



Feature

Doing science together: Gaining momentum from long-term explorative university–industry research programs

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'Doing science together' collaborations are a more intense form of university–industry interactions and are characterized by a mutual involvement and active participation of academic and company scientists in scientific research. Here, we examine the successful approach that AstraZeneca and its internationally renowned academic partners, Karolinska Institutet and Uppsala University, implemented to fully unlock the potential of all parties in long-term, explorative, truly collaborative research programs. The underlying premises of these successful research programs are three collaborative governance mechanisms (3MCs) that are required that leverage the strengths of each organization: mutual collaboration; mutually beneficial science; and a mutual governance model with senior management involvement.

Keywords: doing science together; academic engagement; university industry interaction; joint research; research collaboration; joint publications; governance; alliance management; managing collaborations; drug development

Introduction

Scientific knowledge that forms the basis for innovation activities in the pharmaceutical industry is rapidly evolving. Science leads to new insights and tools that pave the way for innovative ways to address global health challenges. To keep

pace with the developments in the relevant scientific areas, pharmaceutical companies develop strategies for integrating knowledge originating outside the boundaries of their own research and development (R&D) processes. Delivery, market, regulatory, and competitive pressures,

along with emerging science, require the prioritization of the portfolio programs and force companies to search for viable partners in academia.

The literature on university–industry interactions emphasizes that there are various forms of knowledge-based interac-

tions between academic institutions and companies.^{1,2} In general, university–industry interactions involve coordinated R&D activities and resource pooling among companies and universities to reach mutual R&D objectives.³ Larger pharmaceutical companies in particular have been engaged in collaborative partnerships with academia to address R&D challenges for decades,^{4,5} in addition to merger and acquisition strategies.⁶ Although these collaborative science programs share the objective of increasing the innovation potential of a company,⁷ they differ in terms of the level of active engagement of company researchers. Traditionally, universities have focused on explorative research, whereas companies have predominantly focused on the commercialization of knowledge.^{8–10} More recently, research activities have become more open and use new forms of organizing collaborative research.^{6,7,11–13} In the context of these university–industry interactions, literature on conflicting logics highlights the difficulties of scientific collaboration between academic and industry partners, resulting from different objectives, orientations, and perceptions.^{14,15}

Here, we contribute to current understanding of the recent phenomenon of long-term explorative research collaborations between university and industry by proposing a new concept of ‘doing science together’ collaborations. ‘Doing science together’ means that all partners have almost-equal participation in scientific activities, exchange new ideas, and get inspiration. The phenomenon we describe below can be considered a more intense version of university–industry interactions, involving long-term, explorative research collaborations. Being a more intense version of university–industry interactions, ‘doing science together’ collaborations challenge our understanding of incentives, alliance management, partners, gestation period, and their respective research contributions, especially regarding the active participation of each partner in long-term, explorative research collaborations.¹⁴

Our contributions to this understanding revolve around characterizing this specific type of collaboration and developing recommendations for governance across academia and industry as well as policies to attract these types of fruitful

collaboration to gain momentum and improve value. We study the benefits to partners as well as how governance structures change within long-term explorative collaborative research. We do so by considering four of AstraZeneca’s large-scale, long-term, overlapping collaborative research programs with its internationally renowned Swedish academic partners, Karolinska Institutet and Uppsala University. We conclude with specific recommendations based on the lessons learnt.

Varieties of collaborative science

We conceptualize the various types of R&D-related interaction between academia and industry along a continuum, from ‘commissioned research’ that is directed to company needs, to research that is exclusively driven by academic scientists. Depending on the position on this continuum, there are differing demands upon a company and its partners in academia in terms of capabilities and demands for successfully managing the research-based university–industry interactions.

