The Role of Testing and Tools for Innovation

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CV

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2014– Head of Dept. Computer Science, Lund University
2011–2012  Guest professor NCSU
2009–2010 Senior researcher, Sony Ericsson, part time
2008– Director for Industrial Excellence Center EASE
2005–2011 Special Researcher, Swedish Research Council
2004– Professor of Software Engineering, Lund University
2002–2003 Fulbright Research Scholar WSU
1998–2004 Assistant Professor, Lund University
1991–1997 Consulting expert, Q-Labs AB
Research interests

1992
• Reliability testing
• Inspection methods
• System validation
• Agile management
• Test management
• Unit testing
• Regression testing

2016
• Product line testing
• Open innovation

Empirical research, experiments, case studies, the digital society
In a nutshell

• Basic concepts of innovation
• Testers and innovation
• Software testing aspects of open innovation
• Industry participants: how to invest in a community to get best value out from the open community
• Researchers: how to get open source tools spread and utilized in a wider audience
Tools in software research and practice

- Do you work on tools in your research?
Outline

• Background and definitions
• Industrial attitudes to open innovation – a survey
• Open source tools in practice – a case study
• Open innovation and test tools
• Implications for industry-academia collaboration
WHAT IS INNOVATION?

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Topical definitions

• An **innovation** is the *implementation* of a new or significantly improved *product* (good or service), or *process*, a new *marketing method*, or a new *organizational method*. [OECD 2005]

• **Open innovation** is a paradigm that assumes that firms can and should use *external ideas* as well as *internal ideas*, and internal and external paths to market [Chesbrough 2003]

• **Open-source software** (OSS) is computer software with its source code made available with a *license* in which the copyright holder provides the *rights to study, change, and distribute the software* to anyone and for any purpose [St. Laurent 2008]
Innovation Types

- **Product Innovation** is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses.

- **Process Innovation** is the implementation of a new or significantly improved production or delivery method.
Innovation Types

• **Marketing Innovation** is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

• **Organizational innovation** is the implementation of a new organizational method in the firm’s business practices, workplace organization or external relations.
Software Innovation

Product innovation

Software technology
- new architectures, new languages, e.g. cloud technology

Software business
- new business models, e.g. software as a service, crowdsourcing

Marketing innovation

Process innovation

Software engineering
- new processes, new methods, e.g. agile methods

Software management
- new organisational models, e.g. outsourcing, open innovation, open source software

Organisational innovation

Test tools – the tester’s workbench

Where is the innovation?

Photo: CC avotius at Flickr
Testing Tool Innovation – jUnit

Product innovation

- The framework in itself
- Eclipse plug-in

Process innovation

- Test-Driven Development
- Test and production code in the same language

Marketing innovation

- Open source
- Agile facilitator

Organisational innovation

- Bring developer and test views together
- Open source

Tools in software research and practice

• Do you work on tools in your research?
• Would you like them to be used in practice?
• What does it take to make tools used?
• What are the costs/benefits for industry?
A Survey on the Perception of Innovation in a Large Product-Focused Software Organization

Johan Linåker, Hussan Munir, Per Runeson, Björn Regnell, and Claes Schrewelius

Abstract: Context. Innovation is promoted in companies to help them stay competitive. Four types of innovation are defined: product, process, business, and organizational. Objective. We want to understand the perception of the innovation concept in industry, and particularly how the innovation types relate to each other. Method. We launched a survey at a branch of a multi-national corporation. Results. From a qualitative analysis of the 229 responses, we see that the understanding of the innovation concept is somewhat narrow, and mostly related to product innovation. A majority of respondents indicate that product innovation triggers process, business, and organizational innovation, rather than vice versa. However, there is a complex interdependency between the types. We also identify challenges related to each of the types. Conclusion. Increasing awareness and knowledge of different types of innovation may improve the innovation. Further, they cannot be handled one by one, but in their interdependent relations.

