Social and Group Influence on Information Technology Adoption: The Case of Open Source Software Adoption

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ABSTRACT: This paper studies the role of social influence in the adoption of information technology. Previous studies have demonstrated the crucial role of social interactions in the case of Open Source Software adoption behaviors for individuals. However, the literature reveals ambiguity on the definition and the measurement of social influence concept. Thus, this paper attempts to develop a kind of understanding about this ambiguity by clarifying the sources of social influence in organization: voluntary use, image, visibility, normative influence, conformity motivation. These concepts identified already in the literature are summarized into two second order constructs in the research model: *group pressure* and *social influence*. The research model developed aim to explain and predict Open Source Software adoption behavior depending on these two concepts. Data validation using the Partial least square approach has uncovered new and thorough theoretical and empirical results in the field of information technology/system adoption.

KEYWORDS: Social influence, group pressure, Open Source Software, adoption behavior, second order constructs, hierarchical structure, PLS approach.

1 INTRODUCTION

Open Source Software OSS is an emerging phenomenon that attracts computer scientists, researchers and managers over the world. The adoption of OSS solutions is an unavoidable reality that registered rapid growing last decades ([9], [10]). Without a doubt, OSS represents a growing share of the software market and is increasingly being considered alongside traditional, commercial software ([23]).

We consider that Open source software is any software product which is available freely to users so that they can adopt it without any fees. They can also modify the product if they have skills and intention. Those rights are reserved by free software licenses as advanced by AFUL ([38]).

OSS is an important trend in the information technology (IT) adoption landscape. OSS adoption studies are increasingly growing. Our research is included in this topic. It aims to identify factors that can influence the adoption behavior of OSS solutions as a specific case of technology. Given that many factors influence the adoption behavior of information technology in general, this paper aims to enrich existing literature about social influence construct in IT adoption area.

Our previous studies ([9], [10]) revealed the important role of social influence as an organizational factor of OSS adoption as well as proved in previous IT adoption studies ([13]). However, literature seems controversial and ambiguous about social influence definition. Difficulties were encountered on the operationalization and the measurement of this concept.

This idea was also supported by others studies ([21], [13]). In fact, the need to better understand social influence itself and the relationship between social influence and Technology Adoption was expressed. Unclearness was also confronted in identifying sources of social influence in the organizational context. This is was difficult given that social influence is related to colleagues, boss and group influence at the same time ([26], [37], [9], [10]).

The interdisciplinary foundations of social influence have led to a heterogeneous set of conceptualizations ([13]). These include, for example, subjective norm, group norm, social identity, social capital, social network configuration, and critical mass ([34]). This paper focuses on this limit in order to clarify sources and mechanisms of social interactions that occur within the organizational context and influence the individual behavior to adopt an open source software OSS. Thus, we try to answer the following question:

To what extend social influence sources affect the individual adoption behavior of OSS in an organization?

To answer this question, the paper is organized as following: first, we present a literature review on IT/IS adoption. Special focus will be devoted to social influence concept. Second, we will concentrate on theoretical constructs to develop a broader definition of social influence and construct the conceptual model that explain the impact of various sources of social influence on individual behavior to

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adopt an OSS. Third, we will present the research methodology used to validate theoretical constructs in the Tunisian context. Then, Results of data processing using PLS approach will be exposed. Finally, research findings and implications will be interpreted and discussed.

2 LITERATURE REVIEW

This paper focuses on social interactions within organization and their impact on individual behavior to adopt technology. We tried to identify different sources of social influence that seem ambiguous in previous studies. To devote this theoretical gap, a review of IT/IS literature is necessary. Special concern will be dedicated to social influence and related concepts already used.

2.1 SOCIAL INFLUENCE LITERATURE

Social influence has been incorporated into all major theoretical models related to Technology Adoption researches, such as the Theory of Reasoned Action TRA ([11], [2]), Theory of Planned Behavior TPB ([1]), the Technology Acceptance Model TAM 2 ([33]), and the Unified Theory of Acceptance and Use of Technology UTAUT ([34]).

Several studies have applied and extended existing models in several contexts and for many new technologies cases ([19], [35], [9], [10], [12], [28], [15], [37]). A significant body of IS researches integrates social influence in its theoretical foundation and explores the relationship between social influence and technology adoption ([13]).

Social influence, in its broadest sense, has been widely used on technology adoption literature. Several concepts related to social context influence have been advanced. In UTAUT model for example ([34]), social influence has been approached to three concepts: *subjective norms*, *image*, and *social factors*. Table 1 below summarizes some concepts encountered in previous studies that seem capture the social influence concept.