‘Commissioned research’ is usually of direct commercial relevance for companies.¹⁶ We refer to this type of research as ‘commissioned research’ and not as ‘contract research’ because collaborations involving companies are normally contract based. Hence, contract research is a less specific term to characterize this type of research. In commissioned research, the company specifies not only research questions and expected outcomes, but also research tasks that ought to be completed and the methods that should be applied. In this case, the company outsources well-defined parts of a research or development project to academia. For successful ‘commissioned research’, the company needs skills for procurement and strong contracts, whereas the academic partner needs the competencies for the deliverables.

‘Doing science together’ collaborations are characterized by a mutual involvement and active participation of academic and company scientists in both the scoping of the joint research and implementation of the project. Given that both parties are mutually involved, absorptive capacity and skills for procurement are not enough to manage this type of collaboration successfully. In addition, it is required that governance mechanisms are put in place

that bridge the different institutional logics of academia and industry. Given that the outcomes of more explorative research cannot be clearly defined ahead of time, contracts should state the principles of the collaboration but need to be supplemented by governance mechanisms that allow for an active management and built-in flexibility of the collaboration toward specified objectives.

Academia-led research constitutes the other end of the continuum, where the company might collaborate through financing and monitoring the results obtained by researchers in academic institutions. Typically, this type of research is highly explorative and can lead to discoveries that do not immediately translate into R&D projects for the company. The company needs skills and individuals to interpret and assess the strategic relevance of science (also called ‘absorptive capacity’¹⁷), whereas the university should have stronger science skills.

Here, we characterize four different ‘doing science together’ collaborations between AstraZeneca, Karolinska Institutet, and Uppsala University.

Collaborations between AstraZeneca and Karolinska Institutet and Uppsala University

To study the phenomenon of ‘doing science together,’ we collected information on four of AstraZeneca’s research programs with its partners in Stockholm and Uppsala (Sweden), in which some of the authors participated. More specifically, we draw upon close interactions as well as discussions and specific interviews with the experts involved at both the company and the universities, as well as access to systemic project data structured in the company databases. These materials are used to analyze the four chosen research programs. Hence, we follow a qualitative research approach that is close to the informants and their interpretations, as recommended by Gioia *et al.*,¹⁸ to build upon the expertise of the authors for eliciting tacit knowledge and interpreting events to build meaning.

The company focuses on collaboration with internationally leading scientists and their research groups.¹⁹ The agreements tend to be concentrated on specific research and geographical areas. These collaborations can involve many different

forms of knowledge exchanges, alongside specific contractual agreements, as further analyzed below. In these programs, AstraZeneca has made substantial investments of multimillions of US dollars into academia.

To attract R&D investments and spur innovations, the Swedish Government wants to incentivize research collaboration between academia and industry. To attract ‘doing science together’ collaborations, governmental funding to catalyze and encourage academia to collaborate with companies can lower the threshold for academia to engage. The incentive for a government is to drive knowledge co-creation leading to innovations meeting global health challenges, anchoring company R&D investments, and paving the way for future export earnings. In addition, the large Swedish national infrastructure Science for Life Laboratory (‘SciLifeLab’)²⁰ is a prime example of how a government can provide the infrastructure forming a national platform for collaborative groundbreaking science.

All four research programs are specifically chosen for being large-scale, long-term, and trust-based relationships. The relationships were informal, in part, based

on personal contacts at first or an answer to a call for proposals from the company, but eventually relied more on developed processes at the organizational levels. The programs cover a range of therapeutic areas relevant for AstraZeneca (Table 1). Table 1 also specifies the mutual benefits to the partners, as well as lessons for improvements to the governance structure.

Each of the four research programs addressed different therapeutic areas but provided clear mutual benefits for AstraZeneca and its academic partners. The governance structures show some similarity because some form of Joint Steering Committee in which decisions regarding the programs were made by senior academics and senior managers from both partners was established in each program. This governance structure developed as a learning from the earlier programs (particularly positron emission tomography; PET) when the need for joint steering became evident to ensure that the program reached the desired objectives. These improved governance practices and structures were enabled by the shared understanding of partners’ competences and objectives as well as by the presence of alliance man-

agers with a science background. These enabling circumstances supported effective communication, building of trust, and exploring new ways to advance research programs. In addition, the experiences gained in earlier programs as well as the trust and the understanding of each other’s objectives generated through these programs supported the development of more streamlined contractual arrangements. These contractual arrangements became increasingly fit for purpose, thus reducing the turnaround time for new collaborations.

