

# Road to Sustainable Financial Inclusion: Diffusion of Smart Card Technology

**Abhishek Behl\***, **Archana Singh\*\*** and **Maneesha Vashishtha\*\***

E-mail: abhishekbehl27@gmail.com; archana.singh@scmspune.ac.in;  
maneesha.0602@gmail.com

## ABSTRACT

*Smart Card is a top grossing technology which is being used in Public Policy Programs by Government of India. Mahatma Gandhi National Rural Employment Scheme (MGNREGS) is one such scheme which has significantly contributed in the financial inclusion uniformly across India. Considering the adoption and penetration of Smart Cards and changing trends in Financial Inclusion, this study will contribute in understanding the barriers of adoption of Smart Cards. The research also seeks to investigate the enablers of adoption of Smart Cards in MGNREGS to enhance financial inclusion. The research uses an in depth analysis of limited literature resulting in a model based on constructs. The constructs were carefully chosen from technology acceptance model (TAM) and innovation resistance theory. The constructs were then stitched in a model using Structured Equation Modeling (SEM). The research found social influence, perceived ease of use and perceived usefulness as some of the significant factors for*

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\* Symbiosis Institute of Research and Innovation, Symbiosis International University, Pune

\*\* Symbiosis Centre for Management Studies, Symbiosis International University, Pune

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*readiness of adoption of Smart cards. On the contrary facilitating conditions was one of the non-significant factors found out from the study. Trust and credibility risk were also considered in the model and strangely the results pointed out that privacy and security risks were inversely proportional to behavioral intentions. Thus inclusion of these factors in the model was significantly important and added a new dimension to the existing literature. The results covering various vivid dimensions will help the public policy makers and banks to make the exercise of financial inclusion much more efficient.*

**Keywords:** Behavioral Intention, Financial Inclusion, MGNREGS, Smart Cards, Technology Acceptance

## Introduction

The usage of smart cards has been witnessing a paradigm shift in the past decade and its application has also been diversified. The usage of Smart cards has not only transformed the lifestyle of the customers but has also changed the dynamics of liquid cash in the market. The roots of Smart Cards have also started penetrating into rural regions using public policy framework (Das, 2013). The growth of public policy schemes in India have majorly contributed to financial inclusion by linking the rural masses with the mainstream financial supply chain. The role of smart card has been phenomenal in this process of inclusion. The diffusion of Smart Cards has been has not only used banking as a medium but also other areas like agriculture and livestock. The smart cards have evolved from contact cards to contactless cards depending on its application (Das, 2013; Mishra et al., 2014). The usage and diffusion of Smart Cards has been limited in rural areas. The world has gradually started witnessing growth in the customer base of Smart Cards with Kenya and Philippines being some of the pioneer countries in this change. In the Indian setup, where more than 70% population lives in rural areas, Smart cards can be handy in solving the problem of financial inclusion effectively. The present study aims at developing a conceptual model of factors responsible for behavioral intention of usage of Smart Cards for financial inclusion in India.

The paper proposes a reliable and valid construct “Readiness to Adopt Technology” (TAR) built upon 4 basic pillars of Perceived Ease of Use

(PEOU), Perceived Usefulness (PU), Facilitating Conditions (FC) and Societal Influence (SI). The paper also focuses on finding out Degree of Diffusion as a factor of Perceived Risk and therefore building a model which encompasses TAR as a construct in the behavioral intention of usage of Smart Cards for financial inclusion in rural areas. The model can be further expanded to different geographical areas and for different technologies in order to generalize the results at a later point.

### **Literature Review**

The usage of Smart Card in India has been growing at a rapid pace. It is maximum in the financial industry with banks being the biggest stakeholders of the same. The outreach of banks into rural frontiers has been increasing using public policy programs. Mahatma Gandhi National Rural Employment Scheme (MGNREGS) is one such scheme which has been one of the biggest public policy programs to cater the problem of financial inclusion in rural India. The scheme guarantees a 100 day job guarantee and in return of the work pays the workers via banks or post offices (Jain and Jain, 2013). The diffusion of the scheme has been in all the states in India and therefore it forms one of the only schemes launched by Government of India to eradicate the problem of unemployment and including the rural masses to financial supply chain simultaneously (Murthy et al., 2013). The scheme has been using different technology innovations to distribute the wages, the most of it being a Smart Card. A Smart Card in MGNREGS is an identity card which contains the basic information of the person along with the details of his/her job profile. The same card can be used to deposit or withdraw money from the banks (Singh and Gupta, 2013). MGNREGS therefore, has launched an all-in –one card which not only serves the purpose of proof of identity of a person but also used for financial transactions.

