Fontys ICT, Partners in Education Program - Intensifying Collaborations Between Higher Education and Software Industry

Patrick de Beer
Fontys University of Applied Sciences, ICT
Prof. Goossenslaan 1
Tilburg, The Netherlands
+31885085982
p.debeer@fontys.nl

Samuil Angelov
Fontys University of Applied Sciences, ICT
Rachelsmolen 1
Eindhoven, The Netherlands
+31683971655
s.angelov@fontys.nl

ABSTRACT
In this paper, we describe the existing successful practices at the Fontys University of Applied Sciences, ICT in establishing and maintaining collaboration with industry within its ICT curriculum. We describe our approach and the major challenges that we face. In particular, we provide concrete examples from one semester of the Software Engineering curriculum where different forms of collaboration are employed. Our approach, experiences and lessons learned may be valuable to other software engineering programs in involving industry partners in the education process.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science]: Curriculum – Software Engineering.

K.4.3 [Organizational Impacts]: Employment – Software Industry

General Terms
Management, Experimentation, Legal Aspects.

Keywords
Education, software engineering, industry partners, employers, collaboration, cooperation, sharing experience, social constructivism, visible learning, higher vocational education.

1. INTRODUCTION
The organization VNO-NCW (Confederation of Netherlands Industry and Employers, being the largest employers' organization in the Netherlands) and the Dutch Scientific Committee for government policy (WRR) have stressed in their recent mid-term vision documents that higher education institutes should pay attention to both research and maintaining a good connection and collaboration with the industry for which their students will be future employees [4], [7]. The good connection and collaboration with the industry is not always present in the traditional education.

Fontys University of Applied Sciences offers predominantly bachelor level studies (4 years). The focus of the education are the applied aspects of a domain. Upon completion of their studies, the students need to be able to directly get involved in the industry as qualified professionals. Fontys University of Applied Sciences consists of numerous schools, among which the ICT school. The ICT school offers four major and five additional graduation paths, with Software Engineering as one of the major paths.

Fontys University of Applied Sciences, ICT has come up with a solution to improve on the good connection with the industry by establishing a program for close cooperation called "Partners in Education" (PiE). Partners in Education are companies with which we have the agreement that they heavily invest in our students and education program. By now, the program has been successfully implemented in the 4 year curriculum of the ICT school, and in particular in the Software Engineering bachelor. In this short paper, we describe the implementation of the PiE program in our organization.

First, in Section 2, we delineate the differences existing between the education environment in a university and the working environment in a company. These differences are a starting point for involving industry partners who with their expertise can bring the work field reality in the education environment and therefore better prepare students for their professional life. Next, we look at how relevant industry knowledge and experience can be integrated in our courses. Based on the identified problems and solutions, the set-up of the PiE program is described (Section 3). Finally, we provide an example how the PiE program is implemented in our semester 4 of the Software Engineering program (Section 4). We end the paper with our conclusions.

2. UNIVERSITY VERSUS INDUSTRY ENVIRONMENT
The vision of Fontys ICT is to provide an educational model that is driven by student's needs and interests, learning through cooperation with fellow students and providing meaningful, realistic, industry scenarios and problems for our student projects. In this way, we aim at educating students that are wanted in and valuable for the industry. The importance of industrial

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involvement, where students can experience the problems encountered in the industry is also emphasized in [5].

The way of working in a traditional educational environment differs from an industry environment. Examples for differences are the environmental dynamics, anticipation to change in the market versus fixed courses, dealing with multi-discipline cooperation, hard deadlines for releases, effects of poor quality software to the business. It is until the freshly graduated student starts working that he experiences the effects of the mentioned examples. Similar observations are made in [3] where also the importance of having good team cooperation skills is mentioned. Another difference that can be observed is rooted in the rapid developments taking place in the software engineering domain. Educational material is often lagging behind the latest technologies and trends. Keeping the material up-to-date requires a lot of effort from teaching personal and it is questionable if it is an effective solution, given the fact that often software technology gets quickly outdated. At the same time, the industry quickly reacts to such developments and expects certain knowledge from the graduating students even in the most recent technologies [8].

These differences can be summarized in 3 categories for which a solution is needed:

1. Early experience industry way of working
2. Keep up-to-date with latest trends and technologies
3. Team cooperation

With our PiE program, we have found a way to implement different kinds of close cooperation with industry that offer solutions to these problems:

Guest lectures - guest lectures are an approach to demonstrate to students how is theory applied in the field or to demonstrate new trends and technologies (addressing problems 1 and 2).

