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Can the OSS-Focused Education Impact on OSS Implementations in Companies? A Motivational Answer through a Delphi-Based Consensus Study

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Abstract: In the last few decades, the Open Source Software (OSS) diffusion has grown remarkably in companies. In this context, the present study has analyzed the factors that incentivize OSS implementations for enterprise purposes, linking two perspectives: (1) managerial and (2) educational. Thus, the Delphi methodology was applied to a panel of experts with two aims: (1) to know managers' perceptions about organizational users' motivations toward OSS after receiving OSS training and (2) to develop a forecasting study to examine the OSS diffusion in the medium term in companies and educational centers. In this context, the Self-Determination Theory (SDT) was the theoretical approach through which we identified the motivational factors. Specifically, three SDT motivations were added: (1) autonomy, (2) competence and (3) relatedness. The 104 selected experts were managers from companies with employees who have studied in educational centers where OSS usage is mandatory. The results show that managers perceive that OSS training incentivizes OSS implementations in companies. At the same time, user motivations are considered to be extremely relevant, especially autonomy. In addition, is the results foresee a similar level of OSS implementation in the business and educational fields in the medium term. Finally, conclusions, practical implications and limitations are discussed.

Keywords: Open Source Software; education; companies; Delphi method; perception; motivations; self-determination theory; forecasting

1. Introduction

Open Source Software (OSS) is a set of computer programs with two fundamental characteristics [1,2]: (1) it has been promoted in a collaborative way; and (2) the source code is open and, consequently, it can be modified. As a result, four abilities are identified as being associated with the OSS movement [3]: (1) to implement this software for any intention, (2) to analyze the software functionalities and adapt them, (3) to make copies and (4) to make improvements to the software and distribute it.

In the last few decades, OSS has been a phenomenon with growing popularity [2,4]. Numerous business, economic, education and public administration investigations have echoed this recognition from multiple points of view [2,5–11]. Indeed, many institutions consider that OSS is a credible alternative to proprietary software [9,12]. Thus, OSS is also considered to be a global phenomenon, which tries to control the whole software design cycle [13]. As a result, a large number of projects associated with OSS has emerged in many contexts [14,15].

In this context, the present study analyzes OSS implementations while adopting two types of views: (1) managerial and (2) educational. In a general way, companies consider that OSS offers an option for technological transformation [5,16]. On the one hand, while assuming a development perspective, companies have become increasingly involved in the OSS movement [17,18]. On the other hand, from a commercial point of

view, OSS is progressively being incorporated into commercial products [19]. Indeed, COSS (Commercial OSS) is currently being adopted [6] by many organizations. In addition, according to [20], two ways for integrating OSS in companies have been identified: (1) consolidating OSS components in company proprietary solutions and (2) the company providing its own proprietary software to the OSS community.

As a result, OSS diffusion in companies has obtained many defenders. In fact, the number of OSS projects in the business field has increased notably [6]. Thus, some studies affirm that many firms are using OSS to improve their internal research and development capabilities [5]. However, little literature has systematically evaluated the user motivations toward OSS in companies, and little evidence is available about the key enabling factors of the OSS diffusion. In addition, many companies still face numerous difficulties and challenges when they want to implement OSS solutions [21]. Despite this, the reputation of OSS has been progressively increasing among consumers and firms [22].

The present article is an attempt to fill this gap. It is focused on analyzing the OSS implementation in companies, linking two perspectives: (1) managerial and (2) educational. Specifically, the main aim has been to carry out a study to observe if individuals who have received OSS training previously when they were students, regardless of the educational level, are motivated to use OSS in their organizations. According to [23], "current policies do not efficiently promote a culture of trust and awareness on OSS that is still lacking among public administrations and should be promoted through active policies on training and education". Thus, considering the defined objective and the lack of evidence supporting it, it is presumably difficult to get a significant dataset.

