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Significance of DOI Model for Adoption of Cloud Computing

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Abstract : ***Cloud computing is one of the virtual service models in technology, characterized to support organizations by minimizing cost, increase business agility, anywhere any time–on demand accessibility et.al. This wide virtual connectivity is delivered to the users/ organizations with the help of different service models. Cloud computing offers optimum utilization of resources including elasticity. Cloud services offered by third party-service providers on pay-per-use model are delivered to the customer by using Cloud computing platform. Cloud computing platform leads the organizations to gain productivity and enhance the services delivered by them. Cloud computing provides an opportunity to organizations to transform their businesses and create a value proposition between organizations and users. Cloud computing model supports self-services and on-demand service delivery. Cloud as defined by NIST (800-145, 2011) gives a clear view of the service and deployment models. This study addresses and analyzes the Roger's model 'Diffusion of Innovations' significance towards Cloud computing adoption. Model identifies the contribution of variables (constructs) viz. Knowledge, Persuasion and Decision. Decision process includes relative advantage, compatibility, complexity, trialability, and observability. Study is being conducted among employees working in medium-large public organizations, whose job is performed by technology.***

Keywords : Cloud Computing, perceived characteristics, relative advantage, compatibility, complexity, trialability, observability, Knowledge, Diffusion of Innovation (DOI), Software-as-a-Service (SAAS), Platform-as-a-Service(PAAS), Infrastructure-as-a-Service(IAAS).

1.Introduction

Information technology is perceived as a new 'AVTAR' in the business World. Organizations around the world, need speedy platform to exchange real time information. Among others, virtual office is one of the viable ventures for the organizations in current scenario. As real estate prices are high in prime locations in metro cities (Delhi, Mumbai, Bangalore, Hyderabad, Chennai) therefore it is difficult for organizations to invest in big offices. Organizations are working via virtual offices; employees can work from home or any where through virtual connectivity. Physical business environment is converted into virtual, which helps to minimize the capital and operational expenditure. This wide virtual connectivity is delivered to the users/ organizations with the help of different service models. Cloud computing is one of the virtual service models in technology, characterized to support organizations by minimizing cost, increase business agility, anywhere any time–on demand accessibility et.al. Cloud computing platform focuses on the services rather than on the product, that is why it is commonly defined as 'service delivery platform'. Cloud computing as a proposition, offers optimum utilization of resources including elasticity. Resources can be aligned as per the user/ organization's demand. According to Pavlou and El Sawy (2006), Cloud computing service model fulfills the organizations' needs and enhances its capabilities to hold its business competence in the market. "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" (NIST Special Publication 800-145). Cloud platform provides three different services viz. software-as-a-service (SAAS), platform-as-a-service (PAAS) and infrastructure-as-a-service (IAAS) by using delivery architecture such as public, private, hybrid and community models. Cloud services are offered by third party-service providers on pay-per-use model. Cloud computing platform allows organizations to focus less on IT infrastructure maintenance and use their resources in core activities and productive assignment. Various services such as banking, insurance, education, governance, healthcare et.al. are delivered to the customer by using Cloud computing platform. There are many challenges for the Cloud users w.r.t. services and deployment model to be used for delivering services. Organizations have to determine Cloud archetype which can leverage and promote business for real time delivery and long term growth. Cloud computing platform leads the organizations to gain productivity and enhance the services delivered by them.

2. Cloud Computing Background

Cloud computing provides an opportunity to organizations to transform their businesses and create a value proposition between organizations and users. Value proposition includes product and service enhancement, new channel extension and creation of new markets. On the other hand organizations can concentrate on their core competencies rather than IT infrastructure. Cloud computing model supports self-services and on-demand service delivery. Cloud Models defined by NIST (800-

