

# Investigating Factors Influencing the Adoption and Use of Free and Open Source Software (FOSS) in Tanzanian Higher Learning Institutions: Towards an Individual-Technology-Organizational-Environmental (ITOE) Framework

Simeo Kisanjara<sup>1</sup>, Titus Tossy<sup>2\*</sup>  
Mzumbe University  
[sbkisanjara@mzumbe.ac.tz](mailto:sbkisanjara@mzumbe.ac.tz)<sup>1</sup> [ttossy@mzumbe.ac.tz](mailto:ttossy@mzumbe.ac.tz)<sup>2</sup>

\*Corresponding Author

**Abstract-** This paper is located within the global debates about adoption and use of Free and Open Source Software (FOSS) in developing countries' Higher learning Institutions (HLIs). From the perspectives of Tanzania, this paper investigates factors influencing the adoption and use of the FOSS. The rationale for the investigation stems from the notion that Tanzania HLIs is yet to fully adopt and use FOSS despite huge investments and efforts being made on ground. This is facilitated by the lack of clear FOSS adoption and use framework. The source of these data was a questionnaire which comprised of structured questions. The questionnaire used a five-point Likert Scale. The population sample for the study was all HLIs stakeholders in Tanzania. Participants included both public and private HLIs. The positive factors includes autonomy for code modifications, IT staffs and decision makers, organization awareness, trustworthiness of FOSS, licensing and scalability, collaboration and knowledge sharing, collaboration on international ICT, organization policy and good social economic policy. The negative influencing factors included: Lack of proper plan, low confidence, lack of expertise, unfit for purpose, difficult to implement, lack of supporting software. Furthermore, this paper motivates other researchers to analyze why the adoption and use of Free and Open source software is still low in higher learning Institutions in East Africa though there are potential benefits that have been advocated in many previous studies. Finally the paper has proposed Individual-Technological-Organizational- Environmental (ITOE) framework for adoption and use of FOSS.

**Keywords-** ITOE framework; Free and Open Source Software; Tanzanian Higher Learning Institution

## 1. INTRODUCTION

In the recent times, there has been a move by Higher Learning Institutions in developing countries to adopt an advanced approach. This accelerates teaching and learning activities by skipping, less efficient, more expensive or more polluting technologies and move directly to more advanced ones (Karume and Mbugua, 2012). One such move is the crusade to adopt and use the free and open source software (FOSS). In this sense, Information and communications technologies (ICT) hold great promise for learning and teaching in Higher learning Institutions because they can enhance interaction among people, information, and systems in ways that have never been possible before (Lwoga, et al., 2006).

supported that Higher learning institutions enhancement of interaction among people, information, and systems caused by ICT in teaching and learning in higher learning Institutions (Lwoga, et al., 2006). Garrigos & Minoves (2009) learning institutions especially Europe and some countries in Asia, are increasingly interested in the use of Free and Open-Source software (FOSS). The reasons for

this is that Free and Open-source software is considered to be more secured, open, interoperable, safe and trustworthy than commercial software (Stuble, 2006; Printzos, 2011; Mathew & Stones, 2009). In addition, Free and Open source is used successful in Higher learning Institutions environments to setup a web based online conference Halsted (as cited in Hantea, 2006) or support web information management (Cartelli (as cited cited in Hantea, 2006).

It is observed that Free and Open source is used successfully in Higher learning Institutions environments to setup a web based online conference. According to Stuble (2006), in the past, the use of free and open source software (FOSS) in higher institutions was generally limited to system-level applications like operating systems and Web servers, largely because the personnel who could modify and customize the software came within this territory. Khan and UrRehman (2012) argue that, today millions of users all over the world are using the FOSS. Therefore, they insist that both the number of users and the number of FOSS increase day by day. According to new

study by the Campus Computing Project (2008), colleges and universities are far more likely to select open-source Learning Management Systems (LMS) to handle online courseware and e-learning system. The Free and open source community has offered several LMS options (Rowell, 2008). The examples of LMS are Tutor and Caroline, but the front runners among U.S. colleges and universities are Sakai and Moodle (Rowell, 2008).