Keywords: product innovation, process innovation, business innovation, organizational innovation, software engineering, software business, survey, case study, empirical investigation

1 Introduction

In recent years, the focus on innovation has increased in many lines of business. Novel products and services have always been important, while with an increasing pace of change, new technologies and market concepts being launched, with small vendors coming up and changing the scene in very short time, the need for continuous innovation is stressed in larger companies. Internet technologies for communication and distribution, and products and services primarily differentiated with respect to software, enables this shift by lowering the thresholds for new actors, and thereby threatening the position of existing ones.

Innovation is not only bringing new products to the market. The Organisation for Economic Co-operation and Development (OECD) Oslo manual [1], which is used to guide national statistics collection on innovation, distinguishes between four categories, i) product, ii) process, iii) marketing, and iv) organizational. These categories are defined as follows:

A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses [1, §156], while a process innovation is the implementation of a new or significantly improved production or delivery method [1, §163]. In the context of software engineering, we also count software development processes and practices as “production” methods in the process innovation category.
Research Methodology

- Online internal survey in a local branch of Multi-national
- 5,000 globally distributed employees
- Software development for communication devices
- 229 responses received out of 900
- Respondents were managers, software developers and testers
- Transition from Closed Innovation to Open Innovation
Research Questions

1. What are the general perceptions of the term innovation?
2. What relations are assumed between product and process, organizational and marketing innovation, respectively?
3. Which challenges exist with respect to the four types of innovation?
Results (Quantitative Analysis)
Results (Qualitative analysis)

Innovation Perception

• Some respondents consider innovation as part of their everyday work, while others are a bit more unclear on the distinction between their everyday work and innovative activities, or just creativity as a process.

• A tester stated:

“Working with testing does not lead to innovation in the product apart from some ideas that pops up occasionally.”
Results (Innovation perception)

“I don’t think it is possible to be innovative in this area [organizational innovation].”

Lack of understanding amongst employees regarding interplay of different innovation types !!
Results (Product vs Process Innovation)

“If the development process is driven as a rigid framework that is complex and difficult to understand who decides what and why, then you do not get in the dynamics of ideas.”

- Strict and complex processes creates overhead, distraction and occupying time !!
- In contrast to other research: processes save time for routine work to spend on innovation
- Implication: solutions or tools that reduces overhead, distraction and time consumption help innovation
Results (Product vs Process Innovation)

“…well defined and established processes leads to innovative products.”

“The process innovations are often meant to make development faster with more quality, but I’m not sure the gained resources are spent on product innovation.”

• Well defined process encourages innovation and creative thinking (role clarification)
Results (Product vs Organizational Innovation)

“Oh, with a flexible and happy organization I believe we can get a more innovative climate”

“Organization organized for better collaboration (=no filtering, no proxies, smaller proximity, time zone, etc. . . ) is more likely to produce more innovative ideas. Layering, direct reporting, micro management, and similar old-school practices are killing innovation.”

• Crowdsourcing ideas, engaging in Open Source communities, welcoming third-party developers, acquiring promising startups are few ways of organizational innovation!!
Results (Business Innovation challenges)

• Reaching the end customer
  – Layers between producer and consumer makes it hard to articulate the needs of customers

• Product and marketing sync
  – Views on top innovative features might differ in different organizational units
  – Wrong features might get promoted due to lack of sync between marketing and product development
Results (Organizational Innovation challenges)

- Closed organizational borders
  - Missing out on existing knowledge beyond organizational borders

- Intra-organizational collaboration
  - Multiple managers can cause complex hierarchy and thereby, hard to prioritize features

- Intra-organizational learning
  - Unaware of existing knowledge in other organizational units may be a hindrance to an innovation process
Conclusion from innovation survey

1. Product innovation is mostly associated with the term innovation

2. Product innovation triggers process and business; product and organizational innovation trigger mutually

3. Challenges relate to timing, attitudes and communication with customers, across departments
Apply to your tools/technique/company

