Diffusion of free/open source software as innovation: A case study of METU

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April 8, 2005

Abstract

In this research, the diffusion of free and open source software (FOSS) on desktop PCs at Middle East Technical University in Ankara (METU) is investigated within the framework of the diffusion of innovation theory. This work aims to propose some policies for the migration to FOSS on desktop PCs at METU. The research is conducted through two similar web-based surveys. The first survey was held during 27-28 September 2003 after the examination of exemption for the IS100 course. The second survey was held between 23 March and 24 May 2004 in the whole of the METU campus. This survey was open to all students and academic and non-academic staff with a METU network account. There were 402 participants in the first survey and 1224 in the second. As expected, Microsoft OS rules the desktop PCs within the METU campus. According to the surveys, there is a rather large PC user base which could potentially migrate to GNU/Linux system. In addition to a large amount of data, it has been found out that a migration to FOSS is welcomed greatly by the users if the process is explained on the basis of public economic gains. However personal migration is still difficult if the user is left alone to install any new OS. Activities which will eventually increase the awareness for FOSS at METU, change in the curriculum of the IS100 course, collaboration among METU FOSS users and creation of a software catalog with possible FOSS equivalent for METU courses are some of the propositions which will eventually help the migration process. Furthermore, different innovation-decision models are discussed based on the research findings.

1 Introduction

Many innovations require a lengthy period of time to be adopted. The main problem is, "how to speed up the rate of diffusion of an innovation". This section is mainly based on Rogers's book "Diffusion of Innovation"(Rogers, 1995, 1-130, 405-442).

According to Rogers (1995), diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system. Diffusion is a special type of communication in which the messages are about a new idea. Due to this "newness", diffusion has some degree of uncertainty. When new ideas are invented, diffused, and are adopted or rejected, they lead to certain consequences, such as social change. Many technologists believe that if an innovation has certain advantages and that an innovation would sell itself; but often this is not the case. In fact, most innovations diffuse in a rather slow rate or they never reach a user base. One example is the control of the scurvy in the British Navy, which took nearly 150 years after its reasons and cure have been understood. Another well-known example is the non-diffusion of the Dvorak keyboard in the U.S., which

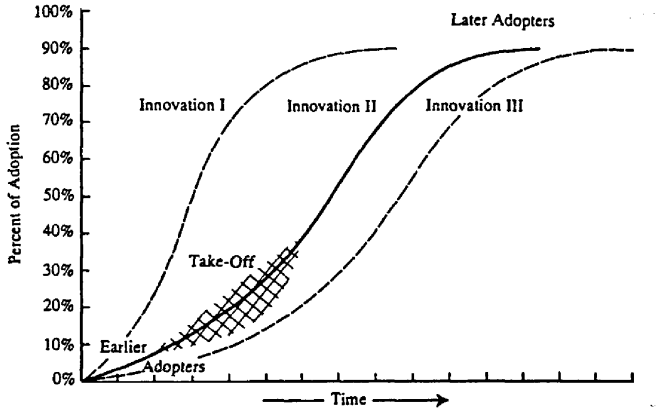

Figure 1: Diffusion of Innovation Models (Rogers, 1995)

is more efficient than the "QWERTY" keyboard. This example could be extended to Turkey as the very low acceptance and usage of the "F" Turkish keyboard on PCs despite the fact that this type of keyboard has been the standard for all typewriters for many decades.

1.1 The Four Elements in the Diffusion of Innovation

The four elements in the diffusion of innovation are innovation, communication channels, time, and the social system. The adoption rate of an innovation is shown in Figure 1.

The Innovation: An innovation is an idea, practice or object that is perceived as new by an individual or group of individuals. If the idea seems new to the individual, it is an innovation. Newness of an innovation may be expressed in terms of knowledge, persuasion or a decision to adopt (Rogers, 1995).

A technology usually has two components:

1. Tools embedded within technology: hardware.
2. The information-base: software.

The social embedding of the software of a technology is less visible than its machinery or equipment, and so the technology is often thought mainly in hardware terms.

Characteristics of Innovation:

1. Relative advantages -economic terms, social prestige, convenience and satisfaction- are the degree to which an innovation is perceived as better than the precedent ideas.
2. Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters.
3. Complexity is the degree to which an innovation is perceived as difficult to understand and use.
4. Trialability is the degree to which an innovation may be experimented with on a limited basis.
5. Observability is the degree to which the result of an innovation are visible to others.

Communication Channels: A communication channel is the means by which messages get from one individual to another. Mass media efficiently informs an audience of potential adopters about the existence of an innovation, that is, it creates awareness-knowledge. But interpersonal channels are more effective in persuading an individual to accept a new idea, especially if these people are homophilious, i.e. similar in certain attributes, such as beliefs, education, social status etc. But the problem arises when the diffusion occurs within a heterophilious group which is often the case.

Time: The elements of time is also involved in diffusion.

- During the innovation-decision process by which an individual passes from initial knowledge of an innovation through its adoption or rejection.
- The innovativeness of an individual or other units of adoption, i.e. relative earliness/lateness of the adoption.
- Rate of adoption in a system, usually measured by the number of adopters in a given period of time.

The five main steps of the innovation-decision process are

1. knowledge,
2. persuasion,
3. decision,
4. implementation,
5. confirmation.

Knowledge occurs when an individual (or decision-making unit) gets some information about an innovation. Persuasion is the formation of a positive or a negative opinion for the innovation in question. Decision is made for the adoption or the rejection of the innovation. When the adoption is chosen, implementation begins. During the process of implementation the innovation starts to be used, after which, depending on the experience gained, confirmation occurs when the innovation-decision reaches its target.