The opportunities of adoption of FOSS do not only save cost to higher learning institutions, but also free use of source code, free copy making and distributing the software to others. Moreover, FOSS is increasing the computing power to the students by making them interact more with hands-on practices (Shaame, 2014). Furthermore, Free and Open Source Software (FOSS) grants the users the right to run the software, inspect, modify, and distribute the source-code/software (Khan and UrRehman, 2012).

Despite that there are plenty Free and Open Softwares, the implementation and use FOSS in Tanzania's Higher learning Institutions as well as other developing countries is still very low (Lwoga, et al., 2006). Studies show that Higher learning Institutions decision makers are often uncertain on criteria for the process of making decisions about adoption and use of free and open source software, due to the conflicting advice from research papers, books and articles there is tendency to highlight advantages and disadvantages of FOSS (UKEssay, 2014). Therefore, this paper aims to investigate factors influencing the adoption and use of Free and Open Source Software (FOSS) in Tanzania Higher Learning Institutions. This study was thus guided by the following research questions:

- *What are the factors influencing the adoption and use of Free and Open-Source software in Higher learning Institutions?*
- *How do influencing factors enhance the adoption and use of free and open source Software in Higher learning Institutions?*

## 2. FACTORS INFLUENCING THE ADOPTION AND USE OF FOSS

There is very little information in the models, theories, and frameworks to explain the adoption of open source software in organizations (Buffett, 2014). For example, the Technology Organizational-Environment (TOE) framework has been used for many years to understand organizational adoption of technology (Morgan and Finnegan, 2007). The TOE model defines a "context for change" consisting of the three main elements, which interact with one another to influence technological innovation decision-making (such as the adoption of Free and Open Source) and impact on organizational performance (Dedrick & West, 2004).

While this paper came up with investigative and strong emphasis of four factors positively or negatively affecting the adoption and use of FOSS towards the Individual-Technological –Organizational- Environmental (ITOE)

framework in higher learning institutions as described in fig 1: The common trend is that the influence in adoption and use of FOSS is not the same as in other software and a change has to happen within the ITOE in order to successfully make decision based on FOSS.

### Positive Factors perspectives

#### Individual Factors

- **Clear Perception of new technology on IT staff and Decision Makers:** The quality and consistency of the messages regarding FOSS which are received by the IT staff and decision makers will influence positively their openness to considering FOSS as a viable solution (Buffett, 2014)
- **Staff awareness:** The implementation of new technology such FOSS in higher learning institution is influenced by the awareness of stakeholders such as staffs who are users of the FOSS. Staff should know the advantages and disadvantages of the FOSS. This information positively influences the adoption and use of the FOSS.

#### Technological factors

- **Autonomy for code modification:** a gain in autonomy for code modification offered by the Free and open source community is a factor influencing the adoption and use of the free open source software (West and Derrick, 2008; Fitzgerald, 2004; West and Derrick, 2004). Therefore, the success of Linux operating system makes the concept of open source software familiar to many institutions that deal with information and communication technology activities (Weber, 2004).
- **Low cost for FOSS:** Most of third world countries facing complex situations related to computer software that result in the use of pirated software products which are not secured at all (Bruggink 2003). The philosophy of free and open source technology lends itself to making technology available to the masses at relatively low cost compared to proprietary software (Kurume and Mbugua, 2012)
- **Technical characteristics:** This is a factor that seems to be significant in making decisions based on adoption such as, dependability, safety, worth, and performance (Morgan and Finnegan, 2007).
- **Trustworthiness:** The reduced complexity of the trusted computing base (TCB) decreases the probability of failures during the development and maintenance process, which in turn increases the trustworthiness of the implementation. In addition, the proposed architecture allows a cost-effective evaluation according to security standards, e.g., the Common Criteria, because security-critical is changing only rarely (Stuble, 2006: Wheeler, 2003: Tong, 2004).

- Concerns regarding licensing and Scalability: It can be installed on a machine and then obtain and install many other freely distributed software programs to make a complete installation, for example, Linux. These installations are usually referred to as Linux systems, because they consist of much more than just the kernel. Most of the utilities come from the GNU project of the free software foundation (Mathew and Stones, 2009).

