

Cloud Adoption: Linking Business Needs with System Measures

Shikha Gupta^{1*} and A. K. Saini²

¹*School of Engineering and Technology,*

Ansal University Haryana, Gurgaon, Haryana, India; shikhagupta@ansaluniversity.edu.in

²*University School of Management Studies, GGS Indraprastha University, New Delhi, India; aksaini1960@gmail.com*

Abstract

Cloud has become an inevitable utility for organizations to leverage their IT resources and processes. It has reached a level from innovation to diffusion to adoption. Organizations are looking towards cloud adoption as a solution to decrease their IT over budgets and also to concentrate more on their core business activities. The cloud has changed the entire IT usage scenario. It has changed the IT usage from self-owned IT resource utilization to rented pay per use as a utility. Though cloud adoption brings with it lots of opportunities and benefits, there are issues which surface its adoption and the companies which take an informed decision after weighing all the issues surrounding the adoption are able to sustain in a better way than those companies which adopt cloud uninformed. The study attempts to analyze the link between business needs and system measures from three perspectives: Technology, Business Needs and Economic Factors and proposes a theoretical framework based on IT adoption theories.

Keywords: Business Needs, Cloud Adoption, Economic Factors, IT Adoption Theories, System Measures, Technology

Paper Code: 15835; **Originality Test Ratio:** 07%; **Submission Online:** 11-April-2017; **Manuscript Accepted:** 15-April-2017; **Originality Check:** 18-April-2017; **Peer Reviewers Comment:** 25-April-2017; **Double Blind Reviewers Comment:** 03-May-2017; **Author Revert:** 12-May-2017; **Camera-Ready-Copy:** 18-May-2017

1. Introduction

Cloud computing has transformed the IT landscape as a computing paradigm in terms of its IT usage and ownership. Its benefits like reduction in financial burden its usage and efforts have resulted in rapid growth prospects of the cloud computing market. Companies are looking at cloud adoption as an alternative for their over burdening IT budgets. The seemingly economical model of cloud offerings has made it more attractive for small and medium-sized companies and as a result more and more companies going for it or has started planning towards its adoption. Cloud computing is recognized as the most promising computing paradigm of the last several years¹. Cloud Computing has revolutionized the concept of ICT. By 2011, it had become the top technology priority for companies worldwide and as per reports year 2020 will see \$241 billion cloud computing market². Its features like economy, elasticity and flexibility of usage most economically viable option. But at the same time as with all other technologies it has its own share of concerns and issues, so in order to establish a well-connected link between business needs and system measures it becomes imperative to understand its strength and weaknesses³. We will analyze the scenario with the exiting theories for technology adoption and establish a theoretical framework based on the theories. We have categorized the relevant theories into these three categories i.e. Technology, Business needs, Economic Factors.

2. Cloud Computing Concept

Various researchers have defined cloud in different ways. The National Institute of Standards and Technology defines the Cloud Computing as:

Cloud computing refers to a model which can be used to enable convenient resource polling feature in a shared environment which can be done on-demand. According to some other authors, cloud is a service model for provisioning IT resources which is based on virtualization and works on distributions environment^{4,5} defines cloud as a set of services which gives infrastructure resources utilizing media and data storage. Cloud Computing can also be defined as online model for services providing hardware and software as per demand of the customer and you have to pay for the usage only⁶.

Cloud computing represents a convergence of two major trends in information technology — (a) IT efficiency, whereby the power of modern computers is utilized more efficiently through highly scalable hardware and software resources and (b) business agility, whereby IT can be used as a competitive tool through rapid deployment, parallel batch processing, use of compute-intensive business analytics and mobile interactive applications that respond in real time to user requirements⁷. Figure 1 depicts the cloud computing architecture.

3. Technology, Organization, and Environment Context of Cloud Adoption

The TOE framework developed in 1990⁸ identifies three aspects technological context, organizational context, and environmental context of an enterprise's context to explain the technological innovation adoption. Technological context describes both the internal and external technologies in terms of practices and equipment etc, relevant or available to the organization⁹⁻¹².