145,2011) gives a clear view of the service and deployment models shown below–

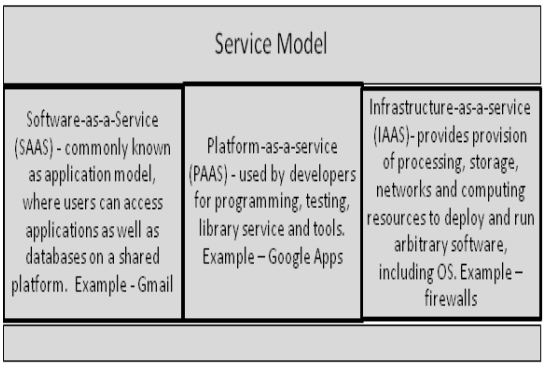

Figure 1

Service models are delivered by public, private, hybrid and community deployment models. Cloud computing services have two aspects- one is to change the way an organization works by allowing for 'greater collaboration' and other is more 'creative processes and ideas' with respect to the real time (FD, USA). Deployment environment ensures the security and the availability of the services to a group/s.

Cloud computing is essentially related to receiving and delivering on-demand services. Being a demand oriented model, there is full control on operational costs and demand for resources. Selection of Cloud services and service providers are two entities that play an important role in successful Cloud computing adoption. Service providers manage IT resources including data security and privacy (KPMG, 2010). Service providers deploy services and distribute them in various locations. Services requirement and distribution is followed by a Service Level Agreement (SLA). SLA includes the resource allocation and desired utility of users. Service level agreement is taken into consideration for this study. This study is framed around the 'Diffusion of Innovation' (DOI) theory. Model identifies the objectivity of the decision constructs viz. relative advantage, compatibility, complexity, trialability, and observability Model also includes three constructs – knowledge, persuasion and decision. Objectives of the study are –

1. To understand the Rogers' model 'Diffusion of Innovations' significance towards Cloud computing adoption.
2. To identify that knowledge and persuasion contribute independently for adoption of cloud computing.
3. To identify the decision constructs viz. relative advantage, compatibility, complexity, trialability, and observability contribute towards cloud computing adoption by the employees of medium-large public organization.

3. Literature & Theory Background

This section includes an overview of the Rogers theory 'Diffusion of Innovations' (DOI) and discusses the model apt for adoption. Rogers (1995) described five stages, which are important for the innovative decision process. Adoption of Cloud computing by the organization is an innovative approach. Organization has to take an appropriate decision at the right time and motivate the users. Three important constructs that influence the innovative decision for adoption are knowledge, persuasion and decision. These three constructs, are preceded by implementation and confirmation. According to Rogers (2003), innovation-diffusion process is "an uncertainty reduction process" (p. 232), and he proposes attributes of innovations that help to decrease uncertainty about the innovation. Attributes of innovations includes five constructs of innovations: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. Rogers (2003) stated that "individuals' perceptions of these characteristics predict the rate of adoption of innovations" (p. 219).

Constructs	**Definition**
Knowledge –(K)	Knowledge is a first stage towards adoption of new technology. An individual seeks information about the innovation. "What?," "how?," and "why?" are the critical questions in the knowledge phase. During this phase, the individual attempts to determine "what the innovation is and how and why it works" (Rogers, 2003, p. 21).
Persuasion- (P)	Persuasion is related to the awareness. Individual becomes interested towards adoption and requires more information, which enhances the possibility of technology adoption.
Decision of adoption and rejection involves the weighing of advantages, disadvantages, costs and trade-offs. Following constructs have been defined by Rogers to analyze the decision of new technology:	
Relative Advantage (RA)	The degree to which an innovation is perceived as being better than the idea it supersedes. The cost and social status motivation aspects of innovations are elements of relative advantage (Rogers 2003,p. 229).
Compatibility (CM)	The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters (Rogers, 2003, p. 15).

Complexity (C)	The degree to which an innovation is perceived as relatively difficult to understand and use". As Rogers stated, opposite to the other attributes, complexity is negatively correlated with the rate of adoption. (Rogers, 2003, p. 15).
Trialability (T)	The degree to which an innovation may be experimented with on a limited basis. Also, trialability is positively correlated with the rate of adoption (Rogers, 2003, p. 6, p. 16).
Observability (O)	The degree to which the results of an innovation are visible to others. (Rogers, 2003, p. 16).

