

Exploring the Dimensions of University-Company Collaborations: Research, Talent, and Beyond

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ABSTRACT

This paper explores the benefits of university-company collaborations beyond research and talent – primarily from a US and Canadian perspective. Company connections to specific universities may initially be based on research relationships or talent acquisition needs. Additional collaborative dimensions may include marketing, sales, public policy, local economic development, and philanthropy. University-company partnerships are complex and fragile. To build effective and enduring partnerships, we describe collaboration scenarios to: incubate collaborations, connect experts, assess and communicate collaborative value, and grow relationships. The paper presents a set of recommended activities to achieve a greater sustained impact for innovation and learning: orchestrate collaborative events, measure and track results, facilitate learning, catalyze research through philanthropy, leverage regional development and government incentives, incubate a collaborative ecosystem, and make collaboration results more visible and actionable.

Keywords

university-company relations, strategies, tactics, collaboration scenarios, research, virtualization, frameworks, innovation, metrics

1. Introduction

To incubate and derive the greatest benefit from university-company relations, it is helpful to recognize that there are multiple dimensions for engagement and differing goals based on academic or company contexts. Talent and research are only two dimensions. Companies look for new creative talent to fuel their innovation programs, and universities seek students to educate and place in rewarding professional or academic careers. Companies and universities both invest in research to create new innovations. This is the primary focus of ICSE’s SER&IP Workshop series and this has been described in detail by others [1,2]. But other dimensions and goals are important as well. These include upskilling (targeted tutorials) for professional development, innovation incubation-acceleration-inspiration, marketing and sales, and policy influence. All of these dimensions have by necessity been virtualized, with varying degrees of success, due to the onset of the COVID-19 pandemic.

The dimensions of research collaboration are connected to the differing goals of academia and industry. While research and education are the primary goals for universities, companies are driven to increase revenue and decrease costs. Companies don’t necessarily desire novelty – but they warm quickly to opportunities for company growth. In the authors’ experience, companies have two preferred models for software engineering innovation: (1) the acquisition [of companies] that add customer or shareholder visible value to the product portfolio and (2) the development of application frameworks (such as Android, AWS, and others) that tie customers more closely to company products and platforms. In contrast, companies may shun “purer” software engineering research on improved practices and tools as effort with a lower perceived ROI (Return On Investment) – particularly in the short term.

2. Differing Motivations and Challenges?

The authors explored university-company software research collaborations in previous papers, with a focus on strategies for open innovation [3,4,5]. This paper presents a wider spectrum of collaboration goals beyond research and talent.

Companies and universities are driven by different motivations and timelines. As businesses, public companies need to meet the quarterly ROI demands of their shareholders, accelerate product R&D, recruit and retain talent, and sell product. With company success, increased investments in external research and philanthropy become more likely. Universities by contrast are driven by education, funding, and research cycles – and value academic freedom. Educating students and performing research are key university goals. Success is often measured in terms of student admissions, student graduations, publications (reputation), and funding received from student fees, alumni, governments, NGOs, and company contracts. Patent revenue, while important, is not generally a significant source of revenue for most universities.

University-company partnerships serve some important research and education objectives for universities: they catalyze the calibration of research with real-world challenges faced by companies, and they accelerate student education through practical internships. Universities frequently partner with companies to develop new curricula in light of emergent technologies. There can be an extra business benefit when companies view universities as potential large enterprise customers. The sale or donation of equipment and services can have an ongoing market-building value to companies. Philanthropic and marketing partnerships (often driven by alumni relationships) can lead to increased company visibility through company (or founder) naming of university faculties, departments, institutes, buildings, lecture halls, academic chairs, scholarships, etc.

Before embarking on a collaborative relationship, each partner needs to identify and share their objectives for the relationship to set mutual expectations. For a university-company collaboration related to software engineering research, it is essential to have goals that go beyond just “publishing another research paper.” University researchers are frequently challenged by a company’s unwillingness to share results – particularly those learnings associated with failure or competitive advantage – or to provide access to R&D teams. Company and university collaborators should frequently ask the question: “How does our partnership deliver real value to our stakeholders?” to help reset expectations if necessary.

