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ORIGINAL RESEARCH

Business Factors Challenging SMEs for Adopting Cloud-Based Solutions

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Abstract

The SMEs are essential players in the development of innovativeness, effectiveness, entrepreneurship and the institution of a valuable revolutionary system for developing nations. Cloud computing is a growing trend in India; however, the Indian SMEs are not well aware of the benefits of this technology. The vast SME population in the industrial state of Karnataka also needs to get acquainted with cloud computing for amending their growth and effectiveness besides staying ahead in the competition on the global as well as the national front. This includes the elements of management of technology and innovation such as adaptation as upgradation. This study aims to find the impact of business factors, economic performance and environmental performance that challenges the SMEs for cloud computing adoption. This is a survey-based study with 410 SME respondents from Karnataka. The multiple linear regression analysis is employed to achieve the objectives of the study. Findings indicate that adopting the technology of cloud computing benefits the SMEs of Karnataka to overcome the business challenges they face germane to their businesses. It was found that the technological, organizational, environmental performance and the economic performance factors were positively related to each other, emphasizing the importance of these factors.

Keywords SME · Cloud computing · Adaptation · Business factors

Introduction

The modernistic creed of neo-liberalism and globalization has accentuated the functionality of the small and medium enterprises (SMEs) as the backers of a fostering business environment and economic effectiveness besides being able to improve the economy of the developing nations. According to the European Commission, the factors mostly incorporated for categorizing the SMEs are the "*number of employees, the annual turnover and the active balance*" (Akbari, 2012). SMEs are categorized into three (Akbari, 2012), namely, micro-entities: enterprises comprising utmost ten employees; small companies: enterprises comprising at the most 50 employees; medium-sized companies: enterprises comprising not more than 250 employees. In India, the SMEs are demarcated mainly through the number of employees and outlay on the industrial unit and equipment that leads to a small sector that comprises micro-enterprises (up to ₹25 lakh investment and 9 employees); small enterprises (up to ₹5 crores investment and 10–40 employees); medium enterprises (₹5 crores and ₹10 crores investment and 10–40 employees) (Siddiqui & Aljahdali, 2013).

In the recent few years, there has been more attention to the cloud computing technology and in spite of several professed advantages, numerous SMEs, be that as it may, give the impression of being conventional concerning the migration to cloud (Gartner, 2008). According to a survey conducted by Gartner and other research analysts, a majority of the international enterprises have migrated to cloud in 2011. Likewise, IBM had anticipated a twofold increase in cloud migration by 2014 (Opara-Martins et al., 2014). Forbes has predicted a 78% hike in the adoption of cloud computing in the SMEs in the USA (Forbes et al., 2015).

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Need for Cloud Adoption in Karnataka's SMEs

This research is motivated by few studies pertinent to the technology adoption in the SMEs of Karnataka, particularly cloud computing. Karnataka is one of the substantial industrial states of India and housed about 4.81 lakh registered MSMEs in the year 2014 according to Rangaprasad (2016). While some of the SMEs have adopted technologies, the majority have not. It is imperative to comprehend the business challenges of adopting cloud computing and highlight the factors that impede this adoption and aid the growth of the SMEs in Karnataka. Furthermore, it is essential to classify the factors based on different categories to thoroughly understand the adoption challenges from several perspectives. Also, it is elemental to identify the risks of cloud adoption in the SMEs so that cloud service providers can provide viable options to ease the cloud adoption process.

Therefore this study aims to find the impact of business factors, economic performance and environmental performance challenges that the SMEs encounter for cloud computing adoption. There are three objectives of this study, namely to explore the relationship of: (a) influencing factors of business challenges with cloud computing; (b) influencing factors of business challenges with overall economic performance of SMEs; (c) influencing factors of business challenges with overall environmental performance of SMEs. The following section details the literature review, followed by research methodology, data analysis, findings and conclusion of this study.

Literature Review

Cloud Computing in SMEs

Technological advancements and inventions are essential for a company's growth and for the ones who want to remain at the top with a competitive edge in the market share (Becheikh et al., 2006).Cloud computing has been referred to as 'the fifth utility' (alongside water, power, gas, and phone) whereby computing services are promptly accessible on request, as other utility services accessible to the public (Heeks & Bailur, 2007). Cloud computing has emerged to develop into one of the highest technological precedences for businesses globally (Gartner, 2011). Cloud computing is a model for enabling ubiquitous, 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 (Mell & Grance, 2011).

The key characteristics of cloud computing are (Reilly et al., 2011):

- On-demand self-service
- Ubiquitous network access
- Location-independent resource pooling
- Rapid elasticity
- Pay per use

Cloud computing endeavors to provide a virtualization of services to facilitate the user to avail the applications from anywhere across the globe, after getting subscribed to the services for cheaper costs that hinge on the quality of service (QoS) constraints (Buyya et al., 2009). Cloud emancipates the SMEs from the low-level errands of planning the IT infrastructure which allows more emphasis on novelty and creating business value for the services (Garg et al., 2013). While cloud computing can guarantee on-request computing power, better execution, dependability, and adaptability to the business, it additionally offers low ecological cost as far as better vitality proficiency, contrasted with the customary circulated venture server farms, which is an advantage to society (Erdogmus, 2009; Katz, 2009).

As per Walsham et al. (2007), these levels of investigation can be assembled into

1. Small-scale level to concentrate on the SMEs that utilize cloud computing application.
2. Meso level to concentrate on the SMEs that serve as a go-between to convey cloud computing services.
3. Full-scale level to concentrate on SMEs that convey the framework, decide the approach and set tenets and controls inside which cloud computing applications can be received and utilized.