Hence, a Delphi study has been carried out. Indeed, this method is recommended in those fields with little evidence or without a historical dataset. Specifically, Delphi proposes to collect experts' opinions based on a well defined process regarding the selection of experts, the number of rounds and the consensus. The application of this method had two aims: (1) to determine manager perceptions about the organizational user's motivations toward OSS after receiving OSS training and (2) to develop a forecasting study to examine the OSS diffusion in the medium term in companies and educational centers. Therefore, this study includes: (1) motivational factors, (2) enabling factors and (3) OSS implementation impact on education and business. The selected experts are managers in companies with interning students from educational centers where OSS use is mandatory. Most of these experts come from the region of Andalusia (Spain). It is worth noting that the government of this region has provided incentives through the implementation of policies to promote the use of OSS solutions for educational purposes.

Thus, the present article aims to determine the opinions of a set of managers regarding OSS user motivations. This investigation has been supported by the Self-Determination Theory (SDT). This approach considers that users try to satisfy their computational needs that have motivational dimensions. Specifically, this theory is focused on three central intrinsic motivations and psychological needs: autonomy, relatedness and competence.

Based on these aims, two research questions were defined:

RQ1. *Can factors such as popularity, flexibility, cost, ease to use and training determine the implementation level of OSS solutions chosen by companies?*

RQ2. *Can autonomy, competence and relatedness determine the implementation level of OSS solutions chosen by companies?*

After completing this study, some contributions were identified: (1) it has improved the understanding of the factors that explain the level of OSS implementation in companies, (2) it has highlighted the relevant role of OSS-focused education in OSS use and diffusion and (3) it has allowed us to define a forecasting analysis of the level of OSS implementation in educational centers and companies for the year 2025.

The rest of the article is structured as follows. Section 2 shows the theoretical background; Section 3 provides the application of the Delphi method; Section 4 shows the

results and discusses them. Finally, Section 5 discusses the conclusions, limitations and practical implications.

2. Theoretical Background and Research Questions

2.1. Managerial Perspective

The literature shows the numerous connections between OSS and companies. In this respect, Ref. [24] determined three typologies of approaches regarding the relationship between OSS design, companies and communities: (1) symbiotic, when a company tries to co-develop itself and the community (2) commensalistic, when the intention of a company is to prosper by using mutual resources that are regularly replenished, although it participates minimally in the development of these resources, and (3) parasitic, when a company only focuses on its own benefits, without considering that its actions might prejudice the community. In addition, according to [25,26], the highest level of association that companies have with the OSS movement happens when organizations take part in OSS communities by performing tasks such as coding software, supporting the community or co-managing the community.

Moreover, companies can use different types of Information and Communication Technologies (ICT). There is a large number of companies that have used OSS-based ICT [26], such as Open solutions for Enterprise Resource Planning (ERP) systems. This type of ICT provides significant benefits for companies compared to proprietary ERP, such as (1) lower costs, (2) lower inventories, (3) higher productivity, (4) higher operational efficiency and (5) better competitive advantages [27]. In this context, according to [28], ERP vendors have started to consider that OSS brings the same or better capabilities to companies compared to proprietary enterprise systems. Indeed, the OSS abilities, such as providing freedom, flexibility, security, cost effectiveness and high quality have positioned this type of software as a workable alternative to proprietary enterprise systems [19].

Despite the popularity of OSS at present, the spread of this movement has not reached its peak, and research continues on the factors that could expand OSS usage in companies. This popularity is affected by factors such as the provision of OSS user support, the quality of the software [2] or higher visibility of OSS in search engines [1]. In addition, it is expected that OSS solutions reduce costs or increase revenues [29,30]. In most cases, OSS costs are reduced due to the absence of licensing fees [6,31,32]. Other factors, for instance the of flexibility OSS to read, modify and customize the source code as needed [33], contribute to cutting ICT project costs.

At the same time, some studies have analyzed their pros for OSS users. Reference [34] states that OSS users value positively the flexibility, the code availability, the possibility to modify the code, the knowledge sharing through the community and the motivational growth associated with OSS. Further, users perceive OSS as being useful and easy to use. Thus, Ref. [35] demonstrated that these perceptions are due to the influence of factors such as software quality, system capability, social influence and software flexibility.

