It Takes Two to Tango – An Experience Report on Industry–Academia Collaboration

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It Takes Two to Tango — An Experience Report on Industry–Academia Collaboration

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Abstract

Industry–academia collaboration is critical for empirical research to exist. However, there are many obstacles in the collaboration process. This paper reports on the experiences gained by the author, in a 2-year collaboration project on software testing which involved on-site work by the researcher in the industry premises. Based on notes, minutes of meetings, and progress reports, the project history is outlined. The project is analyzed, using collaboration models as a frame of reference. We conclude that there must be a balance between company 'pull' and academia 'push' in the collaboration Management support is inevitably a key factor to success, while other factors like cross-cultural skills and interfaces towards key resources also contribute.

1 Introduction

Industry–academia collaboration is a must for empirical research to take place, as the source of the empiricism is industry. Like-wise, for industry to gain from knowledge created in academia, collaboration must take place. The predominant work products from academic research are journal and conference papers. These are *not* designed to be a communication channel between academia and industry, and hence there are needs for a more direct communication in order to get mutual benefits from the collaboration.

This paper reports on experiences gained during a 2-year industry–academia project on software testing, where the researcher was located part-time in the industry premises, working in a role as consultant on strategic issues related to software testing. The objective is to identify success and failure factors for such collaboration, to help future improvements. The project was funded by a Swedish research funding body, with the aim of "increased personal mobility between sectors, universities, countries and disciplines"[1].

The information presented here on the project is based on personal notes, minutes of meetings, and progress reports. The analysis is based on two collaboration models for industry–academia research. The report is inevitably subjective, as it reports the author's own experiences and not the industry view, and does not hence qualify for being called a case study [9].

We analyze the sequence of events in the project in relation to two published models for industry–academia collaboration, one process-based by Gorschek et al. [5] and one relational by Sandberg et al. [10]. Having these model as the theory framework for the analysis helps reducing the subjectivity of which items are reported.

The experience report concludes that industry–academia collaboration would benefit from having both industry 'pulling' and academia 'pushing' the project. The need for management support and champions in the

[1] http://www.stratresearch.se/en/Ongoing-Research1/Mobility-grants/

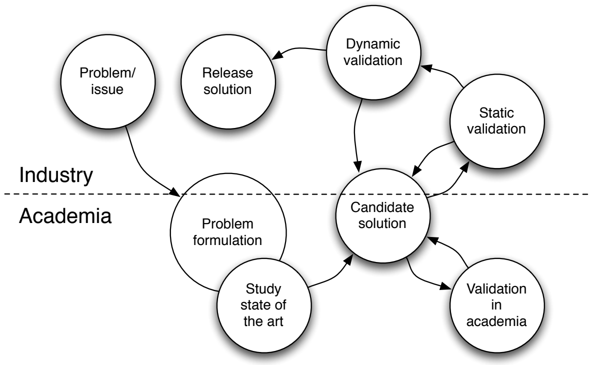

Figure 1: An activity model for technology-transfer in industry–academia collaboration, from Gorschek et al. [5].

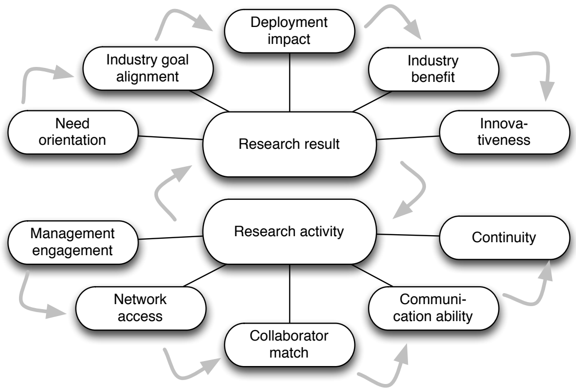

Figure 2: A relational model for industry–academia research, from Sandberg et al. [10]. Bowed arrows mean "enables".

company are reported elsewhere (e.g. [11]), and supported in this analysis. Other factors include adaptability to different cultures, and a preparedness for continuous change.

Section 2 presents related work on the topic, including models for industry–academia collaboration. In Section 3, the plans for the project are presented, and in Section 4 the actual project is described. Section 5 analyses the project outcome, and Section 6 concludes the paper.

