decision-critical data as early as possible, whereas the academic group may have more flexibility to explore other scientific directions that promise novel discoveries, independently of an originally set objective.

In industry, a group of senior experts is collaborating on a given project. This contrasts the typical situation in academia where projects have to be carried out with undergraduate, graduate, or young postdoctoral fellows, i.e., collaborators who are still in education and learning on projects. It should be emphasized that frontier research is an exquisite vehicle for best education of young scientists. This important aspect must not be ignored by a potential industrial partner. Therefore, the latter must not expect or push for important results too quickly and, should even be prepared to offer additional education or training of young collaborators of the academic group by the experts in its industrial environment.

In most cases, the academic research supervisor represents one major discipline, and the multidisciplinary aspect of a complex project has to be managed through collaborations between groups in different institutions or universities. The establishment of a multidisciplinary research group in academia is the exception. In the healthcare industry, it is the rule. Thus, collaboration with an industrial partner may offer a particular benefit to an academic group. This aspect should be clearly recognized by both parties.

Another important difference concerns the continuity of expertise established by the collaborators. Typically, young collaborators, after concluding their Ph.D. thesis or postdoctoral research period, are expected to leave for a further training stage abroad in complementary fields. Rarely does a collaborator stay on in the same group for many years, even if his or her departure represents a major loss of competence for the research group. Thus, technical or methodological expertise in an academic group tends to be volatile. It is essentially maintained only by its supervisor and, in lucky cases, senior group members in permanent positions. Industry, on the other hand, takes all efforts to maintain its expertise and skill set in key scientific and core technology areas and can do this by an appropriate personnel policy.

Research groups are used to struggling for approval; there is always competition between good ideas. Academic groups are used to quite long approval times; however, on top of this, even best projects may receive an "approved, but not funded" verdict or still face a substantial reduction of the requested support, which is often totally unrelated to the quality of the project. Such measures slow down or render a project ineffective. In general, industry cannot accept such non-competitive measures. Once a project is recognized as being of high priority, everything is done to ensure that it starts promptly and with sufficient resources.

Scientific projects often develop their own dynamics, spawning sub- and side projects, establishing frameworks of internal reference that tend to maintain longevity irrespectively of external points of reference or peer review. In an industrial environment, projects have a clear target and are logically structured into shorter phases with defined deliverables and assessment points. Decision-critical experiments are performed in due course to address all relevant aspects of the project in each phase in order to guide towards possible solutions and to re-assess the validity of the project at each stage. If such a reassessment leads to an overall negative conclusion, a given project is stopped promptly in order to free the resources for other, more promising tasks. The situation is often quite different in academia, where each project also has an important educational function. This is particularly true for Ph.D. theses which often cannot be stopped abruptly or radically shifted into other directions. Rather, the initiated work would continue along related sub-projects that could still produce publishable results and finally lead to a successful wrap-up of the thesis, however, without ever reaching the goals originally set. This attitude may be fully justified and should be recognized as such by the industrial partner in a given collaboration. Likewise, the academic group should also understand the mechanisms of industrial project management with its regular assessments, decisions and prompt actions on new critical results.

Industrial projects are typically driven by a project group that involves many experts from different scientific and technology backgrounds, thus ensuring full and timely support from all required disciplines. This contrasts most settings in academia, where a research group spans essentially one major scientific discipline or technology area. The integration of several disciplines and technologies within one and the same academic group is the exception, and is encountered only with relatively large and fully established research groups. Even for such groups, it is quite common to seek collaborations with other academic groups to complement their own expertise and skill set, in order to make sure that a given project receives the necessary multidisciplinary support typically required for cutting-edge life science projects. Interacademic collaborations may suffer from proper task allocation, timing and other coordination problems, as an academic partner typically would not favour "service support" to other groups, but needs to focus on collaborating contributions that can lead to first-author publishable results as well as work efforts that can be rounded up in Ph.D. theses of its collaborators. The situation is quite different with an industrial partner, where the multi-disciplinary environment may be fully established and the concept of (expert) service provision to a project is a well established mode of operation. A collaboration with an industrial partner may thus provide a number of significant benefits to an academic group. In order to foster cross-disciplinary collaborations, academic research networks and centres of competence have been established in recent years. These are interesting new developments. However, it remains to be seen to what extent such largely top-down implemented schemes will succeed in overcoming intrinsic barriers to unconditional collaborations.

Academia has a prime responsibility in teaching next generations. Scientific and technological training is best provided by involving young talents in research programs at the cutting edge. In industry learning is a constant and lifelong requirement, which is facilitated through permanent involvement in multi-disciplinary project teams. Apart from this, there is a need for more formal knowledge transfer, which is being addressed by courses at different levels, regular or ad hoc organized seminars with internal or external experts, or more recently by elegant web-based knowledge management tools. The unique feature of all these teaching activities in industry is their peer-to-peer nature, differing from the senior-to-junior teaching in academia. In collaborations between industrial and academic groups this should be recognized, and special efforts should be undertaken by the involved industrial experts to provide adequate teaching to the junior partners involved from the academic side. Most often this can be and is being done "through the project". Interestingly, most often this is not seen by the industrial expert simply as a time-consuming and painful obligation, but rather as a most rewarding and motivating exercise bringing young interested talents "up to speed" in novel technologies and concepts required in a given project.

