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Open source software: a gendered technology?
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Abstract

Exploiting the data gathered from Open Source Software contributors through in-depth interviews and Delphi method, this paper examines to what extent does gender variations affect the process of open source software development. Regardless of the rising literature on open source software process, information about gender and its issues in open source software is still limited, though the gender issues seem to be persisting issues on women in software technology industries. The extremely scarce numbers of women in open source software process reveals broader issues on the construction of open source software in its design and usage thus lead to the question of whether open source software is a gendered technology. This paper discussed that appropriate feminist approach through the lens of social constructivist's theory are important in understanding open source software development process as whether it is a gendered technology.

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1. Introduction

Both men and women have gender identities that structure their experience and beliefs which need a full understanding of theoretical integration of genders in technology studies [1, 2]. Most of feminist scholars in the field of technology studies view technology as socially constructed and genders plays a role in its production [1]. Most of the gender and technology literature concentrates on gender and technology in the workforce but there are only limited studies with regard on exploring how technological designs probably differ based on the gender of the designer and users [3].

Open Source Software (OSS) is considered as a technology produced from OSS process. This process is unlike the traditional software engineering practices where it depends mostly on contributions, with no formal planning but somehow produced successful OSS. However, to show that the gender issues exist in OSS process, OSS survey and reports [4, 5] showed a great gap between genders where less than 2% are female contributors in OSS development and only 7.3% are female contributors in Australia [6] which shows how scarce female contributors in OSS process. Surprisingly, no evidence reported that the female's participation level has changed from the previous studies [7]. This phenomenon of social dynamics refelected that OSS is a thoroughly male dominated domain where women are not included in OSS process [5, 8]. Exclusion of women in technology production is translated to social exclusion thus profoundly affects the outcome of the technology is made [9]. OSS as a technology where its designs

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probably differ based on the gender of the designer and users [3] thus this study tried to find the answer for: to what extent does gender variations affect the process of Open Source Software Innovation? It is about how gender identities construct OSS characteristics thus shows whether OSS is a gendered technology or otherwise. The interest of this study is about documenting the social processes through which OSS innovation came to acquire their characteristics.

2.0 OSS-Technofeminist-ComTech conceptual framework

This study is guided by OSS-Technofeminist-ComTech conceptual framework which is developed in this study based on the stand that OSS is a product of socio-technical process[9, 10]. The proposed relationships among the constructs of interests in this conceptual framework are derived from Social Construction of Technology Theory (SCOT) theory by Pinch & Bijker [12], Feminist theory [13], Technofeminism [9] and Technology Use concept [14]. Since OSS process involves diverse social groups of contributors, SCOT theory is applied. Feminist and Technofeminism theory are important since it pays particular attention to gender' contributions that help shape and assign meanings to OSS [9, 10].

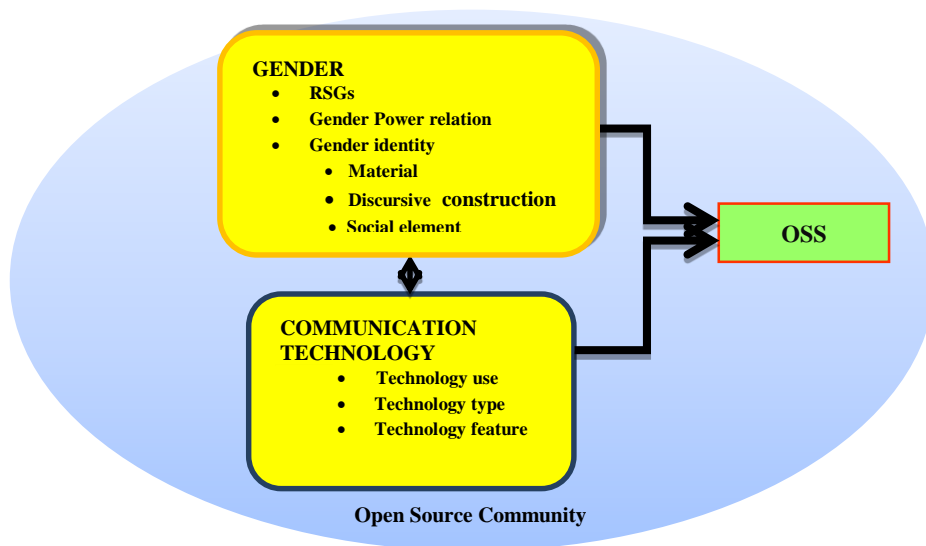


Fig. 1 OSS-Technofeminist-ComTech conceptual framework

The concept of technology use are used in the study along with SCOT and feminist theory since the nature of OSS development is mostly relies heavily on computer-mediated communication. Figure 1 shows the OSS-Technofeminist-ComTech conceptual framework and Table 1 shows the description of the constructs in OSS-Technofeminist-ComTech conceptual framework.

