

# AN EMPIRICAL ENQUIRY INTO THE ADOPTION OF OPEN SOURCE SOFTWARE BY INDIVIDUAL USERS IN FRANCE

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## ABSTRACT

In face of proprietary software, products distributed by the Open Source Software (OSS) community are constantly gaining credibility. Companies and institutions are starting to adopt them on large scales and several governmental initiatives have encouraged their use in the private sector. The objective of this paper is to present the first results of a study being undertaken of which the final goal is to improve our knowledge of the mechanisms and the determining factors when the end user adopts (or does not wish to adopt) OSS solutions. It is based on an on-line enquiry and in the first instance merely gives an overview concerning the image and the perception of OSS software.

## KEYWORDS

Free software, Open Source Software, factors for the adoption of software, empirical enquiry, Technology Acceptance Model.

## 1. INTRODUCTION

In the space of a decade, the principle of the free diffusion of software at no charge, and allowing anyone the right to modify the source code and to re-diffuse it, has rapidly spread in the computer world. Originally just a curiosity used by a small number of enthusiastic computing developers, Open Source Software (OSS) has now attained the status of a credible and serious alternative to proprietary software. Moreover, the French market for OSS software already reached 450 million Euros in 2006 and the IDC estimates that by 2008, the world figure will be 35 billion dollars. Certain well known cases amongst which include public institutions, (such as the police or the ministry for finance) have officially adopted this software in large scales which has further increased the legitimacy of the movement.

This tendency to take OSS seriously at an institutional and industrial level has been accentuated by diverse phenomena:

- § The emergence of a credible offer of OSS in several categories of software, OSS is no longer confined to only operating systems (of which Linux is the standard);
- § The development, according to several business models, of computer service consultancy companies specialized in the implementation of OSS software
- § The increasing interest which the OSS universe has created (development methods, community organization, business model, etc) among researchers and universities
- § The adoption of the principle of OSS by several main actors of the software industry (such as Sun, IBM or even Microsoft).

However, the manner in which these tools are adopted and diffused remains little known. Fashion based explanations are unlikely as the movement is constant and durable (Miralles, 06). Many research works concerning the adoption of OSS by companies and public institutions can be found, however few studies

exist concerning the analysis of the motivations and the reticence with regard to its usage on an individual user level (whether it be at his home or at his place of work).

A direct observation of the use of personal computers by the general public indicates that the majority of users use proprietary software, preinstalled by the computer manufacturers. Following several recent events, users are more and more interested in software that is freely available and that can be downloaded from the net. The media have reported news concerning OSS on many occasions, the most noteworthy being the legal proceeding instigated by the European Union against Microsoft concerning the web navigator and multimedia reader ( provided by default with the Windows operating system). The media coverage of the row over the illegal downloading of music has also contributed to making the public aware of the question of intellectual propriety in the field of digital technology.

In short, the diffusion of OSS is no longer only limited to the confined sphere of computer developers. The use of this software in the professional world is no longer an exception and it is gradually being introduced into the private sphere of general public users. What is the real situation? Is private use the logical follow up to professional use? Is its use limited to certain categories of software? What is the point of view of the end user concerning the phenomena of OSS and its specific characteristics (almost no cost, the availability of the source code, no maintenance contract, etc)? This paper is an intermediate report. It presents the first results of a study that is in progress and of which the final goal is to increase our knowledge of the mechanisms and the determining factors when the end user adopts (or does not wish to adopt) OSS solutions. Our objective is to analyze the factors involved in adopting OSS according to a variant of the TAM (Technology Acceptance Model) (Davis, 89) model using the experience obtained by (Legris, 03) when he made his study of the theme and by integrating different critics of the model. We have particularly made the hypothesis that the way the user views the characteristics of certain OSS influences his propensity to accept it. We will mention the noteworthy characteristics shown by our data and will then propose our model as well as the first results of the analysis. The research methodology adopted was that of an empirical field analysis carried out through an on-line questionnaire.

