Understanding SaaS adoption: The moderating impact of the environment context

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UNDERSTANDING SAAS ADOPTION: THE MODERATING IMPACT OF THE ENVIRONMENT CONTEXT

Abstract

In the information management literature, Software-as-a-Service (SaaS) is recognized as a technology capable of providing operational and financial benefits to firms, and it is rising as the dominant IT service delivery model. Considered to be a promising solution it is garnering interest among researchers and professionals. However, SaaS can represent a vulnerability to firms due to its nature. The weighing of the pros and cons leads to firms' uncertainty regarding SaaS adoption. Through the lenses of technology-organization-environment (TOE) framework we examine the contextual factors that influence the adoption of SaaS. Furthermore, this study explores the moderating effects of the environmental context in the adoption of SaaS and how it shapes the direct influences of technological and organizational contexts of the TOE framework. Data collected from 259 firms were used to test the proposed model. The study found the significance of the technology, organization, and environment context for SaaS adoption. Moreover, it was found the moderator influence of the environment context between the organization context and SaaS adoption. This study contributes to a deepest understanding of the determinants of SaaS adoption by providing a holistic theoretical lens, advancing newer paths of approaching the TOE framework.

Keywords: Information technology (IT) adoption; Software-as-a-service (SaaS); Technology-organization-environment (TOE) framework; Institutional theory (INT);

1. INTRODUCTION

Software as a service (SaaS) refers to software remotely hosted, developed, managed, and delivered via the internet by a service provider (Cho & Chan, 2015). It is considered to be a promising solution (W.-W. Wu, 2011a), and is garnering interest among researchers and business managers (Chou & Chiang, 2013) with a market forecasted to reach $112.8 billion in 2019 (Goode, Lin, Tsai, & Jiang, 2015). In the information systems (IS) literature, SaaS is recognized as a technology capable of providing operational and financial benefits to firms, and it is rising as the dominant information technology (IT) service delivery model (Subashini & Kavitha, 2011). Notwithstanding, SaaS can represent a vulnerability to firms (Benlian & Hess, 2011), given that it is delivered via the internet, and firms often face serious challenges related to software availability and critical data management (S.-G. Lee, Chae, & Cho, 2013). The weighing of the pros and cons regarding the technological, organizational, and environmental scope, leads to firms' uncertainty regarding SaaS adoption.

Information management literature emphasizes SaaS as a leading type of cloud service (Wu, Lan, & Lee, 2011). SaaS simplified the IT delivery (Sultan, 2013) and several vendors started offering the service, such as Salesforce.com, SAP HRM, Microsoft Office Live, Google Apps, Cisco WebEx web conferencing (Gupta, Seetharaman, & Raj, 2013; Senyo, Addae, & Boateng, 2018). Previous studies have explored cloud computing as a general concept, such as cloud computing success (Garrison, Wakefield, & Kim, 2015), cloud-based e-invoicing (Lian, 2015), cloud computing procurement and implementation (Jones, 2015), and cloud computing security (Rasheed, 2014). However, the literature suggests that there is a significant distinction between the sourcing models that integrate cloud computing. As the determinant factors for SaaS may considerably differ from the other cloud services that incorporate cloud computing (i.e., infrastructure-as-a-service and platform-as-a-service) due to its nature (Schneider & Sunyaev, 2014). As an example, there might be differences between SaaS adoption factors and PaaS, as the former is designed for users and the later that is design for IT developers is considered more complicated (Hsu, Ray, & Li-Hsieh, 2014). Meanwhile, recent research pointed out gaps in knowledge and partial understanding of the topic. Even though the majority of studies addressed the current state and development trends of cloud computing as a global concept, to date, few studies have focused on SaaS using a well-established research framework, theory, and research

methodology (Senyo et al., 2018; Wu et al., 2011), and more research is needed to improve our understanding of the topic (see Table 1).

Over the years several theories and explanatory frameworks have been developed to analyze the IT adoption, which is considered a very important line of research, helping us to understand the technology itself and its effects on a firm's productivity and competitiveness (Bayo-Moriones & Lera-López, 2007; Liu, Ke, Wei, Gu, & Chen, 2010; Oliveira & Martins, 2011). One such framework is the technology-organization-environment (TOE) model (Tornatzky & Fleischer, 1990). The TOE framework explains the different factors that influence innovation adoption at a firm level taking into consideration the technological, organizational, and environmental contexts. A pertinent element of the TOE framework, comparing to other theories and frameworks on IT adoption, is the inclusion of the environmental context in which the institutional theory (INT) was found to be suitable to fill it in (Tajudeen, Jaafar, & Ainin, 2018). The factors included in the INT (DiMaggio & Powell, 1983) widely embraces the environmental institutional constraints that may influence the adoption phenomenon. The INT provides theoretical strength to the environmental context of the TOE framework (Oliveira & Martins, 2011; Soares-Aguiar & Palma-dos-Reis, 2008; Venkatesh & Bala, 2012; Yoon & George, 2013), and deep understanding on the type of pressure exerted that influence SaaS adoption. Early research suggests that both theories (i.e. TOE framework and INT) should be integrated in order to explain more effectively the IT adoption (Cegielski & Hall, 2016).

Since it was introduced, the TOE framework has often been modified either to improve the model, either to be adapted to the context of the technology studied. In the majority of studies, the analysis of the direct effect of TOE contextual factors is well established (Baker, 2012). TOE framework is one of the theoretical frameworks most widely applied to the research of firm-level IT adoption (Oliveira & Martins, 2011; Venkatesh & Bala, 2012; K. Zhu, Kraemer, & Xu, 2006), and is a useful framework to understand the adoption of new technologies, such as software-as-a-service (SaaS). Beyond technological, organizational, and environmental direct influences provided by the TOE framework to understand the technology adoption phenomenon, the literature on SaaS has highlighted a non-direct influence of the institutional environmental factors in the adoption decision process (Schneider & Sunyaev, 2016). According to Schneider and Sunyaev (2016), the reason for such an outcome is related to the uniqueness of the SaaS environment, such as the

uncertainty that emerges from the lack of transparency, and the immature legal situation that may allow for legal conflicts on data privacy. Even though new updates have been made in order to better protect European citizens data privacy through the GDPR (that was implemented in 25 May 2018), due its initial stage there are no evidence of their impact when it comes to SaaS. Thus, it seems that the outcomes of the institutional environmental pressures are mixed, as Kung, Cegielski, and Kung (2015) found a direct positive influence of mimetic and normative pressures on the intention to adopt SaaS. Although the study suffers from an incomplete sample (i.e., IT managers from manufacturing and retailing organizations), making it difficult to generalize, the results of the institutional influences are conflicting. To bring clarification on earlier results, new approaches of the institutional environmental pressures are needed. In their research on green supply chain management practices adoption, Q. Zhu and Sarkis (2007) approached matters differently by assessing the role of environmental pressures as moderators. Although they did not use the TOE framework in their study, they established the moderator effect pattern of the institutional pressures on the effect of green supply chain management practices and the organizational process. In light of the conflicting results surrounding the environmental factors regarding SaaS, and in the way of how can it shape the relationships between the remain contexts (i.e. technology and organization), the following question arises: *what are the technological, organizational, and environmental drivers for SaaS adoption, and how does the environmental context moderate the remaining contexts?*

