Cloud Computing: Determinants Of Software As A Service (Saas) Model Adoption

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Abstract : Cloud computing is a cutting-edge technology that has been recognised by the organisations and individuals for a wide range of potential applications. Software-as-a-Service (SaaS), one of the cloud computing models, is a service which is provided at the topmost service layer, that receives computing resources and services from external providers and allow the remote use of business applications. Since the first appearance of the concept, few researches are dedicated to determining the drivers and complexities of adopting SaaS cloud computing services thus, the literature is limited on this topic. As more adopters are becoming familiar with the technology and implementing cloud computing in their business work, understanding what determines adoption decisions is essential for future cloud technologies to be aligned with the consumer's needs. In this study, a research model is introduced based on the technology-organization-environment (TOE) framework to assess the determinants that influence the adoption of SaaS cloud computing services. This paper primarily aims to present the concept of SaaS service model and to critically evaluate the drivers and complexities for adopting SaaS cloud services. The results of the study will provide practical strategies not only for the organisations considering the adoption of SaaS cloud services, but also for the vendors supplying SaaS services.

Index Terms: Cloud computing, SaaS, software as a service, cloud security, on-demand service; cloud sourcing, cloud integration

1. INTRODUCTION

Cloud computing has rapidly developed into a alluring technology that attracts great attention from both academia and business spheres in recent times. In cloud computing, computational resources such as computing power, storage and business applications are delivered as generic utilities in the form of services that the users can lease and release in an on-demand fashion over the Internet [1]. Generally, these resources can be rapidly allocated and deallocated with a minimal interaction and management effort by the cloud service providers [2]. Here, the consumers of cloud services do not own, manage, or operate the underlying infrastructure, platform, or software applications but rather access the leased resources remotely through the Internet [2].

Even though several formal definitions for cloud computing have been proposed in both academia and industry, the one provided by U.S. NIST (National Institute of Standards and Technology) appears comprehensive as it includes key elements widely used in the cloud computing technology: Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [2].

According to this definition, cloud computing provides a convenient on-demand network access to a shared pool of configurable computing resources, where resources refer to computing applications, network resources, platforms, software services, virtual servers, and computing infrastructure. Further, this paper from NIST which defines cloud computing also details the three commonly used cloud service models namely, Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Each of these cloud computing models has specific set of features that could serve the requirements of various individuals and organisations. Here, the SaaS cloud services are provided at the topmost service layer and allow the remote use of business applications [8]. In recent times, the SaaS model is being increasingly adopted by the organisations for sourcing business application software [4]. In traditional on-premise software deployment model, application software is deployed, controlled and managed by the firm. In contrast, in SaaS model, software applications are hosted, controlled and managed by the third-party software service providers and delivered to the firm as a service through the Internet [4], [7]. Further, the SaaS model can be viewed as an evolution of the application services provision (ASP) model [4], that attempt to address the shortcomings of ASP [7]. Unlike ASP model, SaaS is typically based on multi-tenant architecture which enables it to achieve economies of scale by sharing infrastructure [7]. It is possible to define the Software as a Service model as a service where software applications are deployed on cloud infrastructure by the cloud service providers, and the consumers who have subscribed for the service can use these applications through various thin client devices such as web browsers or a program interfaces, over the Internet [2], [4]. Here, the consumers do not have the ability to control or manage the underlying cloud infrastructure such as virtual servers, network, operating systems, storage, or the software application capabilities, except for limited ability for configuring application settings [2]. Today, software applications available through SaaS ranges from simple office automation applications to complex enterprise resource planning (ERP), accounting, treasury management and customer relationship management (CRM) applications [4]. Many factors influence the adoption of SaaS cloud computing model. Organisations must systematically examine these factors during their decision-making process for adopting SaaS cloud-based solutions [6]. Since sourcing business applications based on SaaS is a relatively new model for most firms, they are struggling in their SaaS related decision-making process regarding whether to adopt SaaS and, if so, how the firm can derive a positive impact through SaaS on firm performance and also how the challenges related to SaaS services can affect the firm [4]. It is evident that, even though there is much research on the broader topic of cloud computing, literature which specifically focused on SaaS is still limited and not yet fully established [4], [9], [10]. At large, there has been a lack of research studies that comprehensively identify and analyse the main determinants of SaaS adaption, or which investigates key drivers and challenges for SaaS in various decision domains [4], [9], [10]. Accordingly, this paper addresses this void in the literature by critically examining the determinant factors that influence the decisions for cloud computing adoption in organisations. Thus, the research topic ‘Cloud

