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Determinant of Cloud Computing Adoption in Banking Operations Excellence

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Abstract. Cloud computing technologies are disrupting many industries in recent times. From hospitality to healthcare and travel, many services are now being delivered through the cloud. Cloud computing has proven to be an extremely fast and cost efficient method of delivering scalable services to a large section of the population. However, the financial services industry has been skeptical about the adoption of cloud computing due to various factors. Data Security and Privacy as well as issues regarding Data protection have been investigated to cause such skepticism. This paper attempts to determine the perception of IT staff with experience in cloud computing in financial institutions related to the core factors influencing the decision to adopt cloud computing in banking operations. The primary data for this study has been obtained through a survey of 212 IT professionals in major banking organizations. The data analysis was performed with the help of ADANCO 1.1, a path modelling software. A structural equation model was constructed to understand the relation between the latent constructs and the dependent variable. The model demonstrated a very close association between the latent constructs and the dependent variable. While earlier research focused primarily on the technological barriers to the adoption of cloud computing, this paper explores other factors which may contribute to the adoption decision of cloud computing hence furthering our understanding of the major factors influencing the decision to adopt cloud computing in banking operations.

Keywords: Cloud computing, Adoption Decision, Regulatory burden, Reputational Risk, Competitive Landscape, Vendor Support, Partial Least Squares, Structural Equation Model.

1.0 Introduction

The advent of cloud computing has disrupted the way technology services are delivered to businesses and consumers alike. While no single definition of cloud computing exists, Plummer et al. (2008, p. 3) define it as "a style of computing where massively scalable IT-related capabilities are provided as a service using Internet technologies to multiple external customers". This means that businesses no longer have to rely on locally scalable IT infrastructures to deliver their services but can instead outsource such services to external cloud service providers.

There are three types of cloud computing services, namely PaaS, SaaS and IaaS (Misra & Modal, 2011). PaaS is a type of service in which the customer is provided a platform to develop and run applications without the requirements of a physical layer (infrastructure, space, etc.). SaaS is a type of cloud computing service in which the end application or software is delivered through a cloud-computing platform (Example: Salesforce). IaaS is a type of service in which the physical computing resources, such as location, database, security, backup, etc., are provided by the cloud vendor. Using these services reduces the cost of owning and operating IT assets within the business (Chang, Amara, & Sanford, 2010).

Cloud services can be deployed using a private, public, community, or hybrid model (Marston et al., 2011; Neves et al., 2011; Rath 2012). In a private cloud deployment, the cloud infrastructure is operated solely for single organization (Mell & Grance, 2011). While such a model increases security and privacy, it also increases the cost of operating a cloud model (Haff, Gordon. 2009). In a public cloud, multiple organizations and individuals share the cloud infrastructure (Rouse, Margaret. 2014). In a community cloud, several organizations from a specific community share the cloud infrastructure (Mell & Grance, 2011). A hybrid cloud

consists of one or more cloud deployment models (public, private, or community), which provide the benefits of multiple deployment models. According to Gartner, a hybrid cloud service is a shared deployment of private, public, or community clouds provided by different service providers (MacDonald & Bittman, 2010).

Brender and Markov (2013), in a case study of five financial institutions, indicate that business and procedural factors influence the adoption decision more than technical factors. The study is limited to a very small sample for generalization. Again, in a study of leading German Banks, Dutta et al. (2013) conclude that regulatory issues, data confidentiality, and security are the top risks to the adoption of cloud computing. However, the data corresponds only to German Banks, which are known to have stringent regulatory policies.

Lampe et al. (2013), in an interview of 12 representatives of financial institutions, point out that technological factors, such as security, vendor lock-in, and organizational factors, like agility and cost reduction, play a major role in the determination of whether financial service companies adopt a cloud computing framework. Oliviera and Thomas (2014) explore factors such as compatibility, complexity, and relative advantage in the service sector as primary influencers in the adoption of cloud computing. They note that for SMEs, gaining a relative advantage over the competition is a major decision factor. However, the analysis is limited to the country of Portugal and covers mainly the manufacturing and services sectors.

Morgan and Conboy (2013), in a survey of CIOs of 12 major financial institutions, note that security factors remain the primary inhibitors to cloud adoption in financial firms. However, the findings are limited by the fact that the survey does not consider the primary decision makers in these decisions, such as infrastructure managers and outsourcing managers. Popovich and Hocenski (2010) highlight security, compliance, storage, and privacy breaches as considerations for cloud deployments in a recommendation paper on cloud adoption. However, there are no constructs qualified in order to assess whether these are the major impact factors.

In the scope for future research, many authors have recommended a study on the environmental factors influencing the adoption decision in cloud computing on a standalone basis. Oliveira & Thomas (2014), Pearson (2009) and Tianfield (2012) have mentioned regulatory burden as a factor to be explored. While sub-factors, such as compliance cost (Choo, 2010), have been studied, the results have not been captured through qualitative assessments, such as surveys/interviews. Truong (2010) and Habib et al. (2010) have studied factors such as strategic advantages of cloud computing and operational cost savings, however, other factors, such as economies of scale and faster rollout of new services, have not been studied in detail (Goldstuck, 2011). Authors such as Subhashini and Kavitha (2010) and Godse and Mulik (2009) have mentioned reputational risk factors, such as threat of hacking incidents and vendor reputation. Finally, Garrison et al. (2012) and others have observed vendor support as a key variable in the adoption decision. However, sub-factors, such as vendor training and business continuity, have not been explored qualitatively.

Application of Product Adoption Theory and Theory of Diffusion of innovation:

The theory of Product Adoption deals with as to how, why and to what extent a new product is understood and adopted by market consisting of individuals and organizations. This theory contributed second theory - Diffusion of Innovation. Applying the theory of adoption, this article examines as to how, why and to what extent cloud computing is under stood and adopted by bank employees in particular.

While the adoption theory centers around market and product, the diffusion of innovation theory explains as to how, why and what rate new ideas and technology spread and its market share. Diffusion is the process of communicating the innovation over time among the participants in a social system. Rogers (2003) identified four elements influencing the spread of new technology namely innovation itself, communication channels, time and social system. There is a point at which an innovation reaches critical mass and categories of adopters are innovators, early adopters, early majority, late majority and laggards. The criteria of this adopter

categorization are degree of an individual addictiveness for new idea. While adoption theory applies around employees and cloud computing technology, the diffusion of innovation theory applies to adoption of cloud computing by bank employees, as to how, why and what rate new ideas and cloud computing technology spread and its market share in the banking industry. For this purpose, only employees of banks were chosen as users and adopters. There is point at which an innovation of cloud computing reaches critical mass and categories of adopters (bank employees) are innovators, early adopters, early majority, late majority and laggards. The theory identified the market spread as 2.5% innovators, 13.5 early adopters, 34% early majority, 34% late majority and 16% laggards. In this study, all respondents for the questionnaire survey were bank employees and a specific question was asked as to which category of adopters the employees belong. This is further discussed in the section under discussion, analysis and findings.