Answering this question provides a deeper understanding on SaaS adoption and brings new avenues for exploring the TOE framework. Previous research suggest that future should address this topic using well-established research frameworks, models, theories, and research methodologies (Senyo et al., 2018). The application of TOE framework fills this gap. Also, IT literature reveals lack of understanding on the extent of influence of the institutional pressures on SaaS (Yigitbasioglu, 2015), as the moderating effects arises from the environment in which firms operate (Kreuzer, 2017). Earlier research reported little understanding of the moderating effects in the IT adoption research (Mohtaramzadeh, Ramayah, & Jun-Hwa, 2018). IT literature has a gap regarding the impact of the moderator effects within the TOE framework and its importance in innovation adoption concerning the possible external factors (Alsaad, Mohamad, & Ismail, 2018; Venkatesh & Bala, 2012). Assessing the moderating influences of the environmental factors over the technological and organizational factors provides a more contextualized view of the topic under

study and the TOE framework itself (O'Leary-Kelly, Martocchio, & Frink, 1994). We develop a conceptual model incorporating the TOE framework and the INT theory for understanding SaaS adoption. We argue that this integration (of the TOE framework and INT theory) will enhance the explanatory power of our model to elucidate the SaaS adoption phenomenon (Oliveira & Martins, 2011). Moreover, our study assesses the role of the environmental factors as moderators in the TOE framework.

The paper is structured as follows. We begin by discussing the broader literature on SaaS. We then introduce SaaS, TOE framework, and INT theory. Next, we present the research model and hypotheses, followed by methodology, data analysis, and results. Finally, we discuss our findings and propose some avenues for future research.

2. LITERATURE REVIEW

Software-as-a-Service

IT literature reports that SaaS enables firms to access software applications in an outsourcing arrangement (Goode et al., 2015). It allows providers to offer on-demand access to several software products in a multi-tenant architecture (Benlian & Hess, 2011). Firms remotely access software that is hosted in an off-premise location via the internet (Espadas et al., 2013), and the responsibility for the regular development and software maintenance resides with the service provider (Cho & Chan, 2015). Due to its IT architecture, SaaS offers several benefits, from the lower implementation costs to the improvement in software quality (Choudhary, 2007). Few researchers have addressed the SaaS adoption topic (W.-W. Wu, 2011). Table 1 lists the studies focused on SaaS.

Firms decisions are shaped considering the specific environment where they are established (DiMaggio & Powell, 1983; Ke, Liu, Wei, Gu, & Chen, 2009). Consequently, the environment factors are quite relevant for the adoption of IT technologies such as SaaS (Kim, Jang, & Yang, 2017). They represent the firms' ecosystem where multiple actors (i.e. suppliers, vendors, authorities) act in an institutionalized structure (Hartmann, Wieland, & Vargo, 2017). Previous research acknowledge the importance of the environment's role evaluation in the technology adoption scope (Dowell & Muthulingam, 2017). Specifically in SaaS, Xin and Levina (2008) included the institutional influences in their study to study SaaS adoption, however, without

offering empirical evidence of its applicability. Benlian et al. (2009) concluded that the social determinants are main influencers for SaaS adoption. They draw their study based on transaction cost theory (TCT), resource-based view (RBV), and the theory of planned behavior (TBP). Their does not give a complete examination of the environment institutional pressures (i.e. normative, coercive, or mimetic). Wu (2011) used diffusion of innovation's theory and technology acceptance model (TAM) to study SaaS adoption, and suggest that social influence is a very important element for SaaS adoption. However, the pattern of the influence was unclear. Lee at al. (2013) employed the political, economic, social and technological analysis (PEST analysis) to analyze the characteristics of SaaS markets in their initial stages of the diffusion process. Although they sought to improve knowledge from a multi-angular point a view, their data were limited to 24 surveys from IT consultants. Yang et al. (2015) explored SaaS environmental contexts, yet, their study focused on only the direct effects of the variables. Kung et al. (2015) used INT theory to assess the adoption of SaaS in manufacturing and retail firms. Their study examined the moderating role of complexity in the INT variables pressures. Weerd et al. (2016) used organizational factors for the study of SaaS adoption. However, their study did not explore the technological and the environmental factors.

The majority of studies on SaaS adoption have focused on assessing the direct effects of a limited set of factors without assessing the moderator influences. Despite the relevance of earlier studies for the understanding of SaaS, researchers have been suggesting that testing the moderating effects accounts for a significant part of the growing body of empirical research findings in IS (Carte & Russell, 2003), as there are gaps of understanding of the moderating effects in the IT adoption research (Mohtaramzadeh, Ramayah, & Jun-Hwa, 2018). Identification of the direct factors for SaaS adoption is important, however understanding how they may be affected by possible moderators is not less important. Considering the more profound understanding of the phenomenon that the moderator variables could give us, more effort should be made to assess its influences on SaaS. In this study, we respond to this demand. To the best of our knowledge, no study has undertaken a comprehensive approach to understand the moderator influences.

