

NEW MODEL FRAMEWORKS FOR UNIVERSITY AND INDUSTRIAL PARTNERSHIPS

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Opportunities for universities and businesses to collaborate are changing rapidly in response to shifts in the global economy. In the United States, investors expect businesses to accelerate their growth and to deliver greater return on investment, creating a push to innovate and innovate quickly. Ongoing globalization also drives companies to develop enhanced and novel products, methods, and processes to stay ahead of competition from overseas.

In response to these needs, companies are finding a competitive advantage in working externally and developing strategic partnerships. Companies realize they can accelerate innovation by leveraging external expertise in new ways with partnerships that complement their short-term and long-term needs. Unlike previous university engagements that may have focused only on philanthropic giving or recruiting efforts, the new engagement models are strategic and tightly aligned with business needs. Universities are responding to these requests from industry and are engaging as willing and savvy partners. The resulting partnership models regularly produce successful and creative research while enjoying substantial ancillary benefits to both partners.

BUSINESS MOTIVATIONS TO PARTNER

There are many reasons for companies to leverage external resources.^[1] Today's competitive landscapes often demand that businesses be creative in solving customer needs and developing new technology. Businesses can't rely solely on their own internal research and development groups for technology advances. A partnership often reduces risks for businesses to advance new technology or develop new products. Collaboration that shares the roles of discovery, development, and commercialization also accelerates the process by spreading out tasks among different groups rather than relying on one entity to do it all. Additionally, external partnerships can allow companies access to specialized skills or capabilities they don't have internally, alleviating the need to build those capabilities in-house, which consumes both time and capital.

Research investment at universities can also provide longer-term benefits. These collaborations build new relationships and shared resources to foster greater organizational capacity.

They can provide access to talent to address current needs as well as access to talent for future hiring. Some additional motivations and benefits are listed in Table 1.

UNIVERSITY MOTIVATIONS TO PARTNER

University motivations to partner often mirror corporate motivations. Just as companies recognize that they are not coming up with all the good ideas in-house, universities realize that collaborating with industry can enrich their research profiles, encourage them to think about new and different challenges, and create a more robust training experience for students. Universities increasingly strive toward industry partnerships that lend themselves to experiential learning and help produce more job-ready graduates. Companies and universities often possess complementary missions, resources, and assets, and so there can be mutual benefit in working together.^[2]

Universities are also motivated to seek alternative funding sources to diversify their innovation resources in response to reduced government budgets and increased competition for federal grants and state funds. Universities increasingly must look to funds from alumni donations, private donations, foundations, and industrial partnerships. In some cases, businesses

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and private donors are inspired to advance science and address societal needs through philanthropic giving.^[3] In other cases, funding comes in the form of sponsored research with a distinct business interest. In the end, businesses and universities can benefit from collaboration, ultimately leading to growth and economic benefit for both parties.

OPTIONS FOR EXTERNAL COLLABORATION

Today there are several options available for companies to collaborate externally, either with universities or with other entities. Many of these collaboration models have different characteristics regarding time to execution, intellectual property (IP) ownership, and publication requirements. The choice of what type of organization to partner with depends on how well the company's needs are aligned with the skills and capabilities the organization provides. Some of these partner types and provisions are listed in Table 2.

While no one partnering type addresses every potential need or scenario, these options give businesses flexibility in terms of how to access technology, capabilities, and market information. Intellectual property ownership has typically governed whether parties can work together, but today many business partnerships have evolved to include terms that provide access to IP and commercial rights and focus more on the value and benefits of the relationship than on IP ownership. Many business-university agreements have moved to a model where the terms are flexible with phased options available for companies to have royalty-free access to the sponsored research they've funded that generates IP, additional options for licensing, and exclusive licensing. These phased options provide flexibility that meets the needs of the university as well as the business since the potential scale of production, the business strategy, and timing to commercialization can vary greatly. The ability of academia and industry to negotiate and manage intellectual property terms with equity for both parties can make or break deals to establish agreements and working relationships.