Research Questions

The objective of this research is to establish the environmental factors influencing the adoption of cloud computing in the area of banking operations. Banks are highly regulated entities. Banks are not only subject to regulatory policies implemented in their home countries but also are subject to local regulatory policies in the countries in which they operate. The research aims to answer the following questions:

a. Do regulatory burden, competitive advantage, reputation risk, and vendor support contribute to the decision-making process on cloud adoption in banking operations?
b. Are these factors statistically significant?
c. Can these be compared to a similarly regulated industry, such as healthcare, based on research conducted?
d. Does technology adoption and its spread among professional banking employees compare and confirm with contributions of Rogers in the theory of diffusion of innovation

2.0 Review of Literature

2.1 Regulatory Burden

Regulatory Burden refers to the cost imposed by the business by a regulatory framework, which includes regulatory, legislative, and taxation measures (Bickerdyke & Lattimore, 1997). Regulatory burden is not a measurable cost, as it includes additional aspects, such as litigation, change, and inequity (Peck et al., 2012). While there are many models for estimating compliance burden for businesses, such as cost-benefit analysis (Froud et al., 1998), there are some key issues in measuring and quantifying such costs (Michaelas et al., 2012). An analysis of the regulatory burden in cloud computing has mostly focused on the security and confidentiality aspects of providing critical services, such as banking and healthcare, through a cloud-based model (Ramgovind et al., 2010; Svantesson & Clarke, 2010). However, there are other sub-factors, such as cross-border data flow and regulatory conflicts between cloud consumers and providers, which have not been considered together with other regulatory factors.

Data Confidentiality: Data confidentiality is a key issue in IT departments in banking and financial services companies (Armbrust et al., 2009). Regulators across the world expect financial institutions to have adequate controls in place to ensure that customer data is protected. The most common solution for data confidentiality is usually implemented through data encryption (Chen & Zhao, 2012). Data confidentiality is a primary inhibitor of cloud computing adoption in the banking domain (Zissis & Lekkas, 2012).

Cross-Border Data Flow: In an increasingly globalized business landscape, there is substantial attention provided to the flow of data from one region to another, as this has significant impact on ensuring privacy and security of data (Bhaduria et al., 2011). Data in Transit procedures issued by regulators enforce banks and other financial institutions to make sure that customer data is protected during transit. Meeting the restrictions

on cross-border data transfer to maintain the levels of data protection required by regulations is a challenge in cloud adoption, particularly in the banking industry (Pearson, 2009).

Data Security: Data security is another vital variable when studying the adoption of cloud computing in banking operations. Zissis and Lekkas (2012) state that security is the biggest management issue with Cloud computing. While security is a minor issue when banking services are deployed on the premises, it is not guaranteed in a cloud-computing environment (Rao, Nazeer, Rani, & Krishna, 2011).

Regulatory Conflict: Storing and managing data in the cloud could trigger a number of different regulatory requirements (Sotto et al., 2010). The conflict in regulatory landscape between the bank and the cloud service provider is another variable of interest in the study of cloud computing adoption. The vendor and the bank may be subject to different regulatory policies, such as European laws, that need an organization to know the location of the personal data is in its possession at all times (Tianfield, 2012).

Compliance Cost: The cost of compliance is another significant regulatory burden when implementing cloud-based architectures. Regulators in various countries impose reporting and other compliance requirements on banks in order to ensure that any cloud-based systems have adequate security and recovery policies in place (Kim et al,, 2009). This results in an increased cost of operations for the bank (Choo, 2010).

H1: Regulatory Burden highly influences the competitive landscape of cloud computing in banking operations.

H2: Regulatory Burden highly influences reputational risk in the customer adoption of cloud computing in banking operations.

H3: Regulatory Burden highly influences vendor selection in the customer adoption of cloud computing in banking operations.

H4: Regulatory Burden highly influences the adoption decision of cloud computing in banking operations.

2.2 Competitive Landscape

The financial services business is characterized by increased competition to provide similar basic services, such as loans/deposits, brokerage services, wealth management, corporate banking, etc. Product differentiation in these markets is extremely difficult to achieve and has high costs when traditional IT systems are used. However, cloud computing is able to provide significant cost savings in such environments (Marston et al., 2012).

Strategic Advantage: Cloud computing is expected to bring about strategic advantage for banks when implemented correctly. Banks can deploy IT resources more efficiently, thereby increasing the time available for core business activities, such as customer acquisition and retention, product management, digitization, and other value added activities (Low et al., 2011). However, Lin and Chen (2012), point out that the relative advantages of cloud computing were not very obvious in interviews with IT professionals across organizations in Taiwan.

Operational Cost Savings: Various research papers have analyzed the impact of cost savings as a construct for cloud computing adoption. Ankeny (2011) points out that, due to cloud computing being a subscription model, there are potentially huge cost savings for small firms. Cloud computing provides services only based on the demand for those services in a pay-as-you-go model, allowing banks to minimize cost and maximize resource utilization (Wang, Von Laseqski, Kunze, & Tao, 2010).

Faster Service Rollout: The adoption of cloud computing is expected to result in faster rollout of relevant banking services to clients. Cloud computing service providers are able to quickly scale infrastructure to

support increased demand. This allows banks to rapidly deploy their services across wide regions (Habib, Ries, & Muhlhauser, 2010; Marston, Li, Bandyopadhyay, Zhand, & Ghalsasi, 2011).

Economies of Scale: The adoption of cloud computing is expected to provide economies of scale. Big banks have legacy issues with divergent banking platforms implemented across different regions, non-standardized applications, redundant systems, etc. Deploying cloud solutions across the different regions would allow banks to standardize processes, rationalize systems, and bring about economies of scale. Hence, cloud-computing implementations are found to be cost effective and provide economies of scale (Goldstuck, 2011; Grossman, 2009).

H5: The competitive landscape has a positive influence on the reputational risk associated with cloud adoption in banking operations.

H6: The competitive landscape globally has a significant statistical contribution on decision makers in adopting cloud computing in banking operations.

