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Abstract

In this paper, we contend that due to the particularities and widespread use of new ICT, traditional ways of explaining IT adoption in companies -rational decision making, technology diffusion models, and the psychology of the decision maker- are insufficient to explain some observed cases of ICT diffusion. We prove that there is a new role played by the user community in the technology adoption process, brought about by factors like the existence of a strong development community in the case of OSS, or widespread access to Internet technology. A mixed two-phase method was used for this study. In the first phase, through a qualitative analysis of some significant cases we depicted under which conditions a significant adoption of a particular technology (OSS) might unfold, showing that in some circumstances user groups could play a significant role. In the second phase an exploratory quantitative analysis was carried out to verify the new dimensions of the technology adoption process. The results showed a high influence of social factors like peer group adoption and user's pressure. Due to reasons of geographical proximity the research was carried out in Spanish companies, but we believe that, like with similar adoption studies, the results are of general nature as there are no culturally specific dimensions that we could identify. Conclusions and further research are outlined.

1. Introduction

Information and Communication Technologies (ICT) have become pervasive in companies to the point that choosing particular platforms, for example Open Source[1] (OSS) or a particular ERP is becoming of strategic importance. Decisions of technology adoption have been studied through various lenses, and the literature is

[1] In this paper we studied Open Source adoption without constraining it to Linux, the widely known example of OSS. During the research, both in the qualitative and quantitative phases, we considered as OSS technology Linux and any other software considered as such by the Open Source Initiative http://www.opensource.org.

rich in frameworks that propose how technologies spread through industries and how individuals make their particular technology adoption decision. Nevertheless, observing the reality of software adoption, we found that some realities could not be readily explained, like the non-adoption of OSS when all reports show its economic superiority even in the absence of network externalities, or, in some other instances, its adoption when it is not clear its superiority and network externalities do exist. This paper, then, sets off to explore this phenomenon with the intention to better understand how decision makers currently make decisions of information technology adoption.

Towards the 1960's and 1970's, ICT started to be a real force in the world of business. Their main driving force was the potential savings they heralded through the possibilities of automating arduous, repetitive manual tasks such as the jobs involved in calculating and processing payroll and accounting. In this context, the decisions on whether to adopt a certain technology were usually governed by the expected cost savings due to certain technical characteristics. Nevertheless, nowadays ICT plays a much broader role within companies and has become one of the fundamental pillars of many companies' competitive advantage. Thus, technology supports, sustains and decisively contributes to business growth. Depending on the context, a single technology can be implemented in many different ways and can serve different purposes. Choosing one technology or another no longer solely depends on cost saving criteria, rather it is a fundamental issue for all executives due to the strategic implications involved. What is more, management and governance of ICT are other key factors worthy of attention.

This paper contains an analysis of the criteria for adopting ICT used by executives in IS (Information Systems) departments in Spanish companies. This includes not only the considerations that have traditionally been regarded as most important - cost, technological features, and costs of change – but also other criteria that were previously given less importance, such as the organization's capacities to implement technological solutions, the presence of network externalities, and social factors like user's pressures. Finally, it explores the importance of having a set of criteria related to the psychology of the decision maker. A dual approach was adopted to achieve the goal of this study. First of all, in-depth interviews were conducted with eleven representative companies in order to reveal the underlying criteria for a specific decision: the adoption of

open source software. As a result of a combined analysis of the interviews and the existing literature, an initial conceptual framework was established. The results of the interviews, the method, and the proposed framework were published in Miralles et al (2005). The research we present here is the validation of the framework performed by conducting surveys to Spanish companies or multinational subsidiaries in Spain that had the authority to make decisions on IT matters.

This document is organized in the following way. The next section following this introduction contains a brief survey of the theoretical frameworks for adopting technology; the second contains a presentation of the research methodology including the results of the qualitative part that we use as basis for the questionnaire and the ensuing statistical analysis; and the third presents the empirical results of the questionnaire-based study on the criteria used to adopt ICT in Spanish companies.

2. Literature Review

Prior to making a decision on technological innovation, companies assess the benefits and costs involved in adopting new technologies. For this assessment to be comprehensive not only direct costs and revenues should be taken into account, other more general non-economic factors should also be considered. These non-economic determinants are related to the companies' organizational conditions and to more subjective factors affecting the decision maker, such as the reputation that could be garnered from being the first to adopt a given technology. We consider that there are three theoretical approaches that should be considered: (1) attempting to understand the economic/rational determinants, (2) formulating the analysis in terms of design and the process of implementing an innovation, and finally (3) trying to understand the decision maker's social and psychological determinants.

2.1. Rationality in decision-making

The initial model of decision-making is based on making decisions using economic an rationality criterion. In this sense, the decision made is the one that provides the decider with a maximum benefit or that that makes the most efficient use of the resources available. The adoption of technology in this sense requires knowledge

of the relevant parameters affected by the decision and the relationship between the expected benefits obtained from the decision. When the benefits are expected to materialize in the future, the principle of economic rationality is formulated on the basis of future expectations. In this case a rational hypothesis of expectations (Lucas, 1975, Sargent & Wallace, 1976) is used and is developed under the assumption that each economic agent uses in an optimal form all the information available to him[2] to visualize his expectations of the future. The basic principle of the model of the rational expectations is based on knowing all the information that the decision maker requires, the way in which this information conditions the awaited result, and the processes that lead to a balanced result in the future.

