Factors Influencing Cloud Analytics Adoption in Indian Pharmaceutical Industry

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Abstract—Pharmaceutical firms have access to tremendous amount of data which they can use in order to gain insights to augment and accelerate drug development by employing analytics tools to make informed data-based decisions. This research aims to analyze the various factors on which the adoption of cloud-based solutions for analytics in the Indian pharmaceutical industry is decided. This research will help policy makers, key personnel and decision makers in various firms understand the factors that are required to be taken into consideration for adoption of cloud analytics solution. Data collected through an online survey have been analyzed by employing PLS-SEM technique which is a combination of confirmatory factor analysis and multiple regression techniques. The study uses an integrated framework based on the Extended Theory of Perceived Behavior (TPB) and Technology Acceptance Model (TAM) for determining the significant factors affecting the adoption of cloud computing software for analytics in Indian pharmaceutical industry.

Keywords - Technology Adoption, Cloud Analytics, Theory of Planned Behaviour, Pharmaceutical Industry

I. INTRODUCTION

To remain competitive in an ever-changing business world, many firms are under increasing pressure to build and scale up their business intelligence operations rapidly and at a minimal cost. Cloud computing is transforming the way organisations provide IT services and how businesses and users engage with IT resources [1]. It represents a paradigm change by introducing flexible service models to which businesses can subscribe on a pay-as-you-go basis.

Cloud Analytics is an amalgamation of cloud computing and big data analytics. The practise of storing and processing data in the cloud in order to get useful business insights is known as cloud analytics. Cloud analytics algorithms are used to analyse big data sets in a manner similar to on-premises data analytics to find patterns, forecast outcomes, and provide other data that is helpful to business decision-makers [2].

Cloud-based big data analytics is a service that provides aspects of the big data analytics process via a public or private cloud. It employs a variety of analytical tools and approaches to assist organisations in extracting information from vast amounts of data and presenting it in a way that is easily categorised and accessible via a web browser.

Large quantities of data is available as a result of the quick development of social networking, cutting-edge mobile technologies, e-commerce websites, search engines, and other new digital technologies. [1] This gives businesses the chance to produce and collect data that are characterised by the three Vs - Volume, Variety, and Velocity. [2] Volume describes the enormous amount of data that businesses gather in order to find hidden information, patterns in the data, and to get important knowledge. [3] Variety refers to the various data types, unstructured, semi-structured, and structured data.[4] It is difficult to manage these with traditional analytical systems. Velocity, on the other hand, represents the rate of data generation and real-time data analysis. [5] The advent of the digital age has led to a rise in different types of data with every passing day. Cloud computing provides an apt platform for big data analytics.

The focus of this paper is to examine the effect of various factors influencing the adoption of cloud analytics in Indian pharmaceutical industry using a combined framework of Technology Acceptance Model (TAM) [6] and Theory of Planned Behaviour (TPB) [7] extended with Cost and Trust as additional variables.

II. LITERATURE REVIEW & RESEARCH FRAMEWORK

Various approaches have been used in the existing literature for analysing the decision of adopting cloud based services including cloud analytics. Most of the studies have discussed cost as the basis of decision for adoption of cloud services and few others studied the effect of requirements like security and availability.

Menzel et al. (2011) shows a cost-oriented decision model approach by presenting a generic multi-criteria decision-making framework. [8] It shows a method for comparing cloud infrastructure providers based on cost, benefit, opportunity, and risk evaluations.

A multi-criteria decision model is also proposed by Saripalli and Pingali (2011) where the authors present a hierarchy of relevant criteria (e.g., suitability, economic value, usability, reliability, and security) and assign weights to the criteria using a wide-band Delphi method. [9] Martens et al.(2012) present a total cost of ownership (TCO) approach for cloud computing services [10] while Johnson

and Qu (2012) propose an analytical decision model for cloud migration decisions that considers various business requirements such as security and availability. [11] Walterbusch et al. (2013) extend work presented by Martens et al (2012) by presenting a simple mathematical model and a Web-based application for evaluating cloud services from a total cost of ownership (TCO) standpoint. [12]

A study conducted in the United States by Parson (2021) examined IT specialists' decisions to implement big data analytics in SMEs using the TAM model. According to the study's findings, perceived usefulness and perceived ease of use had a substantial impact on BDA acceptance. [13]

Garrison (2018) tries to gain a better understanding of the reasons that motivate people to utilise cloud-based services despite the privacy and security risks. To explain user intents to use cloud-based services, the author created a research model that integrates the theory of planned behaviour (TPB) and constructs from past research. Their findings confirm the existence of links between predictor variables (attitude, subjective norm, perceived behavioural control, and information privacy) and outcome variables (behavioural intention). [14]

But there is a dearth of studies on adoption of cloud analytics that take into account the factors related to technology usefulness and ease of use along with behavioural aspects of the personnel involved in taking the adoption decision along with the cost factor. This paper is an attempt to fill this gap in the literature as it incorporates all these factors in an integrated multiple regression framework based on TAM and TPB extending the model with cost and trust as additional variables.