A Social System: A social system is defined as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems. The four distinct units making up the social system are listed below:

Norms: Established behavior patterns for the members of a social system.

Opinion leaders: Those who are at the center of interpersonal communication networks.

Change agents: Individuals who influence clients' innovation-decisions in a certain direction.

Aides: People who intensively contact clients in order to influence their innovation-decisions, an aide is less than a fully professional change agent.

Types of Innovation-Decision

There are four types of innovation-decision processes, the last one of which is a combination of the first three innovation-decision types. These are listed below:

1. Optional innovation-decision: Choices made individually to adopt or to reject an innovation independent from other individuals in the system. But even in this case these decisions might be influenced by the norms and the interpersonal networks of the system.

2. Collective innovation-decision: Choices made with the consensus of all members of the system. Once a decision is reached, all members take the same action.

3. Authority innovation-decision: After certain choices are made by a decision maker, all the units of the system obey this decision.

4. Sequential combination of two or more of the above: Often an innovation-decision is taken with a combination of some of the above mentioned innovation-decision types.

Consequences of innovation are concerned with the adoption or the rejection of the innovation by the system or the individual. There are at least three kinds of consequences:

1. *Desirable vs. undesirable* consequences, depending on whether the effects of an innovation are functional or not.

2. *Direct vs. indirect* consequences, whether the changes occur in immediate response to an innovation or as a second-order result of the direct consequences of an innovation.

3. *Anticipated vs. unanticipated* consequences, depending on whether the changes are as expected or not.

Change agents usually expect that the innovation they introduce to the system will have desirable, direct and anticipated consequences. But even in a successful process of change there will always be some kind of undesirable, indirect and unanticipated consequences.

1.2 Critical Mass and Interactive Innovations

Critical mass is the point at which enough individuals adopt an innovation so that the further rate of adoption becomes self-sustaining. Critical mass is highly significant in the adoption of an interactive innovation such as electronic messaging systems, fax, and teleconferencing. The adoption of interactive innovations depends on the perceived number of individuals who have already adopted the innovation. An interactive innovation becomes useless if other individuals with whom the adopter wishes to communicate do not adopt that interactive innovation. With each new adopter, the utility of the interactive innovation increases. As seen from the Figure 2, the shape of the "S" curve for the rate of adoption of an interactive innovation differs from that of the usual innovation. In other words, the rate of adoption of an interactive communication does not take of like the familiar "S" shape until a critical mass of adopters is reached.

1.3 Criticism of Diffusion Research

Since 1970s some criticism started to take shape among the diffusion scholars. One of the most important shortcomings of research on the diffusion has been the pro-innovation bias. (Rogers, 1995) defines the pro-innovation as "the implication in diffusion research that an innovation should be diffused and adopted by all members of a social system, that it should be diffused more rapidly, and that the innovation should be neither re-invented nor rejected". The pro-innovation bias is seldom stated straightforwardly, often it is assumed and implied through the publications on diffusion. The reason behind the pro-innovation bias is that much diffusion research is carried out by change agencies. On the other hand, successful diffusions have the data which could be retraced by diffusion researchers, while efforts of unsuccessful diffusions do not leave much trace that can easily be reconstructed.

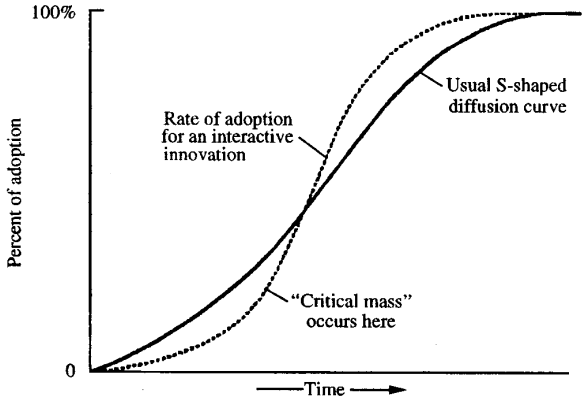

Figure 2: The Rate of Adoption (1) for a Usual Innovation, and (2) for an Interactive Innovation, Showing the Critical Mass (Mahler and Rogers, 1999)

Another criticism toward the diffusion research is the individual-blame bias, which is the tendency that the researcher take the "side" of the change agency, rather than that of the potential adopter. The problem arises because it is the potential adopter that is responsible for the situation, not the system.

There is another problem concerning the research methodology of diffusion of innovation. Often data is gathered through surveys, which ask the participant when he/she decided to adopt the innovation, yet he/she may fail to give the right answer. Through survey methodologies, only snapshots are collected since most diffusions involve processes that extend in time; a research mainly covers the sequential flow of events.

Diffusion researchers have not paid much attention to the consequences of innovation. The diffusion of innovation, often, widens the socioeconomic gap between the higher and the lower status segments of a system. But in the 1960s, the classical diffusion model started to be used by development agencies in Latin America, Africa and Asia for the proliferation of developing countries. In 1970 an intellectual shift occurred and a new criteria began to emmerge for the development of a just social structure (Rogers, 1995).

A highly significant criticism of the theory has been carried out by Flynn and Preston (1999). They question influential universal models of "theory-led" explanations of the diffusion in telephone systems with respect to the development of historical trajectory of telecommunications in Ireland from 1922 to 1998 with the empirical data. Flynn and Preston (1999) criticize Rogers's model for its "universalistic assumptions that innovations diffuse within a context marked by an autonomous or free market and that diffusion is driven by the demands of individual consumers freely exercising their market power". Flynn and Preston (1999) argue that through empirical studies, a robust theory could be developed by taking into account the role of social and institutional factors that shape the trajectory of diffusion.