2.3 Reputational Risk

`Since cloud computing involves the use of shared resources, a malicious event on one of the tenants of the computing platform may also affect other tenants as well as the organization (Ahmed & Abraham, 2013). Additionally, trust issues become important, due to cloud computing platforms being de-centralized, and computing resources are deployed beyond the perimeter of the organization (Habib et al,, 2010).

Negative Publicity: The financial crisis has attracted a lot of attention to the business principles on which the current banking system operates. Banks are faced with unprecedented challenges in winning back customer loyalty amid a slew of negative press reports (Armbrust et al., 2010). In such conditions, an event such as the loss of confidential customer data or security breaches can impact the reputation of the bank (Gu & Cheung, 2009).

Threat of Hacking Incidents: Security threats due to hacking damage the credibility of the organization. While in traditional on-premise application deployment models, sensitive data resides within the enterprise boundary; in cloud deployment models, the data is stored outside the enterprise on the vendor side. This results in a potential threat, as vulnerabilities at the vendor side could allow external parties to gain access to the bank's data (Subhashini & Kavitha, 2010).

Data Leaks: Data breach is another key issue to be addressed when adopting cloud computing systems. Since user and business data are co-located in a cloud environment, they are considered high value targets (Golden, 2009; Kaufman, 2009). While external criminals pose the biggest risk to data breaches (73%), they have the least impact, whereas insiders with a risk factor of 18% pose the highest impact (Cooper, 2008; Subhashini & Kavitha, 2010).

Vendor Reputation: The reputation of vendors plays an important part in the adoption decision of cloud computing (Bisong & Rahman, 2011). Since cloud vendors do no typically use common open standards, issues related to vendor lock-ins and data portability issues arise (Habib, Ries, & Muhlhauser, 2010). If the vendor goes bankrupt or is subject to regulatory investigation, these could have an adverse impact on the organization.

H7: *The reputational risk factors highly influence the decision to adopt cloud computing in the banking sector.*

2.4 Vendor Support

Many key players, such as IBM, Microsoft, Google, Amazon, Salesforce.com, EMC, and Cisco, have emerged in the cloud computing vendor space (Marston et al., 2011). Each vendor has its own proprietary cloud computing landscape, resulting in a lack of standardization. The regulations imposed on the vendor may be different from the regulations imposed on the customer (Parrilli, 2010). Therefore, it is important for companies to plan their vendor selection process carefully before adopting cloud-based solutions.

Good Support: Cloud vendors need to be able to provide excellence support in order for cloud computing technologies to be employed in mainstream businesses. This is because a business like Banking does not have sufficient in-house expertise to manage and support its cloud deployments. With the scalability of the cloud platform, many vendors are now able to provide a comprehensive suite of product offerings that enable businesses to successfully implement and deploy cloud-based services (Garrison et al., 2012).

Security Patches: The increased prevalence of malicious software has resulted in many cloud-based systems exposed to vulnerabilities in protection, securing client assets. Many threat vectors have emerged in the recent past, which have managed to gain unauthorized access to critical systems and confidential data resulting in data breaches and erosion of customer confidence. Hence, vendors are required to keep their security systems up to date in order to ensure that such incidents do not compromise their customer data (Bisong and Rahman, 2011). Padhy et al. (2011) mention that cloud computing allows a customer to eliminate overhead related to installing and operating applications on dedicated hardware and outsource the same to an SaaS vendor who will then be responsible for infrastructure maintenance, updating of security patches, etc., as required.

Training: Cloud vendors are expected to have programs developed to support fundamental security, risk management skills, and the knowledge required to manage security in a cloud environment (Popovic & Hocenski, 2010). Behrend & Wiebe (2011) also state that training and support for key stakeholders, such as IT administrators and instructors, is a concern in a study of cloud computing adoption in community colleges. The vendors will need to invest resources in hiring and training key staff to maintain and support the cloud infrastructure in order to maintain uptime and reduce downtime.

Business Continuity: The vendors should have an appropriate business continuity strategy, without which customers will not be able to migrate to a cloud-based infrastructure. Proper disaster recovery procedures and business continuity plans should be applied to reduce risks of data loss in the event of a disaster (Armbrust et al., 2010).

H8: Vendor Support influences the competitive landscape in the customer adoption of cloud computing in banking operations.

H9: Vendor Support influences Reputational Risk in the customer adoption of cloud computing in banking operations.

2.5 Adoption Decision

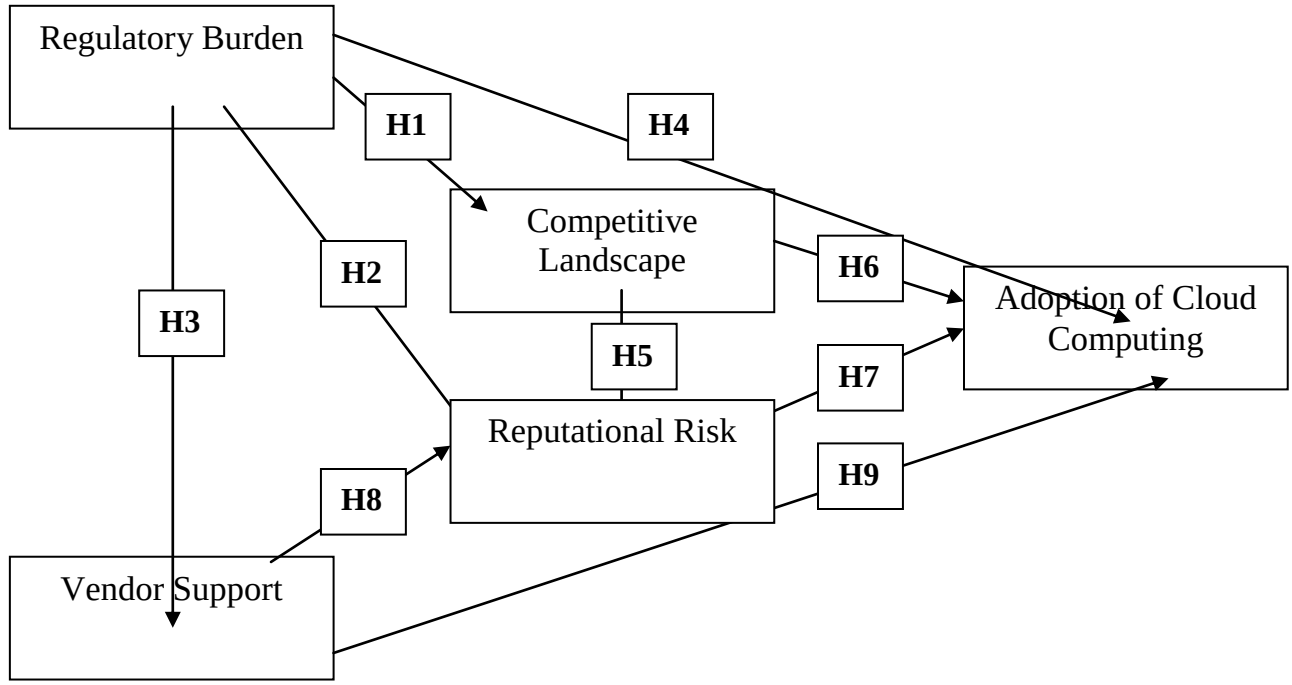
The decision to adopt cloud computing in banking operations was measured using the following factors:
Increased Innovation: Cloud computing is expected to increase the pace of innovation in banking services, as banks can focus on development of products and services without worrying about the platform of deployment and active management (Berman & Kesterson-Townes, 2012; Lin & Chen, 2011).
Future Potential: The potential for the future of cloud computing in banking is enormous. However, both the banks and the regulators should work closely in order to determine the nature and scope of services that banks can outsource to the cloud. Additionally, vendors should be active in engaging with their customers to help design, implement, and support the necessary cloud architecture (Armbrust et al., 2010; Buyya et al., 2009).