Computing: Determinants of Software as a Service (SaaS) Model Adoption' was considered timely. It is expected that this study contributes to the body of knowledge in the subject of the SaaS cloud model by evaluating the determinants of SaaS adaption focusing on the key drivers and the complexities in various decision domains. Moreover, the present study seeks to develop a research model based on the cloud computing related technology acceptance literature that combines several variables proven to be relevant for SaaS adaption by prior research. This paper consists of five sections. In the following section, a review is conducted of the prior literature that specifically focuses on papers that are cloud computing and SaaS related. This bibliographical review provides the theoretical foundations for the research model proposed in this study. In Section 3, the research methodology is explained, and the research model is introduced. Next, the discussion on the key drivers and complexities of SaaS adaptation is presented in Section 4. Finally, in Section 5, conclusions are drawn and suggestions for future research directions are made.

2 Literature Review

SaaS cloud services and cloud computing in general have progressed through the recent advancements in hardware, distributed computing, virtualization technology and service delivery over the Internet [6]. This Literature Review will first focus on locating the research topic within the business discipline of technology acceptance. Next, it will explore the literature on the prior research based on various technology acceptance frameworks which looks at the factors influencing technology acceptance with a special emphasis on research based on SaaS technology adoption. This structure is adapted for the review so that it best fits with the author's research question; 'What are the determinant factors of Software as a Service (SaaS) model adoption?'

2.1 Adaption Models

In literature, several extensively used technology acceptance models can be found [6], [11]. They provide valuable frameworks for identifying the critical factors that influence the adoption of information and communication technology, its' usage and related organisational behavior [11]. One such framework adopted in many disciplines is the theory of reasoned action (TRA) introduced by Fishbein and Ajzen which aims to explain, how individual's pre-existing attitudes will influence their behavioral intentions [9]. Later, the theory of planned behavior (TPB) was developed by Ajzen which relates one's beliefs and behavior [9]. Davis subsequently formed the technology acceptance model (TAM) to explain the link between technology acceptance and the intention for using it [12]. This model suggest that the perceived usefulness and perceived ease of use shall be the most critical factors in the process of technology adoption and system use [13], [14]. Further, Tornatzky and Fleisher introduced the technology-organisation-environment (TOE) framework which is one of the most widespread theoretical frameworks on ICT adoption [9]. This framework proposes that technological innovation adoption is influenced by the technological context (internal and external technologies relevant to the firm), the organisational context, and the environmental context [9]. In addition, another widely applied theory in literature for technology acceptance is diffusion of innovations (DOI) which was introduced by Rogers in 1962 [9], [15]. This theory attempts to explain how, why, and to what rate over time, an idea or technology spreads through a specific population or social system [9], [15]. Several recent DOI theory-related research studies can be found in the area of information systems [16], [17], [18].

2.2 Adaption of Cloud Computing and SaaS

The number of empirical studies specifically focused on research on adoption of cloud computing technologies is not yet very numerous, although some can be found with different adoption frameworks such as TOE and TAM [9]. For instance, in order to facilitate understanding of Software-as-a-Service (SaaS) solutions adoption, Wu [19] developed an explorative model using TAM with additional domineering constructs such as marketing effort, security and trust, that examines important factors affecting SaaS adoption. Also, Behrend et al. [21] examined the behavior of students in SaaS cloud model adoption setting based on TAM. They found that background characteristics of students have influenced the usefulness perceptions, while ease of use was based on the initial experiences with the platform, and instructor support [21]. Similarly, Burda and Teuteberg [22] explain the end user adaption of cloud storage using a technology acceptance model that based on users' perceptions of risk and trust as well as major antecedents of trust such as satisfaction, provider's reputation, familiarity [22]. The study showed that trust can be considered as a factor that reduce uncertainty and the perception of risk, which are major inhibitors for intention of use cloud storage [22]. Moreover, Sharma et al. [23] developed a hybrid model which extends TAM with three external constructs (trust, computer self-efficacy, and job opportunity) to predict motivators inducing the adoption of cloud computing technologies by information technology professionals. The proposed factors were found to be important in influencing the cloud computing adoption. The results of this study showed that trust, job opportunity, self-efficacy and perceived usefulness and ease-of-use are the best predictors of cloud computing adoption [23]. In literature, some other studies analyse adaption of cloud computing technologies using frameworks such as TOE, DOI. Such is the case of Oliveira, Thomas, and Espadanal [6] who developed a research model based on DOI and TOE, to assess the factors that influence the adoption of cloud computing in the manufacturing and services sectors. Further, Nkhoma and Dang [20] use data from a survey of IBM to investigate the drivers and hindering factors of cloud computing adoption. Similarly, Abdollahzadegan et al. [24] conducted a study focusing on the TOE framework with the purpose of evaluating the impact of organisational factors on cloud computing adoption in SMEs. They found that organisational factors such as top management support, firm size and technology readiness have a high impact on initiatives for adapting cloud technology in SMEs [24]. Likewise, Alshamaila et al. [25] conducted a qualitative exploratory study with TOE framework as the theoretical base, with a sample of 15 different SMEs and service providers. They identified that relative advantage, uncertainty, compatibility, geo-restriction, trial-ability, organisation size, top management support, prior experience, innovativeness, supplier efforts and so forth as the factors playing a significant role in SME adoption of cloud services [25]. Further, Yang et al. [26] propose a model based on TOE and use survey data from 173 organisations in China to analyze factors that influence readiness of organisational