• What are your contributions to:
  – Product innovation
  – Process innovation
  – Market innovation
  – Organizational innovation
<table>
<thead>
<tr>
<th>Product innovation</th>
<th>Process innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marketing innovation</td>
<td>Organizational innovation</td>
</tr>
</tbody>
</table>

Open Innovation using OSS: Findings from Case Study at Sony Mobile

Hussan Munir & Johan Linåker (PhD Students)
Case Study at Sony Mobile Lund
Tools under study

- **Gerrit** is an OSS code review tool created by Google in connection with Android in 2007. It is tightly integrated with the software configuration management tool GIT, working as a gatekeeper, i.e. a commit needs to be reviewed and verified before its allowed to be merged into the main branch.

- **Jenkins** is an open source build server that runs on a standard servlet container e.g. Apache TomCat. It can handle Maven and Ant instructions, as well as execute custom batch and bash scripts. It was forked from the Hudson build server in 2010 due to a dispute between Oracle and the rest of the community.
Sony Mobile’s Tools Department

Sony Mobile

Tools department

Product Development

Knowledge transfer

Jenkins & Gerrit
Open Source Software Community

Other Software organizations
NPOs
Individuals
Research Methodology

- Mine the Jenkins and Gerrit code repositories
- Extract change log data
- Identify top stakeholders and contributors
- Select interviewees from the change log data
- Survey findings
- Answers to RQs
Stakeholders’ Contribution

Table 5  Percentage of Sony Mobile’s contribution compared to other Software organizations

<table>
<thead>
<tr>
<th>Tools</th>
<th>Sony</th>
<th>Google</th>
<th>Ericsson</th>
<th>HP</th>
<th>SAP</th>
<th>Intel</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gerrit</td>
<td>8.22</td>
<td>38.52</td>
<td>0</td>
<td>0</td>
<td>10.70</td>
<td>0</td>
<td>42.55</td>
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<tr>
<td>PyGerrit</td>
<td>97.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2.47</td>
</tr>
<tr>
<td>Gerrit-Event</td>
<td>66.1</td>
<td>0</td>
<td>3.34</td>
<td>4.06</td>
<td>0.23</td>
<td>2.03</td>
<td>24.25</td>
</tr>
<tr>
<td>Gerrit trigger</td>
<td>65.2</td>
<td>0</td>
<td>9.07</td>
<td>2.49</td>
<td>0.75</td>
<td>1.30</td>
<td>21.21</td>
</tr>
<tr>
<td>Team Views</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>External resource-dispatcher-pl</td>
<td>89.6</td>
<td>1.48</td>
<td>4.83</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4.08</td>
</tr>
<tr>
<td>Build Failure Analyzer</td>
<td>85.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>14.45</td>
</tr>
</tbody>
</table>
Reasons for OI adoption

- Competitors pressure
- Product lost its revenue potential
- To build a community
- Non competitive tools

Number of respondents
OSS Strategy makers

![Bar chart showing contributions by different roles with number of respondents. Legal managers have the least with 4, Top level managers have the most with 12, Low/Mid level managers have 12, and Engineers have 11.](image-url)
Opening Up

- Process of opening up correlates to general adoption of Open Source in the company.
- Move from Windows to Linux.
- Adapting to Google’s Open Source tool chain.
- Bottom-up and Top-down
Determinants of Openness

Or... When to open up?

