The Role of Testing and Tools for Innovation

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CV
Professor Per Runeson

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

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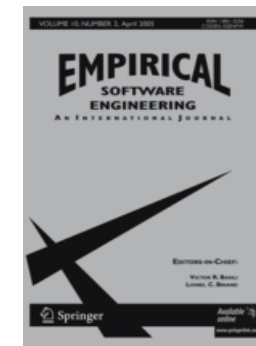1991–1997 Consulting expert, Q-Labs AB
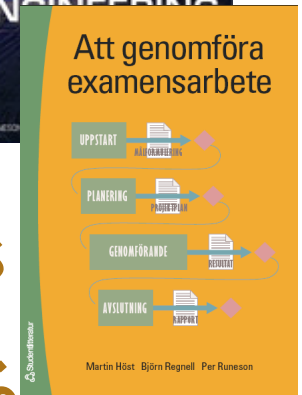
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Research interests

1992

- Reliability testing
- Inspection methods
- System validation
- Agile management
- Test management
- Unit testing
- Regression testing
- Product line testing
- Open innovation

2016

Empirical research
– surveys, case studies,
– experiments
– 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?

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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?

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]

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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

Process innovation

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

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

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

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

Marketing innovation

Organisational innovation

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

Test tools – the tester's workbench
Where is the innovation?

Photo: CC avotius at Flickr

Testing Tool Innovation – jUnit

Product innovation

Process innovation

The framework in itself
Eclipse plug-in

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

Open source
Agile facilitator

Bring developer and
test views together
Open source

Marketing innovation

Organisational innovation

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

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?

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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

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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. ... is a complex interdependency between the types. **Conclusion.** Increasing awareness and ... ... innovation. Further,

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

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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?

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Results (Quanitative Analysis)
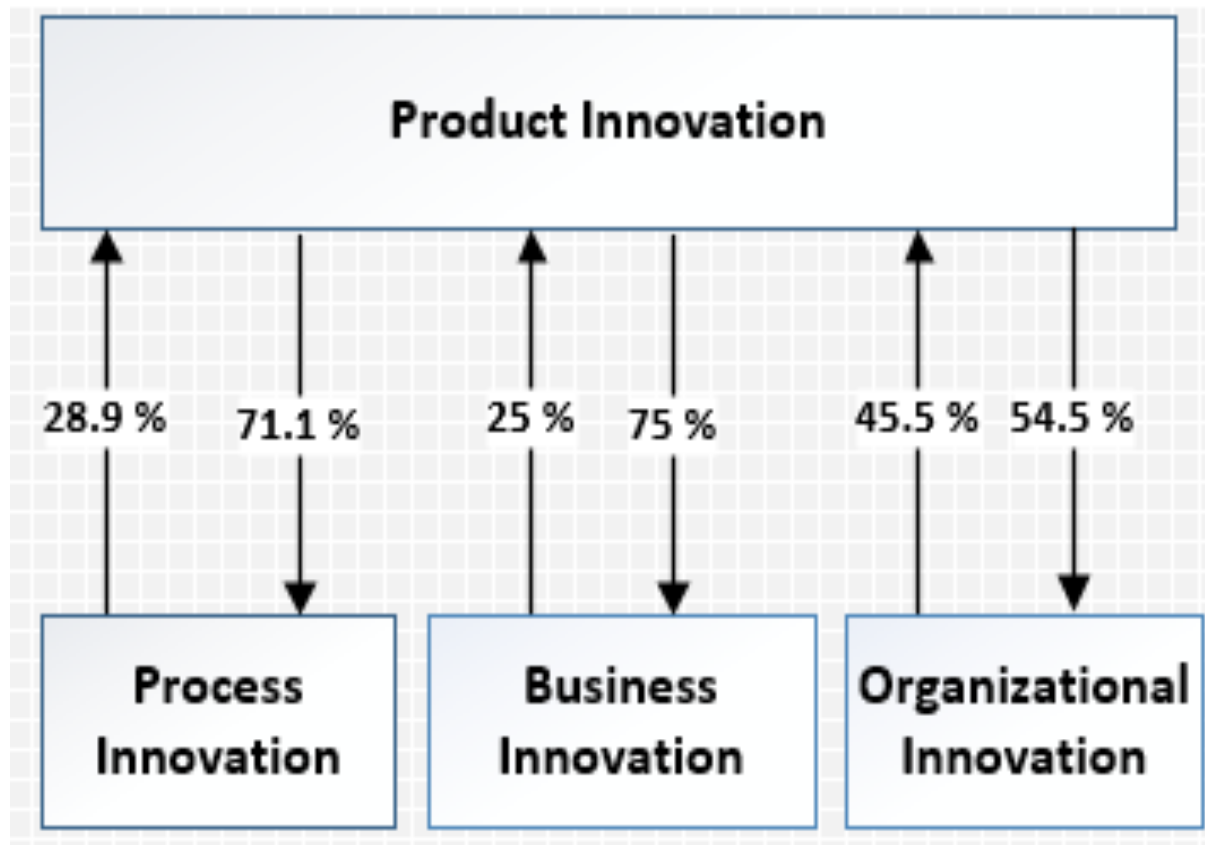
Results (Qualitative analysis)