users to adopt SaaS. This study suggest that it is required for organisational users to get prepared from technological, organisational and environmental aspects for the adoption of SaaS which includes factors such as relative advantage, top management support, simplicity, customizability, and competitor pressure. Some other research in literature proposes different cloud system adoption and usage models based on DOI theory. Such is the study by Lin and Chen [18] who investigated how cloud computing is understood by Information Technology professionals and the concerns they have with respect to the cloud services adoption. This study conducted using a survey in Taiwan and found that compatibility of the cloud services with policies of companies, information security, business requirements and relative advantages of cloud solutions are the primary concerns that IT professionals have with respect to the cloud services adoption and based on these concerns many companies reject adoption of cloud solutions, until certain uncertainties related to cloud technology, such as security, standardization, have been reduced and successful business models are introduced. Further, some studies integrate DOI theory with other frameworks such as TOE. For instance, in a study conducted by Hsu et al. [16] combine aspects of DOI and TOE to investigate the adoption intentions for cloud computing using a sample of 200 Taiwanese firms. They concluded that perceived benefits, business concerns, and IT capability within the TOE framework are significant factors that determine cloud computing adoption, while the external pressure found to be a factor which is insignificant. A similar study had been conducted by Oliveira et al. [6] where they propose a model that also combines elements of DOI theory and the TOE framework to assess the determinants that influence the adoption of cloud computing. These authors distinguish three types of adoption factors: individual factors, internal organisational structure, and the organisation's external characteristics. Meanwhile, results from data collected from 369 firms in Portugal suggest that factors such as top management support, technological readiness, relative advantage, complexity and firm are directly affecting the cloud solutions adopting decisions. Along the same line, Low et al. [17] conducted a study to investigate the factors that affect cloud computing adoption by firms belonging to the high-tech industry. They used a questionnaire-based survey to collect data from 111 companies in Taiwan and concluded that relative advantage, firm size, and top management support, trading partner pressure, competitive pressure, have a significant impact on the decisions for SaaS adaption. Some of the previous studies have specifically focused on analysis of the factors affecting SaaS adaption. For instance, in [27] Wu et al. reported on a case study conducted on a Taiwanese company where they presumed that SaaS adoption is a trust issue. They concluded that the case company consider more about benefits related to strategy than economic benefits and more about the subjective risks than the technical risks. Another study was conducted by Benlian and Hess [7] where they developed a research model based in an opportunity-risk framework. In this research, they analyze opportunities and risks of SaaS adoption as perceived by IT executives using a survey of 349 IT executives employed at German companies. Their findings suggest that, with respect to both adopters and non-adopters of SaaS, security threats act as the dominant factor which affect overall risk perceptions of IT executives. They also found that, the with respect to SaaS opportunities, the strongest driver affecting IT executives' perceptions is the cost advantages. Further, they found significant variances between SaaS adopters' and nonadopters' perceptions of risks, such as performance risks, economic risks and opportunities such as quality improvements and access to specialized resources. Also, Madisha [28] conducted a research into SaaS readiness and adoption in South Africa which is an emerging economy. The study concluded that resources, awareness and market forces have a significant correlation to SaaS adoption while low internet reliability, high internet costs and limitations of internet accessibility were found to be inhibitors to the adoption of SaaS. Finally, in a similar research, Lee, Chae, and Cho [29] applied a method based on the two-factor theory in order to classify the SaaS market into drivers and inhibitors for SaaS adoption. They concluded that the customer factors and economic factors were the most important drivers of SaaS adoption while social, economic and political factors inhibited SaaS adoption.

3 RESEARCH METHODOLOGY

The purpose of this chapter is to review the appropriateness of the research design. This research examined the existing research published on the topics related to adopting cloud computing services and with a special emphasis on the studies based on the SaaS cloud services adoption. The study used a profiling method, which is well-established for investigating and analyzing the drivers and complexities for SaaS cloud services adoption.