## **2. RELATED WORKS**

Several research works have studied the question of OSS adoption in the business world. A precursory evaluation was made by Chau and Tam (Chau, 97) in which they studied the adoption of open software (in the sense of respecting certain standards of interoperability), whereas OSS was not yet a known and studied phenomena. The evaluation made in (Wang, 01) of all the OSS available at that time can be considered as proof of a growing interest in the phenomenon. The evaluation criteria that were developed give a first indication of the adoption factors which would later be identified. We will here mention the level of available technical support, the degree of extensibility and personalization, the close-at-hand internal expertise which is available, the cost of usual maintenance and the question of long-term evolution. In (Farber, 04), the author presents six factors which reveal the concern of CIOs and which seems to inhibit the adoption of OSS in companies. We will particularly mention the functional insufficiencies (compared with proprietary software) as well as the lack of a clear direction for the evolution of OSS. Another organizational analysis concerning the adoption was carried out in (Dedrick, 04), where a series of case studies analyzed the factors for adopting OSS server platforms. This study shows that the possibility offered by the Linux operating system to configure and to install highly competitive value-for-money personal computers (PC) as departmental servers is the factor that most stimulates adoption. Finally, as far as an analysis of the factors for adopting OSS in public organizations is concerned, the strategic and political dimension is at the forefront in (Mindel, 07), where the institutional choice of OSS in developing countries is viewed as an important lever for acquiring a certain technological independence in relation with more industrialized countries.

To sum up, it seems quite evident that the organizational adoption of OSS is motivated by a concern for the profitability, durability and interoperability of computing systems as well as for a certain strategic long-term view of the future of the software industry. On an individual user level, the process of acceptance seems to us to be quite different. If the individual user is concerned by the value for money and the progressive nature of his computer equipment, there is probably also a practical, personal and even a psychological dimension involved in the fact that he deliberately chooses OSS instead of a proprietary solution. This is what we will explore in our enquiry directly aimed at users.

### 3. RESEARCH METHODOLOGY

Several models have been created to explain and predict the behavior of individuals who use information and communication technologies. The theoretical bases for these models are taken from research into social psychology, the best known model being that of technology acceptance (Davis, 1989) commonly known as TAM (Technology Acceptance Model). This model has been widely used in information systems and marketing studies and several extensions and variations have been proposed. As far as we are concerned, we have adopted the variant developed by (Legris, 03) who observed a significant relationship between the perceived usefulness and the perceived ease of use, which in turn condition the attitude with regard to usage and the intention to use.

In the context of this paper, our considerations are two-fold: on the one hand, to verify the correlation between the adoption of OSS and some working hypotheses inspired by (Legris, 03); and on the other hand, to study the impact of some external variables related to the view that users have of the universe of OSS and concerning its employability, the view of friends and family and the aptitude of its usage to serve as a distinctive factor.

The hypotheses from which the questionnaire was prepared are as follows:-

- § H1: The general satisfaction with OSS has a positive correlation with its acceptance.
- § H2: The ease of use is positively correlated to its acceptance
- § H4: The aptitude of the solution to carry out the task is positively correlated to the acceptance.
- § H5: The ease with which an individual changes to an open source solution is positively correlated with its adoption.

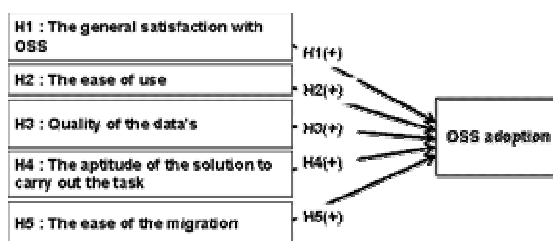


Figure 1: The research model

Unlike in the TAM model, we have not postulated initially that there is a relationship of causality between the 5 items, neither have we explicitly put forward hypotheses on the means of impact of the external variables. The objective of the analysis being the individual user, we had a certain familiarity with the adoption process. The variety of software types and adoption processes would have made it particularly difficult to make case studies. This is the reason why, we directly explored our field of study with the help of a questionnaire. The volume of data that could be obtained and the access to a variety of individuals who could reply, made this strategy relevant for exploring this field.

A test version of the questionnaire was handed to 60 people at the beginning of 2007. A few small modifications were made, and the definitive version of the questionnaire included 88 questions. They were divided up as follows:-

§ Questions 1-14 were general questions concerning OSS: the different denominations, how the phenomenon is seen, the fields of application (office automation, education, multimedia, web etc) as well as the global perception of the value of their usage.

§ Question 15 was a decisive question for distinguishing users from non-users.