Organizational context is the reference of descriptive measures such as scope, size, and managerial structure about the organization. Environmental context refers to the industry, Industry characteristics, competitors, Technology support infrastructure and dealings with the government; Government regulation⁸. TOE provides a useful analytical framework that can be used for studying the adoption and assimilation of different types of IT innovation. The TOE framework makes Rogers'

innovation diffusion theory better able to explain intra firm innovation diffusion¹³. The study follows TOE framework to establish a theoretical framework for cloud adoption.

4. Theoretical Framework for Cloud Adoption

We conducted a structured literature review of all the important issues pertaining to cloud adoption with the purpose of extracting the most important and prevalent issues of cloud adoption by organizations. For a reliable review we used scientific databases like IEEE Explore, ACM, EBSCO, Web of Science, and Science Direct.

The above factors were summarized and grouped into three main categories:

- Technological context
- Organizational context
- Environmental context

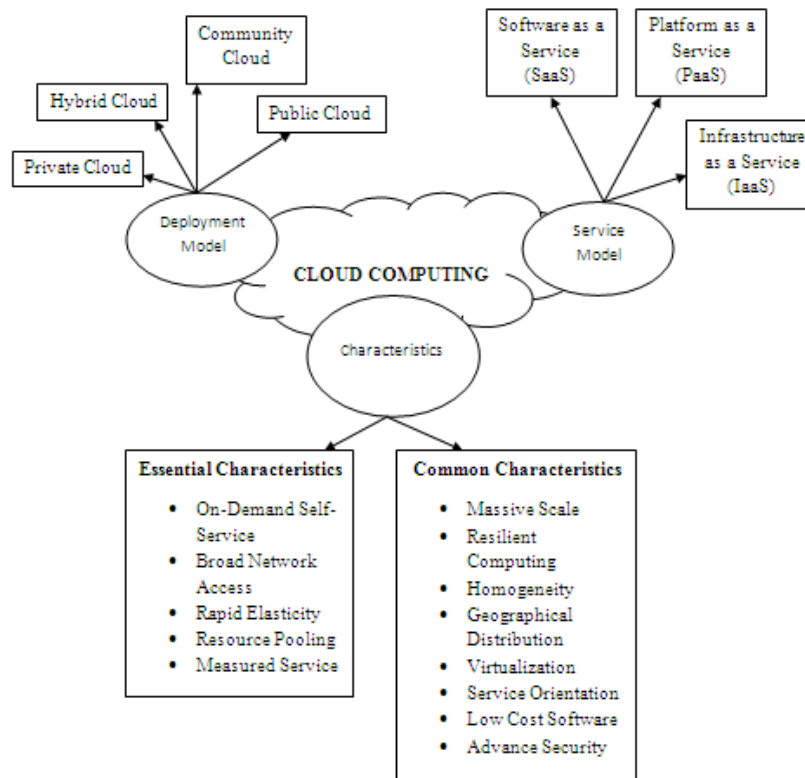


Figure 1. Architecture of Cloud Computing¹⁴.

Table 1. Extracted Issues from Various Databases

Issues	#S	IEEExplorer	ACM	EBSCO	Web of Science	Science Direct
Data Control	149	24	30	36	28	31
Data Criticality	125	28	26	21	24	26
Trust	174	36	38	35	31	34
Risk	191	40	36	38	40	37
Performance Assurance	155	38	38	34	21	24
Data Security and Privacy	217	48	41	46	42	40
Service Environment	191	43	34	42	37	35
Cost	165	32	35	31	30	37
SLA	94	21	20	19	20	14
Reputation of Service Provider	125	22	32	30	21	20

Table 2 provides the categorization of different issues of cloud adoption into these three categories.