The usage of Smart Cards has been phenomenal in countries like Kenya and Philippines which has helped their economy to grow and overall increased financial inclusion. Considering the increase in number of bank accounts in rural India due to MGNREGS, Smart Card seems to a viable option to financially include a large mass of rural people. The transaction can be made using a finger print impression or a retina scan or both in rural areas as they face problems in remembering the security

codes. The transactions can be made at banks, Point of Sale, Post Offices, and Business Correspondents etc. Further researches have shown that hardly 10% of the cards are used frequently by the rural people (Singh and Gupta, 2013). The Smart Card technology unlike the mobile banking does not require complex methods to be memorized to do a transaction. The all purpose card can not only help the customer to use it as a proof of identity, but also to transact with banks of post offices (Jain and Jain, 2013). The advantages offered by Smart card technology are unmatched, yet there is a dip in growth rate of Smart card users in the country under MGNREGS. Therefore, there is a need to study the barriers and enablers of adoption and diffusion of Smart Card technology in Rural India. This study aims to dissect the minds of rural people to study the adoption rate of Smart Cards under MGNREGS. The study therefore reviews the existing models encompassing Behavioral Intention (BI) of customers towards technology adoption. It also aims to compare the existing models and derive useful and relevant constructs for the present study.

### *Technology Acceptance*

The financial industry in its recent years has seen continuous infusion of innovation and technology. The adoption of these innovative technologies has been variable across various parts of the world due to difference in the set of technology like internet banking, mobile banking, e-commerce, etc. (Barczak et al., 1997; Black et al., 2001; Howcroft et al., 2002; Liao et al., 1999; Tan and Teo, 2000). There have been multiple models which measure the acceptance rate of any technology, some of which are Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), etc. This research uses four of their common constructs which are relevant and justifiable in this research. A brief overview of the same is as follows:

### *Perceived Usefulness and Perceived Ease of Use*

These two constructs are the building blocks of any technology based model as they intend to study the degree of ease and degree of usefulness of the technology. The constructs seem much more important when applied to a newly launched technology in an unexplored space. PU is defined as the degree of belief of an individual in enhancing the performance

of work using the new system (Davis, 1989). PEOU on the other hand refers to the degree of belief of an individual that there will be no efforts infused while using the new set of technology (Davis, 1989).

Studies have proved that both PU and PEOU influences attitude of an individual towards acceptance of any innovation in technology. The relation between the two constructs and behavioral intention has also been studied with reference to financial supply chain. While a handful of studies concentrate on the adoption of new technology in the rural geography especially in the financial supply chain. The studies have figured out that PU and PEOU have been positively correlated with the behavioral intention of the end user (Agarwal and Prasad, 1998; Davis et al., 1989; Davis and Venkatesh, 1996; Featherman et al., 2010; Hess et al., 2014). This study therefore is keen in proposing the following relations.

- PU will have positive significant effect on behavioral intention towards Smart Cards.
- PEOU will have significant effect on behavioral intention towards Smart Cards.

### *Societal Influence*

Societal Influence as defined by Venkatesh et al. (2012), is a degree of belief an individual perceives about his/her joining the usage taskforce of the new technological product. The germination of SI was from TAR model which indicates a direct relation between SI and BI. The linkage of SI and BI broadly was also studied in image in innovation diffusion theory (IDT). Although different theories propose different representation of the same relationship, the degree of association between the two remains more or less the same. Studies have also indicated the peer pressure and society plays an important role in influencing a person to take a decision. The relevance of the construct increases many folds in a rural set up where the society or people are mostly illiterate or functionally literate.

The construct SI has therefore been a part of many studies with technology diffusion in financial studies being the central idea theme (Kleijnen et al., 2004; Nysveen, 2005; Venkatesh et al., 2012, Baker et al., 2014).

The usage of Smart Cards falls under the same ambit of technology adoption and therefore normative pressure or societal influence seems to

a key driver for higher adoption rate. This study deduces the following relationship:

- Societal influence will have a positive significant effect on behavioral intention to use the Smart Card.