Motivation Types	Potential Benefits
Accelerate Innovation	<ul style="list-style-type: none"> • Save time by collaboration rather than building expertise in-house • Leverage university resources for rapid execution • Access specialized facilities, faculty, and students • Engage more and different perspectives for diversity of thought on difficult problems
Change Corporate Culture	<ul style="list-style-type: none"> • Enhance creativity and resourcefulness of workforce through interactions with external partners
Drive New Business and Customer Insights	<ul style="list-style-type: none"> • Defend and expand existing businesses • Deliver value to customers • Attract new customers
Increase Brand Value	<ul style="list-style-type: none"> • Expand corporate recognition to members of the technical community, customers, and future employees • Attract talent

External Partner Type	What They Provide
Universities	<ul style="list-style-type: none"> • Longer horizon work, fundamental science, underpinning work in support of strategic program • Research in emerging areas
Government Labs	<ul style="list-style-type: none"> • Leading-edge research that needs unique capabilities • Projects linked to national objectives
Contract Research Organizations	<ul style="list-style-type: none"> • Market connected projects, ones utilizing unique capabilities
Intermediaries (AKA technology match makers)	<ul style="list-style-type: none"> • Grand challenges and areas where totally different thinking is needed
Consultants	<ul style="list-style-type: none"> • Cases where confidentiality precludes use of intermediaries • Market insights • Fast turnaround of projects due to expertise and ability to direct resources to specific activities
Venture Capitalists	<ul style="list-style-type: none"> • Innovative ideas provided through investment and/or partnership

OPTIONS FOR UNIVERSITY-SPONSORED RESEARCH

Industry typically enters into strategic engagements with universities that consist of sponsored research through: services agreements, sponsored research agreements, consortium membership agreements, and master research agreements. These agreements provide a range of options for consideration of how work can be successfully executed for specific purposes including:

***Services agreements.** A services agreement allows work to be carried out at the university with the intent of generating test results, sample analysis, technical information, or market studies. The agreements typically do not have provisions for IP, since the expected deliverables are reports of results or other data without interpretation or recommendations. Terms can be flexible as to whether the company would allow all or portions of the work to be published or require that it be considered confidential. Universities often execute services agreements at the departmental or college level;*

the costs for services or capabilities are often fixed; and these agreements can often be entered into easily, enabling work to commence quickly.

Sponsored research agreements. *Sponsored research agreements at universities are used for research projects that leverage the intellectual capacity and creativity of the professor and student or postdoc. Projects sponsored through these agreements span several months to a few years, and, while they often tackle longer-term questions for the company, they could be either fundamental or applied science.*

Research agreements are typically negotiated between the university and the business or technology organization on an individualized (project-by-project) basis. Setting up these agreements can be time- and resource-intensive. They often involve terms for publishing, IP, and royalties, which trigger negotiations and require time investment from technical, legal, and management roles within the company. As a result, executing agreements in different departments and at various universities for a large company can be quite taxing.

Consortium membership agreements. *A research consortium is a collaboration among many universities and companies that provides access to cutting-edge pre-competitive research. Agreements may have options for IP terms, but generally these forums engage companies to provide input on the industrial relevance of the work. Structured membership fees provide different levels of access to technology developed as well as different levels of benefit to their membership.*

Master research agreements. *Master research agreements are structured to define an engagement between the university and business that fosters a strategic relationship. Terms for publishing, IP ownership, and options for licensing are usually included. Master research agreements involve investment of time to negotiate on the front end, so they are an appropriate investment for longer-term relationships ranging from five to 10 years.*

HOW UNIVERSITY-BUSINESS PARTNERSHIPS HAVE CHANGED

Recent shifts in university-business partnerships reflect changes in global economic drivers. Businesses have always had cooperative relationships with universities, but some of the older engagement models are giving way to more mission-driven alliances. Corporations are no longer willing to make donations for unrestricted grant opportunities or pursuits in basic science without a specific business purpose or research objective in mind. Instead, competition and investor pressures necessitate more accountability and tangible benefit to the company.

However, that same competition and pressure is also driving companies to pursue external research as part of their corporate strategies. Universities are also more interested in partnerships, due in part to increasingly competitive and scarce government funding pools.

In response to these drivers, practitioners at the university-industry interface are collaborating to develop resources

and share learnings that can enhance and support effective partnership opportunities. Forums such as the Industrial Research Institute (IRI) enable industry members to learn how others execute open innovation activities.^[4] IRI is an effective organization that brings technology leaders from diverse industries and across all research and development (R&D) functions to create and exchange knowledge for improving their organization's technology management capabilities. Universities are also leveraging resources such as the University Industry Demonstration Partnership (UIDP)^[5] to learn how to position their university or individual departments to work with industry. UIDP works to identify key issues impacting university-industry relations and develop innovative approaches to partnership and collaboration. While members of these groups and other practitioners regularly observe that research partnerships are not one-size-fits-all, there are some new models emerging.