Table 1: Studies on SaaS diffusion

Author(s)	*IT*	*Theory / framework*	*Drivers*	*Data*	*Comments*
Weerd, Mangula, and Brinkkemper (2016)	SaaS adoption	TOE framework	Top management support	21 interviews	Focused on only the direct effects of the variables.
Yang, Sun, Zhang, and Wang (2015)	SaaS readiness	TOE framework	*Technological*: Simplicity, compatibility, experienceability, relative advantage. *Organizational*: Top management support, IT infrastructure. *Environment*: Partner pressure, competitor pressure. *Others*: Attitude toward SaaS Intention to use SaaS	173 firms	Focused on only the direct effects of the variables.
Kung et al. (2015)	SaaS adoption	Institutional theory, DOI theory		289 retail firms	Did not examine the moderating role of the INT variables' pressures on technological and organizational contexts.
S.-G. Lee et al. (2013)	SaaS adoption	PEST analysis	Customer factors, market factors, economic factors, supplier factors, political factors, social factors, technological factors.	3 firms (24 responses)	The research aimed to improve knowledge from a multi-angular point a view, yet, the data were limited to 24 IT consultants.
W.-W. Wu, Lan, and Lee (2011)	SaaS adoption	Perceived Risks and Perceived Benefits	Perceived Risks and Perceived Benefits factors		Focused on only the benefits and risks, neglecting other technological, organizational, and environmental factors.
Benlian and Hess (2011)	SaaS adoption	Opportunity-risk framework	Salient risks beliefs, salient opportunities beliefs.	349 IT executives, Germany	Did not consider possible environmental factors.
Benlian, Koufaris, and Hess (2011)	SaaS quality and usage continuance	IS SERVQUAL	Responsiveness, rapport, reliability, features, flexibility, security, SaaS quality, satisfaction, perceived usefulness, SaaS continuance intention.	172 firms	Limited insights into the influence of technological, organizational, and environmental factors on SaaS.

Author(s)	*IT*	*Theory / framework*	*Drivers*	*Data*	*Comments*
Fan, Kumar, and Whinston (2009)	SaaS and traditional software	Game theory approach	Comparative statistics		Did not consider moderator factors.
Benlian, Hess, and Buxmann (2009)	SaaS adoption	Resource-based view, Transaction cost theory, Theory of planned behavior	TCT: Application specificity, application adoption uncertainty. TPB: attitude toward SaaS-adoption, subjective norm. RBV: Application inimitability, strategic value of application.	374 IT executives, Germany	The study did not examine how the social determinants influence the adoption (i.e. normative, coercive, or mimetic).
Xin and Levina (2008)	SaaS adoption	Production cost economics, Resource based view, Property rights theory, Institutional theory, IT governance theory.	Degree of desired software customization, demand uncertainty for client-specific functionality, demand uncertainty, number of users, client's IT capability and cost, institutional influences and IT architecture.		Not empirically validated.
Choudhary (2007)	SaaS and perpetual licensing software	Two-period quality model	Price in period, software quality, buyer type, ratio of second-generation vs. first-generation users, ratio of cost of quality (SaaS *vs*., perpetual licensing), benefit from basic features, component of utility function, social welfare under perpetual licensing and SaaS.		Modeled the differences in how new software features are disseminated in SaaS and perpetual licensing.

TOE Framework

The TOE framework enables researchers to grasp the broader picture in which the innovation occurs, integrating the different factors that influence adoption into their respective context (Baker, 2012; Bose & Luo, 2011; Venkatesh & Bala, 2012). These contexts (i.e., technological, organizational, and environmental) influence the adoption of IT innovation at a firm level (Tsou & Hsu, 2015; K. Zhu, Kraemer, et al., 2006). In existing research, the TOE framework has received considerable empirical support, as it has been applied to the study of several types of technology adoption (Yeo & Grant, 2018)(Maduku, Mpinganjira, & Duh, 2016). Among the different types of technologies, it was used to study cloud computing (Low, Wu, & Chen, 2011; Oliveira, Thomas, & Espadanal, 2014; Senyo, Addae, & Boateng, 2018) and green IT (Bose & Luo, 2011).

Notwithstanding, the TOE framework alone neglects the impact of inter-organizational relationships (Chan & Chong, 2013). The firms environment is characterized by institutionalism and ambiguity, that can bring both opportunities (i.e. new technology and resources) and constraints (i.e. regulation in the decision process) (Bradley, Shepherd, & Wiklund, 2011). In na increasingly globalized market the exogenous factors have extended (Zhang & Dhaliwal, 2009). Its scope goes beyond competition and covers a wide range of factors such as culture and social ones (Damanpour & Schneider, 2006; Wejnert, 2002). Not considering the relevant combination of exogenous factors may lead to inconclusive findings (Lucianetti, Chiappetta Jabbour, Gunasekaran, & Latan, 2018). Firms must be capable to align the environment landscape in terms of the their strategical decisions (R. P. Lee, 2010).

IT literature reports that INT theory has the strength to reinforce the environmental context of the TOE framework (Oliveira & Martins, 2011; Soares-Aguiar & Palma-dos-Reis, 2008; Venkatesh & Bala, 2012; Yoon & George, 2013). The INT theory specifies distinct institutional pressures, such as coercive (pressures exerted by institutions on which firms depend), normative (pressures emerging from professionalization) and mimetic pressures (arising from an imitation process, that emerge from the firm's environment and shapes its behavior) (DiMaggio & Powell, 1983; Ke, Liu, Wei, Gu, & Chen, 2009). The theory posits that the firm's decision is beyond rational thinking, and instead drifts from its institutional context: firms tend to maximize their legitimacy in the decision-making process through the support of their institutional environment (Heikkilä, 2013; Kostova, 1999), and act according to what is expected, justifying their decision (Cui & Jiang, 2012; DiMaggio & Powell, 1983). Previous studies who have applied the INT together with the TOE framework in such a manner, advocate its ability to emphasize the environmental drivers (Tajudeen et al., 2018). INT theory has been successfully applied to the study of electronic supply chain management (Ke et al., 2009), e-procurement (Soares-Aguiar & Palma-dos-Reis, 2008), electronic human resource management (Heikkilä, 2013), green IS (Butler, 2011), an intranet (Baptista, Newell, & Currie, 2010). INT pressures were found to be a significant determinant for the adoption of technology adoption, specifically when it comes in terms of remote based systems like SaaS (Tajudeen et al., 2018). However, the INT does not consider the technological and organizational factors that influence the adoption process. Integrating INT theory in the TOE framework thus fills this gap (Tornatzky & Fleischer, 1990) and enhances the explanatory power of the conceptual model (Oliveira et al., 2014).