Table 1 : Constructs of OSS-Technofeminist-ComTech conceptual framework

Constructs	Source
Relevant Social Groups (RSGs) a) The RSGs can be institutions and/or organization of groups of individuals that assign similar meanings to a particular technological artifacts. b) RSGs involved not only the obvious RSGs pertaining to that certain technology is considered but less obvious RSGs may need to be included.	Pinch and Bijker [12]

Gender Power relation

- a) It shows that the particular power dynamics which is embodied in the conceptualization of differences and sameness, or inequalities or assumed equalities between men and women Wajcman [9], Cockburn and Omrod [13]
- b) Gender power relations recognize that men and women are structurally positioned differently in society, hence considers how this differentiation acts as the basis for the unequal distribution of power although not all men and women share the same experiences

Gender identity

Wajcman [9]

- a) Gendering of technology involves several dimensions that are; material, discursive and social elements
- b) Gender identity is embedded in technology construction. It captures the notion of socio-technical in technology development that social and technological elements are mutually constituting and hence the co-production of gender and technology

Technology Use

- a) technology use influence in the framework since the nature of OSS development is mostly relies heavily on computer-mediated communication Crowston et. al [14]
- b) crucial in coordinating OSS development activities that has significant impacts
- c) The technology type such as Internet Relay Chat (IRC), Concurrent Versions System (CVS), or subversion is critical for knowledge sharing and creation of OSS development especially in coordinating OSS development and for mediating control of OSS source code when at the same time
- d) The influence of the features offer by technology use have impacts on the OSS development in terms of sharing of knowledge and creation of software innovation .

3.0 Study Approach

Qualitative methodology is employed to seek rich understanding of “how” and “why” of real-life events on how OSS is developed in terms of plan, design and implementation in OSS communities. Begin with by analyzing the existing work and literature of both technological and sociological aspects on OSS process, the study then employed in in-depth interviews with OSS contributors and Delphi method with the experts in OSS communities. In order get a balanced and diversified sample, two types of sampling have been chosen: 1) snowball sampling strategy to populating the panel of experts in the Delphi method and 2) purposive sampling. Purposive sampling technique to select informants on the basis of certain criteria that satisfy the specific needs in a study [15] who can provide an in-depth representation of OSS innovation

3.1 In-depth Interview

In-depth interviews were conducted in several OSS conference involving eleven OSS contributors including two female contributors with various education level and contributions in OSS projects. The data collected are used as the basis for first round Delphi questionnaire.

3.2 Delphi Method

To get consensus, three rounds of Delphi method were conducted with 6 experts in OSS communities. However, only one female expert is involved since it was challenging to find one because of the scarcity of female contributors in OSS process until the three rounds of Delphi. Delphi method is used to replace face-to-face meetings and is suitable for decision-making, estimation and complex judgment that must include experts’ opinions and judgment [16].

The first round (R1) of Delphi method questions were based on the in-depth interview data to determine the relative rank or priority of the items identified under each of the sections which were rated using 5-

point Likert-type scal. The results were analyzed by using the median score, instead of mean. Median of the responses to each item was chosen as the measure of central tendency rather than mean. However, in order to get the idea of the range of variety of answers Inter-Quartile Range (IQR) is calculated. R1, second round (R2) and third round (R3) utilized the quartile deviation (QD) to identify the consensus. The second round (R2) considered the answers and suggestions from R1. The panels are informed of the overall responses by the other experts and are asked to examine their own responses with regard to the overall responses. In the third round (R3) was the final round of Delphi method, experts were again required to evaluate their responses with considering the overall experts' responses that in the end become the consensus as to their priority of extremely relevant. As shown in Table 2, analysis is done based on classifications where the consensus was determined at three levels. High level consensus and moderate level of consensus of the results gathered are considered in this study.

Table 2: Level of Consensus and Importance

Quartile Deviation	Level of Consensus	Median	Level of Importance
Less or equal to 0.5 ($QD \leq 0.5$)	High	4 and above ($M \geq 4$)	High
More than 0.5 and less than or equal to 1.0 ($0.5 < QD \leq 1.0$)	Moderate	3.5 and less ($M \leq 3.5$)	Low
More than 1.0 ($QD > 1.0$)	Low and no consensus	---	---

4.0 Is OSS a gendered Technology?

Both male and female play their roles in OSS process whether directly or indirectly as code developers, writing documentations, involved in designing and by posting questions on forums, IRC and mailing lists.