Adoption Benefit : Cloud computing provides many benefits to banks (Low et al., 2011; Kim et al. 2009), in the form of lower costs associated with IT assets, increased availability and scalability, increased speed of time to market products and services, and lowered overhead required to manage the systems and processes.

Competitive Edge: Cloud computing provides banks with the competitive edge in the market place (Garrison et al., 2012; Truong, 2010). With the increasing number of technological disruptors in the banking industry, such as Lending Club, PayTm, PayPal, Wealthfront, etc., banks need to also have the necessary product reach and scale to compete effectively. Cloud computing can help provide such a competitive edge.

3.0 Research Methodology

Through the literature review and scope of future research specified in the review articles, four key environmental variables were identified for analysis. These variables are: Regulatory Burden, Competitive Landscape, Reputational Risk, and Vendor Support. The research framework used for this study is shown below.



H = Hypothesis

Figure:1 Research Framework

Data Collection

The reflective factors for each of these variables were established through a questionnaire distributed online to the survey participants. The questionnaire was pre-tested with a sample size of 30 participants. The questions were modified, based on the feedback received. The final questionnaire consisted of 18 questions (six

questions each for regulatory burden and competitive landscape, four questions for reputational risk, and three questions related to vendor support). Three questions were meant to collect demographic data, such as organization size, region, and management level. A five-point Likert scale was used to measure responses, with 1 being Strongly Disagree and 5 being Strongly Agree.

The survey participants were working professionals with IT backgrounds in leading banks. The participants were chosen based on knowledge and experience related to cloud computing deployment and support in various banks across America, Europe, Asia, and Oceania. Out of a sample size of 775 potential respondents to which the survey was sent, only 212 usable survey responses were received, indicating a response rate of 27.3%. The geographic distribution and characteristics of the survey group is listed in the table below.

Table 1: *Respondents across Region, IT Professional Level, and Size of Organization (n = 212)*

Item	**Measure**	**Frequency**	**Percentage**
Region	Asia	168	79.2%
	Europe	17	8.01%
	Americas	14	6.6%
	Oceania	13	6.1%
Profession of respondents working in banks	Lower Management	58	27.3%
	Middle Management	137	64,6%
	Executive	27	12.7%
Educational Qualifications of respondents	IT and Computer Graduates		63%
	Other Science and Engineering graduates with IT experience		21%
	Other well versed in computer operations by corporate training		16%
Size of the banking organization (Employees)	<20000	75	35.3%
	20000 – 50000	47	22.1%
	50000 – 100000	21	9.9%
	>100000	69	32.5%
	Role of bank employees as adopters	Time Taken to adopt from the date of induction of cloud	Adoption percentage of bank employees in

Time Taken to adopt cloud computing by bank employees and their role in relation to Diffusion of Innovation Theory		computing	the sample survey (No. of employees)
	Quick Adopters (Innovators)	One Month	11% (23)
	Trend Setters (Early Adopters)	Three Months	21% (45)
	Pragmatics who adopts with peer's interaction (Early Majority)	Five Months	23% (48)
	Conservatives who adopts only after peer's pressure (Late Majority)	Seven Months	39% (83)
	Sceptics with suspicion of innovation (Laggards)	Twelve Months	6% (13)
Total			100% (212 Employees)

The collected data was analyzed using ADANCO 1.0 to build a process model using partial least squares regression. Partial least squares is a bilinear factor model used to analyze the relationship between the latent constructs and the independent variable. This method uses a linear regression model by projecting the independent variable and latent constructs into a new space (Wold, Herman, 1985).

4.0 Data Analysis

As a holistic statistical approach for data analysis, hypotheses are tested on direct and indirect relationships among observed and latent variables under Structural Equation Modelling. Under SEM, the variation and co-variation of Measured Variables (MV) are accounted. (Hoyle, 1995). Models and relationships among various MVs are tested under Path Analysis. In many ways, like correlation and regression, Path Analysis with SEM is similar to traditional methods. First, both Regression and Path Analysis are based on linear statistical models. Second, if certain assumptions are met, statistical tests associated with both methods are valid. Regression methods assume a normal distribution, while Path Analysis assumes multivariate normality. Third, neither approach offers a test of causality. (Suhr 2008)
Despite above, differences persist between Path Analysis and Regression Analysis. Path Analysis is used as a highly flexible and comprehensive methodology. Variables in Path Analysis could be independent and dependent, whereas variables in Regression Analysis are either independent or dependent. Researchers are able to recognize the imperfect nature of their measures under Path Analysis. Error or unexplained variance is explicitly specified in SEM, while Regression Analysis assumes measurement occurs without error.

Data Reliability

The reliability of the model can be estimated using the figures of Joreskog's rho and Cronbach's alpha. This parameter is used as a lower bound estimate of the reliability of a data set. A Cronbach's alpha value greater than 0.7 is considered acceptable (Hair et al., 2012).

Table 2: *Values of overall reliability constructs*

Construct	Jöreskog's rho (ρ_c)	Cronbach's alpha(α)
Adoption Decision	0.8907	0.8363
Regulatory Burden	0.8589	0.8096
Competitive Landscape	0.8802	0.8181
Reputational Risk	0.8425	0.7666
Vendor Support	0.8738	0.8078

The value of Cronbach's alpha for each latent construct is greater than 0.7 (minimum value – 0.7666). The value of Jöreskog's rho is also greater than 0.8, which indicates strong composite reliability (Wertz et al., 1974). Hence, the model can be considered reliable.

