Moving Beyond: Insights from 1st International Workshop on Software Engineering Research and Industrial Practices (SER&IPs 2014)

Sridhar Chimalakonda
Software Engineering Research Center
IIIT Hyderabad, India
sridhar_ch@research.iiit.ac.in

Y. Raghu Reddy
Software Engineering Research Center
IIIT Hyderabad, India
raghu.reddy@iiit.ac.in

Rakesh Shukla
Infosys Labs, Infosys Limited
Bangalore, India
rakesh_shukla@infosys.com

ABSTRACT

Software engineering researchers and their industrial counterparts have emphasized that research is essential for innovation. In practice, rather than ending up in a win-win situation, most of the times both the parties lose because of differences in expectations between the two sides. In this report, we briefly summarize the key insights from 1st International Workshop on Software Engineering Research and Industrial Practices (SER&IPs 2014) co-located with 36th International Conference on Software Engineering (ICSE 2014). The core lesson that stems out of this workshop is a definite need to have multiple approaches to deal with software engineering research-industrial practices partnership. Specifically, the workshop presented two keynotes: one from an industrial researcher explaining the need for academic expertise and an academic researcher on how their research added value to industry. An invited seminar unveiled short-term and long-term funding opportunities followed by a list of presentations from peer-reviewed submissions from both software engineering research and industry partners. Finally, the workshop ended with group discussions, brainstorming of potential topics that can lead to fruitful collaboration between software engineering researchers and industrial practitioners. A major lesson from the workshop is the choice of a topic that fosters a win-win situation for both parties in short-term and long-term collaborations.

Keywords

Software engineering research, industrial practices, collaboration

1. MOTIVATION AND AIM

One of the primary goals for conducting software engineering (SE) research is to advance state-of-art in various areas of software engineering and create a significant impact on state-of-practice in the software industry. However, achieving this goal is often challenging for both SE research and industrial practice communities. Early traces of major challenges in software industrial practice are documented in Fred Brooks' seminal work [1]. While assessing the impact of software engineering research on practice through the IMPACT project of ACM SIGSOFT, wide gaps between research and practice were noticed in several areas of software engineering [2, 3]. Ghezzi pointed out a decrease in industry participation and disappearance of software engineering research labs from large scale organizations [4]. Lionel Briand underlined the need for a strong emphasis on the engineering aspects of software engineering to improve the credibility of researchers and to make research more relevant to industry [5]. Andy and Greg presented practical insights on the nature of different aspects of software development from an industry perspective [6]. An ICSE 2011 panel discussed the key challenges of applying software engineering research in practice [7]. Despite several attempts along these lines, there is still a wide gap between software engineering research and practice.

Given this context, the main goal of the 1st International Workshop on Software Engineering Research and Industrial Practices (SER&IPs 2014) workshop was to bring together researchers and practitioners to discuss the current state of SE research and industrial practices (IPs) and advance collaboration to reduce gaps between research and practice. Most companies involved in IT solutions and services are facing challenges to incorporate research output into practices. On the other hand, most researchers have difficulties in empirically investigating their research in industry-scale environments. Therefore, the challenges are to identify the gaps, discover ways to collaborate and use SE research for the benefit of IPs and vice-versa.

Different perceptions and expectations are one of the critical obstacles in collaboration between SE researchers and practitioners. Researchers have a view that practitioners are reluctant to share real industry data due to confidentiality agreements. Practitioners believe that researchers are mostly working on either dated or futuristic theoretical challenges, which are very far from IPs. Researchers believe that practitioners are looking for quick fixes to their problems instead of using systematic methods or engaging in-depth research. Practitioners have a view that case studies in research do not represent complexities of real projects and have doubt on the results produced by research. Researchers expect good problems along with real industry data and a few years to generate good publications, which may affect a specific domain in a limited way. Practitioners expect a quick general solution which must earn substantial profit immediately. Researchers and practitioners need to overlap research and practice to build trust in their partnership. The workshop was a platform aimed to discuss and address such challenges in the domain of software engineering.

