

Industry/University Collaboration in Software Engineering Education: Refreshing and Retuning Our Strategies

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Abstract—This panel session will explore strategies for industry/university collaboration in software engineering education. Specific discussion topics will include new strategies for successful industry/university collaboration, exploration of reasons why some of the old strategies no longer work, and regional/geographical differences noted by the international set of panelists. The panel hopes to identify new promising strategies for such collaborations. Specific industry representatives will be invited to attend and participate in the discussion.

Index Terms— Education, software engineering, strategies, collaboration.

PANEL DESCRIPTION

It comes as no surprise that most of the students in software engineering and computer science undergraduate and master's degree programs end up in industry, so it is natural for the attendees of the Joint Software Engineering Education and Training (JSEET) track and Conference on Software Engineering Education and Training (CSEET) to be interested in industry/university collaboration. As a consequence of this interest, industry/university collaboration in software engineering education has been studied off and on for years [1-8]. In fact, it has been written about and discussed from so many angles that you might think there is nothing left of interest to say about it.

In our recent software assurance curriculum efforts [9], a strategy for successful industry/university collaboration was presented. This strategy is based on other strategies that have been successful in software engineering degree programs. The recommended steps excerpted from our strategy are listed below.

“In addition to participating in industry advisory boards, making donations, or providing discounts on equipment and software, there are a number of other ways in which industry can contribute. These include

- encouraging employees to work with universities as adjunct faculty or guest lecturers—This can enrich both the industry organization and the university program.
- sponsoring and speaking at faculty development workshops—It's important to provide faculty

development workshops for those who wish to teach a new discipline. However, the cost of such workshops can be significant. Industry could assist with the cost, help to shape the material, and provide guest speakers for such workshops.

- providing grants to help develop new degree programs—Implementing new degree programs is very expensive, and assistance with some of the development costs could help get a new program off the ground.
- providing scholarships and summer internships to students in these programs—These programs are good ways to ensure that graduates can hit the ground running once they complete their degree program.
- providing support for realistic capstone projects—Industry could provide valuable support by proposing capstone problems, acting as a client, reviewing deliverables, and/or furnishing advice about project management, development methods, and technology.
- modifying and updating employee position descriptions to raise the bar—Many industry position descriptions focus on low-level skills, such as an ability to code in C or Java and do not highlight more advanced skills needed to produce assured software.
- creating an endowed chair position in software assurance—An endowed position would ensure longevity for the program.”[9]

You might conclude that if you just execute these steps—voila—a great collaboration is almost guaranteed! However, we are finding that it's not that easy. Achieving these goals requires a lot of effort and lead time. Industry executives, whose support is needed for these collaborations, want to understand the accrued benefits to their organization.

A lot has changed in our environment in recent years. Some of the obvious changes include the following:

- Software engineering staff members change jobs often. The idea of investing in professional development of staff because they will be spending their entire career in one or two companies seems outdated. Staff members don't have loyalty to companies and vice-versa.

- Industry investment in software engineering education has become an expensive luxury that has been discontinued in many companies.
- Financial analysts are concerned with the next quarterly report more than with what might happen five years from now.
- Some organizations that hire software engineering graduates have little actual interest in software engineering and just want programmers who can churn out software quickly, regardless of the method or lack thereof.
- We are now in a global economy. Software is being produced worldwide and software engineering degree programs are offered worldwide. Strategies for industry/university collaboration that work in one country or region may not work at all in another.

It seems inevitable that new strategies for industry/university collaboration are needed, and we need to understand the environment in which specific strategies, whether new or old, are successful. We are hopeful that this session will allow us to identify and discuss successful strategies.

Tim Lethbridge reports that at the University of Ottawa it is now mandatory for undergraduate students to do four co-op work terms in industry. Many companies report that they learn from what the students bring in terms of process and design knowledge, and the students bring back industrial experiences to discuss in the classroom. The students have deep knowledge by the time they start their fourth year capstone projects, which are also done with industry, often small companies.

Mikio Aoyama reports that he has been working on curriculum development and has been teaching in an education and training program of professional software engineers for DENSO, one of the largest automotive suppliers [10].

Panel participants will discuss these issues and challenges. In addition to exchanging views with one another, we will invite industry counterparts to attend the session and participate in the discussion. We expect that their active participation, along with that of other attendees, will round out the session. We anticipate that less than half the time allocated for the panel will be devoted to panelist viewpoints, and the remainder will involve audience participation and interaction.

PANELISTS

Nancy R. Mead (*Panel Chair*) is a Fellow and Principal Researcher at the Software Engineering Institute (SEI). Mead is also an Adjunct Professor of Software Engineering at Carnegie Mellon University. She is currently involved in the study of security requirements engineering and the development of software assurance curricula.

Mead has more than 150 publications and invited presentations, and has a biographical citation in *Who's Who in America*. She is a Fellow of the Institute of Electrical and Electronic Engineers (IEEE) and a Distinguished Member of the Association for Computing Machinery (ACM). Dr. Mead received her PhD in mathematics from the Polytechnic Institute

of New York, and received a BA and an MS in mathematics from New York University.

Mikio Aoyama is a professor at the Department of Software Engineering, Nanzan University, Japan. He received a BS and MS from Okayama University, and a Doctor of Engineering from Tokyo Institute of Technology. In 1980, he joined Fujitsu Limited, where he was involved in the development of large-scale distributed software systems.