2 Related work

Models for the collaboration between industry and academia involve a clear process from identified needs to improved industry practices [5], see Fig. 1. Being a good role model for industry–academia collaboration, experience reports show that the collaboration in practice is far from straightforward, leading Sandberg et al. [10] to define more relational models for the collaboration, as shown in Fig. 2. This model has two main foci; research activity and research result. Each of them have five aspect, which are interconnected, enabling each other in a chain of dependencies.

Success factors for collaboration are reported to be "management engagement" in the research activity, and "need orientation" in the choice of research topic, according to Sandberg et al. [10]. Wohlin et al. [11] corroborate their results in a survey, identifying "company management support" and "champion at the company" being the top two factors. The researcher's "attitude and social skills" come third. They surveyed both industry practitioners and academics, and found industry ranking higher the "researcher's commitment to focus on industry needs", "support from company management" and a "visible presence in industry", while academics ranked higher the "champion's network within the company" and "buy in and support from industry collaborators".

One factor in the industry–academia collaboration the credibility of knowledge for software practitioners. Rainer et al. [8] identified local opinion-based knowledge be more trusted in industry than empirically-based knowledge, especially if it comes from a remote context, see Table 1. This is a special challenge facing industry–academia collaboration.

Industry or practice-academia collaboration is important for several fields of research, such as Chemical Engineering [7], Civil Engineering [2], Pharmaceutical research [1], and Physics [12]. Each field of study seem to have their specific challenges. In Software Engineering a specific characteristic of the industry–academia collaboration is that it must involve the oper-

Table 1: Matrix of the suggested credibility of knowledge for software practitioners, from Rainer et al. [8].

Source of knowledge	Type of knowledge	
	Opinion	**Empirical**
Local	1 (most credible)	2
Remote	3	4 (least credible)

ational departments on the practice side. It is not sufficient for software engineering researchers to collaborate with research departments in industry; collaboration must involve the real development projects.

3 Plans for The Industry–Academia Project

The project, which is reported here is a 2-year industry–academia project, funded from a program at Swedish Foundation for Strategic Research[2] with a specific goal of increasing the "strategic mobility" between industry and academia. Researchers could get funding to spend time in industry, or industry people could get funding to spend time in an academic research environment.

The industry and academia partners in this project are active in a long-term collaboration, which has endured in various forms for more than a decade, including part-time employment of researchers in the company. In parallel with the current project, other collaboration projects took place; most prevalently a 10-year industry excellence center on software engineering[3], for which the author is director.

The project in this experience report had the following objectives defined in the application:

> *The main objectives of this strategic mobility project is to 1) boost the effects of the new industrial excellence center by widening the industry–academia contact network for the center director, 2) establish a 'bridgehead' within the company organization for empirical research on software testing, and 3) support transfer of knowledge between two of the company's development sites.*

The scope was software testing in a broad sense, with a focus on processes and management as the intersection of the researcher's competence and the industry needs.

An application, following an easy and lightweight process, was sent in in September 2008, and the funding was granted in December 2008, with a project plan covering 2009 and 2010. The application was supported by letters of intent from the industry partner and the University, to make personnel and other resources available for the project. It was deferred to a later stage to define which department of the company the work should take place in, as well as formal employment roles – whether the researcher should be employed by the company or by the University and the external funds be transferred accordingly. The negotiations on the industry side was made by their university relations coordinator, and not a specific department within the company, which later should turn out as a problem.

The work plan comprised three phases, one at the regional office of the company, the second at another site abroad, and an evaluation phase to the end. These were the plans, but the outcome became different, as described in the next section.

4 Actual Industry–Academia Project

This section is based on personal notes, minutes of meetings, e-mail correspondence and progress reports from the project. The description is made by the researcher solely, as the industry contact persons were not available, and

[2] http://www.stratresearch.se/en/
[3] http://ease.cs.lth.se

is hence naturally biassed, despite all attempts to be as objective as possible.

During Spring of 2009, the university relations coordinator at the company and the researcher met and discussed options at which test department to find a 'liasion' or 'champion' to act as the host for the researcher. The company was in a phase of major reorganization, and change of technical platform, as well as development process. Consequently, the organization was not very attracted by activities that might require some resources to initiate. Being busy with various other activities, neither the company coordinator nor the researcher pressed on very hard to get things going.

