Study of different factors leading to the choice of Developers and Users to participate in major Open Source Library Software (OSLS) with special emphasis on gender differences

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ABSTRACT

It is almost obvious that the Open Source Library Software (OSLS) is the future for the modern libraries. While many researchers attempt to understand the process and structure of the available OSLS, their development, impact and management, few found a gender composition in participation of the development process and during their implementation worth studying. This study observed, highlighted and compared the patterns of women's and men's participation in the OSLS project development process with reference to proprietary software. This paper would study select factors leading to the choice of Developers to participate in these major OSLS development projects and Registered Users in implementing these OSLS projects in their respective sites, with special emphasis on gender differences. To find out gender participation in development and implementation of OSLS projects with select OSLS viz. DSpace, E Prints, Evergreen, Greenstone Digital Library Software, Koha, NewGenLib and OpenBiblio, the methodology involved analytical as well as theoretical study. The dataset involved both secondary and primary level of data. An online database has been developed for primary data collection. There is a difference between male and female participation in the given set. This study also has significant

practical implications. Specifically, OSLS exponent should be aware of the differential effects of gender dimension in terms of choice to participate in the development process and implementation of open source software..

General Terms: Free Open Source Software;

Open Source Library Software, Library Software

Keywords: Open Source Library Software, Libraries, Gender Dimension

INTRODUCTION

Information and communication technologies, like any other technologies, impact men and women in different ways. Software is at the heart of the development of information communication technologies (ICTs). In an ICT-based society, it is increasingly important that software is designed to meet the requirements of diverse users. The development mode of Free/Libre Open Source Software (FLOSS) is another most common and successful examples for this aim. FLOSS or FOSS has had a major impact on the computer industry since the late 1990s and has changed the way software is perceived, developed and deployed in many areas. Libraries are also part of it. Libraries have been using ICT based resources and services to satisfy the diverse information needs of their users. Libraries have been transforming to ICT based resources and services and gradually becoming more of infobraries. And open source software in library and information science is proving to be major driving force in this regard.

RESEARCH BACKGROUND

Martin Michlmayr (2007) researched and established in his thesis that free and open source software, or FOSS, is typically developed in a collaborative fashion and the majority of contributors are volunteers. Even though this collaborative form of development has produced a significant body of software, the development process is often described as unstructured and unorganized. His dissertation studied the FOSS phenomenon from a quality perspective and investigates where improvements to the development process are possible.

Claire E. Gilbertson (2011) found out that Free/Open Source Software (FOSS) is a powerful development paradigm for creating software. Claire compared several surveys and have commented that existing FOSS communities are very homogenous populations and made up of mostly men. OSLS being an integral subset of FOSS are also a party to these studies.

While many researchers attempt to understand the structure, domain, functionalities of the available Open Source Library Software (OSLS), even their development, impact and management, few studied the gender participation and tried to check whether there is any specific motivational factor responsible for participation or non-participation towards any particular sex. OSLS is a way of working within a library organization to derive benefit for the organization from technology choices that promote freedom, collaboration, co-operation and openness. To maximize benefit from an OSLS strategy, an organization must develop its OSLS ecosystem, whether this consists of internal capacity or partnerships with strategic business partners who have developed their own OSLS ecosystem. There are a number of areas within libraries where OSLS tools are often used, and can be deployed or adapted to improve the quality of experience by librarians and patrons alike. These include the operating systems that run our computers, the desktop productivity applications that we use, our institutional repositories, library information systems, and various web and distributed applications. Its success has also attracted researchers from different disciplines to analyse its unconventional innovation approach. But according to a FLOSS survey on FLOSS developers in 2002, "women do not play a role in the [FLOSS] development; only 1.1% of the FLOSS sample is female." (Ghosh et al. 2002).

The association of men with technology, and therefore with information science, calls into question the choice for emphasizing information science as a primary component of modern librarianship, now deemed LIS. In this study we will intend to point out that while women have a chance of upgrading their ICT skills and knowledge through participating in the development of the Open Source Library Software, but the opportunity is less available due to their latent participation in the process.