The model for this paper comprises of six independent variables namely – perceived usefulness, perceived ease of use (derived from TAM); subjective norm, perceived behavioural control (derived from TPB); and, cost and trust (derived from previous literature). The effect of these independent variables has been assessed on the dependent variable of behavioural intention to adopt cloud analytics.

Technology acceptance model [6] helps us in understanding how the user responds to a new technology which is introduced to him in terms of acceptance or rejection of the same. This model measures two variables perceived usefulness (PU) and perceived ease-of-use (PEOU). Perceived usefulness refers to the user's assessment of the technology in terms of its usefulness in accomplishing his job i.e., whether this technology is expected to help him in doing his job better than the previous system. Perceived ease of use refers to his judgement regarding how easy to use this new technology is for him.

Based on these two factors user can either accept the new technology or reject it. Therefore, the following two hypotheses are framed for the study:

H1: Perceived usefulness has a positive effect on cloud analytics adoption intention

H2: Perceived ease of use has a positive effect on cloud analytics adoption intention

Theory of Planned Behaviour [7] provides three major constructs which are Attitude towards a behaviour, Subjective Norms (SN) regarding the behaviour and Perceived Behavioural Control (PBC) in making of intentions to perform a behaviour. This paper considers attitude to be measured in a decomposed way through the TAM variables of PU and PEOU and combines them with SN and PBC proposed by Theory of Planned Behaviour.

Subjective Norm relates to an individual's belief of whether indulging in a behaviour would subject him or her to the likes or dislikes among his or her social group. [15] The intention to perform a certain behaviour would be strong if such behaviour is approved by or preferred by the social group of an individual. Contrarily, social disapproval will weaken the intention to engage in the behaviour.

The following hypothesis stems from the above discussion:

H3: Subjective norms have a positive effect on cloud analytics adoption intention

Perceived Behavioural Control refer to the circumstances where an individual has or does not have total control over the behaviour [6]. It refers to the easiness or difficulty of engaging in a behaviour considering the facilitators and inhibitors in performing the said behaviour and is influenced by an individual's cognitive capabilities, previous experiences and their expectations about ease or difficulty of engaging in the behaviour. If the individual perceives to have control over performing the behaviour, he is expected to have a higher intention to perform that behaviour.

The following hypothesis is thus framed for the study:

H4: Perceived behavioural control has a positive effect on cloud analytics adoption intention

Cost has been suggested to be a significant consideration in adoption of cloud based services including analytics [12]. For this study, cost is measured using the items for price value given by Venkatesh et al. (2012) [16] which measure if the users feel that the cloud analytics services are reasonably priced. In case the cost of these services is believed to be reasonable by the potential users, they tend to have a higher intention to adopt these services. Therefore, the following hypothesis has been tested:

H5: Cost perceived as reasonable has a positive effect on cloud analytics adoption intention

Trust on the cloud analytics provider or the vendor is an important aspect in decision to adopt the services as security of the data is a major concern.[9] Trust is comprised of the belief that the vendor will be able to fulfil the needs of the firm, will honour the commitments and will take care of the adopting firm's benefit. [17] Trust has thus been suggested to be a significant factor in influencing

adoption intentions. [18]. Therefore, the following hypothesis is framed for the study:

H6: Trust on the vendor has a positive effect on cloud analytics adoption intention

The behavioural intention to adopt cloud analytics services has been taken as the dependent variable in the model. Intention is found to be significant in leading to actual behaviour [6] and hence by measuring intentions we can get an insight regarding the potential behaviour which in this case would be the actual adoption of cloud analytics.

III. METHODOLOGY AND ANALYSIS

A. Data & Methods

Purposive sampling technique was used to gather data from an online survey of middle and top level managers of pharmaceutical firms in India using a structured questionnaire based on 5 point Likert Scale. All scale items were adapted from prior literature with perceived usefulness and ease of use items adapted from Davis (1989) [6], Subjective norm and Perceived Behavioural Control items adapted from Taylor and Todd (1995), Trust items adapted from McNight et al.(2002) [19] and Cost items adapted from Venkatesh et al. (2012) [16]. Power analysis was used to ensure adequate sample size for the study. Sample size is determined by using G*Power software which employs the formula suggested by Faul et al. (2009) [20]. At 5% significance level and 95% power, a minimum sample size of 89 is required assuming medium effect size. Actual sample size used for the study is 180 which is well above the minimum required size for adequate power. Sample characteristics are presented in Table 1.