In addition, the governance practices and structures enabled AstraZeneca and its academic partners to make difficult decisions, such as the termination of the Translational Science Center (TSC) research program that, after a reprioritization of research areas within AstraZeneca, lacked alignment of the research goals between the partners. In addition, the joint scientific output was not commensurate with the funding provided. The governance structures established in the four research programs were also designed to act as quality control mechanisms and a means to reduce concerns around the quality and reproducibility of the associ-

TABLE 1

Overview of the four selected research programs, including partners, area, benefits, and governance lessons.

Project	Therapeutic area	Mutual benefits	Governance
PET 2006–2026 Partner: Karolinska Institutet (KI)	Initially central nervous system diseases; from 2012, extended to oncology, respiratory, cardiovascular, and inflammatory diseases	KI gained access to AstraZeneca’s funding, pharmaceutical expertise, and compound library. AstraZeneca gained access to scientific and technical competence in more than 100 subprojects and new insights into their drug candidates	Collaboration based on dual employment and co-localization; Joint Steering Committee and Method Development Committee
TSC 2012–2018 Partner: KI	Cardiovascular, metabolic, and neurological diseases	Pool for future recruitments for both partners, validating proof-of-concepts, and publications in academic journals	Funded postdocs co-supervised by KI principal investigator and researcher from AstraZeneca; Joint Steering Committee
SciLifeLab 2014–2019 Partners: KI, KTH Stockholm, and Uppsala University	Various; aligned to areas in AstraZeneca’s strategic interest	New avenues for therapies; progressing from <i>in vitro</i> to <i>in vivo</i> studies with validation in clinical cohorts through patient segmentation; discovering biomarkers; progressing compounds to clinical testing; improvement of patient care; and publications in academic journals	AstraZeneca in charge of process for selecting grants, which were allocated to three academic institutions: Part of larger national initiative: Scientific dialogs to align objectives and outcomes: Peer Review Committee: Joint Steering Committee
ICMC 2013–2020 Partner: KI	Cardiovascular and metabolic diseases; three main strategic areas: cardiac regeneration, diabetes, and diabetic nephropathy	Joint journal publications and conference presentations; joint set-up of single-cell sequencing platform	Senior representation in Joint Steering Committee: Joint research

*It should be acknowledged that publications are not a perfect representation of collaboration and that not all co-authors contribute equally to a manuscript.

ated research. More specifically, research proposals associated with the four research programs were scrutinized by a panel at AstraZeneca and, if approved, supervised by the corresponding Joint Steering Committee to decide on progression, suggest corrective measures, or propose termination.

The four research programs are also described in terms of their explorative nature and the active participation of AstraZeneca researchers. Figure 1 positions the four research programs within the continuum between commissioned and academia-led research. The PET program is characterized by a more commissioned approach and a less explorative nature, but still with an active participation of AstraZeneca researchers. The Integrated Cardio Metabolic Center (ICMC) program was designed from the start as a highly explorative ‘doing science together’ program. The two other programs, TSC and SciLifeLab, started as explorative academia-driven programs but with limited active participation of AstraZeneca researchers. However, this participation increased over time for both programs, partly because of active alliance management and improved governance on both sides. The programs developed into ‘doing science together’ programs characterized

by mutual collaborative research between company and academic researchers.