2 Methodology of the Survey

According to Rogers, most of the diffusion research surveys have been conducted on potential adopters, and survey methods in diffusion research tends to "destructure human behavior" (Rogers, 1995). Web surveys became highly popular as the compatibility across web browsers increased and free or inexpensive softwares became available. According to Burkey and Kuechler (2003) web-based surveys do not have the same potential for bias that occurs in personal interviews.

Participants had considerable freedom in their answers; i.e., no one was forced to partici-

pate in the survey. When a questions was left unanswered, a notice popped up, reminding the participant to answer for the sake of the survey without forcing them to cover all questions.

In order to prevent inaccurate feedback through multiple responses, access to the surveys on the same IP was restricted. For the first survey which was done to students taking the examination of exemption for the IS100 course. As the second survey targeted the whole campus, the restriction was carried out by LDAP authentication.

The surveys were done with the PHP programming language, and answers were stored within a Postgresql database. Further, a web link was provided through the popular web-mail login page in order to encourage and increase the participation for the second survey. The survey was designed in a multiple pages with forking depending on the answers given. The forking of the survey were done on the basis of adopters behavior;

1. Those who adopted free software,
2. Those who will use free software (among those who are aware of FOSS),
3. Those who will not use free software (among those who are aware of FOSS),
4. Those who never used free software (among those who are aware of FOSS),
5. Those who never heard of what free software and/or open source softwares are.

Depending on the adopters' behavior, the survey consisted of 3 to 6 sequential web pages. The design of these web surveys mostly follows the outlines described by Burkey and Kuechler (2003).

Aims of the Survey: Two nearly identical surveys were held at different times. The reason behind the time difference was to understand METU's social contribution to the usage and diffusion of FOSS and to the PC usage habits by targeting different groups within the METU campus. There were different aims of these surveys, one of the most important was to understand the diffusion of the usage of FOSS OS and the reasons of adoption or rejection of the FOSS in METU. Furthermore, the survey also aimed to understand the desktop computer usage habits of all participants.

Test Subjects: Two web-based surveys have been carried out. The first one was done in 27-28 September 2003 after the examination of exemption for the IS100 course, which is taken by freshmen and the student of English preparatory class. It is designed to give the student enough knowledge of computing, word processing as well as using spreadsheets, which are unfortunately limited solely to Microsoft products. The aim of the course is to prepare the student to be self-reliant on his/her assignments which will be done on a PC. Students taking this exam consider themselves as computer-literate and try to exempt themselves from taking this course. The second survey was done during 23 March and 24 May 2004 within the whole of the METU campus. All students, staff, academics and others having a METU account, had the chance to participate in the second survey.

3 Results and Discussion of the Surveys

In this section results and discussion of both surveys will be presented. Firstly, general habits of PC usage and profiles of the participants will be revealed; secondly depending on the behavior of the participants' FOSS adoption, results will be discussed.

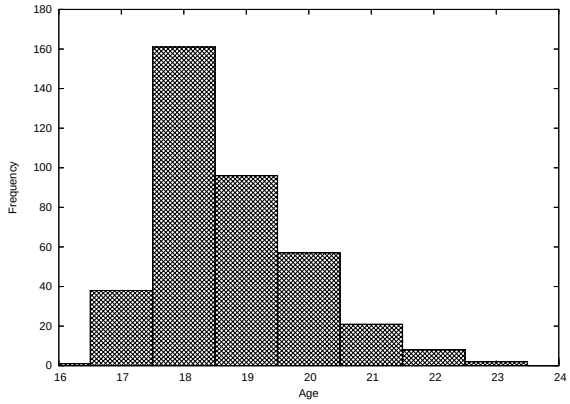

Figure 3: Age Distribution of Participants (First Survey)

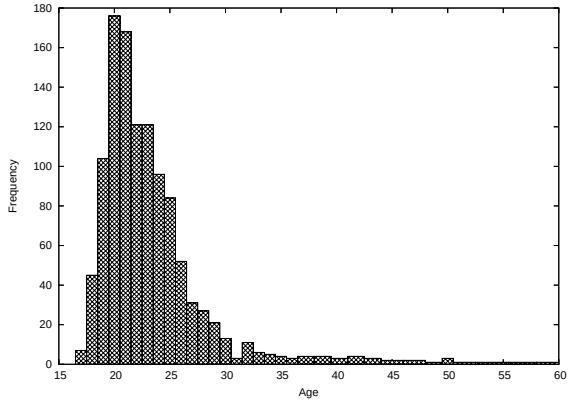

Figure 4: Age Distribution of Participants (Second Survey)

3.1 General Profile of Participants

There were 402 participants in the first survey and 1224 in the second one. The initial questions were on demography. This survey type also follows the conventional way of starting by asking the age of the participant. As predicted, the age average of the first survey was 18.8 and 23.2 in the second one. The age distribution is shown in Figure 3 for the first survey and the second survey's age distribution is shown in Figure 4. The difference is because the first survey was concerned with the freshmen, while the second one was open to the entire campus.

Sex distribution is also consistent within the first and the second surveys: 77.8% male and 22.2% female for the first survey, and 74.7% male and 25.3% female participation for the second one. There were no other choices provided for the question on gender.