Some very successful "open source" software products have been and are being developed, distributed, and supported in the field on a voluntary basis by and for users themselves—no supplier required (von Hippel, 2002). The choices that induce users to contribute to an open source project "for free" and the mechanisms by which the various tasks can be effectively carried out are currently a subject of study for both practitioners and academics. To this point, explorations of the mechanics of and the incentives to participate in open source software projects has focused on the core tasks of developing and debugging and improving the open source software itself. Major choices used to explain why users would voluntarily work on these basic tasks include: (1) a user's direct need for the software and software improvements worked upon; (2) enjoyment of the work itself; and (3) the enhanced reputation that may flow from making high-quality contributions to an open source project. But a complete open source software development and diffusion system contains mundane but essential tasks as well—and the three motivations just described seem to apply relatively poorly to these. We, therefore, devote this empirical exploration to understanding why and how a task at the mundane but necessary end of the scale gets done.

OBJECTIVE OF THE RESEARCH PROBLEM

The objective of this research paper is to study select factors leading to the choice of male and female developers to participate in major OSLS development project vis-a-vis propritory software and male and female registered users in implementing/using these OSLS projects in their respective sites. The study will observe how in both the scenarios choices differ or remain same with different genders. Here 'project' is defined as the all public activities performed for the intentional benefit of the respective OSLS. This study is a part of a bigger research which is aimed in finding out the aspect of gender participation in development processes of select major OSLS projects

RESEARCH METHODOLOGY

To find out gender participation in OSLS projects, the methodology involved analytical as well as theoretical study. The dataset involved both secondary and primary level of data.

For Primary data –An online database has been developed by using PHP. PHP code has been embedded into HTML code so that it can be used in combination with various web template systems, web content management systems and web frameworks. For the validity or authenticity and reliability of data collection, the users and developers listed in the official website and official wiki of the respective OSLS site are only contacted. Thus there is representation from majority of the countries across the globe. OSLS taken are DSpace, E Prints, Evergreen, Greenstone Digital Library Software, Koha, NewGenLib and OpenBiblio. This study is based on 99 validated replies from the developers and 433 validated replies from the users.

For the purpose of better sample coverage of data collection, 'ALA Women and Gender Studies Section', 'IFLA Women and Information and Libraries Special Interest Group Mailing List (will-l)' have been approached.

For Secondary data – The notion that there is a Gender disparity in participation is evident in the secondary data sources like European Commission reports, postings in WSIS Knowledge communities, reports of Information Meeting for Permanent Delegations of the Information Society Division Communication and Information Sector and also reports of Community Leadership Summit and various books and journal articles.

RESEARCH ANALYSIS

❖ *Developers View Point*

Amongst forty six questions inquired in the questionnaire for the OSLS developers, questions pertaining to their choice between proprietary and open source have been discussed here. A number of sets of answers for each question have been set up and have coded the responses of each individual. There is one ID code generated automatically against the response of each individual. The coding may be considered a method of summarizing the responses of each individual

Questions were framed to capture the agreement with statements about OSLS and proprietary software. To determine their psychological attribute or simply attitude, scales are being used. Likert type of scale is usually called Summated Rating Scale simply because the attitude score of an individual is obtained by adding the response scores on all the component items.

A summated scale, like a differential scale, consists of a series of items to which the subject is asked to react. The type of summated scale most frequently used in the study of social attitudes follows the pattern devised by Likert (1932) and is referred to as a Likert-type scale. In such a scale, the responded are asked to respond to each item in terms of several degrees of agreement or disagreement; for example,

- Strongly Agree   (5)
- Agree   (4)
- Neutral   (3)
- Disagree   (2)
- Strongly Disagree   (1)

The data derived using the Likert scale is given here

Table No: 1					
Data on the agreement with statements about FOSS/OSLS and proprietary software.					
Options	I believe that users of software should have the right to see the source code	OSLS is superior in quality to proprietary software (fewer bugs, more features etc.)	Open source development is the most efficient way to develop Library software	Proprietary software has its uses and proprietary development may create some software more efficiently	Some proprietary software is high quality, although ideally all software would be developed as open source/ free software
	A	B	C	D	E
Strongly Agree	46	33	16	5	7
Agree	33	36	43	25	32
Neutral	15	26	31	66	50
Disagree	2	3	6	3	8
Strongly Disagree	3	1	3	0	2

In the given table the frequency of the scores against each option is given. The numbers given under the scale positions are not there on the questionnaire given to the respondents. They are shown here to indicate the scoring system. The data in the table is represented graphically below with the help of area diagram.