According to Heeks (2006), four stages for the discourse of cloud computing in SMEs are:

1. The preparation of SMEs in the clouds—needs and requirements. This incorporates the necessities of SMEs, prerequisites and longing to embrace cloud computing.
2. The selection and the procedures of appropriation of cloud computing by SMEs—address the reception of cloud computing by SMEs, by highlighting the procedure that includes relocation to the cloud, execution and cloud combination issues with legacy IT frameworks.
3. The utilization of cloud computing by SMEs adoption is not an important state of use.

Factors for Adopting Cloud Computing in SMEs

SMEs need not upgrade and maintain servers or various applications and securities. Rather, they can depend on the service provider on cloud who can effortlessly scale up and down with the help of aligning and re-aligning virtual and physical resources for meeting the actual requirement (Chen et al., 2011; Kloch et al., 2011; Li et al., 2009; Marinos et al., 2009; Nair et al., 2010; Petrakou et al., 2011; Sultan, 2010, 2011). Cloud computing services give an open platform for every country, every organization and for every business to improve competitiveness and promote innovation (Kloch et al., 2011; Sultan, 2011; Tumer, 2010; Williams et al., 2009). Greater security is probable because of scale economies and the ability of affording better experts for security (Chang et al., 2017; Kloch et al., 2011; Levy, 2009; Sulistio et al., 2009).

The reasons for adopting cloud computing based on social factors are user friendliness (Fahmideh et al., 2019) and cooperation in IT (Chen et al., 2011; Williams et al., 2009). It offers new chances for social networking and collaboration among business partners by allowing access to information sources which are distance and time independent (Nair et al., 2010; Petrakou et al., 2011; Tumer, 2010) and opportunities for engineers, marketing staffs, sales and more for developing new skills (Khajeh-Hosseini et al., 2010).

Reasons for adopting cloud computing based on technological factors are reliability that can be enhanced with the help of redundant sites (Kloch et al., 2011; Sultan, 2010), flexibility in the response to amend, scalability through forceful provisioning of resources (Chang et al., 2017; Sulistio et al., 2009), high quality service, accessible anytime, at any connection, device and place (Marinos et al., 2009) and network governance and IT state, and management models of flexible license, perceiving how operations are carried out based on SLA (service level agreements) as explained by Dillon et al. (2010). It is found that reducing the cost is the main reason behind implementing cloud-based system for the majority of the SMEs (Akbari, 2012). Cloud computing plays a major role in addressing the fundamental contribution and inefficiencies of the competitiveness as well as the growth of the enterprises mainly in SMEs (Alkhalil et al., 2013).

Theoretical Background of the Three Models: TAM, TOE, and TCE

The technology acceptance model (TAM) lays down three main factors that are noticeable in the milieu of application of information technology and acceptance, namely Perceived usefulness (PU), perceived ease of use (PEOU), and attitude toward usage (ATU) (Ajzen & Fishbein, 2000; Davis, 1989). In fact, perceived usefulness (PU) and perceived ease of use (PEOU) have been recognized as the two most important factors in explaining individual users' adoption intention (Davis, 1989).

The technology organizational environment (TOE) model undertakes common established factors for foreseeing the prospect of technology adoption. The model alludes that adoption of any technology is inclined to the development of that technology (Kauffman & Walden, 2001), organizational circumstances, organizational restructuring (Chatterjee et al., 2002), and industry environment (Kowath & Choon, 2001). The factors that are formulated and supported within the TOE model are technological factors such as security concern, deployability and reliability; organizational factors such as firm size, perceived benefits, firm scope and technological knowledge; and environmental factors such as web service provider's trust, regulatory influences, dependent readiness of partners, and competitive pressure (Lippert & Govindarajulu, 2006). Low et al. (2011) argue about the determinants of adopting cloud computing with eight main factors of the TOE model, namely relative advantage, firm size, complexity, trading pressure from partner, competitive pressure, compatibility, technology readiness and top management support.

Williamson (2007) stated about the organization dealing with the transaction cost economics (TCE) around the "Carnegie Triple" that means be disciplined, have an active mind, and be interdisciplinary. Cloud computing with the TCE implementation is the computing paradigm shift that is massively scalable, driven by scaling economies, dynamically configured, encapsulated like abstract entity and delivered with the demands of the users (Aubert et al., 2004). In the TCE framework, the identified factors are asset specificity, transaction cost like information costs, contracting costs and coordination costs (Aubert et al., 2004; Cacciola & Gibbons, 2012; Yigitbasioglu, 2014), and occurrence frequency (Sobragi et al., 2014). The business challenges identified in the adoption of cloud computing (CC) through the TCE model are security risks: privacy, performance, confidentiality and availability (Yigitbasioglu, 2014).

Adoption of Cloud Computing in the SMEs

Cloud computing is a huge opportunity gained in the Indian market as it equips a large number of SMEs with scalable, user-friendly and reliable application that helps to expand their business (Sharma et al., 2010). Sultan (2011) determined the fiscal feasibility, effectiveness and several advantages of cloud-based solutions in SMEs. To effectively facilitate and improve the SMEs, amendment of policies are

essential for the adoption of cloud computing (Carcary et al., 2014).The most significant factor in cloud computing is the high quality of technology that supports the SMEs and the partner of the IT functions in the outsourced business strategy (Adam & Musah, 2015). Hamburg and Bucksch (2016) expressed that cloud computing in the SMEs strengthens the economic growth of the global countries.

In India, it is known that the small and medium industries play a crucial strategic role in entrepreneurship development, creation of employment, distribution of income, reduction of poverty, manufacture of products for exports and growth (Siddiqui & Aljahdali, 2013). The five characteristics of cloud computing as specified by the National Institute of Standard and Technology (NIST) are on-demand self-servicing, resource pooling, and measured service with pay per use, rapid elasticity and broad network access.

