

# Technology organization environment framework in cloud computing

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## ABSTRACT

Cloud Computing is a rapidly emerging technology over the last few years, that has abolished the burden of purchasing heavy hardware and software. Cloud computing has been advantageous to Small and Medium-sized Enterprises (SMEs), though many SMEs have not adopted to delve into its appealing benefits. To increase the cloud adoption rate in these Enterprises, the most important thing is to understand the aspects which influence the cloud adoption. The article focuses on these factors, which influence the use of cloud services by establishing the three layer hierarchical framework based on the grounded on the Technology Oriented Environmental (TOE) framework through systematic literature review. Because cloud-based solutions offer numerous benefits for companies, they have precious cloud determinants. This paper therefore took into account the Technology Organization Environment TOE model for Cloud Computing adoption. In addition, the questionnaires designed at the end also indicate the significant connection in the decision of adoption between three context of TOE. Moreover, the designed questionnaires has been used for the analysis of cloud computing adoption in Bangladeshi SMEs.

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## 1. INTRODUCTION

Nowadays, cloud computing has been a major agenda in the computing field. Cloud computing is the on-demand delivery of computer system resources as a service over the network [1]. The features of cloud computing, including scalability, flexibility and pay-per-usage model [2] has the potential to influence the various aspects of social and economic activities globally in various types of enterprises. Cloud computing offers enormous benefits to all organizations and enterprises, including SMEs [3]. SMEs are the enterprises in which amount of personnel are less than certain limits, and they are control the data of high sensitivity. Some cases of sensitive data which is controlled by SMEs are: data of intelligence agencies and government federal, financial data of companies, purchase contracts, company databases, de-identified research data, bank associated data like bank accounts, pin, passwords, balances and dealings, trade secrets, email accounts, drug formulas, accounting records and source codes [4]. The adoption of cloud computing is growing rapidly as it allows enterprises to concentrate on their essential business events, and, thus, efficiency is improved [5]. An adequately adopted cloud provides a plenty of benefits to the enterprises such as unlimited computing power, easy access of data and applications, lower IT expenditure, and build up competitive advantage. Recently,

SMEs has shown a great concern in including cloud computing to their overall Information technology (IT) strategies. A recent report by Mckinsey [6] on the adoption rate of cloud service by SMEs informed that, 70% of SMEs have formerly bought at least two cloud service, and 40% have bought six or more cloud services. Nevertheless the touted benefits of cloud computing, its adoption and implementation in SMEs is faced with many challenges including national and international regulations, shortage of industry-specific conformism to principles, security and privacy threats [7-9]. Due to these challenges, some enterprises are quiet anxious around the threats of shifting business-critical applications to the cloud. There is therefore the need to understand the factors that can influence their rate of adoption in companies in order to grow in cloud computing.

This study will examine the perception of IT professionals as regards cloud services in the context of the Technology Organization Environment (TOE) and IT professionals are concerned about their adoption [10]. Recently, adoption of technology has become the most advanced area for research in Information Systems. Most researchers focused on the new factors that affect technology adoption at both the individual, the organizational levels. Various theories and models established to explain technological adoption, assuming new factors in all practicable areas. These include Reasoned Action Theory (ART), Planned Conduct Theory, Technology Model for Acceptance (TAM), comprehensive TAM, unified technology (UTAUT) and the motivational model, the Theory of Innovation Dissemination, social cognitive theory and Technological Environment Organization (TOE). Much research conducted at the individual level of technology adoption and a few organizational tasks. This study focuses mainly on the organizational framework, such as the Environment Technology Organization (TOE). The context of an organization has a big effect on accepting and carrying out the revolution. TOE is the framework covering three different roots in the perspective of an organization in the decision-making process. Technological, organizational and environmental contexts are these fundamental principles. In this field of technical adoption, it takes an hour to look at future research opportunities. The TOE Framework contributes too many areas by explaining different technological developments, such as e-commerce, business resource planning, green IT Start-Up, cloud computing, Small and medium-sized companies (SMEs), etc.