3. Dimensions of University-Company Relations

Innovation and talent are two of the dimensions of university-company collaboration – or, as Garber [6] describes, “points of engagement.” For the purposes of this discussion, we distinguish between invention – an act of discovery – and innovation – which includes the process of commercialization (transformation of new ideas into valued services or products). We also consider talent as individuals with specialized abilities – such as scientists, engineers, medical professionals, lawyers, social scientists, business professionals, and educators.

A more extensive list of dimensions of university-company relations includes these eight non-orthogonal dimensions:

- *Innovation*, as catalyzed through university research collaborations and talent exchanges – internships, academic sabbaticals, and consulting opportunities – or company staff as university visiting scientists.
- *Talent pipelines* filled by: (1) students who have graduated from educational institutions through certificate or degree (professional or research) programs, (2) upskilling company staff through customized education (informal, certificate, or degree) programs, and (3) programs of knowledge transfer through internships, apprenticeships, fellowships, adjunct professorships, mentorships, sabbaticals, etc.
- *Marketing collateral*, through brand association, benchmarking, and increased visibility (note that both universities and companies use marketing to promote and leverage their international brand equity to sustain and grow sales and to expand their research reputation).
- *Sales* – Universities “sell” opportunities for learning and research while companies “sell” enterprise services and equipment.
- *Philanthropy* – Universities receive company goodwill in the form of cash, scholarships, fellowships, or in-kind donations, while companies are rewarded by tax benefits and increased brand equity for social responsibility.
- *Public policy* – A company incubates relationships with influential academics and university institutes to increase the company’s awareness of regulatory trends and to lobby for favorable government policies.
- *Government benefits* (incentives, matching funding) catalyze university-company partnerships.
- *University alumni* are motivated to catalyze company relationships with their alma mater as a result of personal affinity (and a desire to remain “connected”), familiarity with academic staff, and motivation to “do good” for both their university and fellow graduates.

From experience, the authors observed that the full benefit of a relationship are not always realized – and the reason may be internal to the company. There may be little or no coordination across all dimensions as itemized above. For example, a company may miss opportunities to recruit talent from universities if there is a lack of coordination between the company’s engineering and staffing functions. Staffing is a Human Resources (HR) function – often focused on high volume recruiting of undergrads. HR might not leverage company personnel who are connected with universities through research, sales, marketing, policy development, or philanthropy.

4. University-Company Collaboration Scenarios

Motivation for collaboration is generally driven by a company’s need to catalyze and accelerate innovation, followed by an ongoing push to upskill employees as technologies evolve. With a combined 50+ years of personal experience partnering at the intersection of company, university, and government research partnerships, the authors observed four broad categories of collaboration scenarios that describe:

- (a) Feeding the “funnel” of commercialization
- (b) Scouting and initiating relevant collaborations
- (c) Sustaining and leveraging collaborations
- (d) Tracking and demonstrating collaboration value

Open innovation and open collaboration strategies are expanding the world of corporate product innovation. In traditional corporate research, companies looked to their own R&D labs to invent new technologies and processes. Corporate executives viewed intellectual property as a “secret sauce” to be protected to maintain competitive advantage. But today’s product development environment is much more open: corporate R&D groups work with many partners. External collaborations have contributed to an expanding range of new products and services, and university-company collaborations are an important part of many companies’ innovation processes.

The process of transforming company ideas into commercial products is often described as a “funnel” or referred to as the “cone of commercialization.” As ideas enter the funnel, complemented by external innovation, they are iteratively refined into commercial products through requirements analysis, design, development, prototyping, and deployment. In an effective university-company research partnership, contributions may influence any of the phases in the cone of commercialization.

Partnerships are complex and fragile, and there are many obstacles to effective collaboration. Our experience, in agreement with [7] but contrary to that observed in [8], indicates that such university relationships generally benefit from a “champion” who can direct the collaboration efforts of company (and/or university) staff and assemble the fiscal resources needed to scout, grow, and sustain the relationship. If a company collaboration champion should retire or transition to a new role or company, collaboration relationships are prone to spin-down or failure unless a new champion emerges.

