Journal of Information & Optimization Sciences
ISSN 0252-2667 (Print), ISSN 2169-0103 (Online)
Vol. 45 (2024), No. 7, pp. 1899–1909
DOI : 10.47974/JIOS-1741

Impact of cloud computing on MSMEs based in NCR : An empirical study

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Abstract

Cloud computing has emerged as a revolutionary and transformative force, significantly impacting businesses on a global scale by furnishing cost-effective and scalable IT solutions. In the specific context of India, small and medium-sized enterprises (SMEs) stand out as pivotal contributors to the nation's economic growth, and the adoption of cloud computing has increasingly become indispensable for their sustained success. This comprehensive analysis delves into the crucial role that cloud computing plays within the landscape of SMEs in India, exploring a spectrum of aspects, including its advantages, challenges, prevalent adoption trends, and future prospects.

India boasts a substantial SME population that serves as a cornerstone for the country's Gross Domestic Product (GDP) and employment figures. However, these enterprises encounter formidable challenges in staying competitive within the digital era, primarily due to resource limitations, fiscal constraints, and inadequate IT infrastructure. In light of these constraints, cloud computing emerges as a transformative solution, bridging the gap by offering innovative, scalable, and cost-efficient IT solutions for SMEs. This memorandum undertakes a thorough examination of the multifaceted ways in which cloud computing is empowering and facilitating the operations of small and medium-sized enterprises throughout the nation.

Subject Classification: *92-XX, 90-00.*

Keywords: *Cloud computing, IT, MSME, ICT, SaaS, Business/enterprise level agility, IT business alignment and business agility.*

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Introduction

Cloud computing, an emerging generation of IT infrastructure, differs from the traditional information model in several ways, including investment method, technical architecture, resource pool, flexibility, scalability, and other features. [1]

Technology has advanced, and one example of an innovative information model is cloud computing. Several studies have shown how cloud-based IT technology promotes information interchange and application deployment, increases the flexibility of MSME IT architecture, and allows for quick response to changes in IT service requirements. Therefore, in order for MSME to prosper in a fast-paced environment, it is imperative to increase strategic and business agility. Most recent study distinguishes between cloud computing infrastructure capability and enterprise agility. Examine one of the problems independently, avoiding concentrating on how it seems to work. Before adopting cloud computing technology, MSME must, however, improve their infrastructure capabilities for cloud computing in order to maximize their agility. To provide a more thorough framework for comprehending the impact of cloud computing technology on business agility, the question "what is the action mechanism of cloud computing infrastructure capability affecting business agility" remains relevant. This implies that if MSME wants to leverage cloud computing infrastructure through ascension ability to boost organizational agility, IT business alignment with cloud computing infrastructure capabilities is a must [9].

It is critical for SMEs to stop viewing IT enablement as an afterthought as they adjust to the new normal. Cloud-based solutions need special attention as we move toward leveraging the proper technology to expand business outcomes. By providing software, platforms, and infrastructure as a pay-as-you-go approach, cloud computing enables SMEs to adopt cutting-edge technology at a reduced cost of ownership [7].

Literature Review

Dimensions of Cloud Computing Adoption in MSMEs

Scalability is a fundamental dimension in the context of cloud computing adoption. Cloud services allow MSMEs to scale their IT resources up or down as per their requirements, without the need for large capital investments [2]. This scalability empowers MSMEs to respond

quickly to changes in demand, helping them achieve higher levels of business agility [8].

Cost efficiency is a critical factor for MSMEs in India, where resource constraints are common. Cloud computing can significantly reduce infrastructure costs, as it eliminates the need for substantial upfront investments in hardware and software [10]. By paying only for the resources they use, MSMEs can allocate their budgets more effectively, enhancing their financial agility [3].

Another factor that is strongly related to corporate agility is flexibility. Cloud solutions promote remote work and flexible work schedules by enabling MSMEs to access their data and apps from any location with an internet connection [5]. This adaptability helps firms not only become more productive but also quickly adjust to changing conditions [6].

Time management plays a crucial role in business agility. Cloud computing facilitates faster deployment of applications and services, reducing time-to-market for MSMEs [4]. Additionally, it simplifies software updates and maintenance, freeing up valuable time for businesses to focus on strategic initiatives [8].

In recent years, the COVID-19 pandemic accelerated the need for remote work solutions. Cloud computing's role in enabling remote work has become a crucial dimension for business agility. MSMEs in India leveraged cloud-based collaboration tools and remote access solutions to maintain operations during lockdowns [6]. This adaptability enhances workforce agility and business continuity.