Convergent validity

Convergent validity is defined as the degree to which two measures of construct that are assumed to be related are actually related (Campbell & Fiske, 1959). The convergent validity of the model is assessed, based on the values of average variance extracted for each construct. An AVE value > 0.5 for each construct is desired (Chin, 1998).

Table 3: *Values of construct validity*

Construct	Average variance extracted (AVE)
Adoption Decision	0.6710
Regulatory Burden	0.5060
Competitive Landscape	0.6484
Reputational Risk	0.5175
Vendor Support	0.6340

In the above table, the AVE values for all latent constructs are greater than 0.5, which indicates good convergent validity.

Construct	Adoption Decision	Regulatory Burden	Competitive Landscape	Reputational Risk	Vendor Support
Adoption Decision	0.6710				
Regulatory Burden	0.3877	0.5060			
Competitive Landscape	0.4133	0.2441	0.6484		
Reputational Risk	0.4638	0.4193	0.3319	0.5175	
Vendor Support	0.4447	0.3202	0.3599	0.4018	0.6340
Squared correlations; AVE in the diagonal.					

Discriminant validity

The degree of discrimination between latent constructs is modeled using ADANCO 1.1. Campbell and Fiske (1959) introduced discriminant validity. It tests whether constructs that are unrelated are in fact unrelated. The square root of AVE (average variance) should exceed the value of other variables (Herz, 1986). The below values indicate discriminant validity testing.

Table 4: *Values for discriminant validity*

Goodness of Fit Model

The goodness of fit of a model measures how well the model fits the set of observations of a variable. An SRMR value of less than 0.08 is desired to indicate a stable goodness of fit. Since the SRMR value 0.0773 is less than the cut-off value of 0.08 (Hu and Bentler, 1999), the research model is seen to have a good fit.

Structural Equation Model

Path modeling is a special case of structural equation modeling, where single indicators are used for each variable in the causal model. The correlation is the equation to the sum of the contribution of all paths through which the variables are connected. The strength of each path is calculated as a product of the path coefficients along the path (Wright, 1934). The R-squared value of 0.619 supports the model.

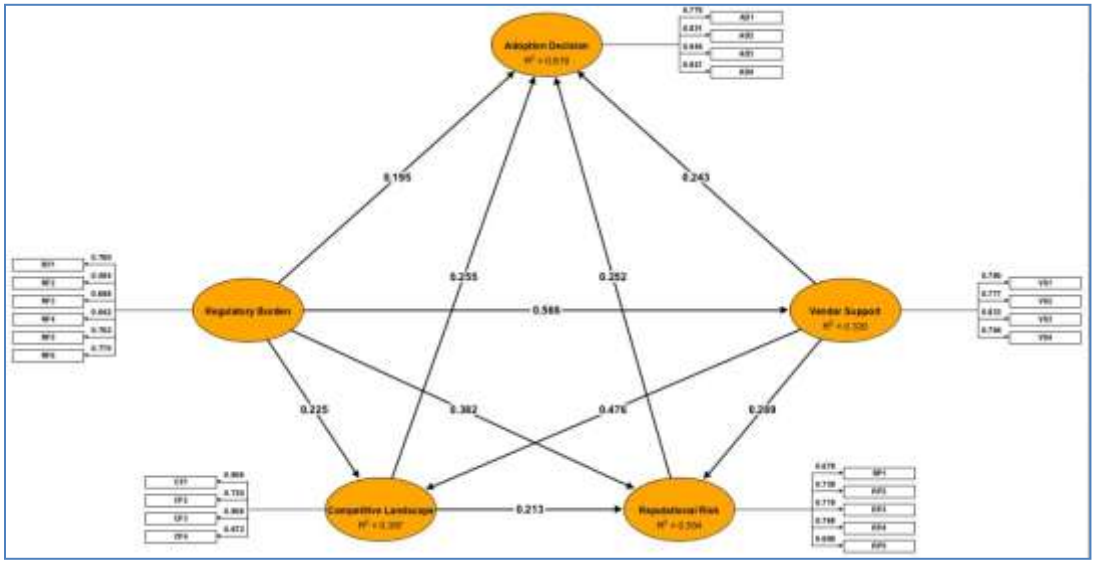


Figure 2: Structural Equation Model with path coefficients

Hypothesis Testing

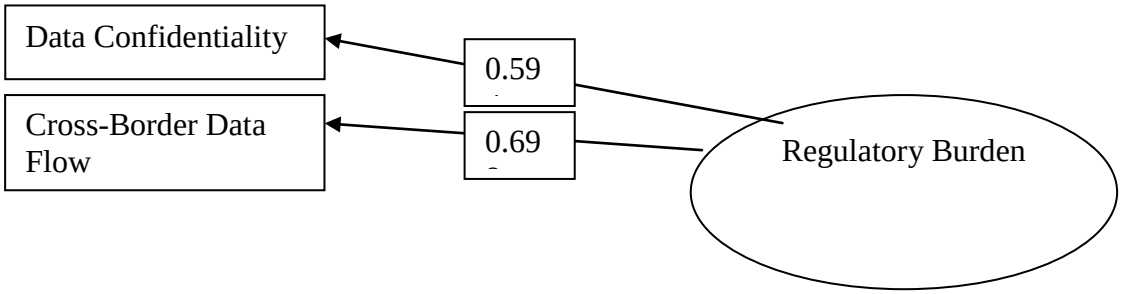
The software package ADANCO 1.1 uses a variance to model structural equations and hypothesis testing. Bootstrapping methods can be used to model unknown population data (Efron, 1987). The level significance is measured using the t-statistic. The p-values and t-values for significance tests are tabulated below.