The usage of cloud computing in the SMEs is a one-stop solution for the financially weak SMEs (Babu & Chakravarty, 2014). Because of the IT expertise, resources, size and other efficient constraints, CC is highly beneficial to the Indian SMEs (Priyadarshinee et al., 2014). The IT sector plays a pivotal role as far as it is concerned in Indian SMEs, so the adoption of the CC storage supports the growth of the economy with SMEs market (Priyadarshinee et al., 2014).

Ramadoss et al. (2012) presented a study about enterprise modernization with cloud computing that has reached high popularity in Karnataka, as it transforms the consumption and management of IT services. Cloud computing usage has increased in Karnataka that allows organizations to undergo a process of scaling up and down their business resources based on their needs (Sowmya & Jyothi, 2015). Rangaprasad (2016) has described Karnataka as the state that gives high importance to small and medium enterprises for its promotion, growth and development.

Role of Cloud Computing in the Competitiveness of SMEs

A firm's competitiveness depends on its capability to be more efficient than others in the market place (Ajitabh & Momaya, 2004; Satyanarayana et al., 2021). However, a firm's competitiveness is a complex concept that depends on different aspects which are both external and internal to the firm (Ambastha & Momaya, 2004). In addition, a firm's innovation capabilities and competitiveness (economic performance) can be measured on financial and several other factors of competitiveness (Momaya, 2019). According to Yin et al. (2019), the strategies that enable firms to maximize the value and at the same time minimize the resources required result in enhanced productivity and competitiveness. Further, an effective management of technology and innovation (MoT) aids firms to become competitive at the global level, against its competitors (Momaya, 2017).

Cloud computing provides many opportunities to businesses to be more efficient such as virtualization of services, on-request computing power, better execution, low cost, agility, dependability, scalability and adaptability to the business (Buyya et al., 2009). These advantages can in turn improve the competitiveness of the business and promote innovation (Buyya et al., 2009; Erdogmus, 2009; Katz, 2009; Tumer, 2010; Williams et al., 2009). Several recent studies emphasize the potential role of CC in boosting the competitiveness of SMEs (Assante et al., 2016). Technology such as cloud offers similar advantages to all SMEs, but these are rarely converted into real sustainable competitive advantages. A recent study has identified CC as a technology-driven enabler that helps increase the supply chain responsiveness. CC has caught the attention of many industries and countries due to the significant role they play in assisting firms to do real-time analysis of voluminous data (Chauhan et al., 2021).

According to the literature, while TAM prevails as an efficient indicator for the prediction of acceptance and use of new technologies in various domains, TOE collaborates the technologies with the operational and managerial performances of the organization. The TCE, on the other hand, highlights the effect of the adoption on the economic and environmental performances of the firms. However, there are almost no studies that have integrated the three models to ascertain the influence on the cloud adoption in SMEs.

Technology factors, organizational factor and environmental factors have been arrived from the TOE model proposed by Davis. In this, we have taken factors from TOE (Technological, organizational and environmental), TAM (technological acceptance model), TCE (transaction cost economics model).

Research Gaps

Among the studies that have determined the factors which influence the adoption of CC, research has not been carried out in an expansive way. They have been found to have limited the findings to only a single (or at most two) challenge faced by the SMEs, for instance technical or economic challenges. Therefore, the model that is required must have an integrated outlook, taking in the other chosen elements from the three models studied, i.e., TAM, TOE and TCE. It is also significant to outline the risks of adoption of cloud computing in the research.

From the literature review and gaps, the following research questions are derived:

1. Is there any impact of these business factors on the SMEs for cloud computing adoption?
2. Is there any impact on the SMEs' economic performance due to cloud computing adoption?

3. Is there any impact on the SMEs' environmental performance due to cloud computing adoption?

The following hypotheses are formulated from the literature review to achieve the objective of this study:

H_a: there is a significant impact of factors influencing business challenges on cloud computing adoption.

H_b: there is a significant impact of factors influencing business challenges on overall economic performance.

H_c: there is a significant impact of factors influencing business challenges on overall environmental performance.

Research Methodology

The research study is specified by a preliminary problem statement and hypothesis formulation. The study proposes to analyze the business challenge factors required for the SMEs for cloud computing solution adoption. The objective of this study is to find the impact of business factors that challenges the SMEs for cloud computing adoption. The study analyzes the impact of these factors affecting the SMEs' environmental and economic performance.

The survey method is followed to collect primary data for this study. Proper care was taken during the data collection process to ensure the authenticity of the data. Further, data collected were checked internally for consistency. Karnataka state has nearly 4.80 million SMEs and is one of the leading states in the IT/ITES exports. These SMEs are also considered to be in a leading position in technology adoption for their business growth. Hence, Karnataka is chosen for the present study and SMEs in Karnataka are the study samples.

Questionnaire Preparation

The final questionnaire consists of eight constructs, namely, technological factors, technology acceptance factors, organizational factors, environmental factors, economical performance, environmental performance, risk factors and finally cloud computing adoption. Further, the questionnaire emphasizes on the organizational factors, environmental factors and factors of economic performance and environmental performance along with the risk factors.

In addition to these items measuring the study variables, the questionnaires consist of five questions on the demographic profile of the respondents, followed by the questions on information communication technology (ICT) usage and the respondent's supplier's usage of cloud computing solution. Finally, there are three questions on the overall intention of CC adoption by the respondents. There are 49 questions covering all the above items in each factor. Five-point Likert scale is used for most of the items and some demographic questions are on nominal scale and ordinal scale.