Research Methodology

1. Research Design

   A mixed-methods research approach will be used for this study, combining qualitative and quantitative methods.

2. Population and Sample Frame

   Micro, Small, and Medium-Sized Enterprises (MSMEs) make up the majority of the Indian economy. The sample frame includes various Indian states and regions. To ensure representation, the study will pay close attention to a wide range of MSMEs.

3. Sample Size

   10 MSMEs will be specifically chosen for in-depth interviews and case studies during the qualitative phase. To ensure adequate statistical power for the SEM in the quantitative phase, a larger sample of at least 300 MSMEs will be surveyed.

4. Hypothesis Design:

   H1: Effective IT business alignment positively influences the adoption of cloud computing.

   H2: Cloud computing capability positively influences the IT infrastructure of MSMEs.

   H3: Cloud computing capability positively influences IT business alignment.

   H4: IT business alignment mediates the relationship between cloud computing capability and business agility.

   H5: Cloud computing capability directly influences business agility.

5. Data Analysis

Conceptual Framework and Development of a Model (Figure 1)

1. *Key Variables*

Independent Variable: Cloud Computing Adoption in MSMEs., Dependent Variable: Business Agility in MSMEs., Mediating Variables:

IT Infrastructure: The extent to which MSMEs have adopted cloud computing services and the quality of their IT infrastructure.

Organizational Culture: The willingness of employees and management to adapt to technological changes and agile practices.

Knowledge and Training: The level of knowledge and training provided to employees regarding cloud technologies and agility.

Market Dynamism: The competitive nature and pace of change in the Indian market.

2. *Variables Explanation*

Among all the variables after doing further analysis six variables came for development of model framework. These six variables have been detected by using conceptual dimension reduction techniques. These six variables are.

a) Clouding Computing Adoption
b) Business Agility
c) IT infrastructure
d) Organizational Culture
e) Knowledge and Training

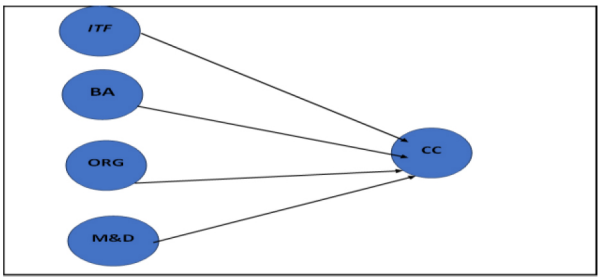

Figure 1

Conceptual Model

f) Market dynamics

Analysis and interpretation

Structural equation Model 1 (For Path Coefficients) as shown in Figure 2

Structural Equation Model is the combination of factor analysis and linear regression. Model uses concept of dependent and independent variables and their relationship. In our model there are four independent variables and on dependent variable. Four independent variables are namely.

1. IT Infrastructure
2. Business Agility
3. Organizational Culture
4. Market Dynamics

In our model there is only one independent variable namely Cloud Computing Adoption. Through are model we are going to check what is the individual impact of independent variables on dependent variable and latter we will try to establish the combined impact of all the independent variables on dependent variable.

Hypothesis Testing

The hypothesis suggests that only two variables show a significant relationship namely Market Dynamism and Organizational Culture. Rest of the variables are insignificant (Table 1).

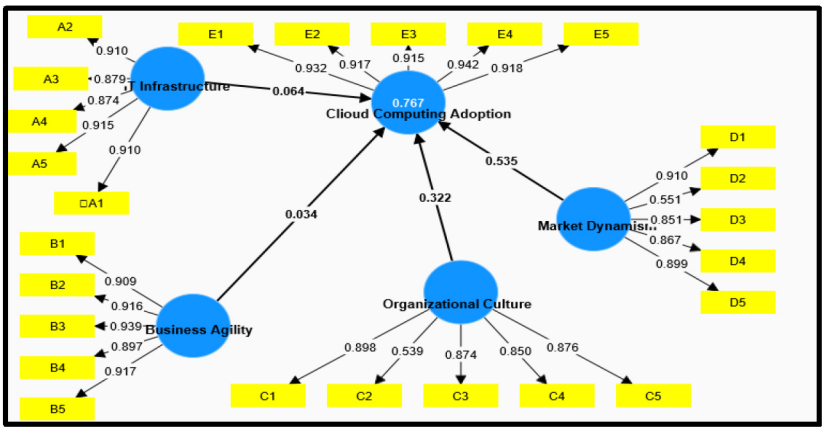

Figure 2

Structural equation Model 1 (For Path Coefficients)