Given the explorative nature of these research programs, it is not surprising that journal publications and conference presentations jointly authored by AstraZeneca researchers and their academic partners have been key benefits and have served as key performance indicators (KPIs) of the collaborations. AstraZeneca researchers published 1682 journal publications originating from collaborations between AstraZeneca and either of the two universities (Figure 2)*. This high number of publications demonstrates the dedication toward publications within these explorative collaborations, which should be emphasized given that recent research has suggested that companies are withdrawing from publications.²¹ At the same time, companies increase their probability of publishing in high-reputation journals through collaborations with other companies.²² However, AstraZeneca’s academic partners might be very interested in publishing collaborative research because the collaboration might, up to a threshold, increase the probability of publishing in highly reputable journals.²³ Publishing in these journals also demonstrated the research associated with the ‘doing science together’ collaborations meet standards and expectations of the sci-

entific community in terms of reproducibility, data quality, and research designs.

The knowledge generated from the collaborations and interactions with the external scientific community was added value toward making AstraZeneca’s research more effective. Given that the collaborations were in the early discovery phase and not pertaining to a specific drug, the scientific work was linked toward validating ways to monitor disease progression. In this context, concrete primary outcomes were, for instance, the recruitment of patients to a clinical trial sponsored by AstraZeneca as well as the comparative identification of differently expressed genes between diseased and normal tissue. Secondary benefits included the identification of specific patient cohorts that could receive specific treatments for previously unmet therapeutic needs.

Gaining access to AstraZeneca’s excellent research capabilities enabled the university scientists involved in the collaboration to realize benefits that go beyond the recognition associated with publications. More specifically, the collaborative research programs with AstraZeneca provided many of the involved principal investigators at Karolinska Insti-