Data Collection

With all the above presumptions and considering the non-response error, 784 questionnaires were distributed among selected SMEs. The minimum time required to complete a questionnaire was approximately 20 min. On repeated reminding and regular personal follow-ups covering the tradeshow participants, email notifications, Linked-In messages and telephonic reminders, 480 questionnaires were returned reporting 61.22% response rate. On perusal, it was found that few response sheets were incomplete and few were not marked properly in spite of repeated reminders. Hence, those respondents were not considered for analysis. Totally, the final sample consisted of 410 responses.

Pilot study For pilot study, the questionnaire was circulated among 110 SME respondents in and around Karnataka. The respondents were randomly chosen to take part in the study. Out of the questionnaires that were circulated, 73 questionnaires were returned, of which 30 questionnaires were found usable.

Confirmatory Factor Analysis (CFA)

CFA is the measurement of the SEM and in this study we have used CFA to analyze and draw the relationship among the business factors derived out of various models such as technological, organizational and economical model, transactional cost economics model, and technology acceptance model. The fit indices of CFA are presented in Table 1. The estimates of items/variables and their corresponding factors are presented in Table A1 in the appendix section given in the supplementary file.

It is found that the GFI (goodness of fit index) value 0.983 and AGFI (adjusted goodness of fit index) value are greater than 0.949, which shows that the model is a good fit. The calculated CFI (comparative fit index) value 0.891, which is less than 0.90 means that it is a perfect fit. Also it is found that RMR (root-mean square residuals) is 0.018, which is less than 0.1, and RMSEA (root-mean square error of approximation) value is 0.07, which is less than 0.08, indicating it is a perfect fit (Hair et al., 2010).

Reliability

The internal flexibility of the items to each subscale was examined using Cronbach alpha method and the score for the respective factors is presented in Table 2. Cronbach's alpha value is greater than 0.7 for all the factors indicating the reliability of the factors.

Table 1 Fit indices of confirmatory factor analysis (CFA)

Model	Normed chi-square (×2/*df*)	GFI	AGFI	CFI	NFI	TLI	RMSEA
Technological factor model	3.218	0.983	0.949	0.891	0.867	0.873	0.08
Organizational factors model	3.895	0.952	0.906	0.970	0.960	0.952	0.08
Environmental factors model	2.014	0.994	0.971	0.995	0.990	0.984	0.050
Economic performance model	4.397	0.973	0.910	0.989	0.986	0.972	0.090
Environmental performance model	4.86	0.998	0.978	0.900	0.89	0.88	0.694
Risk factors model	4.450	0.963	0.905	0.981	0.975	0.961	0.08
Recommended value	Less than 5	0.8–0.9	0.8–0.9	0.8–0.9	0.8–0.9	0.8–0.9	< 0.080

Source: *Fit indices—Hair et al. (2010)

Table 2 Reliability scores of factors used in this study

Factors	Cronbach's alpha	No. of items
Technological factors	0.836	5
Organizational factors	0.790	4
Environmental factors	0.847	4
Economic performance	0.795	6
Environmental performance	0.839	5
Risk	0.843	5
Cloud computing adoption	0.892	3

Data Analysis

Detailed analysis of the collected data was attempted as per the objective stated earlier. Based on the type of data and research questions, appropriate statistical analysis was applied on the data collected from the respondents. Statistical software, namely, SPSS (Version 21) and AMOS (Version 20), were used for data analysis. In this study, the multiple linear regression analysis technique is employed to explore the relationship between the factors.

Descriptive Analysis of the Samples

The profile of the respondents which include the size of the company in terms of the number of employees, turnover of

Table 3 Respondent profile of the SMEs surveyed

Variable	Groups	Frequency	Percent
Size of company in terms of employees	Below 10	52	12.7
	10–50	119	29.0
	50–100	87	21.2
	100–150	51	12.4
	Above 150	101	24.6
Turnover of company in crores	Below 10	164	40.0
	10–20	114	27.8
	20–40	50	12.2
	40–80	17	4.1
	Above 80	65	15.9
Age of company in years	Below 2	79	19.3
	2–5	79	19.3
	5–10	59	14.4
	10–15	61	14.9
	Above 15	132	32.2
Sector of the industry	Others	138	33.7
	Retailing	20	4.9
	Manufacturing	150	36.6
	IT	102	24.9

company in crores, age of company in years and sector of the industry is presented in Table 3. The mean and standard deviation of the variables for the corresponding factors are presented in Table A2 in the appendix section.

Hypothesis H_a: There is a significant impact of factors influencing business challenges on cloud computing adoption.

Dependent variable: cloud computing adoption.

Independent variables:

1. Overall risk
2. Overall organizational factor
3. Overall environmental factor
4. Overall technological factor

The multiple correlation coefficient (0.777) as presented in Table 4 shows the degree of relationship between the actual values and the predicted values of the cloud computing adoption. Because the predicted values are obtained as a linear combination of the overall technological factor, overall organizational factor, and overall environmental factor, the coefficient value of 0.777 indicates that the relationship between cloud computing adoption and the three independent variables is quite strong and positive as indicated in Table 5. However, the overall risk and the coefficient value of 0.777 indicate the relationship between cloud computing adoption and the overall risk is negative.

The coefficient of determination *R*-square measures the goodness of fit of the estimated sample regression plane (SRP) in terms of the proportion of variation in dependent variables as explained by the fitted sample regression equation. Thus, the value of *R* square 0.603 simply means that about 60.3% of the variation in CC adoption is explained by the estimated SRP that uses overall technological factors, overall organizational factors, overall environmental factors, overall risks as independent variables, and *R*-square value is significant at 1% level.