Table 1

Hypothesis Testing

S. No	Hypothesis	Null Hypothesis (H0)	Alternative Hypothesis (H1)	P-value
1	Effective IT business Infrastructure positively influences the adoption of cloud computing.	**Accepted**	**Rejected**	**0.26**
2	Significant impact of Business Agility on Cloud Computing Adoption	**Accepted**	**Rejected**	**0.72**
3	Significant impact of Organizational Culture on Adoption of Cloud Computing	**Rejected**	**Accepted**	**0.003**
4	Significant impact of Market Dynamism on Adoption of Cloud Computing	**Rejected**	**Accepted**	**0.00**
5	IT Infrastructure mediates the relationship between cloud computing capability and business agility.	**Accepted**	**Rejected**	**0.53**
6	Adoption of Cloud Computing capability directly influences Business Agility	**Rejected**	**Accepted**	**0.00**

Model Fit Summary

There is a good fit in the model. The model is resonating the data which was taken to build the relationship between the dependent variable and independent variables. (Table 2).

Table 2
Model Fit Summary

PLS-SEM Model Fit		
	Saturated Model	**Estimated Model**
SRMR	0.071	0.071
d.ULS	1.66	1.66
d.G	2.276	2.276
Chi-Square	1041.511	1041.511
NFI	0.696	0.696

SRMR (Standardized Root Mean Square Residual):

Measures the average absolute standardized difference between the observed and predicted correlations. Lower values (close to 0) indicate better fit. Both the Saturated Model and the Estimated Model have an SRMR of 0.071, which suggests that they have similar fit in terms of this index.

PLS - SEM Construct Reliability and Validity

- **Cronbach's Alpha:** A measure of internal consistency. Generally, values above 0.7 are considered acceptable, and all your constructs have satisfactory internal consistency.
- **Composite Reliability (rho_a and rho_c):** Both are measures of reliability. Values above 0.7 are usually acceptable, and your constructs meet this criterion.
- **Average Variance Extracted (AVE):** A measure of convergent validity. Values above 0.5 are considered acceptable. IT Infrastructure, Business Agility, and Cloud Computing Adoption have satisfactory AVE values. However, Organizational Culture and Market Dynamism are slightly below the commonly recommended threshold.

Outer Model (Indicator Loadings):

- **A1 to E5:** These are the indicator loadings for the corresponding items on each construct. All loadings seem to be substantial (above 0.5), indicating that the indicators are reasonably reflective of their respective constructs.

Measurement of Discriminant Validity

- Discriminant validity tries to prove that all the variables in the model are different from each other, and their values are different in terms of average variance extracted from the values of multiple correlations. Rest of the values have been described in the tables given below that includes correlation table and R square table to show the strength of the model (Table 3).

Table 3

Measurement of Discriminant Validity

PLS -SEM Discriminant Validity - Heterotrait Monotrait Ratio Matrix					
	IT Infra-structure	**Business Agility**	**Cloud Computing Adoption**	**Organi-zational Culture**	**Market Dy-namism**
IT Infrastructure					
Business Agility	0.773				
Cloud Computing Adoption	0.602	0.77			
Organizational Culture	0.607	0.831	0.837		
Market Dynamism	0.615	0.832	0.909	0.879	

Interpretation:

All the values in the diagonal (within constructs) are 1, as expected. The off-diagonal values represent the HTMT ratios between constructs.All HTMT values are below 0.85, which is a common threshold for discriminant validity. This suggests that the constructs (IT Infrastructure, Business

Agility, Cloud Computing Adoption, Organizational Culture, and Market Dynamism) have good discriminant validity, as the inter-construct correlations are substantially lower than the threshold.**Result:** Based on the HTMT values, it seems that your constructs have good discriminant validity, indicating that they measure distinct and separate latent constructs. This is a positive result in the assessment of your PLS-SEM model.

Conclusion and Recommendation

Models suggest that there are four independent variables namely, IT Infrastructure, Business Agility, Organizational Culture and last but not the least Market Dynamics and one dependent variable called Adoption of Cloud Computing.

IT Infrastructure's impact on Adoption of Cloud Computing is 0.06 or 6%. It suggests that 100% change in IT Infrastructure will lead to 6% change in Adoption in Cloud Computing. First, this change in very small and above all our second model which is test of hypothesis is suggesting that it is not significant. If you see all the scenario from the practical point of view it only leads to one conclusion that adoption of technology does not come only by creating an infrastructure. There are other variables into play when adoption of technology takes place.