Drivers emerging from the literature

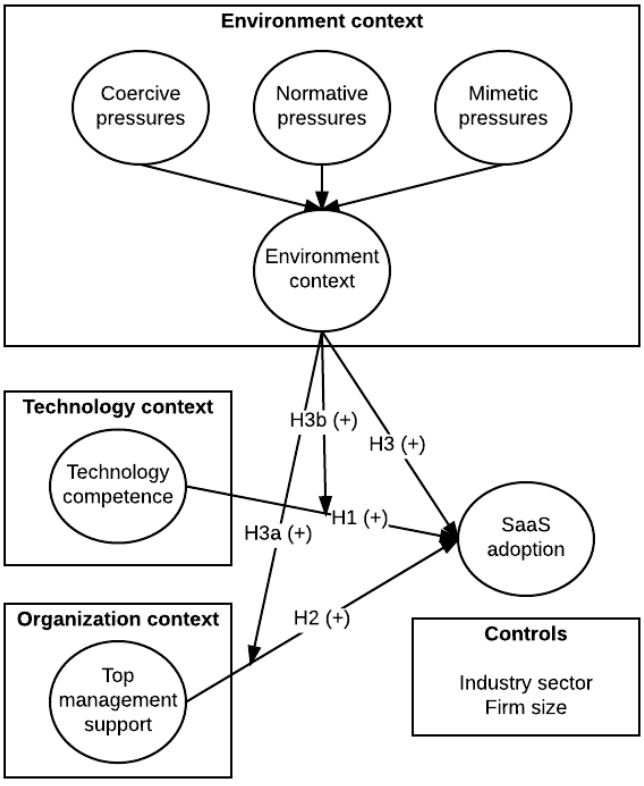
Following previous research that applied the TOE framework in their studies, a two-step process (Venkatesh & Bala, 2012; K. Zhu, Kraemer, et al., 2006) was undertaken to identify and gather the set of relevant factors for the study of SaaS adoption (Zhu, Kraemer, & Xu, 2006). First, we based our variable identification on prior research that applied the TOE framework. Through a scholarly databases search (i.e. Proquest, EBSCOHost's, Academic and Business Source, Google scholar) we gathered the most consistent significant constructs from well cited published studies. Then, we examine each factor and analysed its suitability to the study of SaaS adoption. Among the technological factors, technology competence (Venkatesh & Bala, 2012; K. Zhu, Dong, Xu, & Kraemer, 2006; K. Zhu & Kraemer, 2005; K. Zhu, Kraemer, et al., 2006), which refers to the technological structure and IT knowledge (K. Zhu & Kraemer, 2005), was seen as relevant. From the organizational context we identified top management support (Bose & Luo, 2011; Chan & Chong, 2013; Oliveira et al., 2014; Yang et al., 2015), which ensures the convergence of the organization interests around the new technology (S. Lee & Kim, 2007). From the environmental context, competitive pressure and regulatory support were the most important (Bose & Luo, 2011; Oliveira et al., 2014; Thomas, Costa, & Oliveira, 2016; K. Zhu & Kraemer, 2005). However, it is our understanding that these factors do not provide broad environmental coverage for the study of SaaS adoption. Plus, competitive pressure and regulatory support factors already embedded in the INT theory, cover more comprehensively all the possible external forces that may influence SaaS adoption (DiMaggio & Powell, 1983; Yang et al., 2015). Institutional pressures were found to be important influencers of adoption in earlier studies (Bala & Venkatesh, 2007). Thus, the INT pressures were the selected factors identified from the environmental context (Powell & DiMaggio, 1991; Teo, Wei, & Benbasat, 2003).

3. CONCEPTUAL MODEL

The proposed model for this research incorporates two well supported theoretical lenses: the TOE framework (Tornatzky & Fleischer, 1990) and the INT theory (DiMaggio & Powell, 1983). The integration of both theories enhances the explanatory power of the models (Tajudeen et al., 2018). Based on the TOE framework, three categories of factors are considered as potential influencers of SaaS adoption (i.e., the technology, the organization, and the environment). Based on the literature we selected technology competence in the technology context (Venkatesh & Bala, 2012;

K. Zhu, Kraemer, et al., 2006). Top management support was nominated for the organization context (Chan & Chong, 2013; Oliveira et al., 2014). Normative, mimetic, and coercive pressures from the INT were nominated in the environmental context. In order to answer our initial question, "*how does the environmental context moderate the influence of technological and organizational contexts in the adoption process?*" we propose that the environmental context not only has a direct effect on adoption of SaaS (as usual in adoption model literature) but also moderates the remaining contexts. As previous research reported little understanding of the moderating effects in the IT adoption research (Mohtaramzadeh, Ramayah, & Jun-Hwa, 2018), we intend to advance understanding of how the different effects of technological and organizational contexts are shaped by the environmental contexto in SaaS context. Figure 1 presents the conceptual model for SaaS adoption.

Figure 1: Conceptual model of SaaS adoption



The Role of Technology-related Factors

Technology competence encompasses the technical infrastructure and human knowledge that can influence the firm's adoption of an innovation (K. Zhu & Kraemer, 2005). It was found to be an important driver of IT adoption (Abdollahzadehgan, Gohary, & Amini, 2013; Low, Chen, & Wu, 2011; Zhu et al., 2006). Although the IT architecture on SaaS shifts the responsibility of the maintenance, availability, and security procedures from the client side to the supplier, the diversity of SaaS-based solutions and industry-specific requirements may require ongoing control of the legal and organizational compliance. Prior research suggest that further understanding of how these competencies may be instrumental is worthy to address (Bassellier, Benbasat, & Reich, 2003). In such case, technology competence would be essential to ensure that the procedures are being appropriately addressed. Earlier research found this factor relevant to the understanding of the adoption of other technologies (Garrison, Wakefield, & Kim, 2015; Oliveira & Martins, 2011). In this study, we posit that technology competence will have a positive effect on SaaS adoption. Thus:

H1. Technology competence will positively influence SaaS adoption.

The Role of Organizational Factors

Top management support plays a vital role in the adoption of new technologies (Liang, Saraf, Hu, & Xue, 2007) and it is well-recognized in the literature as a key determinant for the success of IT projects (Bose & Luo, 2011; Maduku, Mpinganjira, & Duh, 2016). Several studies have been conducted using this variable for the study of the IT diffusion. For example, Hsu et al. (2018) invoke the important role of top management on the firms strategies and decisions. Top management support has been theorized in the literature since the 60s, and since then has been identified as a critical factor to the success of key organizational activities (Brady, 1967; Ragu-Nathan, Apigian, Ragu-Nathan, & Tu, 2004). Although it is mainly recognized by its positive influence, early research also suggest that too much support of top management may in fact have the opposite effect, and its absence may have no impact on the course of events (Young & Jordan, 2008). Nonetheless, the majority of the studies support the positive influence of this factor on IT adoption. Typically, new technological adoptions are deployed from the top down (i.e. from top management to the bottom of the hierarchical structure) (Gangwar, Date, & Ramaswamy, 2013).

Top management can give an important strategic message, bringing together the firm's efforts toward SaaS adoption, helping to reduce possible conflicts or resistance toward SaaS (F. Wu, Mahajan, & Balasubramanian, 2003), as employees better recognize the value proposition of SaaS when top management supports the initiative. Top management supports the increased intention to adopt SaaS.