Experts with Tips - involving experts from industry in the education process and at the education premises allows students to learn about the way of working in the work field, getting tips from experts (addressing problems 1 and 2).

Visits in the field - visiting the work field offers to students the chance to see and experience how things are done in practice, how is collaboration achieved in practice, observe the actual industry dynamics (addressing problems 1 and 3),

Workshops - workshops are a way to easily demonstrate to students the industry way of working or new technologies. Having experienced practitioners to give a workshop gives students a realistic setting and a quick learning curve by directly experience the industry way of working, (addressing problems 1, 2 and 3).

Expert clients - project-based courses are made more realistic by providing an industry clients for projects (addressing problem 1).

3. THE "PARTNERS IN EDUCATION" PROGRAM

Being located in a high-tech region, our school experiences a constant high demand for highly qualified software engineers. The region has numerous software companies and high-tech companies with software departments. Therefore, there are ample opportunities to find partners that can be involved in the education. However, experience has shown that companies have opportunistic behavior, i.e., they tend to cancel previous agreements with the school for their involvement in the education process when workloads for them increase (a new project, client, deadline emerges) or when new software engineers are not urgently needed. This, however, is unacceptable for an education environment where continuity is a prerequisite.

In order to provide a stable cooperation with the partners, we have introduced the following solutions:

- A program coordinator
- Working with covenants

A coordinator of the program caters for the maintenance of the pool of partners, for performing yearly evaluations on the cooperation, for communicating possible partners to education organizers (curriculum bodies, course creators and maintainers). The coordinator is the entry point for requests to access to our students and an exit point for requests for contributions to the education. This role ensures a clear communication channel for both sides. The coordinator is given 7 hours a week for the PiE tasks but typically there are more (where much more hours are spent) and less busy weeks. Therefore, the hours only illustrate the average weekly load of a coordinator in a semester.

For a company to be involved in the education process, a covenant is signed. The covenant expresses the mutual interest in the cooperation and the dedication of both sides to it. A company signing the covenant and thus involved as a partner in education is allowed to directly contact students for internships and to approach students for other possible activities at the company side. It is given access to an yearly company market event and obtains access to knowledge created in the school. Given those rights, a partner company is requested to contribute to course developments when needed, contribute a number of hours to the education process (in one of the techniques introduced in Section 2), ensure presence and support during open days for potential new students, participate in an advisory body on our curriculum ("Work-field commission"), provide experts during student graduations. The role of the PiE in the Work-field committee and as external experts is only advisory, meaning that school staff takes the final decision on curriculum changes and on a final grade of a student. Still, their opinion is highly valued and listened to. There are no financial exchanges in the PiE program.

To ensure a good partner collaboration, before signing the covenant, a company passes a trial period as a "candidate partner" (between 6 and 12 months). In this trial period, the company gets involved in the education process as agreed with the school so that both sides can experience the collaboration process and estimate its stability and positive effects. Should both sides evaluate the trial period positively, the signing of a covenant is a natural next step. This set up provides us with a stable environment where only dedicated companies are involved in the education process. At present more than 40 companies are involved in the PiE program (ranging from small and medium to large enterprises). The program has a high reputation among the industry and there is a constant list of waiting companies interested to get involved in the education process.

Our coordinator and covenant approaches do reflect best practices reported in literature. In [2], to improve the collaboration between industry and academia, suggestions are presented in a "good practice model for collaboration". The authors consider as crucial the following strategies:

1. Ensure partner commitment and continuation.
2. Ensure that a partner can fulfill its commitment
3. Define clear objectives
4. Ensure mutual benefit

These activities are operationalized in our context by the introduction of the trial cooperation period and the covenant.

In [6], success factors of industry collaboration are presented. It is concluded that support from company management and a champion within the organization are crucial for a successful cooperation. Within our PiE program, the company management is involved in the signing of the covenant and is therefore fully aware of the commitments. The program coordinator fulfills the champion's role.

4. IMPLEMENTATION OF PiE WITHIN SOFTWARE ENGINEERING

The collaboration types with our PiE presented in Section 2 are used throughout the complete 4 years of our Software Engineering bachelor. In this section, we discuss semester 4 courses of the software engineering program, as they cover the complete spectrum of collaboration forms. This period is prior to the semester where the students will have their first internship. The internship is their first experience in the working field they are educated for. It is therefore extra important to build up a realistic expectation of their possible daily work.