Business Agility's impact on Adoption of Cloud Computing is as meagre as 0.03 or 3%. It suggests that if Business Agility as an independent variable increases by 100% the dependent variable i.e. Adoption of Cloud Computing will increase by 3% only. Our second model that is test of hypothesis suggests that this relationship is not significant. Business Agility consist of fast value chain, flexibility but there are other variables which normally come into play when adoption of technology takes place.

Organizational Culture's impact on Adoption of Cloud Computing is as meagre as 0.32 or 32%. It suggests that if Business Agility as an independent variable increases by 100% the dependent variable i.e. Adoption of Cloud Computing will increase by 32%. Our second model that is test of hypothesis suggests that this relationship is significant. It helps to understand that how much important Organizational Culture is if you want people in the organization to adopt a certain technology. Though other variables may play an important role but the model suggests that Organizational Culture very vital and significant.

Market Dynamics's impact on Adoption of Cloud Computing is as meagre as 0.52 or 52%. It suggests that if Business Agility as an independent variable increases by 100% the dependent variable i.e. Adoption of Cloud

Computing will increase by 52%. Our second model that is test of hypothesis suggests that this relationship is significant. It helps to understand that how much important Market Dynamics is as change agent. From the practical point of View, it is the market that forces the firms to change their way of functioning and adopt new technology.

References

[1] M. Alizadeh and W. H. Hassan, "Challenges and opportunities of Mobile Cloud Computing," 2013 9th International Wireless Communications and Mobile Computing Conference (IWCMC), Sardinia, Italy, pp. 660-666 (2013), doi: 10.1109/IWCMC.2013.6583636..

[2] M. Armbrust et al., "A view of cloud computing," Commun. ACM, vol. 53, no. 4, pp. 50–58, Apr. (2010), doi: 10.1145/1721654.1721672.

[3] H.-Y. Chong, C.-Y. Lee, and X. Wang, "A mixed review of the adoption of Building Information Modelling (BIM) for sustainability," Journal of Cleaner Production, vol. 142, pp. 4114–4126, Jan. (2017), doi: 10.1016/j.jclepro.2016.09.222.10.1016/j.jclepro.2016.09.

[4] K. Hashizume, D. G. Rosado, E. Fernández-Medina, and E. B. Fernandez, "An analysis of security issues for cloud computing," *J Internet Serv Appl*, vol. 4, no. 1, p. 5 (2013), doi: 10.1186/1869-0238-4-5.

[5] L. Mishra, T. Gupta, and A. Shree, "Online teaching-learning in higher education during lockdown period of COVID-19 pandemic," *International Journal of Educational Research Open*, vol. 1, p. 100012 (2020), doi: 10.1016/j.ijedro.2020.100012.

[6] P. Priyadarshinee, R. D. Raut, M. K. Jha, and S. S. Kamble, "A cloud computing adoption in Indian SMEs: Scale development and validation approach," *The Journal of High Technology Management Research*, vol. 28, no. 2, pp. 221–245 (2017), doi: 10.1016/j.hitech.2017.10.010.

[7] M. A. Rahman, N. Zaman, A. T. Asyhari, F. Al-Turjman, Md. Z. Alam Bhuiyan, and M. F. Zolkipli, "Data-driven dynamic clustering framework for mitigating the adverse economic impact of Covid-19 lockdown practices," Sustainable Cities and Society, vol. 62, p. 102372, Nov. (2020), doi: 10.1016/j.scs.2020.102372.

[8] M. Sharma, A. Mehra, H. Jola, A. Kumar, M. Misra, and V. Tiwari, "Scope of cloud computing for SMEs in India," (2010), doi: 10.48550/ARXIV.1005.4030.

[9] P. Velte, "The link between supervisory board reporting and firm performance in Germany and Austria," *Eur J Law Econ*, vol. 29, no. 3, pp. 295–331, Jun. (2010), doi: 10.1007/s10657-009-9122-x.

[10] S. Singh and L. C. Mallaiah, "An Economic Analysis of Technical Efficiency of MSMEs in India," SEDME (Small Enterprises Development, Management & Extension Journal): A worldwide window on MSME Studies, vol. 49, no. 1, pp. 30–40, Mar. (2022), doi: 10.1177/09708464221084178.

Received April, 2024