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An Investigation into the Prospect of 3G Adoption in Kolkata: A Structural Equation Modeling Approach

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An Investigation into the Prospect of 3G Adoption in Kolkata: A Structural Equation Modeling Approach

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Debabrata Datta***

Abstract

The paper investigates the prospect of 3G rollout in India with the help of an empirical analysis of a survey on a random sample of 400 mobile phone customers in Kolkata. The study applies structural equation modeling and explores the adoption intention of this new facility among the respondents. It is found out that presence of low cost alternatives plays a significant hurdle for success of 3G services. This research reveals that perceived expense, an established inhibitor of technology adoption has no significant influence on adoption behavior here. The study further shows that the mobility factor, considered to be a prime motivator of 3G use is not found to be statistically significant.

JEL Classification: D12, L96.

Keywords: Presence of alternatives; adoption intention; purchase intention; SEM

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An Investigation into the Prospect of 3G Adoption in Kolkata: A Structural Equation Modeling Approach

1. Introduction

Mobile technology has evolved from first generation (1G) analog (voice-only) cellular telephony of the 1980s to second generation (2G) mobile standard based on digital technology, where consumers avail the facility of text messaging as well. However, the advent of 3G technology implies the replacement of circuit switching standards by packet switching standard and increase in quantum of data transmission. In addition to verbal communication it includes data services and access to television/video, thus offering a triple play service. Possibility of high speed internet service and video chatting are the major features of 3G. Notwithstanding the advanced features of this new technology, mass adoption may not be observed due to compatibility problem and absence of "killer application"[1] like short messaging service in case of 2G. (Funk 2007)

Mass acceptance of an emerging technology may face several problems. Affinity towards a new technology can decline due to difficulty in adopting it. For example, in order to enjoy the 3G services, the consumers have to invest in a costly 3G handset and this may be a barrier to the adoption rate. Adoption of 3G technology may however be positively impacted by prestige associated with it. The status associated with adopting the new technology and the accompanying attractive handset would draw consumers who are less sensitive to price and more sensitive to conspicuous consumption. For the corporate professionals on the other hand need satisfying capacity of the technology may be the persuasive factor.

India with a population of 1210.2 million (Census 2011 provisional) people has a large market for the mobile service providers. The Indian economy has been experiencing high growth rate over the last ten years but the income of the urban India has been rising at a faster rate. The electronic media has a huge effect on preferences for a new product in the telecom market. Worldwide, the telecom services have been switching over from 2G to 3G platforms. In 2010, 143 countries were offering 3G services commercially, compared to 95 in 2007.

Despite this, there is a skepticism regarding adoption of 3G technology given the huge sum of money spent by companies to buy 3G spectrum in India. Companies in a bid to outbid each other spent huge amount of money to buy bandwidth. It seems difficult to visualize that in near future they would be able to breakeven without a clear understanding about the pace of adoption of new technology. Hence there is a need for studying the possibility of 3G adoption in Indian economy from the demand perspective and this is the motivation of the paper. While doing this there is a need for menu planning

[1] *The Economist*, 26 August 2000, p.65.

that will lead to price discrimination and capture each individual consumer's perception we have to use tools borrowed from psychological analysis.

In what follows, we address the issue of 3G technology adoption by taking into account different factors and try to gauge the pent up demand for this particular technology and service. The first part of the paper is the literature review on the variants of technology acceptance model. Thereafter we present the proposed theoretical model which is an extension of the basic TAM model. The model is then estimated using structural equation modelling (SEM) the details of which are mentioned in Appendix B. Data for our study have been obtained through a primary survey elaborated in section 4 of this paper. The questionnaire used for the survey is provided in Appendix A. The survey is conducted in the city of Kolkata. Comment on generalisation of the results and their implications are discussed in the last two sections.

2. Literature review

Several theories and models have tried to explain or predict a person's technology acceptance. Notable among them are *the Theory of Planned Behavior* (TPB, Ajzen, 1985), *the Technology Acceptance Model* (TAM, Davis, 1989), and the *Unified Theory of Acceptance and Use of Technology* (UTAUT), (Venkatesh et al., 2003). Among them, the TPB and the TAM are generic and have been used to study various technology acceptance phenomena that differ in terms of technology, target users, and context.

According to the TPB, an individual's acceptance of a technology can be explained by her intention, which is jointly determined by attitude, subjective norms, and perceived behavioral control. Attitude refers to a person's positive or negative evaluative affect about performing a behavior (Ajzen, 1985); subjective norms denote the person's perception of others' opinions about whether she should perform the focal behavior (Ajzen, 1985). Perceived behavioral control is the person's perception of the presence or absence of required resources for performing a behavior (Ajzen, 1985). This theory has been tested in a wide variety of settings; e.g., health care (Conner and Sparks, 1996), consumer decision making (Fortin, 2000), and technology acceptance/adoption (e.g., Chau and Hu, 2001). The TPB is, in principle; open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behavior after current variables have been taken into account. We have introduced 'presence of alternatives' as an economic factor in our model.