In order to measure the social factors and effects of working and studying at METU, the first survey asked whether it was the participant's first year at METU or not. 61.3% of 388 participants who answered this question were in their first year of METU and the rest were not.

The titles of all participants are shown on Table 1, obtained from the second survey. As expected, undergraduate students are the most populated group. The participation of academics would not be high if research assistants did not consist 14.4% of the participants, while the total number of academicians represents 16.6% of the 1131 people in total who answered that question. But as expected, 66.9% of the participants are undergraduate

Table 1: Title Distribution of Participants (Second Survey)

	Frequency	Percentage
Undergraduate	757	66.9
Research Assistant	163	14.4
Master Student	123	10.9
Administrative Staff	39	3.4
Ph.D. Student	25	2.2
Teaching Staff	14	1.2
Prof. Dr.	4	0.4
Assist. Prof.	3	0.3
Assoc. Prof.	2	0.2
Specialist	1	0.1
Total	1131	100.0

Table 2: Computer Usage Experience of Participants (First Survey)

	Frequency	Percentage
1 year	43	11.1
2 years	27	7.0
3 years	48	12.4
More than 3 year	270	69.6
Total	388	100

students and the total number of all students (of both undergraduate and postgraduate levels) is 79.0%.

The experience of computer usage and the diffusion rate among participants are rather high compared to old but large scale surveys carried by TUENA[1] for the Ministry of Transportation's of Republic of Turkey: The Turkish National Information Infrastructure Masterplan report (**?**). For the first survey, answers were given in a pull down menu with four choices; the distribution is shown on Table 2. For the second survey, the answers was obtained through a text box for the same set of questions. The PC experience distribution of the second survey is shown in Figure 5. 69.6% of the participants of the first survey have computational experience for more than 3 years, and the average of the second survey's participants computer usage is 8.4 years. These results show that most of the students who participated in these surveys started to use computers before their entry to the university.

All computers at METU's computer laboratory (approximately consist of 500 PC) are dual boot (Microsoft XP and Mandrake Linux distribution). The participants were asked only in the second survey whether they had a computer which they could install and configure softwares to their own taste. 90.7% (of 1023/1128 people) were positive, while 9.3% (105/1128 people) were negative.

To find out the METU's social system of the participants within the context of the theory of diffusion it has been asked to state two sources where the participant gets any aid whenever he/she encounters any problem with their PCs. The most important answer for both surveys were friends. Friends, got 43.3 % of the answers of the first survey and 36.9% of the second survey. The Web is the second most important source to solve problems regarding PCs in both surveys. The whole distribution could be found on Table 3 The most important source of help given in the "other" choice is "a relative" (with 17 of 27 answers in the first and 15 of 70 in the second survey). But in the second survey, participants reveal

[1]Turkish National Information Infrastructure Project Office. http://tuena.tubitak.gov.tr/

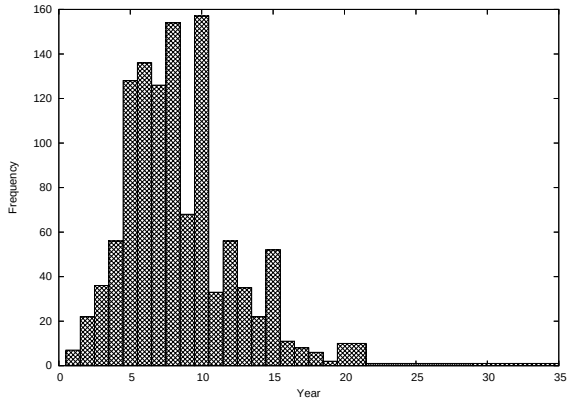

Figure 5: Distribution of PC Experience (year) of Participants (Second Survey)

with 17 answers that they solve their own problems by themselves, while the third choice is "technical support" provided by the PC vendor (with 11 of 70 answers).

As predicted, the OS distribution was in the favor of Microsoft products. After six years of its launch, the mostly used operating system by the first survey's participants was still Windows 98 with 40.5% of all answers. The distribution of the first survey's participants who used OS is shown in Table 4. On the other hand, OS usage varied in the second survey where Microsoft products still lead but GNU/Linux OS has its share with 5.9% and BSDs consist of 0.2%, making FOSS users 6.1% of valid answers. Windows XP was the leader with 63.7% usage within the second survey's participants which might also show the difference of hardware quality from that of the first survey's participants, where Windows XP share was 37.2%. On the other hand, Windows 98 is still important among the participants of the second survey, being the second most used OS with 18.7%. Answers regarding Windows 98 are quite interesting since it is not supported anymore, and users are often forced to upgrade their operating system as well as their hardware due to the increase of needed resources required by newer Microsoft products. This user group could be persuaded to migrate to GNU/Linux products which does not require much resource if well configured. Moreover, the process to migration from Windows 98 to XP might be as difficult as the migration process from Windows to GNU/Linux. The distribution of the second survey's OS usage is shown in Table 5.

The usability of a computer has become one of the most important areas of research. When the participants were asked if they were satisfied with their operating systems, results from the first survey were as follows; 12.3% were not satisfied, 22.3% had no idea and 65.5% were satisfied (out of 391 answers). And according to the second survey: 71.7% were satisfied, 10.4% were not satisfied and 17.9% had no opinion.