Table 2. Categorization of Different Issues

Categories	Factors of Adoption
Technological context	Data Control
	Data Criticality
	Data Security and Privacy
Organizational context	Performance Assurance
	Cost
	Risk
Environmental context	Trust
	Service Environment
	SLA
	Reputation of Service Provider

4.1 Issues and challenges of adoption

Despite the fact that cost assumes a noteworthy part in choice to receive cloud yet issues like security, execution and so on can't be overlooked¹⁵. It turns out to be critical to consider every one of these parameters alongside adaptability, unwavering quality, security, accessibility, protection, and make them a piece of legally binding understandings while adopting. A relative examination of Growth of IT and development of the organization is a key component towards the choice of cloud adoption alongside different issues.

4.2 Cost of cloud adoption

As always Cost is the main driver for cloud adoption apart from other parameters like scalability, elasticity, agility, availability, cost-efficiency, extensibility¹⁶⁻¹⁹ where small and medium scale companies are mainly attracted towards reduced cost structure

due to no or minimal capital expenditure (CAPEX) and operational expenditure (OPEX) in IT²⁰⁻²⁴. As per^{25,26} the main cloud computing attributes are pay per use, elastic self-provisioning through software, simple scalable services, virtualized physical resources, speed and flexibility to enhanced performance. As per^{20-22 25,26} cloud computing provides significant cost reductions in areas like capital acquisition, IT infrastructure operations and maintenance costs. The pay-per-use model further decreases the financial burden substantially^{21,27}.

4.3 Perceived cloud adoption risks

Cost and risk are key variables in making a decision to adopt cloud. The most important factor is inclination which comes on awareness. But these variables cannot be compared with each other as no matter how much disproportionate cost v/s risk is one will not go for cloud if risk is very high.

4.3.1 Risk of Performance

Performance is an important factor and issue in cloud adoption. Various researchers have mentioned that due to a number of reasons like lack of critical skills or developing wrong skills, inexperienced staff, lack of organizational learning performance of cloud if not as expected can result in potential losses to the company due non availability of data and processes, slow response time, business discontinuity, unavailability of services^{21,28,29}.

4.3.2 Risk of Security and Privacy

Unplanned and uninformed adoption decision can lead to serious losses in terms on security and privacy^{21,30-33}. Security concerns like security incident management and reporting, authorizations and authentications, data backup mechanism proper identity management, auditing, security verifications, System Vulnerability, data transmission protection etc have

to be considered well and planned well during cloud adoption decision along with privacy issues like data protection, confidentiality, copyright and audits, maintaining privacy of data from unwanted disclosure as ignoring these issues can lead to not only financial losses but also loss in goodwill^{34,35}.

4.3.3 Risk of Service Environment

Service environment includes compliance, legal requirements, Rules and regulations pertaining to data storage, confidentiality and disclosure change across local as well as global level as cloud computing spans countries across the globe^{32,35} resulting in compliance and data privacy issues^{17,19,32,35}. Generally companies are not aware of location of their data. Another serious service issue is data portability³⁴.

5. Role of Trust in managing risk in cloud adoption

Trust can be defined as party's willingness to have a vulnerable action that can be a threat to the trustier whether being a organization or human³⁴. When a company takes a decision to adopt cloud trust plays an important role in selecting a particular cloud service provider which becomes all the more important when adoption is for mission critical data¹⁷⁻¹⁸. A well planned contractual agreement can play an important role in generating an initial trust towards service providers^{36,37}.

In light of the arrangement of issues, the following level of variables was set up as appeared in the figure beneath.