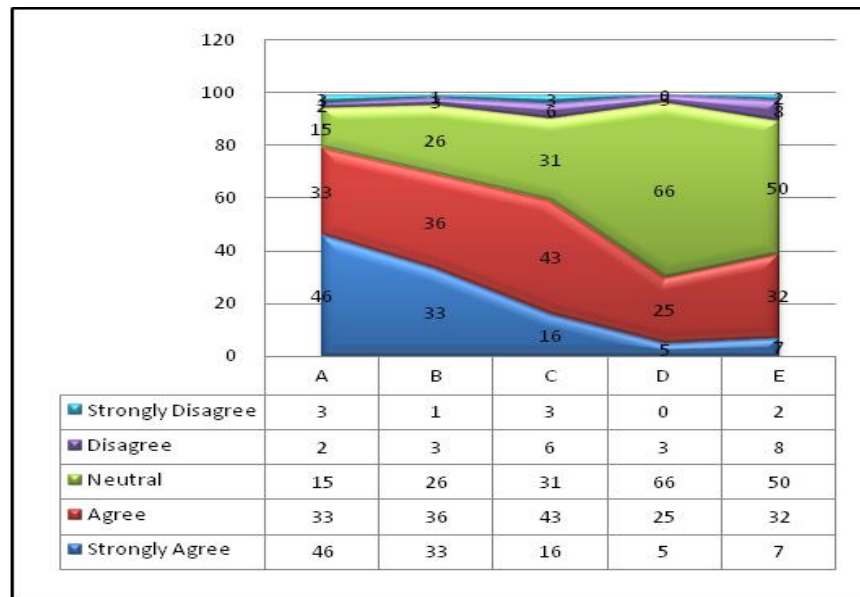|	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
A	3	2	15	33	46
B	1	3	26	36	33
C	3	6	31	43	16
D	0	3	66	25	5
E	2	8	50	32	7

Figure: 1 Data on the agreement with statements about FOSS/OSLS and proprietary software of the Respondent Developers

In the given diagram the alphabets in the x-axis stands for different questions as posed in the questionnaire also given in the table number 1. The diagram denoted the areas covered by different options against respective questions. The majority stand neutral in the fourth question denoted D. Similarly respondent strongly agreed in first question number denoted by A. Very few respondent have shown strong disagreement in the any of the questions.

The procedure that is followed to construct a Likert-type scale is as follows:

(1) Firstly assembled a large number of items considered relevant to the attitude being investigated and either clearly agree or clearly disagree.

(2) Secondly these items are administered to a group of subject representative of those with whom the questionnaire is to be used. The subjects indicate their response to each item by checking one of the categories of agreement - disagreement.

(3) Thirdly the responses to the various items are scored in such a way that a response indicative of the most agreeable attitude is given the highest score. It makes no difference whether 5 is high and 1 is low or vice-versa. The important thing is that the responses be scored consistently in terms of the attitudinal direction they indicate. Whether "agree" or "disagree" is the response to an item depends, of course, upon the content and wording of the item.

(4) Fourthly each individual's total score is computed by adding his item scores.

(5) Fifthly the responses are analyzed to determine which of the items discriminate most clearly between the high scorers and the low scorers on the total scale. Items that do not show a substantial correlation with the total score, or that do not elicit different responses from those who score high and those who score low on the total test, are eliminated to ensure that the questionnaire is "internally consistent"-that is, that every item is related to the same general *attitude*.

A series of Likert-type questions that when combined describe a personality trait or attitude - means and standard deviations are best used to describe the scale.

Table No: 2 Data on the agreement with statements about FOSS/OSLS and proprietary software in Likert Scale for Respondents Developers					
Questions -	A	B	C	D	E
Total Points Received	414	394	360	329	331
Total Points Possible	495	495	495	495	495
Mean	4.18	3.98	3.64	3.32	3.34
Standard Deviation	0.97	0.90	0.93	0.62	0.81
Correlation	0.749	0.800	0.730	0.483	0.537

Respondent Developers as a whole supported the FOSS movement ideologically. Majority of the respondent developers agree that software users should have the right to see software's source code (Mean 4.18, Standard Deviation 0.97). They also agree that OSLS is superior in quality to proprietary software (fewer bugs, more features etc.) (Mean 3.98, Standard Deviation 0.90). Most respondent developers also agree that open source development is the most efficient way to develop Library software (Mean 3.64, Standard Deviation 0.93).

Correlation Coefficient

The quantity r, called the linear correlation coefficient, measures the strength and the direction of a linear relationship between two variables. The mathematical formula for computing r is:

$$ r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2}\sqrt{n(\sum y^2) - (\sum y)^2}} $$

where *n* is the number of pairs of data.

