Supporting team coordination of software development across organizational boundary

Anh Nguyen Duc
Doctoral thesis presentation
Trondheim, Norway
April 10\textsuperscript{th} 2015
Agenda

- Research problem
- Goal & Research questions
- Overview of studies
- Synthesis of findings
- Discussion & Conclusion
Research context

**OSS**
Open Source Software as a collaborative phenomenon between companies and communities

**GSD**
Global Software Development across geographical, temporal, organizational boundaries

**DSD**
Distributed Software Development = OSS + GSD
Insufficient support of DSD coordination
Little is known about cross-boundary coordination problems

Coordination problems and mechanisms within an organization might be different from those across organizations
Little is known about cross-boundary coordination mechanisms

- Global boundaries
- Organizational boundaries
  - is part of

  Coordination mechanisms
  - resolves
  - is part of
    - People
    - Technology
    - Process

- Coordination problems
  - impacts

- Project outcomes
Research goal

to understand and improve team coordination challenges in organizational boundaries in DSD
Research questions

① How is the collaboration of technical tasks characterized at organizational level?

② How do organizational boundaries impact coordination of development activities in distributed software development?

③ How can coordination practices and tools support software development across organizational boundaries?
Agenda

- Research problem
- Goal & Research questions
- Overview of studies
- Synthesis of findings
- Discussion & Conclusion
Overview of studies

- **RQ1**: How is the collaboration of technical tasks characterized at an organizational level?
- **RQ2**: How do organizational boundaries impact coordination of development activities in distributed software development?
- **RQ3**: How can coordination practices and tools support software development across organizational boundaries?

- **S1**: OSS integration in commercial companies
- **S2**: Collaboration in OSS projects
- **S3**: Impacts of global boundaries in DSD
- **S4**: Organizational boundary and spanners
- **S5**: Forking and coordination in multiple platform systems

Timeline:
- 2011
- 2012
- 2013
- 2014
Research methodology

RQ1: How is the collaboration of technical tasks characterized at organizational level?

RQ2: How do organizational boundaries impact coordination of development activities in distributed software development?

RQ3: How can coordination practices and tools support software development across organizational boundaries?

S1: OSS integration in commercial companies

S2: Collaboration in OSS projects

S3: Impacts of global boundaries in DSD

S4: Organizational boundary and spanners

S5: Forking and coordination in multiple platform systems
## Data collection and analysis

<table>
<thead>
<tr>
<th>Phases</th>
<th>Elements</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data collection</td>
<td>Issue tracking system</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Version control system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Survey</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interview</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observation</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Document</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Data analysis</td>
<td>Thematic analysis</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meta analysis</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Statistic analysis</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Correlation analysis</td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regression analysis</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Agenda

- Research problem
- Goal & Research questions
- Overview of studies
- Synthesis of findings
- Discussion & Conclusion
RQ1: How is the collaboration of technical tasks characterized at the organizational level?

- OSS inter-organizational collaboration
  - commensalistic relationship between companies and communities
  - indirect interactions among companies via OSS infrastructures
- Commercial inter-organizational collaboration
  - various types of technical dependencies across boundaries
RQ2: How do organizational boundaries impact coordination of development activities in DSD?

- **Collaboration policies** influence the attitude toward the joint work

  “...so we are in the competition with [Team A1]. Maybe [Team A1] want to do it too so we need to discuss and make arguments about why should we do it instead...But we also want to look good compared to [Team A1]. And we know they want to do the same ...” (Manager – Case River – Study S4)
RQ2: How do organizational boundaries impact coordination of development activities in DSD?

- **Collaboration policies** influence the attitude toward the joint work
- Mismatches in **engineering processes** inhibit some coordination mechanisms

  “...we work in such different ways that we don’t share work processes. We communicated in a higher level than what we are doing now ...” (Team leader – Case Ocean – Study S4)
RQ2: How do organizational boundaries impact coordination of development activities in DSD?

- **Collaboration policies** influence the attitude toward the joint work
- Mismatches in **engineering processes** inhibit some coordination mechanisms
- Limited ability to organizing **team structure** increases escalation and coordination needs
- Differences in **development practices** and standards introduce misexpectation of quality and performance of the joint work
RQ3: How can coordination practices and tools support coordination of development activities across organizational boundaries?

- Leverage global barriers
- Mediate technical dependencies
- Transfer status information
- Facilitate practice flow

Emergent vs. formally assigned
- Small vs. large project
- Commercial vs. OSS projects
  - Comprehending and transferring tasks
  - Site visit
  - Enforcing practice around boundary object

Product owner
Scrum master
Program manager
Product owner
Bridge engineer
Hub developer
Team leader
RQ3: How can coordination practices and tools support coordination of development activities across organizational boundaries?

- Duplication dependency
- Issue tracking systems
  - Trace dependencies of cross-platform issues
  - Notify relevant developers about the changes of the issues
  - Facilitate cross-platform reviews
- Version control systems
  - Temporize coordination needs
Agenda

- Research problem
- Goal & Research questions
- Overview of studies
- Synthesis of findings
- Discussion & Conclusion
Contribution to research

① Updated view about the participation of commercial companies in OSS projects
② Synthesized existing knowledge about the impacts of global boundaries on DSD project outcomes
③ Extension of the socio-technical coordination with organizational dimension
④ Illustration of the use of boundary spanning theory in DSD context
⑤ Description of duplication dependencies and approaches to manage them
Recommendations to practice

① Be aware of different impacts of global boundaries on project outcomes
② Consider both business and technical aspects when making cross-boundary coordination strategies
③ Identify, recognize and support emergent boundary spanners
④ Navigate informal communication by enforcing process standards
⑤ Automate the notification of dependent issues across codebases
⑥ Establish a united code merging process across codebases
⑦ Enhance cross-function communication of dependent issues
Limitations