ADDRESSING THE DIFFERENCES

These differences in environment, concept and operation need to be properly recognized and respected by both partners in collaborations between academia and industry. Interestingly, it appears that in general good solutions can be found that equally satisfy the needs on both sides. Under such circumstances, these collaborations are most rewarding and a continuous source of mutual stimulation and motivation, regularly leading to significant scientific advancements and interesting innovations.

It is worth noting that in the majority of all such collaborations, comparatively little money is involved from the side of the industrial partner, i.e., ranging from a one-time paid-up fee for some specific materials, (unpublished) procedures or key data sets, to fellowships for one or more junior collaborators in the academic group over a limited period of time. Yet the benefits for academic groups can be enormous and multi-faceted. They often lie more on the immaterial side, giving access to key technologies to the academic group, opening new research opportunities, providing insights into new scientific and technical problem areas of high actuality, significance and impact. Therefore, many academic research groups actively seek and receive this type of collaboration.

There has been a good tradition for such collaborations to be set up easily and with lean conditions. However, more recently, academic institutions have come more and more under financial pressures, being forced to seek substantially more funding from non-governmental sources. To the extent that governments are not recognizing the prime value of higher education of its young generations, as well as the eminent importance in promoting science and technology, this forces academic institutions to seek more financial returns from their research through collaborations with paying customers. Whether the concomitant commercialization of science is a viable concept in the long term remains to be seen.

In principle, nothing is wrong with the imposition of science and technology politics that foster the entrepreneurial attitudes of professors and their academic research groups, provided this does not jeopardize the prime missions of academia to guarantee excellent modern education and knowledge transfer, independence of decision-making, as well as advancement of science and technology ultimately for the benefit of its paying society and eventually mankind at large. Along this philosophy, most if not all larger academic institutions have established special technology transfer groups with a two-fold responsibility. On the one hand, they should assist the academic research group to better assess their possibilities in seeking intellectual property protection and, on the other hand, help them in negotiating the most favourable conditions for collaborations with industrial partners. If properly done, such technology transfer groups can be truly helpful also for an industrial partner to set up a good collaboration, since their expertise in formal aspects of technology transfer and intellectual property protection may simplify the negotiations with an industrial partner.

However, in many cases and in spite of best intentions by technology transfer groups, their activities have negative impacts on intended collaborations of academic groups with industrial partners. This is particularly true when their primary focus is on a short-term maximization of the financial income for a whole research institute, rather than on the actual needs of and the many immaterial benefits for a specific academic group through collaboration with an industrial partner. The often overestimated value of an offered technology or exaggerated projection for a potential outcome from a given collaboration further contributes to unrealistic financial requests and stiff legal formalities which tend to undermine easy collaborations on a step-by-step, exploratory and mutual-benefit basis. The technology transfer groups often also underestimate the possibilities (and needs) of a globally operating enterprise to select collaborating partners from academic institutions all over the world. Industry will always look for the best collaborative partner, not only in scientific and technological terms, but also regarding open and lean ways for cooperation on a true win-win basis for all involved partners.

SPIN-OFF START-UPS

Another remarkable development is the tendency of academic staff members to spin off some of their research discoveries into start-up companies for further development and commercial exploitation. This has become quite common in the U.S. over the last two decades and has also been advocated in Europe as a means to accelerate technology transfer from early discovery to tangible applications with commercial impact. While this is certainly a viable modality for entrepreneurial researchers in academia and may offer interesting new job opportunities for young scientists, there are several critical aspects that have to be carefully observed.

Starting a new enterprise around a promising discovery or technology may be comparatively easy, although the efforts, particularly in Europe with its partly over-regulated and financially not overly abundant environments, must not be underestimated. Likewise, the rapid and successful development into a truly selling product is often not easily achieved. However, even if the initial hurdles are mastered successfully, the maintenance of the enterprise by a sustained flow of innovations to keep it ahead of its competition is considerably more difficult, and this is where most successfully started enterprises still eventually fail. All this takes a heavy toll in energy, time and effort from the founding scientist in academia and may detract too much from prime scientific and teaching responsibilities. More importantly, the founding and running of a private enterprise requires an established intellectual property base and its continuous development. Accordingly, patenting has become more widespread for academic research groups compared to the past. This, however, keeps them from early publication, which may adversely affect young scientific collaborators whose further career development may critically depend on timely publications, as well as the possibility of presenting their research at international symposia or in front of recruiting bodies. Furthermore, it can lead to serious conflicts of interest when the founder wishes to enter further collaborations with other industrial partners that may be considered competitors in some of the activity areas of the small enterprise. Furthermore, it may counteract the easy exchange of scientific results both within the research group of the founder itself and with other academic research groups, which may be quite disruptive for an academic research environment. It is often not easy, but absolutely mandatory, to find an acceptable balance between the potentially positive and negative consequences of running start-up companies in parallel to one's prime academic responsibilities.

CONCLUSION

In spite of all these developments, we have witnessed a continuous flow of highly rewarding collaborations with academic research groups and are quite confident that this mode of close, lean and open industrial-academic interactions can be maintained in the future. They are a valuable source of much mutual stimulation, inspiration and discoveries. They represent a most effective way for academic groups to sense the rapid developments of science and technology in industry and to see new needs and opportunities for basic and applied research. They also offer the industrial partner possibilities to spin out research questions of fundamental interest that regularly emanate from applied research and development activities. Thus, both academic and industrial partners may profit much from such collaborations, which ultimately advance science and technology to the benefit of the science community at large.