2006-424: CHALLENGES/ISSUES IN A INDUSTRY-ACADEMIC COLLABORATION

Jayathi Raghavan, Embry-Riddle Aeronautical University

Jayathi Raghavan is an Assistant Professor in the Department of Mathematics at Embry-Riddle Aeronautical University. She received her Ph.D. in Applied Mathematics in 2000 and MS in Computer Science in 1998 from Washington State University. Dr. Raghavan has taught a variety of mathematics courses, programming and database systems courses for the past six years. Her current area of interests are, Computational Mathematics, Database Systems and Software Engineering. She has worked on industry and government funded projects in the area of database systems and mathematics education. She has made several presentations and publications in these areas.

Massood Towhidnejad, Embry-Riddle Aeronautical University-Daytona Beach

Massood Towhidnejad (towhid@erau.edu) is chair and Professor of Computer and software engineering at Embry-Riddle Aeronautical University. He received his Ph.D. in Computer Engineering in 1990 at University of Central Florida. Dr. Towhidnejad current areas of interests are Software Engineering, Software Quality Assurance, and Software Testing. Over the past 15 years, he has worked on number of projects founded by government and industries. The result of his work has been published in over 60 articles.

Challenges in an Industry-Academic Collaboration

Abstract:

Studies have shown the benefits of industry-academic collaborations for the students, faculty and industry partners. However, there are many challenges in establishing such collaborations that if not addressed, may result to either the failure of such collaboration or an unpleasant experience for parties involved. In this paper, the authors first summarize some of the advantages of such collaborations as it is reflected by their experience and in literature survey. This is followed by identifying a series of challenges they may arise. Some of the challenges mentioned in this paper may be familiar to experienced collaborators, and hence this paper is intended for audiences who are new to collaboration or who intend to pursue such collaborations in the future. In this paper, the authors mainly concentrate on the issues that are more relevant to collaborations in the area of computing and software engineering.

Introduction

Over the past decade there have been several studies conducted on the benefits of Industry-Academic Collaboration. Such collaborations are accepted to be of mutual benefit to stakeholders in both organizations.

In an academic institution, there are numerous benefits for the students, and the faculty involved in these collaborations. The following provides a sample of these benefits[6,7,8]:

Potential Benefit to Students

- *Non-curricular learning.* Students who work on collaboration projects are expected to learn industry practice and new technology, which may not be part of the curriculum. This enables such students to face unfamiliar situations with confidence and courage.
- *Scholarships and stipends.* With graduate tuitions on the rise all over the country, students are in more need of research assistantships than ever. The industry collaboration provides the funding for academic research, which in turn helps provide scholarship for the students in the form of either stipends or tuition waivers.
- *Experience working on real-world projects and settings.* Students are expected to work on projects throughout their curriculum, more so in technological programs. But most often, students end up working on small projects in small-scale world, and typically on their own or with one additional person. When such students graduate and are employed by the industry, they are overwhelmed by the magnitude of the project that they have to work with. The industry-academic collaboration provides an opportunity for the students to work on the large-scale projects, and large group of people, which is closer to what they are expected to face after graduation. In addition, industry projects, typically are associated with hard deadlines, students who worked on these projects learn to adhere to these deadline.
- *Increase job prospects after graduation.* A student who has worked on collaboration projects often are familiar with industry culture, appreciates quality and are often willing to learn new things to keep abreast of the technological and environmental

changes. The student will be an asset to any employer. More often, the students are hired by the industry sponsoring the collaboration.

- *Improved appreciation of quality*. Students typically do not appreciate the need for quality in the final product they produce for class projects. But software quality is essential for industry projects and often goes through several level of testing to eliminate errors. Students working on collaborative projects have to undergo the same level of quality assurance and hence have a better appreciation for software quality.