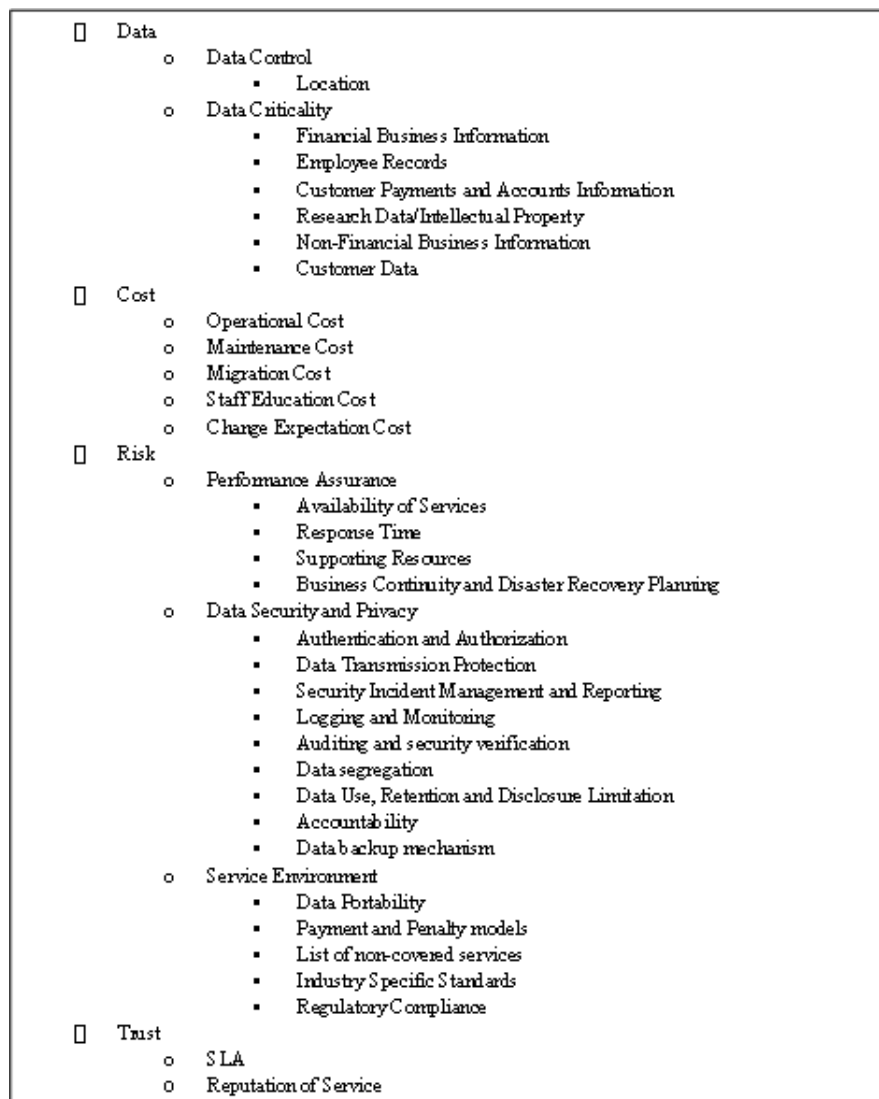


Figure 2. Different factors of cloud adoption framework.

6. IT ADOPTION THEORIES

There are number of theories for IT adoption. As cloud adoption decision requires considering a number of parameters like cost, resources, data, ability and willingness to transition to new technology, we have analyzed the cloud adoption decision from the perspective of four theories of IT adoption namely:

- Diffusion of Innovation Theory
- Resource Based Theory
- Resource Dependence Theory
- Transaction Cost Theory

We have divided these theories on the basis of three categories: Technology, Business Needs and Economic factors.

6.1 Diffusion of Innovation Theory (DOI)

DOI helps in explaining organization’s propensity and decision of technology adoption³⁸. The main thesis of the theory is that innovations are communicated through certain channels over time within a particular social system which affects the rate of adoption^{38, 38-39} suggest three attributes affecting adoption rate as relative advantage, complexity, and compatibility where *Relative Advantage* of an innovation is the measure to which a new idea is said to be better than previous related idea^{38,39}. suggests that relative advantage positively affects adoption. The second attribute is compatibility which is defined as a measure to which the new idea is said to be consistent with existing technology and experience. A lack of compatibility in IT with individual needs may negatively affect the individual’s IT use^{40,41}. So adoption is directly proportional to degree of compatibility. Third attribute is Complexity.⁴² defined complexity as the measure to which the new idea is said to be relatively difficult to use and understand. Rate of adoption is inversely proportional to complexity. Table 3 describes the different attributes along with their definitions.

