

# Research Statement<sup>1</sup>

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My research focuses on software engineering, especially stakeholders' social interaction in requirements engineering (RE) of open-source software (OSS). RE involves human-centric activities that require interaction among different stakeholders. Traditionally, RE has been considered as a centralized, collocated, and phase-specific process. However, in an OSS development environment, the core RE activities are iterative and dynamic, and follow a rather decentralized software engineering paradigm. Social interaction among stakeholders becomes even more critical in OSS RE as it is through stakeholders' social interaction that technical aspects are clarified and organizational dependencies are resolved. My research seeks a fundamental understanding of how stakeholders' social interaction influences RE activities in OSS development.

In order to achieve my research goals, I prefer taking a comprehensive approach that involves investigating real world phenomena based on an underlying theoretical foundation and discovering useful new knowledge. To that end, I examine stakeholders' social interaction in OSS RE utilizing models and theories originally developed in other disciplines, such as sociology and anthropology. Furthermore, such models and theories often require adjustments from an RE perspective, which I find very challenging and fascinating, thereby developing my research interest along this line.

## Recent Research<sup>2</sup>

**Requirements Identification of OSS Systems.** In [J5], I investigate new requirements identification in OSS and the stakeholders' organizational arrangements supporting such an activity. In particular, I examine the theory of structural hole from the context of contributing new requirements in OSS projects. According to this theory, people connected to diverse groups in their social network can broker knowledge across social clusters that often allows them to contribute new ideas. After studying three large OSS projects, I find that structural hole positions emerge in stakeholders' social network and they are positively related to contributing a higher number of new requirements. My research further contributes a necessary adjustment for the theory in an RE context as I discover stakeholders' roles, along with structural hole positions, play an important part in identifying new requirements.

**Stakeholders' Group Size and Requirements Realization of OSS Systems.** Requirements are realized through change tasks performed by developers. In my research, I introduce a novel approach of framing developers' collective resolution of OSS change tasks as a social information foraging (SIF) problem [J3]. According to SIF, group size is a key in a collaborative environment affecting productivity and problem solving expertise. My research perspective enables me to quantify the effect of group size on individual developer performance during requirements realization and predict the optimal group size. My study uncovers the mismatch of optimal and actual group sizes in OSS projects and also reveals the association of optimality with improved productivity. The impact of this research can extend frontiers of knowledge in areas dealing with stakeholders' social interaction, such as social coding and recommendation systems.

**Creativity in RE.** In order to gain a competitive edge in the modern software industry, requirements engineers need to *create innovative requirements* that distinguish their software from similar products. Such creativity in RE could be achieved: by exploring all the possibilities under certain constraints (*exploratory creativity*), by making unfamiliar connections between familiar possibilities (*combinational creativity*), or by changing the constraints and expanding the search space (*transformational creativity*). In [C9], I present a novel framework that provides an automated support for combinational creativity in RE. Leveraging the concept that humans' interaction in a social group generally evolves around common topics, my creativity framework mines familiar ideas from requirements and social interaction associated with stakeholder groups. It further combines these ideas in an unfamiliar manner to automatically generate original and relevant requirements. [C9], presenting this work, *has been selected as a best paper and an extension has been published in the "Requirements Engineering Journal" [J4].*

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<sup>1</sup> Citations refer to the list of publications in my CV. Also, I acknowledge the contributions of my coauthors.

<sup>2</sup> Some of my recent research have has been supported by US National Science Foundation (NSF) grants.

**Other Research in Collaboration.** My broad research interests have led me to work on a number of other collaborative projects. The following presents a highlight of my achievements through such collaborations.

- **Managing Just-in-Time Requirements<sup>3</sup>.** My work involves traceability enabled refactoring aimed at fulfilling more just-in-time requirements. Along with researchers from our group and Asia, I develop a new scheme that precisely determines *where* the software should be refactored and *what* refactorings should be applied in order to realize just-in-time requirements in a timely manner [C8].
- **Porting Mobile Games.** I have been collaborating with researchers from our group and South America, and successful mobile game development companies from the Americas. The objectives of these ventures have been envisioning portability of mobile games as an aspect and rethinking modularity along a technical-organizational-ecosystem dimension [C4, C6]. An extension of the research presented in [C6] was selected as a *best paper* and published in the book “Advances in Intelligent and Soft Computing” (cf. [B1]).
- **Software Engineering Education.** I am also interested in software engineering education research to reduce the gap between academia and industry and to share newly discovered knowledge among students through effective teaching and learning. My work along this line compares the performances, processes, and strategies between students and professionals conducting assisted requirements tracing, identifies the improvement areas for students, and further determines effective learning activities for students [C7].

## Future Research

My future research will continue investigating stakeholders’ social interaction in other RE activities from a theoretical premise. Furthermore, collaborating with several industry contacts I have developed during my graduate years, I plan further expansion of my research towards commercial software development and software ecosystem directions. In particular, my research in the next five years will concentrate mostly on the following fronts:

- **Transformational Creativity in RE.** Inspired by the promising findings in my recent work [C9, JS2], an important agenda of my future research is to investigate transformational creativity in RE. To that end, I plan to study existing requirements along with stakeholders’ social interaction for products providing similar facilities in a different application domain, public knowledge repositories such as Wikipedia, and discussion about similar software products over online forums.
- **Requirements Prioritization and Negotiation.** I envision a systematic investigation of stakeholders’ social interaction involving requirements prioritization and negotiation will provide an *ecologically valid* advanced mechanism for *conflict resolution*. My research plan includes conducting field studies, and investigating prioritization and negotiation activities with the help of models and theories from other streams, such as sociology and psychology.
- **Mobile Game Ecosystem.** Motivated by the encouraging findings presented in [C4, C6, B1], I plan to investigate mobile game development from a software ecosystem perspective. An important agenda of my research along this direction will be exploring the underlying software engineering processes and principles that successful mobile game development teams follow. In addition, I aim to investigate different porting strategies that help vendors survive and thrive in the mobile game ecosystem.

The goals of my research are to further advance the fundamental understanding of RE process in a distributed software development environment, and to explore the survival mechanisms for mobile game software in their highly competitive ecosystem. An additional outcome of my research will be an integrated RE framework that will leverage the benefits of stakeholders’ social interaction, reduce the interference cost and communication overhead involved in social interaction, thereby open new avenues for RE activities. Currently, I am preparing detailed proposals for my future research agenda. My objective is to submit these proposals to external funding agencies, including the Software and Hardware Foundations (SHF) program of the United States National Science Foundation (NSF)<sup>4</sup>.

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<sup>3</sup> Requirements with lightweight representation and continuous refinement in an iterative and incremental development project.

<sup>4</sup> [http://www.nsf.gov/funding/pgm\\_summ.jsp?pims\\_id=503301&org=CCF](http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503301&org=CCF)