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 !!

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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

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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)**

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Results (Product vs Organizational Innovation)

"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

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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

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Apply to your tools/technique/company

- What are your contributions to:
    - Product innovation
    - Process innovation
    - Market innovation
    - Organizational innovation

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Testing Tool Innovation _____

Product innovation

Process innovation

Marketing innovation

Organizational innovation

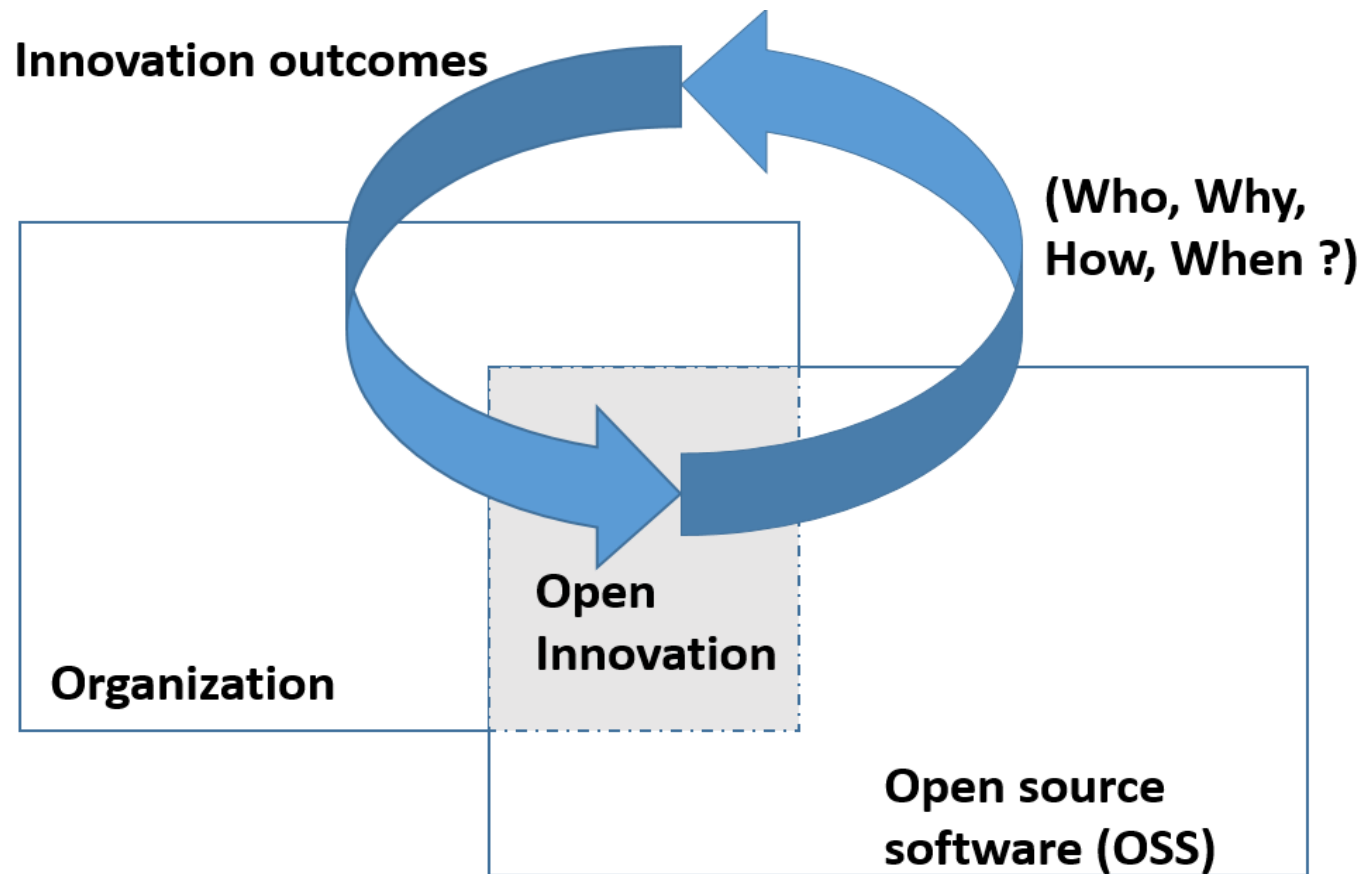[OECD Oslo Manual – Guidelines for Collecting and Interpreting Innovation Data, OECD 2005]