This research addresses the research question; 'What are the determinant factors of Software as a Service (SaaS) model adoption?' and research objectives;

- Analyse the determinants which act as the drivers for SaaS adoption.
- Analyse the determinants which act as the complexities for SaaS adoption.

It is vital to have this type of research, to foster an in-depth understanding of the subject area of SaaS cloud services adoption, while critically analysing the key drivers and prevalent challenges, as most of the prior research have focused only to identify the correlation of factors affecting adoption decisions, without discussing and analysing them.

3.1 Research Design

The purpose of this chapter is to review the appropriateness of the research design. This research focused on identifying and engendering valuable insights into the research topic by conducting a comprehensive and systematic literature review which involved search, selection, analysis, and synthesis processes [30].

The selection of papers for this study was based on the criteria where the papers that (1) have explicitly included the terms ‘‘SaaS” or “Cloud Computing” in the title, abstract, keywords, or body of the paper, (2) have a emphasis on the adoption, technology acceptance, or use of cloud technologies, were selected. Upon analyzing various theories and frameworks used in a number of studies on cloud services adoption and technology acceptance, it was decided to use technology-organisation-environment (TOE) framework which considered to be particularly interesting for the present research. The choice of TOE framework can be justified by its robustness and its widespread acceptance for understanding the technology adoption in a significant amount of prior research related to the research topic.The TOE framework classifies three groups of factors determining the IT adoption from technological, organisational, and environmental contexts [9, 35] and is one of the frameworks widely used to describe the factors for technology adoption [10]. It explains how technological introductions (SaaS procurements in this research) are determined by the factors related to technology, organisation, and the environment. This framework has the benefit of easily grouping factors that have been derived from prior studies [10]. However, inability in comprehensively explaining the relationship among variables (Iacovou, Benbasat, and Dexter 1995 and inability to systematically explain the cognitive behaviours of decision-makers can be identified as the primary limitations of the TOE framework. Despite these limitations, the TOE framework has been widely applied to various types of research studies in the context of technology adoption [17], [31]. The analysis phase of this study primarily focused on analyzing the drivers and complexities of the SaaS cloud services adoption, highlighting prevailing findings related to the proposed research model, and identifying supporting evidence in the literature. Further, the paper aimed to highlight the new insights that can contribute to the future research and therefore, moved further than simply mapping or describing the current discourse.