Table: 1

Rogers (2003) argued that innovations offering more relative advantage, compatibility, complexity, trialability, and observability will be adopted faster than other innovations. Rogers does caution, "getting a new idea adopted, even when it has obvious advantages, is difficult" (p. 1), so the availability of all of these variables of innovations speed up the innovation-diffusion process. This study analyses the contribution of constructs and correlation among constructs (defined in DOI model, Rogers 2003) for adoption of cloud computing.

4. Research Model

The scope of the paper is to analyze the contribution and influence of modified DOI model for adoption of Cloud computing. The proposed model for the current study comprises constructs i.e. knowledge, persuasion and decision includes relative advantage, compatibility, complexity, trialability, observability.

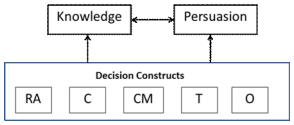

Figure: 1 – Proposed Model

Abbreviations : RA- Relative Advantage, C-Complexity, CM- Compatibility, T-Trialability, O-Observability

5. Hypothesis

Hypothesis 1 : *Knowledge and Persuasion influence independently for Cloud computing adoption among employees of medium-large public organisations.*

Hypothesis 2 *: Decision constructs viz. Relative advantage, compatibility, complexity, trialability, and observability contribute towards cloud computing adoption by the employee of organization.*

Hypothesis 3 *: Knowledge, Persuasion and Decision are positively correlated and altogether influence for adoption of Cloud computing.*

5.1. Methodology and Analysis

This paper includes responses from the medium-large public organizations (employees) who have already adopted Cloud computing. A structured questionnaire was administered on a five point likert scale. A total of 385 responses were collected from the employees of medium-large public organizations (using cloud computing). Out of 385 only 339 (N=339) responses have been included in the study. 46 responses were discarded due to incomplete responses. Data has been collected through Google online survey form and by personal visits. Some employees refused to fill the survey form.

Table 2 below shows, descriptive information of seven constructs. Mean value of CM (compatibility) is 4.306 which is higher than other constructs' mean value. It indicates that compatibility is one of the important construct and contributes towards the adoption of Cloud computing.

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
Persuasion	1.6726	.62411	339
Knowledge	1.9882	2.62890	339
RA	4.0767	.60080	339
C	3.8142	.60435	339
T	3.9381	.79885	339
O	3.6136	.85030	339
CM	4.3068	.62515	339

Table: 2

KMO shown in Table 3 indicates the appropriateness of the factor. KMO 0.650, gives an appropriate middling degree of common variance. Kaiser (1974) recommends accepting values greater than 0.5 as acceptable. Bartletts test is another indication for the appropriateness of factor analysis. The significant value of this test less than alpha value (0.05), points out that there is a correlation among the constructs.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.650
Bartlett's Test of Sphericity	Approx. Chi-Square	303.889
	df	21
	Sig.	.000

Table: 3

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.214	31.625	31.625	2.214	31.625	31.625	1.79	25.577	25.577
2	1.083	15.471	47.096	1.083	15.471	47.096	1.496	21.366	46.943
3	1.031	14.721	61.817	1.031	14.721	61.817	1.041	14.874	61.817
4	0.952	13.594	75.412						
5	0.771	11.018	86.43						
6	0.53	7.575	94.004						
7	0.42	5.996	100						

Extraction Method: Principal Component Analysis. Table: 4

Seven constructs were extracted (Table 4). Factor 1 has an eigenvalue 2.214. Since it is greater than 1.0, it shows that factor is equally contributing towards the adoption of Cloud computing. 31.625% variance is explained by the statistics (Table 4). Eigenvalue of factor 2 and 3 is 1.083 and 1.031. In total 61% variance is explained.