In October 2009, a champion was identified, who saw the value in getting access to a researcher "for free", and the project got started. It was decided that the researcher remained full-time employed at the University, and the external funding be transferred to the University. The researcher signed a nondisclosure agreement, got company ID card, access to the company intranet and premises.

The industry champion was responsible for the development of the new test processes, and had a strategic leadership role in coordinating improvement projects in the field of software testing. The champion was chairman for weekly meetings with different test managers in the organization: every second week it was a broader information forum, the other week a more focused steering group forum for test improvement projects. The researcher was invited to those meetings, which formed the pulse and contact point towards the organization.

The first annual report to the funding agency summarizes:

> *The project is finally started, after 10 months' delay. In the current financial situations, with accompanying reorganizations, it has been hard to find an organizational 'home' at the host company. [...] Causes of the delay are, in addition to the current focus on short term goals, lack of experience in collaboration with academia. They don't really see beforehand what an academic may contribute to industry. Some obstacles are at the formal level: how to register an co-worker in the personell-administrative system, who works as a consultant, but is not paid from the company? The solution is that the researcher currently is classified as 'internship' in the company's database.*

One additional effect of the reorganization was the closing-down of the remote site, at which the last six months of the project were planned to be spent.

The researcher got specific task forces to investigate, but had also to search for his own projects to investigate. An example task force was to summarize the research contribution to whether code coverage is a good measure of test progress, or not. One own project identified was the acceptance testing, run at a different site, which seemed not to be effective in making acceptance decisions. A master thesis project was launched during Spring of 2010, that got access to data from the acceptance testing. The master student developed a statistical model, utilizing the data more effectively to support decisions [6]. The outcome of the project was presented to the quality department, and they took some ideas into practice when restructuring the acceptance testing procedures.

Another master thesis project on prioritization of regression test cases, initiated before the project start, was concluded in May 2010. It was later presented as a conference paper [4].

At this point in time, the champion and point of contact left his position. His responsibilities were shared between two others. The one running the meeting fora did not have a so central position in the organization, and consequently, the value and attendance rate of the meetings decreased. The other took over the responsibility for the test strategy, as well as an overall operational responsibility. He utilized the researcher in some discussions, but not as systematically as the first champion did.

In the fall of 2010, a PhD student project was initiated, based on the researcher's identification of redundant testing being conducted in the different test organizations, working in parallel. The PhD student was given access to the environment, and conducted a case study about the redundancy of testing across different test organizations. The results were presented to the champion in December 2010, and found being additional support for an ongoing, more lightweight investigation, with similar goals.

The second annual project report summarized:

> *During 2010, the researcher has spent one day per week in the company. On this day, a steering/reference group for test activities on the company had regular meetings. In this group, the researcher has a function as external expert, and has given advice and comments from a scientific perspective.*

During spring 2011, the PhD student project was finalized and additional presentations were given. The researcher spent less time in the company during Spring 2011, due to other commitments and lack of requests from the company. The requests, in turn, were reduced due to limited presence in the company.

During the Fall of 2011, the researcher spent abroad as a visiting professor. However, since the company had closed down its premises in the host university's vicinity, the planned transfer of experiences could not take place.

5 Evaluation

In this section, the procedures and the outcome of the project are evaluated. Firstly, it is analyzed with respect to the models presented in Section 1, by Gorschek et al. [5], Sandberg et al. [10], and Rainer et al. [8]. Second, the setting up of the project are discussed, thirdly, general organizational aspects are discussed, and finally improvement for further projects are identified.

5.1 Collaboration Models

This project is hard to fit into the Gorschek et al. [5] technology transfer model (see Fig. 1), since there was no specific technical goal to address. Rather, the project goal was to fill a certain function of constituting *"a 'bridgehead' within the company organization for empirical research on software testing"*. The specific task forces had more of the technical goal, and the working process resembled then the technology transfer model in the small scale.

The Sandberg et al. [10] model is more suitable to analyze the outcome of the project (see Fig. 2). Admittingly biassed, due to self reporting and lack of industry participation in the analysis, the model items are commented as instantiated in the project, in Tables 2 and 3.