4.1 Guest Lectures

The "guest lectures" solution has been applied to the "Enterprise Architecture" course. In this course, the students learn the basics of Enterprise Architecting (EA) and how to elaborate an EA. The EA course is theoretic and experienced tough because of the high abstraction involved of translating from a real-life based case description to architectural models. To place things more in its context, one of our PiE (a Dutch bank) explains how EA is applied in their work, giving the students a meaningful context and better understanding of the topic.

4.2 Experts with Tips

The "experts with tips" cooperation, where students learn how experts would approach a certain problem, has been applied in the courses: "UI design & usability" and "Prince2 PID".

The course "UI design & usability" teaches students the development process towards an effective user interface from a user centered perspective. During the design process, expert designers are invited to test the student prototypes, share their opinion and give tips on how to improve the design. The experts also share their way of working in practice.

The course "Prince2 PID" teaches the students how to create a Prince2 project initiation document. Experienced practitioners are available in a consultant role for the students helping them in creating a proper document. The final documents are reviewed and graded by the teachers and the practitioners.

4.3 Experts at Work

The "Experts at work" approach is used in our "Agile Software Methodologies" course. In this course, the students learn about Agile software development methods. The course starts with a general introduction in Scrum and students get an assignment to research several kinds of Agile methodologies themselves which are presented in the classroom. To give this theoretical knowledge a practical body, our students are asked to visit any of our PiE or other software company to compare theory with how things are done in the field. At many companies, the students are invited for half a day, where they can experience how an Agile team's daily work looks like. Also they have the chance to interview engineers on how the software development process is actually implemented in their organization.

4.4 Workshops

Within the course on "Agile Software Methodologies", a PiE is invited to demonstrate by example how Agile planning and estimation is actually performed. The students are involved in Agile planning exercises, where they experience common pitfalls of the planning activity like unclear requirements, not planning for the activities actually asked for, under and overestimating.

4.5 Expert Clients

Since recently we started on a smaller scale by experimenting with the coupling of a PiE to students' long term group software development projects [1]. During this course students work for 20 weeks on a software case which is built via an Agile approach. In this project, the students apply newly learned theory in an as close as possible practical setting. In the past, we did this based on case descriptions. Because of the lack of a real customer this was not always seen as a challenging exercise. Since last year, we are actively looking for PiE who have real projects for the students, and where the company is acting as the customer and product owner of the product to be build. We see that those groups which are linked to a real customer are much more motivated in delivering a quality product.

5. DISCUSSION

The close collaboration that we have with our partners is appreciated by our students which is reflected in the semester feedbacks. Especially the moments where there is a possibility to visit and interview companies at location are positively received. Also, the direct relation with practical experienced experts in the class room and projects are seen as valuable.

The additional work teaching staff has to invest in this cooperation is rather minimal. Our PiE coordinator sets up and manages the contacts and the "semester coordinators" arrange the coupling of the partners with actual course content. When this work is done, course teachers only need to ensure support to the partners (ensure resources if need, introduce the partners). A positive side effect is that this is also a good way for the teachers to match (and perhaps improve) their knowledge with the input offered by the partners.

In project based courses, it is more difficult to involve a partner. This is caused by the number of hours required form a partner to invest and the regularity of the contact moments when someone has to be available from the company (on a weekly basis).

The type of collaborations with industry we are applying now are received well resulting in minimizing the gap between education and industry. However, our approach on the types of collaboration has been intuitive and evolutionary. it would be interesting to

investigate which types of industry collaborations work best when and if there are other collaboration types that might be a good addition to our current set of practices.

6. CONCLUSIONS

Highly valuable and wanted graduated students for the software industry are those who have had experience during their whole education with topics that are relevant to the industry. The main topics identified are: being familiar with the way of working in the industry, knowing the latest trends and technologies and having major experience working in teams. To address these in an efficient way in our curriculum, a good connection and collaboration with the software industry is needed. At Fontys ICT, this collaboration is realized through the Partners in Education program (PiE). Students, staff, and PiE react positively on the approach. Although quite some effort has to be spent by our PiE, it is seen by most of them as a successful way of promoting their company under potential future employees, which is important in a market where less software engineers are offered than needed. Next to that, it offers them graduated student that meet end qualifications which matches more closely compared with students who graduated from more traditional educations. By being involved in advisory boards like the curriculum advisory board and graduation boards, our partners have sufficient channels to offer improvements to our education, which they may see as needed in practice. A challenge at present is the constantly growing number of students. This combined with our class system (classes of 25 students) requires that partners either invest much more time in their activities or that 2 or 3 partners get involved for a single course.

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