Table 5: *Outcomes of hypothesis testing*

Hypothesis	**Effect**	**Path Co-efficient**	**Mean value**	**Standard error**	**t-value**	**Supported**
H1	Regulatory Burden -> Competitive Landscape	0.4937	0.4903	0.0726	6.7994	YES
H2	Regulatory Burden -> Reputational Risk	0.6506	0.6493	0.0551	11.8113	YES
H3	Regulatory Burden -> Vendor Support	0.5658	0.568	0.0629	9.0009	YES
H4	Regulatory Burden -> Adoption Decision	0.6229	0.6217	0.0561	11.1104	YES
H5	Competitive Landscape -> Reputational Risk	0.2128	0.2155	0.0655	3.2486	YES
H6	Competitive Landscape -> Adoption Decision	0.3083	0.2999	0.0702	4.3908	YES
H7	Reputational Risk -> Adoption Decision	0.2525	0.2595	0.0852	2.9648	YES
H8	Vendor Support -> Competitive Landscape	0.4756	0.4833	0.0882	5.3934	YES
H9	Vendor Support -> Adoption Decision	0.4627	0.467	0.0742	6.2324	YES

5.0 Research Findings:

Regulatory Burden:



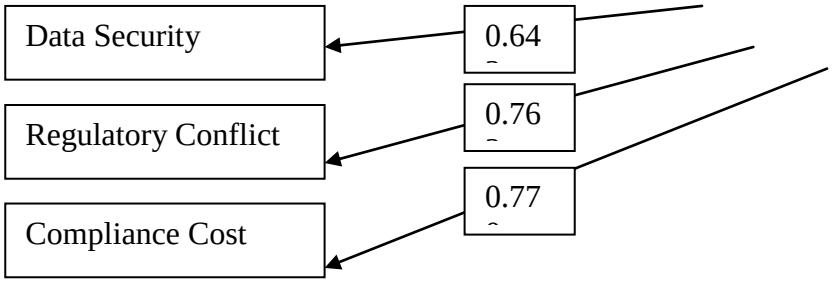


Figure 3: Regulatory Burden and associated path coefficients

In the structural equation model above, the path coefficient for Data Confidentiality is 0.594; cross-border data flow is 0.698; data security is 0.642; regulatory conflict is 0.762; and compliance cost is 0.770. This signifies that all constructs have a moderate effect on the independent variable Regulatory Burden, as all values are between 0.5 and 0.8 (Fahrmeir, Künstler, Pigeot, & Tutz, 2007).

H1: Regulatory Burden has a significant effect on competitive landscape in cloud computing adoption.

The first hypothesis attempts to measure the impact of regulatory burden on the competitive landscape in the adoption of cloud computing in banking operations. The t-value for this relationship is 6.7994. Since it is greater than 2.59, H1 is strongly supported. This implies that regulatory burden influences the competitive landscape around cloud computing adoption significantly. Marston et al. (2011) indicates that regulations play a vital role in the development of the cloud computing ecosystem. However, the hypothesis is not verified through any measurement instrument. Nkhoma, Dang & De Souza (2013) state that the perceived environment barriers to cloud computing are not supported, based on a survey of 1,200 technology decision makers performed by IBM. However, the survey involved over 16 industries and, hence, cannot be generalized only to the banking and finance sector, as these are more regulated than other manufacturing and service sectors.

H2: Regulatory Burden has a significant effect on reputational risk associated with the adoption of cloud computing in banking operations.

The second hypothesis attempts to measure the association between regulatory burden and reputational risks in the adoption of cloud computing in banking operations. The t-value for this relationship is 11.8113. Since the value is greater than 2.59, H2 is strongly supported. This implies that the regulatory burden associated with the adoption decision also impacts the reputation of the bank, if regulatory compliance standards are not met. Earlier studies (Armbrust et al., 2010; Tianfield, 2012) have supported that regulatory impacts affect the reputation of the organization. However, the strength of such a support impact has not been studied. Through our survey, we have determined that regulatory burden does have a strong correlation with the reputational risk associated with the adoption of cloud computing advancing the research on this subject.

H3: Regulatory Burden has a significant effect on vendor support associated with the adoption of cloud computing in banking operations.

The third hypothesis attempts to measure the association of regulatory burden and vendor support in the adoption of cloud computing in banking operations. The t-value for this relationship is 9.009. Since the value is greater than 2.59, H3 is strongly supported. Chow et al. (2009) have investigated the impact of regulations on vendor support in cloud computing. They observe that regulations play an important role in the organization-vendor relationship, since vendors and organizations can be in different organizational jurisdictions. Subhashini and Kavitha (2011) have concluded similarly through a literature review of cloud computing resources. This paper validates the findings of previous authors.

H4: Regulatory burden has a significant effect on the adoption decision associated with adoption of cloud computing in banking operations.

The fourth hypothesis aims to assess the impact of regulatory burden on the adoption decision in the customer adoption of cloud computing in banking operations. The t-value for this relationship is 11.1104. Since the value is greater than 2.59, H4 is strongly supported. This implies that regulatory burden has a significant effect on the adoption decision of cloud computing in banking operations. Morgan and Conboy (2013) did not find a strong support for regulatory effects to influence the adoption decision. Oliviera and Thomas (2014) found that regulatory factors are the least significant factor in the adoption decision. However, since their sample only included one country (Portugal), the same cannot be generalized. Additionally, while the effect of regulatory aspects on the adoption decision has been studied, the impact on the overall cloud computing landscape has not been studied, while in this paper, we have attempted to model such indirect impacts.

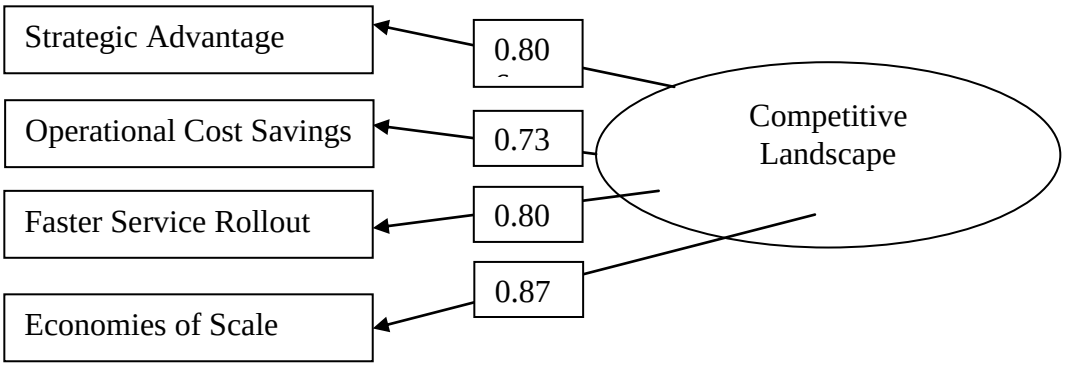


Figure 4: Competitive Landscape and associated path coefficients

In the structural equation model above, the path coefficient for Strategic Advantage is 0.806; Operational Cost Savings is 0.730; Faster Service Rollout is 0.806; and Economies of Scale is 0.872. This signifies that the constructs Strategic Advantage, Operational Cost Savings, and Economies of Scale all have a strong effect on the independent variable Competitive Landscape, since they are greater than 0.8, while the construct Faster Service Rollout has a moderate effect on the independent variable with a value of 0.730.