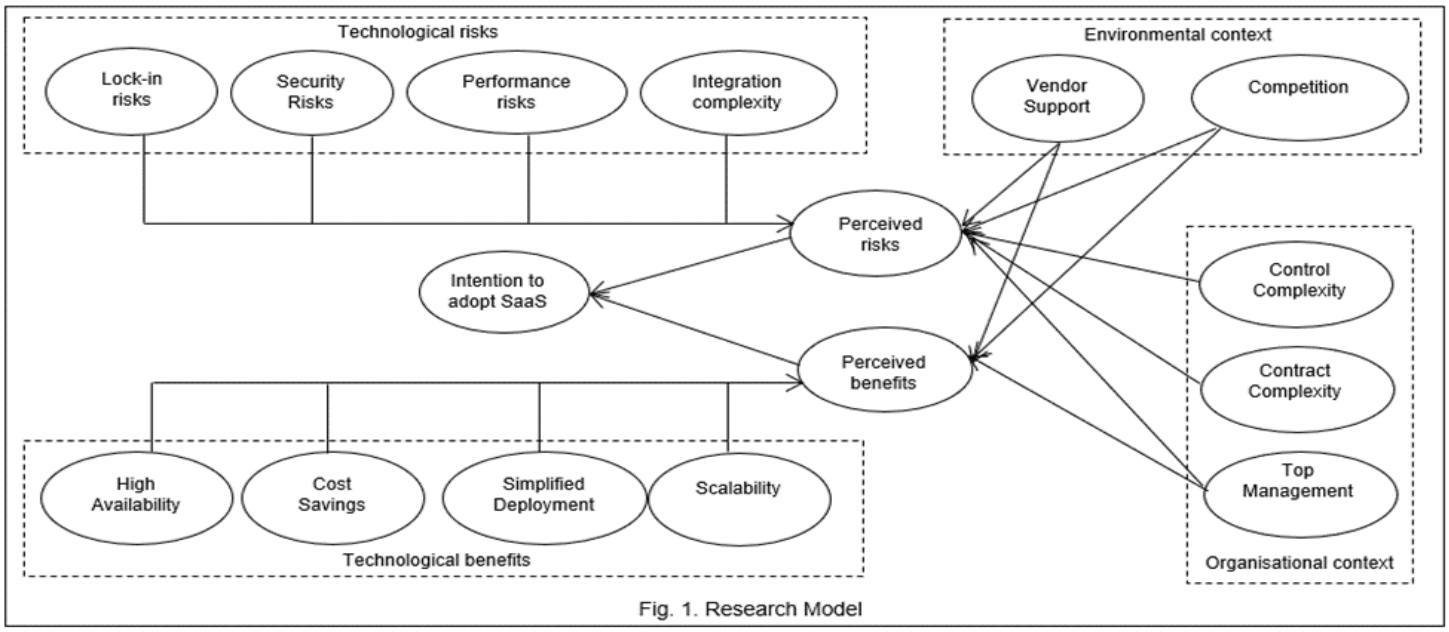

Fig. 1. Research Model

4 Discussion

4.1 Drivers for SaaS Model Adoption

In recent times, Software as a Service (SaaS) is increasingly used by firms for sourcing business application software [4]. It is evident that many factors perform as drivers which influence such business decisions for the adoption of SaaS cloud computing services. This section discusses in detail the drivers for SaaS cloud service adoption, identified in the proposed research model.

4.1.1 High Availability

Most software systems consider high availability as a critical factor as it’s considered a significant requirement for business continuity. Therefore, the SaaS applications need to ensure that organisations are provided with service around the clock. Here, high availability refers to the high uptime a system needs to perform and function, to deliver its services in a continuous manner [31]. Typically, in SaaS deployments, there is a perceived benefit where the provider being able to deliver better availability than the client itself [5], [32]. Implementing such high availability solution involves performing improvements to the architecture both at the application and the infrastructural levels, to enable scalability and, redundancy and high availability [33]. Generally, this involves adopting a multi-tier architecture which is supported by a load-balanced multiple application instances, running on a scalable number of server instances. Further, resiliency to both hardware and software failures and the ability to withstand distributed denial of service attacks (DDoS), needs to be built into the SaaS application and should be actively supported by the deployment architecture. In such a DDoS resilient implementation, techniques such as connection limiting, synchronous cookies, and auto expandable bandwidths are used [33]. Further, an appropriate backup and replication setup shall in place to support business continuity (BC) and disaster recovery (DR) needs, in order to face any unplanned emergencies. Such configuration is vital to ensure the safety of the business data and minimal downtime. The SaaS cloud service provider may additionally replicate the data at multiple geographical locations across countries, to maintain high

availability for the SaaS applications [33]. Adoption of such implementation techniques test and validate the availability of the SaaS application services.

4.1.2 Software Maintainability

Unlike on-premise solutions, for SaaS service model, the supplier provides maintenance and assumes operational responsibility. Therefore, typically the adopters of a SaaS solution can use the solution without worrying about the maintenance of software while the continuity of the service is guaranteed by the SaaS service provider. A SaaS provider typically releases new functionality on a regular interval based on customer feedback and market trends to ensure that the value they offer to customers is constantly increasing. Here, the software updates are all made centrally to the service providers hosting environment and not transferred to the computers or servers of the adopting organisation. This results in significantly less overhead and maintenance burden for the adopting firms. Typically, during such upgrades, new core functions are automatically released to all customers and new integrations with other systems are performed. Similarly, performance improvement and bug fixing, and software patching is centrally performed by the service provider. These tasks all lie with the SaaS provider and often go unnoticed for the customers. In general, SaaS systems are user-friendly and configurable, and the users can perform system updates without IT department support. In addition, SaaS adopters are relived from bearing the burden of hosting software and managing related IT infrastructure. However, despite the fact that the supplier manages and maintains the software, there may be additional work and responsibilities passed to the customer to test the systems with respect to each update done by the supplier in terms of operational functionality and local integrations and also need to continuously follow the release notes in order to obtain information on the updates.

4.1.3 Reduced Implementation and Ownership Cost

One of the most important determinant factors in SaaS services adoption is the total cost of ownership. SaaS cloud solutions help enterprises to reduce the total cost of ownership as it eliminates the requirement for heavily invest in the IT infrastructure, software maintenance, upgrade services and IT staffing by shifting it to a third-party vendor. This helps business organisations requiring IT application solutions to lower their initial entry costs. It has been observed that, cloud-based solutions give businesses and users easy access to massive computational, communication and information processing power at minimal costs [6]. By moving IT functions such as business applications to the cloud, organisations can potentially reduce the overall cost of implementing IT solutions [6]. Aligning with this, Leimeister, [34] also found that cost advantages are a possible benefit that have made IT outsourcing to be considered as one of the most important strategic concepts in recent decades. Therefore, in most instances, SaaS cloud computing solutions offer monetary benefits that business organisations can no longer ignore. Moreover, most SaaS cloud services are delivered as measured services where cloud services automatically control and optimize resource usage by enabling a metering capability at different levels of abstraction, fitting to the nature of the services being delivered (e.g. storage capacity, processing power, bandwidth, and concurrent or active user accounts). This enables to actively monitor, control and report the resource usage which provides transparency in calculating chargers, for both the service provider and consumer of the cloud service [2].