Based on the previous references, the present study has adopted the following enabling factors while considering the managerial perspective: (1) popularity, (2) flexibility, (3) lower cost, (4) ease to use, (5) and training. The selection of this dimensions has allowed us to define the following research questions:

RQ1. *Can factors, such as popularity, flexibility, cost, ease of use and training determine the implementation level of OSS solutions chosen by companies?*

Motivational factors in OSS communities have been discussed widely by the literature. For example, some researchers, such as [36] or [1], have tried to find out which are the essential incentives for OSS communities to share their knowledge. Other authors have carried out studies about the participants' motivations while adopting different profiles and situations [37–39]. Nonetheless, no research has been identified OSS motivations associated with the educational field. Section 2.2 exposes the background in this respect.

2.2. Educational Perspective

Nowadays, ICT are indispensable for the development of a huge range of educational activities [40–44], and, perhaps, OSS is one of the ICT with the largest spread in educational contexts [32,45]. The educational benefits of OSS are widely recognized [46], such as (1) lower maintenance and implementation costs than proprietary solutions and (2) better conditions regarding licensing agreements [47]. In fact, many public administrations have adjusted their regulations and requirements in order to stimulate OSS implementation in educational contexts [48–50], such as the governments of Andalusia (Spain) and Australia [51].

In addition, OSS enhances the education quality due to providing [34]: (1) better utility; (2) higher student yield; and (3) greater student gratification. In a similar way, OSS provides flexible software through which instructors and students could contribute to effective learning experiences and resources, using an interface that it is appropriate for education [52].

The OSS movement contains parallel principles with teaching fundamentals, such as the feelings of community and teamwork [45]. However, this connection between OSS and education has not been analyzed sufficiently. No evidence has been found regarding the student assimilation of the OSS principles as a factor that drives OSS use in other fields, particularly in a business context. In this context, motivational theories suggest that ICT users have the tendency to address their software needs through emotions. Consequently, Self-Determination Theory (SDT) could contribute a framework to achieve the relevant research purposes. In the following section, this theory is introduced.

2.3. Self-Determination Theory (SDT)

SDT was proposed by [53]. It has been applied as a motivational framework in a huge range of fields [54,55]. In the organizational context, SDT has been mainly used to carry out motivational analysis about organizations [55,56].

On the one hand, this theory is focused on three central intrinsic motivations and psychological needs: autonomy, relatedness and competence [56–58]. These three constructs motivate individuals to complete tasks or actions because they are inherently engaging or pleasant to work on [59]. On the other hand, SDT foundations establish that extrinsic motivations appear when behaviors are performed because of external forces [60–62]. Although SDT does not identify which motivations are predominant, the literature about SDT supposes that autonomy is more essential than the other motivations [63].

According to [64], autonomy refers to the personal acts through which individuals feel that they are controlling their own behavior, without forgetting external factors and initiatives that also exist [65,66]. Competence is associated with a feeling of self-efficacy [65,67]. Furthermore, autonomy is related to self-regulation [54], and relatedness is linked with the desire of being part of a group [57]. Based on these principles, people usually have a psychological state of learning autonomously [68,69], experimenting with internal control over educational aims and findings [70]. Indeed, according to [71], motivations linked with autonomy have a greater influence on personal gratifications than external incentives.

Moreover, relatedness allows us to establish emotional connections with others [54,64]. Based on that, relatedness should be highly present in educational contexts, since it improves the engagement in collaborative tasks between students [72–74]. In fact, Ref. [75] demonstrated that relatedness is a good dimension for measuring the intentions of students to finalize a course. The intrinsic characteristics of educational environments therefore incentivize the activation of the skill to develop links with others [65], through which it is possible to reduce misgivings and raise knowledge sharing about OSS [76].

Finally, competence refers to the desire to be sufficient [68]. In fact, it is related to the effective behavior and the growth of personal capabilities [77,78]. As a consequence, it is possible to define a relationship between competence and benefits based on ICT usage [79]. Based on the previous statements, the following research question was defined:

RQ2. *Can autonomy, competence and relatedness determine the implementation level of OSS solutions for companies?*

3. Method

The Delphi method was used to achieve our research aims. This method has been adopted widely in collecting the opinions of experts in all of the research fields [80]. It is highly recommended for investigations in certain areas where there is almost no historical data [81] or when experts have difficulties attending work sessions [82]. Some relevant considerations must be explored in the use of this method.