The multiple regression equation:

$$\begin{aligned}\text{Cloud computing adoption} &= 3.967 + 0.107\ (\text{overall technological factor}) \\ &\quad + 0.063(\text{overall organizational factor}) \\ &\quad + 0.205(\text{overall environmental factor}) \\ &\quad - 0.053(\text{overall risks}).\end{aligned}$$

Based on the standardized coefficient, the overall environmental factor (0.372) is the most important to extract cloud computing adoption, followed by the overall technological factor (0.351), fand then the overall organizational factor (0.181); the overall risk factors are the least and negative (-0.114).

Hypothesis H_b: There is a significant impact of factors influencing business challenges on overall economic performance.

Dependent variable: overall economic performance.

Independent variables:

1. Overall risk
2. Overall organizational factor
3. Overall environmental factor
4. Overall technological factor
5. Cloud computing adoption

Table 4 Model Summary of hypothesis H_a

R	*R* square	Adjusted *R* square	Std. error of the estimate	*F* value	*p* value
0.777	0.603	0.599	1.343	153.836	0.000**

$^{**}p<0.01$, $^{*}p<0.05$

Table 6 Model summary of hypothesis H_b

R	*R* square	Adjusted *R* square	Std. error of the estimate	*F* value	*p* value
0.845	0.714	0.710	3.188	201.288	0.000**

$^{**}p<0.01$, $^{*}p<0.05$

Table 5 Multiple linear regression of overall technological, overall organizational, overall environmental and overall risk factors on cloud computing adoption

Independent variables	Unstandardized coefficients	Standard error	Standardized coefficient (beta)	t statistics	*p* value
(Constant)	3.967	0.557	–	7.122	<0.001**
Overall technological factor	0.107	0.013	0.351	8.557	<0.001**
Overall organizational factor	0.063	0.014	0.181	4.407	<0.001**
Overall environmental factor	0.205	0.021	0.372	9.793	<0.001**
Overall risk	−0.053	0.016	−0.114	−3.407	<0.001**

$^{**}p<0.01$, $^{*}p<0.05$

The multiple correlation coefficient (0.845) as presented in Table 6 measures the degree of relationship between the actual values and the predicted values of the overall economic performance. Because the predicted values are obtained as a linear combination of overall technological factor, overall organizational factor, and overall environmental factor and overall risks, for cloud computing adoption the coefficient value of 0.845 indicates that the relationship between overall economic performance and the four independent variables is quite strong and positive.

Table 7 shows the results of regression analysis showing the impact of overall technological factors, overall environmental factors, overall organizational factors, overall risks and cloud computing adoption on the overall economic performance. The results indicate that the model is able to predict 71% of the total variance in the overall economic performance. The technological, organizationa, and cloud computing adoption factors impact the SMEs' economic performance positively. However, overall risk and environmental factors are not able to predict the impact of the overall economic performance, as the P values are insignificant. The results of ANOVA indicate that the model is significant in predicting the impact of overall economic factors $F = 201.288$, $p < 0.001$.

Therefore, the following regression equation can be derived:

Overall economic performance

$$= -(2.176) + 0.119(\text{overall technological factor}) + 0.272(\text{overall organizational factors}) + 0.127(\text{overall environmental factors}) + 1.368(\text{cloud computing adoption}).$$

Hypothesis H_c: There is a significant impact of factors influencing business challenges on overall environmental performance.

Dependent variable: overall environmental performance.

Independent variables:

1. Overall risk
2. Overall organizational factor
3. Overall environmental factor
4. Overall technological factor
5. Cloud computing adoption

Table 8 Model summary of hypothesis H_c

R	*R* square	Adjusted *R* square	Std. error of the estimate	*F* value	*p* value
0.804	0.647	0.642	1.639	147.793	0.000**

**$p < 0.01$, *$p < 0.05$

As shown in Table 8, the multiple correlation coefficient that measures the degree of relationship between the actual values and the predicted values of the overall environmental performance is 0.804. Because the predicted values are obtained as a linear combination of overall technological factor, overall organizational factor, overall environmental factor and cloud computing adoption, the coefficient value of 0.804 indicates that the relationship between overall environmental performance and the three independent variables is quite strong and positive. The relation between overall risks and the coefficient value of 0.804 with overall environmental performance is negative.

The results of the regression analysis using all the independent variables as predictors of overall environmental performance indicates that the model is able to predict 64.7% of the total variance in overall environmental performance as shown in Table 9. The results of ANOVA indicate that the model is significant in predicting the impact of overall environmental performance factors $F = 397.065$, $p < 0.001$.

The technological, organizational, and cloud computing adoption factors significantly impact the SMEs' environmental performance positively, whereas there is no significant impact of overall environmental factor and overall risk on SMEs' environmental performance.

Therefore, the following regression equation can be derived:

Table 7 Multiple linear regression of technological, organizational, environmental, risks, and cloud computing adoption on the overall economic performance

Independent variables	Unstandardized coefficient	Standard error	Standardized coefficients (beta)	*t* statistics	*p* value
(Constant)	−2.176	1.403		−1.551	0.122
Overall technological factor	0.119	0.032	0.140	3.687	<0.001**
Overall organizational factor	0.272	0.035	0.281	7.860	<0.001**
Overall environmental factor	0.127	0.055	0.082	2.296	0.022
Overall risk	0.016	0.038	0.012	0.419	0.675
Cloud computing adoption	1.368	0.118	0.490	11.594	<0.001**

**$p < 0.01$, *$p < 0.05$

Table 9 Multiple linear regression of technological, organizational, environmental, risks and cloud computing adoption on the overall environmental performance