Table 3. Attributes of Diffusion of Innovation Theory

Concept Definition - Diffusion of Innovation Theory	
Relative advantage	Degree to which an innovation is perceived as being better than the idea it supersedes
Compatibility	Degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters
Complexity	Degree to which an innovation is perceived as relatively difficult to understand and use

6.2 Resource Based Theory (RBT)

The resource-based theory is part of the theories that consider the resources as the foundations for a firm’s strateg⁴³. ⁴⁴defines firm resources(physical capital resources, human capital resources

and organizational capital resources) as all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. As per⁴⁴ value, rareness, imperfect imitability and substitutability are the four attributes of the theory. The thesis of the theory is the competitive advantage the organization should get by technology adoption.

Resource must be valuable and an enabler to the firm conceiving and implementing strategies, this can positively affect the rate of adoption. Second attribute is rareness, the resource should be unique or rare i.e. imperfect imitable and should be sustainable .All the attribute positively affect cloud adoption decision. Table 4 describes the various attributes and their explanations.

Table 4. Attributes of Resource Based Theory

Concept Definition - Resource Based Theory	
Value	Degree of o the Value of IT Resources to the organization for strategic decisions
Rareness	Uniqueness of IT resources in comparison to competitors
Imperfect Imitability	Inability of competitors to imitate the resources
Substitutability	Degree of availability of substitution resources

6.3 Resource Dependence Theory (RDT)

Resource Dependency theory^{45,46} explains the relation between an organization and its external environment in terms of dependence on resources. Thesis of the theory is that organizations tend to adopt cloud to utilize resources such as virtualization capabilities, higher elasticity, economies of scale, and arguably more expertise in running IT services or software that are not available internally⁴⁵ suggest three factors that determine the degree of dependence of one organization on others which are namely Environmental Concentration, munificence and interconnectedness where concentration is the widely dispersion of power and authority among the environment, munificence refers to the level of availability or scarcity of critical resources. Interconnectedness is about the number and pattern of linkages among organizations⁴⁷. Table 5 describes the various attributes and their definitions.

Table 5. Attributes of Resource Dependence Theory

Concept Definition - Resource Dependence Theory	
Environmental Concentration	Widely dispersion of power and authority among the environment
Munificence	Level of availability of Critical Resources
Interconnectedness	Number of pattern and linkages among organizations

6.4 Transaction Cost Theory (TCT)

Transaction Cost Theory is important from the perspective of economic factors affecting cloud adoption. The thesis of the theory is that economic efficiency can be reached through the balance between production costs against transaction costs where transactions is an exchange of services or goods between economical actors, who are technologically independent parts outside or inside an organization⁴⁸. The parameters of theory are specificity, uncertainty and infrequency⁴⁹ where Asset Specificity is the measure to which the item can be reuse with alternative uses without sacrificing productive value⁵⁰, uncertainty is related with the complexity of the product/service to be acquired and infrequency of contracting can also increase transaction costs⁴⁹. The costs of relationship building, formulation of adequate con-

tracts and ensuring consistency of goals between the contracting parties are the main costs generated by infrequency.

Table 6. Attributes of Transaction Cost Theory

Concept Definition - Transaction Cost Theory	
Asset Specificity	Degree of necessity of an asset for production of a product
Uncertainty	Aspects like actual costs of production, uncertainties in market, economic scenarios, contractual complexities etc.
Infrequency	costs to increase consistency which include contracts adequacy, long term relationship

Figure 3 below shows the impact of all the theories discussed above on technology adoption.

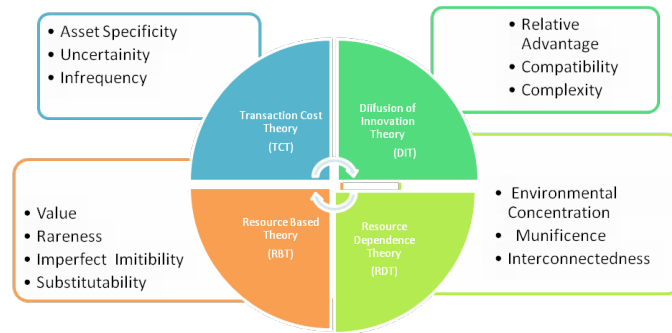


Figure 3. Impact of theories on Technology Adoption.