SER&IPs 2014 was held in Hyderabad, India on Sunday, June 1st 2014, in conjunction with ICSE 2014 [8] and the proceedings were published in ACM digital library [9]. There were 41 submissions from multiple countries (including Germany, India, Israel, Norway, Singapore, the United Kingdom and the United States), out of which 8 were accepted at an acceptance rate of 20%. The rest of this report summarizes the key aspects of the workshop.

2. INVITED TALKS

There were two keynotes, one from industry and one from academia, and an invited seminar.

2.1 Confessions of an Industrial Researcher: A Typical Bollywood Story

Thomas Zimmermann, an industrial researcher in Software Engineering Group at Microsoft Research presented his journey as an industrial researcher in the areas of software analytics, empirical software engineering, mining software repositories, and games research. He emphasized the advantages of his association with University of Calgary and University of Washington as adjunct

assistant professor and affiliate faculty. The main crux of his talk was his confessions.

He started his talk with a typical Bollywood movie story - "There's a guy. There's a girl. In the beginning they don't like each other. Then they fall in love but when they fall in love their families do not accept. In the end, they unite with interesting twists." He then described how research-practice partnerships are analogous to typical Bollywood movie stories and presented his journey of how research and practice can overcome hurdles and join together.

He elaborated on how his position at Microsoft Research has helped him to bridge the two worlds. He talked about his experience of collaborating with engineers from large-scale software projects at Microsoft as well as students and professors from universities all over the world during his work. He also discussed best practices, challenges, common mistakes, and lessons learned based on several empirical studies related to refactoring, bug reporting, and analytics in general.

More specifically, he talked about his collaboration with three invited researchers in three areas of research. He explained the visit of Miryung Kim (the University of Texas at Austin), her research on refactoring in collaboration with Empirical Software Engineering (ESE) group of Microsoft Research. He presented how her analysis of existing refactoring practices at Microsoft and quantitative analysis of Windows 7 version history helped Microsoft and how that research was later published in ACM FSE 2012 [10]. He then presented the work on design of bug fixes in collaboration with Emerson Murphy-Hill (North Carolina State University), which was analyzed to improve bug fixing process at Microsoft and was later published in ICSE 2013 [11]. He then narrated how Tim Menzies' (West Virginia University) expertise and his seven principles on data mining were brought to strengthen Microsoft's ESE group. Finally, he concluded the talk by emphasizing how industry can utilize academic experts' expertise and how academic researchers can harness the industrial environment for empirical validation of their research ideas.

2.2 Millions of Lines, Thousands of Bugs, Hundreds of Programmers: A Report from the Back of the Front

Prem Devanbu has nearly 20 years of industrial experience at Bell Labs and its various offshoots and has been a Professor at University of California Davis for more than a decade. He gave an engaging keynote explaining his experiences of working on research problems that are of interest to academia, industry and open source community. He presented his decade long research journey on discovering ways to exploit the copious amounts of available open-source project data to enhance the lives of programmers. In this keynote, he summarized his ways of collaboration with industry and how his research work was successfully published in top conferences and journals as well.

He started his talk with an interesting example of how election poll predictions of 1948 United States Presidential Election failed miserably. He used this analogy to explain the nature of empirical studies in software engineering focusing on his work on bug detection. He explained how they have used open source datasets like *Eclipse*, *Apache*, *Aspecj* for analyzing bugs and how they have identified biases in empirical research and how that can lead to side effects in research. He delved into the idea of repeating empirical studies in industry especially in the area of bug detection, bug fixes, mining bug data in collaboration with

Microsoft Research. He emphasized how real issues from industry can motivate new research directions for academic researchers.

An interesting lesson from this keynote is the idea of looking at research from academic perspective in the front and from an industry perspective at the back and eventually how open source and community-driven research can bridge academia and industry.