Scouting for partners, emergent technologies, and talent is a necessary precondition to feeding the funnel of innovation. Scouting is often achieved through participation in meetings, conferences, and one-on-one interactions. Interactions may range from informal meetings and presentations (at the company, the university, or a conference) to partnerships that grow from existing consulting engagements. Companies may also proactively scout for new partners by announcing scholarships, internships, “Request for Proposals” (RFPs), or “Grand Challenges” with monetary incentives to spark and catalyze interest in specific technologies and company interaction.

The initial phase of collaboration is a critical time for setting the collaboration agenda, and it is almost impossible to make an effective start without a high degree of dynamic interaction. Investments in dynamic interaction catalysts such as white boarding, shared meals, and intensive collaborative discussions has two important objectives: (a) it establishes trust across the collaborators based on initial progress in an informal setting, and (b) early conversations are the first step in establishing shared team expectations, norms, beliefs, and mental models. COVID travel restrictions may limit face-to-face work – therefore, collaboration can benefit from independently facilitated (e.g., sessions orchestrated by trained facilitators) participative sessions complemented by informal virtual social interactions.

Interaction value may be assessed initially by satisfaction surveys of partners. However, companies generally prefer that an assessment of long-term value demonstrate ROI, with a quantification of the relationship in terms of costs and benefits. University research may be supported by company funding – to cover the cost of one or more graduate students, release time (e.g., from teaching) for university PIs (Principal Investigators), equipment/service costs, conference travel, and overhead university administrative costs. However, non-monetary research support from companies is also an option, which might include the donation or loan of equipment/services, the loan of company experts, or access to company labs – or even access to anonymized real-world data for research purposes (e.g., from data-intensive companies like Facebook, Google, and Twitter).

In order to measure value beyond partner “satisfaction reports” and co-authored publications, the value of university collaboration (from a company perspective) should be assessed using some tangible measures, including R&D product schedule acceleration, patents filed/licensed, talent hired, and products/services sold. The purpose of these metrics is to ensure that some business value is achieved: to demonstrate “shareholder value” to management. Universities generating intellectual property generally measure their “ROI” in terms of patent portfolio revenue across a wide range of technologies including IT, pharmaceutical, and agricultural innovations – contract research, and government grants. Company program managers should remember that universities are neither free nor necessarily low-cost research resources – and that the cost of overheads (i.e., the cost of administrative staff, heat, light, power, etc.) that are typically included in most academic research contracts may double the cost of research in many countries – particularly in the United States.

5. Collaboration Scenario Descriptions

The following collaboration scenarios – written primarily from a company perspective – have proven useful to the authors in the setup and management of effective collaboration programs. The four “scenario groups” are: *innovation funnel* (initiating the program and leading innovative collaborations), *collaborating and learning* (expanding the impact of innovations through effective communications and information sharing across organizations), *measuring and demonstrating success* (increasing visibility of a collaboration program to stakeholders and leaders), and *managing relationships* (maintaining connections).

5.1 Innovation Funnel Scenarios

Collaboration programs depend on scouting partners and emergent technologies, with a focus on innovation that delivers value to stakeholders. Some key roles and practices are needed to “feed the innovation funnel” of a collaboration program.

- *Collaboration Champions* are the catalysts who drive success and guide the collaboration program
- The *Scouting Process* assesses and selects the right focus of people and emergent technologies
- *Collaboration Brokers* work to ensure that expectations for the collaboration relationship are achieved

5.1.1 Innovation Funnel #1: Collaboration Champions

A collaboration champion is an influential person in the power structure of a company or university who promotes an emergent or ongoing collaboration program. Without a champion, a collaboration program is prone to failure. A collaboration champion

envisions new collaboration opportunities, supervises the process of scouting for collaboration partners, and heads off potential problems with the program. A champion understands, motivates, and guides collaboration partners to achieve valued results.

An experienced champion may be critical in keeping a collaboration relationship compliant with corporate, university, and government regulations for program governance, accounting, privacy, and knowledge sharing. An inexperienced collaboration manager might not understand all of the compliance issues, but a good collaboration champion is a person who has the experience and understanding of compliance issues from previous collaborations to guide the teams to do their work such that it does not bring disrepute to the company or the university.