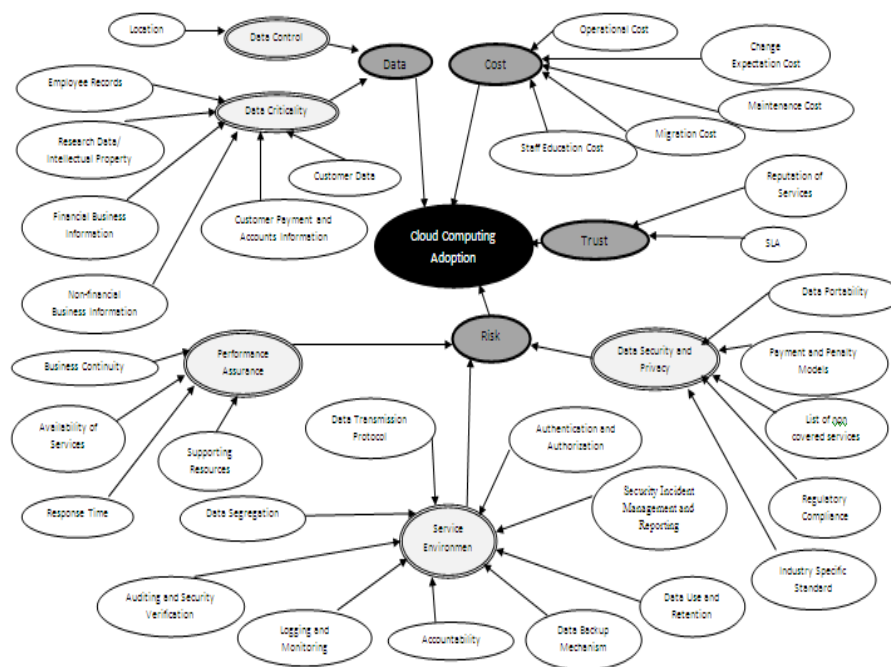


Figure 4. Cloud adoption Theoretical Framework based on TOE Framework.

Table 7. Dimensions of Cloud Adoption and Adoptive Theories

Data	Asset Specificity	TCT
	Value	RBT
	Rareness	RBT
	Munificence	RDT
Cost	Relative Advantage	DIT
	Infrequency	TCT
Performance Assurance	Compatibility	DIT
Service Environment	Environment Concentration	RDT
	Interconnectedness	RDT
Data Security & Privacy	Uncertainty	TCT
	Complexity	DIT
Trust	Infrequency	TCT
	Imperfect Imitability	RBT
	Substitutability	RBT

Mapping of different dimensions of cloud adoption with Technology adoption Theories is done in Table 7.

Finally a theoretical Cloud Adoption framework based on TOE Framework is proposed as shown in Figure 4.

7. Conclusion

The study shows that companies are adopting cloud but its adoption has some issues attached with it which should be taken care of and an informed decision should be taken while going for cloud adoption. The study attempts to list and categorize these factors and develop a framework of cloud adoption. Various Technology adoption theories were studied, the factors were analyzed and mapped against these theories and after mapping the factors and establishing them against theories finally the study proposes a framework for cloud adoption which is based on TOE (Technology, Organization, and Environment) framework and which spins around various issues of adoption

8. Acknowledgements

The authors acknowledge the contribution of Mr. Varun Mehra and Ms. Sonali Chawla for their contribution towards the paper.