#### Organizational factors

- Organization awareness: Adoption of FOSS requires an organizational change. Internal barriers must be addressed, governance introduced, risks identified and managed on a case by case basis, skills and knowledge imparted on the teams who will be affected, support for the initiative built up, purchasing policies adapted (Buffett, 2014). As indicated by Forrester (2007), once an organization has transitioned from considering FOSS to adopting FOSS and then to adopting FOSS for a large number of business capabilities, FOSS becomes an integral part of the business and is considered in parallel with other options, such as commercial software.
- Organization Standards/Policies: the promising standards and policies towards adoption and use of FOSS is a major factor, for example, many Tanzania higher learning Institutions have clear standards and policies which affect positively the adoption and use of FOSS.

#### Environmental Factors

- Collaboration and knowledge sharing: The global open source community provides opportunities for South-North and South-South collaboration and knowledge sharing a place to share all the initiatives across the continent (Kurume and Mbugua, 2012).
- Social economic and Political: According to Weber (2003), countries with a variety of socioeconomic and political backgrounds are making steady advances in FOSS adoption and use in a particular higher learning institution.
- Collaboration on International ICT Policy: Collaboration on international ICT policy is a factor which catalyses the environment of adopting and use of FOSS for East and Southern Africa (Kurume and Mbugua, 2012). For example, by the year 2005, 15 countries in Africa had initiated some FOSS policy activities.

#### Negative Factors perspectives

##### Individual factors

- Low confidence*: Low confidence on open source software is one of the issues that add cost because many higher learning institutions opt to use commercial software because they are not sure of the FOSS future (UKEssay, 2014).

- Lack of technical Support and expertise based on FOSS*: Higher education institutions in Tanzania still use proprietary software in teaching different application as well as programming subjects using Microsoft supported languages which results in too many graduates having the understanding of Microsoft products only. This situation results in lack of technical support based on open source software that is cheap and promotes creativity among users for it allows modification of source codes (Lwoga, et. al., 2006).
- Adequate capacity to implement, use and maintain*: There is need for adequate trained people to support and use the FOSS solution. Training of users and developers should be a high priority (Reijswoud and Mulo. 2012).
- Lack of Awareness*: The *personnel reluctance* to switch from traditional methods of doing different activities such as teaching to technology oriented approaches. The problem is on how to implement and adopt the use of the FOSS, for example, in e-Learning system in Tanzania. Most academicians are satisfied with the way they conduct lectures and interact with students (Lwoga et. al., 2006).
- Staff fear and Resistance against FOSS: Most of individual staff fears to loose or they feel difficult to acquire new skill on the FOSS. In addition Johnston and Seymour (2005) mention that the South African public sector finds it difficult to upgrade skills of staff members because of resistance to change.

#### Technological Factors

- Low bandwidth* in the connectivity and speed of delivery systems in most of the higher learning institutions in Africa. For example, SUA's bandwidth is as low as 256kbps downlink and 128kbps uplink to link to the Internet. this is also the factor which hinder the adoption and use of FOSS, as it is the FOSS that can be used in many aspects such as in e-learning (Lwoga et. al., 2006)
- Lack of Supporting Technology*: In many institutions in third countries like Tanzania they lack supporting technology towards the FOSS implementation such software hinders the adoption and use the so called FOSS

#### Organizational Factors

- Total Cost Ownership*: TCO refers to all costs associated with the use of computer hardware and software, including the administrative costs, license costs, hardware and software updates, training and development, maintenance, technical support and any other associated costs in most higher learning institutions the affording the cost is a problem (Sterling, 2003: Lwoga et al., 2006).
- Proper Plan/IS/IT Strategy*: The absence of proper plans towards adopting free and open



source software is one of constraints in utilizing opportunities of FOSS in many higher learning Institutions (UKEssay, 2014)

#### Environmental Factors

- Complexity - difficulty to implement or manage, due to insufficient infrastructure that supports the implementation such as consistent power supply, supporting soft Policy support for a FOSS strategy: Support for FOSS needs to be extended to all key players at governmental level, departmental level, IT professionals and computer users in general (Reijswoud and Mulo. 2012).
- Unfit for purpose: ability to meet business goals and environment are different kinds of FOSS with different characteristics; hence, it should adhere and fit to the purpose intended, that is to say, to install it where it is going to be utilised, otherwise it is useless within the organization.