5.1.2 Innovation Funnel #2: Scouting and Pathfinding

In a collaboration program, scouting for potential partners and developing innovation roadmaps is one of the first steps. There are many ways that staff at companies and universities find partners. Conferences and workshops are good places to meet for informal discussions. Searches through publications, reports, and press releases may generate some potential leads. But more intensive scouting and serendipity (Grand Challenges, RFPs, Hackathons, etc.) may also be required identify the right partners.

Departmental research reviews or research consortia events are fertile opportunities for universities to promote their work to multiple companies. Personal contacts are also an effective approach to connect with prospective collaborators. These include alumni contacts, internship programs, fellowships and scholarships sponsored by companies, and temporary personnel exchanges through sabbatical (university to company) and visiting scientist (company to university) programs.

5.1.3 Innovation Funnel #3: Broker Relationships

Collaboration relationships may need someone to “broker” the relationships, to structure the relationship in a way that considers the incentives for all parties to the collaboration. For example, a collaboration program generally needs funding in the form of gifts or contracts. A collaboration broker can help resolve negotiation roadblocks by suggesting alternative collaboration catalysts – cash gifts, contracts, goods and services (donated or loaned), government matching grants, etc.

5.2 Collaboration and Learning Scenarios

Every collaboration needs to overcome communication challenges – and in the age of COVID-19 – particularly the challenge of social distancing. Effective virtual collaboration depends on finding and using the right tools. Also, collaboration programs need to drive sharing and learning activities, because cross-organization sharing is hard. Company staff are frequently so focused on their deliverables that they forget to share. Culture clash is a similar obstacle: The open innovation culture of universities may conflict with a closed proprietary company culture.

5.2.1 Collab #1: Virtual Collaboration

Prior to the COVID-19 crisis, multi-organization collaborations employed virtual collaboration techniques to extend geographic reach – everything from old technology (tele-conferences, video-room conferences, and email) to more modern collaboration methods (social media, chat, desktop video conferencing, shared data). Collaboration technology is useful for focused collaborative work (screen sharing, video meetings) and for more informal information sharing and socializing (online text chat, Slack, and others). In an effective collaboration relationship, the participants are constantly reevaluating and optimizing their communication strategies. For example, while a virtual meeting can replace a physical meeting, meeting attendees must be identified in advance and motivated to participate. In contrast, a physical “in person” event enables valued serendipitous conversations and connections between individuals who may not have otherwise connected.

Virtual collaboration is not just a matter of technology, it also requires the willingness to work synergistically with remote partners. In an interactive collaborative relationship, the participants help each by asking and answering questions, giving and taking advice, making design decisions, and solving problems together. Technology can make these activities faster and smoother, but good teamwork is not an automatic benefit of collaboration technology.

5.2.2 Collab #2: Share Results

Frequent open communications foster effective collaborations through interactions and discussions among the partners. Sharing results with a broad community is extremely useful to iterate and cultivate ideas, and to receive critical feedback. The forums for sharing can vary widely: online talks, face-to-face visits, workshops, informal seminars, reports, journal papers, and conference presentations. University researchers may incorporate what they learn into new courses and research programs. Information sharing also may attract talent to a company and promote products and services.

In the authors’ experience, innovation is catalyzed by frequent informal meetings to share and brainstorm ideas facilitated by a white/black board (or virtual space). Facilitated workshops, innovation incubators (to develop new ideas), and accelerators (to scale the business) all provide structure and catalyze a free flow of ideas to maximize the potential for innovation. Informal meals and social events are useful to catalyze internal sharing. External sharing may take the form of seminars, instructor-led training, participation on standards committees, and submissions to peer reviewed publications.

The COVID-19 crisis raised barriers to the in-person sharing of collaboration results. It takes more effort to establish informal communication channels. Initially, COVID-19 led to the cancellation of formal forums (e.g., conferences, consortium meetings, university seminars) and it has taken time to “go virtual.”