For OSS users, 55 questions were provided and grouped into seven sections (of which sections b-f corresponded to the 5 hypotheses mentioned earlier).

- a. Q16-Q39: the type and the way of usage as well as the general behavior with regard to OSS.
- b. Q40-Q42: Evaluation of the user's general satisfaction.
- c. Q43-Q47: Evaluation of the ease of use
- d. Q48-Q51: Evaluation of the quality of information provided by the OSS solution.
- e. Q52-Q56: Evaluation of the aptitude of the OSS solution to carry out the requested task.
- f. Q57-Q61: Evaluation of the ease of migration to the OSS solution
- g. Q62-Q70: Evaluation of the impact of the external variables previously cited.

For non users, 10 questions (Q71 -Q80) concerned the reasons for the non-use of OSS. Finally, the last questions (Q81 -Q88), were to find out the profile of the participant (sex, age, professional category and level of knowledge of computers).

The questionnaire was elaborated and the results processed using the software Sphinx. The request for participation in the enquiry was diffused by E mail.

## 4. RESULTS

The results that are presented here are preliminary results. They originate from a first analysis of the answers. Our aim here is to give an initial general view of the perception and the usage of OSS solutions on an individual level.

### 4.1 Characterization of the sample

The 361 people who answered were of an average age of 35 and were mainly men (84,4%). Two thirds of those interviewed considered their computer knowledge to be superior to the average, and almost 2/3 of those interviewed are computer experts. Two social and occupational group contained three-quarters of those interviewed; executives (55%) and students (24%). Those who replied were, in fact, mainly men who were very enthusiastic about computing.

As a first step, we divided up the sample into 3 levels according to their degree of implication in the sphere of free software.

Table1: The three levels of the sample

	<b>Non User (NU)</b>	<b>User (US)</b>	<b>User and Contributor (UC)</b>	<b>Sum</b>
<b>#</b>	35	264	62	<b>361</b>
<b>%</b>	10%	73%	17%	<b>100%</b>

In the rest of this section, these three categories are respectively noted "NU", "US", "UC". The users (US and UC) were long-term users (more than 80% had been using an OSS solution for more than a year) and intensive users (more than 80% used it all the time) The OSS used covered a broad spectrum (Operating System, office automation, web navigation, multimedia creation) and was used as much in the private sphere as in the professional one.

### 4.2 General perception of Open Source Software solutions

Using these categories as a basis, we want to define the outlines of the image that each category had of OSS solutions. This study clarifies which elements of the general characteristics of OSS solution were common to those who replied. The following table synthesizes this perception:

Table 2: Perception of OSS

	<b>NU</b>	<b>US</b>	<b>UC</b>
A sphere reserved for initiates	<b>25%</b>	6%	3%
Use at no cost	<b>28%</b>	<b>22%</b>	10%
The future of software	9%	<b>28%</b>	<b>35%</b>
An innovative project	12%	19%	<b>19%</b>
A utopia	9%	2%	3%
A collection of software blocks	<b>16%</b>	<b>23%</b>	<b>31%</b>

By arranging the items relevant to the perception of OSS in decreasing order, three distinct views became apparent. This difference in perception was confirmed by a Khi2test:

§ For the NU, OSS software is free of cost but is reserved for initiates and the field of free software is made up of group of software blocks.

§ For the UC, the OSS solution also represents the future of software it is made up of shareable software blocks and free software is an innovative project.