Within the "rational" domain, adoption of ICT is also related to three fundamental concepts:

1) technological innovations' rupture with already existing technologies: The **degree of radicalness** of the change that the organization must go through when adopting the technology at issue (Lyytinen & Rose, 2004, Srinivasan et al. 2002 and Dewar and Dutton, 1986).

2) the existence of knowledge barriers such as uncertainty about future ICT developments: **Knowledge barriers** exist in face of change (Attewel, 1992, Fichman and Kemerer, 1997 and Tornatzky and Fleischer, 1990). The adoption of a new technology presumes the acquisition of knowledge and the transferring of this knowledge between the possessors of the knowledge and those that must decide on their adoption.

And 3) the presence of network externalities. **Network externalities** (Shapiro and Varian, 1998 and Shapiro and Varian, 1999) are obtained from the greater benefit that the buyer receives from the growth of the number of users.

Although these factors are the main dimensions that drive the rationality of decision-making process in ICT adoption, in our understanding they are too broad to be useful to understand the CIO decision process. Based on the practical experiences of analysts and IT professionals stated in the general press and technical reports3,

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[2] In some instances of this paper we will refer to the CIO or the decision maker as "he" without any implicit dimension of gender.

[3] Bozman, J., Gille, A., Kolodgy, C., Kusnetzky, D., Perry, R. and Shinag, D. (2002), Windows 2000 versus Linux in Enterprise Computing, IDC White paper 02C3512SOFTWA3512, October 2002, and Wang, H. and Wang, C., (2001). Open Source Software Adoption: A Status Report. IEEE Software, March/April 2001

we postulate three dimensions at the individual-level that affect the decision process for IT adoption in companies: cost, technological attributes, and lock-in.

Cost reduction has been proposed as one of the main criteria of technology adoption (Bethuyne, 2002) and it has been postulated, for example, as the main factor by OSS followers in front of proprietary solutions. In that case, cost advantage is a good driver to help decision makers to cope with uncertainty and to soften radicalness of OSS adoption. On the other hand, factors as the irreversibility[4] of the decision and the presence of network externalities by increasing the availability of complements and other ancillaries have a strong influence on technology costs (Shapiro and Varian, 1998).

Technological Attributes group a set of characteristics that are routinely mentioned by CIOs and by some reports as relevant in the ICT adoption process, in general, and in the OSS case, in particular (Rogers, E. 1995; Venkatesh et. al., 2003). Initially, five criteria have been identified: reliability, performance, scalability, security and brand name. Our starting position is that some of these criteria will be taken into account by CIOs in order to advance in their decision making process and may influence the perceived radicalness of IT innovations. In the case of OSS, we propose that CIOs use these technological attributes to evaluate radicalness of OSS compared to proprietary solutions and to consider existing knowledge barriers in the adoption of OSS.

Lock-in appears due to switching costs (Shapiro and Varian, 1998). Switching costs are present in all technology adopting decisions and organizations tend to minimize the lock-in that these costs generate. Lock-in is produced due to many different decisions, like long term agreements with the suppliers, and the refusal of the workforce to learn new software applications. Lock-in is also caused by external situations that, in most cases, organizations can not control. Switching costs could be formally considered and accounted as an additional cost in ICT adoption, but our belief is that lock-in is treated by the decision maker from a more qualitative perspective.

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[4] This construct is analogous, although of opposite in direction, to what Rogers (1995) labels *trialability*.

2.2. Diffusion of innovations

From the standpoint of rationality in decision-making, as explained above, costs are the central factor in adopting ICT. Nevertheless, this study on the adoption of ICT in companies starts from the premise that the phenomenon of adoption depends on both objective and subjective factors. Within this framework, the theory of the diffusion of innovations is one of the most widely used theoretical perspectives to analyze the adoption of innovation, from a perspective other than rationality based on costs. The goal of the theory of the diffusion of innovations, developed by Rogers (1995), is to explain the evolution of technological innovation from its introduction until it is fully used. This theory proposes that the characteristics of the diffusion be studied using four lenses: (1) process of decision making, (2) individual tendency to innovation, (3) the rate of adoption, and (4) the perceived attributes of the innovation.

Normally, the process of innovation diffusion moves slowly during the early stages of adoption and picks up momentum as the number of users increases. For this reason, the company that adopts an innovation must take into account the characteristics of both the target population and its workers. Since this progress takes place gradually, there is a degree of uncertainty that affects the results of the investment in ICT. Uncertainty is a common feature in emergent sectors and those that intensively use technology. The more radical the technological change, along with the greater need to train workers, the greater the uncertainty and, in the end, the greater the difficulty of adopting the innovation, even when the new technology is clearly superior. Bearing in mind the schema of analysis, the adoption of technology is a process in which decision makers might be influenced by both (1) the organization's capabilities and (2) the existence of network externalities in the diffusion of the technology.