Open access sharing (contributing to an open source repository) may help foster new collaborations. There is a long history of innovative open source assets launching world-wide interest in a new technology, such as Amazon’s Free RTOS, Facebook’s PyTorch, Google’s TensorFlow, and Microsoft’s Azure SDKs.

5.2.3 *Collab #3: Develop Talent*

Collaboration programs incubate talent for both companies and universities. Through the collateral of research investments, companies can scout postgraduates as prospective interns and full-time hires. Coordination gaps between a company’s staffing and research organizations may lead to missed opportunities. Universities facilitate career choices for their graduates by organizing career fairs and providing advisory services.

5.3 Scenarios for Measuring Value

Each university-company research collaboration should demonstrate stakeholder value. For companies, value is often measured in terms of budget, ROI, schedule, talent (internships, number of hires and staff departures), patents, sales, etc. For universities, value may be determined by novelty of research, number of publications, gift and contract funding, students graduated, reputation building, etc. To establish and manage mutual university-company expectations, the following scenarios have proved useful:

- Identify and Track Collaboration Assets to assess value
- Use a Collaboration Dashboard to demonstrate value
- Evangelize Collaboration Benefits

5.3.1 *Measure #1: Collaboration Measurables and Assets*

First and foremost, companies should use a database to manage and coordinate university collaborations. The following observables should be tracked and indexed:

- Names/coordinates of university partners
- Names/coordinates of company sponsors
- Collaboration satisfaction indexes (as determined by surveys of company and university partners)
- Number of relevant university events, conferences, etc.
- Number of publications, patents, licenses, etc.
- Number of projects, universities, researchers, students
- Value of gifts, equipment and service donations/loans
- Project, consortia, internship, and sponsorship funding
- Number of internships, mentorships, hires, resignations

A database enables searches by topics, funding, geography, university, business unit, etc. and enables prompt answers to questions from company leaders such as:

- Who are collaboration partners at university X?
- What collaboration partners do research on topic Y?
- How much did we [the company] spend on topic Z?
- At which university does the company invest the most (gift funding, contract funding, consortia funding, etc.)?
- What are our most “successful” collaborations?
- At which university do we hire the most talent?

Company leaders are often interested in derived metrics, such as average grant amounts or year-over-year trends, while compliance managers may require reports on specific universities. For example, a report could reveal gift funding where a university leader sits on the company’s board of directors or a company executive sits on a university board. The authors observed that a scorecard approach (a dashboard that incorporates multiple metrics) helps give the company a balanced impression of broad collaborative value.

5.3.2 *Measure #2: Collaboration Dashboard Reporting*

Collaboration measurables should be shared on a standard dashboard – so that collaborators and business unit leaders have the relevant information at their fingertips to demonstrate the value of the relationship, particularly when seeking ongoing or new funding. Collaborators should plan for periodic program reviews to confirm ongoing value and progress.

Dashboards can be useful to check that overall company and university goals are being achieved. From an academic perspective, company partnerships provide funding and help calibrate research scholarship. However, receipt of tainted funding can lead to resignation [9] or dismissal by university governing bodies.

Dashboards also help to validate expectations or suggest action to change the direction of a collaboration – or even project termination. On several occasions, Fraser has observed situations where company collaboration champions retired – or participating business units were wound down and staff dismissed. In some of these situations, it took months to determine that there was little or no interest inside the company to continue program sponsorship. In one case, program termination took more than two years due to contractual requirements at the cost of several hundred thousand dollars.

5.3.3 *Measure #3: Evangelize Collaboration Benefits*

In addition to sharing technical results, a collaboration program should demonstrate how results contribute to company ROI (Return-on-Investment) be it short or long term. Program value needs to be documented: it should not be assumed to be “obvious.” It is often desirable that a company’s legal staff, public relations, and product leadership (technical, marketing, and sales) review results prior to sharing publicly to avoid disclosures that might compromise company interests.

A university-company collaboration program should produce demonstrably favorable outcomes for both industry and academic partners. University-company partnerships sponsored by R&D teams of profitable product organizations frequently have greater longevity than those programs tied to research cost centers or short-lived executive initiatives – since product organizations often have a clearer impact on company ROI.

5.4 Relationship Scenarios

Relationships are as important as technology in building an effective collaboration program.