The analysis of the cross-tab distribution in the second survey concerning the level of satisfaction of OS vs.the OS used is not included in the first survey where nearly all participants use Microsoft products. From these results it is easily seen that 95.2% of GNU/Linux users are satisfied, while 73.2% of XP users, 61.3% of Windows 98 and 67.3% of Windows 2000 are satisfied with their OS used. By adding the percentage of the group which expressed uncertainty concerning their satisfaction with the group which are not satisfied, it gives a user base (of 26.8% of XP, 38.8% of Windows 98 and 32.7% of Windows 2000 users) which could be a good target with a great potential for a conversion to GNU/Linux. Two participants who use BSD, stated that they were satisfied with their OS.

The upgrading of an OS to a later version could lead to certain undesirable and unpredictable consequences, such as problems related to hardware drivers or some backward compatibility. Backward compatibility is one of the main assets for the open source softwares and a major target of criticism concerning Microsoft products. But the main challenge

Table 3: Sources of Help Regarding PC (First Survey)

	Frequency (1st survey)	Percentage (1st survey)	Frequency (2nd survey)	Percentage (2nd survey)
Friends	302	43.3	805	36.9
Web	114	16.3	536	24.6
Professional support	108	15.5	115	5.3
Books	24	3.4	39	1.8
Documentation on the installation CDs	58	8.3	187	8.7
Students	–	–	83	3.8
Department's PC coordinator/CC Staff	–	–	164	7.5
Does not need any help	65	9.3	183	8.4
Other	27	3.9	70	3.2
Total	698	100	2182	100.0

Table 4: The Operating System Used by Participants (First Survey)

	Frequency	Percentage
Windows 98	159	40.5
XP	146	37.2
Windows 2000	46	11.7
DOS	21	5.3
Windows 95	13	3.3
Linux	6	1.5
Unix derivatives	1	0.3
Macintosh	1	0.3
Total	393	100.0

Table 5: The Operating System Used by Participants (Second Survey)

	Frequency	Percentage
XP	677	63.7
Win98	199	18.7
Win2000	107	10.1
Linux	63	5.9
Other	8	0.8
Win95	4	0.4
BSD (Free/Net/Open)	2	0.2
Win3.1	2	0.2
Macintosh	1	0.1
Total	1063	100.0

Table 6: Cross-tab of OS Downgrade vs. the OS Used (First Survey)

used OS		downgraded or not?		Total
		No	Yes	
Microsoft OSs	Frequency	270	111	381
	% within the used OS	70.9	29.1	100.0
	% within the downgrade	98.2	99.1	98.4
GNU/Linux	Frequency	5	1	6
	% within the used OS	83.3	16.7	100.0
	% within the downgrade	1.8	0.9	1.6
Total	Frequency	275	112	387
	% within the used OS	71.1	28.9	100.0

Table 7: Cross-tab of OS Downgrade vs. the OS Used (Second Survey)

used OS		downgraded or not?		Total
		No	Yes	
FOSS OS	Frequency	48	17	65
	% within the used OS	73.8	26.2	100.0
	% within the downgrade	6.3	5.8	6.2
Microsoft OSs	Frequency	710	278	988
	% within the used OS	71.9	28.1	100.0
	% within the downgrade	93.7	94.2	93.8
Total	Frequency	758	295	1053
	% within the used OS	72.0	28.0	100.0

is to do with the change of users' habits, which they gain from the earlier versions. Such problems sometimes result in the immediate downgrading of the newly installed software. It was obvious from the start that Microsoft products dominate the METU campus. Hence, in order to find out whether such Microsoft upgrades are problematic or not, the survey also asked whether the participant downgraded his/her operating system after an upgrade. The cross-tab of downgrade vs. OS for the first survey is displayed on Table 6. Both surveys presented approximately the same result for this problem; those who downgraded to the previous version consisted of 28.9% (out of 387 answers) in the first survey and 28.0% (out of 1063 answers) in the second one. Furthermore, the downgrade rate among Microsoft OS users in the first survey is 29.1% and in the second survey, 28.1%. These results show that FOSS OS users tend not to downgrade as much as Microsoft users. The cross-tab of downgrade vs. OS for the second survey is on Table 7. If these individuals downgrade their OS due to backward compatibility or hardware problems, this creates another potential target for the free, open source software migration.

In order to describe more precisely the social and communicative systems of computer usage at METU, questions regarding software providers were asked. In the answers, nearly the same total percentage in both surveys was obtained as regards the illegal ways of software procurement. These illegal ways consist of friends, ambulant street vendors (who are in fact just sellers of often pirated software copies) and peer to peer programs which aid to share files and software on the Internet. In the first survey, the total percentage of these three sources is 60.3% and in the second, 56.1% of participants. As Table 8 and **??** display, friends constitute the most important routes in obtaining software. This question was answered by ticking the listed sources, which were not limited to any number of choices.

The objective to find out how FOSS is generally perceived and how the participants

Table 8: Software Providers

	Frequency (1st survey)	Percentage (1st survey)	Frequency (2nd survey)	Percentage (2nd survey)
Friends	188	35.2	545	30.1
Preinstalled on the PC	134	25.1	381	21.1
Ambulant street vendors	77	14.4	271	15.0
P2P programs	57	10.7	199	11.0
Authorized sellers	45	8.4	61	3.4
School/work, university	27	5.1	244	13.5
GPLed software	6	1.1	103	5.9
Total	534	100.0	1808	100.0

might respond to different innovation-decision process led to three Lieckert type propositions, results are given on Table 9. For an evaluation, inclinations were calculated for each proposition. All answers had a value starting from one to five, where the answer "Absolutely no" had a value of 1 and "Absolutely yes", of 5. Number of answers were multiplied by their corresponding value and the sum was divided into the total number of answers that showed an inclination for the Lieckert type proposition.