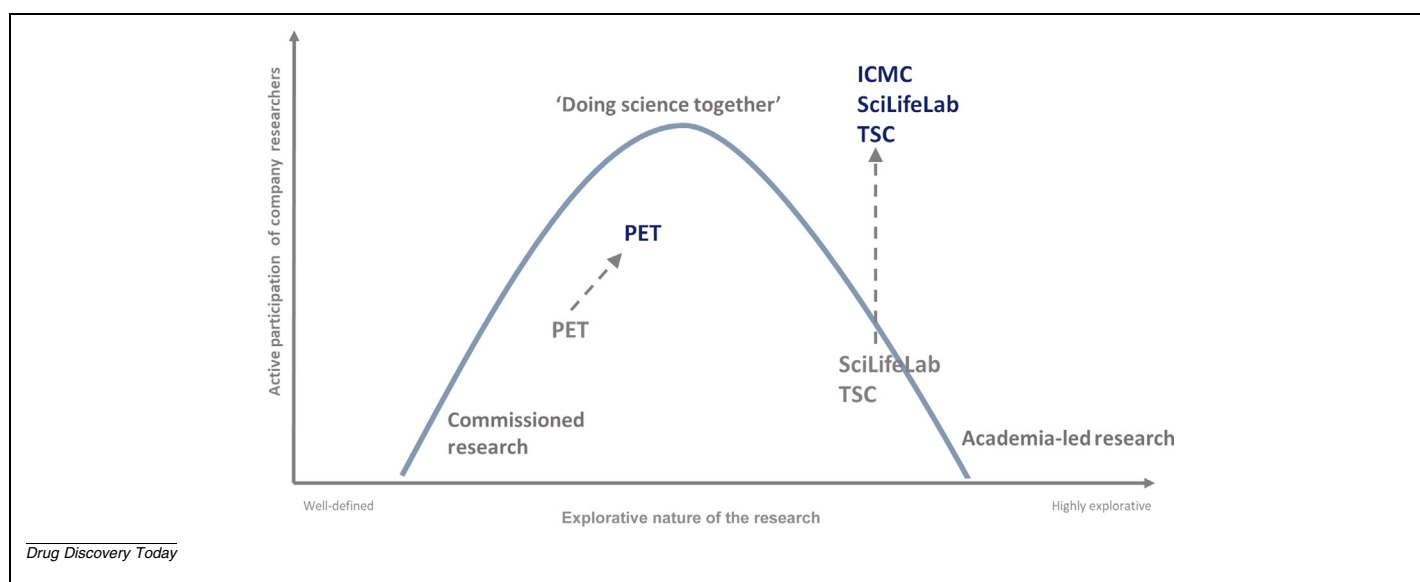
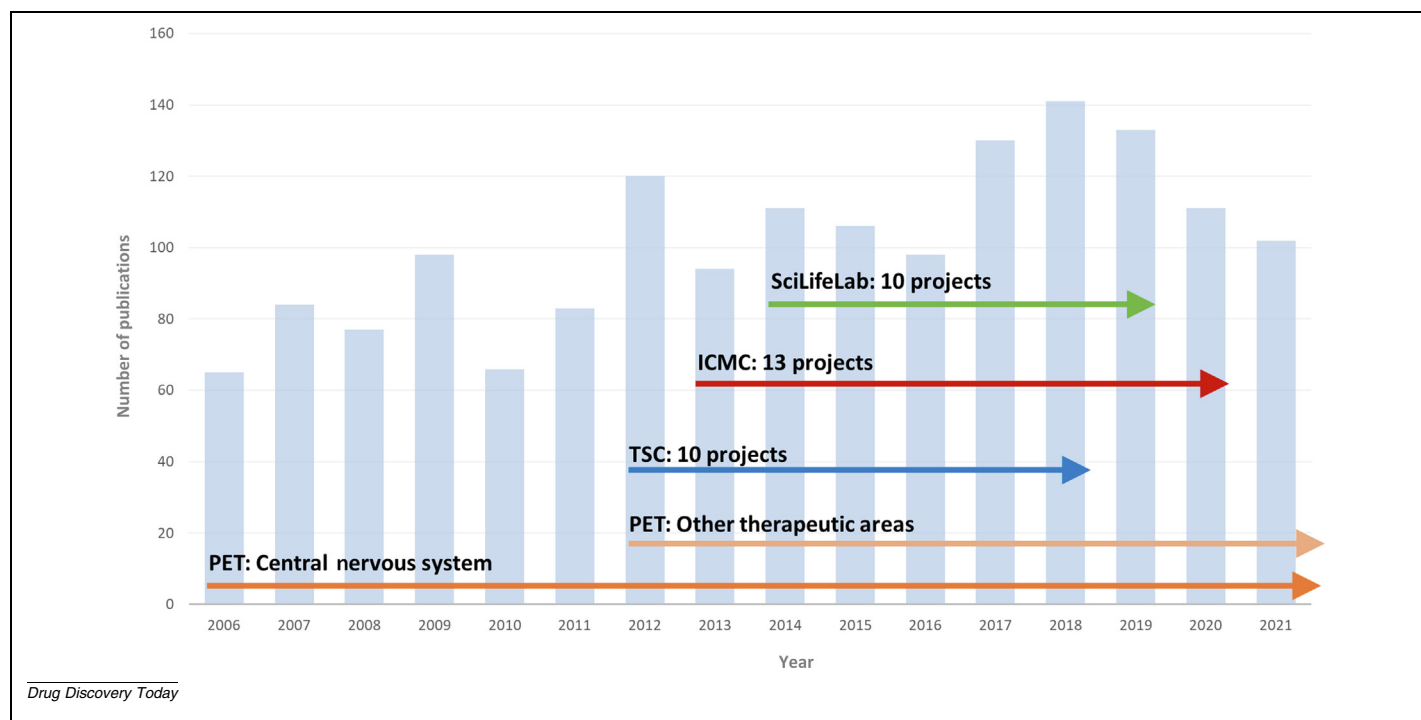


FIGURE 1

Four selected research programs and their development within the ‘doing science together’ landscape. The figure characterizes the four research programs between AstraZeneca and its academic partners, Karolinska Institutet and Uppsala University, based on the degree of the explorative nature of the research and the active participation of company researchers. The arrows illustrate how the program characteristics changed over time. Abbreviations: ICMC, Integrated Cardio Metabolic Center; PET, positron emission tomography; SciLifeLab, Science for Life Laboratory; TSC, Translational Science Center.