ASPECTS OF NEW RESEARCH PARTNERSHIP MODELS

In new partnership models, both industries and their academic partners tend to invest more resources and allocate more employee time for collaborations. During the past five to 10 years, more collaborative partnerships have developed where companies have made multi-year commitments, assigned employees full-time roles for managing sponsored research, and fostered individual projects with strong technical champions. Investment has also increased on the university side with an increasing number of industry alliance offices, staffed by employees whose job it is to broker and enable partnerships with industry. Some of the many new partnership models include: master research agreements; co-location or other face-to-face engagement; and the use of requests for proposals (RFPs).

Master Research Agreements

Master research agreements can require a significant front-end time investment to negotiate since terms for publishing, IP ownership, and options for licensing are usually included. However, compared to traditional sponsored-research agreements with individual faculty members, master agreements allow broader engagement, which maximizes faculty involvement and generates more ideas and new ways to address research needs or technical challenges. With many aspects of a sponsored research engagement pre-defined by the agreement, new projects may be launched quickly, matching the pace of change in strategies and priorities within the corporation. Master research agreements are appropriate for partnerships where a strong alignment between corporate needs and university capabilities creates fertile ground for valuable projects and deep involvement between the two parties.^[6] The investment in these partnerships often spawns additional strategic engagements that may not fall directly under the terms of a research agreement, such as targeted or enhanced recruiting,

pursuit of testing service agreements to leverage facilities, or participation in other university programs such as consortia and capstone projects. To expand on this further, the engagement under the MRA and our presence on campus is a strong driver for participating in the capstone process and would not occur in the absence of the engagement.

Co-Location

Another emerging model is the move towards co-location or on-site research collaborations. This type of engagement brings together researchers, students, and faculty to engage frequently and work as a team, rather than older models where research is strictly sponsored by industry and performed by academia. Co-location is a significant investment, requiring dedicated staff from industry and space from the university, but without the barrier of travel for meetings it enables closer collaboration.

Physical presence matters since it:

- (1) enables quick response time;
- (2) provides meeting space with infrastructure;
- (3) fosters trust through personal relationships;
- (4) facilitates valuable research with ideas and project plans developed jointly;
- (5) provides faculty with more insight and exposure to industry research needs;
- (6) enables serendipity, such as identifying previously unexamined research areas;
- (7) increases student interactions with industry researchers, fostering mentoring and providing broader exposure to industry culture and career opportunities;
- (8) allows employees to participate in recruiting and other campus events and to network with local professional societies, other area companies, and groups across the university;
- (9) may spawn additional strategic engagement opportunities through better understanding of partner school capabilities and programs.

Requests for Proposals

Another effective way to encourage broad university engagement is to utilize requests for proposals (RFPs). In an RFP process, the company crafts problem statements that are circulated in a confidential manner among university departments. Faculty are invited to generate research proposals in response, and the company reviews the proposals for ideas worthy of funding. Compared to engaging only one department or selected faculty to write proposals, this methodology produces two to five times the number of proposals with a greater diversity of ideas. Proposals also tend to be more competitive and effective in meeting the technical needs. While faculty may dislike the competition with their peers, their chances of obtaining funding are typically better than the probability of obtaining funding through federal grants.^[7]

Publishing RFPs on a regular cycle provides a framework to pace both work and funding. Setting this pace provides the company with predictability in annual budgets and provides the faculty some predictability in opportunities. The pacing also establishes expectations to complete projects within defined budgets and time windows so that new projects can launch. Most projects range from six months to up to three years. Faculty generally prefer to secure funding for a student or postdoc with student funding for two to three years and postdoc funding for one to two years. Successful projects that lead to further insights and those that are strategically aligned can be extended. Additionally, since the expected duration of projects is generally known, the flexibility of adding new projects over a longer research-agreement period allows the portfolio of research at the university to change along with changes in corporate strategy. In some cases, RFPs inspire additional ideas from faculty. While these ideas may not directly address the need in the RFP, they may be very exciting to the company. An ongoing relationship encourages the faculty to propose that idea to the company, while regular communication and sharing of RFPs builds awareness of industrial research needs and helps faculty develop ideas with a greater chance of success.

An example of an on-site collaboration mode using a master research agreement and request for proposal process is described in the case study highlighted in Figure 1.