H5: The competitive landscape has a significant influence on the reputational risk related to cloud adoption in banking operations.

The fifth hypothesis aims to assess the impact of the competitive landscape on the reputational risk associated with the customer adoption of cloud computing in banking operations. The t-value for this relationship is 3.4286. Since the value is greater than 2.59, H5 is strongly supported. This implies that the competitive landscape in cloud computing results in an increased prevalence of security issues and thereby increases the reputational risk associated with the customer adoption of cloud computing in banking operations. Nuseibeh (2011) did not find any relation between competitive landscapes influencing the reputation of the organization. However, since the study did not focus on such indirect relationships, the same may have not been analyzed. Elena and Johnson (2015), in a structured interview of 24 subjects in UK Government organizations, found that the competitive landscape of cloud computing does impact the risk culture of organization, of which social or reputational risk is one. However, the qualitative correlations were not measured as part of the study, which has been done in this paper.

H6: The competitive landscape has a significant influence on the customer adoption of cloud computing in banking operations.

The sixth hypothesis aims to assess the impact of competitive landscape on the adoption decision of cloud computing in banking operations. The t-value for this relationship is 4.3908. Since the value is greater than 2.59, H6 is strongly supported. This implies that the competitive landscape has a significant role in the customer adoption decision in banking operations. While cost savings have been highlighted as a significant factor in the adoption decision (Gupta et al., 2013; Lampe et al., 2013), additional parameters, such as strategic advantage and economies of scale, have been taken into consideration in our research.

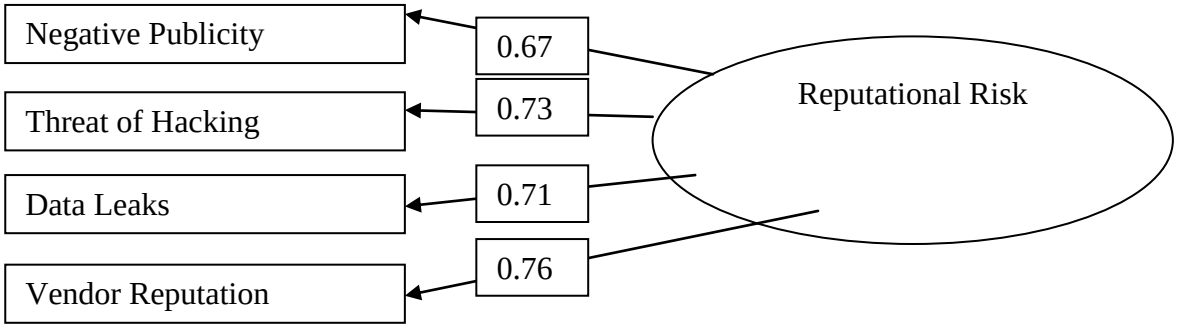


Figure 5: Reputational Risk and associated path coefficients

In the structural equation model above, the path coefficient for Negative Publicity is 0.678; Threat of Hacking Incidents is 0.739; Faster Service Rollout is 0.719; and Vendor Reputation is 0.768. This signifies that the constructs have a medium effect on the independent variable Reputational Risk. However, since Threat of Hacking Incidents and Faster Service Rollout have path coefficients closer to 0.8, these may be considered to have a strong effect on Reputational Risk (Wright, 1921).

H7: Reputational risk has a significant influence on adoption decision on cloud computing in banking operations

The seventh hypothesis aims to assess the impact of reputational risk on the adoption decision of cloud computing in banking operations. The t-value for this relationship is 2.9648. Since the value is greater than 2.59, H7 is strongly supported. This implies that reputational risk plays a significant role in the adoption decision of cloud computing in banking operations. While earlier studies have established the importance of reputation of both the organization and vendor on the adoption decision of cloud computing (Dillon et al., 2010; Habib, Ries, & Muhlhauser, 2010), a quantitative measure of such a relation had not been established. Further, the studies had primarily focused on reputation as a sub-factor of security/technical factors rather than treating the same as an environmental factor that influences cloud adoption.

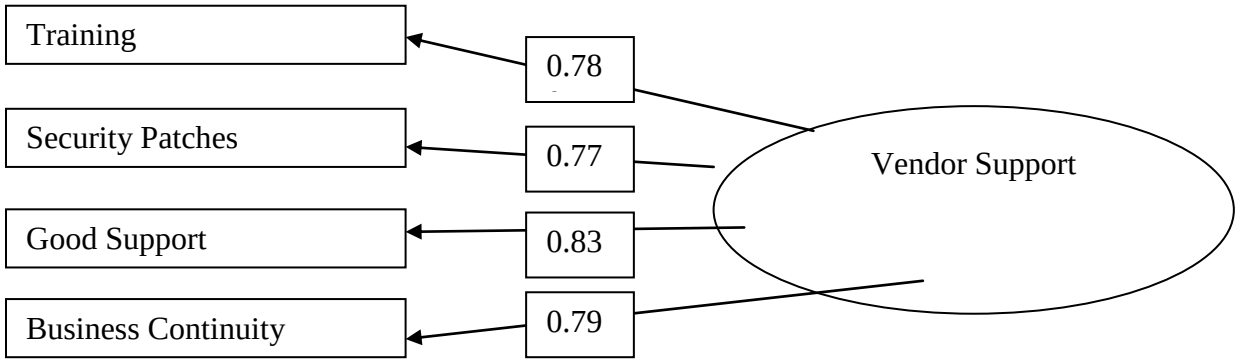


Figure 6: Vendor Support and associated path coefficients

In the structural equation model above, the path coefficient for Training is 0.780; Security Patches is 0.777; Good Support is 0.833; and Business Continuity is 0.794. This implies that while Good Support has the highest impact on the Vendor Support variable, business continuity with a value of 0.794, which is closer to 0.8, also has a strong effect. Training and Security Patches have a moderate effect on the independent variable (Wright, 1934).

H8: Vendor support has a significant influence on the competitive landscape in the adoption of cloud computing in banking operations.

The eighth hypothesis aims to validate the influence of vendor support on the competitive landscape in the adoption decision of cloud computing in banking operations. The t-value for this relationship is 5.3934. Since the value is greater than 2.59, H8 is strongly supported. This implies that vendor support plays a significant role in the competitive landscape of cloud computing in banking operations. While studies (Garrison et al., 2012; Ramagovind et al., 2010) have indicated that good vendor relationships provide a competitive advantage in cloud computing, the impact has not been studied with specific constructs. Additionally, the presence of a large number of multinational companies in the vendor space, such as Amazon and Google, has perhaps been a factor in such a relation not being explored earlier.