The Role of the Environmental Factors

Research lacks for understanding on what extent institutional pressures influence cloud services (Yigitbasioglu, 2015). Although previous studies suggest that firms decisions are tempered in presence of institutional pressures (Ang & Cummings, 1997) recent research lacks for its application in SaaS scope and TOE framework design. The environment context is based on INT theory (DiMaggio & Powell, 1983), and includes normative, mimetic, and coercive pressures. Each variable is triggered from a different institutional angle that instigates the firm's action distinctively. The coercive pressures refer to the submission of the focal firm to the pressure from other institutional entities such as government, etc. Resource-dominant organizations, parent corporations, government regulators, and associations are sources of such coercive pressures (Liang et al., 2007; Teo et al., 2003). The degree of coercive strength from these entities determines specific formal or informal pressures on the firm's actions (DiMaggio & Powell, 1983; Teo et al., 2003). In the normative pressures, the institutional angle is related to what is shared between firms, persuading firms to accept the shared decisions from the entities that promote that pressure. Examples of pressure sources include customers, the general public, and suppliers (F. Wu et al., 2003). Normative pressures are formed from the norms, rules, and information shared between firms (Powell & DiMaggio, 1991). In the mimetic pressures, the institutional angle has to do with what the rival entities are accomplishing, leading to a copying posture from the firms. Mimetic pressures describe the imitative behavior of firms toward similar organizations to capture their success (Glover, Champion, Daniels, & Dainty, 2014; Teo et al., 2003). Learning with their peers, firms achieve economic advantages by minimizing experimentation costs (Levitt & March, 1988). It is, therefore, reasonable to believe that the INT variables represent specific factors of the environment context, i.e., INT variables are the first-order construct, and these constructs are formative of the second-order construct, which is environmental context (reflective-formative type) (Ringle, Sarstedt, & Straub, 2012).

The environment context reflects the environment surrounding the firm's activity (Tornatzky & Fleischer, 1990). Elements like the industry, competitors, and regulatory bodies illustrate the environment context (Venkatesh & Bala, 2012). Interacting with these elements allows the firms to take advantages, but also constrains its activities (Damanpour & Schneider, 2006). The elements converted into institutional pressures are found to be significant for SaaS adoption (Yoon & George, 2013). According to the IT literature, firms maximize their legitimacy in the decision process through the support of their institutional environment (Heikkilä, 2013; Kostova, 1999). Jansen, Van Den Bosch, and Volberda (2006) argue that environmental factors moderate the effectiveness of some types of innovation. They support that several managerial implications are balanced from the environmental pressures. Other studies also report a significant moderator effect of the environmental factors on the company's performance (Wang, Chen, & Chen, 2012). Firms operate as part of a specific environment, and their decisions are shaped by its context (DiMaggio & Powell, 1983; Ke et al., 2009). Although earlier studies report a direct influence of the environmental context in SaaS adoption (Yang et al., 2015), there is no evidence of the possible moderating effects that this context can produce in the technological and organizational contexts to explain the adoption process. As firms are part of a distinct surrounding environment, and their actions are affected by it, it is legitimate to question if the environmental context somehow influences the remaining contexts of the TOE framework. Therefore, in this study, we posit that the environmental context may positively moderate the SaaS adoption process. Thus:

H3. Environment context positively influences SaaS adoption.

H3a. Environment context moderates the relationship between technology competence and SaaS adoption.

H3b. Environment context moderates the relationship between the top management support and SaaS adoption.

Control variables

Firm size and industries are used as control variables (K. Zhu, Dong, et al., 2006). These variables help us to considerer the differences between the firms (Liang et al., 2007).

4. RESEARCH METHODOLOGY

Measurement

An instrument was developed, and a questionnaire survey was conducted for collecting data. The constructs were adapted from published literature regarding the SaaS context (see Table 2), using a seven-point numerical scale. For content revision and validity, a panel of experts of five IS professionals and IS researchers was formed. Based on their observations, we rewrote some of the items to improve the clarity of our questionnaire. Then, we undertook a pilot test in a sample of 30 firms. The results demonstrate evidence of the validity and reliability of the instrument.

Table 2: Measurement Items

Constructs	*Authors*
Tech Competence Is the IT infrastructure in my firm able to adopt SaaS? Is my firm committed to ensure that SaaS is familiar to employees? Does my firm have good familiarity with SaaS?	Chan and Chong (2013)
Top Manag. Support My management is likely to take the risk involved in implementing SaaS. My management proactively makes efforts for the adoption of SaaS. My management transmits its support for adoption of SaaS.	Chong and Chan (2012)
Coercive Press. It's our government's intention that our firm adopts SaaS. It's our industry association's intention that our firm adopts SaaS. The competitive environment forces our firm to adopt SaaS.	Liang et al. (2007)
Normative Press. Our suppliers are increasingly adopting SaaS. Our customers are increasingly adopting SaaS. Did the Government influence your firm to adopt SaaS?	Liang et al. (2007)
Mimet. Press. The adoption of SaaS is positively perceived by our competition. The adoption of SaaS has greatly benefitted our firm. The adoption of SaaS is positively perceived by our customers and suppliers.	Liang et al. (2007)
SaaS Adopt. My firm is devoted to adopting SaaS. The business processes in my firm require the adoption of SaaS. Some of my firm's departments require the adoption of SaaS.	Chan and Chong (2013)

Data collection

A survey instrument was developed and distributed online to a list of 2,000 companies of Dun & Bradstreet, considered one of the world's leading sources for business. To maximize the response

rate, several procedures were undertaken. First, we used the "key informant" approach for data collection (Oliveira et al., 2014; Pinsonneault & Kraemer, 1993). This approach was helpful for identifying qualified respondents. Second, we sent a follow-up message of the original invitations. Thus, the non-respondents received a follow-up email after two weeks. At the end of eight weeks, a total of 259 usable responses were obtained (165 early respondents and 94 late respondents). The response rate was of 13%. Comparing the early and late respondent groups, the results from the Kolmogorov–Smirnov (K–S) test indicate an absence of non-response bias (Ryans, 1974). Third, we offered to share the results of the research. The common method bias was examined in two ways. First, Harman's one-factor test (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) confirms that none of the factors individually explain the majority of the variance. Second, using a marker variable approach (Lindell & Whitney, 2001), adding a theoretically irrelevant marker variable in the research model, obtaining 0.044 (4.4%) as the maximum shared variance with other variables; a value that can be considered as low (Johnson, Rosen, & Djurdjevic, 2011). No significant common method bias was found. The majority of the respondents were qualified – yielding 60% rate of board managers, CIOs, and heads of IT. Table 3 shows the characteristics of the respondents.