The TAM is developed specifically for explaining and predicting an individual's acceptance of IT (Davis, 1989;). This model argues that perceived usefulness and perceived ease of use are critical determinants of an individual's technology acceptance (Davis, 1989; Taylor and Todd,1995; Chau and Hu, 2001). Perceived usefulness refers to the degree to which a person believes that using the focal technology would enhance his or her performance, whereas perceived ease of use denotes the extent to which a person believes his or her use of the technology would be free of effort (Davis, 1989). The TAM has been empirically examined across a variety of technology acceptance scenarios that include email (e.g., Gefen and Straub, 1997), and enterprise systems

(Venkatesh et al., 2003). This model has shown high predictive power of technology adoption across different technologies, user groups, and organizational contexts (Davis et al., 1989; Venkatesh and Davis, 2000).

According to Chau and Hu (2002), in order to examine technology acceptance by working individuals, it is essential to include factors that pertain to the individual (e.g., attitude, perceived behavioral control), the technology (e.g., perceived usefulness, perceived ease of use). Their results show that the TAM applies for both the U.S. and Switzerland, but not for Japan, this finding suggesting that this model might not predict technology acceptance equally well across different socio cultural contexts.

Attitudes towards usage and intentions to use may be ill formed or lacking in conviction or else may occur only after preliminary strivings to learn to use the technology. Thus, actual usage may not be a direct or immediate consequence of such attitudes and intentions (Bagozzi et al., 1992).

Several researchers have replicated Davis's original study (Davis 1989) to provide empirical evidence on the relationships that exist between usefulness, ease of use and system use (Adams, Nelson & Todd 1992; Davis 1989; Hendrickson, Massey & Cronan 1993; Segars & Grover 1993; Subramanian 1994; Szajna 1994). Venkatesh and Davis extended the original TAM model to explain perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes.

End-user services in third generation mobile telephony (3G) networks are being developed using more complex service models than those of previous wireless networks. Services like channel integrating, network mediating and mobile commerce services may serve prevalent latent demand.

The above mentioned supply side factors can be viewed as necessary but not sufficient condition for adoption of the new technology. The issue of widespread diffusion of new technology depends on demand for such services by ultimate customers.

However, the overall performance of the third generation market was disappointing: services started late and there was generally much less demand for them than originally expected. Hence the speed of diffusion of third generation subscribers was much slower than earlier generations (Gruber, 2007).

The mass adoption will be possible if the consumers weigh the incremental benefits of adopting new technology against the cost of change in the environment of uncertainty and limited information. While setting the price of the service and promoting the product, suppliers must be aware of latent demand determining factors. In this study we are trying to identify the drivers and inhibitors of preference for 3G adoption by masses.

3. Model and constructs

We have followed the Technology Acceptance Model by Davis, 1989; Chin, 2000. Figure 1 provides our research model and hypotheses. Our objective is to examine key factors

that influence 3G technology use, specifically 3G technology through mobile phone usage. The model features factors which have been found to have strong influence on technology adoption.