Firstly, the basic aim of this method is to determine the consensus or dissensus among experts regarding a topic with that has uncertainty or is poorly explored [83]. Secondly, the selection of the panel of experts is key to this method. In this context, it must achieve two premises to reach the validity of the findings: (1) the participation of experts must have proven experience in the relevant matter, (2) the panel must be heterogeneous. This heterogeneity usually involves divergent levels of knowledge or it is determined by variables such as sex and age [82,84]. Depending on the heterogeneity or homogeneity of the experts, the required size of the panel could be different. In a general way, the more heterogeneous a panel is, the fewer experts are needed for it.

It is critical to solve four issues regarding: (1) number of rounds, (2) consensus, (3) selection of the panel of experts and (4) design and validation of the questionnaire.

3.1. Number of Rounds

A study with two rounds was developed. This is because studies focused on Delphi foundations suggest that the suitable number of rounds could be two or three rounds [85–87]. As a result, most studies that use the Delphi method in the ICT field were designed with two rounds [80]. Additionally, the results tend to improve as the number of rounds increases, although, as a negative consequence, the abandonment rate of participants could also increase [88].

3.2. Consensus

The consensus is asserted when most of the opinions are included within the interquartile range or when there is no significant divergence among the experts' perceptions [85,87,88]. The questions were the same in all the rounds. In the second round, each expert was given their answers in the first round along with the aggregated answers from the expert panel (mainly the median, standard deviation and mean).

3.3. Selection of the Panel of Experts

The selected experts are individuals with enough proficiency in three fields: OSS, business and education. Thus, the experts' knowledge about these matters was previously verified. Additionally, experts with different positions in companies of several industries were selected to ensure the heterogeneity of the panel. All these companies have been using OSS solutions for at least three years.

As previously mentioned, the optimal size of a panel depends on two factors: (1) aims of the study and (2) the heterogeneity of the panel. With this in mind, it a minimum of 20 experts in similar ICT study areas was suggested [80]. A total of 153 invitations were distributed, from which 104 experts participated in the first round, and 81 experts in the second round. This response rate is in line with other studies that have applied the Delphi method [89,90]. Table 1 summarizes the demographic profiles of the experts in the first round. These values confirm the heterogeneity of the panel.

Table 1. Demographic profile of the experts.

Dimension		Number	%
Gender	Male	70	67.31%
	Female	34	32.69%
Age	18–25	0	0.00%
	26–35	7	6.73%
	36–45	29	27.88%
	46–55	28	26.92%
	56–65	40	38.46%
	>65	0	0.00%
Educational level	Ph.D.	8	7.69%
	Secondary School	5	4.81%
	Bachelors	73	70.19%
	Masters	17	16.35%
	Others	1	0.96%
Position	Project Manager	39	37.50%
	Instructor	40	38.46%
	CEO	10	9.62%
	Engineer	1	0.96%
	Doctor	1	0.96%
	Architect	3	2.88%
	Lawyer	3	2.88%
	Administrator	7	6.73%

3.4. Design and Validation of the Questionnaire

A web-based questionnaire was designed after conducting a literature review focusing on topics related to OSS, SDT and Delphi (Table 2). Initially, the Delphi method guarantees the reliability of the questionnaire, although a pre-test was carried out with 11 experts to ensure its robustness. This pre-test helped us to develop the final version of the questionnaire.

Table 2. Questionnaire in the first round.

Section			
First: Demographic and Personal Items			
Gender	Age	Educational level	Position
Second: Self-Determination Items			
Constructs	Items		Source
Indicate your agreement or disagreement with the following items.			
Autonomy (AUTO)	AUTO1	Students felt they had a sense of choice and freedom using OSS.	[68,91]
	AUTO2	OSS education provides interesting options and choices for students.	
	AUTO3	Students have more control while using OSS.	
	AUTO4	OSS gives students more chances to control their own assigned tasks.	
Competence (COMP)	COMP1	Students are better with OSS than other users.	[68,91,92]
	COMP2	OSS students have a stronger capability than other users.	
	COMP3	After receiving an OSS training, students feel competent.	
	COMP4	Students have been able to learn interesting new skills through OSS.	
Relatedness (REL)	REL1	Students really like OSS users.	[91,92]
	REL2	OSS gives students more chances to interact with others.	
	REL3	Students feel close to others while using OSS.	
	REL4	Students have more opportunity to have close connections with others though OSS.	