Table 3: Sample (n=259)

Industries	*N=259*	*%*	*Respondent's position*	*N=259*	*%*
Services	117	45%	Board member	21	8%
Manufacturing	82	32%	CIO	5	2%
Commerce	24	9%	IS Manager	130	50%
Construction	21	8%	Other Manager	140	40%
Health	9	4%			
Information/ communication	6	2%			

Firm size (number of employees)	*N=259*	*%*
Micro (=<10)	20	8%
Small (11-50)	54	21%
Medium (51-250)	126	49%
Large (>250)	59	22%

5. DATA ANALYSIS

The partial least squares (PLS) technique was applied in this study. The reason for using PLS is because it is a useful technique for analyzing topics that have not been tested before (Ke et al., 2009; Teo et al., 2003). The PLS allows latent constructs to be modeled with formative indicators (Goo, Kishore, Rao, & Nam, 2009). Also, the PLS technique prevents restrictive distributional assumptions when determining path coefficients that are significantly different from zero (Fornell & Bookstein, 1982; Gefen & Straub, 2005; Goode et al., 2015). Our research model has never been tested before; the variables are not normally distributed ($p<0.01$, Kolmogorov–Smirnov's test) (Chin, Marcolin, & Newsted, 2003), and include formative constructs. Therefore, PLS is an appropriate method for this study. Smart PLS 3.0 (Ringle, Wende, & Becker, 2015) was used to evaluate the reliability and validity of the measurement model, and analyze the structural model.

Measurement model

A measurement model was conducted to assess the construct reliability, convergent validity, indicator reliability, and discriminatory validity of scales for the reflective constructs. The results of the measurement model are shown in Tables 4 and 5. Construct reliability was tested using the composite reliability (CR). The CR results are higher than 0.7 for all constructs (Table 4), indicating the appropriateness and internal consistency of the constructs (Henseler, Ringle, & Sinkovics, 2009; Straub, 1989). Convergent validity was demonstrated using average variance extracted (AVE). The AVE values are higher than 0.50 for all constructs (Table 4), and thus the convergent validity of the measurement model is established (Fornell & Larcker, 1981; Hair, Sarstedt, Ringle, & Mena, 2012). To achieve indicator reliability, the loading should be higher than 0.7 (Churchill, 1979; Henseler et al., 2009). In Table 5 we see that all loadings are higher than 0.7, and consequently, the reliability indicator is satisfied.

Table 4: Descriptive statistics, correlation, composite reliability (CR), and average variance extracted (AVE)

	Mean	*SD*	*CR*	*Tech Comp*	*Top Manag. Support*	*Coerc. Pressures*	*Normat. Pressures*	*Mimet. Pressures*	*SaaS Adoption*
TC	3.906	1.330	0.857	**0.817**					
TMS	3.781	1.627	0.960	0.679	**0.943**				
CP	2.596	1.476	0.925	0.270	0.294	**0.897**			

NP	3.036	1.299	0.907	0.487	0.478	0.560	**0.874**		
MP	2.960	1.420	0.980	0.390	0.443	0.661	0.546	**0.970**	
SaaS Adop	2.934	1.694	0.951	0.572	0.589	0.564	0.633	0.546	**0.931**

Notes: Values in diagonal (bolt) are the AVE square root; standard deviation (SD).

Fornell-Larcker criteria, cross-loadings, and the heterotrait-monotrait ratio (HTMT) (Henseler, Ringle, & Sarstedt, 2015) were used to examine the constructs' discriminant validity. We assess the discriminant validity of each construct using the correlation between constructs and AVE squared root. As shown in Table 4, the AVE square root of each construct (diagonal elements) is higher than the correlations between the constructs. Thus, the first criterion for the discriminant validity of the constructs is supported (Fornell & Larcker, 1981). The second criterion for discriminant validity is that the loadings (in bold) should be greater than cross-loadings (Chin, 1998). In Table 5, the loadings (in bold) are greater than the cross-loadings. Finally, based on Table 6, all the HTMT are lower than the threshold of 0.9. Thus, the discriminant validity of the constructs is confirmed.

Table 5: Loadings and cross-loadings

Construct	*Item*	*TC*	*TMS*	*CP*	*NP*	*MP*	*SaaS Adop*
TC	TC1	**0.733**	0.491	0.105	0.306	0.272	0.342
	TC2	**0.884**	0.629	0.331	0.503	0.404	0.565
	TC3	**0.828**	0.530	0.178	0.352	0.260	0.456
TMS	TMS1	0.618	**0.919**	0.195	0.407	0.372	0.490
	TMS2	0.616	**0.953**	0.294	0.468	0.412	0.560
	TMS3	0.682	**0.956**	0.330	0.471	0.462	0.605
CP	CP1	0.187	0.223	**0.920**	0.494	0.521	0.470
	CP2	0.207	0.213	**0.910**	0.440	0.517	0.451
	CP3	0.320	0.343	**0.858**	0.560	0.718	0.581
NP	NP1	0.453	0.471	0.521	**0.918**	0.510	0.625
	NP2	0.451	0.427	0.407	**0.865**	0.484	0.541
	NP3	0.371	0.351	0.538	**0.837**	0.435	0.488
MP	MP1	0.392	0.453	0.651	0.543	**0.958**	0.569
	MP2	0.384	0.426	0.616	0.509	**0.981**	0.517
	MP3	0.359	0.411	0.655	0.535	**0.972**	0.503
SaaS Adop	SaaSa1	0.577	0.616	0.443	0.583	0.467	**0.901**
	SaaSa2	0.513	0.487	0.546	0.588	0.520	**0.948**
	SaaSa3	0.507	0.540	0.583	0.595	0.536	**0.943**

Table 6: Heterotrait-Monotrait Ratio (HTMT)

Construct	*TC*	*TMS*	*CP*	*NP*	*MP*	*SaaS Adop*
TC						
TMS	0.798					
CP	0.302	0.314				
NP	0.591	0.533	0.644			
MP	0.446	0.462	0.708	0.603		
SaaSa	0.666	0.629	0.620	0.715	0.577	

Note: Values in diagonal (bolt) are the AVE square root.

The results support the construct reliability of the measurement model. Therefore, the constructs were fit to be used to test the structural model.