The **capabilities of the organization** are important as the adoption of new technologies can be restricted if knowledge barriers exist. Complex technologies impose a burden of learning when being adopted (Fichman and Kemerer, 1997), especially when resolving technical problems proves tricky and magnifies the feeling of the irreversibility of the investment made (Kogut and Kulatilaka, 2001). In addition, the company's culture, and in particular its attitude toward uncertainty are also important, as it influences the degree of risk that an

ICT adoption decision maker is willing to take, and very often determines the budget available to take risks and to experiment with new –often unproven- technologies (Dedrick and West, 2003).

The presence of **network externalities** also affects the degree of IT adoption in an organization, as the value of using an IT platform grows in proportion to the size of the adopter network (Brynjolfsson and Kemerer, 1997). This phenomenon, which implies increasing returns to scale from the demand side, has two distinctive characteristics, as (a) the ultimate benefits of IT adoption will be determined by the expectation of the decision maker on how the technology will evolve; and (b) increasing returns for the adopter lead to a distinctive pattern of technology diffusion known as market tipping with "winner takes all" outcomes (Shapiro and Varian, 1998). These two characteristics affect the adoption process of a particular technology in an organization, as managers may be tempted to commit to a major initial rollout of a particular technology within a firm, or they may wish to wait in order to minimize the risk of ending up with a "stranded" technology (Markus 1987; Cool et al, 1997). These issues are particularly relevant to analyze decisions like the adoption of Linux as a platform.

2.3. Psychology of the decision maker

The theory of innovation diffusion, presented in the previous section, provides a context for examining the importance of the impact of ICT in terms of adoption time, although it does not broach the decision maker's individual process. There are other theories that study the individual's psychological variables as determining factors in the acceptance of technology, in which the perception of usefulness and user-friendliness, subject to the specific beliefs of the individuals, are the determining factors when adopting technology. The theory of the psychological features of the decision maker posits that these decisions are affected by subjective norms or are influenced by other people's opinions. The central issues addressed by this approach are informational cascades, reputation concerns of IT managers and the theory of concern about the supplier's reputation. On the other hand, ICT user acceptance studies have analyzed the importance of social influences on IT adoption decisions.

First, **informational cascades** take place when a decision-making agent bases his or her decisions on information gathered from third persons. For example, an individual has a personal opinion about a given product, and then shares his or her impression with another person, who in turn forms his or her opinion of the product based on what the first person thinks of it, and so forth. Informational cascades take place when individuals ignore their personal information and mimic the decisions previously made by other agents (Kauffman and Li, 2003). Decisions made this way can be appropriate as long as the private information taken into account is not "contaminated" by erroneous public information.

Second, the IT manager is influenced by **concerns about his or her reputation**. In this sense, Kauffman and Li (2003) have pointed out that "reputational herding" occurs in IT platform decisions, as CIOs do not want to be associated with having chosen the "loosing platform." Therefore, they will go with the majority regardless of evidence that a non conventional decision could be to the best interest of the company.

Third, the **theory of the supplier's reputation** (Huil, 2004, Yoon et al, 1993) examines the decisions on adopting technology based on the vendor's reputation. Bearing in mind this reputation, decision makers make the decision that poses the least risk for their own reputation within the company and sector.

Finally, **social influences** have been treated from the standpoint of technology acceptance by users (Venkatesh et al., 2003). Several theories have included social influences variables to analyze intention to use of technology artifacts like computers or information systems (Technology Acceptance Model (Davis et al, 1989 and Venkatesh and Davis, 2000), Theory of Reasoned Action (Davis et al, 1989 and Sheppard et al, 1988), Theory of Planned Behavior (Taylor and Todd, 1995 and Ajzen 1991)). Venkatesh et al. (2003) have recently formulated a "unified theory of acceptance and use of technology", which includes social influences as one of the direct determinants of behavioral intention. Most of these theories focus on subjective norms, defined as "person's perception that most people who are important to them think they should or should not perform the behavior in question" (Fishbein and Ajzen, 1975). Subjective norm effects on usage intention are based on compliance and voluntariness. Hartwick and Barki (1994) found that subjective norm had a significant effect on intention in mandatory settings but not in voluntary settings. Venkatesh and Davis (2000) coined the term compliance to refer to the casual mechanism that underlies this effect. Others theories include

internalization of social influence and image or identification (Venkatesh and Davis, 2000). Internalization has been defined by "influence to accept information from another as evidence about reality" (Deutsch and Gerard, 1955) and was incorporated into the initial TAM to create a new model by Venkatesh and Davis (2000). Deutsch and Gerard (1955) refer to this process of internalization as informational social influences.