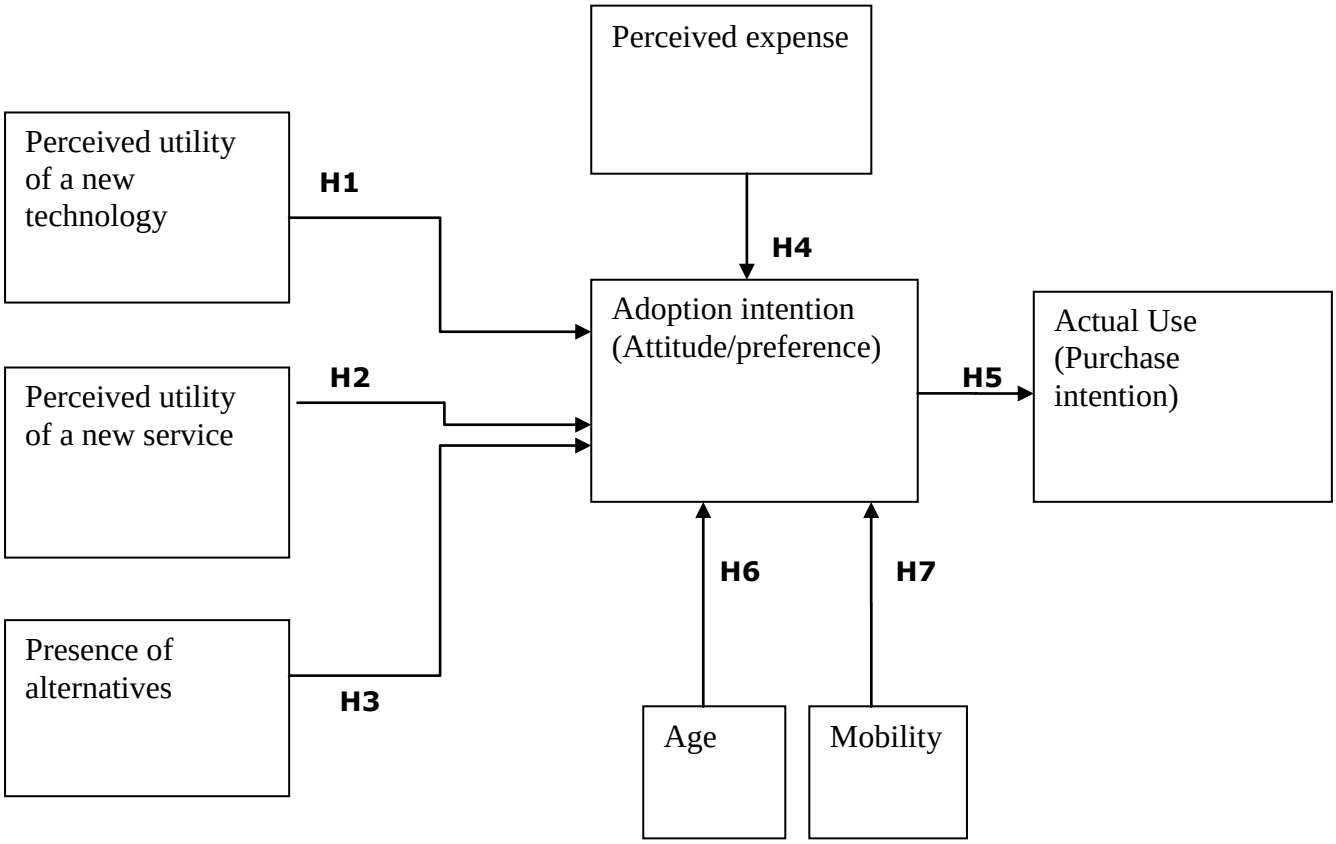

Fig No: 1 Research Model and hypothesis

Explanation for different constructs used in the model

3 a. Perceived utility of a new technology

In this study among the three earlier described models, we have adopted the TAM as this theory is widely used and comprehensive in nature. The model of innovation (Rogers, 1995) indicates that understanding the attributes of an innovation is of particular importance, as individual beliefs related to these attributes are determining factors of future adoption and actual use. While gauging the perceptions of consumer acceptance the field of marketing research have used the concept of perceived utility. The study of mobile marketing by Bauer, Barnes, Reichardt, and Neumann (2005) shows that the higher perceived utility of mobile marketing is helpful for making positive attitude towards it. This same observation is obtained in a study by Merisavo et al. (2007) about mobile advertising. Based on this the following hypothesis is proposed.

H1: A consumer's perceived utility of 3G technology will have a positive influence on her adoption intention of the technology.

3 b. Perceived utility of a new service

Several studies have been dedicated to identify the trajectory from technology adoption to actual use. Geoffrey Moore (1999), has explained the lifecycle of a new product by using the classic, Technology Adoption Lifecycle developed by Roger (1995). The study of Moore and McKenna (1999) has shown that though a particular category of the consumers known as innovators will tend to respond to the intrinsic value of a new technology, the early adopters and early majority are driven by the practicality and extrinsic benefits accrued by the service. In this regard while discussing the mass adoption researchers generally pay attention to the service adoption. The following hypothesis is therefore, proposed.

H2: A consumer's perceived utility of 3G service will have a positive influence on her adoption intention of the technology.

3 c. Presence of alternatives

In study of economic literature presence of alternatives play a crucial role. These alternatives are probable substitutes of the product or the service. Robert F Allen and Jianshou Shen (1999), have demonstrated in their study that presence of alternatives in higher education system increases the net demand elasticity of the education service provided by the public sector. We can say that the demand of the service provided by the telecom operators will be more responsive if substitutes like 2G or internet connection through computers are available.

H3: A consumer's possible access to substitutes will have negative impact on her adoption intention of the technology.

3 d. Perceived expense

Consumer adoption can be hindered by perceived expense. While adopting and then actually using a new technology a consumer will conduct a cost-benefit analysis. The actual purchase is related to the cost of purchase. The perceived expense is anticipated to have negative effect on adoption intention. The literature of perceived expense shows that it is related to the quality perception of the service or the product. In case of 3G technology adoption, the cost for the consumer is sum of the service charge and mobile handset charge taken together. The hypothesis to be tested is as follows:

H4: A consumer's perceived expense on a 3G technology adoption as a whole will have a negative influence on her intention to adopt and actual use.

The adoption intention will ultimately be converted to the actual use. Studies in the field of ICT adoption primarily have used TRA or TAM (e.g.Lu,Liu,Yu & Wang 2010,Venkatesh,2007;Bruner II & Kumar,2005) and have discussed adoption behavior or the attitude or preference for a particular technology adoption. There is high correlation established between adoption intention and actual use. Agnew (1998) has reported the more pertinent relationship between beliefs and the direct measure of attitude. Individually generated beliefs are related to overall attitudes. We can argue that from the attitude of use, intention to use will be generated and that will in turn result in actual purchase. Thus the hypothesis formulated is as follows:

H5: A consumer's intention to adopt a new technology will have a positive impact on her/his actual use.