4.1.4 Rapid Elasticity and Scalability

One of the key features of cloud services is that the ability to elastically provisioning and releasing its capabilities, automatically or manually, to scale rapidly upward and downward proportionate with the usage [2]. Scalability is a desirable attribute for continuous business growth as the efficient environment of cloud computing can host extremely large volumes of data. For the adopters of cloud services, often the capabilities available for scaling in cloud services appear to be unlimited and available for provisioning in any amount at any time [2]. As such, scalability is an important quality factor in designing SaaS solution architectures. The use of scalable resources and resource pooling among firms results in IT efficiency, while the business agility of cloud computing is delivered though the ability to deploy resources rapidly and the ability of responding rapidly to the changing market demands [6]. In this context, the convergence of IT efficiency and business agility can be identified as positive aspects that are delivered though cloud computing services [6], which stimulates SaaS adoption.

4.1.5 Simplified Deployment and Cross Integration

With SaaS deployments, firms can eliminate the software development and deployment effort with respect to developing the core functionalities of the systems. Further, the firms do not have procure and configure IT infrastructure including the hardware. At the same time, it also enables the rapid deployment of SaaS applications which help businesses to be more responsive and proactive in operations [8]. In addition, integrations with other standard systems are often available in-built to the SaaS services, requiring only the configuration effort. Similarly, performance improvement, bug fixing, and software patching at the time of deployment is centrally performed by the supplier and often go unnoticed for the adapting firms. However, if integration of SaaS application with on premise systems is required, the firms need to put an additional development and configuration effort which may result in complexities.These features of SaaS services result in a change of the role of the IT unit of adopting firms, where the role shifts from provision of ICT services such as application development, systems administration and maintenance, towards management and support of SaaS applications, configure various SaaS services, and integration of SaaS services with the firm's on-premise application systems.

4.1.6 Competition and Management Support

Prior studies indicate that SaaS enables firms to differentiate their business from competition and therefore, the competition was found to be positively related to the perceived benefits [10]. In addition, the top management support is identified in literature as one of the most critical driving factors for the adoption of SaaS [17], [10]. With top management support there is a high probability for management to allocate adequate resources for such adoption and encourage employees to use SaaS application services for firm's operations.In literature, there are several prior studies which highlights that top management support have a positive relationship with the perceived benefits and drive the intention

for SaaS cloud services adoption [17], [10]. Similarly, Kim et el. found that management support was more significant than the resource requirement or IT capacity for the adoption of SaaS [10]. This study also observed that top management support towards SaaS adoption found to decrease the risk factor and boost the benefit factor. This observation can be interpreted as, when adopting SaaS cloud services top management support can reduce the burden of adoption and increase firm confidence. These findings suggest that competition and top management support can act as a critical driving factors for SaaS adoption.

4.2 Complexities of SaaS Model Adoption

Evidence form prior studies suggests that not all companies are rushing to adopt solutions offered through cloud services [6] and many organizations may still be reluctant to introduce SaaS solutions. Among the reasons are the obstacles and difficulties exist in the organizations' adoption of cloud computing as it is a disruptive technology that has not reached a level of maturity with lack of industry specific conformity to standards, lack of understanding between the organizations and the cloud providers as to service scope and implementation and a high level of associated risk and costs [6]. This section discusses the major complexities in SaaS cloud services adoption.

4.2.1 Availability and Performance Risks

Issues with systems availability in SaaS applications such as uncertainty of service availability, slowness, reliability and particularly the unexpected system downtimes may lead to loss of valuable information and revenue [35], [36], [37]. Such concerns on uncertainty of system availability and performance to the expected service level, discourage the firms to adopt SaaS applications [35], [36]. Here, the reliability of the different SaaS cloud computing models typically differs in terms of availability offerings. Private clouds deployed on on-premise infrastructure are generally more reliable than other deployment models [38], while the other models such as private clouds based on third party infrastructure, public clouds and hybrid clouds offer comparatively less reliability as they depend on the availability of the service provider's infrastructure as well as the quality of the connectivity to the cloud service [38]. In this context, it is of a significant importance that the service level agreements (SLA) are entered into between the SaaS service providers and the client firms, as a mechanism to ensure that the required service availability and performance of the SaaS applications, which is typically expected to be hundred percent or near hundred percent availability with no latency. [37], [39].