<div align="center">**Table 2.** *Cont.*</div>

Section			
Third Section: Forecasting Items			
Indicate your agreement or disagreement with the following items.			
Enabling factors	EN1	The popular solutions based on OSS are the ones that will dominate the educational field.	[35,93,94]
	EN2	OSS flexibility allows students to be able to develop their own study tools.	
	EN3	The low cost of OSS will provide people with greater access to educational resources.	
	EN4	The ease of using OSS-based ICT will provide people with access to educational resources.	
	EN5	Most users will use OSS because of their OSS training.	
Indicate the degree of OSS implementation in education in Spain in 2025.			
OSS impact in the educational system	IMPL1	. . . in Pre-school and Primary Education Schools.	
	IMPL2	. . . in Compulsory Secondary Schools.	
	IMPL3	. . . in Advanced Secondary Education Schools (Baccalaureate).	
	IMPL4	. . . in Vocational Skills Education Schools.	
	IMPL5	. . . in Degrees (University).	
	IMPL6	. . . in Postgraduate Education.	
Indicate the impact that a received education in OSS will have on companies depending on its size.			
OSS Impact in companies	IMPACT1	Microenterprise	
	IMPACT2	Small Enterprise	
	IMPACT3	Medium enterprise	
	IMPACT4	Large enterprise	
	IMPACT5	Multinational enterprise	

The experts were invited to participate in the study by e-mail. The e-mail contained the URL of the questionnaire. Three sections can be identified in it: (1) demographic dimensions, (2) motivational questions and (3) forecasting questions. Table 2 shows the variables in each section.

In total, 30 items were incorporated into the questionnaire. In the first section, the experts were asked to indicate their gender, age, position and educational level. In the second section, the experts were asked about some statements related to SDT constructs (autonomy, competence and relatedness). Finally, in the third section, the experts were invited to provide their opinion regarding three groups of variables: enabling factors for OSS implementations, level of OSS implementation in educational centers in 2025 and the impact of received OSS training on different companies by sizes.

In the second and third sections, a five-point Likert scale was used to express the degree of agreement, except for Sections 3.2 and 3.3, in which a percentage scale was used. These types of questions allowed us to obtain probabilistic estimations. In addition, a wide variety of statistical techniques can be applied with these questions.

3.5. Collecting Data and Analysis

The experts were contacted by applying a controlled feedback. This process is essential in a Delphi study [85,88]. Feedback allows experts to obtain aggregate information from the answers obtained in the previous round [80]. Indeed, experts should know the mean, the median, standard deviation and interquartile range for each variable [88]. In this respect, the median is the most relevant measure in a Delphi study and it is recognized as the best statistical method to reach the consensus [85]. In fact, many studies have determined that only communicating the mean to experts may not lead to consensus [35]. Experts were therefore encouraged to be persuaded by the median in their new responses. As a result, in the present study, the experts had access to the mean, median, standard deviation and the first and third quartile in the second round.

4. Results and Discussions

In general, the findings show that a consensus was attained in the second round. Therefore, the experts' opinions regarding the questions were established within the interquartile range (Table 3). While the results in the first round already began to define a weak consensus, the consensus did not become more robust until the second round. Indeed, while considering the value of the median and the number of responses within the interquartile range, it can be highlighted that the standard deviations were reduced, and the experts' opinions were becoming more aligned. Therefore, no more rounds were needed to reach consensus in this study.

Table 3. Results in the second round [1].