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

Hussan Munir & Johan Linåker (PhD Students)

Case Study at Sony Mobile Lund

Innovation outcomes

(Who, Why, How, When ?)

Open Innovation

Organization

Open source software (OSS)

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
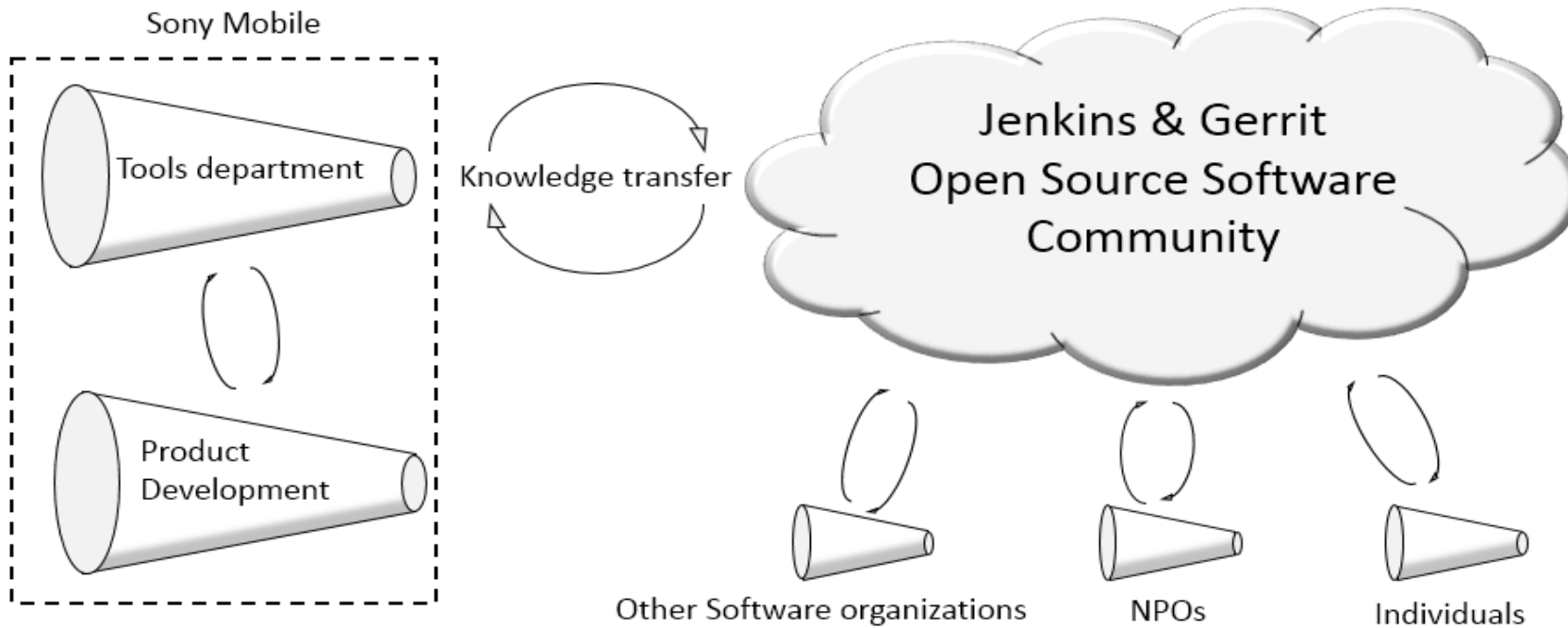
Research Methodology