4.2.2 Security and Confidentiality

Due to the ever-growing interest in SaaS cloud services, there is a clear and continuous effort to evaluate the recent trends in security vulnerabilities for such technology [39]. In this context, it is evident that, even though cloud computing aims to provide IT efficacy and business agility using virtualization and resource sharing techniques, it is fraught with security risks [33]. According to an IDCI survey, 74% of IT executives and CIO's have cited security issues as the primary challenge that prevents their adoption of the cloud services model [3]. Security within SaaS cloud services is a particularly significant issue since the infrastructure used to provide services do not owned or managed by the users themselves. The users, neither have the control over the security architecture of the cloud service, nor have any knowledge of security threats and vulnerabilities faced by their data and services in cloud [40]. Such vulnerabilities in SaaS applications may lead to the loss of valuable information and sensitive data or sometimes directly the money [33], [35]. This is a significant concern when the firms and users have valuable personal and business information processed and stored in SaaS cloud computing services [40]. Here, each SaaS project should be evaluated by the adopting firms on the project's own merits, as the different cloud projects, even by a single provider, will possibly leverage completely diverse sets of configurations and technologies, [41]. Some of the security issues that should be considered during SaaS adoption are data breaches, data loss, accounts hijacking, insider threat, malware injection, abuse of cloud services, insecure APIs, denial of service attacks, insufficient due diligence, data loss and shared vulnerabilities [40]. Such security concerns discourage the firms to adopt the SaaS applications [35]. To address these issues, SaaS cloud computing service providers must ensure that their client firm's information is well protected and safe. This, however, is becoming increasingly challenging due to the ever-changing threat landscape of cyber security, where new security threats, new laws, and new compliance requirements emerge frequently [41], [42]. Cloud service providers shall implement range of measures including technical, physical, and administrative measures in order to protect a wide range of data, such as personal data, financial data and other sensitive enterprise data from theft, loss, alteration or misuse [41]. Unfortunately, many small-scale SaaS cloud service providers are not able to function at a level of sophistication that meets customer governance and risk management capabilities [41]. It is notable that some organisations have focused on security issues in the cloud computing services to help make cloud computing a credible and secure option for information technology solutions. One such organisation is the Cloud Security Alliance (CSA), a non-profit organisation formed to promote the use of best practices for providing security assurance within the domain of cloud computing and provide education on the uses of cloud computing services to help secure all other forms of computing [40].

4.2.3 Control Complexity

When leveraging the services delivered by the SaaS cloud service providers, the client firm's data ownership and control is a primary concern [20], [43], [44]. Since the SaaS applications are deployed at in the service providers infrastructure, the users of such servicers have no control over the cloud infrastructure, security, storage or the application capabilities. Thus, firms often feel uncertain and insecure as they must rely on the cloud service provider's provisions for the system availability, integrity and protection against emerging cyberthreats [20]. At large, firms adopting cloud services possess a very limited or no knowledge of the exact location of the service provider's datacenter and do not possess any control over the physical access mechanisms to their data in these datacenters [40]. Most well-known and established SaaS cloud service providers have datacenters located around the world, which can be an issue for many client firms due to compliance and data privacy laws in various countries. Such regulations often make locality of data critical in many enterprise architectures. For instance, in many countries in Europe, regulations are in place to ensure that

certain types of data cannot leave the country because of potentially sensitive nature of information [40]. In addition to the regulations imposed by local laws, there's also the question of whose jurisdiction the data falls under, when an investigation occurs or for arbitration purposes [40]. These concerns make firm's decisions to migrate to cloud computing services complicated.

4.2.4 Integration Complexity

Integrating the SaaS applications can introduce challenges, both with respect to the way different systems interact with each other and the existing workflows in place. Here, the complex integrations in SaaS applications can present significant challenges for the adopting firms and is among the key reasons for slow adoption of SaaS applications [37], [43]. It has been identified that, complex integrations of SaaS applications with other in-house applications or other SaaS vendors requires the expertise of highly skilled technicians and cloud consulting firms. Therefore, such integrations can cost 30-45% of the overall SaaS implementation, and is still a big challenge [37]. The adopting firms need to count such cost and use methods, technologies and tools that are reliable and tested, because poorly implemented integrations may result in unreliable applications that failing to communicate with each other resulting in loss of revenue and productivity, which wipes out the benefits of adopting SaaS. A further concern with regard to SaaS integration is the lack of interoperability standards within the cloud computing arena, which may result in a possible lock-in situation for the adopting firms [37] where, due to issues in interoperability, there is an limited flexibility to integrate with SaaS applications provided by the various other vendors [37]. However, in recent years, integration as a service (IaaS) which is a cloud-based delivery model has received wider adoption, as it offers ways for simplifying integrations and reduce the cost of integrations in cloud-to-cloud platforms [37]. Also, it is observable that most SaaS vendors are focused on addressing in-house integration issues by pre-building integration support within the SaaS solutions, with the aim of reducing the cost and complexity of integrations [37], [45].