Table 1. Social influence' related concepts in previous studies

Social influence related concept	IT Adoption Theory or references	Definition
Subjective norms	[33], [1] ([34], [11]	"A person's perception that most people who are important to him think he should or should not perform the behavior in question" [11]
Social factors	[29]	"The individual's internalization of the reference group's subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" [29]
Image	[33], [25]	"The degree to which use of an innovation is perceived to enhance one's status in one's social system" [25].
Social influence	[34]	"The degree to which an individual perceives that important others believe that he or she should use the new system" [34].
Social influence as a process of: Identification, Internalisation and compliance	[18], [33], [34], [22], [28], [13], [27]	- *Identification:* when an individual adopts a behavior or opinion derived from another because he wants to establish or maintain a satisfying self-defining relationship to another person or a group [18]. - *Compliance:* it implies a change in behavior in response to social pressure without corresponding changes in beliefs or attitudes ([18]) - *Internalization:* takes place when an individual integrates a referent's belief into its own cognitive belief structure based on congruence in values [18]

Social influence has been originally defined as the change in an individual's thoughts, feelings, attitudes, or behaviors that results from interactions with another individual or a group ([18], [13]). In addition, social influence has been defined as "*The degree to which an individual perceives that important others believe that he or she should use the new system*" ([34]).

Social influence is associated to three processes: compliance, internalization and identification as advanced originally by [18] and defined in the table 1 above. This idea was also defended by a significant number of researches ([33], [34], [22], [28], [13], [27]).

Despite of various definitions and perceptions, difficulties were encountered in the operationalization of social influence concept. Indeed, the difficulty of measuring social influence was widely claimed in the literature. The founders of TAM 1 ([5]) reported that social influence has not been incorporated in the model because of measurement problems. Later, in TAM2, researchers analyzed and added the social influence [33]. Limits regarding the right representation of social influence were also highlighted in another paper [7] where it was expressed the need for much more investigations to better understand the influence of peer groups on adoption decisions.

Literature review demonstrates that several researchers ([17], [32], [8], [19]) adapted *subjective norms* as defined in the TRA model ([2], [11]) to present the social influence concept. Subjective norms have been defined *as "a person's perception that most people who are important to him/her think he/she should or should not perform a certain behavior"* ([2], [11]).

However, it was observed that the conceptualization of subjective norms raises theoretical and operationalization problems. It is difficult to distinguish whether user behavior is caused by referents influence on personal intention or by personal attitude [22]. Similarly, the difficulty of measuring subjective norms was pointed also because it is not easy to measure the perception of others' opinions (which is already difficult to observe) [28].

Consequently, those findings lead researchers to question whether the concept of subjective norms captures the full extent of social influence ([19], [9]), [10]).

Many other researchers ([12]), [15]), [19]), [35]) adapted items of *social influence* concept as advanced in the UTAUT model [34]).

In addition, the distinction of social influence process as presented above (compliance, identification and internalization) identify if the social influence becomes from referents or from the individual attitude toward others point' of view [22]. This finding leads us to introduce another concept to gather all sources of social influence on individual behavior in an organization: group influence.

2.2 GROUP PRESSURE' LITERATURE

In technology adoption models, definition of social influence sources reveals ambiguity. Indeed, items of social influence measurement include influences of superior, colleagues and friends ([34], [7], [17], [8]). In fact, interpersonal influences come from a variety of people, such as neighbors, relatives, family members, and friends [19].

To resolve the encountered difficulty about social influence sources, we propose adding group influence as a source of social influence that comes only from colleagues or friends at work. Literature was so reexamined to find a concept that present group influence. We identified an interesting paper that was not very exploited in previous studies. It is the paper of [31] on innovation management in organization. The concept advanced in his paper was « *group pressure* ». This concept is not very common in IT literature. However, by analyzing its definition, we notice that it agrees with previous concepts advanced on IT adoption theories: *social influence*, *subjective norms* and *social factors* ([34], [29]).

Group pressure reflects the influence that comes from social actors with whom the individual is in continuous interaction. These groups are generally defined on hierarchical levels or departments within the company ([31], [26], [9], [10]). Social group refers to a group of individuals who share the same geographical space or occupy the same functional borders as departments within organizations. Thus, groups can be constructed based on hierarchical levels [26].

The referent is defined like a person that has a particular power and confidence related to his specific status and previous relation or experience. Proximity is an important criterion that qualifies the referent [37].

Groups are defined on the basis of similarities of interpretations, social and cognitive repertoires that make some collective thinking. The individual seeks to comply with his group in the organization and behaves in an expected way for its peers. Thus, he internalizes their expectations towards his behavior [26].

In addition, Theories of conformity in social psychology have suggested that group members tend to comply with the group norm [19].

In order to define precisely the group pressure concept, we refer to a paper [28] that studied social influence by reproaching it to subjective norms concepts. Conclusions of his analyses introduced the three following dimensions of subjective norms: *normative influence*, *conformity motivation* and *observed behavior*. Those findings seem interesting because they fit with group pressure definition as advanced by innovation management theory [31].

3 THEORETICAL CONSTRUCTS

The aim of the paper is to find a broader definition of social influence and its empirical evidence through the case of OSS adoption in an organizational context. We tried to limit colleagues influence in 'group pressure' variable. Thus, we think that social influence concept is not the *normative influence* or the *conformity motivation* as defined before [28]. It does not meet the definition of *subjective norms* as introduced in IT adoption theories which comes with group influence.