Construct	Item	Mean	St. Dev.	Median	Q1	Q3	N° Responses	Inter. Ratio [2]
Autonomy	AUTO1	3.64	0.68	4	3	4	72	0.89
	AUTO2	3.63	0.66	4	3	4	73	0.90
	AUTO3	3.67	0.79	4	3	4	67	0.83
	AUTO4	3.56	0.91	4	3	4	65	0.80
Competence	COMP1	3.52	0.9	4	3	4	65	0.80
	COMP2	3.58	0.83	4	3	4	67	0.83
	COMP3	3.68	0.83	4	3	4	64	0.79
	COMP4	3.78	0.76	4	3	4	67	0.83
Relatedness	REL1	3.32	0.83	3	3	4	66	0.81
	REL2	3.35	0.85	3	3	4	63	0.78
	REL3	3.37	0.84	3	3	4	64	0.79
	REL4	3.4	0.85	3	3	4	64	0.79
Enabling factors	EN1	3.63	0.89	4	3	4	63	0.78
	EN2	3.69	0.82	4	3	4	65	0.80
	EN3	3.99	0.75	4	4	4	48	0.59
	EN4	3.81	0.73	4	3	4	66	0.81
	EN5	3.51	0.76	4	3	4	70	0.86
OSS impact in the educational system	IMPL1	0.36	0.19	0.3	0.3	0.5	51	0.63
	IMPL2	0.43	0.21	0.4	0.3	0.6	54	0.67
	IMPL3	0.43	0.2	0.4	0.3	0.5	51	0.63
	IMPL4	0.43	0.19	0.4	0.3	0.5	51	0.63
	IMPL5	0.42	0.19	0.4	0.3	0.5	50	0.62
	IMPL6	0.44	0.21	0.4	0.3	0.6	55	0.68
OSS impact in companies	IMPACT1	0.4	0.2	0.4	0.3	0.5	49	0.60
	IMPACT2	0.38	0.19	0.4	0.2	0.5	60	0.74
	IMPACT3	0.38	0.18	0.4	0.3	0.4	44	0.54
	IMPACT4	0.4	0.2	0.4	0.3	0.5	46	0.57
	IMPACT5	0.37	0.21	0.3	0.2	0.5	55	0.68

[1] Total number of experts: 81 (Response rate: 78% for the first round). [2] Interquartile ratio: Number of responses within the interquartile range/Total number of experts.

As different sections of the questionnaire were progressed through, the constructs related to the SDT gradually reached the greatest level of consensus for the study. Specifically, more than 80% of the responses regarding the autonomy construct were located within the interquartile range and, in some cases, like the item AUTO2, the interquartile ratio reached 90%. The median was 4, indicating a high level of agreement regarding the proposed assertions. Based on these results, it can be affirmed that the experts considered that employees with previous OSS training are more autonomous and, therefore, they are more motivated to use OSS solutions in an organizational context.

These results are in line with the literature. Thus, in a general way, autonomy-based motivations can be seen to have a greater impact on satisfaction than external motivations [71], as long as as they are referring to the individual feelings through which a

person control their own behavior [65,66,68–70]. In a similar way, Ref. [63] considered that autonomy is more essential than the rest of the SDT dimensions.

In addition, the constructs of competence and relatedness obtained similar results. Both constructs reached levels of consensus in close to 80% of the responses, although the results of these consensus were different for both constructs. On the one hand, the median in the second round for the competence was 4. Based on this result, it was deduced that the experts considered that the acquired competence by individuals who have received OSS training is a relevant factor for effective behavior toward OSS usage for business aims. Therefore, in accordance with the preexisting literature in the theoretical framework, competence can be seen to be a key factor for job satisfaction or levels of job burnout [78].

On the other hand, the consensus for the construct relatedness was analogous. The interquartile ratio for competence was similar, although the general opinion was divergent. The median for relatedness was 3 in all of the items, thereby suggesting that relatedness would have less impact on the motivation to use OSS than competence and autonomy. Thus, the previously described results allow us to answer the RQ2, affirming that autonomy, competence and relatedness can determine the implementation level of OSS solutions for companies. It has therefore been observed that managers consider the motivational factors of potential users to be extremely relevant for OSS implementations in companies.

Consequently, although autonomy and relatedness are not mutually exclusive according to SDT foundations, it is appreciated that autonomy provides a greater perceptions of security towards and confidence in business projects based on OSS. This result seems to indicate that the acceptance of enterprise OSS solutions has managed to surpass the collective experience. These findings could be useful to define a successful adaptation plan for companies that want to transform their ICT from proprietary software to open solutions. In addition, companies with consolidated OSS solutions could improve the acceptance of these measures by designing actions aimed at boosting the users' motivations.