Answers for the first proposition is encouraging for the process of migration within public places such as libraries, possible public kiosks (which are still not that popular in Turkey) and computer laboratories, if the economical ramifications are explained to users with clarity and precision.

When results given for the first and the second propositions are compared, it can be seen that personal economical gain is more important for freshmen students than for the public; and in the second survey, participants expressed the same view/opinion. From these results it might be concluded that a personal and public migration policy designed on economic grounds would be effective.

The inclination for the third proposition was 3.26/5 in the first survey and 3.04/5 in the second one. Thus, participants did not appear to have a strong inclination to either "way", revealing that personal migration would unlikely difficult if the user is left alone with no help during any installation process, even just to try any FOSS OS. However, if the users are informed that there are various Live CD options, the trialability of the innovation could be carried out without hesitation or fear.

The first step in the innovation-decision process is knowledge. In order to assess this, the participants were asked whether they have ever heard of free softwares, open source software concepts. The distribution for the surveys is given on Table 10 The awareness of innovation i.e. to the free, open source softwares in the first survey is 40.5%, and in the second one, 77.1%. While the first survey targeted mainly the freshmen, their answers seem to indicate that within METU's social system, the greater the computer usage experience, the higher the awareness of innovation.

After this question the first forking within the survey occurs. For those who have not heard of FOSS concepts, the survey ends. Until that point, the difference between the first and the second surveys is the demographic questions such as those concerning the section to which they belong as well as personal/professional/academic titles of the participants.

Table 9: Three Lieckert Type Propositions

	Number of answers (first survey)	Inclination, over 5 (first survey)	Number of answers (second survey)	Inclination, over 5 (second survey)
Public sector should consider solutions other than software which have a licensing fee.	384	3.69	1060	3.99
As a personal user I should consider other solutions than software which have licensing fees (i.e. Microsoft products) in order to decrease my own expenditure.	385	4.30	1057	3.99
I am afraid of losing data while installing new software on my computer.	381	3.26	1057	3.04

Table 10: Distribution of Participants Who Have Heard of the Concepts of FOSS

	Frequency (1st survey)	Percentage (1st survey)	Frequency (2nd survey)	Percentage (2nd survey)
No, never heard	234	59.5	245	22.9
Yes, heard of the concepts	159	40.5	823	77.1
Total	393	100.0	1068	100.0

Table 11: Communication Channels of the FOSS Concepts

	Frequency (1st survey)	Percentage (1st survey)	Frequency (2nd survey)	Percentage (2nd survey)
Friends	58	35.8	259	32.3
Internet	52	32.1	355	44.2
Printed press	39	24.1	121	15.1
Television	5	3.1	7	0.9
Courses	2	1.2	32	4.0
Radio	0	0	3	0.4
Students	–	–	10	1.2
Other	6	3.7	16	2.0
Total	162	100.0	803	100.0

3.2 Those Who Have Heard of the Concepts of Free and Open Source Software

To find out about the communication channels, the questions of how the participant first heard of the sources and how they learned about free software and open source software concepts were asked. The communication channels of free software and open source software concepts are on Table 11. The communication channels of the concepts are primarily the through the Internet with 44.2% and secondly, friends with 32.3% in the second surveys. This is natural since these concepts are born within and spread through the Internet. The different distribution of percentage between friends (with 35.8%) and the Internet (with 32.1%) in the first survey might be explained by the spread usage of Internet technologies within the METU campus compared to that of Turkish high school environments.

One of the most crucial softwares, the killer application for desktop usage, is the office suite to which a word processor, a spreadsheet, a slide show and some other minor programs are incorporated. On the open source software front, among certain choices is one of the most important software, is the OpenOffice suite. One of the most important aspect of such a softwares is it has many different releases for a multitude of operating systems which eases the migration from any OS to another. Those who know about the open source, free software concepts were asked whether they have ever used OpenOffice. 19.2% out of 156 participants of the first survey who gave answers have used at least once OpenOfice, in the second survey this percentage rises to 43.3% out of 755 answers. While the OpenOffice product is vital in METU, the IS100 course is based on Microsoft products as well as the campus, making the trialability and usage of OpenOffice software useless for many.

In order to estimate the number of people who are converted, which is the second step of the innovation-decision process, the trialability of the innovation was assessed by asking the participant if he/she ever tried using FOSS OS. This question leads to the second forking in the survey with those who have tried FOSS OS and those who have not, within the group that has heard of the concepts of FOSS. Among those who have heard of these concepts, 37.2% (out of 156 answers) have tried FOSS OS. Among the participants of the second survey 50.3% (out of 757) is the ratio of those who have tried FOSS OS at least once.

Table 12: People Considering to Migrate to a FOSS OS

	Frequency (1st survey)	Percentage (1st survey)	Frequency (2nd survey)	Percentage (2nd survey)
No, do not consider to switch	19	33.3	101	26.6
No idea	26	45.6	167	43.9
Yes, consider to switch	12	21.1	112	29.5
Total	57	100.0	380	100.0

3.3 Those Who Have Not Tried FOSS OS

The reason why a participant has not even tried a FOSS operating system is crucial while constructing a policy that attempts to persuade people to adopt the innovation. This question was asked with four choices (very important, important, less important and not important). An inclination variance was calculated by a value number starting from 0 to 3, where the answer of "Not important" had a value of 0 and "Absolutely important" was equal to 3. Later, these numbers were multiplied by their corresponding value and their sum were divided to the total number of answers. It has been found from the first survey that the speed of the Internet and a lack of a friend who can help are the most important reasons of not having tried yet any FOSS OS. For the second survey, as the number of participants increased, an inclination variance emerged for each reason of non-trialability. The most important reason-category was not among the provided ones, but the one given under the choice "Other" which was selected by 54 participants. The second most important reason for not having tried at least once was a lack of friend who is also interested in the subject, willing to help, the inclination for this choice was 1.62/3, which is between the values of "Less important" and "Not important at all".