Independent variables	Unstandardized coefficient	Standard error	Standardized coefficient (beta)	*t* statistics	*p* value
(Constant)	1.295	0.721		1.795	0.073
Overall technological factor	0.080	0.017	0.203	4.826	< 0.001**
Overall organizational factor	0.109	0.018	0.242	6.102	< 0.001**
Overall environmental factor	0.005	0.028	0.007	0.169	0.866
Overall risk	− 0.008	0.019	− 0.013	− 0.417	0.677
Cloud computing adoption	0.611	0.061	0.473	10.067	< 0.001**

$^{**}p < 0.01$, $^{*}p < 0.05$

Table 10 Results of the hypothesis

Impacted factors	Business factors influencing
Cloud computing adoption (H_a)	Overall environmental factors, overall technological factors, overall organizational factors
Overall economic performance (H_b)	Overall technological factors, overall organizational factors, overall environmental factors, cloud computing adoption
Overall environmental performance (H_c)	Overall technological factors, overall organizational factors, cloud computing adoption

Overall environmental performance
$= 1.295 + 0.080$(overall technological factor)
$+ 0.109$(overall organizational factors)
$+ 0.611$(cloud computing adoption).

Findings and Discussion

Since all the null hypothesis is rejected and an alternative hypothesis is accepted, it is inferred that there is a positive impact of business factors that challenges the SMEs for cloud computing adoption. It is also found that the overall technological, overall organizational, and overall environmental and cloud computing adoption are able to positively predict the impact of the overall economic performance. Similarly, the overall technological, overall organizational and cloud computing adoption are able to positively predict the impact of environmental performance.

The correlation between economic performance factors and environmental performance factors w.r.t technological factors is presented in table A3 and table A4 in the appendix section given in the supplementary file. Here, TOE + TAM + TCE model has been followed. TOE and TAM models were tested as independent variables against cloud computing adoption as a dependent variable, and after adoption or because of the adoption of the cloud computing business model, the SME/organizational performances was measured. In other words, the impact of CC adoption increased the environmental performance and economic performance of the organization (Table 10).

Conclusion

This study revealed that adopting the technology of cloud computing benefits the SMEs of Karnataka to overcome the business challenges they face germane to their businesses. The findings of the study reveal that the risk factors are majorly the reason for the low rate of cloud computing adoption, thereby accentuating the need to mitigate these risks. The major benefits for adopting cloud-based applications in SMEs are scalability and reduced outlay. The SMEs could evade higher investments for the computing services by efficiently adopting the cloud computing technology. Cloud computing is hence an ideal solution for the innovation-driven SMEs.

The findings of this study also signify that the technology providers must keep in mind that it requires some amount of expertise for integrating the existing applications with the cloud applications and the compatibility, thereby necessitating the provision of development tools along with easy-to-understand tutorials. A comprehensive assessment is required which is pertinent to cost facets such as capital expenditures and operating expenses and contrasting the cloud services and prevailing technologies for SMEs.

Key Questions Reflecting Applicability in Real Life

1. What are the challenges in terms of business factors driving the SMEs for adoption, adaptation or upgradation of the cloud computing solutions?
2. How do operational cost, firm's profitability managing products or services and scalability contribute to SMEs to adopt or manage cloud computing technology?
3. How do TOE, TAM, and TCE model drive SMEs to manage the technology for their business growth?
4. How do CAPEX and OPEX investments drive SMEs to adopt or manage the cloud computing technology?
5. What are the important criteria or factors of any cloud service provider should address so that any SME can manage or adopt such technologies for its business growth?

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Declarations

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

References

Adam, I. O., & Musah, A. (2015). Small and medium enterprises (SMEs) in the cloud in developing countries: A synthesis of the literature and future research directions. *Journal of Management and Sustainability, 5*, 115. https://doi.org/10.5539/jms.v5n1p115

Ajitabh, A., & Momaya, K. (2004). Competitiveness of firms: Review of theory, frameworks and models. *Singapore Management Review, 26*(1), 45–61.

Ajzen I., & Fishbein M. (2000). Attitudes and the attitude-behavior relation: Reasoned and automatic processes. In W. Stroebe, & M. Hewstone (Eds.), European review of social psychology (pp. 1–33). Wiley https://doi.org/10.1080/14792779943000116

Akbari, M. (2012). Cloud computing adoption for SMEs: challenges, barriers and outcomes. https://arrow.tudublin.ie/scschcomdis/49/

Alkhalil, A., Sahandi, R., & John, D. (2013). Migration to cloud computing—the impact on IT management and security. In 1st International workshop on cloud computing and information security, Atlantis Press. https://doi.org/10.2991/ccis-13.2013.46

Ambastha, A., & Momaya, K. (2004). Challenges for Indian software firms to sustain their global competitiveness. *Singapore Management Review, 26*(2), 65–78.

Assante, D., Castro, M., Hamburg, I., & Martin, S. (2016). The use of cloud computing in SMEs. *Procedia Computer Science, 83*, 1207–1212.

Aubert, B. A., Rivard, S., & Patry, M. (2004). A transaction cost model of IT outsourcing. *Information & Management, 41*(7), 921–932. https://doi.org/10.1016/j.im.2003.09.001

Babu, P. B., & Chakravarty, P. S. (2014). Impact of cloud computing on small and medium enterprises in India. *Galaxy International Interdisciplinary Research Journal, 2*(1), 19–37. https://doi.org/10.5281/zenodo.834565

Becheikh, N., Landry, R., & Amara, N. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from1993–2003. *Technovation, 26*(5), 644–664. https://doi.org/10.1016/j.technovation.2005.06.016

Buyya, R., Yeo, C., Venugopal, S., Broberg, J., & Brandic, I. (2009). Cloud computing and emerging IT platforms: Vision, hype, and reality for delivering computing as the 5th utility. *Future Generation Computer Systems, 25*(6), 599–616. https://doi.org/10.1016/j.future.2008.12.001

Cacciola, S., & Gibbons, R. (2012). Coase meets the cloud: How and when can outsourcing IT improve organizational performance? White paper, November, 28.