2.3 The Many Facets of Industry-Academia Funding

Judith Bishop, Director of Computer Science at Microsoft Research gave a seminar on the many facets of industry-academia funding from an organization's perspective.

She emphasized the need for having ideas as well as money before starting any kind of industry-academia collaboration. Contrary to common belief that academics have the ideas and industry has the money, she elaborated how sometimes a university group might have accumulated too much money and needs ideas for student projects and on the other hand, industry sometimes might have work to do or technology to be tested and needs trusted partners from academia.

She also talked about the importance of industrial data for academic researchers and vice-versa. She then presented the many facets of why and how industry and academia collaborate. She then explained some basic models of collaboration, showing examples of successful and unsuccessful funding collaborations. She then talked about the initiative of Software Engineering Innovation Foundation (SEIF) that supports researchers worldwide in engaging with Microsoft Research. She finally concluded the talk by suggesting that understanding the many facets of funding by both academia and industry is crucial for successful collaboration.

3. PAPER PRESENTATIONS

The final workshop consisted three regular full papers, as one paper was withdrawn due to travel funding issue, and three short papers. One position statement was accepted but was not presented due to personal reasons. Here, we briefly summarize the papers.

"Certus - Glimpses of a Centre for Research-based Innovation in Software Verification and Validation" by Sagar Sen (Certus V&V Centre, Simula Research Laboratory, Norway) – In this short paper, Sen presented the organizational structure of *Certus*, a research-based innovation centre driven by industrial research and how it supports the aspirations of SE researchers. He emphasized how this model can encourage national/international funding schemes and can create a win-win situation for the triple helix: government, researchers and industry. He also stressed the importance of publishing in reputed conferences and journals and successful transfer of research to industry through innovations as two key factors in flourishing win-win partnerships.

"Making Sense of Academia-Industry Gap in the Evolving Cloud Service Brokerage" by Bimlesh Wadhwa (National University of Singapore), Aditi Jaitley (University of Delhi) and Bharti Suri, (GGS Indraprastha University) – In this short paper, the authors presented cloud computing as a topic that is of significant interest to both academia and industry and how it offers a myriad of possibilities for software engineering researchers and practitioners for fruitful collaborations highlighting industry issues, needs, demands in which academia can participate. The paper ends with a roadmap for researchers based on the proposed practice-informed research approach in the area of Cloud Service Brokers.

"Overcoming Challenges in Collaboration between Research and Practice: The Agile Research Network" by Helen Sharp, Laura Plonka (The Open University, UK), Katie Taylor and Peggy Gregory (University of Central Lancashire, UK) - The idea of an agile research network was proposed as an approach for addressing collaboration challenges (timeliness, relevance, rigor and accessibility) between research and practice in this short paper. Sharp presented the analysis of these challenges in the context of two case studies (i) Integrating UX design into a DSDM project (ii) Reporting agile progress in non-agile environments. She ended the talk by presenting the lessons learnt (building trust, appropriate contracts, flexibility, outputs tailored to specific audiences, funding, research expertise) during their experience.

"Impact of Internet of Things on Software Development - Challenges and R&D Opportunities" (Accenture Technology Labs, India) by Vikrant Kaulgud, Sanjoy Paul and Nataraj Kuntagod - This paper was not presented.

"An Exploratory Study on Reuse at Google" by Veronika Bauer, Jonas Eckhardt, Benedikt Hauptmann (Technische Universität München, Germany) and Manuel Klimek (Google, Germany) - This full paper presented the experiences of an exploratory study with 49 participants at Google to understand reuse practices and provides practitioners with examples of scalable reuse practices. Based on survey research, interviews and questionnaires, this study makes an attempt to understand (i) various roles involved in reuse practices from an organization perspective (ii) current reuse practices, processes and their frequency of use (iii) measures for assessing reuse practices (iv) issues, challenges and success factors (v) potential improvements from engineers. Finally, Bauer pointed out open issues for researchers and presented key considerations for practitioners towards aligning their efforts for improving reuse practices.