Component Matrix[a]

	Component		
	1	2	3
Persuasion	.043	-.276	.873
Knowledge	.126	.599	-.146
RA	.698	.424	.171
C	.701	.213	.241
T	.596	-.392	-.384
O	.523	-.520	-.104
CM	.768	-.004	-.031

Extraction Method: Principal Component Analysis.
a. 3 components extracted **Table: 5**

Rotated Component Matrix[a]

	Component		
	1	2	3
Persuasion	.122	-.092	.904
Knowledge	.386	-.294	-.400
RA	.831	.064	-.037
C	.737	.190	.121
T	.154	.778	-.165
O	.103	.723	.143
CM	.598	.482	-.025

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 5 iterations. **Table: 6**

Table 5, represents the contribution of factors. Factor 1 shows, maximum contribution of five constructs (decision) i.e. RA,C,T,O,CM. Second factor shows contribution of Knowledge and Observability. In the third factor, persuasion contributes 87%.Table 6, shows rotated matrix and indicates maximum contribution of constructs viz. RA, C,CM,T,O, Persuasion.

Correlations Matrix

		Persuasion	Knowledge	RA	C	T	O	CM
Persuasion	Pearson Correlation	1	-.033	-.008	.057	-.041	.054	.023
Knowledge	Pearson Correlation		1	.079	.088	.024	.005	.027
RA	Pearson Correlation			1	.468**	.170**	.087	.473**
C	Pearson Correlation				1	.183**	.278**	.333**
T	Pearson Correlation					1	.322**	.400**
O	Pearson Correlation					.	1	.240**
CM	Pearson Correlation							1

**. Correlation is significant at the 0.01 level (2-tailed).

Table: 7

Table 7, represents the correlation matrix. A significant correlation has been obtained among C, T, O and CM. Table indicates no or less association of constructs viz. knowledge, persuasion and relative advantage.

5.2. Hypothesis Testing & Discussion

Hypothesis Testing	Result
Hypothesis 1	Not Supported -Table 5,6
Hypothesis 2	Supported – Table 5,6
Hypothesis 3	Supported – Table 5,6,7

Table: 8

Roger's model discusses the critical components in the change systems. When individual opts for change then it is knowledge that motivates and gives understanding about the change. The relationship with knowledge is based on the other contributors which control the innovation as observed from the Table 5 and 6. Hence it's being analyzed that knowledge alone does not contribute to Cloud computing adoption. Knowledge is one of the construct, other than 5 constructs (Decision) defined by the Roger's DOI model (Figure 1).

Persuasion is also supported by the decision constructs i.e. RA, C, T, O and CM (Table 5 and 6) . According to Jayaraj Rottman & Lacity (2006), DOI model is characterized for adoption of ICT and five constructs (Table 1) influenced by the same.

However the findings indicate that decision constructs influence the adoption of Cloud computing rather than knowledge and persuasion. Each decision constructs play an important role for the same. This study confirms that DOI framework and its constructs give a roadmap but merely knowledge and persuasion do not influence Cloud computing adoption as observed from the analysis.

In order to envisage the Cloud characteristics, functional importance and its efficiency is most important for adoption of Cloud computing. Though it is being reviewed from the existing literature that knowledge about "how to use technology?" is very important but our study shows that availability is more important than knowledge in the context of Cloud computing adoption. The Cloud computing services rely on Internet and its

speed. If the services reach the user as when required, it increases the potential of adaptability. In our analysis, complexities and compatibility are influential constructs for adoption of Cloud computing..

Cloud Computing is considered as an innovation in technology. Cloud computing is a serious proposition for the medium-large public organizations as it directly impacts the capital expenditure. Therefore Cloud computing model emphasizes on operating expenditure rather than capital expenditure. According to a study done by Verdantix with multinational companies- Aviva, Boeing, Citigroup, Juniper networks et.al stated cost reduction from 40 to 50% after Cloud computing adoption.

6. Conclusion

Population for the study is limited to Mumbai only. The proposed model shown in Figure 2 is developed based on the DOI model (Roger, 2003). Diffusion is the process through which innovation can be communicated. Adoption of cloud computing and influence of the constructs involves the objectivity and availability of technology. Cloud computing is one of the dynamic tools which helps organizations to enhance their productivity. Diffusion of Innovation theory (Rogers, 1995) can be used as a tool of communication structure in current scenario. It will help to align the policy and to analyze the perception of the adoption process by intended users (using decision constructs viz. relative advantage, compatibility, complexity, trialability, observability). We hope this paper is one of the sources for the literature in future with the changing pace of technology.

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