According to technology adoption theory and research on technology use, age is normally used to profile individuals (Appelbaum, 1990; Brosnan,1999; Harris & Davison, 1999). Older people are often categorized as being more resistant to using new technology. Huff and McNaughton (1991) and Fichman (1993) contend that heavy users can be distinguished from light users according to their age. However, Rogers (1995) finds earlier adopters are not different from later adopters in terms of age. We propose the hypothesis as follows:

H6: Age will influence a consumer's adoption behavior.

The main thrust of the 3G technology is 'always on' or 'on-the move' usage of internet. So the mobility factor of the consumers should be important in the estimation of the demand of the consumer. In our study we introduce this mobility factor in technology acceptance model. The reason of the adoption and actual use of the technology will depend on the consumers' need to use the technology while moving. The hypothesis proposed is as follows:

H7: Mobility will influence the adoption behavior positively.

The proposed model to test the above hypothesises is as follows:

$$Di = Oi[\alpha+\beta1(perutilnt)+\beta2(perutnser)+\beta3(prealt)+\beta4(perexp)+\beta5(age)+\beta6\ (mobility)],$$

Apart from age and mobility, all the other constructs are obtained from responses to questions categorised by Likert scale. The extent of measurement error may be very high for such factors. Hence SEM is used, where in the first stage the relationship between indicators and latent factors are established through factor analysis. Given these relationships the coefficients are then obtained by maximum likelihood estimation to minimize a fit function which is the difference between observed and model implied variance and covariance matrices.

In the above model the intercept term α controls for the external factors like the effect of advertisement, societal influence and peer group pressure on adoption intension. The coefficients β1, β2, β3, β4, estimate the impacts of the latent constructs-perutilnt (perceived utility of new technology), perutnser (perceived use of new service), prealt

(presence of alternatives), perexp (perceived expense). Appendix B provides the details about the estimation procedure.

4. Data

The survey was conducted from June 2010 to February 2011 at Kolkata, India.

Table 1: Demographic profile of the respondents.

Measure	Items	Frequency	Percentage
Gender	Male	230	58%
	Female	170	42%
Age	18-23	40	10%
	23-30	170	42%
	31-40	110	27%
	41-50	40	10%
	51 and above	40	10%
Income	below 5000	20	5%
	5000-10000	90	23%
	10000-20000	80	20%
	20000-30000	110	27%
	30000 and above	100	25%
Occupation	Professional	100	25%
	Govt-executive	70	17.5%
	Nongovt-executive	70	17.5%
	Student	110	27.5%
	Selfemployed	50	12.5%
Remark	India's urban minimum monthly wage is INR 10500.		

A total 400 completed questionnaires have been collected from the respondents who do not already have 3G phones. This is to exclude those who have already adopted the technology. Above table presents the profiles of the valid respondents. Male participation is more than female participation and the monthly income of the majority (nearly 70%) was more than the urban monthly average income in India.

4.1. Instrument development

In Behavioural Sciences four types of validity measures are identified: *content validity, criterion validity, construct validity*, and *convergent/discriminant validity*. Content validity is a "conceptual test", whereas the other three are data based. The item scales were engineered to suit the context of the study. Table 2 gives the operational definitions and the cited references from where each of constructs was obtained. Multiple-item scales from pre-validated measures in ICT TAM studies are used in the questionnaire to ensure validity of the constructs.

Table 2: Explanation of Constructs

Construct	Description	Reference
Perceived utility of a new technology	A consumer's overall assessment of the utility based on the perceptions of what is obtained from the technology	Zeithaml (1988)
Perceived utility of a new service	A consumer's overall assessment of the utility based on perceptions of what is obtained from the service	Zeithaml (1988)
Presence of alternatives	The presence of different technology standards to serve the same status.	Introduced by authors and tested for reliability and content validity checked by taking expert opinions from professionals through a pilot survey most frequently used items were considered.
Perceived expense	The monetary sacrifices necessary to obtain a new mobile phone and services	Voss, Parasuraman, and Grewal (1998)
Perceived no need	When the perceptible difference between the actual and desired states with respect to a particular need or want is not considerable	Engel et al. (1993)
Adoption intention	The degree to which a person has formulated conscious plans to use a mobile phone with a new telecommunications technology	Warshaw and Davis (1985)
Actual use	The degree to which a person has formulated conscious plans to buy a mobile phone with a new telecommunications technology	Warshaw and Davis (1985)

Reliability and internal consistency of the responses were checked through Cronbach's alpha (Cronbach, 1951; Peter, 1979). Table 3 lists Cronbach's alpha for each of the constructs. Nunnaly (1978) has indicated 0.7 to be an acceptable reliability coefficient but lower thresholds are sometimes used in the literature.

