

**A STUDY OF MOBILE DATA: PRODUCT
INNOVATION, CONSUMER AWARENESS AND
ADOPTION**

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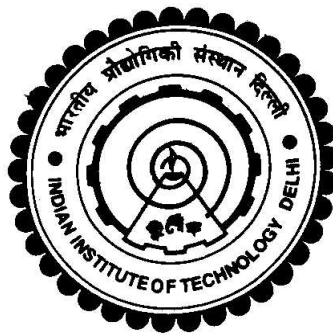
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CERTIFICATE

This is to certify that the thesis titled "**A Study of Mobile Data: Product Innovation, Consumer Awareness and Adoption**" being submitted by **Mr. Murali Krishna Medudula** to the Indian Institute of Technology Delhi for the award of the degree of Doctor in Philosophy (Ph.D.), is a record of bona fide original research work carried out by him. He has worked under my guidance and supervision, and has fulfilled the requirements for the submission of the thesis, which has attained the standard required for a Ph.D. degree of the Institute. The results presented in this thesis have not been submitted elsewhere for the award of any degree or diploma.

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ABSTRACT

With improvements in telecom technologies, the networks which were once only capable of carrying voice have now been transformed into IP networks which are capable of carrying both voice and data traffic. The network technology improvements and ubiquitous access enabled consumers to access faster and more reliable mobile data services. The growth phase of Indian telecommunication sector has been very impressive, and for the very 1st time during the year 2016-17, the average consumption of mobile data reached 1GB/ subscriber. The growth rate clearly indicates the consumer preference towards usage of mobile data services. The growth in mobile data subscriptions and mobile data usage presents an opportunity for the mobile data product innovators to better understand the user behavior intention to adopt their data innovations. This would help the stakeholders in the industry to better create and manage their mobile data product innovations. This will help in further increase of growth rate in mobile data usage.

The extensive literature review on various adoption theories and IT adoption studies revealed several constructs which are being used to study the user behavior intention to adopt. This study presented various adoption theories from literature and makes use of Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) constructs, consumer awareness constructs and other security related constructs to explain user behavior intention to adopt mobile data in a select category of mobile data product innovations.

The study made use of both the qualitative and quantitative research methodologies. Grounded Theory, a well-established qualitative research method has been used to identify the consumer awareness related constructs. Using the grounded theory method, the

discussion with respondents are broken into thought units, upon which the axial coding is being performed to identify the underlying constructs. Out of the findings of grounded theory research two constructs, each one from the pre-purchase and purchase category was being selected for the study. The constructs "Consumer Knowledge" and "Risk Perception" were being identified in the grounded theory process and are being understood for their influence on several other constructs in the conceptual model.

Using the literature review and expert opinion, the other constructs used in the study includes Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, Hedonic Motivation, Habit, Perceived Risk, Trust, Perceived Security, Perceived Privacy, Behavior Intention and Use Behavior.

Several hypothesis were formulated based on prior theories in literature and expert opinion. Post hypothesis formulation, the test instrument was being developed using the well-established scales from the literature. The test instrument is being checked for internal consistency using Cronbach alpha. The test instrument is also checked for Content Validity, Convergent Validity, Discriminant Validity and Face Validity. During the Exploratory Factor Analysis, the items in test instrument with poor loadings are being discarded. Confirmatory Factor Analysis (CFA) is being used to check the convergent and discriminant validity.

Total Interpretive Structural Modeling (TISM) is being used to identify the hierarchy among the consumer awareness and security related constructs. The TISM shows the consumer awareness factors to be the driving factors with security related factors in the middle and top levels. Structural Equation Modeling (SEM) technique is being used for testing the hypothesized relationships in the UTAUT2 and Consumer awareness based