The literature review has allowed us to identify a broader definition of social influence that is related to three constructs in IT theories: *image, visibility and voluntary use* as proposed previously [37]. This idea is supported by empirical results in the case of OSS adoption ([9], [10]). Those factors were used in an independent way in previous studies. In this paper we try to gather them as dimensions of the same construct "social influence".

In fact, image has an important impact on OSS adoption intention. Indeed, OSS users have a higher profile compared to those who do not use. This behavior is usually associated to computer experts and high skilled persons. In addition, it was demonstrated that OSS adoption in the organizational context is not 'free' to the extent that individual does not always use the software that fits with his personal choice ([9], [10]). This justifies that the use of OSS may be required or prohibited and introduced the relevance of 'voluntary use' concept used already in previous research [34].

Previous results ([9]), [10]) showed also that '*visibility*' ([34], [37]) is interesting because it reflects the observed behavior (OSS use). It means the transparency and the ease of seeing others behavior in the company.

As a consequence of above analyses, it seems better to use social influence as a multidimensional concept composed of *Image, visibility* and *voluntary use*. In accordance with this idea, the paper [37] used social influence as a multidimensional variable composed of: *image*, *visibility*, *voluntary use* and *subjective norms*. However, in our model, *subjective norms* were removed to *group pressure* variable like defined in a previous study ([28]).

Thus, in our study, *group pressure* was defined through two dimensions: *normative influence* and *conformity motivation* ([28]). These two dimensions define the *group pressure* in a manner that comes well with group pressure as advanced before ([31]). The *observed behavior* dimension ([28]) has been removed to the concept of *social influence* as it comes with *visibility*.

The resulting constructs are so multidimensional (second order construct). *Social influence* is reflected on image, visibility and voluntary use. *Group pressure* is reflected on normative influence and conformity motivation. This finding introduces the hierarchical structure of the model constructed ([36]).

4   CONCEPTUAL MODEL AND HYPOTHESES

Discussions above about social influence construct led us to found the conceptual model of the research and related hypotheses (see fig. 1). It presents the resulting hierarchical constructs with their dimensions. Social influence is reflected in image, voluntary use and visibility; and group pressure is reflected on normative influence and compliance motivation.
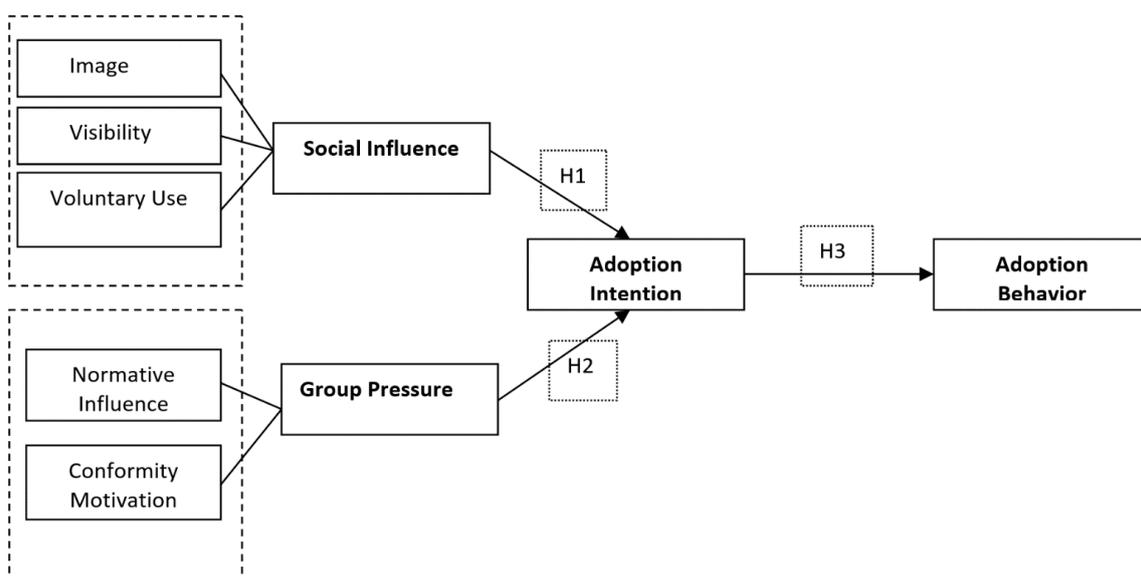

Fig. 1.   The Research conceptual Model and hypotheses

The hierarchical structure of the model is presented in the table below:

Table 2.   The hierarchical structure of the conceptual model

First order construct	Second order construct	References
Image		
Visibility	Social influence	[34], [37], [9], [10]
Voluntary use		
Conformity motivation	Group pressure	[28], [9], [10])
Normative influence		