5.4.1 *Relationship #1: Support Internal Relationships*

Most collaborations tend to focus on technology ideas – technology experts must share innovative ideas and make things work. But it is difficult to spread new ideas if experts are isolated and the relationships within a company are weak. To foster learning within the company, collaboration leaders should reinforce internal networking and the learning process:

- Build a network of internal and external experts
- Make collaboration results visible across organizations
- Foster shared learning
- Preserve organizational and community memory
- Share “best practices”
- Leverage partnerships to identify and recruit talent

5.5 Scenario Failure Modes

Scouting for possible collaboration partners has two main pitfalls. One problem is that some partners are chosen based on the personal preferences of powerful and influential leaders rather than an objective assessment of how well the partnership might fit the needs of the company or university. An open call for collaboration proposals may not always solicit a manageable number (or quality) of relevant responses. A challenge is when a call generates hundreds of proposals – requiring significant company resources to review – for a small number of awards. While an RFP process helps catalyze new relationships, it may also impact company reputation if proposal rejections are high.

One pitfall of virtual collaboration is that it does not always give equal power to all participants in a collaborative effort. In a university-company partnership, team members from industry and academia will usually have differing levels of productivity in the details of design and development. Company collaborators may have more development experience and more focus on product features and commercialization. However, academic team members, who are both organizationally and geographically distant from industry R&D staff, should not be treated as junior partners. University collaborators can inspire many innovations: new architectural ideas, reuse of open source code, better design for usability, and ideas for applications beyond the company’s traditional thinking. The potential for inspiration through cultural diversity found at both domestic and foreign universities can be particularly high.

Sharing results is an area where the collaboration partners need to spend extra effort early in the partnership – to agree on what kinds of external sharing will satisfy everyone’s needs. For university participants, the ability to publish results freely is very important, but companies want to guard innovations and data that might give them a competitive advantage in the marketplace. Both sides may need to make compromises.

When choosing some of the collaboration measurables and doing assessment, the choice of metrics could sometimes result in unproductive behavior. If there is a big reward for the number of meetings in the assessment metrics, everyone will try to schedule more meetings, even if they aren’t really needed.

6. Sample Collaboration Programs

University-company collaboration programs are as numerous as universities, faculties, companies, business units, technologies, etc. They can be simple stand-alone programs or complex partnerships that combine the resources of multiple universities and/or companies. Companies range from start-ups with limited resources and narrow research interests to multinational companies with a breadth of interests and resources. Some research-oriented programs (e.g., Ripple) are designed to foster

increased focus and visibility for new technologies – rather than direct one-to-one staff engagement with academic researchers. Examples of company software research programs include:

- The AWS (Amazon Web Services) Research Initiative (ARI) in partnership with the US NSF and NIH.
- The Cisco Research RFP program connects Cisco staff and academic researchers to facilitate collaboration.
- The Cuebig Data for Good initiative provides access to anonymized privacy compliant location-based data for the scientific community to catalyze new societal value.
- Facebook Research supports research through fellowships, data access, research awards, etc.
- Google Research cultivates and administers relationships with universities and research institutions.
- Intel Labs sponsors and partners with university research centers and government agencies.
- Microsoft Research collaborates with the global research community through multiple programs/events.
- The Qualcomm AI Research initiative through Innovation Fellowships and university partnerships seeks to advance core capabilities in perception and reasoning.
- The Ripple Blockchain Research Initiative (\$50 million over 5 years) catalyzes university research in blockchain, cryptocurrency, and digital payments.
- The Samsung GRO (Global Research Outreach) Program is an annual solicitation of research proposals.
- The Siemens University Relations Program sponsors idea competitions, hackathons, doctorates, and teaching positions.

Carver and Prikladnicki also present an excellent list of successful collaboration projects and programs [10].