Here in the given table 2 the correlations for A, B and C imply that they are statistically significant. It also indicates that the correlation coefficient for question nos. A, B and C are quite high and can be described as strong. That means the attitude of the respondent developers towards the belief that users of software should have the right to see the source code is highly positive. Similarly their attitude towards OSLS is superior in quality to proprietary software and open source development is the most efficient way to develop Library software is also very positive. Whereas for question number D the correlation is 0.483 that implies their attitude towards proprietary software has its uses and proprietary development may create some software more efficiently is quite weak.

Table No: 3 Data on the agreement with statements about FOSS/OSLS and proprietary software in Likert Scale for Female Respondents Developers					
Questions -	A	B	C	D	E
Total Points Received	44	42	36	40	38
Total Points Possible	55	55	55	55	55
Mean	4.00	3.81	3.27	3.63	3.45
Standard Deviation	1.00	1.25	1.34	0.67	1.03
Correlation	0.729	0.801	0.594	0.723	0.397

Respondent Female Developers as a whole are indifferent towards the FOSS movement. Majority of the respondent developers agree that software users should have the right to see software's source code (Mean 4.00, Standard Deviation 0.10). They also agree that OSLS is superior in quality to proprietary software (fewer bugs, more features etc.) (Mean 3.81, Standard Deviation 1.25). Most respondent female developers also agree that Proprietary software has its uses and proprietary development may create some software more efficiently (Mean 3.63, Standard Deviation 0.67).

Here in the given table 3 the correlations for A and C imply that they are statistically significant. It also indicates that the correlation coefficient for question nos. A and C are quite high and can be described as strong. That means the attitude of the respondent developers towards the belief that users of software should have the right to see the source code and OSLS is superior in quality to proprietary software are highly positive. Whereas for question number E the correlation is 0.397 that implies their attitude towards the say that proprietary software is high quality, although ideally all software would be developed as open source/ free software is quite weak.

Table No: 4					
Data on the agreement with statements about FOSS/OSLS and proprietary software in Likert Scale for Male Respondents Developers					
Questions -	A	B	C	D	E
Total Points Received	370	352	324	289	293
Total Points Possible	440	440	440	440	440
Mean	4.20	4.00	3.68	3.28	3.33
Standard Deviation	0.97	0.85	0.86	0.60	0.78
Correlation	0.753	0.802	0.767	0.463	0.567

Respondent Male Developers as a whole supported the FOSS. Majority of the respondent developers strongly agree that software users should have the right to see software's source code (Mean 4.20, Standard Deviation 0.97). They also agree that OSLS is superior in quality to proprietary software (fewer bugs, more features etc.) (Mean 4.00, Standard Deviation 0.85). Most respondent male developers also agree that Open source development is the most efficient way to develop Library software (Mean 3.68, Standard Deviation 0.86).

Here in the given table 4 the correlations for A, B and C imply that they are statistically significant. It also indicates that the correlation coefficient for question nos. A, B and C are quite high and can be described as strong. That means the attitude of the respondent developers towards the belief that users of software should have the right to see the source code, OSLS is superior in quality to proprietary software and Open source development is the most efficient way to develop Library software are highly positive. Whereas for question number D the correlation is 0.463 that implies their attitude towards uses of proprietary software and towards the thought that proprietary development may create some software more efficiently is more or less weak.

Users View Point

Amongst thirty one questions inquired in the questionnaire for the OSLS users, questions pertaining to the choice factor for choosing and continuing with the current OSLS package have been considered and analyzed here. The data derived using the Likert scale is given below

Table No: 5 Data on the agreement with statements about OSLS and proprietary software.					
Options	I believe that users of software should have the right to see the source code	OSLS is superior in quality to proprietary software (fewer bugs, more features etc.)	Open source development is the most efficient way to develop Library software	Proprietary software has its uses and proprietary development may create some software more efficiently	Some proprietary software is high quality, although ideally all software would be developed as open source/ free software
	A	B	C	D	E
Strongly Agree	240	190	100	110	175
Agree	524	368	724	492	408
Neutral	507	537	405	735	753
Disagree	86	180	168	54	64
Strongly Disagree	32	23	3	6	3