Table 3: Reliability Analyses by Constructs

Constructs	Cronbach's Alpha	Number of Items
Perceived utility of a new technology	0.833	3
Perceived utility of a new service	0.540	3
Presence of alternatives	0.837	2
Perceived no need	0.840	3
Perceived expense	0.750	3
Adoption intention	0.558	2
Actual use	0.730	2

Data on the constructs were first tested for reliability and internal consistency using Cronbach's alpha. It basically tests the stability of using the data for further analysis. On an average, indicators used in this study have alpha values of 0.70. Hence the responses are found to be suitable for further analysis.

The responses to questions on each construct are combined in groups using factor analysis. Once the groups within each construct are identified, simple averages are taken to form the indicators. Confirmatory factor analysis (CFA) is performed on the full model. Fit indices and Chi- square statistic show that the measurement model has a good fit. Hence we proceed to estimate the structural model.

The key parameters to be estimated in CFA are the regression coefficients (i.e., factor loadings), the factor and error variances. Given that the latent and observed variables are specified in the model in AMOS (Analysis of Moment Structures) Graphics, the program automatically estimates the factor and error variances.

4.2. Hypothesis Testing:

In our study we have used the ML method for estimating the parameters and the path coefficients indicated the relationships between different constructs. It is found that

perceived utility of new service positively influences the adoption behavior with the path coefficient value 0.528 (P value .000). The adoption behavior is influenced by the presence of alternatives with path coefficient value-0.254 (p value .000). Therefore we find support for hypotheses H1 and H3. While we find weak hypothesis H2, since the coefficient is significant only at 10% level. Interestingly the path coefficient (0.027 with p value >.10) between perceived expense and adoption intention is found to be non-significant. The result contradicts the proposed hypothesis. The proposed hypothesis of association between adoption intention and actual use is supported given the path coefficient 0.928 and the p-value of 0.00. Control variables, namely age and mobility are tested and we find that age influences the adoption intention negatively but significant only at the 10% level (p value .131). Whereas the moderating variable mobility is observed to have no influence on adoption intention with path coefficient of .024 and the p value > .15. Therefore we do not find support for the hypotheses H4 and H7 in our sample.