2.4 Summary of literature review and research question

The three research strands –rationality in decision making, diffusion of innovations, and psychology of the decision maker, summarized in table 1- have shown us different dimensions that are relevant for ICT adoption decisions in organizations. Nevertheless, non of these research streams focuses specifically on the reasons of a CIO's ICT adoption criteria. In particular, social influences have been studied mainly form a standpoint of IT user acceptance, and we have no evidence of research on social influences on CIO's ICT adoption decisions. Therefore, in this research, taking the construct of *informational social influences* from the user acceptance area (Venkatesh and Davis, 2000 and Deutsch and Gerard 1955) we propose a research question formulated as: "*Are CIOs under informational social influences in their IT adoption decisions?*"

Body of Literature	**Relevant Dimensions**
Rational decision making	Cost (hardware, software, reliability, industry maturity, etc) (Bethuyne, 2002; Armelini et al, 2004)
	Technological attributes (fit to task, difficulty in administration, ease of experimentation, platform long term availability) (Roger, 1995; Venkatesh et al, 2003)
	Lock-in (portability, brand image, etc) (Shapiro and Varian, 1998)
Technology diffusion	Organizational capabilities (budget size, time availability for experimentation, innovative culture) (Fichman and Kemerer, 1997; von Hippel, 1994; Kogut and Kulatilaka, 2001, Moore and Benbasat, 1991; Venkatesh et al, 2003; Dedrick and West, 2003)
	Network externalities (availability of complements, skills of existing IT workers) (Brynjolfsson and Kemerer, 1997; Shapiro and Varian, 1998; Markus 1987; Cool et al. 1997; Iacovou et al, 1995; Zhu et al, 2002)
Psychology of the decision maker	Informational cascading (observation of decisions of peer groups, information overload, existence of conflicting data) (Kauffman and Li, 2003; Li, 2004)
	Reputation concerns of the IT manager (career, incentive incompatibility, agency problems) (Kauffman and Li, 2003)
	Vendor's reputation (company reputation, brand value) (Huil, 2004; Yoon et al, 1993)

	Social influences (users' group opinions, subjective norm, image) (Venkatesh and Davis, 2000; Hartwick and Barki, 1989; Deutsch and Gerard, 1955)

Table 1: Main IT adoption decision frameworks

3. Research Methods

Since one of the motivations for starting this research was our suspicion that the decision to adopt an OSS platform could be influenced by two factors not considered in the literature (1) the user driven pressures due to the community effect of the developer community, and (2) broader considerations of social responsibility, we needed to gather a deeper understanding of the overall decision-making process of the CIO. Following Mingers (2001), we decided to adopt a pluralistic research methodology. In the first step, we use qualitative methods, carrying out in-depth interviews with 11 CIOs of national and multinational companies that have been purposefully chosen. In the second step we test the insights gained by carrying out a survey, as suggested by Markus (1994), Ngwenyama and Lee (1997) and Carlson and Davis (1998). This overall research strategy allows enhancing the generalizability of our results (Lee and Baskerville, 2003). In this way, we hope to not only confirm the existence of these dimensions on a broader basis, but also to get more insight about the relative importance and the relationships that underlie the decision making processes of CIOs.

3.1 First Step. Qualitative Approach.

In order to identify the variables that affect decisions to adopt a given technology, semi structured interviews were conducted with eleven IS managers at several Spanish and multinational companies in both the public and private sector. Given the nature of the research and the reduced set interviewees, we chose to focus our questions on the adoption of Open Source, and then the adoption model was generalized and the questionnaire and statistical results were not specific to OSS. The main goal of the interviews, then, was to examine which criteria underlie IS managers' decision making in terms of adopting open source software, bearing in mind the theoretical framework outlined in the previous section. Details of the companies and the research method utilized can be found in (Miralles et al 2005). Regarding OSS as a new platform we found that that de companies could be grouped in four groups. *Non-adopters*: Companies that affirmed their lack of interest in

adopting OSS and do not have any meaningful installation. *Specialized*: Companies that have adopted OSS for specialized systems (web server and business-to-consumer system). They are not really open to adopt OSS as a systems platform but superior technology has induced them to adoption for these specialized systems. *Willing*: Companies that are open to use OSS when it becomes a suitable choice for a specific system but they are not planning a full migration of their systems to OSS. *High Users*: Companies that are using OSS widely as a platform for their systems.

In a second step, we took these relative positions of each of the companies and went back to the interview transcripts, to analyze them in terms of the IT adoption criteria that we found in the literature. We found that these criteria could satisfactorily explain the behavior of three of the four groups, but it could not fully explain the case of *High Users* (Table 1.5 shows a summary of the findings). In the companies of this group, we found that CIOs gave significant importance to a dimension that has not been contemplated in previous research on IT adoption: user community power.

	Non-adopters	Specialized	Willing	High Users
Cost			**R**	**R**
Technological capabilities			**R**	**R**
Lock-In	**R**	**R**		
Organizational capabilities		**R**	**R**	
Network Externalities		**R**		
Informational cascading	**R**	**R**		
Reputation of IT Managers	**R**		**R**	
User community effects				**R**

Table 1.5 - IT adoption dimensions in terms of resulting groups in the qualitative step.