## 2. BACKGROUND STUDY

### 2.1. Technology Adoption

Technology adoption for information systems is a mature field of research. In [11] defined technology adoption as the stage in which an individual or an organization will be able to choose a technology for use. The problems relating to technology adoption have gained more prominence in recent days with rapid progress in technology innovations of every imaginable field. Great investment for the introduction of new technologies, made by organizations and governments that can bring a change in the life of users. However, such investments cannot produce results unless the intended users adopt innovations. The evolution of this field of research in information systems must understood and future research opportunities examined [12].

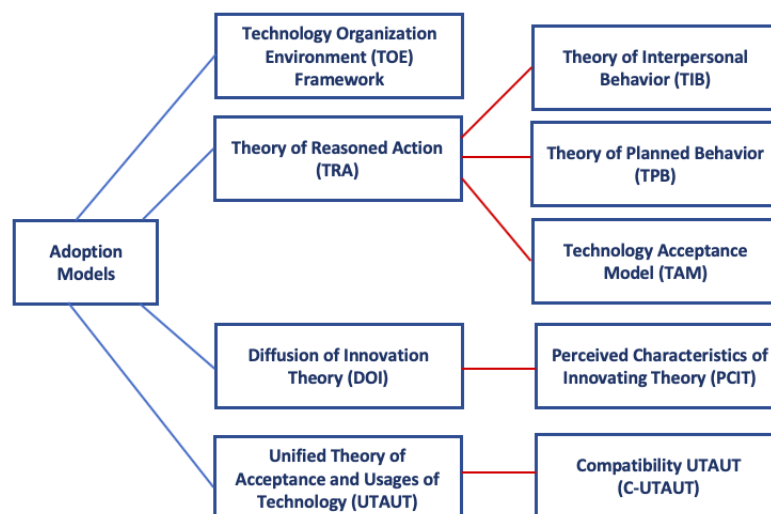


Figure 1. Common Cloud Computing Adoption Models

## 2.2. Cloud Computing

According to National Standards and Technology Institute (NIST) "cloud-based computing as a model that provides fast, convenient on-demand network access to an interaction with a shared bundle of computer resources configurable (e.g., networks, Servers, Storage, Applications, Services). It fosters availabilities that are composed of five basic features (self service on-demand, broad network access, pooling of resource sources, rapid elasticity and measured service) three models: (Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS). A variety of cloud services have been available over the past several years. The cloud deployment models in particular need to be taken into account for a cloud infrastructure installation organization. Here, one of the four models can be selected. A private cloud provides organizational computing services to members of a single organization. Your cloud system is located in your own data center or via an internet data center, which is rented out and operated on-site or managed on an individual basis by a third party [13]. The community cloud provides computer services to enable collaboration for a mission, security or compliance for a specific purpose. Public clouds may be operated by any public cloud company, such as Amazon, Microsoft and Sales Force [14]. The cloud is not limited to one person or a company. There is a hybrid cloud model running on two or more models [15]. As computer services are required, the market continues to increase for companies that cover latency-free and worldwide safe services [16]. Unbiased, companies have started considering how to use hybrid IT in a complex IT environment by combining IT systems and services? Therefore, companies need a systemic approach to set key cloud computing models and IT network values should help to effectively manage cloud computing systems [17].

## 2.3. Adoption Methods and Theories

There are a number of technological innovation and technological adoption theories and studies. Various theories and models for clarifying the occurrences of technological adopt hypothesize new factors in all practicable fields [18]. Utmost common theorization is Technology Acceptance Model (TAM), Theory of Planned Behavior (TPB), Unified Theory of Acceptance and Use of Technology (UTAUT) and TOE framework (Technology- Organization-Environment). The Figure 1 shows few common cloud computing adoption models and Table 1 presents their brief descriptions.