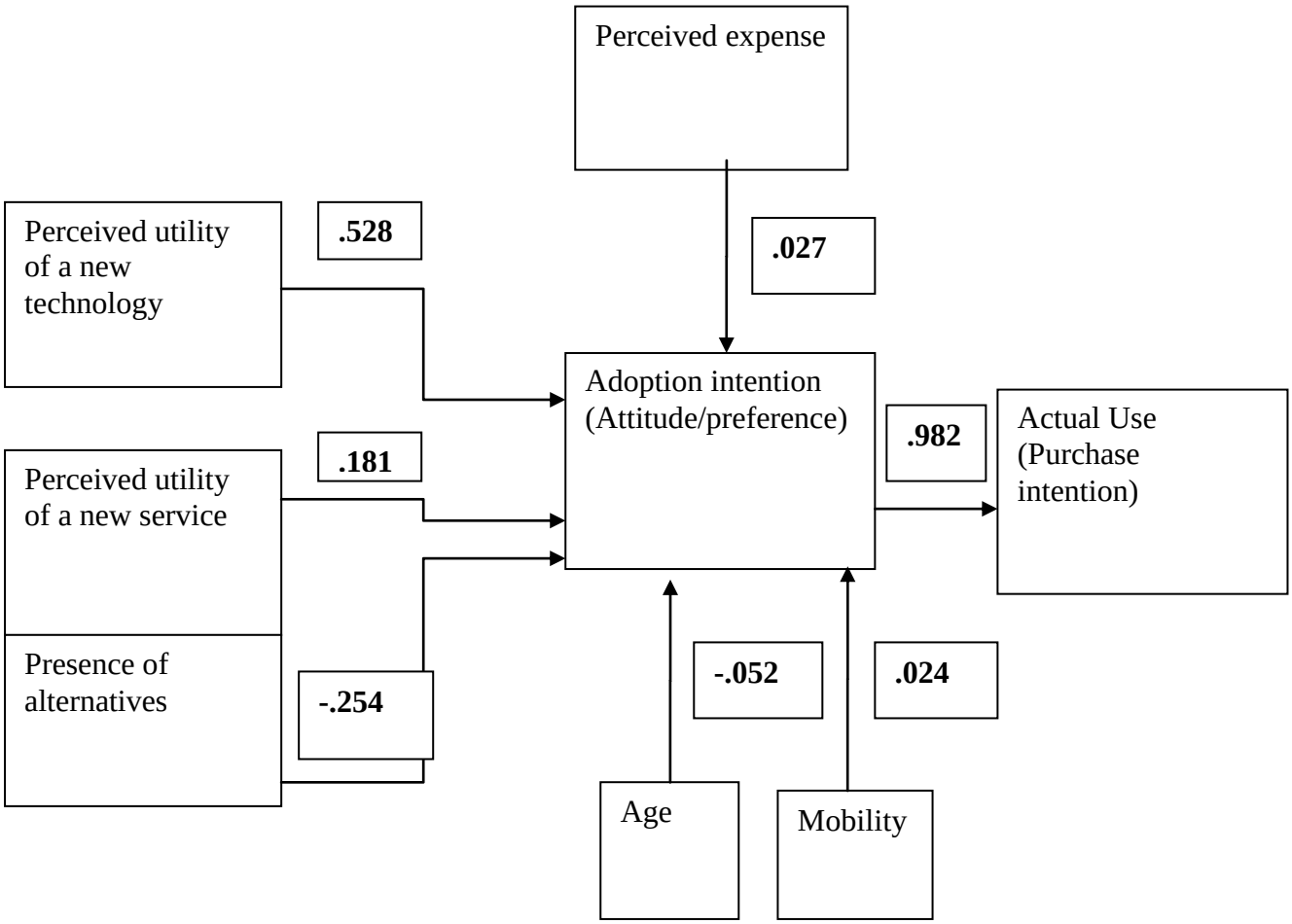

Fig 2: Results of the structural model

Table 4: Results

Parameters (to- from)	Standardized Estimates	Fit Indices	
adoptint <--- perexp	0.027		
adoptint <---- perutnser	0.181	χ2/d.f.	3.506
adoptint <---- prealt	-0.254	CFI	0.916
adoptint <---- perutilnt	0.528	PCFI	0.714
adopint <---- Age	-0.052	RMSEA	0.08
adopint <--- Mobilty	0.024	AIC	499.587
		MECVI	1.297

As can be seen from Table 4, chi-square to degrees of freedom statistic is 3.506 and it points out a better overall fit. Comparative Fit Index (CFI) of the model is found to be 0.916. Parsimony adjusted CFI is also found to be at a satisfactory level. RMSEA is .08 showing a moderate fit of the model. AIC value is slightly more than the saturated model but is significantly less than that from the independence model. Ideally for the hypothesized model, it should be less than both the saturated model and the independence model. Complexity of the model may have affected the parsimony of the model fit. MECVI addresses the generalizability of the obtained results in competing samples. The value obtained for this index for the default model is substantially less than that for the saturated and the independence model. This suggests that the hypothesized model is a good fit and represents a reasonable approximation to the population. Let us now turn our attention to the estimated path coefficients of the hypothetical model. Out of the twenty four paths, twenty coefficients are found to be statistically significant.

Table 5: Summary listing of supported hypotheses

Number	Hypothesis	Path coefficient	P-Value
H1	Perceived utility of new technology will positively influence on adoption intention	0.528	0.000
H2	Perceived utility of new service will positively influence on adoption intention	0.181	0.112*
H3	Presence of alternatives will negatively influence adoption intention	-0.254	0.000
H4	Adoption intention or the attitude positively correlated to actual use	0.982	0.000
H5	Age is a moderating variable and influence adversely adoption intention	-0.05	0.131*

*The path coefficients from perceived utility of new service (perutnser) to adoption intention (adoptint) and from age to adoption intention are found significant at nearly 10% level.

5. Findings and implications:

Result 1. *Adoption or the attitude towards a new technology includes consumers' perceptions on the technology and service.*

Two constructs, namely, perceived utility of new technology and perceived utility of new service are dedicated to capture the consumer's perception about adoption and ultimately to the actual use. These constructs are sometimes overlapping in nature but by the discriminant validity we have distinguished these two constructs. The common perception of a new technology adoption is related to higher quality of voice communication, speedy data transfer than the existing technology. The adoption of the technology may thus be perceived to improve quality of daily life implicitly. However, the service obtained by application of a technology standard is explicit in nature and consumer can evaluate the service according to their need. To understand the consumer behavior for mass adoption, discrimination between constructs of technology and service is essential (Teng, Lu,Yu, 2009).

Result 2: The mass adoption behavior of a technology is determined by the perceived utility of new service but less important than perceived utility of new technology.

The construct perceived utility of new service according to existing literature should be the most important at the mass adoption stage. But in our study it has positive impact but this impact is less than that of the perceived utility of new technology. Our study reveals that perception of new technology is the major driver in Indian market perhaps because telecom operators here highlight the technology itself and not the services.

Result 3: *Perceived expense, the economic variable is not a major factor in influencing adoption behavior and actual use or purchase*.

This study reveals that perceived expense is not a significant factor with regard to attitude building or adoption intention. At early stage of adoption in many countries the price for the service is kept at the bottom level to make the business rollout possible and this may be the reason for respondents not understanding the expense implication fully. In this particular case, at the time of survey, the telecom operators were yet to explicitly advertise the prices for 3G services. This result resembles the result obtained by Teng, Lu, Yu (2009) for the mass adoption behavior in Taiwan. Study conducted by Economides and Grousopoulou (2009), Pagani (2004) have demonstrated that age and income level might be a moderator of the relationship between perceived expenses and adoption intention. In this study we proposed a control variable mobility along with the age as a moderator.