When 54 "Other" answers are analyzed, 9 of them are concerned with the incompatibility of software, 5 are related to lack of time, 10 of them show satisfaction with the Microsoft products and 16 of them point at the needlessness of a trying a FOSS OS. While these results indicate the potential of lock users, the incompatibility among OS could be surpassed by the use of or at least the presentation of a cross-platform office suite such as the OpenOffice.

3.4 Those Who Have Tried FOSS OS

The question asked to the participants, who have tried FOSS OS once but still used OS other than FOSS OS, was whether they considered migrating to a FOSS OS today; results are shown on Table 12. Participants who have tried FOSS OS once and consider migrating constituted 21.1% of the first survey and 29.5% of the second survey. The percentage of those who did not have any opinion was rather high however: 45.6% for the first survey and 43.9% for the second presenting an important base for those who could be convinced to migrate. Those who do not consider switching was 33.3% in the first survey and 26.6% in the second, showing that there is a base which could not be underestimated as they are attached to their OS habits.

3.5 Those Who Will Switch to FOSS OS

Due to the low number of answers the inclination results of the first survey are not discussed. Reasons for switching to FOSS OS in the near future are mostly to do with FOSS's technical merits. The number one reason is its stability, and the third reason (which is close to the first one) is the security that FOSS provides. The second reason is the curiosity of the participants who want to know its usage. These three reasons got an inclination of over 2.5/3, which is between "absolutely important" and "important". Other reasons with an inclination over 2 point in the order of importance are, decreasing software expenditure, independence over firms, getting the ability to control and configure the PC and not to finance transnational corporates. The lowest inclination was for the ease of use, the satisfaction of known users and the easiness to find professional grade software. It could be concluded that GUI, desktop usage, user-friendliness are not appreciated by the future FOSS OS users while stability and security are the ultimate reasons for migration.

The most important reason for not having switched yet is the need to upgrade the PC and the second, the lack of needed professional or educational software. In the first survey there were 12 persons considering to switch, while in the second one there were 104 persons. Through various information campaigns, this problem could also be easily surpassed. Most of the software needed by an undergraduate student are in their stable phases and could be downloaded; further, FOSS OS can run even on old hardwares.

3.6 Those Who Will Not Switch to FOSS OS

Participants who do not consider switching to a FOSS OS were given reasons of four choices ("Very important", "Important", "Less important" and "Not important"). It has been found from the first survey that participants found FOSS OS difficult to use and they cannot found any place for help. In the second survey the most important reason for not switching was the lack of educational and/or professional purpose software with an inclination of 2.26/3. The second most important reason is that old files cannot be used having an inclination of 1.68/3. Other fallowing reasons fear of losing data, difficulties of usage and lack of help centers. Less important reasons include security, PC capacity to run FOSS OS and possible financial cost of migration. These findings indicate that the help of some education on FOSS, many users could switch to FOSS OS. The fear of losing data is another consistent reason with the obtained date from the same question.

3.7 FOSS OS Users

Those who used FOSS OS in the first survey were rather few, just six people. FOSS OS users consisted of the 6.1% of the second survey's participants and 1.5% of the first survey's. In the first survey, there were no BSD users, hence all FOSS OS users were in fact of GNU/Linux. Because, there were two BSD users, in the second survey, the term, FOSS OS, was used to comprise both answers. In this section only the second survey's answers will be discussed because participants who use FOSS OS in the first survey were fewer in number than those of the second survey.

82.2% of those using FOSS OS (62 persons) migrated around two years ago or more, are early adopters. The rest adopted within a year. This answer is also one of the main points of evidence in accordance with S shape of the diffusion of innovation theory, a process still in its early days.

The reasons for using FOSS OS and the inclination of the participants are shown on Table **??**. The top reasons for using FOSS OS are security (2.78/3) and stability (2.7/3). Other two important reasons for using FOSS OS include the ability to configure the PC and not being a lock user of a corporate product. These results reveal that FOSS OS users tend to be early adopters with high technical capabilities, giving not so much importance

Table 13: Four Propositions Given to FOSS OS Adopters (Second Survey)

	Absolutely no	No	No idea	Yes	Absolutely yes	Total	Inclination (over 5)
I would aid people around me to adopt FOSS OS.	0	2	3	25	31	61	4.39
I would be glad to help people around me regarding FOSS.	0	1	2	25	33	60	4.55
I would help my relatives/family to adopt FOSS OS	1	2	6	27	25	60	4.27
I would be glad to help on my relatives/family regarding FOSS.	0	1	1	22	37	60	4.63

to GUIs or PC usability and so on, but rather, emphasizing the importance of not being manipulated by becoming a lock user of a corporate product.

Among those who did migrate, 52 of 63 people installed FOSS OS by themselves, once again showing their relative technical competence and ability. 8 of them received help from their friends, which was the second most selected answer.

The source of FOSS OS is mainly a writable CD (25 out of 65 answers) and CDs given by PC magazines (17 out 65 answers). Thus the role of PC magazines is significant concerning this area. The third source was installation over a network (consisting of 11 answers), which has the advantage of being connected to the Internet within the METU campus because important distributions are mirrored on METU's FTP site, or if not found, they can be installed over the ULAKBİM network (National Academic Computer Network).