"Why is Dynamic Analysis Not Used as Extensively as Static Analysis – an Industrial Study" - Radhika Venkatasubramanyam and Sowmya Gr (Siemens Corporate Research and Technologies, India) - This full paper presented the successes and challenges of usage of static and dynamic analyses during code assessments across various teams in Siemens, India. The authors used surveys and questionnaires to understand the usage of static and dynamic analysis tools for code quality checks and to analyze the reasons for limited use of dynamic analysis tools by developer community. During this study, an analysis of 40 projects revealed several insights for both success of static analysis and issues with dynamic analysis tools. Finally, the authors suggest the use of a proactive approach for code assessment with several future directions for improving program execution.

"A Formal Systems Engineering Approach in Practice: An Experience Report" by Wolfgang Böhm, Maximilian Junker, Andreas Vogelsang (Technische Universität, Germany), Sabine Teufl (fortiss GmbH, Germany), Ralf Pinger and Karsten Rahn (Siemens AG, Germany) - This full paper reported the success factors as well as problems of a joint industrial and academic consortium project that applied SPES modeling framework (SPES MF) and AutoFOCUS3 to a real-life and productive industrial system. The authors presented collaboration goals of this joint initiative from academic (validation of the SPES MF as a development method, validation of AutoFOCUS3 as tool support for the SPES MF, uncovering new research topics) and industrial perspectives (assess the combination of tools and methods for rail automation). To achieve these collaboration goals, the academic tools and methods were applied on a mature case study from Siemens. Then the authors presented the critical success factors

involving product experts, using a mature system for application of academic tools, comprehensive specification of requirements by Siemens supported by mature tools along with constraints and disadvantages. The talk ended by presenting the need to understand the ramifications of collaboration when non-experts are involved.

Each session consisted of talks that are of interest to both SE researchers and practitioners, resulting in active participation from the audience during discussions. In the next section, we briefly summarize the group discussions.

4. GROUP DISCUSSIONS

The major emphasis of the workshop was subgroup discussions and brainstorming-oriented sessions. Every presenter was asked to list an open research issue critical to them, which triggered discussions and informally set a tone for forming the subgroups.

4.1 Diversified SE Research

This group consisted of participants with experienced people from academia and industry with diversified backgrounds. The group was steered by an academician and each of the participants expressed their views during an initial round of discussion and then the following specific research topics were proposed for further collaboration.

- Process Engineering (Practices/Standards)
- Retroactive document generation
- Mitigation of legacy systems
- Formalize interaction as they tend to be abstract
- Metrics-based assessment mechanism

The group started the discussion with topic of process engineering focusing on improving standards in this area and the challenges faced by industry in following these standards. An industry expert emphasized their role in the making of these standards. Then the focus shifted to the discussion of several topics that are mainly driven by industry such as mitigation of legacy systems and metrics-based assessment. Interestingly, there was a discussion around "formalizing interaction" that found interest from both academia and industry participants. An important lesson from this group's discussion was: *"common interests"* usually stem from deeper analysis and brainstorming of initially proposed ideas from both academia and industry.

4.2 Domain Driven Partnership

This group started with individual position statements from each of the participants and soon the discussion went in the direction of domains that drive partnership. A participant from industry emphasized that they are ready to provide operational data as it is critical for them to understand and analyze that data for facilitating reuse in their organization. Immediately, a researcher who works on reuse raised doubts about publishing that kind of work, which is critical from a researcher's perspective. The group went on discussing avionics and program correctness domains to see the potential list of topics for discussion. Another interesting point that emerged out of this discussion was the need to have a data analyst in the industry team who coordinates with researchers and practitioners at the same time. Finally, the team concluded that identifying potential domains for collaboration and having a clear strategy for planning, publishing and developing tools and publications facilitate successful academia-industry partnerships.