### Facilitating Conditions

The success of adoption of any technology is dependent on the facilitating conditions. It can be defined as the degree of belief of an individual regarding the existence of technical and organizational infrastructure to promote, support and enhance the usage of a system (Venkatesh et al., 2012). Facilitating conditions is an externally driven construct and it is similar to the incubator which is used to hatch an egg. Therefore, facilitating conditions performs the functions of an incubator. Also, the presence of apt conditions helps in greater degree of diffusion of any technology. The conditions may be different dependent on demographic factors and the technology incorporated. The construct is important as the stakeholders providing services are different entities. It is therefore important to understand the role of synchronized supply chain to provide Smart Cards in the rural areas. Therefore it can be proposed that:

- FC will have significantly positive effect on behavioral intention of Smart Cards.

In the Indian context, studies related to Smart Card diffusion are limited. There are numerous studies which have used many of such constructs to examine the rate of adoption or diffusion of any particular technology, but very few attempts have been made to study this in the Indian context. The newly derived construct TAR forms the next level of the building blocks standing on the above mentioned four pillars. The present research proposes establishment of discriminant and convergent validity and reliability keeping in mind TAR as a key construct with reference to Smart Card diffusion in rural India. Therefore, the study proposes to hypothesize:

H1: TAR construct is a combination of PU, PEOU, SI,

H1a: Perceived Usefulness is a sub-construct of TAR.

H1b: Perceived Ease of use is a sub-construct of TAR.

H1c: Societal Influence is a sub-construct of TAR.

H1d: Facilitating Conditions is a sub-construct of TAR.

### *Perceived Credibility Risk*

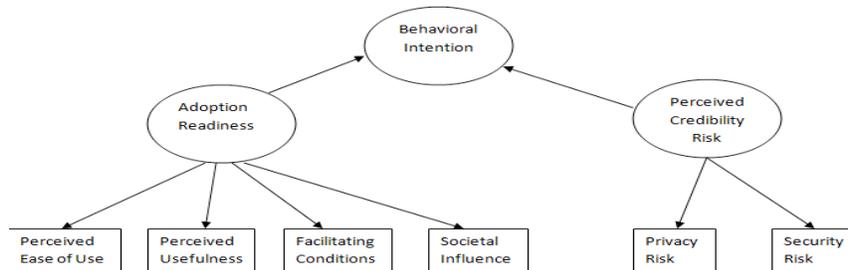
Smart Card is used for financial transactions in MGNREGS as well. The involvement of finance and technology in a rural set up where the audience has limited experience of both financial and technological systems involves a sense of risk in the minds of people. Perceived risk can be defined as the degree of belief of an individual about a system which is free from privacy threats and security threats (Wang et al., 2003). This dimension has been well researched on various platforms where financial and technological sides are simultaneously considered. As the definition quotes, the two dimension, i.e. privacy threats and security threats (Hernandez et al., 2008; Polatoglu and Ekin, 2001; Thakur and Srivastava, 2013) are also carefully studied. Most of the studies have indicated that they are also key determinants for studying the behavioral intention of an end user. Perceived privacy risk in the context of present study is the fear of the rural end users that their personal information about their finances will be shared. The risk includes the fear of sharing the personal information of the customer. The perceived privacy risk affects the customers trust on the technological way of handling their cash and thus prevents them to use technology or at times prevents them to keep any cash in the financial system. Therefore Perceived privacy risk has an inverse relationship with the behavioral intention of people. On the other hand, perceived security risk deals with the risk of losing money while a transaction is made. Studies have indicated that the risk is higher for technologies which involve internet and for customers who are relatively challenged in terms of their knowledge about technology and have a relatively less educational background (Chen, 2013). Therefore, the research proposes an inverse relationship of perceived security risk and behavioral intention of usage of Smart cards in rural India. The study proposes to test the following hypothesis for inclusion of this section.

H2: The construct Perceived Risk is a combination of Perceived Privacy Risk and Perceived Security Risk.

### *Behavioral Intention*

Behavioral Intention is a terminology derived from TAM and its extended versions. It is an amalgamation of two separate terms. Intention as defined in TAR or TPB is “the degree of efforts by oneself to achieve any goal” while the amalgamated term can be restructured and redefined as “the degree of behavior or nature of oneself to enable to achieve any target goal” (Ajzen, 1991). It is also defined as “the subjective probability of performance of any particular behavior in any particular situation” (Fishbein et al., 1975).

The above mentioned constructs will be used in this present study. The constructs are used to develop a conceptual model which will help us in testing the basic hypothesis. The conceptual model presented in Figure 1 reflects a blueprint of the interdependence of the constructs of successful diffusion of Smart Cards in rural India.