9. References

- Marston S, Li Z, Bandyopadhyay S, Zhang J, Ghalsasi A. Cloud computing — The business perspective, Elsevier. 2010.
- Tornatzky L, Fleischer M. The process of technology innovation, Lexington, MA, Lexington Books. 1990.
- Starbuck WH. Organizations and their environments, Chicago, Rand McNally. 1976. PMID:1264511
- Vaquero LM, Rodero-Merino L, Caceres J, Lindner M. A Break in the Clouds: Towards a Cloud Definition
- Fox R. Digital Libraries: The systems analysis perspective. Library in the Clouds. 2009; 25(3):156–61.
- Bandyopadhyay S, Marston SR, Li Z, Ghalsasi A. Cloud Computing: The Business Perspective. 2009 Nov.
- Kim W. Cloud computing: Today and Tomorrow. Journal of Object Technology. 2009; 8(1):65–72. <https://doi.org/10.5381/jot.2009.8.1.c4>
- Tornatzky L, Fleischer M. The process of technology innovation, Lexington, MA, Lexington Books. 1990.
- Starbuck WH. Organizations and their environments, Chicago, Rand McNally. 1976. PMID:1264511
- Thompson JD. Organizations in action, New York, McGraw-Hill. 1967.
- Khandwalla P. Environment and the organization structure of firms, McGill University, Montreal, Faculty of Management. 1970.
- Hage J. Theories of organizations: Forms, process and transformation, New York, John Wiley & Sons. 1980. PMID:PMC1903769
- Hsu PF, Kraemer KL, Dunkle D. Determinants of e-business use in us firms. International Journal of Electronic Commerce. 2006; 10(4):9–45. <https://doi.org/10.2753/JEC1086-4415100401>
- Cloud Security Alliance. Security Guidance for Critical Areas of Focus in Cloud Computing. 2009.
- Gupta S, Saxena KBC, Saini AK. Towards Risk Managed Cloud Adoption :A Conceptual Framework. Proceedings of the 2016 International Conference on Industrial Engineering and Operations Management, Kuala Lumpur, Malaysia. 2016 Mar 8-10.
- Tisnovsky R. Risk versus value in outsourced Cloud computing, Financial Executive. 2010 Nov; 64–5.
- Subashini S, Kavitha V. A survey on security issues in service delivery models of Cloud computing. Journal of Network and Computer Applications. 2011; 34:1–11. <https://doi.org/10.1016/j.jnca.2010.07.006>
- Aljabre A. Cloud computing for increased business value. International Journal of Business and Social Science. 2012; 3(1):234–9.
- Armbrust M, Fox A, Griffith R, Joseph AD, Katz R, Konwinski A, Lee G, Patterson D, Rabkin A, Stoica I, Zaharia M. A view of cloud computing. Communications of the ACM. 2010; 53:50–8. <https://doi.org/10.1145/1721654.1721672>
- Geczy P, Izumi N, Hasida K. Cloudsourcing: managing cloud adoption. Global Journal of Business Research. 2012; 6(2):57–70.
- Oracle Cloud Computing, An Oracle White Paper. 2010 May.
- Kundra V. Federal cloud computing strategy. 2011. Available from: http://www.cio.gov/documents/federal-cloud-computing_strategy.pdf. (Accessed 12th June 2012).
- Tucker L. Introduction to Cloud Computing..... for Enterprise Users. Cloud Computing Sun Microsystems, Inc.
- Veverka M. Sky's the Limit. 2010; 90(1):19.
- Luoma E, Nyberg T. Four scenarios for adoption of cloud computing in China. Proceedings of the European Conference on Information Systems. 2011. Available from: <http://aisel.aisnet.org/ecis2011/123>