- 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
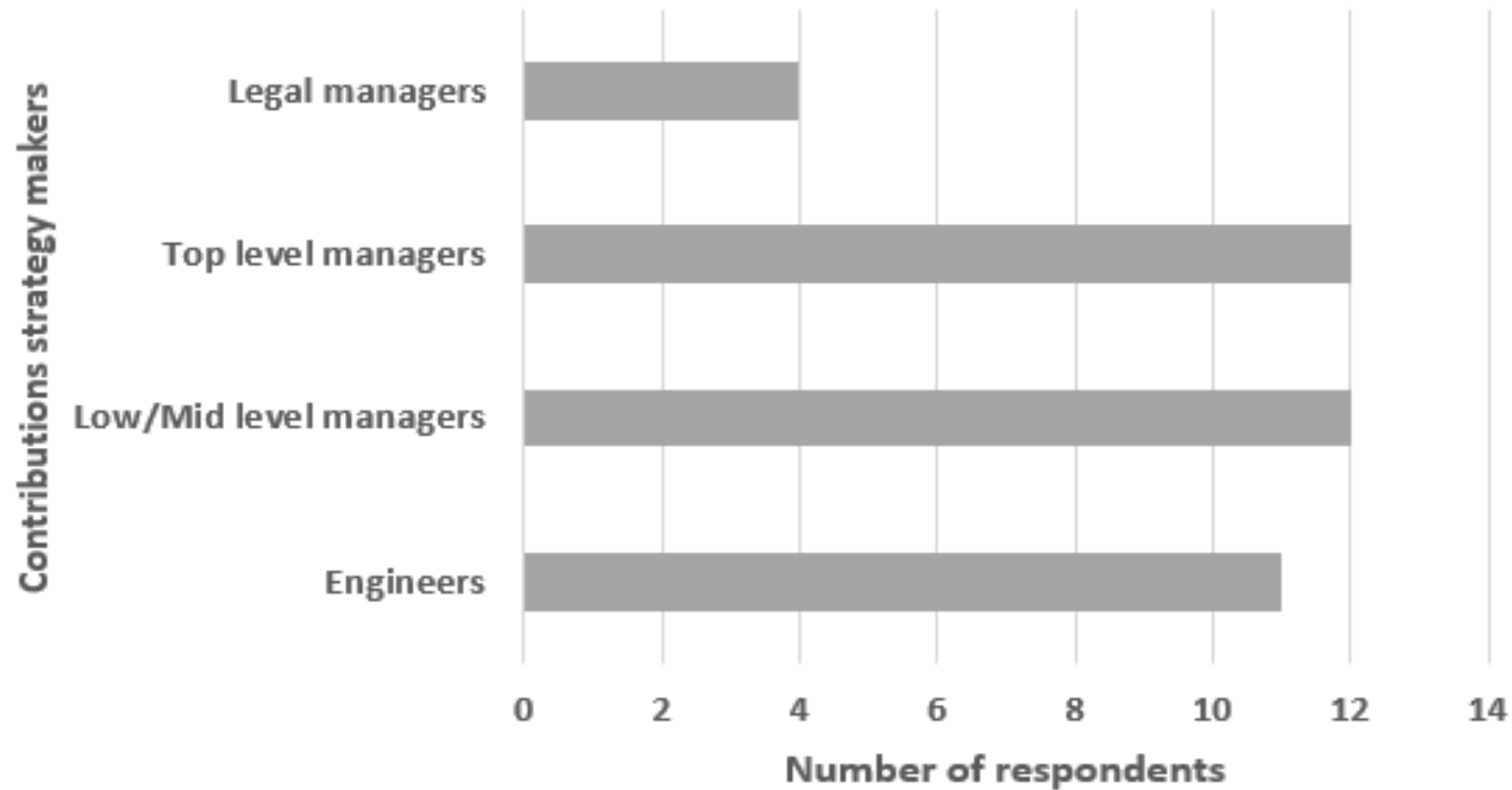
Tools	Sony	Google	Ericsson	HP	SAP	Intel	Others
Gerrit	8.22	38.52	0	0	10.70	0	42.55
PyGerrit	97.5	0	0	0	0	0	2.47
Gerrit-Event	66.1	0	3.34	4.06	0.23	2.03	24.25
Gerrit trigger	65.2	0	9.07	2.49	0.75	1.30	21.21
Team Views	100	0	0	0	0	0	0
External resource-dispatcher-pl	89.6	1.48	4.83	0	0	0	4.08
Build Failure Analyzer	85.5	0	0	0	0	0	14.45