From 1986 to 1988, he was a visiting scholar at the University of Illinois, USA. In 1995, he joined Niigata Institute of Technology as a professor, then moved to Nanzan University in 2001. Aoyama created the software engineering curriculum for the department of software engineering founded in 2009. His research interests include requirements engineering, cloud computing, and automotive software engineering. He is the chair of the REBOK (Requirements Engineering Body Of Knowledge) WG in JISA and the PROMCODE (PROject Management for COnttracted DELivery) consortium [<http://www.promcode.org>]; both are joint projects between academia and industry.

Matthew Bass is a member of the core faculty of Carnegie Mellon's Master of Software Engineering professional programs and the Associate Director of Software Engineering Professional Programs for Corporate and Alumni Relations. Prior to joining Carnegie Mellon, Matthew was a member of the technical staff for the Software Architecture group of Siemens Corporate Research. In this role, he taught software architecture classes, mentored Siemens operating companies in software architecture practices, conducted software architecture reviews for critical projects, and acted as a software architect for multiple domains including automotive, medical, building automation, and power distribution. He spent over three years as a resident affiliate with the Product Line Systems program at Carnegie Mellon's Software Engineering Institute.

With an undergraduate degree in Computer Science and a graduate degree in Software Engineering, Matthew has been a practicing software engineer for more than 15 years, working with Fortune 500 companies across a variety of industry domains. His commitments range from local industry consultation to international invited talks and conference participation.

Tim Lethbridge is a Professor and Vice Dean at the University of Ottawa. His research focuses on software engineering education and systems to help people manipulate complex information.

Lethbridge earned a Bachelor of Science in Computer Science and MSc (CS) from the University of New Brunswick. His PhD from the University of Ottawa focuses on practical techniques for organizing and measuring knowledge.

He has taught courses in Object Orientation, Software Engineering, Software Evolution, and User Interfaces. He published the textbook *Object Oriented Software Engineering: Practical Software Development Using UML and Java*. Lethbridge was also a leader in the development of the Software Engineering 2004 curriculum, sponsored by the IEEE and ACM.

Ana M. Moreno is a Professor of Software Engineering at Universidad Politécnica de Madrid (UPM). She is also Director of the Software Project Management Master Program and UPM Coordinator of the EIT-ICT Labs Master on ICT Innovation. She has participated in different international initiatives related to Software Engineering Education such as the SEI Working Group on Software Engineering Education, the IEEE Computer Society International Committee for Software Engineering Certification Programs the International Reviewers Committee of the Graduate Software Engineering Program (GSWE), and the IEEE CS Educational Awards Subcommittee.

Moreno holds a B.S. in Computer Science and a Ph.D. in Computer Science from UPM. Her research and teaching areas are related to software engineering. She is the author of a significant number of publications in relevant scientific journals. She has also co-authored two international books published by Springer about Empirical Software Engineering and Software Process.

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REFERENCES

- [1] N.R. Mead, H. Ellis, A. Moreno, S. Seidman. Reeducation to expand the software engineering workforce: successful industry/university collaborations (CMU/SEI-2002-SR-001). Software Engineering Institute, Carnegie Mellon University, July 2002.
- [2] "Industrial input to the computing curriculum." Effective Learning & Teaching in Computing, Editors Alastair Irons & Sylvia Alexander, Routledge Farmer, New York, N.Y. pp. 123-135, 2004.
- [3] N. R. Mead. "Industry-university partnerships: the wave of the future?" Fourth Annual Conference on the Teaching of Computing, Dublin, August 1996.
- [4] N. R. Mead, K. Beckman, N. Coulter, and S. Khajenoori. "Industry/university collaboration: closing the gap between industry and academia." IEEE Software, Vol. 14, No. 6, November-December 1997, pp. 49-57.
- [5] N. R. Mead, K. Beckman, J. Lawrence, G. O'Mary, C. Parish, P. Unpingco, H. Walker. "Industry/university collaborations: different perspectives heighten mutual opportunities." CrossTalk, March 2000.
- [6] N. R. Mead, H. J. C. Ellis, A. Moreno, and P. MacNeil. "Can industry and academia collaborate to meet the need for software engineers?" Cutter IT Journal, June 2001, Vol. 14, No. 6, pp. 32-39.
- [7] N. R. Mead, H. J. C. Ellis, A. Moreno, C. D. Tanner, D. Ramsey. "Characteristics of successful collaborations to produce educated software engineering professionals." Computer Science Education, 2002, Vol. 12, No. 1-2, pp. 119-140, Swets & Zeitlinger.
- [8] N. R. Mead, H. J. C. Ellis, A. M. Moreno, S. B. Seidman. "Industry/university software engineering collaborations for the successful reeducation of non-software professionals." 16th Conference on Software Engineering Education & Training, March 20-22, 2003, Madrid, Spain, IEEE Computer Society, pp. 44-51.
- [9] N. R. Mead, J. Allen, M. Ardis, T. Hilburn, A. Kornecki, R. Linger, J. McDonald. Software assurance curriculum project volume I: master of software assurance reference curriculum (CMU/SEI-2010-TR-005). Software Engineering Institute, Carnegie Mellon University, September 2010.
- [10] K. Kobata, T. Uesugi, H. Adachi, M. Aoyama. "Software engineering education program for software professionals of high competency at DENSO." 20th Asia-Pacific Software Engineering Conference (APSEC 2013), December 2-5, 2013, Bangkok, Thailand, IEEE, pp. 117-122.