University consortia have a wider scope, and they often feature multidisciplinary partnerships between different academic units – or multiple universities. These consortia often attract a larger critical mass of researchers and resources. Examples of university collaboration programs include:

- HAI (Stanford University Human-Centered Artificial Intelligence Institute) advances AI research, education, policy and practice to improve the human condition.
- The MIT Media Lab brings together designers, engineers, artists, and scientists that enable people to understand and transform their lives and environments.
- Center for Networked Systems (CNS) at UCSD is focused on problems in modern computing and data processing infrastructure.
- The EPFL Innovation Park hosts technology driven companies in an inspiring environment, with access to cutting-edge research, a large network of dynamic entrepreneurs and established companies.
- The Software Engineering Institute (SEI) explores software engineering, cybersecurity, and AI problems.
- Fraunhofer USA CESE conducts applied research and technology transfer to support the software-enabled innovations developed in industry, government, and academia.

Over the past 25 years, Fraser has orchestrated a variety university-company collaboration programs for Bell Northern Research, Nortel, Qualcomm, Cisco, HP, and Innovec applying the collaboration scenarios outlined above. Programs included:

- (a) *Learning*: ConGESE (Consortium for Graduate Education in Software Engineering) – an industry focused software engineering Master’s degree program supported by a partnership of three companies and six Ontario universities
- (b) *Research*: Team based Domain Engineering at CMU’s Software Engineering Institute (SEI) as a Visiting Scientist
- (c) *Emergent Technology Scouting*: Collaborations included consortia (e.g., MIT Media Lab) and departments (e.g., UCLA ECE) – sponsoring projects, fellowships, internships, seminars, visits, etc.
- (d) *Internal Tech Forums*: Internal company forums (BNR/Nortel Design Forum, QTech, and CTech) to create visibility for research results, partners, and best practices
- (e) *Ph.D. Recruiting*: Leveraging research relationships, to catalyze the “Cisco Choice Select” recruiting program
- (f) *Philanthropy*: Catalyzing research with donor advised fund recommendations (gift funded projects, endowed chairs, conference sponsorships, etc.) and equipment/service gifts

7. Going Virtual for the COVID-19 Pandemic

Collaboration in the era of COVID-19 has created challenges and opportunities. In 2020, social distancing and quarantine requirements led to the curtailment of most face-to-face interactions between universities and companies. Even internships and sabbaticals became virtual. While there were savings in travel hospitality costs, many companies became cautious and curtailed discretionary expenses.

Universities and companies have quickly adopted remote collaboration for all kinds of work. The increase in “work from home” arrangements caused by COVID work restrictions have converted every project and every meeting into a multisite interaction. The new collaboration dynamics directly affect individual meetings and project management. With an increased need for virtual

(socially-distant) collaboration, organizations have chosen a more flexible approach to organizing teams. Now, instead of co-located development, work often spans multiple locations and countries, which makes collaboration more challenging.

In a virtual COVID-19 workplace, the collaboration scenarios we have described become more difficult to execute.

- The innovation funnel processes (scouting and pathfinding, brokering relationships) will require additional attention and resources.
- Students need more options to obtain work-related experience since many companies have gone virtual.
- Identifying new partners remains a challenge, but with virtual outreach (meetings, forums, conferences, etc.), new relationships can be catalyzed.
- Reporting results has new challenges since COVID-19 has created barriers to in-person sharing of collaboration results. And even within a company, sharing and evangelizing the benefits of collaboration will require a greater effort.

Virtual interaction has helped catalyze new opportunities. It has expanded the audience and impact of seminars and conferences. Instead of a few hundred attendees as limited by the physical size of university lecture halls, virtual meeting capacity has extended into the thousands. Similarly, conferences attracted significantly more attendees than in the past – for example, XP (the European conference on Agile Software Development practices) which normally attracts between 150 and 300 attendees – had close to 900 registrants in 2020.

Stanford's HAI has used a combination of Zoom Conferencing and YouTube broadcasting to incubate and extend global outreach complemented by conversational collaboration tools. HAI lecture events normally attracted hundreds of participants, but with COVID-19 virtualization, they now attract thousands! Unfortunately, while meeting attendance increased (both for conferences and university meetings), the fidelity and frequency of one-on-one interactions was limited.