In the given table the frequency of the scores against each option is given. The numbers given under the scale positions are not there on the questionnaire given to the respondents. They are shown here to indicate the scoring system. The data in the table is represented graphically below with the help of area diagram.
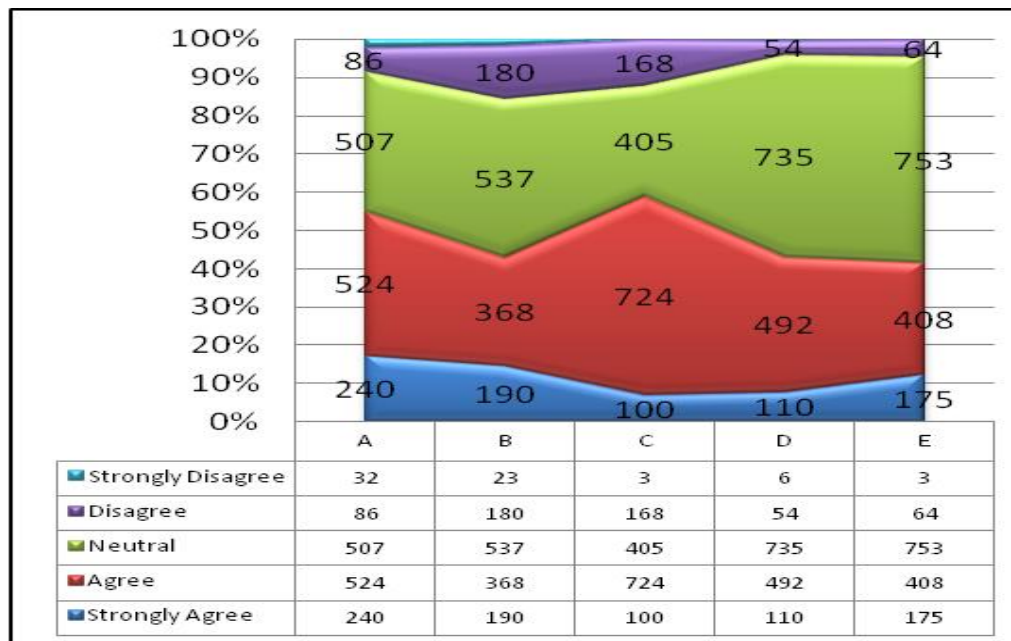

Figure: 2. Data on the agreement with statements about FOSS/OSLS and proprietary software of the Respondent Users

In the given diagram the alphabets in the x-axis stands for different questions as posed in the questionnaire also given in the table number 6.16. The diagram denoted the areas covered by different options against respective questions. The majority stand neutral in the fifth question denoted E. Similarly respondent strongly agreed in first question number denoted by A. Very few respondent have shown strong disagreement in the any of the questions.

A series of Likert-type questions that when combined describe a personality trait or attitude - means and standard deviations are best used to describe the scale.

Table No: 6					
Data on the agreement with statements about OSLS and proprietary software in Likert Scale for Respondents Users					
Questions -	A	B	C	D	E
Total Points Received	1389	1298	1400	1397	1403
Total Points Possible	2165	2165	2165	2165	2165
Mean	3.284	3.076	3.310	3.303	3.317
Standard Deviation	1.044	1.003	0.866	0.727	0.760
Correlation	0.645	0.675	0.784	0.428	0.636

Respondent Users as a whole are neutral towards the OSLS movement ideologically. Majority of the respondent users are neutral towards software users should have the right to see software's source code (Mean 3.28, Standard Deviation 1.04). They are also neutral towards Open source development is the most efficient way to develop Library software (Mean 3.31, Standard Deviation 0.86). They took a neutral stand for proprietary software has its uses and proprietary development may create some software more efficiently (Mean 3.30, Standard Deviation 0.72) and also some proprietary software is high quality, although ideally all software would be developed as open source/ free software (Mean 3.31, Standard Deviation 0.76).

Here in the given table 6 the correlations for A, B, C and E imply that they are statistically significant. It also indicates that the correlation coefficient for question nos. A, B, C and E are quite high and can be described as strong. That means the attitude of the respondent users towards the belief that open source development is the most efficient way to develop Library is highly positive. Similarly their attitude towards OSLS is superior in quality to proprietary software and software users of software should have the right to see the source code is also very positive. Whereas for question number D the correlation is 0.428 that implies their attitude towards proprietary software has its uses and proprietary development may create some software more efficiently is quite weak.