All male interviewees are code developers for a OSS project(s) while both of the female interviewees are contributing in less technical aspect of OSS project(s) such as localisation, bug reporter (who discover and report bugss) and promoting OSS. The interview data correspond to the literature where men are drawn towards technical roles in OSS projects such as code developer, fixing bugs and documentation on the own written patches. The roles difference in OSS projects between genders due to several factors such as preference and life style as discussed in [17] and gender identities. However, most interviewees stated all types of contributions are vital to successful OSS projects.

Delphi results documented all of the panellists agreed that Project Leader is the most important role in OSS project. According to panellist 3 (P03), "*Project leader has to be grounded in the rules of OSS project, for example the trunk control*". This showed project leader has a firm says in determining the movement of OSS project. Maintainer and core developer of the OSS project scored as the second important role. Usually core developer is also the maintainer. Many OSS projects died because of the absence of maintainer. Other technical roles played by male contributors are as the code developers who determines OSS structure which influences the long term savings such as less code, less maintenance and more agile framework. Most non-technical role are played by female in OSS such as users or "*downloaders*". Most downloaders are unaware that they are also contributing to OSS promotion by increasing the popularity of OSS.

RSGs in OSS communities including genders in OSS projects share same interpretation that give meaning on how OSS are designed. It shows that OSS project goals follow the mission of OSS community. As one interviewee (I04) mentioned, *“largely people are motivated more by the project goals directly rather than social peer influence”*. Contributors of OSS join a particular OSS project because they share the same interest in goals of the project that shape similar interpretation of the meaning of OSS innovation. All of the Delphi panelists agreed that goals of the project drive the contributors towards an OSS project though OSS project will evolve as distinct forks or its own category for example KDE desktop as a fork from Linux Kernel or vis a vis GNU OS. However, the direction of OSS project such as the next release dependent on who is actually controlling the release which usually the case in the maintainer who are usually male developers hence male gender power.. The discussions and heated arguments are handled through online discussion mainly mailing list, forum, IRC and social network and CVS/GIT. The differing of arguments among the contributors are,

Usually inflammable and thus we find many serious participators not willing to inflame further and kept to the sidelines. So we find the norm that flames are ignored and many issues may not be solved but a status quo hangs in the air

panelist P03

Face-to-face meeting is one of the medium used to handle arguments regarding the next release. One panelist said (P04), *“we tried to resolve via face-to-face and its positive, but wasn’t useful because when offline, it revert back”*. Although OSS project may be sponsored by certain organization, the direction of the project can be driven exclusively but the contributors still have the say by requesting the organization to either fork the project as in the new GIT branching policy or become another distro of the same code but under a different branding exercise. OSS is based on volunteerism of the same interest. This shows that the goals and mission of OSS project remain the same as the beginning of the project and contributors maintain the similar interpretation and interest of OSS.

5.0 Gender identities in OSS

Gender namely male and female has different impacts on the closure and stabilization of OSS. Some contributors mainly male do not see gender differences impacted OSS outcome. Most of male interviewees did not aware of opposite gender of contributors in OSS project and have generally assumed all contributors are males judging from their nick communication styles. Only two of the interviewees (I01 and I04) certain there were opposite gender contributing in the new features, and design of OSS project. The rest of them did not sure but make assumption there might be some female though the nick name use is general. Contrary to female interviewees, they definitely aware of the gender difference and different treatments they received from other male contributors.

All the experts agree that the number of female in OSS project is extremely low, wish to see more female participations in OSS projects to balance up the social atmosphere. However it is hard for female to join the ‘hacker’ nature of OSS that based on strong programming culture involving long hour of coding activities to committedly contribute with less spare time in comparison with men as they need to attend to housework chores. Since the gap between male and female contributors participation is very large, the panelist and interviewees come to an agreement that they cannot really draw a conclusion how much genders affected the OSS release. P07 simply stated *“there are too few of them to impact the direction”*. However, a panelist acknowledge that some female contributors are also highly skilled technically that somehow influence the decisions made based on their role in OSS project.

So if OSS a gendered technology? Yes, based on the contributors' identities and the power of the leader to determine the outcome.

6.0 Conclusion

It shows that the gender identities exists and constitutes within their contributors towards OSS outcome. This somehow reflected in OSS design outcome based on the identities of the people in the development process. By having a balanced population of both genders perhaps can expand the creativity of OSS communities and hence the outcome of OSS .

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