### 3. THE RATIONALE FOR ADOPTION AND USE OF FOSS IN HIGHER LEARNING INSTITUTIONS

The use of Free and Open source software has been treated as useful for the past few years and popularity of Open-source exploded among consumers and developers (Still 2005 pp. 791, cited in Hentea 2006). Open source is publicly available and developers can reuse the code and refine it to create more complex and better software. In addition to that, free and open source movement is one among other organizational or societal institutions where most software is developed (Shah and Kesan as cited in Hentea, 2006). Free and Open-source movement has developed software such as Linux operating system, Apache, Web server, MYSQL database management system, the script language Perl and the popular mail server; send mail that rivals with commercially available software (Wheeler as cited in Hentea, 2006). In addition, Free and Open-source is changing the way the software code is produced and developed. Free and Open-source (FOSS) is a new business model that is appearing to non-profit government entities established policies to adopt Open source whenever possible (Wheeler as cited in Hentea, 2006).

The characteristics of Open-Source software such as cost, easy available; easy of learning are distinct attributes that are preferable in a Higher learning institutions when compared to commercial software products. Also report indicates that Open source for security protection is often more reliable commercial software (Wheeler, 2005). Linux is an operating system that is superior in base security, applications security, and opens standards compared to Micro-soft windows (Wheeler as cited in Hantea, 2006). Additional advantages is that Open-source products can be modified by users and protect its users from the risks and disadvantages of single source of solutions.

Scalability performance, are better features with the Free and Open-source than other software like commercial

products. For example Open-source software vulnerability scanner Nessus was found to be the most effective tool among other seventeen tools that were evaluated (vulnerability as cited in Hantea, 2006). Free and Open-source software has been proposed in the revised Information Technology curriculum (Malluk as cited in Hantea, 2006) in terms of tool, laboratory software and ingredient for learning in higher learning institutions.

With the free and Open Source Software, the students can learn how to analyses and solve security problems (Tong, 2004). In addition, laboratory projects using FOSS, teaching information's security concepts provide students with the advantage for learning the most current technologies and problem solving skills as well as designs and easy implementations of security architectures (Tong, 2004). The freedom to experiment with various Free and Open-source software products for security laboratory projects stimulate students learning and creativity especially in higher learning institutions than commercial software's (for example, Microsoft windows family). Moreover, Free and Open source is used successfully in university environments to setup a web based online conference (Halstead as cited in Hantea, 2006) or support web information management (Cartelli as cited in Hantea, 2006).

### 4. METHODOLOGY

The source of this data was a questionnaire which comprised of structured questions, using a five-point Likert Scale, where 1=strongly disagree and 5=strongly agree. The questionnaire was developed on the basis of the issues identified through the depth literature review and discussion with the HLIs stakeholders. An open ended question to mention any other relevant HLIs integration issues was also provided at the end of the questionnaire. Negative statements on the instrument were codified in SPSS to avoid confusion and different interpretation of results.

The population sample for the study was all HLIs stakeholders in Tanzania. Participants included both public and private hospitals and health clinics. Out of 650 questionnaires sent to the HLIs professionals, asking them to respond, 570 questionnaires were returned, giving a response of 87%. The respondents were asked to mark the response which best described their level of agreement with the statement. From 570 questionnaires, 560 were considered useful for analysis, giving a response of 98%

### 5. RESULTS AND DISCUSSION

Responses to the survey questions were categorized into positive and negative factors influencing the adoption and use of FOSS in HLIs are summarized in table 1, 2, 3, 4, 5, 6, 7 and 8. The findings of the study identified the challenges; hence, different respondents gave their views on HLIs, in a form of a table, some respondents disagreed, neither agreed nor disagreed, strongly disagreed, agreed and strongly agreed.

## Positive Factors

### 1. Individual

Individual (+) FACTORS	Disagree	Neither disagree	agree or Strong Disagreed	Agree	Strong Agree
Perception on New technology	0 (0%)	11(3.91%)	78(0.87%)	190 (24.78%)	281 (70.43%)
Staff Awareness	38(6.42%)	57(10.18%)	98(17.5%)	101(18.04%)	266(47.5%)

**Table 1: Individual (+) factors towards Adoption and Use the FOSS**

The results show that 281 (70.43%) and 190 (24.78%) of respondents agreed strongly, agree respectively on the Perception of New technology that influenced positively the adoption and use of FOSS. Were only 266 (47.5%) and 101 (18.04%) of respondents who strongly agreed and agreed, respectively, that staff awareness influenced the adoption and use of FOSS. On the other hand, the results further indicate that (0%), 78 (0.87%) of respondents

disagreed, strongly disagreed respectively on the Perception of New technology while 38 (6.42%), 98 (17.5%) of respondents disagreed and strongly disagree respectively on staff awareness. Therefore the findings further indicate that Perception on New technology influenced the adoption and use of FOSS more followed by staff awareness as per Table 1.