4.1   SOCIAL INFLUENCE CONSTRUCT AND IMPACT ON INTENTION AND ADOPTION BEHAVIOR

A significant body of IT/IS research demonstrated that social influence is a key construct that influences both usage intention and usage behavior ([19], [34]). The impact of social influence on human behavior in general and information technology adoption, particularly, has been widely acknowledged ([34], [19], [9], [10], [13]). Social influence has always been a significant, positive and direct determinant of intention ([34], [37], [20], [27]). Previous research ([9], [10]) demonstrated that the social influence is the most important organizational factor in the explanation of the individual intention to adopt OSS. In addition, individuals may adopt a particular technology not because of their own personal persuasion but because of the views of others ([22], [15]). As a consequence, image, visibility and voluntary use (dimensions of social influence) can play a great role in the individual behavior as recognized in previous IT adoption models ([34]) and derived researches. As a consequence we can introduce the following hypothesis:

H1: Social influence has a positive impact on OSS adoption intention

4.2 GROUP PRESSURE CONSTRUCT AND IMPACT ON INTENTION AND ADOPTION BEHAVIOR

The group makes strong compliance pressures on members. It minimizes the internal conflict and focuses on issues that maximize consensus. It is thus extremely difficult for groups to receive threatening information inherent to most innovative ideas ([31]). In the organizational context, the use of a new technology is subject to individual determinant but it is related to the group reference ([8]). In addition, it is possible, for a decision maker, to adopt a technology without really having rational reasons to do so; there are rivals influences, or motivations to follow the opinion of the most people around (reputation effect) ([24]). This idea was supported by many researchers. In fact, compliance conducts individual to accept a particular technology because it comes with the views of other people around him. Internalization makes individuals accept a particular technology because it is congruent with their value system ([15], [22]). Identification leads individuals to accept a particular technology to establish and maintain satisfying self-defining relationship with their social group. If the individual sees others adopt the technology in his entourage, he will be more motivated to adopt it ([6]).

Thus, the social system in an enterprise makes compliance pressures to individual behavior. This appears to have a major influence on the adoption of innovations by the individual in an organization. By analogy, we can introduce the following hypothesis:

H2: Group pressure has a positive impact on OSS adoption intention

4.3 INTENTION AND ADOPTION BEHAVIOR RELATIONSHIP

All previous models in IT area (TRA, TPB, TAM, UTAUT, MPCU, ...) and derived researches used the basic structure that contains the following relation: adoption factors - intention - adoption behavior. Factors depend on every model and every research; but the relation intention-adoption is widely recognized and defended theoretically and empirically. Our research fits with this fundamental structure and proposes the following hypothesis:

H3: Adoption intention has a positive impact on OSS adoption behavior

Then, the mediation role of intention will be also evaluated throughout the following two hypotheses:

H4: Adoption intention mediates (totally) social influence impact on OSS adoption behavior

H5: Adoption intention mediates (totally) group pressure impact on OSS adoption behavior

5 RESEARCH METHODOLGY

To validate the conceptual model, we should first operationalize theoretical constructs. This was done based on previous IT research. However, the operationalization of group pressure and social influence was not easy. Several reasons explain difficulties encountered. The biggest problem is that previous studies have not really defined references that are sources of group pressure. Indeed, there was not separation between superior and colleagues influence ([37]). Items of *subjective norms* (TRA) and *social influence* (TAM, UTAUT) include the influence of these two types of referents which are not the same according to their impact on individual behavior.

In order to fix the relevant scale measurement, it was interesting to consider previous results ([28]) where items related to *normative influence, conformity motivation* were used to measure subjective norms. Those items were adapted to our study to measure the group pressure variable. Then, results of reference [37] were also considered in our paper because they used hierarchical structure where social influence was operationalized using items of image, visibility and voluntary use. Items were adapted from previous studies on IT adoption area based essentially on UTAUT model ([34]).

After that, a questionnaire was developed based on items founded. It was distributed online to Tunisian professionals (205). The OSS considered in the questionnaire was Linux operating system. Responses are then gathered and analyzed first by SPSS; then by smartPLS [39] because of its appropriateness with the research model and objectives.

In fact, the OSS adoption model developed in this paper is characterized by its hierarchical structure. From a theoretical and conceptual point of view, such hierarchical structure calls for an evaluation by structural equations modeling and particularly the Partial Least Square method (PLS) ([4]). PLS approach has many advantages in this regard ([36]). It is even recommended for models with hierarchical structure. In addition, all model constructs are reflective which call for PLS method [16]). Steps of model assessment are doing in respect to previous researches ([14], [36]).

6 RESEARCH RESULTS AND DISCUSSIONS

Research conducted under PLS is always done in respect with the following three steps: measurement model, structural model and finally indirect effect evaluations (moderator or mediator). In addition, the research model is hierarchical one; as consequence, analyses are done in respect to the hierarchical structure (first and second order constructs) ([14], [36]).

6.1 THE MEASUREMENT MODEL

In the research model, all constructs are defined as reflective indicators variables according to previous studies ([16]) because of their theoretical and conceptual definitions. Given this, validity criteria at the measurement model level are: reliability, convergent validity and divergent validity. In this section, we will evaluate these criteria according to the PLS validation process. The first purification of the questionnaire items was done by SPSS analysis. All items have satisfying reliability constraints except for voluntary use variable which was then rejected from the model.