**FIGURE 2**

Co-published articles between AstraZeneca and its partners Karolinska Institutet and Uppsala University as performance metrics during the duration of the four research programs. The figure illustrates the number of articles that AstraZeneca researchers co-published with researchers from Karolinska Institutet and Uppsala University per publication year based on Scopus data obtained in March 2022. The arrows indicate the duration of the four research programs studied in this article. Abbreviations: ICMC, Integrated Cardio Metabolic Center; PET, positron emission tomography; SciLifeLab, Science for Life Laboratory; TSC, Translational Science Center.

tutet and Uppsala University with the foundation for successful additional grant applications for future projects from national and international funding agencies. As an example, a principal investigator who received a substantial grant from the Swedish Foundation for Strategic Research, stated that ‘the outcome of the collaboration with AstraZeneca has been a valuable basis to receive larger research grants’.

Concluding remarks: 3MCs insights for improving the governance of ‘doing science together’ university–industry interactions

Our 3MCs insights aim to facilitate successful, exploratory, active, and long-term research collaboration, which we call ‘doing science together’ collaborations. Although these insights are based upon long-term collaborations between AstraZeneca, Karolinska Institutet and Uppsala University, the 3MCs should be relevant to many firms and universities as well as to governments wanting to incentivize collaborative efforts leading to firm R&D

investments and export revenues from innovation.

Here, we present three insights for mutual collaborations (3MCs) for improving governance of collaborative research between pharmaceutical companies and universities.

Mutual collaboration

Long-term explorative ‘doing science together’ research can be successfully developed when both sides have the capabilities and have developed high trust and expertise. This enables both partners to make difficult decisions about fit and alignment regarding their strategic and operational objectives. These decisions might imply that some scientists and some projects are not included, and terminating collaborative projects happens adaptively throughout the research programs. Both sides win through exchanging challenging research questions, knowledge, materials, and research infrastructure. The university as an organization and its researchers learn more about how companies work, facilitating later collaboration. Moreover, those

university scientists selected for collaboration also continue to do science, in the sense that they publish papers, recruit talent, obtain awards, grants, and scientific reputation, and some even start their own companies.

Mutually beneficial science

Both partners must achieve their expected benefits. In the four research programs discussed above, the company and the university scientists benefited through access to researchers and expertise, research processes and infrastructure, unique cohorts, biobanks, data, and data analysis resulting in biomarkers and targets, and subsequent funding or follow-on projects. From the company side, these benefits are often useful intermediary outcomes within the process of developing new pharmaceutical products. Moreover, joint publications are part of the contract with academic partners. All journal publications, not only those in prestigious journals with high impact factors, are recognized as opportunities for making the research visible both within and outside the company. These

publications capture knowledge emerging as part of the research journey of postdoctoral scholars and PhD students. Another important mechanism for facilitating knowledge flows in long-term projects is dual appointments, such as via affiliations with both organizations, which can range all the way from those at very senior-level positions to PhD students.

Mutual governance model with senior management involvement

'Doing science together' collaborations between universities and firms require specific governance structures, such as dedicated Joint Steering Committees with senior managers and scientists as well as alliance managers that speak the language of the researchers. In the four research programs discussed here, the governance structures became increasingly characterized by senior management-level decisions and by including other departments (e.g., Finance and Legal) into decision processes that resulted in templates for agreements and updates. This shortened the time lag between deciding and executing the research so that more time could be spent on collaborative research. Governance included adding senior managers to the programs' Joint Steering Committees as well as assigning dedicated alliance managers at both partners. In doing so, more mutual respect and trust was developed, which facilitated overall understanding and communication. The governance enabled both parties to share knowledge through co-location and dual affiliations and to set up new more recent research programs that are truly collaborative.

Conflicts of interest statement

Three authors (Kaushik Sengupta, Lena Lewin, and Anna Sandström) have been involved with the collaborations that are studied in this Feature with Kaushik Sen-

gupta and Lena Lewina working as Alliance Managers. We acknowledge the fact that these authors collaborated in these research collaborations when describing our research design on page 2.

Data availability

The data that has been used is confidential.

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