For the *research activity* part of the model, as outlined in Table 2, the *management engagement* played a dual role. Initially, it was lacking due to business on both sides, but once in place, the champions demonstrated management engagement for the project. The weekly meeting fora in the company were instrumental in providing *network access* as well as *communication ability*, in terms of personal networks. Since there were two champions during the project, they can be compared with respect to *collaborator match*. One of them was more actively 'pulling' results from the researcher, creating more mutual benefit, while the other more broadly asked for contributions from the academic perspective. Spending only one day per week reduced the ability to create *continuity*. Much of the time was spent catching up what happens in the organization, and the opportunities for spontaneous meetings also were too small.

Regarding the *research results* part of the model, as outlined in Table 3, the *need orientation* aspect was fully developed. Perhaps it was even too far stretched? The collaboration was based on short term needs, *aligned to*

Table 2: Research activity – model items from to Sandberg et al. [10].

Model item	Project instantiation
Management engagement	The project did not start until management engagement in the form of a champion was found.
Network access	Meeting forum at the core of communication.
Collaborator match	The first champion and the researcher made up a good match, with the champion 'pulling' results from the researcher.
Communication ability	The researcher had the option to communicate through the regular meeting.
Continuity	Spending one day per week in the company was not enough to create continuity.

Table 3: Research results – model items from to Sandberg et al. [10].

Model item	Project instantiation
Need orientation	The project was fully need oriented, which made it change completely compared to original plans.
Industry goal alignment	There was no overall goal, pulled by industry; rather it was academia push to provide results.
Deployment impact	The researcher was not working close enough to practice, to impact on deployment.
Industry benefit	From the researcher point of view, industry *long term* benefits were clear, but decisions are made on *short term* gains.
Innovativeness	Solutions were not specifically innovative, but the company rather needed many small improvement, than one major innovation.

industry goals, and tended consequently to lack an overall orientation. The ability to *impact on deployment* is a matter of closeness to or distance from practice. The champions belonged to top management of the company, and hence their focus was more on high-level issues, which were distant from the day-to-day testing practice. The *industry benefits* should be evaluated by industry representatives, but the researcher tried to make sure that the activities were beneficial for the company. The long-term goals of the collaboration were clear, but sometimes it was hard to connect the to the short-term trade-offs between costs and gains. Finally, the solutions worked on were not very radical, and hence not very *innovative* either. The major ground-breaking results, envisioned by research, are rarely what benefits industry in the short term, but rather a sequence of small improvement actions.

In terms of the 'buy-in' model by Rainer et al. [8], the knowledge presented to the company was mostly *remote empirical* knowledge, i.e. in the *least* credible category (see Table 1). However, begin a researcher, present in person, and tailoring the presentation of the knowledge to the local context, it seemed to be appreciated as 'localized'. If the knowledge could be connect to the practitioners own experiences, it also seemed to gain credibility. However, this is only subjectively experienced appreciation of the knowledge, not investigated by any independent actor.

5.2 Setting Up the Project

The biggest hurdles in setting up the project, was finding a host (liaison or champion) to connect the research project to. This factor is identified among the top key factor in the survey by Wohlin et al. [11] too. In the current project, a university professor was offered "for free"; still managers did not see the benefits beforehand of such a project. Perhaps, research projects should not be "for free"; rather some kind of company commitment or funding may lead to more 'pull' from the company.

Collaborating with the organization through an established series of meetings, was very helpful. The meetings as such gave a natural introduction to the company and its ongoing test improvement projects, and to the key staff at various positions. Further, using shares of the time of an already gathered meeting is much easier than to gather them to a separate meeting. Having said this, it shall be noted most people willingly made themselves available for specific meetings if the project so needed. Some people also indicated a curiosity about what "research tells" on the topic under discussion.

Getting permissions from the development organization was rather straightforward, once the right organizational home was found. However, supporting organization, like human resources and legal departments were not adapted to this type of collaboration. The human resources department had problem to find a suitable job title for the researcher, as mentioned above, which is more of a curious than a serious issue. However, more serious was that the legal department was not up to date with the Swedish law about university–industry collaboration. Secrecy issues about information handed over in a university–industry collaboration is strongly protected by the Secrecy Act (2009:400). However, the legal department enforced signing a non-disclosure agreement, which is not at all valid, since law outperforms contract. However, instead of fighting the debate, the researcher signed the agreement and abided with the law.