6.1.1 RELIABILITY ANALYSIS

To assess the reliability of constructs, one must consider the Cronbach Alpha (α) and the composite reliability. The reliability of indicators (manifest variables) must also be evaluated through communality. The SmartPLS report contains a set of indices for analyzing the reliability of different constructs. The table 3 below presents the main criteria adapted from the software outputs.

Table 3.   PLS outputs about reliability analyses

	Cronbachs Alpha	AVE	Composite Reliability	Communality
Adoption	0,851201	0,869390	0,930118	0,869390
Intention	0,966056	0,936476	0,977888	0,936476
Image	0,834980	0,669974	0,889733	0,669973
Visibility	0,919602	0,861854	0,949257	0,861854
Social influence	0,857552	0,545623	0,892238	0,545623
Normative influence	0,918485	0,803776	0,942437	0,803776
Conformity motivation	0,937647	0,889129	0,960089	0,889129
Group pressure	0,907991	0,645703	0,927141	0,645703

shows very satisfactory reliability results since Alpha value exceeds 0.8 for all variables. For composite reliability, it is recognized that the value must exceed the 0.7 in exploratory research and between 0.8 and 0.9 for Advanced Research. In the case of this study, all constructs have a composite reliability greater than 0.8 and even greater than 0.9in many cases. These results are very satisfactory. We conclude that research constructs are reliable.

The indicators reliability is determined by the correlation with the construct that they present. The correlation value must be greater than 0.7. It means that the latent variable explains more than 0.5 in each of its indicators. Results shows that the communality of all the latent variables is greater than 0.5. This is also satisfactory for second order constructs: *social influence* and *group pressure*.

Indicators reliability can be measured also by the correlation of latent variables with their items. The correlation of a latent variable with each of its indicators must be greater than 0.7. This can be verified by the correlation matrix constructed from SmartPLS outputs.

6.1.2 CONVERGENT VALIDITY

Convergent validity is evaluated according to AVE (average variance extracted) indicators and the unidimensionnality. above demonstrates acceptable values of AVE (>0.5) for all constructs of the research model. To assess unidimensionality in the PLS approach, it is necessary to build the correlation matrix between manifest variables and their latent variables (see Appendix X1 and X2). Correlation matrix already developed is also used to evaluate the convergent validity. It shows a strong correlation of all manifest variables with their indicators (higher than 0.7). Thus, the manifest variables are well unidimensional.

6.1.3 DISCRIMINANT VALIDITY

To assess discriminant validity, we must compare the AVE square root with the latent variables cross-correlations. Indeed, for all first and second order constructs, the AVE square root is greater than cross-correlations (see Appendix X3 and 4). Thus, any latent variable shares more variance with its indicators than with other variables.

6.2 STRUCTURAL MODEL EVALUATION

Validity and reliability of the variables leads us to the evaluation of the structural model and research hypotheses, the second step in PLS approach. The validation of the structural model takes into account the following criteria: the coefficient of determination R^2, the effect size (f^2), the predictive model (Q^2 and q^2) and path coefficients (sign, magnitude, and significance).

6.2.1 THE COEFFICIENT OF DETERMINATION R2

R^2 coefficient is provided by SmartPLS regression. It is calculated only for endogenous variables. So, exogenous variables, which are social influence and group pressure, have no coefficient of determination. High value of R^2 indicates a high explanation power of the model in the studied phenomenon (OSS adoption behavior). Results are summarized in the table 4 below.

Table 4.   Determination coefficient R^2

Endogenous variable	R^2
Adoption	0,562233
Intention	0,354633
Image	0,746797
Normative influence	0,828095
Conformity motivation	0,697617

These results demonstrate that the research model explain more than 56% of the OSS adoption behavior. This percentage is important and demonstrates the relevance of the developed model. Thus, the role of social influence (in its broad sense) on OSS adoption seems important. For other variables (normative influence, conformity motivation, visibility, image), R^2 is also very acceptable. It confirms again the relevance of the model. The explained variance of intention is the lowest in this model (35.46%). This value is significant but small compared to others. As consequence, we can inform that intention is subject to other factors ([9], [10]).

To complete analysis of the determination coefficient, it is recognized to assess the *size of effect* for each exogenous variable impacting other endogenous variables. This indicator is determined through the f^2 value deduced from R^2 values [40].

Table 5.   The effect size of adoption's factors in intention

Exogenous Variable	R^2 Included (intention)	R^2 excluded	$f^2 = (R^2_{in} - R^2_{ex}) / (1 - R^2_{in})$
Social influence	0.355	0.148	0.32
Group pressure	0.355	0.336	0.029

We deduce that social influence explains a large part of intention. In fact, a great portion of intention remains unexplained if we remove social influence. Interpretations are consistent with the statements of Cohen (1988), where the values of 0.02, 0.15 and 0.35 are respectively interpreted as weak, medium and large [14]. For group pressure, the impact appears unimportant on intention since the unexplained part of intention is judged low if group pressure is removed.