26. Iyer B, Henderson JC. Preparing for the future: understanding the seven capabilities of cloud computing. *MIS Quarterly Executive*. 2010; 9(2):117–31.
27. Sultan N. Reaching for the “cloud”: How SMEs can manage. *International Journal of Information Management*. 2011; 31:272–8. <https://doi.org/10.1016/j.ijinfomgt.2010.08.001>
28. Oriol Fito J, Guitart J. Introducing Risk Management into Cloud Computing
29. Aron R, Clemons EK, Reddi S. Just Right Outsourcing: Understanding and Managing Risk. *Journal of Management Information Systems*. 2005; 22(2):37–55. <https://doi.org/10.1109/hicss.2005.368>
30. Huang J, Nicol DM. Trust mechanisms for cloud computing, 1 *Journal of Cloud Computing: Advances, Systems and Applications*. 2013; 2:9. Available from: <http://www.journalofcloudcomputing.com/content/2/1/9>
31. Kynetix Technology Group Cloud computing – a strategy guide for board level executives. Retrieved from: Microsoft Downloads. 2009.
32. Gupta S, Saini AK. A review to assess opportunities and security risk challenges in cloud computing. *IJRET: International Journal of Research in Engineering and Technology*. eISSN: 2319-1163 | pISSN: 2321-7308
33. Söbbing T. *Handbuch IT-Outsourcing: Recht, Strategie, Prozesse, IT, Steuern samt Business Process Outsourcing*, 3rd edn. C. F. Müller, Heidelberg, Germany. 2006. ISBN 978-3-8114-3320-5
34. Jayatilaka B, Schwarz A, Hirschheim R. Determinants of ASP Choice: An Integrated Perspective. *European Journal of Information Systems*. 2003; 12(3):210–24. <https://doi.org/10.1057/palgrave.ejis.3000466>
35. Kandukuri BR, Ramakrishna Paturi V, Rakshit A. Cloud Security Issues. 2009 IEEE International Conference on Services Computing, IEEE. 2009. <https://doi.org/10.1109/SCC.2009.84>
36. Farahmand F, Atallah M, Konsynski B. Incentives and Perceptions of Information Security Risks. In: *Proceedings of the 29th International Conference on Information Systems (ICIS 2008)*. 2008. PMCid:PMC2424033
37. Yang S, Wang K. The Influence of Information Sensitivity Compensation on Privacy Concern and Behavioral Intention. 2009; 40.
38. Rogers M. *Diffusion of Innovations* 4th edition, New York: Free Press. 1995.
39. Moore C, Benbasat I. Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*. 1991; 2(3):192–222. <https://doi.org/10.1287/isre.2.3.192>
40. McKenzie J. How teacher learn technology best. *From Now On: The Educational Technology Journal*. 2001; 10(6). Retrieved March 01, 2005, from <http://www.fno.org/mar01/howlearn.html>
41. Sherry L. The boulder valley internet project: Lessons learned. *THE (Technological Horizons in Education) Journal*. 1997; 5(2):68–73.
42. Rogers EM. *Diffusion of innovations* (5th ed.). New York: Free Press. 2003.
43. Goles T, Chin WW. Information Systems Outsourcing Relationship Factors: Detailed Conceptualization and Initial Evidence. *The Data Base for Advances in Information Systems*. 2005; 36(4):47–57. <https://doi.org/10.1145/1104004.1104009>
44. Barney J. Firm resources and Sustained Competitive Advantage. *Journal of Management*. 1991; 17:99–120. <https://doi.org/10.1177/014920639101700108>
45. Pfeffer J, Salancik GR. *The External Control of Organizations: A Resource Dependence Perspective*. 2nd ed. Stanford, CA: Stanford University Press. 2003.
46. Pfeffer J. A resource dependence perspective on intercorporate relations. In: Mizuchi MS, Schwartz M editors. *Intercorporate Relations: The Structural Analysis of Business*, 25-55. Cambridge, UK: Cambridge University Press. 1987.
47. Cheon MJ, Varun G, James TC, Teng. Theoretical Perspectives on the Outsourcing of Information Systems. *Journal of Information Technology*. 1995; 10:209–19. <https://doi.org/10.1057/jit.1995.25>
48. Williamson OE. The Economics of Organization: The Transaction Cost Approach. *American Journal of Sociology*. 1981; 87:548–77. <https://doi.org/10.1086/227496>
49. Williamson OE. Transaction-Cost Economics: The governance of Contractual Relations. *The Journal of Law and Economics*. 1985; 22–4.
50. Williamson OE. *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*. New York and London: Free Press. 1979.

Citation:

Shikha Gupta and A. K. Saini

“Cloud Adoption: Linking Business Needs with System Measures”,

Global Journal of Enterprise Information System. Volume-9, Issue-2, April-June, 2017. (<http://informaticsjournals.com/index.php/gjeis>)**Conflict of Interest:**

Author of a Paper had no conflict neither financially nor academically.