Reasons for OI adoption
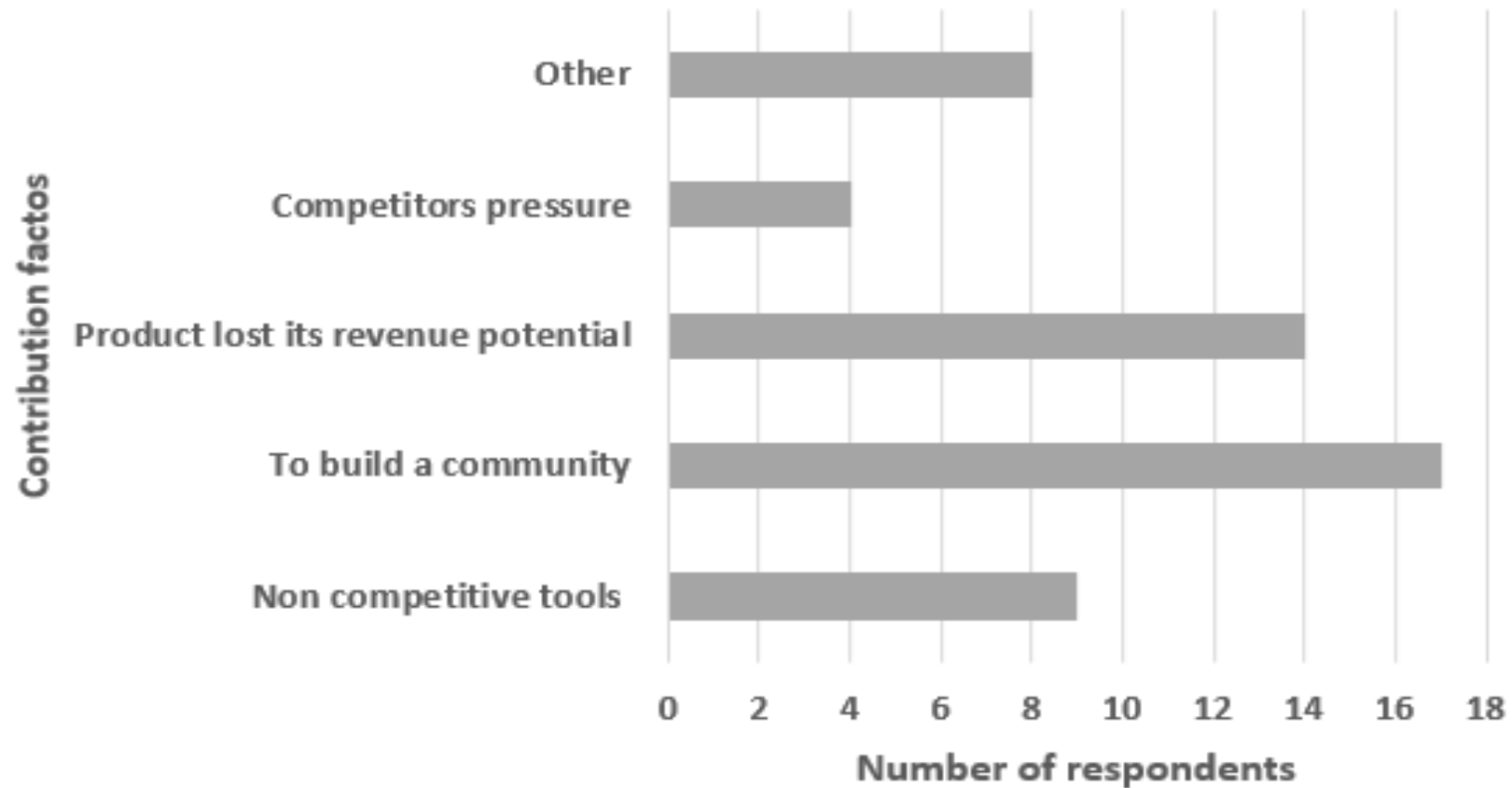
OSS Strategy makers