### 2. Technological

Technological (+) factors	Disagree	Neither agree or disagreed	Strong Disagreed	Agree	Strong Agree
Low cost for FOSS	0 (0%)	9(1.61%)	2(0.36%)	57 (10.17%)	492 (87.85%)
Autonomy for code modification	2(0.36%)	17(3.04%)	4(0.71%)	101(18.04%)	436(77.85%)
Technical characteristics	9(1.61%)	38(6.79%)	32(5.71%)	81(14.46%)	400(71.42%)
Trustworthiness	12(2.14%)	27(4.82%)	81(14.46%)	74(13.21%)	366(65.36%)
Licensing and Scalability	13(2.32%)	36(6.43%)	27(4.82%)	96(17.14%)	288(51.43%)

**Table 2: Technological (+) factors towards Adoption and Use the FOSS**

The results show that 492 (87.85%) and 57 (10.17%) of respondents agreed strongly and agree respectively that low cost of FOSS influenced positively the adoption and use of FOSS while only 436(77.85%) and 57 (10.17%) of respondents strongly agree and agreed respectively that autonomy for code modification influenced the adoption and use of FOSS. On the other hand, the results further indicated that 400 (71.42%) of respondents strongly agreed

on technical characteristics which was followed by 366 (65.36%) and 288 (51.43%) who agreed on Trustworthiness and Licensing/Scalability respectively. Therefore the findings indicate that low cost and autonomy for code modification are key factors in the aspect of technological influence positively influencing the adoption and use of FOSS followed by Technical characteristics, Trustworthiness and Licensing as per Table 2

### 3. Organizational

Organizational (+) factors	Disagree	Neither agree or disagreed	Strong Disagreed	Agree	Strong Agree
Organization awareness	2 (0.36%)	20(3.57%)	18(3.21%)	181 (32.32%)	339 (60.53%)
Organizational Standards/ Policies	12(2.14%)	17(3.04%)	40(7.14%)	167(29.82%)	324(57.87%)

**Table 3: Organizational (+) factors towards Adoption and Use the FOSS**

The results show that 339 (60.53%) and 181 (32.32%) of respondents agreed strongly and agreed respectively on the Organization awareness that influenced positively the adoption and use of FOSS. Meanwhile, only 324 (57.87%) and 167 (29.82%) of respondents strongly agreed and agreed respectively that Organizational Standards/ Policies influenced the adoption and use of FOSS. On the other hand, the results further indicate that 2 (0.36%), 18

(3.21%) of respondents disagreed and strongly disagree on the Organization awareness. While 12 (2.14%) and 40(7.14%) of respondents disagreed and strongly disagreed respectively on staff awareness. Therefore the findings indicate that Organizational Standards/ Policies influenced the adoption and use of FOSS, which was followed by staff awareness as per Table 3.

#### 4. Environmental

Environmental (+) factors	Disagree	Neither agree or disagreed	Strong Disagreed	Agree	Strong Agree
Collaboration and knowledge sharing	04 (0.71%)	10(1.79%)	17(3.04%)	180 (32.14%)	349 (62.32%)
Collaboration on International ICT Policy	9(0.87%)	17(7.39%)	15(1.74%)	177(43.91%)	342(46.09%)
	13(2.32%)	20 (3.57%)	19 (3.39%)	189(33.75%)	319 (56.96%)

**Table 4 Environmental (+) factors towards Adoption and Use the FOSS**

The results show that 349 (62.32%) and 180 (32.14%) of respondents agreed strongly and agreed respectively on the Collaboration and knowledge sharing that influenced positively the adoption and use of FOSS. While only 342 (46.09%) and 177 (43.91%) of respondents strongly agreed and agreed respectively that Collaboration on International ICT Policy influenced the adoption and use of FOSS. On the other hand, the results further indicated that 04 (0.71%) and 17(3.04%) of respondents disagreed and strongly

disagree respectively on the Collaboration and knowledge sharing. While 9 (0.87%) and 15(1.74%) of respondents disagreed and strongly disagreed respectively on Collaboration on International ICT Policy. Therefore the findings indicate that Collaboration and knowledge sharing and Collaboration on International ICT Policy influence the adoption and use of FOSS more followed Social economic/politics in environmental aspect as per Table 3.