To summarize the qualitative results of this study, it suffices here to state the four main findings:

1. We faced a phenomenon that has been widely studied in the organizational learning field, the difference between an individual's "espoused theories" versus the "theories-in-use" (Argyris and Schön, 1978). CIOs explicitly state one set of reasons to make a decision, but we found that they seem to implicitly operate by another We addressed and solved this problem by classifying the companies according to the observed output, and then going back to the interviews to understand their underlying reasoning process.
2. Three types of criteria guide the adoption making process: rational decision-making, technology diffusion considerations and the psychology of the decision maker.

3. Preliminary evidence was found that decision makers have latent reasons that explain the majority of the observed behavior, and these go far beyond technical superiority and economic efficiency. Our findings suggested that CIO's seem to be influenced by information cascading, as the lack of sufficient information is substituted by their peer's decisions.
4. The appearance of community effects. Which are driven by factors such as pressure from the in-house programming community, end user opinions, social corporate responsibility, or cultural and social welfare criteria.

3.2 Second Step. Exploratory Approach

Based on these results, we developed a fifteen-question research instrument (presented in Table 2) that was mailed to chief information officers (or similar positions) in Spanish companies from different economic sectors and of differing sizes. Respondents should answer each question in a five points Likert scale form "strongly disagree" to "strongly agree".

The goals of the study were (1) to reveal the degree of importance the survey respondents gave to a series of fifteen decision-making criteria when adopting information and communication technologies and (2) to determine if there are hidden variables that could explain the observed behavior of CIOs when adopting (or not) new technologies, in particular if they are subject to social influences. Questionnaires, with telephone follow-up, were sent to the 250 largest (by sales) companies in Spain, from which we received 42 replies. In a second step, a massive mailing to 5.317 companies, with no follow up, was carried out. From this, we only received 53 replies. In total, 95 valid replies were obtained.

Traditional "rational" decision making	Cost-based rationality
	Technical characteristics of the software
	Irreversibility of the adopted decision
	Increase of the independence form specific providers
Diffusion of Innovation	Abilities of the own ICT employees
	Risk or failure from the decision made
	The decision moves the company toward a standard
	Avoidance of radical changes
	Abilities of the users
	Existence of support from the provider (or alike)
Psychology of the decision maker	Opinion of colleagues and peer group
	Reputation of the provider

	Believe that the industry will massively adopt the same solution
	Opinion and preferences of the users
	Opinion from top management

Table 2. Dimensions of the Questionnaire.

The results of the questionnaire were first analyzed with basic descriptive and comparative techniques to discover which of the decision factors were considered as most relevant. Afterward, and in order to perform the exploratory analysis to discover the possible effect of social influence, principal component analysis was used. The main goal in using principal component analysis was to identify the possible underlying factors and to investigate if these components could be interpreted as drivers of the social influences.

4. Results and Discussion

4.1 Descriptive statistics

The results from the questionnaire reveal that the three criteria most often taken into account by companies are: cost rationality, standardization of the solution, and the irreversibility of the solution adopted (see Figure 1). The majority of the CIOs continue to use the cost of adopting the technology as the main criterion. This is the most important criterion for 38% of the companies surveyed, and 51% regarded it as important, compared to a scant 2% that gave it little or no importance. The second most often cited criterion used by decision makers is standardization of the solution to be adopted. Thirty-two percent of the companies declared standardization to be very important, while 59% claimed it was important. Finally, for 28% of the companies, the irreversibility of the solution adopted is highly important, and 42% believe it is important (see Figures 2 and 3).

The fact that rationality based on costs and irreversibility of the solution to be adopted are two of the main determinants in the decision making process indicates that the majority of the companies view the process of adopting ICT from the standpoint of economic profitability. Since the companies are mainly interested in costs, it naturally follows that they are interested in the irreversibility of the solution. This factor shows the companies' interest in minimizing lock-in generated costs. On the other hand, the importance of the

standardization of the solution to be adopted indicates that the companies are aware that if they are aiming to survive in competitive markets, they must be "compatible". Thus, they place greater importance on collaboration with other companies and network externalities generated by the use of ICT.

The companies responded that "users' skills" (43%) is a criterion worthy of little importance or they claimed neutrality on this criterion (see Figures 4 and 5), indicating that the companies are indifferent to users' skills. Finally, another criteria that the companies view as not very important is achieving greater independence from suppliers (18%) (see Figure 6).

4.2 Factor Analysis

Applying a principal components analysis in our study enables us to explore the presence of more complex constructs that could explain companies' decisions on adopting ICT. This type of analysis enables us to cluster the variables in the study into different sets that define different types of behavior.

Factor	**Eigen Value**	**% of Var.**	**% of Ac.Var.**
1	3,9	25,9	25,9
2	1,9	13,0	38,8
3	1,2	8,2	47,0
4	1,2	7,7	54,7
5	1,1	7,5	62,2

Table 3. Eigenvalues and explained variance.

Table 3 presents the results, with the eigenvalues and the percentage of variance explained by each one. As we can see, five factors explain 62,2% of the observed variance. Table 4 includes the factor loadings of the five components.