Potential Benefit to Faculty

- *Conduit for research and founding opportunities.* Teaching a full load of classes often does not leave faculty enough time to conduct research. In such cases, faculty have to buy a course release or acquire summer support, which is often paid for through external funding sources. The collaboration projects provide for such funding. The resulting research may lead to artifacts such as journal publications or conference presentation
- *Insight into industry practices.* Often there is a disconnect between the academic and industry practices. Faculty who are involved in an industry-academic collaboration efforts can understand industry practices. This helps them study and analyze the difference between industry and academic practices. The study helps faculty and students involved understand the merits and demerits of both practices and lead to improvement of both.
- *Improved curriculum.* The new research knowledge gained by the faculty from the collaborative activity is transferred to the students through course curriculum changes. This process enables the academic curriculum to stay current and not become outdated.
- *Access to industry expertise.* In small schools, usually there are very few faculty in each department. It is often difficult for a faculty member to find another faculty to collaborate with. The industry-academic collaboration provides such an opportunity.

Potential Benefit to Industry

- *Access to additional employees.* Usually a collaboration team consists of a couple of people from industry, couple of faculty and several students. Thus, the industry gains several employees without having to actually hire any of them. The burden of hiring capable students is on the faculty involved since the industry's funding commitment is to the research activity and not to the individual students. Therefore industry gains capable workers without having to go through the search and interview process. In addition, students who work on these projects are monitored by industry personnel, which will provide insight to their capabilities as for future full time employee.
- *Access to faculty expertise.* Some companies do not have a designated research department and may not have access to cutting edge research to give them an advantage over competitors. In such cases, the faculty involved in the collaborative effort provides them the research at a very low cost to the industry.
- *Ownership of final product.* The industry involved, in addition, to gaining the expertise and the additional employees, they usually get the copyright and patent for the final product.

As it is shown in this section, there are number of benefits for an industry academic collaborations, however, there are several challenges and issues faced by people pursuing such collaborative efforts, which are rarely mentioned in literatures. In the following sections, discuss some of these less talked about challenges faced in industry-academic collaborations.

Issues and Challenges

The benefits discussed in the previous section, are so tempting, that stakeholders in industry and academic organization, would like to jump on any opportunity that arises for such collaborations. However, there are number of issues and challenges that are involved with such collaboration, that one should be aware of in order to make this partnership more successful to both organization. The issues and challenges discussed in the following section are the reflection of over ten years of authors' and some of their colleagues collaboration experience with a wide range of industries, such as a small local company to a large international organization spread over multiple continents. Some of these are funding issues, sensitivity issues, enrolment issues, and technical issues, each of which will be discussed in detail in the following paragraphs.

Volatility of technology market

As a result of the late 1990s dot.com bust, there was a gradual drop both in the number of students interested in pursuing computing education and availability of R & D funds from the computing industry. These problems were worsened by the tragedy of September 11, and almost the stock market melt-down. Industries started to tighten their belt, and were forced to work with a much smaller budget, and as a result they started cutting down their research and development funding. In addition, the parents of students were more concern about how they support their children education, and what their best return on the educational investment is. As a result we see the following trends;

- *Not enough interested student.* Enrollments in undergraduate United States computer science and related programs have declined rapidly. According to an analysis of survey results from the Higher Education Research Institute at the University of California at Los Angeles[10]; in 2000, 3.7% of entering freshmen said they planned to study CS; in 2002 it was 2.2%; in 2004, 1.4%. This is a 60% decline over the four years between the Fall of 2000 and 2004. A similar trend is seen in other CS related and engineering programs as well.

  Some of the reasons for this decline is

  a. decline in the IT industry
  b. increase in outsourcing
  c. misconception of the incoming students that CS and SE are fields focused primarily on programming and Web design
  d. Incoming students focus on the job market today, which may be entirely different four years later.

  Student employees form a transitional workforce. Students move in and out of projects due to various reasons: graduation, transfer in and out of university/program, or transfer in and out of research projects. The decline in enrollment makes it hard to

maintain the flow of student employees to work on collaborative projects, especially in small programs.