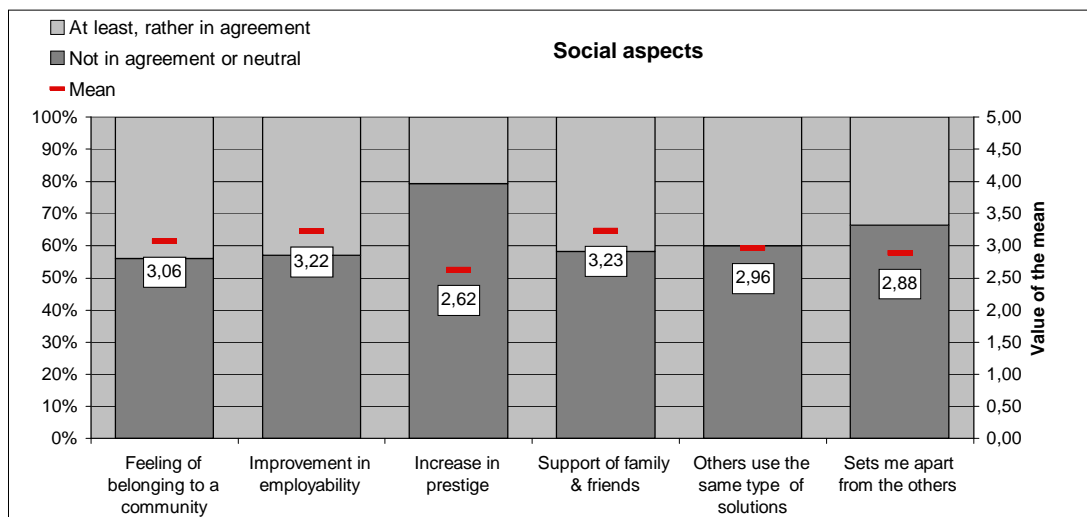
This table also shows that the OSS solutions are seen overall as a realistic new type of projects, in which people become more intensely involved because they think that it represents the future of software. However, motivation because of the fact that it is free becomes less important as the person starts to contribute to its developments.

This point is in accordance with the replies relating to the signification attributed to the term 'free'. Among the six items proposed, the NU classed as number one, the absence of a license fee ( 'free of cost'), the US put the possibility of avoiding the hegemony of proprietary systems in first place ( 'freedom of choice of editor') and the UC focalized logically on the possibility of modifying the source code ('freedom to modify') More generally, we observed variations in the importance attributed to the 4 freedoms usually associated with the term 'free' ( to use, copy, study and modify). The NU focalized on the freedom of use, the US on the freedom to modify and the UC on the freedom to modify and to belong to a community. This communal aspect is an important factor for the NU. Two thirds of them consider that the free solution is a world apart with its own rules, even its own religion (45% were at least 'rather in favor of this idea').

When considering the fields of application judged to be relevant for OSS software, it appears that the more they were involved, the more the individuals who replied felt convinced of the universality of this way of development. More precisely, a third of the NUs considered that it is applicable in all fields with a predilection for the fields of office automation and E learning software. Forty percent of the US were for their part convinced of the applicability of free software in all the fields. The fields that they mentioned are those where free software is circulated the most ((OS, office automation and navigation on the net).

In their behavior with regard to OSS software, the users (US and UC) can be qualified as curious. To carry out a task, more than ¾ of them look for a free solution and test it and more than 2/3 say that they keep in touch with the latest developments in the field of free software. As opposed to a proprietary solution, the same proportion confirmed that they preferred the free solution even though that solution was functionally less comprehensive. When selecting a product, the particular points which most influenced their choice were those of the possibility to configure the product according to their needs, the ease of use and the price. Although safety and ergonomics did feature in their choice, they were not a priority.

Table 3: Users' perception of their image (325 answers)



At the time of choosing to accept the OSS solution, different external variables could potentially come into play. As the adoption of OSS can be considered to be part of a social signal, we tried to comprehend the impact of the social dimension through these six items. The table 3 therefore recapitulates the different aspects relative to the relationships that the users (US and UC) maintain with their social environment.

The users do not have the impression of setting themselves apart from others, neither of increasing their prestige by using OSS software. On the other hand, a more detailed examination of the results shows that when they achieve the status of contributors, the users more clearly perceive the communal dimension of the project and have the conviction that this involvement improves their employability.

Concerning the question of the relationship between adoption in the private sphere and that in the professional one, more than 2/3 of those who replied started to use OSS software in the private sphere. For a fifth of them, the beginning of use was at the same moment in the two spheres. More than 3/4 of them used free software in the two spheres, and more than 55% thought that a contamination effect played a role: using free software in one sphere increases the propensity to use it in the other. Once the choice of free software has been made, the user is unlikely to change again; 70% of users of free software would not envisage returning to proprietary solutions.

As far as the used type of software is concerned, the two dominant uses are for operating systems and office automation. Practically half the software is only used in the private sphere. When the user uses free software in the professional field, this latter is generally also adopted in the private sphere.