Table 1. Adoption methods and theories

Adoption Models	Developed By	Published Year	Used As
Diffusion of Innovation (DOI)	Everett Roger	In 1960	Individually/Organizationally
Theory of Reasoned Action (TRA)	Fishbein and Ajzen	In 1975	Individually
Social Cognitive Theory	Albert Bandura	In 1986	Individually/Organizationally
Technology Acceptance Model (TAM)	Davis, Bagozzi and Warshaw	In 1989	Individually/ Organizationally
Technology Organization Environment (TOE)	Fleischer and Tornatzky	In 1990	Individually/Organizationally
Theory of Planned Behavior (TPB)	Ajzen	In 1991	Individually
Motivation Model	Davis et al.	In 1992	Individually
Extended TAM	Venkatesh and Davis	In 1996	Individually/Organizationally
Unified Theory of Acceptance and Use of Technology (UTAUT)	Venkatesh and Morris	In 2003	Individually/Organizationally

## 2.4. Technology Organization Environment (TOE)

Technological Organizing Environmental (TOE) framework is proposed to study the use of technological innovations [19]. They maintain that the decision to adopt technological innovation based on environmental and organizational factors and technological characteristics. This framework therefore envisages a three-fold framework for technological innovation assumption and execution: the technical, the structural and the environmental context.

- (a) **Technological Context** The technological background refers to the relevant technologies in the enterprise. This includes existing, company- related tools and emerging technologies.
- (b) **Organizational Context** The organizational perspective describes the organizational characteristics. Joint organizational characteristics include corporate size, centralizing degree, formality, management structure complexity, Quality of its human resources and domestic slack resources [20]. Organizational characteristics may also reduce or make it possible for technological innovations to be adopted and implemented.

- (c) **Environmental Context** The environment is the space where an organization carries out its activities. This includes occupational associates, participants and the administration [21]. It is outside of an organization, which has restrictions and prospects on high-tech revolution. This makes the TOE structure widely applicable in various disciplines, because researchers can choose each dimension based on innovation and organizational characteristics such as the work of [22]. In contrast to certain theories or models in the study of Information Systems, the TOE Framework is a generic theory which only mentions several aspects of adoption, without stating the factors of each dimension.

### 3. THE PROBLEM STATEMENT

There is plenty of study at the individual level of technology adoption and a few organizational activities. The purpose of this paper is to conduct a collected, systematic review analysis to classify critical aspects of information technology adoption in cloud computing organizations under the roof TOE framework.

### 4. RESEARCH AND REVIEW ANALYSIS METHOD

Followed by the methodology of systematic literature review, research documents with proper keywords and buzzwords are downloaded from various authentic sources. The following electronic databases were retrieved for the literature search, chosen due to their content being related to the discipline: Google Scholar, academic databases including IEEE Xplore, Springer Link, ScienceDirect, ACM Digital Library, Elsevier etc. The next Figure 2 gives the idea of systematic review process.