6.2.2 PRÉDICTION RELEVANCE (Q2 ET Q 2)

The prediction relevance of the model is judged through the values of Q^2 obtained by blindfolding procedure as presented in the table 6 below.

Table 6.   Prediction relevance of the model (Q^2)

Variable	Q^2 = 1-SSE/SSO
Adoption	0,476864
image	0,492094
Normative influence	0,664574
Social influence	0,545624
intention	0,331853
Conformity motivation	0,619442
Group pressure	0,645703
Visibility	0,610408

According to previous studies ([14]), values of Q^2 greater than zero indicate that the explanatory variables provide a relevant prediction in the model. Values noted in the table 6 (SmartPLS outputs) are very satisfactory for most variables. Thus, the model has an important predictive power especially if we look at adoption and intention prediction (respectively (0.476) and (0.332)). This result demonstrates the ability of the model to predict the individual intention and its adoption behavior toward OSS. Results are satisfactory for first and second order constructs.

Prediction Analyses may be completed by assessment of q^2 values. This criterion evaluates the extent of explanatory variables effect in the prediction of endogenous variables variation. summarizes q^2 values calculated from the data provided by smartPLS.

Table 7. q^2 values for exogenous variable

Exogenous Variable	Q^2 Included (intention)	Q^2 excluded	$q^2 = (Q^2_{in} - Q^2_{ex}) / (1 - Q^2_{in})$
Social influence	0.332	0.138	0.289
Group pressure	0.332	0.315	0.025

Results show that social influence plays an important role in predicting intention. Indeed, the remaining unexplained part of intention in the absence of social influence is important. The value of q^2 is near to 0.3 which is great according to [40]. However, the impact of group pressure is still limited (like its effect size f^2). The unpredicted portion of intention in the absence of group pressure is low.

6.2.3   PATH COEFFICIENTS EVALUATION

Path coefficients evaluation is very important and crucial in PLS analyses. It allows the validation of research hypotheses. Path coefficients should be evaluated according to three criteria: sign, magnitude and significance ([14]).

In this part, we start with hierarchical structure evaluation because it is a part of the structural model. Then, path coefficients and hypotheses will be analyzed.

6.2.3.1   HIERARCHICAL STRUCTURE EVALUATION

Analysis of the hierarchical structure is based on path coefficients between first and second order constructs. below shows results provided by smartPLS outputs.

Table 8.   Evaluation of the hierarchical model

	Second order constructs	
First order constructs	**Group pressure**	**Social influence**
Conformity motivation	0.835	
Normative Influence	0.910	
Image		0.864
Visibilité		0.843

Results demonstrate that structural coefficients between first and second order constructs are high and positive. These results prove the validity and the robustness of the hierarchical structure proposed in the theoretical model. Indeed, path coefficients reflecting hierarchical relations are all higher than 0.8 which is very satisfactory. Given that the hierarchical model is reflexive, we can say that the second order variables are well reflected in their dimensions. Thus, *social influence* is well manifested in the *image* and *visibility*. Likewise, *group pressure* is well reflected in *conformity motivation* and *normative influence*. This is an important theoretical contribution comparing to previous studies in IT/IS adoption and for future researches. Indeed, it introduces new and larger constructs regarding to their dimensions and measurement.

6.2.3.2   SIGN AND MAGNITUDE OF PATH COEFFICIENTS

The structural coefficients presented in the below give an idea about the power of structural relations in the model (the arrow represents the direction of influence). Coefficients are positive and important. The first insight of these results demonstrates that the most important coefficient in the model is that relating adoption intention and adoption behavior (0.75). In addition, the impact of social influence on intention is high (0.51) which means the relevance of social influence as a determinant of OSS adoption. The impact of group pressure is a little low compared to the impact of social influence on intention (0.153). This result demonstrates that the role of group seems not very important. Therefore, signs of structural coefficients are consistent with hypotheses.

Table 9.   Path coefficient values

	Dependant variables			
	Social influence	**Group pressure**	**Intention**	**Adoption**
Group pressure			0.153	
Social Influence			0.510	
Intention				0.750

6.2.3.3 THE VALIDATION OF THE RESEARCH HYPOTHESES

Sign and the magnitude of structural coefficients cannot be completed before studying their significance. The significance is deducted from T values obtained by bootstrap technique. Results as provided by SmartPLS software are listed in the below.

Table 10. Research hypotheses validity

	Path Coefficient	T Statistics (|O/STERR|)	Hypothesis validity
Social influence -> intention	0.510	8,514012	confirmed
Group pressure -> intention	0.153	2,458375	confirmed
intention -> adoption behavior	0.75	19,607996	confirmed

Results prove that research hypotheses are well confirmed. Social influence in the broader sense (social influence and group pressure) has an important role in determining the intention of adopting an OSS. The pressure of group seems to have a much lower impact compared to social influence. These findings can be explained by the specificity of the context in which the study was carried out (Tunisian context).