Result 4: *Presence of low cost alternatives to this technology and service will create inter-technology competition and the diffusion of 3G technology will face hurdle due to this.*

The diffusion of the third generation may be affected by the existence of the second generation technology in mobile communications. The demand of 3G services in 2001, suffered because of the continuing growth of the second generation services. The reason was the inter technology competition, network technologies were competing for a common customer base (Gruber, H., 1995). According to Shapiro and Varian (1999), competition between technologies should be conducive to rapid innovation while competition within technology should lead to lower prices. However, the overall performance of the third generation market was disappointing: services started late and there was generally much less demand for them than originally expected. Hence the speed of diffusion of third generation subscribers was much slower than earlier generations (Gruber, 2007). In Japan the success of 3G business was due to the fact that people are using the 3G enabled mobile phones when they are on the move. The popularity of NTT DoCoMo.s i-mode mobile Internet system in Japan, with over 25 million data subscribers in June 2001, can be cited as evidence that consumers want the sort of always-on services that 3G can offer and from this the viability of the service can be forecasted[2]. Indeed, out of the 65 million mobile subscribers in Japan in the year 2000, the rapidly growing browser or mobile Internet subscriber base accounts for over 31 million, or almost half[3]. The other view is that the i-mode business model is specifically Japanese and cannot be easily replicated elsewhere[4]. In addition to this we can point out that i-mode is not burdened by high license fees. On the other hand, there are analysts who maintain that even with high license fees paid in countries such as the UK and Germany, 3G is a commercially viable service[5].Michael Fitzpatrick (2001) [6] has warned that 3G may be in danger of being squeezed between evolving technologies. On the one side the existing upgraded version of the second generation network (able to

[2] One of the main catalysts for growth of i-mode is seen to be the relatively affordable cost of using the services. The packet switched nature of DoCoMo.s PDC network allows users to be charged only for the volume of information they receive, after a flat fee of about US$3 per month. On average, users pay between US$9 to US$10 per month for accessing services.

[3] It is pointed out, for instance, that in Japan home PC penetration is relatively low, Internet and fixed phone fees are relatively high, workers spend hours each day with little else to do, and i-mode has little competition. See, for example, John Ure, .Licensing third-generation mobile: a poisoned chalice?, *Info*, vol 3, number 1, February 2001.

[4] Simon Dux, .DoCoMo.s i-mode success: the basis for a 3G model?., *Communications Week,* 16 July 2001.

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[6] Michael Fitzpatrick, .Japan sets out 4G stall., *Total Telecom,* 23 October 2000; .NTT DoCoMo chairman urges quicker 4Gmobile., *Total Telecom,* 4 April 2001; .Japan prepares for 4G., *Total Telecom,* 29 June 2001.

handle data but slower than 3G) such as General Packet Radio Service (GPRS) and on the other the advent of fourth generation (4G) technologies as well as wireless computer networking technologies, such as Blue Tooth and 802.11b (also known as Wi-Fi) that links laptop computers to office networks at high speeds can queer the pitch for 3G.
The data analysis generates the insight that as far as consumers can avail the alternatives as described above, the future business prospect for the 3G technology and services seems bleak. The respondents of this study (80%) does internet browsing at their home or at office and the internet through mobile device is not the likely option for them. The employed group in this survey whether in private or in public sector extensively uses data transfer but while doing this, they use either computers or mobile phones given by the organization where they work. Thus there is a scope of higher penetration of 3G services through high value corporate connections rather than through retail sales.

Our study explores the role of the mobility factor for adoption of a new technology. We have found that influence of mobility factor is statistically insignificant. The demand for data transfer can then be met through other less costly alternatives available like fixed line broad band.

6. Conclusion

Our paper finds a major road block for popularity of 3G technology in a developing country like India and that is the presence of cheaper alternatives. In India 3G penetration after one year of introduction is only 9% of the total consumers. Major reason is the huge difference in tariff between 2G and 3G. Off late the telecom operators have started slashing the tariffs for 3G services but still the price difference is sizeable. This raises the question mark over the high auction payments made by the telecom operators. Are they the victim of winners 'curse? If it is so, there may be a huge loss of resources on this count. Our study calls for a introspection by the operators before they plunge into auctions in the future.

7. Limitations and research directions:

The first limitation of the study is that our sample group is from a particular city only. To test the robustness of the results surveys in different cities should be conducted. The external factors like advertisement influence, social influence and peer group pressure are moderating factors with respect to adoption intention and actual use. We have not explicitly used them in our study.