**Figure 1:** Conceptual Model with Hypothesized Relationship

TAM (Davis, 1989) and its subsequent avatars have proposed that dimensions of technology acceptance significantly impact BI to use a new technology. Researchers in different parts of the world have dimension of technology acceptance in internet banking, e-commerce and similar technologies positively impacting usage intention (Barczak et al., 1997; Sathye, 1999; Liao et al., 1999; Tan and Teo, 2000; Black et al., 2001; Howcroft et al., 2002; Flavián and Guinalú, 2006).

Another aspect associated with the online environment which has been drawing a lot of importance in technologies involving financial transactions is credibility risk perception of users. PC risk has been found to be negatively impacting usage intention of online banking (Pikkarainen et al., 2004; Howcroft et al., 2002; Polatoglu and Ekin, 2001).

Researchers have found credibility risk to be significant obstacle to the adoption of online banking in Australia (Sathye, 1999) and in Singapore (Tan and Teo, 2000). Mobile commerce is a technological innovation with similar characteristics. Based on review of existing literature, we hypothesize:

H3. TAR positively influences BI towards usage of mobile commerce.

H4. PC risk negatively influences BI towards usage of mobile commerce

### **Research Methodology**

The present study uses a structured questionnaire as a tool for data collection. As the present study uses constructs which are derived from earlier models or theories, special considerations were kept in mind regarding the reliability and validity of the tool. Face validity and Content validity was checked for each of the item related to every construct (Fornell and Larcker, 1981). The questionnaire comprised of two sections. The first section enquired about the demographic data of the respondents. The second section was used to record their awareness and their behavior and intentions of usage of Smart Cards. The answering pattern in the second section was 7 point likert scales 1-7 with 1 being strongly disagree to 7 being strongly agree.

The final version of the instrument was converted into local language as the target audience might not be aware of English/Hindi. The instrument was also supported by a Manual which was used to assign codes to answers obtained from the rural respondents. Ajmer, Rajasthan was selected to collect data for this study as it is one of the best performing districts in Rajasthan under MGNREGS (Bhargava, 2013). The rationale of choosing Rajasthan is because of the initial launch of Smart cards in the state for pilot testing and Ajmer is one of the districts which have successful deployment of Smart Card technology. A total of 400 respondents were approached for data collection out of which only 292 complete questionnaire were filled. The questionnaire was self administered and special care was taken to collect data from both users and potential users of Smart cards in the district. Table I reflects a quick overview of the respondents.

**Table 1: Demographic Profile of Respondents**

<i>Demographic Factor</i>	<i>Option</i>	<i>% of Respondents</i>
Gender	Male	74
	Female	26
Educational Background	Literate	15
	Functionally Literate	85
Age	20-30	37
	30-40	50
	More than 40	13
Usage patterns	Users	57
	Potential Users	43
Awareness	Yes	91
	No	9

### Data Analysis

The collected data was cleaned and missing values were carefully treated using SPSS. The analysis of the data was done using Structured Equation Modeling (SEM). The advantage of using SEM is to estimate the interrelation between multiple dependent variables (Hair et al., 2006). The present study also incorporated Confirmatory Factor Analysis (CFA) to confirm whether the measurement model is fit or not. The purpose of performing first and second order CFA was also to test the reliability and validity of the model. CFA was performed for both TAR and PC Risk due to the presence of multi item constructs while BI was neglected because of its nature being uni-dimensional. Chronbach alpha was higher than 0.7 which confirmed the reliability of the instrument, while factor loading for the three factors leading to BI was also greater than 0.7.

The result derived from performing CFA at level I led to omitting of three items (SI4, EE1, PE1). Similarly, after performing second order CFA, facilitating conditions as a construct was also eliminated due to a significantly high factor cross loading with the construct PC Risk (Anderson and Gerbing, 1988). The results derived after performing both the levels of CFA and eliminating the constructs or items wherever necessary results in the following results which are reported in Table 2 to 5. The tables also reveal that the measurement model has passed the degree

of fitness. The value of the critical ratio for each and every item with standardized loadings was found to be higher than 0.60 with significance level controlled at 0.001. On a parallel track, it was discovered that the average item to factor loadings exceeds the basic criterion of 0.7 which confirms the convergent validity of the constructs. Convergent validity was also confirmed by using variance extracted estimates for each of the factors and the estimates were found to be greater than 0.5 (Fornell and Larcker, 1981). The results also indicate a significant correlation thereby confirming the presence of nomological validity for the constructs. The results also indicate that the variance developed between the pairs of the set of constructs is lesser than corresponding value of variance extracted estimates which confirmed the presence of discriminant validity in the model. The results in total significantly indicate that the model developed was reliable and valid.