Table - 7

Data on the agreement with statements about FOSS/OSLS and proprietary software in Likert Scale for Male Respondents Users

Questions -	A	B	C	D	E
Total Points Received	907	855	932	914	912
Total Points Possible	1440	1440	1440	1440	1440
Mean	3.239	3.054	3.329	3.264	3.257
Standard Deviation	1.056	1.023	0.867	0.768	0.779
Correlation	0.620	0.657	0.775	0.478	0.640

Respondent Male Users as a whole are neutral towards the OSLS movement ideologically. Majority of the respondent male users are neutral towards software users should have the right to see software's source code (Mean 3.23, Standard Deviation 1.05). They are also neutral towards Open source development is the most efficient way to develop Library software (Mean 3.32, Standard Deviation 0.86). They took a neutral stand for proprietary software has its uses and proprietary development may create some software more efficiently (Mean 3.26, Standard Deviation 0.76) and also some proprietary software is high quality, although ideally all software would be developed as open source/ free software (Mean 3.25, Standard Deviation 0.77).

Here in the given table 7 the correlations for A, B, C and E imply that they are statistically significant. It also indicates that the correlation coefficient for question nos. A, B, C and E are quite high and can be described as strong. That means the attitude of the respondent male users towards the belief that open source development is the most efficient way to develop Library is highly positive. Similarly their attitude towards OSLS is superior in quality to proprietary software and software users of software should have the right to see the source code is also very positive. Whereas for question number D the correlation is 0.478 that implies their attitude towards proprietary software has its uses and proprietary development may create some software more efficiently is quite weak.

Table No: 8

Data on the agreement with statements about FOSS/OSLS and proprietary software in Likert Scale for Female Respondents Users

Questions -	A	B	C	D	E
Total Points Received	482	443	468	483	491
Total Points Possible	725	725	725	725	725
Mean	3.284	3.076	3.310	3.303	3.317
Standard Deviation	1.044	1.003	0.866	0.727	0.760
Correlation	0.645	0.675	0.784	0.428	0.636

Respondent Female Users as a whole are neutral towards the OSLS movement ideologically. Majority of the respondent female users are neutral towards software users should have the right to see software's source code (Mean 3.28, Standard Deviation 1.04). They are also neutral towards Open source development is the most efficient way to develop Library software (Mean 3.31, Standard Deviation 0.86). They took a neutral stand for proprietary software has its uses and proprietary development may create some software more efficiently (Mean 3.30, Standard Deviation 0.72) and also some proprietary

software is high quality, although ideally all software would be developed as open source/ free software (Mean 3.31, Standard Deviation 0.76).

Here in the given table 8 the correlations for A, B, C and E imply that they are statistically significant. It also indicates that the correlation coefficient for question nos. A, B, C and E are quite high and can be described as strong. That means the attitude of the respondent female users towards the belief that open source development is the most efficient way to develop Library is highly positive. Similarly their attitude towards OSLS is superior in quality to proprietary software and software users of software should have the right to see the source code is also very positive. Whereas for question number D the correlation is 0.428 that implies their attitude towards proprietary software has its uses and proprietary development may create some software more efficiently is quite weak

CONCLUSION

To distinct the basic orientations of FOSS/OSLS developers the analysis has to begin with the individual self-perception of these developers as part of the FOSS/OSLS community. The terminology "FOSS" is the older one of the two terms, and the term "OSLS" was invented as a part of it. FOSS developers are sometimes represented as anti-capitalists who are trying to replace proprietary software development with an innovative form of open, free, common software development. Therefore it is rational to assume that the separating line between the developments of two software domains is very choosy.

It is almost obvious for the OSLS users that open source helps in reducing the duplication of efforts and it is the future for the modern libraries.

A primary nearer look on the perception of proprietary software within the OSLS community is provided by the question whether the respondents find that OSLS is superior in quality to proprietary software. While proprietary software is generally associated with boring work and time pressure, FOSS is associated with joyful work. But an important exclusion is offered in the characteristic of innovativeness that is evidently adjoined with both the domains of the two forms of software. Money plays certainly a much bigger role in the sphere of proprietary software than in the domain of FOSS/OSLS.

Thus even with such socially enriched choice factors leading to the OSLS developers' engagement in the development process of OSLS; women developers remain largely non-participant. This research survey has confirmed that women do not participate in great extent in the development of OSLS; only 11% of the OSLS developers sample is female. The situation is not so alarming for the OSLS users. About 33% of the OSLS users sample is female.

Thus the gender balance differs notably from the assumed balance expected in the community. Consequently to give more independence in software development and to serve as an establishment where knowledge can be exchanged more women participation is needed.

Any development process has to be inclusive of nature otherwise that development is not a balanced and sustainable one irrespective of which ever subject area it is dealing with. It is worth noting that though the gender issues that will be raised in this study are widespread, but it should not be considered as universal.

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