6.3 EVALUATION OF MEDIATION EFFECT

The last step in PLS analyses is the evaluation on the indirect effects (mediation or moderation). In this paper, the model has only mediation relation between adoption factors (social influence and group pressure) and adoption behavior. The mediation role is played by intention. Statistical evaluation of mediation effects ([8]) showed that the impact of social influence and group pressure are totally mediated by the intention. In fact, the impact of social influence and group pressure on adoption is very important if we control statistically intention (structural coefficient of higher than 0.49). However, this impact is fully mediated by intention. This is an important theoretical contribution. It consolidates also the initial structure of the proposed model and validates the hypothesis 4 and 5.

7 RESULTS DISCUSSIONS AND RESEARCH CONTRIBUTIONS

The aim of this paper is to analyze sources of social influence (in its broad sense) in an organization and to test its role on individual behavior towards OSS adoption. PLS statistical results showed that social influence and group pressure are two favorable factors of OSS adoption. However, social influence seems capture the greater percentage of the impact on intention insofar as the structural coefficient is 0.51.

Social influence has been included, in the current study, as a second order construct compounded of three dimensions: image, visibility and voluntary use. The principal component analysis PCA showed that the third dimension (voluntary use) is not reliable. Thus, it was removed from the model. This result is also founded in previous study ([37]) where the construct was eliminated too.

In addition, the evaluation of hierarchical structure in the model proved the robustness of the relationship between social influence and its two dimensions (high structural coefficients). This result confirms the theoretical composition of social influence. It is important for future IT adoption researches.

The operationalization of social influence has not been well done; it was removed from the TAM [5] and derivative research. Nevertheless, in all dimensions and proposed measures, social influence has always been a significant determinant, positive and direct determinant of intention.

Current study results are consistent with previous ones insofar social influence was identified as an important factor positively influencing the decision to adopt an OSS through intention (structural coefficient rises to 0.51) like many previous studies ([37], [34], [27], [20], [15], [13]). Thus, the visibility and image play an important role in determining the OSS intention adoption.

Moreover, previous studies ([34], [37]) have proposed as a future research to test the direct impact of social influence on adoption behavior. In our study, this was done when we tested the mediating effect of intention between social influence and adoption behavior. Results showed that the impact of social influence and group pressure are totally mediated by intention. This is an important theoretical contribution for future researches.

In the current study, the impact of group pressure on the intention of OSS adoption is significant and positive but low (structural coefficient of 0.153, significant at $p < 0.05$). To compare this result with previous studies, we must examine the impact of social influence and subjective norms concepts on intention behavior (since *group pressure* concept was not used before). In fact, several researchers have found positive impact on intention behavior ([15], [27], [13], [34], [2]).

Furthermore, positive impact of subjective norms on intention was founded before [28]. Subjective norms were operationalized by three dimensions: normative influence, conformity motivation and observed behavior. In our research, we used only the first two dimensions. The third one is integrated into the social influence through visibility. The positive and significant relationship founded (in the current study) between group pressure and intention confirms the previous results ([28]).

Thus, through this study, we can say that group pressure (normative influence and conformity motivation) has a low positive influence on the choice of the appropriate software for individual in an organization. This choice is somewhat influenced by colleagues.

In practical terms, current study' results are important for managers who want to integrate open source solutions in their companies. Knowing that group pressure has a no great influence on the individual intention to adopt an OSS, allows managers to seek other sources of social influence as we have seen above (image and visibility). They can promote creation of group culture and foster a sense of belonging of individuals in the organization. This result is specific to the study context (Tunisians users and companies) where group culture seems not yet widespread. It could be different in other cases which call for future research.

Otherwise, the great impact of social influence founded in this research, suggest to managers to reward pioneers users of OSS applications in the company. By doing this, they can encourage others to follow their behavior given that image is a dimension of social influence concept. Managers are invited also to create an environment of transparency and visibility so that users of OSS solutions are known and visible to everyone in the company. This will positively influence the intention of adopting an OSS as shown in results above (visibility dimension of social influence).

8   CONCLUSION AND FUTURE RESEARCH

This paper is an attempt to understanding the influence of the organizational social interactions on the individual intention to adopt an OSS. Behind the specific case of OSS adoption, the study is interesting insofar it focuses on *social influence* concept in its broad sense to identify possible sources of social interactions in an organizational context. This topic is interesting because previous studies (and measure) of social influence are ambiguous.

Current study' results showed not only the positive impact of social influence on OSS adoption intention, but also the robustness of the hierarchical structure proposed by the model. Thus, two new concepts are introduced and operationalized in the field of IT/IS adoption. Indeed, **social influence** is defined by two dimensions: *Image* and *Visibility*; **group pressure** is compounded of two dimensions: *conformity motivation* and *normative influence*. Future research can directly adopt these concepts as they are more accurate conceptually and operationally.

Validation of the model in other contexts is interesting and proves much more generalization of the current paper findings. Particularly, the weak influence of colleagues remains a specific result to the Tunisian context. It calls for the validation in other contexts.