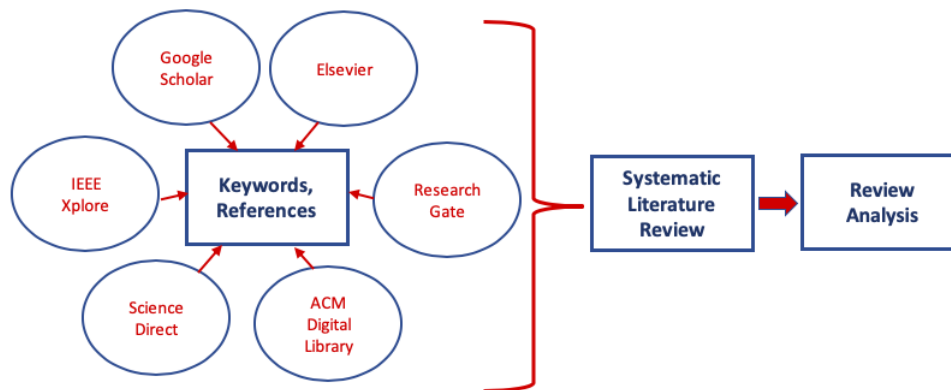


Figure 2. The Systematic Literature Review Process

This paper examined what most of the researchers in this field were focusing on. In the initial search, the paper focused on keywords like model of technology adoption, theories and model of adoption in SMEs etc. Hottest documents have again searched online to contain any missing documents, which have been left out due to new keywords. Since we wanted to look over the years and not apply these theories and models, we have collected papers that provide a general overview of some of the main theories evolved over the years. Seminar and Conference papers on these theories have been downloaded and thoroughly studied to understand the TOE in the domain of Cloud Computing.

### 5. SYSTEMATIC LITERATURE REVIEW

Although some identified factors may vary from study to research in three contexts, TOE has a strong theory and consistent support [23]. For example, In [24], they regarded the TOE as the main historical evidence of e-business diffusion, while in [25] proposed the TOE model to understand the use of RFID by manufacturing companies that want to increase the visibility and efficiency of the supply chain. SMEs use the green practices to analyze the drivers that influenced by TOE Framework. In the [26], results have demonstrated that SMEs' use of Enterprise Adoption (EA) affects technology, organization and environment, concentrated on aspects that affect SMEs adoption of Customer Relationship Management (CRM) and e-procurement systems. This

implies that the TOE model is a powerful tool for foreseeing how SMEs will accept EA. The factors of use of CRMs in hospitals have been discussed in [27]. The TOE framework was used as a test model by [28], who carried out a query to investigate electronic commerce factors among mid-to small- scale (small and medium) 926 companies in Vietnam. Mobile corporations have been investigating through TOE conjunction [29]. The TOE framework used to analyze and develop hierarchical dynamics that stimulus the use of cloud computing in companies [30]. Following an analysis of factors, the most important effects on companies, the organization, and the environment, have been found in technology. These findings have shown that TOE is an appropriate framework for research on Information Technology (IT) system adoption. The results of the study may also allow companies to dedicate resources to develop the successful rates of cloud computing according to the mass of each factor, with lower costs and higher efficiency. Furthermore, results for cloud providers can provide information on the needs of customers and offer appropriate operations and marketing strategies. This defines the three-factor hierarchy that influences cloud computing adoption in companies which represents in Table 2.

Table 2. Three layer hierarchy factors affecting EA of cloud computing

Technology organization environment (toe)		
Technology	Related Improvement	<ul style="list-style-type: none"> <li>- Cost Advantage</li> <li>- Efficiency</li> <li>- Flexibility</li> <li>- Capacity Management</li> <li>- Robustness</li> <li>- Security Concern</li> </ul>
	Compatibility	<ul style="list-style-type: none"> <li>- Easy to use</li> <li>- Usefulness</li> </ul>
Organization	Top Management Support	<ul style="list-style-type: none"> <li>- Vision for Long term</li> <li>- Commitment of Resources</li> <li>- Establishing Goal</li> </ul>
	Organization Readiness	<ul style="list-style-type: none"> <li>- Financial Readiness</li> <li>- Technological Infrastructure</li> </ul>
Environment	Competitive Pressure	<ul style="list-style-type: none"> <li>- Industrial Structure Variations</li> <li>- Relatively Economic Position Increase</li> <li>- New Business Peer Group</li> </ul>
	Administration Regulation	<ul style="list-style-type: none"> <li>- Management Inducement</li> <li>- Regulation, Strategy</li> </ul>
	Technology Support Infrastructure	<ul style="list-style-type: none"> <li>- Access to the Vendor</li> <li>- Suitable User and Technical Assistance</li> <li>- Provider Relationship</li> </ul>