We modeled the environmental factor as a second-order construct, reflective-formative type (Ringle et al., 2012), with coercive pressures, normative pressures, and mimetic pressures that are reflective in themselves. These constructs are formative measures of the environmental context. For the formative construct a measurement model was performed to assess the multicollinearity and the significance and sign of weights. To evaluate the multicollinearity we perform the variance inflation factor (VIF) statistic. Table 7 reveals that the VIF ranges from 1.58 (lowest) to 1.98 (highest). The values are below the threshold of 3.3, indicating the absence of multicollinearity among the variables (G. Lee & Xia, 2010). In terms of significance and sign, the three pressures are statistically significant ($p<0.01$) and with positive sign. Consequently, the formative construct can be used to test the structural model.

Table 7: Formative measurement model evaluation

Formative construct (second-order construct)	*Constructs (first-order reflective)*	*Weights*	*VIF*
Environmental context (reflective-formative type)	Coercive (CP)	0.371***	1.973
	Normative (NP)	0.355***	1.583
	Mimetic (MP)	0.445***	1.929

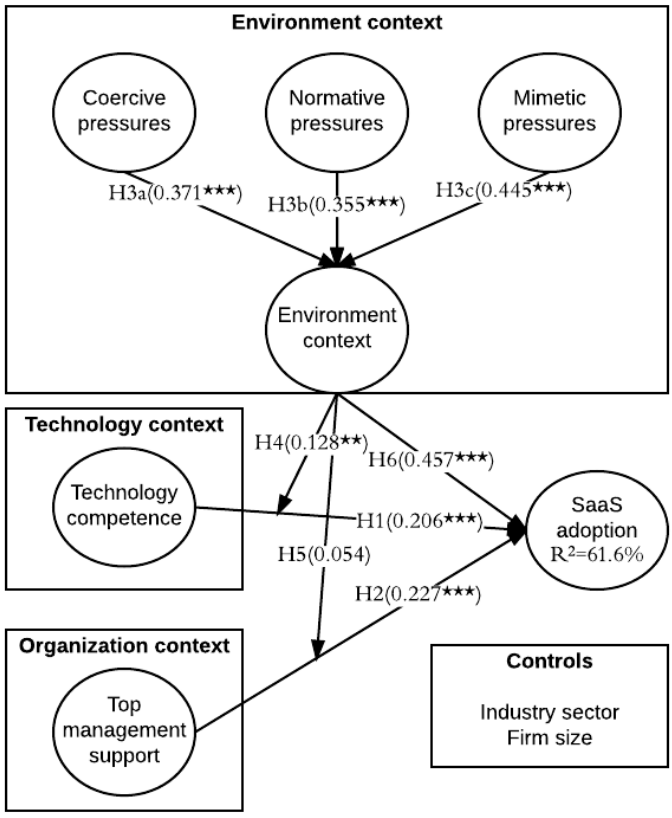
Note: *** *p<0.01; ** p<0.05; * p<0.10*

Test of the Structural Model

Before assessing the structural model, we tested the multicollinearity of all constructs, based on the variance inflation factor (VIF). The VIF ranges from 1.46 to 2.13. The values are below the threshold of 3.3, indicating the absence of multicollinearity among the variables (G. Lee & Xia,

2010). The structural model (Figure 2) presents the variation explained, and the path coefficients. The significance levels of the hypothesized construct were performed using bootstrapping with 5,000 resamples.

Figure 2: Structural model (variance-based technique) for SaaS adoption



*Note: standardized coefficients. *** p<0.01; ** p<0.05; * p<0.10*

Our model explains 61.6% of the variation in SaaS adoption. From the technology context, technology competence is statistically significant ($\hat{\beta}$ =0.21; p<0.01). Thus, H1 is supported. From the organizational context, top management support is statistically significant to SaaS adoption ($\hat{\beta}$ =0.23; p<0.01). Therefore, H2 is also confirmed.

Mimetic ($\hat{\beta}$ =0.46; p<0.01), coercive ($\hat{\beta}$ =0.37; p<0.01), and normative ($\hat{\beta}$ =0.36; p<0.01) pressures are statistically significant related to the environmental context. The environmental

context ($\hat{\beta}$ =0.46; p<0.01) is significant for SaaS adoption. Consequently, H3 is supported. The moderating effect of the environmental context ($\hat{\beta}$ =0.13; p<0.05) is confirmed for the technological context, but not for the organizational context ($\hat{\beta}$ =0.05; p>0.10). Thus, H3a is confirmed, and H3b is not. The environmental context not only explains the SaaS adoption, but also moderates the relationship of technology competence and SaaS adoption.

6. DISCUSSION

Our study examined the factors that influence SaaS adoption giving a contextualized version of the TOE framework, focusing on the role of the moderating effects of the environmental factors. To the best of the authors' knowledge, no studies report the moderator effects of SaaS adoption using the TOE framework (Venkatesh & Bala, 2012). Each context (i.e., technology context, organization context, and environment context) of the TOE framework influences the adoption of SaaS, but because these contexts are part of the same reality, they interact with each other (namely the environmental context), affecting the causal relationship of the direct effects on SaaS. Evaluating the moderators of SaaS adoption through the TOE framework improves our understanding of when and how a specific effect operates (O'Leary-Kelly et al., 1994).

Our results confirm that technology competence is a driver for SaaS adoption. This finding is supported by earlier research (Venkatesh & Bala, 2012). The availability of IT infrastructure and human expertise to implement SaaS are taken into consideration in the adoption process.

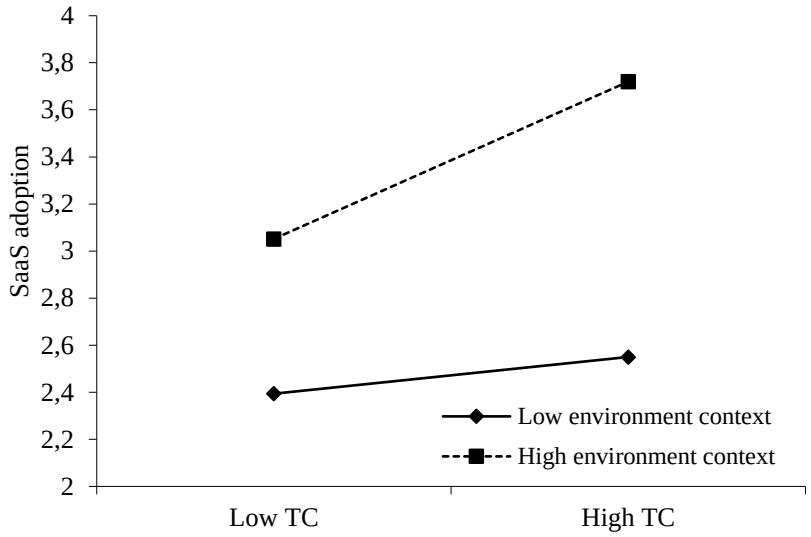
Similarly, top management support was found to influence the adoption of SaaS. An earlier study also reported such an influence of top management on cloud computing (Oliveira et al., 2014). Top management support promotes the firm's consensual decision to adopt SaaS, diminishing the struggle over its rejection.