Carcary, M., Doherty, E., & Conway, G. (2014). The Adoption of Cloud Computing by Irish SMEs an Exploratory Study. *Electronic Journal of Information Systems Evaluation*, *17*(1), 3–14.

Chang, Y. S., Chen, S. Y., Yu, K. C., Chu, Y. H., & Chien, Y. H. (2017). Effects of cloud-based m-learning on student creative performance in engineering design. *British Journal of Educational Technology, 48*(1), 101–112. https://doi.org/10.1111/bjet.12343

Chatterjee, D., Grewal, R., & Sambamurthy, V. (2002). Shaping up for e-commerce: Institutional enablers of the organizational assimilation of web technologies. *MIS Quarterly, 26*(2), 65–89. https://doi.org/10.2307/4132321

Chauhan, C., Akram, M. U., & Gaur, D. (2021). Technology-driven responsiveness in times of COVID-19: A fuzzy Delphi and fuzzy AHP-based approach. *International Journal of Global Business and Competitiveness, 16*(1), 48–61. https://doi.org/10.1007/s42943-021-00036-6

Chen, Y., Fay, S., & Wang, Q. (2011). The role of marketing in social media: How online consumer reviews evolve. *Journal of Interactive Marketing, 25*(2), 85–94. https://doi.org/10.1016/j.intmar.2011.01.003

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance ofinformation technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Dillon, T., Wu, C., & Chang, E. (2010). Cloud computing: issues and challenges. In 24th IEEE international conference on advanced

information networking and applications (pp. 27–33). https://doi.org/10.1109/AINA.2010.187

Erdogmus, H. (2009). Cloud computing: Does Nirvana hide behind the Nebula? *IEEE Software, 26*, 4–6. https://doi.org/10.1109/MS.2009.31

Fahmideh, M., Daneshgar, F., Rabhi, F., & Beydoun, G. (2019). A generic cloud migration process model. *European Journal of Information Systems, 28*(3), 233–255. https://doi.org/10.1080/0960085X.2018.1524417

Forbes, D., Forbes, S. C., Blake, C. M., Thiessen, E. J., & Forbes, S. (2015). Exercise programs for people with dementia. *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.CD006489.pub4

Garg, S. K., Versteeg, S., & Buyya, R. (2013). A framework for ranking of cloud computing services. *Future Generation Computer Systems, 29*, 1012–1023. https://doi.org/10.1016/j.future.2012.06.006

Gartner. (2011). Gartner executive programs worldwide survey of more than 2,000 cios identifies cloud computing as toptechnology priority for CIOs in 2011. Retrieved from http://www.gartner.com/it/page.jsp?id=1526414

Gartner, S. S. (2008). The multiple effects of casualties on public support for war: An experimental approach. *American Political Science Review, 102*(1), 95–106. https://doi.org/10.1017/S0003055408080027

Hair, J. F., Anderson, R. E., Babin, B. J., & Black, W. C. (2010). Multivariate data analysis: A global perspective (vol. 7).

Hamburg, I., & Bucksch, S. (2016). Cloud computing in SMEs. In Proceedings (pp. 54–57).

Heeks, R. (2006). Understanding and measuring eGovernment: international benchmarking studies. In UNDESA workshop, "E-participation and E-government: Understanding the present and creating the future", Budapest, Hungary (pp. 27–28).

Heeks, R., & Bailur, S. (2007). Analyzing e-government research: Perspectives, philosophies, theories, methods, and practice. *Government Information Quarterly, 24*(2), 243–265. https://doi.org/10.1016/j.giq.2006.06.005

Katz, R. L. (2009). *Skills of an effective administrator*. Boston: Harvard Business Review Press.

Kauffman, R., & Walden, E. (2001). Economics and electronic commerce: Survey and directions for research. *International Journal of Electronic Commerce, 5*(4), 5–116. https://doi.org/10.1080/10864415.2001.11044222

Khajeh-Hosseini, A., Greenwood, D., & Sommerville, I. (2010). Cloud migration: A case study of migrating an enterprise IT system to IAAS. In IEEE 3rd international conference on cloud computing (pp. 450–457). https://doi.org/10.1109/CLOUD.2010.37

Kloch, C., Petersen, E. B., & Madsen, O. B. (2011). Cloud based infrastructure, the new business possibilities and barriers. *Wireless Personal Communications, 58*(1), 17–30. https://doi.org/10.1007/s11277-011-0286-7

Kowath, N., & Choon, T. (2001). Determinants of website development: A study of electronic commerce in Singapore. *Information & Management, 39*(3), 227–242. https://doi.org/10.1016/S0378-7206(01)00092-1

Levy, M. (2009). WEB 2.0 implications on knowledge management. *Journal of Knowledge Management, 13*(1), 120–134. https://doi.org/10.1108/13673270910931215

Li, G., Sun, H., Gao, H., Yu, H., & Cai, Y. (2009, August). A survey on wireless grids and clouds. In 2009 eighth international conference on grid and cooperative computing (pp. 261–267). IEEE. https://doi.org/10.1109/GCC.2009.44

Lippert, S. K., & Govindarajulu, C. (2006). Technological, organizational, and environmental antecedents to web services adoption. *Communications of the IIMA, 6*(1), 14.