There were four propositions for those using GNU/Linux in a 5-option Lieckert-type answers. The answers of the second survey are given with their inclination values on Table 13. The inclination values on Table 13 show that all FOSS users are eager to be of help to their social environment.

In order to understand the lacking aspects of GNU/Linux from the standpoint of adopters, some issues were proposed and questioned. The most important lacking point is the ease of use, is the answer having the highest inclination with 2.25. The other closest answer is support in Turkish with 1.78. Even though FOSS OS users appear to be early adopters, they are also critical of FOSS OS's non-user-friendliness.

The last question for FOSS OS users, was concerned with their first source of information, when they encounter problems regarding their preferred OS; according to the second survey, the first source for these early adopters is the Web with 35 answers, and forums, e-mail lists and so on, as the second source with 12 answers.

4 Conclusion

If well configured, the migration to GNU/Linux, which does not require much hardware resource, could be carried out with no complications. By migrating, this user base could acquire the latest versions of software with enhanced security. Those who are unsatisfied with their installed version of Windows OS also present a great potential for further encouragement of the use of GNU/Linux OS. On the other hand, there is also a potential group of users who might migrate to GNU/Linux, i.e. the group which downgrade back to an earlier version of Windows OS, after an upgrade has been made.

Some Lieckert type propositions were given to all participants; according to these propo-

sitions, the process of migration within the public places is welcome greatly with an inclination of 3.69/5 for the first survey and 3.99/5 for the second survey as long as the process is explained on the basis of public economical advantages and gains. Hence it is suggested that such solutions as Live CDs might help the user overcome his/her fear or reluctance for such installations.

Results show that there is also a group of Microsoft OS lock users, who could be persuaded at least to use a cross-platform office-suite like OpenOffice as a first step to approach FOSS.

As the participants' character-profiles evolve the trialability of FOSS OS increases.

According to the surveys used in this study, use of FOSS OS is still in its early stage, but with appropriate policies their percentage of employment and accessibility would rise, at least decreasing the economical cost of software usage in METU as well as generally with all students who eventually graduate and leave. On the other hand, with its large number of different PC users METU would be an important laboratory for the design of migration policies from which other institutions in Turkey could also benefit.

The authors believe that an informative campaign should be designed openly through the medium of the Internet together with the collaboration of METU's FOSS users. For such a collaboration to take place, some simple initiative could be encouraged or provided especially by the METU Computer Center. This could involve the creation of a site such as http://linux.metu.edu.tr/ which should give some basic and simple tips, hints and links much needed for a potential METU GNU/Linux community. Moreover, the addition of a discussion list solely related to FOSS usage in METU should also be considered.

Furthermore, a Live CD customized for METU might be created and distributed with the help of the METU FOSS users and the METU Computer Center. Hence, the relationship between the METU FOSS users and the METU Computer Center is crucial; if such a relationship is to be based solely within the METU Computer Center's bureaucratic hierarchies, the possible volunteer group would be much less willing to collaborate than hoped. If one is to consider a kind of hierarchy, it should be based on technical excellence and meritocracy, so that a communal feeling among METU FOSS users can be created.

Presentations, seminars and conferences in FOSS which target these decision makers could be held in addition to other presentations focusing more on the technical merits of these softwares. Installation festivals or what is known within the FOSS community as "installfests", where newbies bring their PCs and are helped by experienced users in the installation of a FOSS OS, can be highly effective and successful within the campus. Installfest is a very important means for the possible migration of users who feel uncertain or even intimidated by the task and idea of the installation of a new operating system.

One of the most important issues is that the Institute of Informatics, which provide the IS100 courses, should consider stopping the use of the Microsoft material alone. Course curriculum should also comprise FOSS and focus more on computer literacy and not on one product array.

A catalog of required softwares for METU's undergraduate courses should be created and the possible FOSS equivalent should be used or at least proposed to students and academicians. This catalog should be designed with the help of METU's FOSS community.

The breaking of monoculture in a network environment is another crucial aspect. Today, viruses and other threats still target one architecture only and no virus-like threats exist which could target different architectures simultaneously. On the other hand, such courses as IS100 should not just use and teach Microsoft materials, because a university is a place where different approaches should be discussed and tried out, and not contribute to a worldly reigning monoculture.

A massive migration would be extremely difficult in the case of a university; a collective innovation-decision especially would be almost impossible and an authority innovation-decision cannot be taken easily. But such initiative could be taken for the university staff who use PCs for their administrative work, electronic correspondence, and son on. However,

academicians should not be targeted for the purpose of the authority innovation decision in the same degree or manner. Instead, a slow paced but massive information campaign with an optional innovation-decision might be initiated. Because academicians have other special usage of PC and most crucially, they are often difficult to be persuaded to use other system or solutions than what they already use. Thus, after a well-defined, and large user base of FOSS is established, academicians might also be persuaded to switch to use FOSS; or, if the "decision makers" are convinced of FOSS, an authority innovation-decision can be implemented with confidence.

However, it is crucial that a strong unifying vision amongst these decision makers is preserved, maintained and developed.

Follow-up research on the diffusion of FOSS is vital for the theory of the diffusion of innovation and for the design of policies for the diffusion of FOSS. The diffusion of OS and other softwares for desktop PCs with connection to their license schemes and the impact of related policies of conduct would be extremely interesting to further pursue and investigate, particularly within the framework of the diffusion of innovation theory of which there does not appear to be any examples in the current literature.

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