Like any research, there are always encountered limitations. In this research, voluntary use, the third dimension of social influence, was not reliable statistically. According to the theoretical perspective, this dimension is important. However, measurement problems are encountered not only in this study but also in previous research ([37], [34]).). This result calls for verification of the measurement scale and its integration in future models because it has an important role in accordance with theoretical analyses and even our exploratory previous research ([9], [10]).

Furthermore, we propose to incorporate the influence of "leadership" because it presents the influence of the supervisors which is missing in our current paper. Introducing leadership gives more comprehensive and complete analyses of social interactions in the organizational context.

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APPENDIX X1. LATENT VARIABLE CORRELATIONS (DISCRIMINANT VALIDITY) FOR ALL VARIABLES

	adoption	image	Normative influence	Social influence	Intention	Conformity motivation	Group pressure	Visibility
Adoption	0.93241							
Image	0,457905	0.81851						
Normative influence	0,384010	0,515058	0.89650					
Social influence	0,490724	0,864174	0,538235	0.73866				
Intention	0,749822	0,526768	0,453902	0,579690	0.96771			
Conformity motivation	0,152108	0,307964	0,532070	0,211988	0,182451	0.94293		
Group pressure	0,324066	0,485265	0,909997	0,453243	0,384285	0,835235	0.80355	
Visiblity	0,376020	0,457989	0,400118	0,843081	0,459603	0,045340	0,281892	0.92835

APPENDIX X2 LATENT VARIABLE CORRELATIONS FOR SECOND ORDER CONSTRUCTS

	Adoption	Social influence	Intention	Group pressure
Adoption	0.93241			
Social influence	0,490724	0.73866		
Intention	0,749822	0,579690	0.96771	
Group pressure	0,324066	0,453243	0,384285	0.80355

APPENDIX X3. CROSS LOADINGS (DISCRIMNINANT VALIDITY FOR FIRST ORDER CONSTRUCTS)

	Adoption	Image	Normative influence	Intention	Conformity motivation	Visibility
adop1	0,946077	0,476550	0,408740	0,762063	0,181727	0,379259
adop2	0,918542	0,367719	0,297280	0,624462	0,093563	0,316694
img1	0,342166	0,793781	0,431552	0,399679	0,229654	0,490324
img2	0,373701	0,903836	0,451739	0,502599	0,286964	0,469573
img3	0,319727	0,725782	0,308017	0,309057	0,180650	0,165611
img4	0,465769	0,840313	0,475301	0,488610	0,298258	0,308712
infnorm1	0,300617	0,463228	0,880307	0,373143	0,445543	0,357882
infnorm2	0,304127	0,522087	0,864741	0,393629	0,394656	0,497981
infnorm3	0,376046	0,429418	0,911671	0,422017	0,539981	0,288471
infnorm4	0,389532	0,441522	0,928032	0,436398	0,517570	0,308532
intention1	0,722222	0,497310	0,413072	0,962077	0,150322	0,461494
intention2	0,716141	0,509601	0,440912	0,978067	0,173717	0,432113
intention3	0,737921	0,521926	0,463040	0,962922	0,204854	0,440609
mtvconf1	0,083220	0,255573	0,452031	0,127029	0,930077	0,068335
mtvconf2	0,188226	0,313257	0,538101	0,224414	0,951850	0,030404
mtvconf3	0,154284	0,299970	0,511594	0,160852	0,946744	0,031380
visib1	0,317301	0,415338	0,374012	0,406851	0,089927	0,942293
visib2	0,318013	0,373485	0,384425	0,386491	0,022342	0,942777
visib3	0,408926	0,482950	0,355972	0,483315	0,013931	0,899343

APPENDIX X4 CROSS LOADINGS (DISCRIMINANT VALIDITY OF SECOND ORDER CONSTRUCTS)

	Adoption	Intention	Social influence	Group pressure
adop1	0,946077	0,762063	0,504016	0,354629
adop2	0,918542	0,624462	0,402238	0,239046
intention1	0,722222	0,962077	0,562694	0,342084
intention2	0,716141	0,978067	0,553661	0,371541
intention3	0,737921	0,962922	0,566248	0,401158
img1	0,342166	0,399679	0,756012	0,392590
img2	0,373701	0,502599	0,812493	0,433859
img3	0,319727	0,309057	0,532937	0,288537
img4	0,465769	0,488610	0,684938	0,454767
visib1	0,317301	0,406851	0,784235	0,286782

visib2	0,318013	0,386491	0,759243	0,260476
visib3	0,408926	0,483315	0,801889	0,237830
infnorm1	0,300617	0,373143	0,482769	0,789485
infnorm2	0,304127	0,393629	0,597867	0,754622
infnorm3	0,376046	0,422017	0,423366	0,856796
infnorm4	0,389532	0,436398	0,441912	0,856454
mtvconf1	0,083220	0,127029	0,193363	0,748805
mtvconf2	0,188226	0,224414	0,206784	0,815834
mtvconf3	0,154284	0,160852	0,199146	0,795787