## 6. TOE IN CLOUD COMPUTING ADOPTION REVIEW ANALYSIS

Most cloud adoption studies expending the TOE framework define a technological context in terms of innovative technology features. A brief review of articles using the TOE Framework to understand cloud adoption described in Table 3. This paper shows how different perspectives can consolidated through an integrated approach to the understanding of cloud organizations. With four key themes, cloud offerings and their compatibility with business needs can reviewed by organizations. Consequently, this article affects both research and practice. Additionally, the quick checklist use to see how the cloud organization's different aspects work. Further, this paper can help to understand how different factors affect cloud adoption probabilities in different SMEs. The following are sample questions designed from the three perspectives, which must comply with the Technology Organization Environment (TOE) selection when adopting cloud computing. The designed questionnaires represents in Table 4

The adoption of TOE in cloud computing for 20 SMEs in Bangladesh are analyzed under the three context (Technical, Organizational and Environmental). All these SMEs are ready to adopt cloud computing the designed questionnaire of Table 4 has been used to them. The analysis of TOE adoption in cloud computing for 20 SMEs of Bangladesh are shown in next Figure 3.

Table 3. TOE in Cloud Computing and Review Analysis with four main theme

Papers	Domain	Method	Technology Context	Organization Context	Environment Context
Low, Chen <i>et al.</i> [31]	Business	A framework based survey collected data from 111 high-tech companies in Taiwan.	Relative Benefit, Complexity and Compatibility	Support for top management, firm size, readiness for technology	Competitive Pressures and pressure from trading partners
Nasir and Niazi [32]	Business	Effectiveness of the CAAM in assessing readiness of the organization to implement cloud computing is assessed through 3 case studies	Not Significant	Learning Capacity, IT Capacity of the organization	Competitive pressure, Network dominance expectations
Borgman, Bahli <i>et al.</i> [33]	Business	In semi-structured interviews, this qualitative research project compiled data in 15 different SMEs by adopting the theoretical TOE framework.	Compatibility, Complexity, trail ability, relation advantage	Innovation and knowledge prior to that.	Size, top management support, innovation, IT experience prior to implementation
Borgman, Bahli <i>et al.</i> [33]	Business	Developed an enlarged TOE framework in a number of hypotheses carried out by 24 global firms in several industries	Compatibility and Relative Advantage	Top management assistance, firm size and business user IT expertise	Environmental Competition and regulation
Lorraine Morgan [34]	Business	3 case studies by service providers and their customers in literature will build on this research, which does not address the complex and diverse nature of adoption in existing cloud technologies	Compatibility and Complexity, relative advantage and ability to test	IT executives fear of losing control of their IT environment is necessary for collaboration and openness, increased traceability and auditability	Risk assessment and safety and legal issues
Mathews Z. Nkhoma [35]	Business	The quantitative approach for this study is the development and validation of a conceptual theory model	Compatibility, Security, Reliability and Availability, Extension of existing applications	Lack of compliance with IT standards	Complexities in the hidden, Shared best practices, Cost Flexibility, market adaptability
Amin Saedi [36]	Business Technical	The researcher analyzed the data after gathering the data from the interview	Relative benefits, Compatibility, Accessibility, Data Security, Privacy Management	Compatibility, accessibility, privacy and data security deficiencies	Savings in costs, relative benefits, compatibility, accessibility, security and privacy impairments
Hsu, Ray <i>et al.</i> [37]	Business	They have empirically tested their research model with 200 Taiwanese companies	Benefits received, business issues	Capacity for IT	Not Significant