5.3 Business Models and Organizations

In an industry–academia collaboration project, it soon becomes clear that the business models and organizations are different [3].

Firstly, for industry, the driving force is to develop new products on time to put on the market and earn money. For academia, the driving force is to have an impact on the academic scene through publications, and for an applied researcher, to have an impact on industry practice. In the current project, this distinction was well known and respected, although it sometimes was questioned what the researcher would gain from spending time in the industrial context. Once explained, the researcher's presence was fully accepted and appreciated.

The incentives in the two types of organizations, are also different. Appreciation in industry – and sometimes bonus – comes with fulfillment of short to medium term project goals, while the incentives in academia is related to publications and citations – with year-long feed-back cycles – which in the long run may help career promotion and grants for new research. Naturally, this controls priorities in industry towards near-sighted goals, at the cost of long-term perspectives, and vice versa for academia.

This difference in time scale is also reflected in the planning horizon in personal calendars. Researchers make commitments far ahead of time for e.g. conference organization and teaching, while industry staff re-plan their commitments on daily, or even hourly basis, for higher management. Spending only one day per week in a "high-speed" organization makes it very hard to keep up the pace, and practically challenging to negotiate schedules.

Industry organizations change frequently, while academic organizations are very stable.

In this project, re-organizations lead to change in contact person and focus of the project, which lead to re-establishment of network and work procedures.

Last, but not least, is shall be noted that the target organizations for the collaboration project are fully operational product *development* organizations, working at the critical time-line of product deliveries. Industrial *research* organizations naturally have more similarities to the academic organization; however, the do not offer an environment to study and impact on the software *engineering* practices, possibly on the software *technology* only.

5.4 Synching the Tango – Discussion

How could industry–academia collaboration be in better synch, and thus more effective? Many of the factors impacting on this project are due to "bad luck", e.g. coinciding with the financial crisis. Other factors are independent of such events.

This project was not *initiated* by the company; it suffered from lack of 'pull' from the host organization and was mostly 'pushed' by the researcher. Ideally, the demand should come from inside the organization, driven by a commitment to and expectations on the collaboration. Means to achieve this may involve direct costs for the collaboration – if an organization pays the costs from their own budget, they feel obliged to utilize the results – or incentives for the managers and the organization related to their business goals.

The stress for *management support* can not be made clear enough. As the collaboration interacts with short-term projects, while the research goals are more long-term, this conflict must be resolved by company management at all levels. This observation corroborates earlier experience [10] and survey results [11]. The frequency of industry reorganizations can probably not be impacted on, but the hurt caused by them may be reduced by anchoring the collaboration high enough in the management hierarchy.

The *timing* aspect includes both the share of time spent in industry, and the industry versus academia planning horizons. To improve the collaboration, a larger share of the work week should be spent in industry, which on the other hand, conflicts with the long term commitments of the researcher. PhD students are from that perspective better candidates for collaboration, since their schedules and commitments tend to be more flexible, but a student's lack of experience reduces the strategic value for the industry. Industrial PhD students (i.e. industry employees, conducting PhD studies in parallel) are an attractive option, although it is a demanding work situation for the individual.

Being prepared for *change* is a recommended strategy for researchers. The pace of change is much higher in industry than in academia, and is driven by other forces than driving the industry–academia collaboration. Hence, strategies for change and risk mitigation, e.g. for thesis projects, must be part of the academic side of a collaboration project.

For broad software engineering improvement projects, the access to an existing *meeting forum* of key people was valuable. Getting to know formal and informal organizational structures take time, and if that time can be spent on the improvement project itself, it becomes more efficient.

6 Conclusion

Was the collaboration project a success or a failure? With respect to its original plans, it was definitely a failure. The start was 10 months delayed, the transfer part was canceled since the other premises were closed, and the project had to restart with a new champion, half-way. However, with respects to contacts for student projects and performed academic studies, the project still fulfilled some of its goals. Ironically, the academic gains are more visible than the company gains.

For more mutual benefit of the collaboration, a balance between company 'pull' and academia 'push' must be achieved. Management support is inevitably a key factor to success. However, the ability by the researcher to adjust to different cultures, including time perspective is another key to success, as is the access to the organizational key resources through, for example, meeting fora.

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