Factor loadings

	Comp. 1	Comp. 2	Comp. 3	Comp. 4	Comp. 5
Opinion and preferences of the users	0,090	0,034	0,094	-0,048	**0,913**
Abilities of the own I CT employees	**0,672**	-0,019	0,083	0,321	-0,057
Cost-based rationality	0,072	-0,045	**0,719**	0,037	0,061
Abilities of the users	**0,621**	-0,145	0,280	0,402	0,138
Avoid radical changes	0,191	0,275	0,204	**0,722**	-0,238
Increase independence form providers	0,191	0,156	**0,559**	0,010	-0,043
Technical characteristics of the technology	**0,691**	-0,063	0,117	0,060	-0,487
Opinion of colleagues and peer groups	0,359	**0,575**	-0,308	0,075	0,231
Existence of support form a provider	**0,772**	0,166	0,126	-0,114	0,033
The decision is a step toward a standard	**0,612**	0,213	0,062	0,174	0,047
Opinion of the top management	-0,053	0,214	0,187	**-0,737**	-0,064
Provider reputation	0,369	0,305	**0,569**	-0,191	0,092
Irreversibility of the decision	**0,645**	0,105	0,149	-0,076	0,101
Believe that industry will massively adopt	0,112	**0,760**	0,122	-0,322	-0,074
Risk of failure with the decision	-0,026	**0,739**	0,392	0,211	0,032

Table 4. Factor Loadings

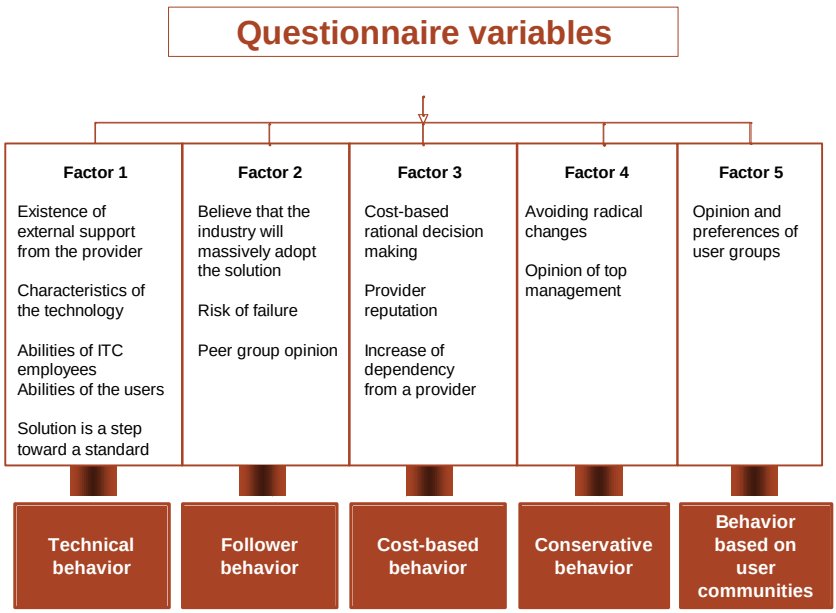


Table 5. Interpretation of the factor loadings.

The results of the factor analysis indicate the presence of five relevant behaviors in the processes of adopting ICT in Spanish companies. Based on the original variables that conform each of the factors we have named these as: 1) technical behavior, 2) follower behavior, 3) cost-based behavior, 4) conservative behavior, and 5) behavior based on the user community (see Table 5).

Technical behavior is related to six variables included in the questionnaire: external support, attributes of the technology, users' and workers' skills, irreversibility, and standardization of the solution. Thus, the decisions made based on this type of behavior include those considerations by IS managers that are related the most technical factors of the technology. The decisions are based on an assessment of the features of the technology: the virtues of its attributes, the external support received, and an analysis of the feasibility of workers adopting them. Follower behavior is directly related to the risk of failure, belief that the market will mainly adopt the solution, and the opinions of colleagues and peer groups. Thus, the decision makers that follow this type of behavior assess the uncertainty inherent in adopting any new technology. The third type of behavior is based on the costs of adopting ICT and on the assessment of factors such as the supplier's reputation and greater independence from the supplier. Companies that base their decisions on these factors regard the cost generated by ICT as very important, and they are thus interested in having low lock-in and greater independence from suppliers. Furthermore, since cost is perceived as a key factor, they will also base their decisions on the supplier's reputation in order to minimize the risks of investing in ICT. Conservative behavior is related to avoiding radical changes and the opinions of upper management. The decision to adopt ICT using this behavior is inversely related to upper management's opinion. That is, the decisions of IS managers display an inverse relationship with the wishes of upper management, just as they reflect the desire of the former to not get involved in radical changes through adopting ICT. The fifth and last type of behavior is closely tied to a single variable: users' opinions/preferences. Thus, these companies' decisions as to whether or not to adopt a given technology are directly related to their customers' wishes. This could be interpreted as the decision maker being in a state of captivity by the consumer.

Using the factor loadings we can recalculate the importance of each of the behavioral profiles (table 6). In this way, although CIO's directly report that cost is there most important variable in decision making, the

statistical analysis shows that de facto, the most important factor is the behavior of their peer group (26% of respondents), that is, what their fellow professionals do (follower behavior). There are also more CIO's (23%) that show a conservative behavioral, mainly based on avoiding radical changes and avoiding standoffs with upper management (conservative behavior). Moreover, this research reports that cost based reasoning is the third most important observed behavior. Finally, technical behavior and behavior based on user communities are the least important ones.