Table 3. TOE in Cloud Computing and Review Analysis with four main theme

Papers	Domain	Method	Technology Context	Organization Context	Environment Context
Ezer Osei Yeboah-Boateng [38]	Business	In order to overcome the sample selection error, random sampling and purposeful sampling were used.	Cloud service testing capacity, provision of essential IT infrastructure and resources, existing system compatibility, strength of in-built safety systems, employee learning capacity, limited technological expertise in similar technologies, non-performance of cloud services in support of operational operations	Top management support and participation, resistance to new technologies, work, culture and style conformity, organizational structure and size impacts and an Initial Industry Adopters	Providers appropriate user and technical support, the selection of qualified and expert cloud vendors, market influence, nature of industry, relations between suppliers, government and competitors
Gangwar, Date <i>et al.</i> [15]	Business	Data was gathered from 280 IT, manufacturing and finance companies in India through a questionnaire	Compatibility, Complexity, relative benefit	Preparation, Top management, Training and Education	Support for Competitive pressure and trade partners
Nedev [39]	Business	A case study is carried out from information collected by a large multinational company through interviews with four IT managers. The results for the studied population can only be generalized by the qualitative method and comfort sampling technique	A relative benefit, compatibility, redundancy, safety and performance	Pressure on competitive and business partners	Size and technological preparedness of a company

Table 4. TOE questioner of cloud computing

TOE of cloud adoption	
Technology	<ul style="list-style-type: none"> <li>- Does the cloud support the systems that are complex?</li> <li>- How does this cloud supplier have safety mechanisms and expertise?</li> <li>- Could the cloud replicate the security measures?</li> <li>- Is the cloud capable of interfacing seamlessly with other legacy cloud applications?</li> </ul>
Organization	<ul style="list-style-type: none"> <li>- How well the top managers are aware of the advantages and risks of moving to the cloud?</li> <li>- How large would the project be depending on the company's size?</li> <li>- How well qualified are our IT resources for cloud-based application issues?</li> <li>- How dramatically the system's working environment will change for cloud employees?</li> <li>- Is the cloud-based work environment a new way to do things?</li> </ul>
Environment	<ul style="list-style-type: none"> <li>- How far the cloud-based application has entered the industry?</li> <li>- Do the cloud already been adopted by important competitors?</li> <li>- Will pass all regulatory and audit controls in the cloud based system?</li> <li>- How many cloud-based suppliers have industry expertise and organizational application?</li> <li>- Do these suppliers have references in the industry or in the specific application?</li> <li>- A large number of suppliers can be chosen?</li> <li>- Can cloud vendors replicate or guarantee current terms and conditions?</li> </ul>

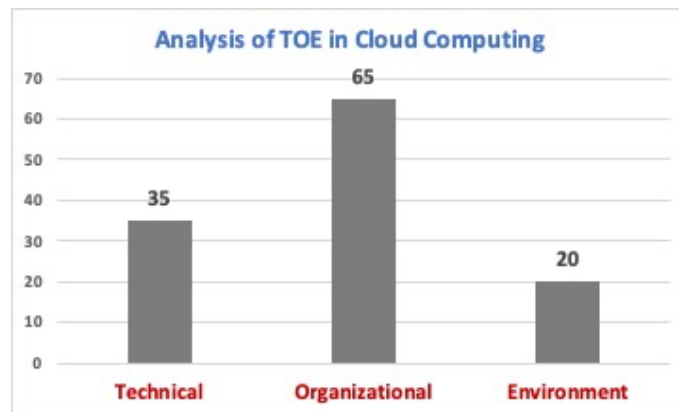


Figure 3. Analysis of TOE framework in Bangladesh's SMEs

## 7. CONCLUSION

The ultimate objective of this study was to conceptualized the link between the TOE framework and the decision of organizations (SMEs) to adopt cloud computing and all three factors that are positively linked to the decision to adopt cloud computing. In addition, the analysis of the review was significant to understand the factors to adopt cloud computing in TOE framework for many recent days organizations. This paper is not free of limiting factors, it only looked for academic papers, white papers, magazine articles, other academic literature databases and papers from forward and backwards searches, whose inclusion would help capture more cloud adoption problems for different types of organizations. In this study, from application to environment, various micro as well as macro level aspects considered in the integrated perspective. Finally, the quick checklist can serve as the roadmap to support organizations/SMEs, using the relevant questions, in exploring four distinction aspects of cloud acceptance.

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