**Table 2: Validation of Measurements – Reliability and Convergent Validity (TAR)**

Variable	Indicator	Factor loading	CR value	LA	CA	Composite reliability	AVE
Perceived usefulness	PE4	0.77		0.80	0.87	0.77	0.63
	PE3	0.80	29.93				
	PE2	0.82	20.75				
Perceived ease of use	EE4	0.78		0.81	0.85	0.79	0.66
	EE3	0.80	23.24				
	EE2	0.86	19.13				
Social influence	SI3	0.76		0.81	0.84	0.77	0.59
	SI2	0.89	23.58				
	SI1	0.80	22.15				

Notes: Significant at: \* $p < 0.05$ , \*\* $p < 0.01$ ; \*\*\* $P < 0.001$ ; LA – loadings average; CA – Cronbach's  $\alpha$ ; CR – critical ratio; AVE – average variance extracted; CMIN (df = 50) = 167; NFI = 0.98; CFI = 0.98; GFI = 0.97; RMSEA = 0.055

**Table 3: Validation of Measurements – Reliability and Convergent Validity (PC Risk)**

Variable	Indicator	Factor loading	CR value	LA	CA	Composite reliability	AVE
Security risk	SR4	0.779		0.75	0.831	0.74	0.56
	SR3	0.837	29.93				
	SR2	0.613	20.75				
	SR1	0.754					
Privacy risk	PR4	0.644	23.24	0.72	0.810	0.70	0.53
	PR3	0.813	19.13				
	PR2	0.802					
	PR1	0.621	23.58				

Notes: Significant at: \* $p < 0.05$ , \*\* $p < 0.01$ ; \*\*\* $P < 0.001$ ; LA – loadings average; CA – Cronbach's  $\alpha$ ; CR – critical ratio; AVE – average variance extracted; CMIN (df = 13) = 12.7; NFI = 0.995; CFI = 1; GFI = 0.996; RMSEA = 0.0

**Table 4:** Validation of the Measurement Model – Discriminant and Nomological Validity (TAR)

	1	2	3
1. Perceived usefulness	<i>0.63</i>	0.76	0.67
2. Perceived ease of use	0.58	<i>0.66</i>	0.72
3. Social influence	0.52	0.45	<i>0.59</i>

Notes: Significant at:  $**P < 0.001$ ; italic figures in diagonal represent the average variance extracted; above the diagonal interconstruct correlations are provided and below the diagonal shared variance (squared interconstruct correlations) are provided

**Table 5:** Validation of the Measurement Model – Discriminant and Nomological Validity (PC Risk)

	1	2
1. Security risk	<i>0.56</i>	0.73
2. Privacy risk	0.54	<i>0.53</i>

Notes: Significant at:  $**P < 0.001$ ; italic figures in diagonal represent the average variance extracted; above the diagonal interconstruct correlations are provided and below the diagonal shared variance (squared interconstruct correlations) are provided

## Hypothesis Testing

The remaining items after Confirmatory Factor Analysis were used to test the empirical model developed earlier. The empirical estimates can therefore be studied from Figure 2 and Table 6. The results from table 6 indicate that the data supports the conceptual model. The hypothesis can be therefore tested using the data from Figure 1. TAR for behavioral intention of usage of Smart Cards can be explained and derived from the four constructs, PEOU, PU, FC and SI. The path analyses showcase the results with respect to the association of each of the construct with TAR. The results indicate that facilitating conditions were not found to be a contributor of TAR while the remaining three elements, PU ( $\beta = 0.98$ ), PEOU ( $\beta = 0.44$ ) and SI ( $\beta = 0.607$ ) contributed significantly. These results helped in testifying the H1.

The results from Figure 2 also indicate that TAR positively influences Behavioral Intention of Smart Card Usage ( $\beta = 0.735$ ) which supports the H3 as well. A similar explanation can be interpreted from the figure about the classification of risks. The figure also reflects that SR ( $\beta = 1.118$ ) and PR ( $\beta = 0.512$ ) significantly support and contribute in predicting PC. Lastly the fourth hypothesis H4 which was trying to relate a significant

impact of PC risk on BI was also tested using the model. Results from the figure indicate that the higher the PC risk, the lower is the Behavioral Intention in the adoption of Smart Card in Rural India ( $\beta = 20.21$ ).