Within the environmental context of SaaS, coercive pressures were found to be significantly related. The mandatory nature of such pressure leads to greater environmental participation, which in turn positively influences the adoption of SaaS. Earlier research also suggests that coercive pressures are a driver for IT adoption (Hu, Hart, & Cooke, 2007). Normative pressures were also found to be significant, in line with earlier research (Liang et al., 2007; Teo et al., 2003; F. Wu et al., 2003). Normative pressures are performed by suppliers, government agencies, and other

entities that have successfully implemented SaaS (Swanson & Ramiller, 2004). These entities by nature share information and norms with the firm, leading to greater participation of the environmental context in SaaS adoption. Similar to other institutional pressures, mimetic pressures were found to be significant. Mimetic pressures reflect the act of imitating other structurally similar organizations, including competitors (Teo et al., 2003). To avoid uncertainty, firms rely on the experience of competitors, leading to greater participation of the environmental context in SaaS adoption.

Regarding the moderating effects, we found that the environmental context influences the relationship between the technology competence and SaaS adoption. As mentioned, technology competence measures the firm's technological ability to adopt SaaS. According to our results, these capacities are positively moderated by the contextual environment. In Figure 3 we can see that the effect of technology competence as a predictor for SaaS adoption will be stronger among firms with a higher level of environmental participation. Thus, when the level of the environmental context participation increases, the importance of technology competence also increases regarding SaaS adoption. Surprisingly, top management support revealed not to be responsive to the influence of the environmental moderator. Our results show non-significance of the environmental context effect on the relationship between top management support and SaaS adoption. It remains unclear why the hypothesized moderating effect was not verified, and further research may be necessary to shed light on this matter.

Figure 2: Structural model (variance-based technique) for SaaS adoption



Managerial implications

Firms are slowly becoming aware of the need to upskill both their technical and business knowledge in order to understand the shift cloud computing introduces, to understand how to capitalize on the benefits that cloud adoption brings, and to understand how to manage procure, integrate and manage cloud computing and cloud-based services. There are several significant implications of this study for managers and decision-makers. First, our findings indicate that they should ensure that the firm has the technological competence to embrace SaaS. The firm needs qualified personnel who can integrate an internal implementation team if the firm's decision is in fact to adopt SaaS, and managers must ensure that the firm has the communications infrastructure necessary to accommodate SaaS. Although SaaS suppliers provide software with a set of IT management services included, to remotely access the software the firm will always have to ensure the adequate communications infrastructure.

Second, managers have to be aware of the environment surrounding the firm, as the environment enhances the importance of the technology competence in the process of SaaS adoption. This implies that SaaS adoption is not an isolated process but pervades the firm's environment regarding technological capability. Firms need to avoid problems associated with integrating and managing a combination of legacy mainframes, a traditional IT client server model and now cloud services.

The question is how to integrate these different IT capabilities to achieve the full benefits available. This involves IT professionals architecting and managing new cloud environments to work in tandem with existing IT infrastructure. Since the adoption of SaaS may entail changes to the firm's business processes, the support of top management is crucial; managers can establish service expectations, stipulate performance goals, and measure performance outcomes at the firm's functional units that utilize SaaS.

Finally, the environmental surrounding exposes another unique aspect of SaaS innovation: it is not an IT solution limited to each firm, but involving a network of firms (Yang et al., 2015) that bring about various pressures affecting SaaS adoption. Formal regulations, shared information and norms from suppliers, government agencies and other entities, and imitating other structurally similar firms, including competitors, leads to greater influence of the environmental context in SaaS adoption. However, the firm’s responsiveness to external pressures will depend on the institution and the kind of authoritative relationship with such pressures, which will shape more comprehensively and accurately the surrounding contexts in which firms operate.

Theoretical Implications

Theoretical implications include the following. First, this study contrasts with earlier research as we draw attention to the moderator effects of the TOE framework. Addressing the moderator influences proved to improve our understanding of the performance of the direct effects of the TOE framework. Second, the research joins two established theories from IT adoption literature, the TOE framework and the INT theory. Based on these we developed a conceptual model for the study of SaaS adoption. Also, the instrument that was applied in this study was confirmed for reliability, validity, and discriminant value. The model developed was demonstrated to be adequate for the study of IT innovations, as we empirically tested it. We hope that our approach opens new horizons for the application of the TOE framework, considering its moderating effects in future studies.

7. CONCLUSION

IS/IT adoption has occupied the IS research community to the extent that IS/IT adoption and diffusion research is now considered to be among the more mature areas of exploration within the IS discipline. This study reports on an empirical investigation to assess the direct and moderator

effects of the TOE framework in the SaaS context. Specifically, the study explored the determinants for SaaS adoption using the technological, organizational, and environmental theoretical lenses of the TOE framework. Coupling the TOE framework INT theory, we examined the determinants for SaaS adoption at firm level. The TOE framework was re-designed in order to examine not only its direct effects, but also its moderator effects. We conducted an empirical study among 2,000 firms to test the research model and hypotheses.

We found that technological, organizational, and environmental contexts are significant influencers of SaaS adoption. While the environmental context has a direct impact on SaaS adoption, we found that it also moderates the relationship between technological context and SaaS adoption, i.e., the effect of technology competence as a predictor for SaaS adoption is stronger among firms with a higher level of environmental context. Furthermore, we confirm the usefulness of integrating the INT theory to improve the explanatory strength of the TOE framework.

This study provides new instrumental ways to use the TOE framework application regarding its moderating influences and represents a significant advance in our theoretical understanding of the SaaS adoption. The results also provide instrumental insights for managers to more effectively adopt the new technology. We hope that this work inspires future attempts to elaborate on our findings.

Despite the contributions provided by this research, the study is not without limitations. First, it was conducted in a small European country (Portugal), during a well-known economic crisis. It would be interesting to apply the model developed in other countries and different economic contexts and to investigate if the results are consistent. Second, SaaS adoption is a dynamic process that is evolving before our eyes. Our study does not offer a longitudinal perspective on the SaaS adoption. As with earlier innovation adoption studies (Zhu et al., 2006), we suggest additional research to assess SaaS adoption over an extended period of time. Future investigations can address the possible application of the model developed in the study of other technologies.

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