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

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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?

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Software Testing in Open Innovation: An Exploratory Case Study of the Acceptance Test Harness

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

capture value. OI is more transactional in nature, compared to OSS, where firms try to leverage external knowledge to accelerate their internal innovation process and in return, contribute back to the community by adopting a selective revealing strategy [8].

Prior to this study, we conducted a systematic mapping study [11] on OI in SE to identify the research in the field. The study shows that empirical studies on the role of testing in OI are scarce. Furthermore, software testing in OI entails a dual role: 1) to verify the functions and characteristics of open components and services, supplied by the community, and 2) to verify the functions and characteristics of services delivered to stakeholder higher up in the value chain (e.g. internal customers, software developers and testers). Further-

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
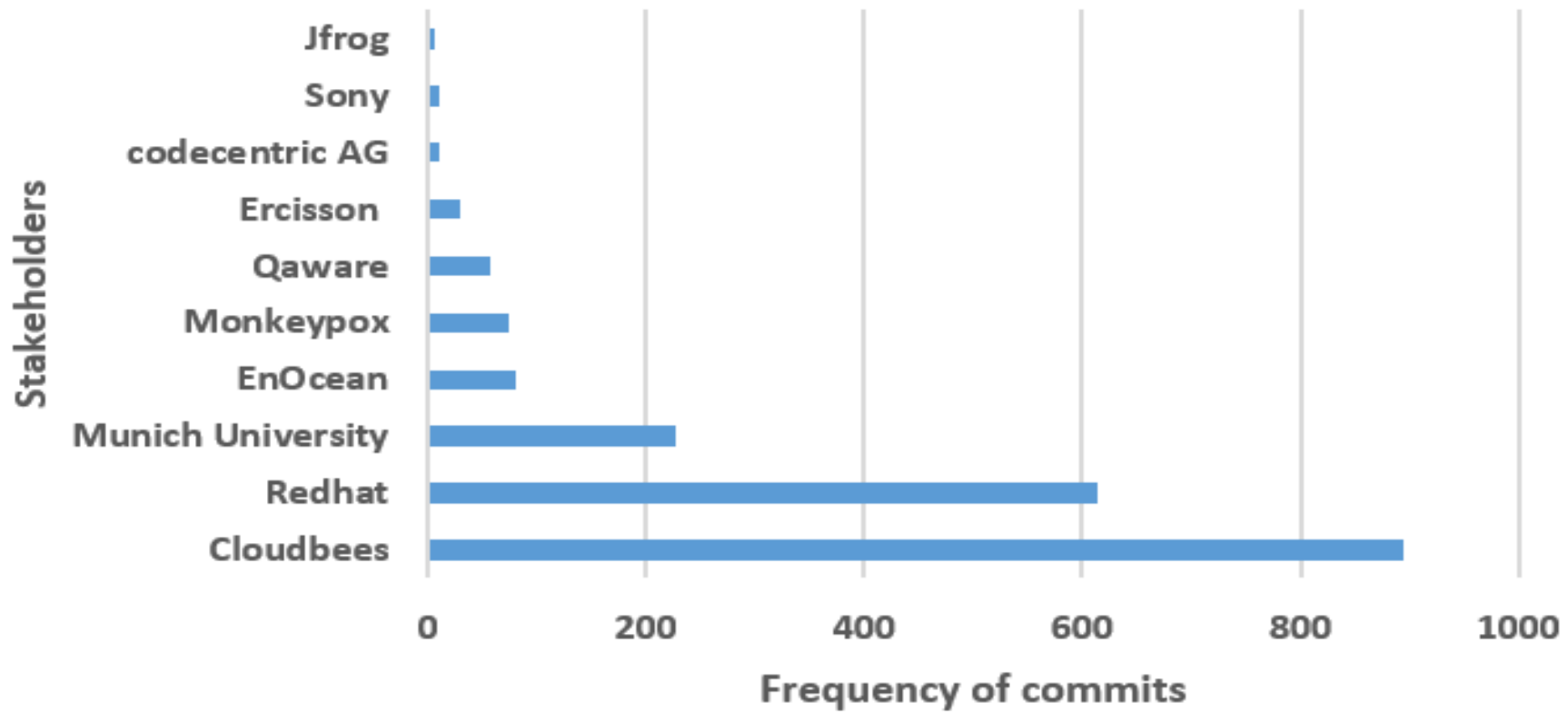
Acceptance Test Harness

- 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

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.

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Our shortest ever paper (140 chars)

http://tinytocs.org

It is More Blessed to Give than to Receive – Open Software Tools Enable Open Innovation

Per Runeson[1], Hussan Munir[1] and Krzysztof Wnuk[2]
[1]Lund University, [2]Blekinge 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 conclude 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

Source of knowledge	Type of knowledge	
	Opinion	**Empirical**
Local	1 (most)	2
Remote	3	4 (least)

A. Rainer, T. Hall, and N. Baddoo. Persuading developers to "buy into" software process improvement: a local opinion and empirical evidence. Proceedings of the 2003 International Symposium on Empirical Software Engineering, 2003. ISESE 2003, page 326, 2003.

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References

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H. Munir and P. Runeson. Software testing in open innovation: An exploratory case study of the acceptance test harness for Jenkins. *First International Workshop of Open Innovation in Software Engineer*ing, ACM, August 2015.

H. Munir, J. Linåker, K. Wnuk, P. Runeson, and B. Regnell. Open Innovation through the Lens of Open Source Tools: An exploratory case study at Sony Mobile. Under submission 2016.

H. Munir, K. Wnuk, and P. Runeson. Open innovation in software engineering: A systematic mapping study. *Empirical Software Engineering*, 21(2):684-723, April 2016.

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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.

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