- *Not enough funding.* According to recent news reports, DARPA (Defense Advanced Research Projects Agency), which has supported research leading to some of the most valuable technological developments over the past five decades, funding for university researchers in computer science has fallen from $214 million to $123 million from 2001 to 2004[2]. Of the Pentagon's $419.3 billion budget request for next year, only about $10.5 million will go toward basic research, applied research and advanced technology development, which is a 20% reduction from last year[4]. The Bush Administration has requested $132.2 billion in federal Research and Development (R&D) funding for FY2006. According to the request, funding for federal research (basic and applied research) would decline from $55.2 billion to $54.8, a 0.6% reduction[3]. In addition, due to various factors like declining federal funding, offshore outsourcing, mergers and takeovers, and budgetary constrains in the industry, there has been a trend to reduce the discretionary funding which results in a decrease in industry funding for research at the industry. According to a recent study, the academic-research funds from industry fell by 1.1% to $2.16 billion, the second consecutive drop after a continuous increase over the past 40 years[1].
- *Company mergers.* There have been increased numbers of M&A (Mergers and Acquisition) activity over the past couple of years, especially software companies. Based upon the most current data from Mergerstat[5], US and US cross-border M&A deal volume increased by a rate of 25%; up from 8,232 to 10,296 in 2004. There are several reasons for a company to go through M&A. The reason may be for cost savings, market share, and elimination of competition or to obtain a new technology. Whatever the reason may be there is always a certain amount of risk and uncertainty involved. The corporate culture and the research focus of the new entity may change and pose a challenge to collaboration efforts. The managers may be tasked with implementing the new corporate policies. The management ranks may suffer more job loss, on a percentage basis, than the employees may[9]. Part of this job loss, may be due to the fact that often managers are tasked with implementing the new corporate policies, which they may disagree on. Since the collaborators are often of managerial rank, sought mainly for their financial decision-making authority, the loss of their job will be detrimental to the collaboration. In addition, for a successful and long lasting collaboration there is a need for a champion in both organizations. Typically, the PI at the university serves that role in academia, and either a technical manager and/or a business manager serves this role in industry. M&A may result in replacement of the champion from the project in the industry which could result in weakening of the relationship.
- *Sensitive contracts requiring citizenship*. Almost fifty percent of the students, or in some cases even more, involved in the graduate work are on student visas, and this causes major problems identifying students to work on projects that requires student to be a U.S. Citizen. Typically, students who are hired to work on industry academic collaboration project are considered to be the first option for employment at the industry. Unfortunately, since 9/11, more and more industries are changing their policy and require students working on their project to be U.S, citizens, or permanent residents, or so called "students who will not have any work visa issue". The main

reason behind this change in policy, is the way United States government, since 9/11, has made it harder for foreign nationals to apply for a work visa. Moreover, with the country at war, there is an increased need for improvement in defense technology and hence more funding is available for defense related projects, which are highly sensitive and require citizenship.

Technical Issues

There are number of technical issues that one should be aware of, when setting up an industry academic collaboration in the area of software engineering. Majority of organizations have been developing software for an extended period of time, and most these organizations have established their own process of software development. With the recent advances of software engineering and the introduction of new techniques and methodologies at the university, there could be a conflicting interest between the academic and industry partnerships. The academic partners would like to infuse the "latest and the greatest" techniques into the industry, where most of these techniques have not been tested in a real world project. Of course, the industry partners are wary of such approach, since they have been very successful in what they have been doing up to now, and they are not to anxious to "rock the boat", and suddenly changing their processes, which could generate unfavorable results. In addition, the industry partners are sensitive to the issue of allowing, people who are not regular employee of the organization to have access to the intranetwork of the company, or sensitive data associated with the organization. These issues are elaborated in detail in the following;

- *Software Engineering principles vs. time constraint*. In the collaboration projects which involves the development of software application, students follow the software engineering guidelines which they have learnt as part of their educational process. They are taught the importance of spending adequate time on requirements gathering, analysis and design for a successful development of an application. As a result, during the early phases of the collaboration, the academic partner, generates a number of software artifacts such as the software requirement specification, and software design specification, and others, however, if the industry partner is more interested on a working product these artifacts may seem of little value than expected. This may results to industry partner's unhappiness regarding the progress of the project. To remedy this, the academic partner, may be forced to rush through the early stages of the development cycle, which could result into a lower quality product, and also contradict what is taught as part of the students curricula.
- *Industry best practices versus academic best practices.* The collaborative projects facilitate a two-way communication between industry and academics and helps to bridge the gap between the industry and research best practices. One of the major challenges in this area, as stated in the previous bullet is the incorporation of software development process best practices (i.e., personal and team software process, or other so called "none productive" activities) in industry. On the other hand, industries, typically, adopt an academic practice and tailor-make that to best fit to their organization, sometimes, these industry customized practices, actually make the original practice more efficient, thereby making them better fit for the real world. We as the academician, should accept these custom made practices with an open arm, and bring it back to the classroom. Unfortunately, sometimes, we the academician are not