In addition, based on the experts' opinions, the five analyzed enabling factors are relevant for OSS expansion; the popularity of OSS solutions, flexibility, low costs, ease of usage and training strengthen the intention to use OSS in companies. These findings allow for answering the RQ1, affirming that the described enabling factors determine the implementation level for OSS solutions in companies.

Moreover, the experts consider that the OSS implementation level in education will be 40% in all of the educational stages, except for Pre-school and Primary Education Schools, which have 30% implementation levels. In a similar way, the experts indicated that the 40% of companies will be impacted by the received OSS training, regardless of their sizes. Multinational companies are the exception, with 30% expected to be impacted by the received OSS training.

These results demonstrate the necessity of increasing the number of educational programs to incentivize the number of successful OSS implementations in companies. Therefore, organizations need to guarantee that the appropriate OSS implementation and acceptance levels are present if they want to make use of all of its potential. Thus, OSS training does not only seek to improve the OSS skills of users but also to increase motivations to use it. In fact, training is considered to be pivotal when companies want to encourage their employees to use ICT. This training could develop employee self-efficacy and increase their acceptance of OSS.

5. Conclusions

The Delphi method has provided an adequate methodological framework for reaching relevant conclusions related to OSS diffusion in companies. In this context, the received OSS training could be an essential predictor for its diffusion with enterprise purposes. For this assessment, three groups of variables were analyzed: (1) motivational, based on the SDT approach, (2) enabling factors and (3) forecasting factors. Based on this research design, two research questions were defined:

RQ1. *Can factors, such as, popularity, flexibility, cost, ease of use and training determine the implementation level of OSS solutions chosen by companies?*

RQ2. *Can autonomy, competence and relatedness determine the implementation level of OSS solutions chosen by companies?*

The answers to both questions were supported by the findings. On the one hand, regarding RQ1, it was possible to affirm that the described enabling factors determine the implementation level of OSS solutions for companies. On the other hand, in a similar way, it can be asserted that autonomy, competence and relatedness can determine the implementation level of OSS solutions chosen by companies. Specifically, this study has indicated that the main enabling factor is related to the previous OSS training. This strengthens the idea that OSS training is considered by companies to be an essential factor in OSS adoption.

Therefore, the educational system plays an important role in OSS diffusion. It could also be considered that public administrations that are committed to the OSS development could become one of the main actors involved in OSS spreading, for instance by defining educational policies to incentivize OSS usage. In addition, it is remarkable that OSS training was the most relevant enabling factor, standing above other more classic factors, such as flexibility, low cost or popularity. Thus, companies and public administration should collaborate closely to promote the design of educational programs with intensive OSS-based ICT usage.

This same conclusion could be extracted by analyzing OSS's impact on educational systems and companies. In both cases, the experts have considered a similar impact involving the aforementioned implementation level. These results show a similar interest in OSS solutions in the medium term, regardless of the size of a company and the educational stage of its employees. Additionally, since the OSS training received is one of the most influential enabling factors on OSS adoption, companies should support new ways of collaboration with public administrations.

In addition, the present study suggests two implications. On the one hand, it has improved knowledge concerning OSS use and adoption, allowing us to address new research questions in this field. According to the findings, two research questions could be proposed: (1) Are OSS solutions viable alternatives for organizational forthcoming challenges? and (2) Are there additional user motivations that allow us to explain the OSS diffusion in companies? Additionally, the findings can cleared up some of the doubts that companies may have about the motivational factors that could drive the implementation of OSS solutions. In fact, these results could support the development of organizational policies to encourage the use of these solutions.

Finally, the present study is not free of limitations. First, this study has assessed OSS in a general way, without specifying any solution. Additionally, this research design has not considered the characteristics and requirements of the different types of OSS solutions. Therefore, the OSS success and applicability were not evaluated. Second, in a similar way, this work has analyzed the educational impact of OSS on any companies, without considering the different sizes of these companies. As such, the results have not allowed us to reach conclusions that could be drawn on the possible effects of OSS-based education on its use in companies. Both limitations could inspire the design of new investigations.

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