The psychological theories in the field of adoption behavior are primarily focused to the need assessment and while doing that these theories rely upon perceived utility of the new service as an indicator of the adoption behavior. In our analysis this particular construct is found to be insignificant. The influence of perceived expense is also similarly found to be insignificant. These contradictory findings may be due to sampling bias, which may be verified by a larger and more representative sample.

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Appendix A

The latent constructs obtained from the questionnaire.

1. Perceived utility of a third generation technology:

a. I believe that 3G technology will improve the communication quality of mobile phone.

b. I believe that 3G technology will facilitate data transfer.

c. I believe that 3G technology can satisfy my need for multimedia services.

2. Perceived utility of service of third generation technology:

a. I believe that the 3G services offered by providers will satisfy my needs.

b. I believe that the 3G services offered by providers are easy to use.

c. I believe that the content of the 3G services offered by the providers is interesting.

3. Presence of alternatives

a. I believe the services provided by 3G can be obtained by substitution.

b. Substitutes are less costly than 3G.

4. Perceived no need:

a. There are few occasions when I need to use a 3G mobile phone.

b. The current 3G services offered by providers are not important to me.

c. At present I do not need 3G mobile phones

5. Perceived expense:

a. I believe that the current price of 3G mobile phones is beyond my budget.

b. I believe that the current charge for 3G service is expensive.

c. I believe that the total cost of 3G adoption is expensive.

6. Intention for adopting new technology:

a. Intend to use a 3G mobile phone.

b. I believe that I will at some point use a 3G mobile phone

7. Intention for actual use of 3G mobile phone:

a. I intend to buy 3G mobile phone

b. I plan to buy a 3G mobile phone

Appendix B

In our model adoption intention is the latent endogenous random variable and the notation η is a vector of the latent endogenous variables. In the adoption intention and purchase intention model at the first stage adoption intention is working as endogenous latent variable. The model we have selected was tested through use of the observable measures of these latent variables. For each concept we have constructed an index with two or more indicator variables. The basic assumption in this procedure is that the observed variables are correlated to the latent variables they measure so. For our analysis we have selected three indicators x1,x2, and x3 for the latent exogenous construct perceived utility of new technology (ξ1), three indicators x4,x5, and x6 for the latent exogenous construct perceived use of new service (ξ2), and two indicators x13 and x14 for the latent random variable presence of alternatives (ξ4), and another latent construct perceived expense (ξ5) with three indicator variables x7,x8, and x9. At the first stage of confirmatory factor analysis we have all ξi's .In the structural model adopint (adoption intention) is the latent endogenous variable [7].The endogenous variable in this stage is also affected by some measures i.e indicator variables and two confounding variables, namely age and mobility. For adoption intention we have two indicator variables y1 and y2, actual use (η2) which has two observed variables (y3 and y4).

Equations written below provide a measurement model for these variables:

$x1=\lambda 1\ \xi 1+\delta 1$ $x2=\lambda 2\ \xi 1+\delta 2$

$x3=\lambda 3\ \xi 1+\delta 3$ $x4=\lambda 4\ \xi 2+\delta 4$

$x5=\lambda 5\ \xi 2+\delta 5$ $x13=\lambda 13\ \xi 4+\delta 13$

$x6=\lambda 6\ \xi 2+\delta 6$ $x14=\lambda 14\ \xi 4+\delta 14$

[7] adoption intention (η1) and actual use (η2) which are affected by the above described exogenous variables (ξi's).

x7= λ7 ξ5+δ7

x8= λ8 ξ5+δ8

x9= λ9 ξ5+δ9

In the second stage we have other endogenous variable Actual use (η2) which has two observed variables (y3 and y4) .This construct also affected by the latent endogenous variable adoption intention (η1).

y1 = λ15 η1+δ15 y3= λ17 η2+δ17

y2= λ16 η1+δ16 y4= λ18 η2+δ18

In matrix form we can write the model as follows

$X= \Lambda_x \xi+ \delta$

$Y= \Lambda_y \eta+ \varepsilon$

The λi (lambda) coefficients are the magnitude of the expected change in the observed for a unit change in the latent variable. These coefficients are regression coefficients for the effects of the latent variables on the observed variables. The δ_I (delta) and ε_i (epsilon) variables are the errors of measurement for xi and yi, respectively. They are disturbances that disrupt the relation between the latent and observed variables. The assumptions are that they are uncorrelated with all latent variables, exogenous and endogenous, and ζ's and have an expected value of zero and δ_I and ε_i are uncorrelated for all i and j.

We assume that each δ_i or ε_i is homoscedastic and non-auto correlated across observations. This assumption is also taken for the ζ_i's, the disturbances for the latent variable model. The standardized regression coefficients measure the expected change in the dependent variable in standard deviation units that accompanies a one standard deviation change in the explanatory variable holding constant the other explanatory variables. The standardized coefficient shows the mean response in standard deviation units of the dependent variable for a one standard deviation change in an explanatory variable.

We have used confounding variables or the control variable to get more robust estimates.

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