#### Negative Factors

##### 1. Individual

Individual (-) factors	Disagree	Neither agree or disagreed	Strong Disagreed	Agree	Strong Agree
Staff fear and Resistance against	0(0%)	12(0.21%)	3(0.54%)	2013(5.89%)	344(61.42%)
Total Cost Ownership (TPC)	1 (0.18%)	30(5.36%)	12(2.14%)	190(33.92%)	327 (58.39%)
Lack of Technical staff & expertise	4(0.71%)	17(3.04%)	4(0.71%)	200(35.71%)	335(59.82%)
Adequate capacity to implement, use and maintain	10(1.798%)	17(3.04%)	13(2.32%)	199(35.54%)	321(57.32%)
Lack of awareness	17(3.04%)	27(4.82%)	81(14.46%)	188(33.57%)	247(44.11%)

**Table 5: Individual (-) factors towards Adoption and Use the FOSS**

The results show that 344 (61.42%) and 2013(5.89%) of respondents agreed strongly and agreed respectively on Staff fear and Resistance against FOSS that influence negatively the adoption and use of FOSS. While only 327 (58.39%) and 190 (33.92%) of respondents strongly agreed and agreed respectively that the higher the Total Cost Ownership (TPC) influence negatively the adoption and use of FOSS. On the other hand, the results further indicate that 335 (59.82%) of respondents strongly agreed on Lack of Technical staff & expertise followed by 366

(65.36%) and 247 (44.11%) adequate capacity to implement/use and maintain, lack of awareness, respectively. Therefore the findings indicated that Staff fear and Resistance and Total Cost Ownership (TPC) are the key factors on individual negative influence in adopting and using FOSS, which was followed by Lack of Technical staff and expertise, Adequate capacity to implement, use and maintain and Lack of awareness as indicated in Table 5.

##### 2. Technological

Technological (-) factors	Disagree	Neither agree or disagreed	Strong Disagreed	Agree	Strong Agree
Lack of supporting technologies	0 (0%)	9(1.61%)	2(0.36 %)	91 (16.25%)	458 (81.79%)
Low bandwidth	2(0.36%)	17(3.04%)	4(0.71%)	101(18.04%)	436(77.85%)

**Table 6: Technological (-) factors towards Adoption and Use the FOS**



The results show that 458 (81.79%) and 91 (16.25%) of respondents agreed strongly and agreed respectively on the Lack of supporting technologies that influenced negatively the adoption and use of FOSS. While only 436 (77.85%) and 101 (18.04%) of respondents strongly agree and agreed respectively that *Low bandwidth* influenced negatively the adoption and use of FOSS. On the other hand, the results further indicated that 0(0%), 2(0.36 %) of

respondents disagreed and, strongly disagreed on the Lack of supporting technologies while 2(0.36%) and 4(0.71%) of respondents disagreed and strongly disagree respectively on *Low bandwidth*. Therefore the findings indicate that Lack of supporting technologies influence negatively the adoption and use of FOSS, which is followed by *Low bandwidth* p as in Table 6.

### 3. Organizational

Organization (-) factors	Disagree	Neither agree or disagreed	Strong Disagreed	Agree	Strong Agree
<i>In Proper Plan/IS/IT Strategy</i>	2(0.36%)	17(3.04%)	4(0.71%)	111(19.82%)	426(76.07%)
<b>Total Cost Ownership</b>	8(1.43%)	27(4.82%)	10(17.85%)	190(33.92%)	325(58.04%)

**Table 7: Organization (-) factors towards Adoption and Use the FOSS**

The results show that 426 (76.07%) and 111 (19.82%) of respondents agreed strongly and agreed respectively on improper Plan/IS/IT Strategy that influenced negatively the adoption and use of FOSS. Meanwhile, only 325 (58.04%) and 190 (33.92%) of respondents strongly agreed and agreed respectively that Total Cost Ownership influenced negatively the adoption and use of FOSS. On the other hand, the results further indicate that 2 (0.36%), 4

(0.71%) of respondents disagreed and strongly disagreed on improper Plan/IS/IT Strategy while 8 (1.43%), 10 (17.85%) of respondents disagreed and strongly disagreed respectively on Total Cost Ownership. Therefore the findings indicated that improper Plan/IS/IT Strategy influence negatively the adoption and use of FOSS, which is followed by Total Cost Ownership as in Table 7.