	Percentage
Follower Behavior	26%
Conservative Behavior	23%
Cost-Based Behavior	21
Technical behavior	17
Behavior based on user communities	13

Table 6. Importance of Behavior Types in Spanish CIO's

5. Contributions, limitations, and further research

The use of information and communication technologies has shifted from being a a support of traditional business practices to a necessity essential for companies to remain competitive and even to generate differential advantages. This study on the criteria for adopting ICT helps us to understand the decision making processes followed by CIOs, thus helping to explain the behaviors observed in companies. It was our initial intention to discover whether informational social influences play a role in IT adoption processes. Our study concludes that CIOs are effectively influenced by informational social influences. In addition the study adds to the existing evidence that managers are influenced not only by costs but also by non-economic variables, like the technological advantages of a certain systems, the user communities in which the decision maker operates, and the reputation of the supplier..

One noteworthy characteristic of the Spanish decision makers when choosing their information systems is that although they are generally conservative (they decide based on costs) they also display a behavior that we defined as "peer followers". As hinted in the study on the adoption of open source software, the empirical

study on the criteria for adopting ICT reveals that the Spanish decision makers are not willing to risk being the first to adopt technologies that might fail. For this reason, they base their decision on the steps taken previously in their industry or on the market reputation of the application or vendor. In summary, costs are only a part of Spanish executives' concerns when making decisions on technology. The environment also plays a key role in ICT decision-making criteria, confirming the existence of herding behavior.

One of the limitations of our study is the geographical scope of the respondents. Both general IS literature and literature of user acceptance models have pointed out that cultural differences can be influential and should be further researched (Burkhardt et.al, 1994). Notwithstanding Venkatesh et. al. (2003) showed that in some instances of technology adoption, cultural differences are not relevant. In our study, the role of cultural specificity is an issue that cannot be tested with the available data, as all CIOs that responded to the questionnaire are from Spanish companies. Therefore a further research project could be the replication of the study in a different environment.

Also, the same methodology can be applied in a more confirmatory piece of research that could be performed by relating the factors developed here with a dependent variable like "intention to adopt" of a particular technology, aiming at proving statistically the existence of user driven informational social influences.