H9: Vendor support has a significant influence on the customer adoption decision on cloud computing in banking operations.

The ninth hypothesis aims to assess the impact of vendor support on the customer adoption of cloud computing in banking operations. The t-value for this relationship is 6.2324. Since the value is greater than 2.59, H9 is strongly supported. This implies that vendor support plays a significant role in the customer adoption decision of cloud computing in banking operations. While earlier studies have demonstrated the importance of vendor selection and support (Vignos, Kim, & Metzer, 2013), sub-factors, such as training requirements and business continuity planning, were not considered.

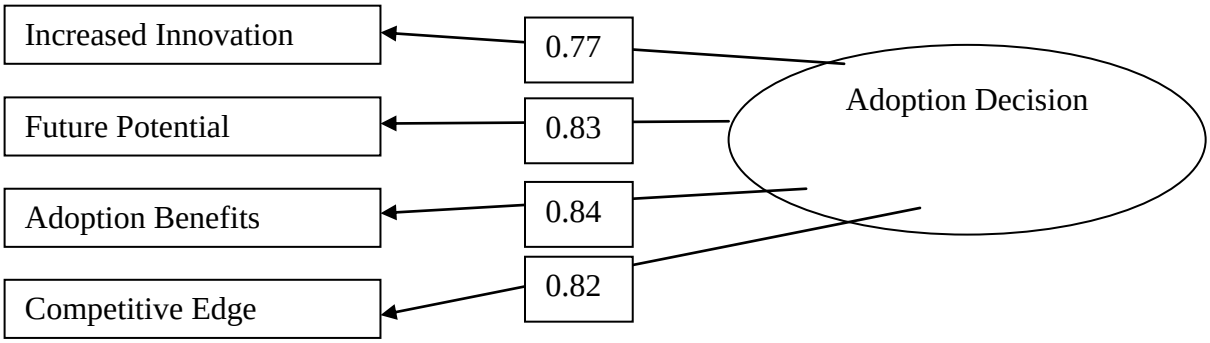


Figure 7: Adoption Decision and associated path coefficients

In the structural equation model above, the path coefficient for Increased Innovation is 0.779; Future Potential is 0.831; Adoption Benefits is 0.844; and Competitive Edge is 0.821. This implies that Future Potential, Adoption Benefits, and Competitive Edge all have a strong effect on the variable adoption decision while Increased Innovation has a moderate effect (Wright, 1921).

6 Implications for the Banking Industry

The results inferred from this study indicate that environmental factors, such as regulatory burden, competitive landscape, reputational risk, and vendor support, merit attention from both IT and business users when deciding between in-house deployments versus cloud-based deployments. However, while in-house deployments allow banks to manage external risk factors, they limit the bank's ability to respond to the ever-increasing demands of their customers to provide efficient, timely service. It is in the interest of the banks to work closely with regulators to provide a meaningful framework to minimize the disruptions that could be caused by cloud computing adoption while ensuring that banks are able to leverage on this new technology efficiently. While critical banking services, such as access to cash withdrawals, personal account information, etc., can be hosted on local datacenters protected from external threats, other products and services can be hosted in cloud computing environments to achieve better results.

7.0: Contributions of This Research

This research investigated the factors influencing the adoption of cloud computing in banking operations to provide an answer to the four research questions raised under Section 1 of this article. Questions were centered around environmental factors, their statistical significance, application of these factors to similar industries and comparison of contributions of this research with technology adoption with Rogers theories on diffusion of innovation. All the four research questions are answered as follows.
First, this research shows that environmental variables, such as Regulatory Burden, Competitive Landscape, Reputational Risk, and Vendor Support, do contribute to the adoption decision in banking operations. While the competitive landscape and vendor support can be seen as opportunities to support adoption of cloud computing, regulatory burden, and reputational risks are the threats impacting the adoption decision. Banks must therefore be cautious in determining which services can be deployed in cloud-based environments and which services need to be managed on the premise.

Second, the hypothesis testing conducted in the research demonstrates high statistical significance of the factors considered. All measured effects between the variables considered have t-values above 2.59, which indicate very strong support for the hypothesis.

Third, although a direct comparison between the factors influencing the adoption decision in healthcare and banking has not been considered as part of our research, literature review of the articles around cloud adoption in healthcare does indicate strong support for the factors considered in our research (Armbrust et al., 2010; Burns, 2013; Sultan, 2014; Thakur et al.)

Finally, the technology adoption and its spread among professional banking employees were tested in the questionnaire of the survey of this study and compared with Rogers theory on Diffusion of innovation (2003). The results of this study are presented along with Rogers Contributions.

A comparative analysis of contributions by Rogers and this study on technology adoption and spread among professional banking employees who are respondents of this survey					
Diffusion of innovation theory	Innovators 2.5%	Early adopters 13.5%	Early Majority 34%	Late Majority 34%	Laggards 16%
This study findings	Quick Adopters in 1 month 11%	Trend Setters adopt in 3 month 21%	Pragmatics adopt in 5 months 23%	Conservatives adopt in 7 months 39%	Sceptics with suspicion on innovation adopt in 12 months 6%
The finding of this study on technology adoption and its spread are different from Rogers findings. Every morning brings a new day. Every morning brings a new technology. This leads to shorter product life cycle. The adoption of new technology on cloud computing among professional bank employees are quicker than Rogers findings. This may probably be due to training and development and experience of the bank employees in information technology.					

7 Limitations and Scope for Future Research

The research aimed to establish a causal link between the customer adoption of cloud computing in banking operations and the environmental factors influencing the adoption decision, such as regulatory burden, competitive landscape, reputational risk, and vendor support. The cloud computing landscape is rapidly evolving and ever changing, which is bringing in new opportunities as well as increased risks. Future research can be directed toward establishing some best practices and models that can be used by banking and financial service institutions to adopt cloud-computing technologies.

8 Conclusion

Cloud computing adoption is known to provide increased benefits in most industries, due to the cost savings, scalability, elasticity of cloud deployments, as well as speed and ease of use. However, regulated industries, such as banking and healthcare, need to pay particular attention to the risks surrounding cloud-computing deployments, particularly those related to regulation and reputation. This research has uncovered the general perception of IT staff involved in the cloud computing adoption decision in relation to the environmental factors, such as regulatory burden, competitive landscape, reputational risk, and vendor support. While data-related incidents in private cloud deployments are quite rare, care should be taken by these industries so that they do not adversely compromise customer data, which may cause significant reputational damage as well as fines imposed by regulators.

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