4.2.5 Contract Complexity

Contract agreements are vital to manage and develop relationship with the SaaS service providers and adopting firms. Here, SLAs are important for the contract to setting agreement for the service levels between the SaaS consumer and the service provider stating specific parameters and minimum levels required for each element of the service provided [43], [44]. Such SLAs must be enforceable and shall include precise remedies for failure to meet those requirements [43], [44]. A contract for SaaS should affirm an institution's ownership of its data stored on the service provider's system and clearly state the rights to get it back. Key to any SLA is the security clause which must detail the system infrastructure and security standards to be maintained by the service provider in addition to framing the rights to audit the compliance. Furthermore, a cloud SLA must specify the cost involved to continue or discontinue the service. An ideal SLA is one which both the cloud consumer and service provider can understand and agree to, including an exit strategy [44], [46]. As IT decision makers evaluate and compare SLAs from cloud computing providers, it is important that they clearly understand what is critical and will be required for the business in the future, since cloud SLAs continue to be complex and are still emerging. The key focus of the SLA should be carefully reviewed, evaluated and measured before being closed as an agreement [44]. Further, it has been observed that typically a cloud service provider's standard contract is written with the terms and conditions to favor the cloud service provider [43]. Gartner the leading research and advisory company, mentions that before subscribing to a cloud-based solution, a firm considering cloud computing shall "understand the detailed terms and conditions... and the risks of signing the service provider's standard contract" [43]. Thus, it is essential to negotiate any revisions necessary with the cloud services provider to ensure that the terms of the contract sufficiently address the adopting firm's requirements [43]. Also, the SaaS contracts must include appropriate terms to ensure pricing for SaaS services does not change beyond what is expected or commercially competitive, during service term renewals or changes in demand and usage. More, contracts shall include expected settings for SaaS provider insolvency or change of ownership. In addition, contractual protections shall be in place to ensure that the functionality and interfaces of the SaaS application do not change unexpectedly, hurting the adopting firm's business. Further, the contracts shall have terms to obligate the SaaS providers to destroy the client firm's data after termination of the contract [43].

4.2.6 Data Disposition at Termination

Vendor lock-in is a major complexity to the adoption of SaaS cloud computing solutions, due to the lack of standardization [46]. Most adopting firms of SaaS solutions are unaware of proprietary standards of cloud service providers which prohibit interoperability and portability of applications [46]. These interoperability and data portability issues stems from lack of integration capabilities between the existing management tools, incompatibility issues with other on-premise software, and inability to shift to another cloud service provider or get data back for an in-house solution [46]. For instance, data provided in a format that is proprietary or inaccessible would be of little or no use when switching to an alternative cloud or in-house solution [43]. To overcome this issue, developing awareness of commonalities and dependencies among cloud-based solutions, selecting of vendors that support standardised formats and protocols such as standard data structures and APIs is important [46]. Further, the contacts shall state adopting firm's rights to access its data on an ongoing basis and elaborate on the process by which it's data will be returned to or retrieved in an appropriate and usable data format upon termination of the contract [43].

5 Conclusion

In recent years, Software-as-a-Service (SaaS) cloud computing model has gained a wide attention. It is evident that, many factors influence the adoption of SaaS cloud solutions and the organizations must systematically evaluate these factors before determining to adopt such solutions. To assess these determinants that influence the adoption of SaaS solutions, this study introduces a research model based on the characteristics of the technology-organization-environment (TOE) framework. In this study, a systematic literature review was conducted, prior empirical research concerning decision making in the context of SaaS cloud services was surveyed and synthesized, and the body of research on identifying determinant factors of SaaS sourcing decisions was

examined. Further, the most influential determinant factors with robust results were discussed in detail as drivers and complexities for SaaS model adoption. It was found that, even though there are numerous benefits the firms can gain though SaaS adoption, there are multiple complexities which firms should understand and focus on in such technology adoption. The outcomes of this study provide a basis for future research in the context of SaaS cloud services and contribute to the development of theory in the cloud computing domain. Further, this work contributes to practice, as the determinant factors of SaaS cloud services adoption serve as a foundation for best practices and guidelines to select and offer SaaS cloud services. Furthermore, the firms may use the determinant factors highlighted in this study to guide their procurement processes and to identify possible benefits and complexities that may arise during the adoption, implementation, or integration of SaaS cloud services.

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