Table I. Sample characteristics

Characteristics	Frequency	Percentage
Gender		
Male	96	53%
Female	84	47%
Age		
25 to 35	50	28%
35 to 45	84	47%
45 to 55	42	23%
55 and above	4	2%

The analysis comprised of testing the construct reliability and validity through confirmatory factor analysis followed by multiple regression analysis employing PLS-SEM using SmartPLS software to estimate the effect of the six independent variables PU, PEOU, SN, PBC, COST, and TRUST on the dependent variable of cloud analytics adoption intention (INT).

Cronbach's alpha was calculated to check for internal consistency reliability of the constructs and convergent validity was established through the calculation of Average Variance Extracted (AVE) [21]. Discriminant Validity of the various constructs in the model was established through Fornell-Larcker Criterion.[22]

Before proceeding for multiple regression analysis, the data was checked for multicollinearity and heteroscedasticity and no issues were found pertaining to these assumptions.

B. Results

Table II presents the results for internal consistency reliability given by Cronbach's alpha and convergent validity given by AVE of the constructs. Internal consistencies of all variables are considered acceptable since the Cronbach's Alpha values exceeded .70, signifying acceptable reliability. The average variance extracted (AVE) of each construct was higher than the standard 0.5, which indicated good convergent validity for the scale.[25]

Table II. Reliability and convergent validity

Construct	No. of Items	Cronbach's Alpha	AVE
Behavioural Intention	3	0.791	0.62
Cost	3	0.755	0.67
Perceived Behavioural Control	4	0.902	0.78
Perceived Ease of Use	3	0.874	0.89
Perceived Usefulness	4	0.901	0.76
Subjective Norms	2	0.796	0.64
Trust	5	0.842	0.76

Table III gives the discriminant validity results based on Fornell Larcker criterion. The square root of the average variance extracted for each of the constructs was found to be greater than the correlation between all given constructs in the model, thus establishing the discriminant validity for all the constructs.

Table III. Discriminant validity

	INT	COST	PBC	PEOU	PU	SN	TRUST
Adoption Intention	0.888						
Cost	0.732	0.817					
Perceived Behavioural Control	0.553	0.452	0.921				
Perceived Ease of Use	0.766	0.748	0.424	0.881			
Perceived Usefulness	0.707	0.659	0.484	0.758	0.941		
Subjective Norms	0.789	0.657	0.411	0.733	0.803	0.858	
Trust	0.589	0.628	0.471	0.673	0.669	0.604	0.871

Result of the multiple regression analysis are shown in Table IV. All the independent variables except subjective norms have been found to be having a significant effect on intention to adopt cloud analytics.

Table IV. Multiple Regression Results

Independent Variable	Coefficient	T Statistics	P Values
Cost	0.437	2.047	0.041
Perceived Behavioural Control	0.289	2.227	0.026
Perceived Ease of Use	0.133	2.067	0.039
Perceived Usefulness	0.298	3.207	0.000
Subjective Norms	0.098	0.735	0.462
Trust	0.143	1.876	0.068
R Square	0.651		
R Square Adjusted	0.622		
SRMR	0.064		

Trust has been found to be significant but only at 10%. Reasonable cost has the highest weight among the independent variables with the perceived usefulness and perceived behavioural control being the next most important factors relatively.

R square and Adjusted R square were found to be greater than 0.6 exhibiting satisfactory explanatory power of the model with 65% of the variation in dependent variable being accounted for by the independent variables.

IV. CONCLUSION

The purpose of this study was to better understand the factors influencing the adoption of cloud analytics in Indian pharmaceutical industry by combining the Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB) extended with Cost and Trust variables.

Cost reasonableness, Perceived usefulness and perceived behavioural control are found to be major factors in affecting intentions followed by perceived ease of use. This implies that if cloud analytics is perceived to be relatively advantageous and is available in reasonable cost, the adoption would be higher.

It is also important to note that perceived behavioural control which refers to the self- efficacy of the personnel in use of cloud analytics and the resources they have at hand for its optimal usage are also significant in forming the adoption intentions. Therefore, companies which plan to adopt cloud analytics must train their employees well on its application and usage and provide them resources to fully utilize its potential.

The perceived ease of use will also result from proper trainings and awareness programs that should be conducted for the organizations where the cloud analytics vendors want to introduce their services. The trust on vendors will be developed subsequently as the clients in pharmaceutical industry become aware of the various features and usage of the cloud analytics through such training and awareness programs.

The findings of this study are significant for the cloud analytics service providers as well as the pharmaceutical companies which plan to incorporate cloud analytics and want their employees to be ready for its adoption. Further research may be conducted in different sectors and countries for establishing the generalizability of these results.

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