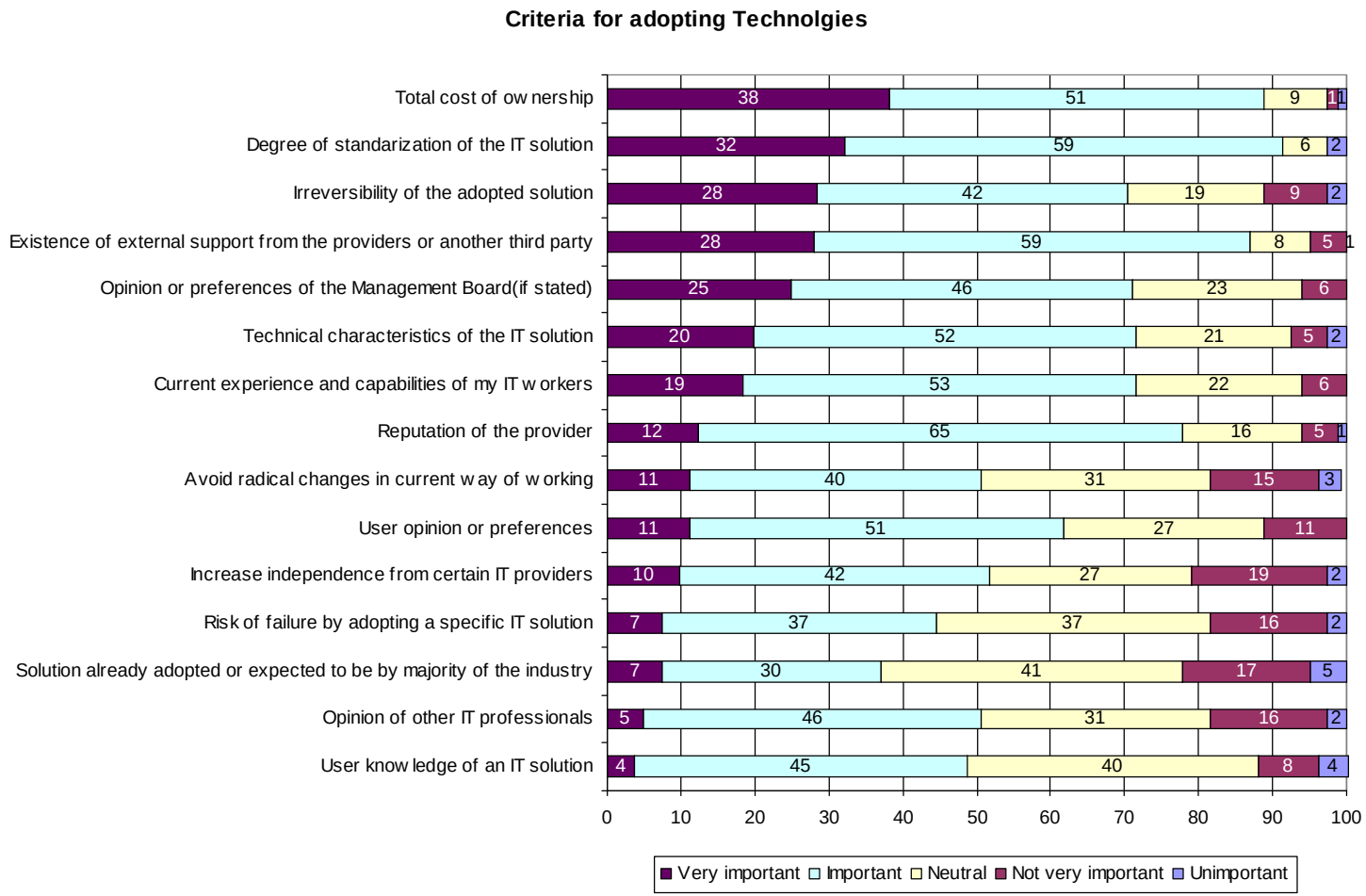


Figure 1. Criteria for adopting technologies

Figure 2. Criteria regarded as important

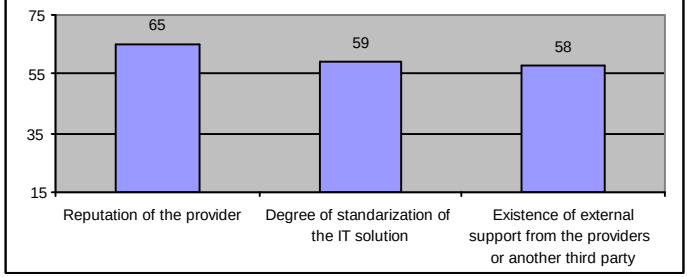


Figure 3. Criteria regarded as very important

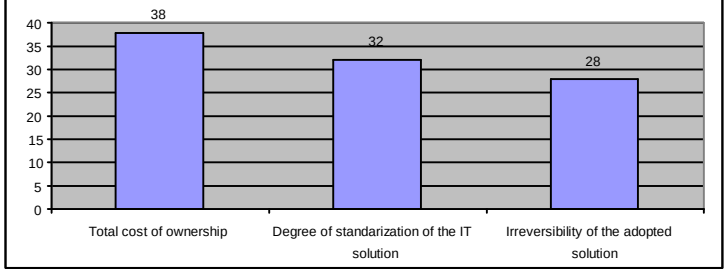


Figure 4. Criteria regarded as unimportant

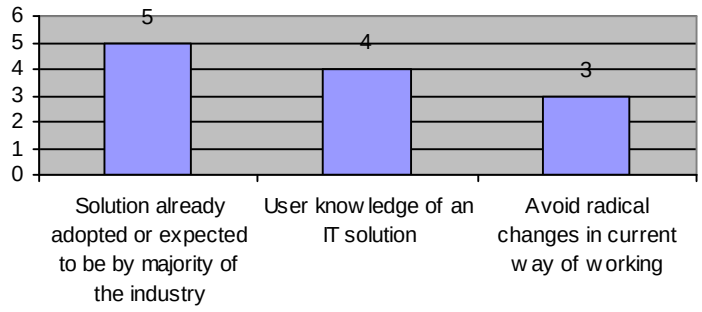


Figure 5. Criteria regarded as neutral

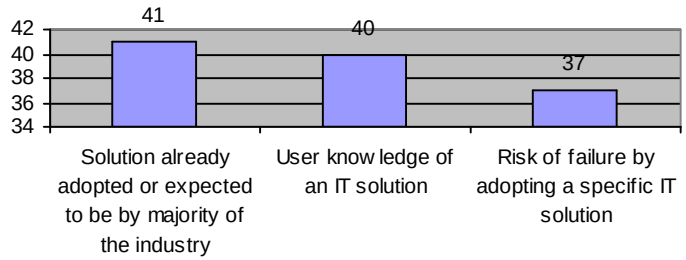
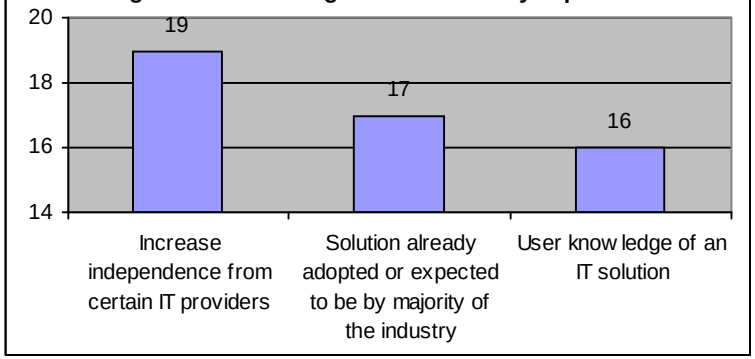


Figure 6. Criteria regarded as not very important



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