- Evaluation of coordination mechanisms
- Exploratory investigation of collaboration and coordination
- General types of coordination problems
- Generalization about coordination mechanisms
Future work

- Quantify some aspects of organizational boundaries
- Evaluate the effectiveness of team coordination mechanisms in DSD
- Investigate the phenomenon of co-opetition
- Explore temporal evolution of coordination of duplicated files
Acknowledgement

- Dedicated supervisions by Prof. Reidar Conradi, Dr. Daniela S. Cruzes, Dr. Carl-Fredrik Sørensen, Assoc. Prof. Torgeir Dingsøyr
- External supervisions and supports by Prof. Audris Mockus
- Evaluation and suggestions by Ph.D committee Assoc. Prof. Carolyn Seaman, Assoc. Prof. Marco Torchiano, Prof. Guttorm Sindre
- Collaboration and paper co-authors
  - Dr. Claudia Ayala, Assoc. Prof. Xavier Franch, Prof. Martin Höst, Prof. Muhammad Alibabar, Randy Hackbarth, John Palframan
- Fruitful discussions
  - Assoc. Prof. Darja Šmite, Prof. Jim Herbsleb
  - IDI PhD Seminar, Forskerfabrikken
- Companies and organizations
  - Fundator, Capgemini, Fast, FPT, Avaya, Wireshark community, Samba community and others participated in our OSS adoption survey
Q&A
BK1-Research methodology

- Open coding
- Identify concepts
- Axial coding
- Measure of some concepts
- Logistic regression

Logistic regression
## BK2-Theory background

<table>
<thead>
<tr>
<th>Theory</th>
<th>Study</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-technical congruence by Marcelo Cataldo</td>
<td>S1</td>
<td>Basic for SNA</td>
</tr>
<tr>
<td>Dimensions of global dispersions by Espinosa</td>
<td>S3</td>
<td>Form data extraction forms</td>
</tr>
<tr>
<td>Inter-discipline theory of coordination by Malone</td>
<td>S3</td>
<td>Explore dependencies and coordination activities</td>
</tr>
<tr>
<td>Framework coordination mechanisms by Kotlarsky, Mintzbergs</td>
<td>S3, S4, S5</td>
<td>Classify coordination activities</td>
</tr>
<tr>
<td>Boundary spanner in practice by Levina</td>
<td>S4, S5</td>
<td>Differentiate emerged and assigned spanners</td>
</tr>
</tbody>
</table>
BK3-Publication list


- **MP6.** Nguyen Duc, A., Cruzes D.S. and Conradi, R. 2014. On the role of boundary spanners as team coordination mechanism in organizationally distributed projects. 9th IEEE International Conference on Global Software Engineering (ICGSE), Shanghai, China.


## BK4-Threats to validity

<table>
<thead>
<tr>
<th>Validity threats</th>
<th>Category</th>
<th>Study</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bias can occur in project/team selection</td>
<td>Internal validity</td>
<td>S1, S2, S4, S5</td>
<td>Select wide range of DSD projects Preliminarily analyze candidate projects</td>
</tr>
<tr>
<td>Bias in data collection</td>
<td>Internal validity</td>
<td>S1, S4, S5</td>
<td>Thorough plan and review study designs by external experts</td>
</tr>
<tr>
<td>Misinterpretation during interviews</td>
<td>Internal validity</td>
<td>S1, S4, S5</td>
<td>Send interview questions beforehand Include more than one interviewers Send post-interview clarifying questions</td>
</tr>
<tr>
<td>Identification of commercial company representatives</td>
<td>Internal validity</td>
<td>S1</td>
<td>Manually check multiple sources to determine developer’s affiliation</td>
</tr>
<tr>
<td>Compounding factor in quantitative model</td>
<td>Internal validity</td>
<td>S2, S5</td>
<td>Include context factors into quantitative models</td>
</tr>
<tr>
<td>Missing repository data</td>
<td>Internal validity</td>
<td>S2, S5</td>
<td>Delete invalid data points with considering the significance of analysis bias</td>
</tr>
<tr>
<td>Generalization to software development</td>
<td>External validity</td>
<td>S1, S2, S3, S4, S5</td>
<td>Determine target population when design study Consider all context factors when drawing conclusion about generalization</td>
</tr>
<tr>
<td>Credibility of findings</td>
<td>External validity</td>
<td>S5</td>
<td>Iteratively provide and receive feedback from relevant stakeholders</td>
</tr>
<tr>
<td>Operationalization of concepts</td>
<td>Construct validity</td>
<td>S2, S5</td>
<td>Use literature and initial interviews to provide reasoning for constructing measures</td>
</tr>
<tr>
<td>Causal-effect relationship</td>
<td>Conclusion validity</td>
<td>S2, S5</td>
<td>No attempt to draw a causal relationship</td>
</tr>
</tbody>
</table>
BK5-Recommendations

1. Using measures of developer’s past performance to predict issue resolution time
2. Involving external stakeholders in resolving OSS component mismatches
3. Alignment of perception on distributed work across time-zones with actual impact
4. Awareness of the influence of global dispersion at different organizational levels
5. No distribution for quality critical software components
6. Establishment of formal coordination approach
7. Establishment of code integration policy across platforms
8. Balance of technical requirement of coordination and organizational policy of competition
9. Identification and recognition of in-practice boundary spanner
10. Automated identification of redundant work across platforms
11. Enhancement of communication across functional units
12. Considering organizational-technical issues when creating forks across platforms