- Non-competitive and non-pecuniary assets
- Will the company benefit from the contribution/work?
- Will it gain traction and get accepted?
- Strategic factors, e.g. first-mover advantage
Open Innovation Future

• Statement from an interviewee

“Everything that Sony Mobile does will be open in the next 5 years”
Apply to your tools/technique/company

- What is open?
- What is not?
- Why?
Software Testing in Open Innovation: An Exploratory Case Study of the Acceptance Test Harness for Jenkins

Hussan Munir (PHD student), Per Runeson

ABSTRACT

Open Innovation (OI) has gained significant attention since the term was introduced in 2003. However, little is known whether general software testing processes are well suited for OI. An exploratory case study on the Acceptance Test Harness (ATH) is conducted to investigate OI testing activities of Jenkins. As far as the research methodology is concerned, we extracted the change log data of ATH followed by five interviews with key contributors in the development of ATH. The findings of the study are threefold. First, it highlights the key stakeholders involved in the development of ATH. Second, the study compares the ATH testing activities with ISO/IEC/IEEE testing process and presents a tailored process for software testing in OI. Finally, the study underlines some key challenges that software intensive organizations face while working with the testing in OI.
Research Questions

• Who are the top stakeholders in the development of Acceptance Test Harness (ATH)?
• What are the key challenges associated with testing in OI?
Research Methodology

1. Extracted the Acceptance Test Harness change log data from GitHub
2. CVSAnalY Tool was used to extract and analyze data
3. Conduct interviews with the key contributors
Case Selection and Unit of Analysis

Jenkins

• A leading Open Source continuous integration server that offers more than 1000+ plugins building and testing Java projects

Acceptance Test Harness

• This project consists of a reusable harness that can be used by plugin developers and users to write functional test cases. These tests can be also run with specific version of Jenkins core and a combination of plugins.
Results (Top Stakeholders)

Acceptance Test Harness Stakeholders

- Jfrog
- Sony
- codecentric AG
- Ericsson
- Qaware
- Monkeypox
- EnOcean
- Munich University
- Redhat
- Cloudbees

Frequency of commits
Challenges

• Difficult to have a complete coverage
  • Many different configurations
  • Open plug-in nature (1000+)
  • Subjective testing of Software Developers

• Lack of resources
  • Core people in the community are really busy
  • Hard to get an answer from the community quickly
Conclusion

• The initial idea of ATH came from the community, the major Jenkins contributor brought ATH to the community’s attention at hackathons.

• Cloudbees, Redhat and Munich University came out as a third biggest contributor, which suggests strong ties between the Jenkins community and industry.

• The ATH testing process does not adhere to the ISO/IEC/IEEE testing standard because testable features are identified by software engineers independently without any formal test plan.
It is More Blessed to Give than to Receive – Open Software Tools Enable Open Innovation

Per Runeson¹, Hussan Munir¹ and Krzysztof Wnuk²
¹Lund University, ²Blekinge Institute of Technology

ABSTRACT

Open Innovation (OI) has attracted scholarly interest from a wide range of disciplines since introduced by Chesbrough [1], i.e. "a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology". However, OI remains unexplored for software engineering (SE), although widespread in practice through Open Source Software (OSS). We studied the relation between SE and OI and in particular how OSS tools impact on software-intensive organization’s innovation capability.

We surveyed the literature on SE and OI [3] and found that studies concludes that start-ups have higher tendency to opt for OI compared to established companies. The literature also suggests that firms assimilating external knowledge into their internal R&D activities, have higher likelihood of gaining financial advantages.

In a case study, we observed how OSS tools Jenkins and Gerrit enabled open innovation [2]. We mined software commits to identify major contributors, found them be affiliated to Sony Mobile,
Credibility of research knowledge

<table>
<thead>
<tr>
<th>Source of knowledge</th>
<th>Type of knowledge</th>
<th>Opinion</th>
<th>Empirical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td></td>
<td>1 (most)</td>
<td>2</td>
</tr>
<tr>
<td>Remote</td>
<td></td>
<td>3</td>
<td>4 (least)</td>
</tr>
</tbody>
</table>

References


OECD Oslo Manual – Guidelines for Collecting and Interpreting Innovation Data, OECD 2005

P. Runeson, H. Munir, and K. Wnuk. It is more blessed to give than to receive – open software tools enable open innovation. *TinyToCS*, 4, 2016.