adoption models. This technique used maximum likelihood estimates in arriving at the model fit indices. Several fit indices such as Standardized Root Mean square Residual (SRMR), Goodness-of-Fit Index (GFI), Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI) and Root Mean Square Error of Approximation (RMSEA) were being checked with the recommended values from the literature for both the UTAUT2 and Consumer awareness based adoption models in the study. Post establishing the criteria for fit indices, the research models were accepted, and hypothesis test results are being interpreted. The hypothesis test results presented the coefficient values and the level of significance of the relationship. The SEM models supported all the hypothesis except for the relationship between Effort Expectancy -Behavior Intention and Facilitating Conditions - Behavior Intention. The consumer awareness based adoption model suggests that the consumer awareness constructs exhibit a significant effect on Perceived Risk which in turn significantly affects Behavior Intention. The model also found out the significant effect existing between the following constructs:- Performance Expectancy- Behaviour Intention, Social Influence- Behavior Intention, Hedonic Motivation -Behavior Intention, Habit- Behavior Intention, Perceived Risk - Behavior Intention, Consumer Knowledge of MDS- Perceived Security, Consumer Knowledge of MDS- Perceived Risk, Perceived Security- Trust, Perceived Privacy- trust, Risk Perception- Perceived Risk and Behavior Intention- Use Behavior.

The contribution of the study to the body of knowledge is highlighted in the final chapter. This study presents the significant factors which are required to be understood and taken into consideration for the development and management of mobile data product innovations. This would help in the improvement of adoption rate and to increase the mobile data growth rate in Indian Telecom Market.

सार

दूरसंचार प्रौद्योगिकियों में सुधार के साथ, जो नेटवर्क केवल ध्वनि संचारित करने में सक्षम थे, अब आईपी नेटवर्क में परिवर्तित हो गए हैं जो आवाज और डेटा यातायात दोनों को चलाने में सक्षम हैं। नेटवर्क प्रौद्योगिकी में सुधार और सर्वव्यापक एक्सेस उपभोक्ताओं को तेज गति से और अधिक विश्वसनीय मोबाइल डेटा सेवाओं तक पहुंचने में सहायक है। भारतीय दूरसंचार क्षेत्र का विकास चरण बहुत प्रभावशाली रहा है और वर्ष २०१६-१७ के दौरान पहली बार, मोबाइल डेटा की औसत खपत १ जीबी/ग्राहक तक पहुंच गई है। विकास दर स्पष्ट रूप से मोबाइल डेटा सेवाओं के उपयोग के प्रति उपभोक्ता वरीयता दर्शाती है। मोबाइल डेटा सदस्यता और मोबाइल डेटा उपयोग की वृद्धि मोबाइल डेटा उत्पाद आविष्कारों के लिए एक अवसर प्रस्तुत करती है ताकि वे अपने डेटा नवाचारों को अपनाने के लिए प्रयोक्ता व्यवहार समझ सकें। इससे उद्योग के हितधारकों को अपने मोबाइल डेटा उत्पाद नवाचारों को बेहतर बनाने और प्रबंधित करने में मदद मिलेगी। इससे मोबाइल डेटा उपयोग दर में और वृद्धि करने में मदद मिलेगी।

विभिन्न उत्पाद अपनाने के सिद्धांतों और आईटी अपनाने के अध्ययनों पर व्यापक साहित्य समीक्षा ने कई संरचना उजागर किए हैं जो कि किसी नयी चीज को अपनाने के लिए प्रयोक्ता व्यवहार का अध्ययन करने के लिए प्रयोग किए जा रहे हैं। इस अध्ययन ने साहित्य से विभिन्न अपनाने के सिद्धांत प्रस्तुत किए और मोबाइल डेटा का एक चुनिंदा श्रेणी में मोबाइल डेटा उत्पाद नवाचार को अपनाने के लिए प्रयोक्ता व्यवहार इरादा को समझाने के लिए स्वीकार्य और टेक्नोलॉजी २ (UTAUT2) निर्माण, उपभोक्ता जागरूकता संरचना और अन्य सुरक्षा संबंधित निर्माणों के एकीकृत सिद्धांत का इस्तेमाल किया है।

अध्ययन ने गुणात्मक और मात्रात्मक शोध के दोनों तरीकों का इस्तेमाल किया। ग्राउंडेड थ्योरी, जो एक अच्छी तरह से स्थापित गुणात्मक शोध पद्धति है उसका उपयोग उपभोक्ता जागरूकता से संबंधित संरचना की पहचान करने के लिए किया गया है। ग्राउंडेड थ्योरी पद्धति का उपयोग करते हुए, उत्तरदाताओं के साथ चर्चा सोचा इकाइयों में तोड़ दी जाती है, जिन पर अंतर्निहित संरचना की पहचान करने के लिए एक्सप्लोर कोडिंग की गयी है। आधारभूत सिद्धांत अनुसंधान के दो निष्कर्षों के निष्कर्षों में से,