8. The Need for Collaboration Coordination

Many organizations (companies and universities alike) perform only localized coordination. For example, many companies do not coordinate their research, talent, learning, marketing, sales, and philanthropy operations. Several issues can emerge:

- Company staffing programs often fail to take advantage of company research relationships which can identify and connect staffing with key graduate student talent.
- Company leaders make funding promises which develop into unfunded mandates due to leadership changes, revenue losses, and collaboration disruptions.
- Ethical considerations – such as using funding from “tainted” sources (Jeffrey Epstein [9]) or misusing data (Facebook and Cambridge Analytica [11, 12]).
- Company staff using university resources without approval can lead to misuse of university resources, contamination of company proprietary property, or litigation by the university [13, 14, 15, 16, 17, 18].
- Inappropriately authorized agreements with professors executing company agreements without formal university approval.
- Company staff inappropriately seeking quid pro quo in return for company gifts to support university research – such quid pro quo might be as innocuous as requesting a presentation on early research results prior to public dissemination.
- Multiple company representatives visiting a university contemporaneously without coordination.
- In the US, the hiring of research staff and interns and the dissemination to unauthorized company/university visitors of certain technologies including specific software technologies must be compliant with export controls (ITAR) [19]. Other countries have similar regulations [20].

A company with a well-coordinated university partnership program can avoid the missteps identified above and achieve better ROI by leveraging a multi-dimensional database spanning the scenarios and dimensions of collaborations described here.

9. Advice for Collaborators

What can university and company prospective partners do to make their collaboration programs more effective and visible?

- *Market collaboration interests and results* – build informative websites that promote collaborative opportunities: identify who is involved in research collaborations, advertise a calendar of upcoming events (seminars, meetings, career fairs), list recent publications, and publish collaboration news.
- *Collaborative events* – organize regular meetings with collaboration partners (consortia meetings, student seminars and poster sessions); invite (or offer) company sponsored hackathons, panels, company sponsorship for academic offsite meetings, company sponsorship of international conferences.
- *Measuring value* – build a set of metrics and a dashboard.
- *Learning engagements* – orchestrate short courses by experts (from academia or industry) to contribute to student education or upskilling of company staff, solicit company input on university curriculum, offer/host guest lectures, and manage adjunct relationships or sabbaticals.

- *Philanthropy* – company gifts (cash, equipment, and services) are a mutually beneficial channel to supplement academic budgets and develop introductions.
- *Regional development and government partnerships* – take advantage of government incentives to catalyze partnerships between the university, companies, and local government.
- *Collaboration funding ecosystem* – develop and/or leverage company RFP (Request for Proposal) programs, Grand Challenges, or government incentive programs that require university-company partnerships.

Each of these strategies can provide many benefits by touching on multiple collaboration dimensions and help catalyze each of the key collaboration scenarios.

10. Summary

This paper summarizes the authors' extensive experience with University-Company partnerships and broad dimensions beyond research collaborations. Four key takeaways are:

- a) University-company relations have multiple benefits related to “open innovation practices” – namely: access to inspiration and innovation through research collaboration; access to talent both at the undergraduate, graduate, doctoral, and post-doctoral levels; marketing through benchmarking and co-branding; sales; and policy influence.
- b) Collaboration scenarios are a useful roadmap to establish effective university-company relationships, with activities that go beyond individual research programs with a wide range of benefits to both university and company stakeholders.
- c) A database of collaboration activities, contacts, funding details, and outcomes helps improve the effectiveness and viability for any collaboration program at scale.
- d) Virtualization of collaboration has become more necessary in the era of COVID-19, but it has not replaced the interactivity and spontaneity of face-to-face research collaborations.

University-company partnership benefits have many “dimensions” beyond research innovation and talent acquisition. A company that is able to leverage other dimensions (marketing collateral, sales, policy influence, government incentives) will build a more profitable collaboration and will produce more business value for the partners over time. If a partnership is unbalanced, with little or no rewards or incentives, participants will eventually disengage. We hope that by sharing our perspectives, we will stimulate discussion and incubate new opportunities for valued university-company research collaborations.

11. Data Availability

This paper reports on the authors' experiences and insights. No code, numeric, or other data was created or analyzed.

12. About the Authors

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[A 10-minute video presentation may be found here: <https://youtu.be/ewgUaK0IgWg>]