Table 4: Categorization of used OSS solutions (323 answers)

Type of solution adopted	Place of use			Sum	%
	Private Sphere	Professional Sphere	Both Spheres		
Network management software	11	2	7	20	6,2%
Software for education and training	4	3	0	7	2,2%
Office automation software	24	7	42	73	22,6%
Software for the creation and the management of Internet contents	11	9	38	58	18,0%
Software for multimedia	24	0	8	32	9,9%
Operating systems	81	10	41	132	40,9%
Management software (accounting, pay etc.)	0	1	0	1	0,3%
	Sum	155	32	136	323
	%	48,0%	9,9%	42,1%	

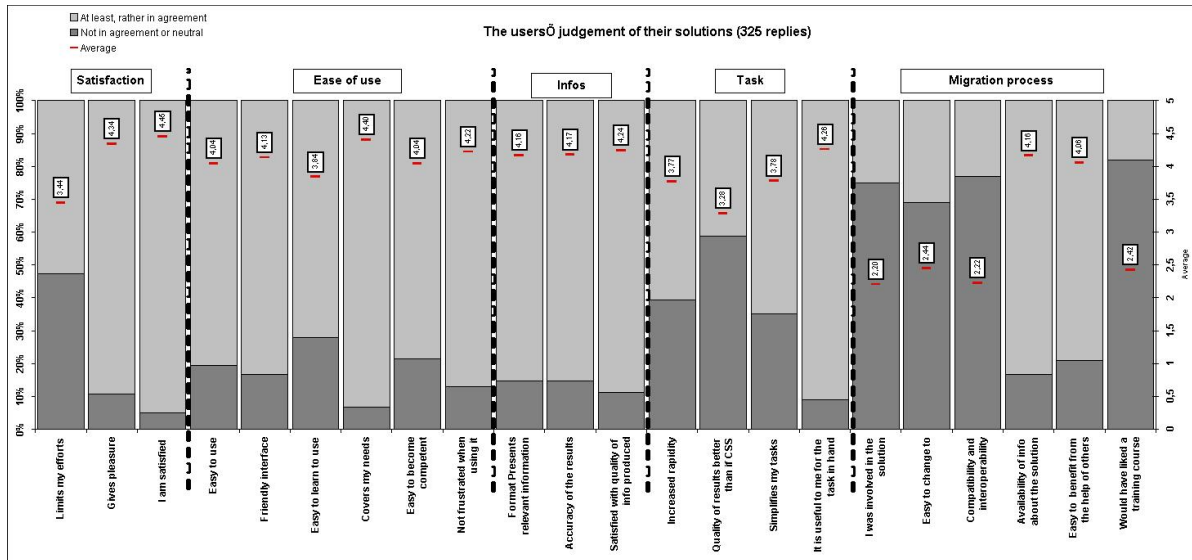
To sum up, those that replied refer to an image of OSS software as a phenomenon with a bright future to which they turn because it is free. The community spirit dominates.

### 4.3 The way that users view Open Source Software

With the aim of extracting a series of salient facts concerning the usage of free software on the part of those who replied, the users were asked twenty questions (US+UC). These questions took the form of affirmations and the answers were included in a Likerts scale on 5 levels, going from "Not at all in agreement" to "Totally in agreement". The answers were coded as '1' for "Not at all in agreement" to 5 for "Totally in agreement". The 22 asked questions could be grouped into 5 themes. The 22 questions can be group into 5 themes; table 5 shows these descriptive results. The information obtained from these results is presented according to our 5 hypotheses:

- § Satisfaction: The users are, on the whole, very satisfied. The variety of the propositions and the low cost of migration probably explain this fact. The 'pleasure' dimension obtained a high average, which denotes a real involvement in the solution.
- § Ease of use: In the different items, the users found the solution, on the whole, easy to use; Their easy use of the tools certainly contributed to this. The interfaces and the ergonomics were judged in a positive way. This point has contributed to the democratization of free software. The great functional richness makes it possible to amply cover the needs of users and these latter do not feel frustrated using it. The only weak point concerns how easy it is to learn to use. As it cannot be compared with proprietary software, we cannot judge if this is a factor that is specific to free software.
- § Quality of information. Users were very satisfied by this point. Both the presentation format and the exactness of information were praised by the users.
- § Aptitude to handle the task: Even though they were totally involved with their own solution, the users of free software recognized that the quality of the results obtained remained relatively close to those they would have obtained had they used proprietary solutions. On the other hand, they estimated, in the majority, that these products simplified their tasks and that they gained time.