Not every successful industry-university collaboration requires on-site industry staff. A master research agreement

<p>Company: Eastman Chemical Company Location: North Carolina State University, Raleigh, NC Agreement: master research agreement Commitment: 6 year (2012-2018), \$10 M minimum of sponsored research Resources: 3 full-time staff scientists, 1 full time admin support Facilities: rental space on Centennial Campus - ~ 1600 ft² with office, meeting space, and labs Agreement includes: requests for proposals (RFP's); emerging opportunities (research projects identified with specific faculty) Annual plan: launch 5-12 new projects/year, carry 30-36 active projects annually Publications, talks, and posters approved: 74 Patents filed: 18; number of Ph.D. students funded: 68; number of postdocs funded: 41; number of MS students funded: 35 Number of NCSU alums hired since 2011: 11 Departments funded: Chemical and Biomolecular Engineering; Chemistry; Physics; Industrial Design; Forest Biomaterials; Food, Bioprocessing, and Nutrition Science; Mechanical and Aerospace Engineering; Material Science and Engineering; Textile Engineering, Chemistry, and Science; Civil and Environmental Engineering Strategic engagement outside of the master research agreement (not part of the funding commitment): capstone courses in design, material science, textiles; graduate student internships; consortium memberships in Advanced Self-Powered Systems of Integrated Sensors and Technologies (ASSIST), Nonwovens Institute; multiple testing service agreements, recruiting</p>
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Figure 1. On-site innovation center case study. (The statistics used in this case study were collected at the time of submission of this manuscript.)

executed with a partner university still allows collaboration across multiple departments and offers a high degree of engagement, particularly if industrial scientists visit the campus quite frequently. A simply outfitted office space and an internet connection allow staff to work on campus regularly (one day per week, every other week, or monthly) and meet and engage with faculty and students while there. Example is shown in Figure 2.

A simpler collaboration model that works well when the geographical distance is a little more remote than those in the figures is useful to consider when it is accessible for a site visit within a day's drive to and from by the project team. Additional university collaboration models may simply target one department or one professor. These collaborations tend to be on a case-by-case basis or ad hoc with sponsored research agreements set up as needed. Projects are identified through informal networks between industry and university researchers, or through knowledge of literature on needed capabilities.

Project Interactions

Deep collaborative relationships between industry and universities require productive interactions. Face-to-face meetings are the most valuable interactions and can be achieved easily when the school and company are located nearby or the partnership includes co-location. If face-to-face meetings aren't possible, project interactions may involve teleconferencing, videoconferencing, and computer-assisted media (Skype, WebEx, etc.). Highly aligned projects tend to be well driven from the industry perspective and are structured at the outset with milestones, deliverables, and expected reporting frequency and format. Project teams often have an employee assigned as the technical leader for the team who facilitates meetings and communications and sets the team's schedules. These highly engaged interactions are intended to create value for both the company (maximizing learning through regular conversations and keeping the project's trajectory germane to corporate interests) and for the university partner (training students in presentation skills and offering exposure to industry professionals). Because this extent of funding-source engagement can be unusual in an academic setting, a good way to start a university relationship may be through a few projects to explore the potential for future collaboration with a higher commitment level.

BENEFITS FROM UNIVERSITY-INDUSTRY PARTNERSHIPS

Many benefits can be achieved by research collaboration. Some of these benefits are easily quantified, while others are almost entirely intangible. The ability to accelerate innovation through university-sponsored research provides financial advantages such as speed to market and improved earnings potential to achieve value creation. Working externally brings new ideas from experts who have had different

experiences, and their lack of corporate exposure can help overcome internal perspectives and biases to solve current challenges. Businesses can capitalize on working with universities to accelerate innovation, change culture, gain new business and customer insights, and increase brand recognition.

With pressure to demonstrate return on investment, many companies are creating metrics or otherwise capturing and demonstrating the impact and value of partnerships.^[8,9] Some metrics are financial in nature and may require crude assumptions when projects are in very early stages as depicted below:

- *Research cost savings (RCS through lower external costs vs. internal costs)*
- *Annual cost savings (ACS)*
- *Net present value (NPV)*
- *Earnings from operations (EFO)*
- *New sales potential (annual sales)*
- *Market opportunity (potential size of new market of interest)*

These measures can be readily monitored and captured over time. Some non-financial measures such as new hires and patents are also easily quantified and tracked to reveal their impact. Another way to parse benefits is between those that are relevant to the business vs. to the university.^[10] However, these outcomes are interconnected and reflect the success and mutual benefit of the partnership. Figure 3 graphically depicts the intrinsic and mutual benefits to collaboration.