interested in learning from our industry partners. Unless these academic best practices are adapted by industry and industry best practices are understood by the academic researchers, there can be no improvement in the software engineering methodologies.

- *Software Compatibility/propriety.* Some software projects involve installing the collaborating industry's software on university machines. This sometimes conflicts with the existing infrastructure as part of the university computer facilities. This causes problems for the development team, who have to spend invaluable project time, finding and fixing these incompatibility issues which are often time consuming, and sometimes requires authority from out side of the department which may not be as cooperative. In addition, the development of an application for the industry collaborators sometimes involves obtaining proprietary data and information. This involves obtaining release at multiple levels and departments within the company causing considerable delay to the project.
- *Collaborative project in the line of production.* Sometimes a collaborative project involves developing a complementary component for the company's software, which is in the line of production. In such cases, care must be taken to make sure that the deadlines are adhered to more strictly than ever, since a delay in the delivery of the component will cause a delay in the delivery or shipment of the entire software. Any delay in such delivery, may result in millions of dollars of loss to the sponsoring company. This requirement poses a challenge due to the non-alignment of industry and academic calendar. The academic calendar has long breaks embedded in it. Graduate student workers may get a one-week break for Thanksgiving and for the spring and a four-week break in December. But the industry usually has no more than two days of break for Thanksgiving or Christmas. If the shipment date is set during one of these periods, it becomes difficult for the academic collaborators to meet the deadline. Any delay will be detrimental to future collaborative efforts with the particular industry. In addition, by getting involved in the production line, the academic partner automatically, whether intended or not, gets involved with the issues related to marketing time, product quality, cost, maintenance, and delivery.
- *IT security challenges/firewall.* Most of the collaborative projects involve development of a software application. As prototypes of the product is developed, it become necessary to make them available to the customer for the purpose of testing, and refinement of the requirements. To facilitate this, either the customers should have remote access to the university computers to test the prototype or the academic collaborators should have remote access to customer's computers to install and maintain the prototype, especially when they are located far apart. The firewalls on either site make it difficult in both cases, which warrant lengthy face-to-face visits either by the industry collaborators to the university or the academic collaborators to the industry. Therefore, as part of collaboration initial planning, one should identify a possible third location, where all parties have access with less complexity, in the mean time it provides the appropriate security, which both parties feel comfortable with.

Summary

As other authors have stated, there are a large number of benefits to the establishment of an academic and industry partnership. This paper identified some of the challenges and issues that are related to these collaborations. The main objective of this paper is NOT to say pursuing these partnerships is unworthy of the effort, but; to simply state, that there are number of challenges associated with them. So before one tries to establish such a partnership, they must first be aware of these challenges, and develop strategies that address them. During the tight budgetary time that most universities are going through, it is very tempting for the faculty and/or university administrator to jump on an opportunity of accepting some funding under such collaboration. However, if appropriate attention is not paid to these challenges, the funding may become more of a burden than a solution to the departmental needs. It is obvious that some of the challenges mentioned in this paper are beyond the control of the collaborators and solution to some other challenges depends on the individual collaborating institutions and their policies. Based on our experience we recognized that solutions to specific challenge in regard to one collaborating partner may or may not work for another partner, therefore it is almost impossible to come up with a generic solution for anyone of the challenges discussed in this paper to be used by others. Therefore, the purpose of this paper was not to prescribe a specific solution to a specific challenge, but simply to inform others of some of the challenges they may face in a collaborative partnership with an industry, and to provide some issues that need to be addressed during their risk analysis as they get ready to set up a partnership.

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