### 4. Environmental

Technological (-) factors	Disagree	Neither agree or disagreed	Strong Disagreed	Agree	Strong Agree
<b>Unfit for Purpose</b>	3 (0.54%)	9(1.61%)	3(0.54%)	89 (15.89%)	456 (81.43%)
<b>Complexity</b>	11(1.96%)	19(3.39%)	4(0.71%)	201(35.89%)	235(41.96%)

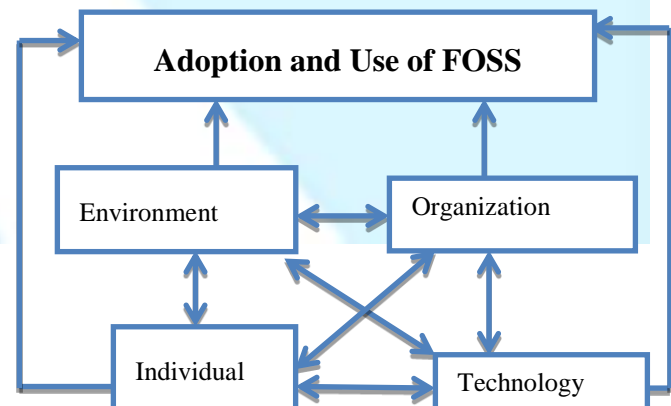
**Table 8: Environmental (-) factors towards Adoption and Use the FOSS**

The results show that 456 (81.43%) and 89 (15.89%) of respondents agreed strongly and agreed respectively on the Unfit for Purpose that influence negatively the adoption and use of FOSS. Whereby, only 235 (41.96%) and 201 (35.89%) of respondents strongly agreed and agreed respectively that Complexity influenced negatively the adoption and use of FOSS. On the other hand, the results further indicate that 3 (0.54%), and 3 (0.54%) of respondents disagreed and strongly disagreed on the Unfit for Purpose while 11 (1.96%) and 4 (0.71%) of respondents disagreed and strongly disagreed respectively on Complexity. Therefore the findings indicate that unfit for Purpose influence negatively the adoption and use of FOSS, which is followed by complexity as indicated in Table 8.

#### The Proposed Individual-Technology-Organization-Environmental (ITOE) Framework for FOSS Adoption and Use

Different studies such as (Dedrick and West, 2004) proposed the TOE model which defines a “context for change” consisting of the three main elements such as Technology, Organization and Environmental, which influence technological innovation decision-making (such as the adoption of Free and Open Source) and (impact on

organizational performance) directly. The model has the following weaknesses: First, it does consider the individual factor as one of the crucial factors in the aspect of context of change. Second, each factor is treated independently and directly influences the adoption of FOSS, which is not true in the context of change. Thirdly the model considers only the adoption of FOSS and not the use of FOSS. Therefore, this study proposed ITOE framework which is the general context for change consisting 4 main elements.



**Fig: 1 the Proposed ITOE Framework (Researchers, 2014)**

These factors depend on each other towards influencing the adoption and use of FOSS in higher learning Institutions. For example, implementing FOSS as a new technology depends on a clear environment such as infrastructures that supports the new technology. On the other hand, to create good environment also need new technology as two-arrow indicates in Fig. 1.

## 5. CONCLUSION & RECOMMENDATION

The study discovered that there are promising adoption and use of Free and Open Source Software (FOSS) in Higher Learning Institutions. Apart of discovering more factors influencing the adoption and use of FOSS, this study has proposed Individual-Technology-Organization-Environmental (ITOE) framework. This will lead higher learning institutions to consider FOSS as helpful in teaching and learning activities and therefore have positive factors influencing the adoption and use the FOSS in teaching and learning process. Similarly the study has shown on how the four factors in ITOE frame work depend upon each other and the drawback needs to be addressed in order to have positive factors towards adoption and use of FOSS.

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