Low, C., Chen, Y., & Wu, M. (2011). Understanding the determinants of cloud computing adoption. *Industrial Management & Data Systems, 111*(7), 1006–1023. https://doi.org/10.1108/02635571111161262

Marinos, A., & Briscoe, G. (2009). Community Cloud Computing. In: M. G. Jaatun, G. Zhao, & C. Rong (Eds.), Cloud computing. CloudCom 2009. Lecture notes in computer science, vol. 5931. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-10665-1_43

Mell, P., & Grance, T. (2011). The NIST definition of cloud computing, recommendations of the National Institute of Standards and Technology, Special Publication 800-145. Retrieved from http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf

Momaya, K. S. (2017). Management of technology and innovation (MOT) for competitiveness: diagnosing problems at vonda motors. Case Centre No. 318-0001-1. https://www.thecasecentre.org/main/products/view?id=149299

Momaya, K. S. (2019). The past and the future of competitiveness research: A review in an emerging context of innovation and EMNEs. *International Journal of Global Business and Competitiveness, 14*(1), 1–10. https://doi.org/10.1007/s42943-019-00002-3

Nair, S. K., Porwal, S., Dimitrakos, T., Ferrer, A. J., Tordsson, J., Sharif, T., et al. (2010). *Towards secure cloud bursting, brokerage and aggregation*. In 2010 eighth IEEE European conference on web services (pp. 189–196). IEEE.

Opara-Martins, J., Sahandi, R., & Tian, F. (2014, November). Critical review of vendor lock-in and its impact on adoption of cloud computing. In International conference on information society (i-Society 2014) (pp. 92–97). IEEE.

Petrakou, A., Brandt, P., Gustavsson, R., & Jokela, P. (2011). Collaborative e-marketplaces containing clusters of SMEs: Drivers and barriers in the local food sector. In 2011 44th Hawaii international conference on system sciences (pp. 1–10). https://doi.org/10.1109/HICSS.2011.111.

Priyadarshinee, P., Jha, M., &Raut, R. (2014). Cloud computing adoption in SMEs: A literaturereview. In AIMS international conference on management. https://doi.org/10.1007/s42943-021-00030-y

Ramadoss, R., Pushpa, T., & Elango, N. M. (2012). An efficient framework to derive transaction slicing with performance forecast for enterprise modernization. *International Journal of Computer Applications, 51*(15), 19–25. https://doi.org/10.5120/8118-1743

Rangaprasad, S. N. (2016). Karnataka State industrial profile 2015-2016. In MSME-Development Institute Government of India. Retrieved from http://dcmsme.gov.in/dips/state_wise_dips/state_profile_karnatka_11316.pdf.

Reilly, D., Wren, C., & Berry, T. (2011). Cloud computing: Pros and cons for computer forensic investigations. *International Journal Multimedia and Image Processing (IJMIP), 1–1*, 26–34.

Satyanarayana, K., Chandrashekar, D., & MungilaHillemane, B. S. (2021). An assessment of competitiveness of technology-based startups in India. *International Journal of Global Business and Competitiveness, 16*(1), 28–38. https://doi.org/10.1007/s42943-021-00030-y

Sharma, M., Mehra, A., Jola, H., Kumar, A., Misra, M., & Tiwari, V. (2010). Scope of cloud computing for SMEs in India. arXiv preprint arXiv:1005.4030.

Siddiqui, A. T., & Aljahdali, S. (2013). Web mining techniques in e-commerce applications. arXiv preprint arXiv:1311.7388. https://doi.org/10.5120/11864-7648

Sobragi, C. G., Maçada, A. C. G., & Oliveira, M. (2014). Cloud computing adoption: A multiple case study. *BASE: Revista De Administração e Contabilidade Da Unisinos= BASE: UNISINOS Accounting and Administration Journal. São Leopoldo, RS, 11*(1), 75–91.

Sowmya, M. R., & Jyothi, S. A. Framework for dynamic relocation of cloud services. *International Journal of New Innovations in*

Engineering and Technology, 3(2). http://www.ijniet.org/wp-content/uploads/2015/06/1.pdf.
Sulistio, A., Reich, C., & Doelitzscher, F. (2009). Cloud infrastructure & applications—CloudIA. In IEEE international conference on cloud computing (pp. 583–588). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-10665-1_56
Sultan, N. (2010). Cloud computing for education: A new dawn? *International Journal of Information Management, 30*(2), 109–116. https://doi.org/10.1016/j.ijinfomgt.2009.09.004
Sultan, N. A. (2011). Reaching for the "cloud": How SMEs can manage. *International Journal of Information Management, 31*(3), 272. https://doi.org/10.1016/j.ijinfomgt.2010.08.001
Tumer, O. S. (2010). Digital ecosystems & Co-innovation towards sustainable societies. In 4th IEEE international conference on digital ecosystems and technologies (pp. 98–101).
Walsham, G., Robey, D., & Sahay, S. (2007). Foreword: Special issue on information systems in developing countries. *MIS Quarterly*. https://doi.org/10.2139/ssrn.1691869
Williams, L. J., Vandenberg, R. J., & Edwards, J. R. (2009). 12 structural equation modeling in management research: A guide for improved analysis. *Academy of Management Annals, 3*(1), 543–604. https://doi.org/10.5465/19416520903065683
Williamson, O. E. (2007). Transaction cost economics: An introduction. Economics discussion paper, (2007–3). https://doi.org/10.2139/ssrn.1691869
Yigitbasioglu, O. (2014). Modelling the intention to adopt cloud computing services: A transaction cost theory perspective. *Australasian Journal of Information Systems, 18*(3), 193–210. https://doi.org/10.3127/ajis.v18i3.1052
Yin, W., Moon, H. C., & Lee, Y. W. (2019). The success factors of Korean global start-ups in the digital sectors through internationalization. *International Journal of Global Business and Competitiveness, 14*(1), 42–53. https://doi.org/10.1007/s42943-019-00003-2

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