पूर्व-खरीद और खरीद श्रेणी से प्रत्येक को अध्ययन के लिए चुना गया। "कंज्यूमर नॉलेज" और "रिस्क पर्सिप्शन" के निर्माण को ग्राउंडेड थ्योरी प्रक्रिया में गया है और संकल्पनात्मक मॉडल में कई अन्य निर्माणों पर उनके प्रभाव के लिए समझा गया।

साहित्य की समीक्षा और विशेषज्ञ की राय का इस्तेमाल करते हुए, अध्ययन में इस्तेमाल किए गए अन्य निर्माणों में प्रदर्शन की उम्मीद, प्रयास की उम्मीद, सामाजिक प्रभाव, सुविधा प्रदान करने, हेडोनिक प्रेरणा, आदत, अनुमानित जोखिम, विश्वास, सुरक्षा, गोपनीयता, व्यवहार इरादा और प्रयोग व्यवहार शामिल हैं।

साहित्य और विशेषज्ञों की राय में पूर्व सिद्धांतों के आधार पर कई परिकल्पना (hypothesis) तैयार की गई। इसके पश्चात साहित्य से अच्छी तरह से स्थापित स्केल का उपयोग करके परीक्षण उपकरण विकसित किया गया। क्रोनबैक अल्फा का उपयोग करते हुए परीक्षण के लिए आंतरिक स्थिरता के लिए जांच की गयी। सामग्री की वैधता, संसृत वैधता, भेदभाव वैधता और फेसवैधता के लिए परीक्षण उपकरण की भी जाँच की गयी। खोजकर्ता फैक्टर विश्लेषण के दौरान, खराब लोडिंग के साथ परीक्षण उपकरण में आइटम को त्याग दिया जाता है। संधारित्र फैक्टर विश्लेषण (CFA) का उपयोग अभिसरण और भेदभाव की वैधता को जांचने के लिए किया गया है।

उपभोक्ता जागरूकता और सुरक्षा संबंधी निर्माण के बीच पदानुक्रम को पहचानने के लिए टोटल इंटरप्रिटिव स्ट्रक्चरल मॉडलिंग (TISM) का उपयोग किया गया है। टीआईएसएम उपभोक्ता जागरूकता को ड्राइविंग कारक के रूप में दर्शाता है और सुरक्षा संबंधी कारकों को कारकों को मध्य और उच्च स्तरों दर्शाता है। UTAUT2 और उपभोक्ता जागरूकता आधारित अपनाने के मॉडल में धारणाबद्ध संबंधों के परीक्षण के लिए स्ट्रक्चरल समीकरण मॉडलिंग (SEM) तकनीक का उपयोग किया गया है। इस तकनीक में मॉडल फिट इंडेक्स पर पहुंचने में अधिकतम संभावना का अनुमान लगाया जाता है। स्टैंडस्टन्डर्डइजेड रुट मीन स्क्वायर रेजिदुअल (SRMR), गुडनेस ऑफ़ फिट इंडेक्स (GFI), कम्पेरेटिव फिट इंडेक्स (CFI), नॉन-नोर्मड फिट इंडेक्स (NNFI) और रुट मीन स्क्वायर एर ऑफ़ अप्रोक्सिमेसन (RMSEA) जैसे कई फिट इंडेक्स का प्रयोग कर UTAUT2 और उपभोक्ता जागरूकता दोनों दोनों के लिए साहित्य से अनुशंसित मूल्यों की तुलना में त्रुटि की जांच की गई। फिट सूचकांकों के लिए मापदंड की स्थापना के बाद, शोध मॉडल स्वीकार किए गए, और परिकल्पना के परीक्षण के परिणामों की व्याख्या की गयी है।