<p>Company: Eastman Chemical Company</p> <p>Location: The University of North Carolina at Chapel Hill</p> <p>Agreement: master research agreement</p> <p>Commitment: 6 year (2013-2019), \$1.5 M minimum of sponsored research</p> <p>Resources: staff scientists on an informal visiting schedule</p> <p>Facilities: drop in space available in chemistry dept. - ~ 240 ft² with office and meeting space</p> <p>Agreement includes: requests for proposals (RFPs); emerging opportunities (research projects identified with specific faculty)</p> <p>Annual plan: launch 2-3 new projects/year, carry 5-6 active projects annually</p> <p>Publications and posters approved: 19</p> <p>Patents filed: 1</p> <p>Number of Ph.D. students funded: 10; number of postdocs funded: 8</p> <p>Number of UNC alums hired since 2011: 9</p> <p>Departments funded: Chemistry; Applied Physical Sciences; Physics/Astronomy; Environmental Sciences and Engineering</p> <p>Strategic engagement outside of the master research agreement (not part of the funding commitment): capstone courses with the Kenan-Flagler Business School Student Teams Achieving Results program (STAR); graduate student internships; donation of 3D printing materials to Maker Space (BeAM); Eastman-funded seminar series; testing services agreements, recruiting</p>
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Figure 2. Network university case study. (The statistics used in this case study were collected at the time of submission of this manuscript.)

The effectiveness of the collaboration can be viewed holistically considering the attributes in Figure 3 and how willing each party is to continue to work through project extensions and through future projects. These attributes can only be achieved through a multi-year agreement and through an engagement model that involves more than one or two faculty members within a given department. A more fruitful relationship can be achieved when there are other activities and opportunities for students and industry such as internships, capstone courses, site visits, workshops, and other technical training or educational exchanges. These other activities and touch-points, while maybe not part of a master research agreement, are also strategic engagements that compound and enhance the feeling that the university and company are working together and looking to each other for opportunities. The relationship becomes more than just sponsored research; it becomes a partnership through cultivation.

CONCLUSION

Corporations are under more pressure today to compete in the global marketplace and to accelerate innovation. These pressures have created opportunities to collaborate externally, looking outside pre-existing internal networks and expertise within their company to conduct research. There are different forums for industry to network externally; universities offer a broader level of engagement, and strategic partnerships with universities have many benefits over the long term. Greater reward tends to come from greater investment: dedication of staff, substantial financial commitment, and willingness to co-locate allow companies to leverage access to broader expertise and higher-quality engagement. The long-term outcomes of these new relationships bring financial value as well as other intangible benefits. Deeper relationships with universities through master research agreements and use of requests for proposals can bring not only new insights, but also the ability to access talent that would normally not be targeted for engagement to solve corporate needs. The evolution of working relationships between universities and industry is now more important than ever to both parties to leverage for success, mutual benefit, and economic development.

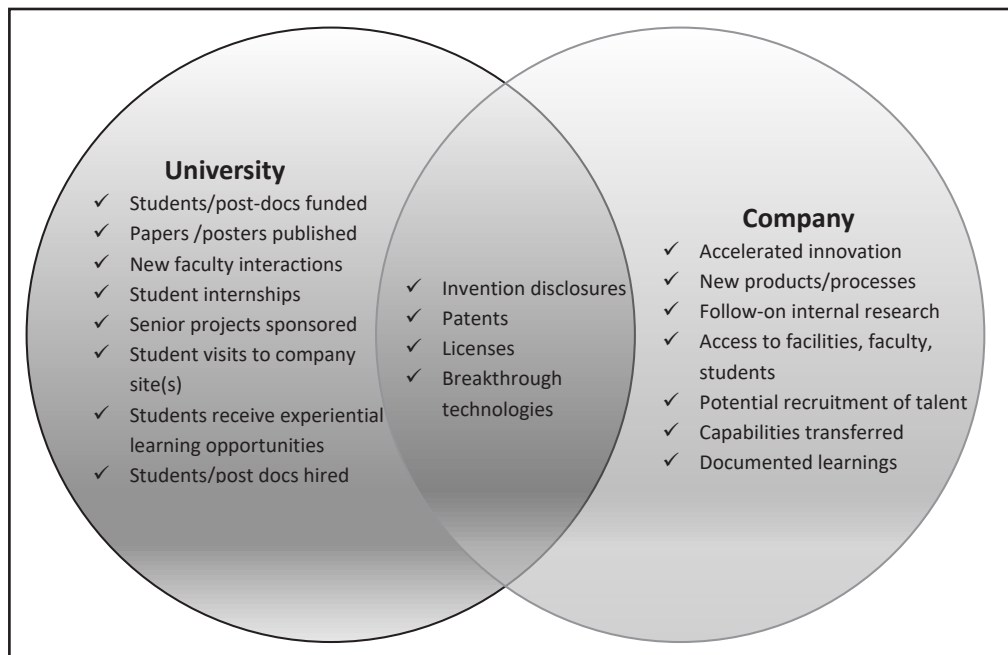


Figure 3. Illustration of the benefits of university and industry collaboration.^[10]

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