Table 6: Hypothesis Testing

Hypothesis	Hypothesized path	Standardized estimate	SE	CR
H1	PEOU $\leftarrow$ TAR	0.98	0.111	10.935**
	PU $\leftarrow$ TAR	0.844	0.085	12.177**
	SI $\leftarrow$ TAR	0.607	0.084	8.118**
H2	PR $\leftarrow$ PC	0.512	0.15	4.838**
	SR $\leftarrow$ PC	1.188	0.247	5.346**
	BI $\leftarrow$ TAR	0.735	0.23	14.058**
H4	BI $\leftarrow$ PC	-0.21	0.241	-3.838**

Notes: Significant at: \* $p < 0.05$ , \*\* $p < 0.001$ ; SE – standard error; CR – critical ratio; CMIN (df) = 370 (113); NFI = 0.869; CFI = 0.904; GFI = 0.993; RMSEA = 0.07

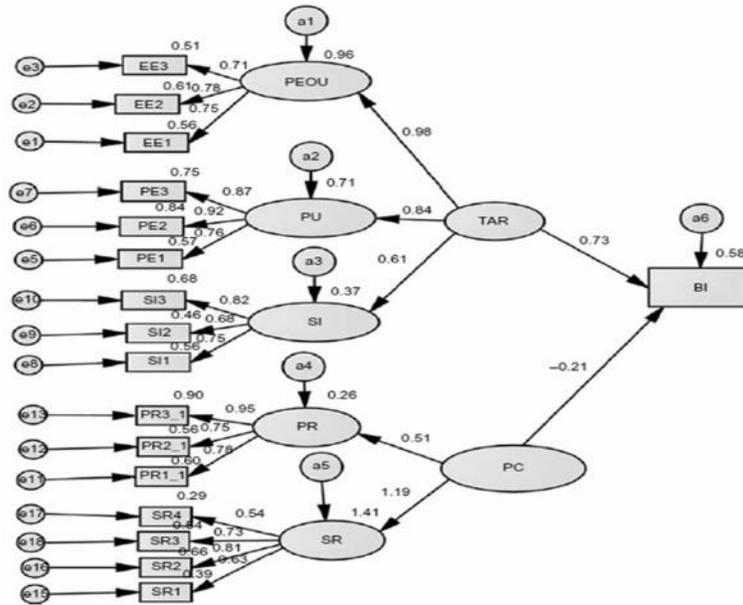


Figure 2: Measurement and Structural Model

## Results and Discussion

The results indicate that the perception about risk by the customer, especially in the rural set up, forms a key factor in predicting the usage of Smart card adoption. The research therefore proposes a model which customizes the PC risk such that the customer can use Smart Cards and other such related technologies without any hassles. The tendency of

usage of Smart Card in a rural set up depends a lot on handling the risk portfolio which is evident from the results. The results found out in this study are in sync with the earlier found results (Luarn and Lin, 2005; Wang et al., 2003). The results of the study indicate a significant role of PR and security in the public perception towards the credibility of Smart Cards and the transactions made using it. The policy makers thus need to focus on the risk aversion strategies to eradicate this problem.

A strange yet important finding which contradicts with the earlier studies is the irrelevant role of facilitating conditions towards the intentions of individuals (Bhattacharjee, 2000; Taylor and Todd, 1995). This may be due to easy access to Smart Cards and remotely present Business facilitators present in the villages. Apart from this, constructs like Societal Influence have significant impact as indicated in previous studies. It was evident from the results that, the rural people tend to get highly influenced with the peers using and experiencing Smart Cards. On the same lines, research also points that the usage of the technology will increase if an individual perceives that the technology is useful and easy to operate. Thus, it is important to make the individuals believe about the uses and ease of usage of Smart Cards.

The results of the study contribute equally towards academia and industry. The research finding not only add to the existing literature related to technology diffusion but also gives a brand new dimension to study the diffusion of Smart Cards in a rural setup especially in a developing country like India. This would also help the policy makers of MGNREGS to re strategize the diffusion plans of Smart Cards in other areas. The results showcased a unique finding in this set up which is alarming for MGNREGS as spending only on infrastructure and distribution of Smart Cards alone will not serve the purpose. The study also contributed in exploring the dimensions of behavioral sciences towards technology which would be useful in understanding the perception and nature of individuals in rural areas.

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