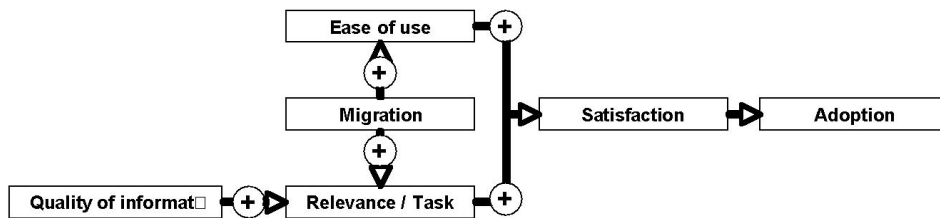
Table 5: The users' judgment of their solutions (325 replies)



§ Migration: This point was a stumbling stock for those who adopted OSS solutions. As much as they recognized that the information was easily available and easy to find help, they still mentioned that there remained difficulties in ensuring the interoperability which therefore complicated the migration. In accordance with the results mentioned previously, the user of free software feels his migration process is his individual responsibility. He does not wish to have the benefit of a training course and rather counts on his own efforts to get help from available information and resource people.

This first excursion into the field concerning the process of adoption of OSS has led us to statistically validate the following causal model particularly through the means of structural equations (figure 2).

Figure 2: Expected relations



#### 4.4 Reasons given by non-users

Those who replied who had not adopted OSS software did not show any curiosity about these solutions. They did not know anything about the universe of free software. Amongst the motives mentioned, they basically pointed out that they did not feel the need. They were also concerned with safety. The actions undertaken by the publishers of proprietary software (patch) and their economic importance were a reassuring factor. The absence of a clearly identifiable publisher and the part to it which can be seen as 'a community of computer enthusiasts' could create a confusion with 'a community of hackers'. Free software continues to have the reputation to be difficult to install.

## 5. CONCLUSION

Open Source Software (OSS) is a credible and a viable alternative to proprietary software. Companies and public institutions are interested in it and several have already adopted it on a large scale. A study of the literature concerning the factors leading to adoption by organizations show that these latter are mainly concerned by the durability and the interoperability of their computing investments. The situation is different for the individual users. Whether he is a non-user, a simple user or a contributing user, the factors for adoption or rejection are different. The goal of this study is to explore the perception of OSS at an individual user level through an empirical questionnaire based enquiry. The methodology used is based on a model which is inspired by technology adoption models such as TAM. A part of the questionnaire is based on 5 hypotheses considered to be positively correlated with the adoption of OSS, another part of the questionnaire aims at exploring the impact of certain external variables such as employability, the view of friends and family or the aptitude of OSS to be a social distinctive factor when being used. The analysis of the results which is presented in this article is not exhaustive. It presents an initial evaluation of the image and the perception of OSS. This shows that OSS has gained legitimacy in the eyes of the 'general public'. This latter considers this movement to be, from a global perspective, as a key trend for the future. Schematically, our main results can be synthesized in the following manner. The non-adoption of OSS solutions has less connection with the characteristics of the product than with people's disinterest. The primary users choose the OSS solution because of its no-cost factor and the fact that it is a different way of computing and using computers. If they are sufficiently involved to contribute to the OSS movement, this involvement is motivated both by an adherence to the values of the OSS movement and by personal interest. A form of dichotomy can be analyzed, whereby those who have adopted OSS do not seem prepared to change again, and those who have not accepted it do not seem prepared to take the first step.

This work is greatly limited because of the studied sample. This is not at all neutral; in fact the majority of those who replied were confirmed computer users and belonged to the socio-economic category of senior executives and university students with a level of A levels + 3 years to A levels + 5 years. The proportion of non-users of OSS in the sample is limited and is not very significant either. The results mentioned remain descriptive and a more in-depth study with more elaborate statistical equipment is envisaged. The first analyses (in particular the correlation between the 5 variables) seem compatible with the processing in the form of structural equations. Although this is only a first step, our analysis has convinced us that the collected data is rich enough to deserve a more in-depth study into the theme of adoption.

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