परिकल्पना परीक्षण के परिणाम गुणांक मूल्यों और रिश्ते के महत्व का स्तर प्रस्तुत करते हैं। SEM मॉडल ने सभी अवधारणाओं को स्वीकार कर लिया सिवाय एफर्ट एक्सपेक्टेसी-बिहेवियर इंटेन्सन और फैसिलिटेटिंग कंडीशन- बिहेवियर इंटेन्सन के। व्यवहार इरादे उपभोक्ता जागरूकता आधारित मॉडल से पता चलता है कि उपभोक्ता जागरूकता के निर्माण अनुमानित जोखिम पर एक महत्वपूर्ण प्रभाव प्रदर्शित करते हैं जो बदले में व्यवहार आशय पर काफी प्रभाव डालता है। मॉडल ने निम्नलिखित निर्माणों के बीच मौजूदा प्रभाव का भी पता लगाया: - परफॉर्मेंस एक्सपेक्टेसी - बिहेवियर इंटेन्सन, सोशल इम्प्लुएंस - बिहेवियर इंटेन्सन, हेडोनिक मोटिवेशन - बिहेवियर इंटेन्सन, हैबिट - बिहेवियर इंटेन्सन, परसीवड रिस्क- बिहेवियर इंटेन्सन, कन्जूमर नॉलेज ऑफ़ MDS- परसीवड सिक्यूरिटी, कन्जूमर नॉलेज ऑफ़ MDS - परसीवड रिस्क, परसीवड सिक्यूरिटी – ट्रस्ट , परसीवड प्राइवेसी - ट्रस्ट, रिस्क पर्सेप्शन - परसीवड रिस्क और बिहेवियर इंटेन्सन—यूज़ बिहेवियर.

ज्ञान के कोष में इस अध्ययन के योगदान को अंतिम अध्याय में दर्शित किया गया है। यह अध्ययन महत्वपूर्ण कारकों को प्रस्तुत करता है जिन्हें मोबाइल डेटा उत्पाद नवाचारों के विकास और प्रबंधन के लिए समझा जाना और ध्यान में रखना आवश्यक है। इससे ग्रहण की दर में सुधार और भारतीय दूरसंचार बाजार में मोबाइल डेटा वृद्धि दर को बढ़ाने में मदद मिलेगी।

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LIST OF ABBREVIATIONS

Title	Page No.
0G	Zero Generation
1G	First Generation
2G	Second Generation
3G	Third Generation
4G	Fourth Generation
AVE	Average Variance Extracted
CDMA	Code Division Multiple Access
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CK	Consumer Knowledge
CMR	CyberMedia Research
CVR	Content Validity Ratio
DOI	Diffusion of Innovation Theory
DoT	Department of Telecommunications
DTPB	Decomposed Theory of Planned Behavior
DTPB	Decomposed Theory of Planned Behavior
EDT	Triandis' Model Expectation–Disconfirmation Theory
EE	Effort Expectancy
FC	Facilitating Conditions
FVM	Fit-viability Model

GB	Gigabyte
GFI	Goodness-of-Fit Index
GSM	Global System for Mobile
HA	Habit
HM	Hedonic Motivation
INN	Innovativeness
IP	Internet Protocol
ITU	International Telecommunication Union
KMO	Kaiser-Meyer-Olkin
LR	Literature Review
MB	Mega Byte
MDS	Mobile Data Security
MM	Motivational Model
MPCU	Model of PC Utilization
NFC	Near Field Communication
NNFI	Non-Normed Fit Index
OTT	Over-the-top
PC	Personal Computer
PE	Performance Expectancy
PEoU	Perceived ease of use
PIIT	Personal innovativeness in information Technology
PR	Perceived Risk
PS	Perceived Security

PU	Perceived Usefulness
QE	Quarter Ending
RFID	Radio-frequency identification
RMSEA	Root Mean Square Error of Approximation
RP	Risk Perception
SCT	Social Cognitive Theory
SEM	Structural Equation Modeling
SI	Social influence
SMS	Short Message Service
SN	Subjective Norm
SRMR	Standardized Root Mean square Residual
TAM	Technology Acceptance Model
TAM2	Technology Acceptance Model 2
TPB	Theory of Planned Behavior
TR	Trust
TRA	Theory of Reasoned Action
TRA	Theory of Reasoned Action
TRAI	Telecom Regulatory Authority of India
TTF	Task Technology Fit
UTAUT	The unified theory of acceptance and use of technology
UTAUT2	Unified Theory of Acceptance and Use of Technology 2