4.3 SE Research for Productivity Improvement in Software Development

The group selected productivity as the main topic after an initial round of discussion among all participants. The group discussed various definitions on productivity in the literature. However, for the group, productivity is to provide quality outcome with minimal effort and time.

The second main point discussed was regarding potential ways to determine areas in which SE research can contribute to productivity improvement. The group discussed various methods to determine areas. The main methods are: (a) request real data from the industry; perform empirical evaluation of the data and determine the areas; (b) request practitioners to supply a list of main areas; and (c) researchers prepare a list of main areas from the literature and validate it from more than one organization.

5. CONCLUSIONS

An increasing need to empirically validate software engineering research in real settings and an emerging need to substantiate industrial research presents a strong need for software engineering research partnerships and workshops like SER&IPs 2014. Successful academia-industry research partnerships in software engineering stem from a strong need to pursue common research goals but identifying these common goals seems to be the major roadblock as well. In this brief report, we have summarized the motivation for the SER&IPs 2014 workshop that aimed at bridging academia-industry partnership in software engineering research. The workshop attracted a diversified mix of contributions from both academic and industrial research on a wide range of topics like software reuse, productivity improvement and provided a good understanding of successes and failures in software engineering research partnerships. The workshop witnessed invited talks from an industrial researcher, an academic researcher and an interesting talk on funding from senior management. In this brief report, we presented SER&IPs 2014 program and a brief summary of each of the presented papers. Round table discussions among academic and industrial researchers in the later part of the workshop made the entire discussion lively and fruitful because of the diversified mix of people with varied backgrounds. We see the success of first edition of SER&IPs 2014 workshop as a starting point for bridging the academia-industry gap in software engineering research. We plan to improve the next editions of the workshop by creating pre and post workshop activities to foster better collaboration among participants.

6. ACKNOWLEDGMENTS

7. REFERENCES

[1] Frederick P Brooks, *The mythical man-month*.: Addison-Wesley Reading, MA, 1975, vol. 1995.

[2] Leon J Osterweil, Carlo Ghezzi, Jeff Kramer, and Alexander L Wolf, "Determining the impact of software engineering research on practice," *Computer*, vol. 41, no. 3, pp. 39-49, 2008.

[3] Jacky Estublier et al., "Impact of software engineering research on the practice of software configuration management," *ACM Transactions on Software Engineering and Methodology (TOSEM)*, vol. 14, no. 4, pp. 383-430, 2005.

[4] Carlo Ghezzi, "Reflections on 40+ years of software engineering research and beyond: an insider's view," in *Keynote address in 31st International Conference on Software Engineering*, 2009.

[5] Lionel Briand, "Embracing the engineering side of software engineering," *Software, IEEE*, vol. 29, no. 4, pp. 96-96, 2012.

[6] Andy Oram and Greg Wilson, *Making software: what really works, and why we believe it*.: "O'Reilly Media, Inc.", 2010.

[7] ICSE 2011 Panel on What Industry Wants from Research, Hawaii, USA.

[8] SER&IPs 2014 Workshop. https://sites.google.com/site/serips2014/.

[9] SER&IPs 2014 Workshop Proceedings. In Companion proceedings of 36th International Conference on Software Engineering (ICSE), Hyderabad, India, 2014. http://dl.acm.org/citation.cfm?id=2593850&picked=prox

[10] Miryung Kim, Thomas Zimmermann, and Nachiappan Nagappan, "A field study of refactoring challenges and benefits," in *Proceedings of the ACM SIGSOFT 20th International Symposium on the Foundations of Software Engineering*, 2012, p. 50.

[11] Emerson Murphy-Hill, Thomas Zimmermann, Christian Bird, and Nachiappan Nagappan, "The design of bug fixes," in *Software Engineering (ICSE), 2013 35th International Conference on*, 2013, pp. 332-341.