Hall of Fame nomination paper:
Distributed Software Development course

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Abstract— Distributed Software Development course is a joint project-based course involving three universities, from Croatia, Sweden and Italy, running each year since 2003. Distributed student teams work on all phases of a complex software engineering project, solving several challenges of working in a global environment, thus obtaining a valuable experience for their future careers. The course is very well received by both the students and course partners from the industry.

Keywords—global software engineering education; distributed software development; project-based courses; cultural differences

I. GENERAL INFORMATION AND COURSE METHOD

Distributed Software Development course (DSD) is a joint course between University of Zagreb, Croatia (FER), Mälardalen University, Västerås, Sweden (MDH) and Politecnico di Milano, Italy (POLIMI), It has been running for 14 years, since 2003, as an elective course on the Masters level of software engineering and similar education. Altogether **482 students** have taken the course since the beginning, coming from **45 countries and 6 continents** (studying at one of DSD sites), working on 73 student projects, out of which 64 were in distributed project teams. The teaching staff is also diverse and distributed into 3 universities, but aims to run the course as "tightly coupled" and coherent as possible, with joint lectures, student presentations, project supervision and grading.

The course is **project-based**, but includes a number of **lectures** related to Global Software Engineering (GSE) and distributed work, best practices in project organization, cultural differences, as well as talks from our industry partners about real-life experiences in GSE. These lectures take place in the first weeks of the course. The **project work**, which starts in parallel with the lectures, provides students with the opportunity to work in distributed groups of 6-8 team members, distributed into 2 locations. Each team carries out one complex software project, often proposed by an industry partner, going through all project phases; from detailed project description and requirements gathering from the customers, through architecture design, implementation, to testing and documenting. Students are exposed to all challenges present in GSE – team organization, distributed collaboration and communication in a foreign language, decision-making process, knowledge transfer, self-assessment, cultural differences, etc. All teams follow the **agile development method**, in particular, the SCRUM framework. They choose SCRUM Master and Product Owner from the team members and have the freedom in organizing their project work and collaboration, selecting the technologies, etc.

An important part of the project work are also 5-6 **presentations** throughout the course, where students describe their project status to other teams and teaching staff. Additionally, each team is **regularly supervised** by two staff members, one per each site, with the purpose of helping students to work effectively in the distributed context - completely new to them - and to make the right technical and organizational choices for the project success.

At the end of the course, a thorough **project evaluation** takes place, with more than 40 elements being evaluated, related to the quality of product, process, documentation and presentations. Team members are provided a set of points for the whole team and asked to distribute the points among themselves. The final grade of each student is given by the teaching staff based on several course elements, including the points acquired from the team. In 14 years of anonymous **course evaluations**, students highly regard the course as relevant and useful, different from all the other courses, an example to the others. Evaluation data is available at the DSD website (see below).

II. DSD COURSE OVER THE YEARS

DSD course has a vibrant history. It started with two partners involved: FER and MDH. The first years were marked by organizational and technical challenges, but also by great enthusiasm and motivation, which we consider our most important course companions. In years to come, **external customers from the industry** were included, ranging from startups, SMEs to multinational companies such as Microsoft and Ericsson, with the aim of emphasizing the "real-life" course factor. In 2009 and 2010, we partnered with Paderborn Universität, Germany, where we experimented with the role-playing of a "merger scenario" and **3-side project teams**. Having this experience, we decided to keep each team located in 2 countries, mostly to reduce the organizational issues involved.

In 2009, a new form of external customers has been added to the course. **SCORE competition,** organized by International Conference on Software Engineering (ICSE), was introduced as a way of bringing together students and fully remote customers, but also to improve students' motivation, due to the global competition. This step yielded great results, explained below.

In 2012, a **new partner, Politecnico di Milano,** joined the course for a long-term cooperation. This brought more diversity into the teams, but also new organizational and technical challenges, such as another academic calendar, a new way of course enrollment and another course grading system. Communication tools were also changed due to the new needs.

In 2014, a significant change was made in the course and project teams' organization. We moved from the iterative software development methodology with stricter project team roles (Project managers and Team leaders) to **agile development** and **SCRUM** framework, easing the organization into more "democratic" way of team members' participation.

Over the years, various changes in factors of the course - especially organizational – occurred, sometimes completely out of our control. Undertaken changes and all sorts of challenges gave us a broad experience of handling different situations, from having an unequal number of students per site, through handling course calendar changes from year to year, to experiencing some dramatic demographical changes due to higher-level countries' policies. In 14 years of uninterrupted course implementation, we managed to keep the partners and the course "tightly-coupled", working on having as many joint elements as possible, including academic calendars, remote enrollments, etc. Based on our knowledge, this is not often seen in the GSE community, so we consider this closeness to be one of the strongest points of our course.

III. DSD EXPERIENCE –AWARDS, PAPERS AND MORE

The DSD course experience, although started with purely educational goals in mind, over the years yielded several indirect outcomes and influence elements:

- **Research papers** – the course setting proves to be a valuable source of data and lessons learned for this type of education. More than 15 research and experience papers came out of the course, such as tips & lessons learned [1][2], research on development processes, appropriate projects and team dynamics [3][4][5], usage of appropriate technologies [6] or collaboration with customers from the industry [7]. Besides being helpful in our own long-term continuous improvement process, we hope these papers have added some value to the body of knowledge in GSE field.

- **Dissemination** – our course experiences were shared on prominent conferences and workshops (such as CSEE&T, ICSE, ECSAW), professional events and talks, but also shared with a broader audience, including a story about the course at the Croatian national TV.

- **Course awards** – the course quality has been recognized in 3 awards, setting an example for others:
  - 2013/2014 - *European University Information Systems organisation* (EUNIS) - "*EUNIS Dorup E-learning Award 2014*"
  - 2009/2010 - *International E-Learning Association* (IELA) - "*International e-Learning Awards 2010*", Runner-up award, in the category of *academic e-learning*.

  - 2008/2009 – "*The best e-course at the University of Zagreb*", 2nd place award

- **SCORE competition awards** – our students had great success in several years of SCORE competition, which fits well to our course context. It can be seen as a proof of sustainable, independently evaluated, high-quality educational outcome of the course. Projects developed for remote customers had the following results:
  - 2015/2016 – 2 teams in the semi-finals (out of 26 registered teams)
  - 2012/2013 – overall SCORE winner (out of 50+ registered teams)
  - 2010/2011 – 2 teams in the finals, 4 teams in the semi-finals (out of 94 teams)
  - 2008/2009 – overall SCORE winner, 3 teams in the finals (out of 50 registered teams)

Throughout our participation in this competition, the global aspect of our course and project work was emphasized, thus promoting the concept of distributed work, as well as GSE field, both in "real life" and education.

- **Vast documentation and course evaluation data** – in 14 years of the course implementation, various data at individual and project level became available for evaluation and research; from students' documents on all project aspects, through detailed project evaluation sheets as a basis for grading, to anonymous evaluations done by students at the end of the course.

More information about the course, implementation details, video excerpts, course evaluation results, project examples and the complete projects archive is available at the official course website: http://www.fer.unizg.hr/rasip/dsd.

IV. REFERENCES

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