A MODEL TO PREDICT USABILITY OF IT SERVICES IN DIFFICULT GEOGRAPHIES

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***Abstract*— While studying the usability of IT-services in difficult geographies, it was realized that unless technology reaches and benefits the last man, it is way beyond its intended role. In this paper an attempt has been made on the usability of IT services in rural areas where topology creates isolation to development activities. The study has been carried out at Samalta, a village located in the central Himalayan region in the Uttarakhand state of India. Primary data for analysis is acquired using questionnaire and interviews of villagers. Collected responses are then analyzed and a regression model is proposed.**

Keywords- IT- Services, Usability

I. INTRODUCTION

The World Bank defines governance as the manner in which power is exercised in the management of a country's economic and social resources for development [1]. The Worldwide Governance Indicator projects of the World Bank define governance as the traditions by which authority in a country is exercised [2].

In a world that is fast globalizing and is supercharged with information, it calls for innovative efforts on behalf of the change leaders to look, sound and feel different. India's long-term growth prospects hinge on how we invest in the nation's future. The key engines for a country's growth are the social and physical infrastructure, which require continued investments to accelerate growth prospects [3]. The social infrastructure needs to be developed in parallel to capacity building. The top down governance model have since inception neglected the needs of the citizens which are seen in the failure of many deemed to be successful initiatives. Oxford dictionary defines initiative as an act or strategy intended to resolve a difficulty or improve a situation; a fresh approach to something [4].

The following are some of the features that IT-initiatives may provide: Oxford dictionary defines Awareness as knowledge or perception of a situation or fact [5]; hence it can be seen as a necessity before usability comes into picture. The AIDA model describes awareness as the initial step for taking action. For the use of IT a person must be at first aware of IT and then he/she can use and get benefited by IT. The skills required for citizens in the 21st century are changing as the Internet and technology transforms the way we do business. Projects need to raise awareness amongst organizations and citizens. Ignoring ICT is not an option; it will impact on the livelihood. [6]. the first such step was taken in 1993 in the United State, under the Clinton presidency [7].

The benefits of IT services usability can be accelerated when key decision makers, from both government and civil society, make public statements of acceptance and encouragement for

IT service to difficult geographies and remote communities. Such key person can help pull support from uncommitted decision makers and smooth the way for IT services usability building initiatives [8]. Efforts should be made to identify such key persons and support their work. The study was conducted in a village to see the level of IT service usability at grass root levels. The following sections deals with the criteria for selection of village, followed by the village profile, methodology, data analysis and finally the conclusion.

II. RESEARCH METHODOLOGY

In our research design, we identified three important parameters that effects practical usability of IT services at village level and defined a set S containing these parameters as elements such that

S = {I, GD, GP} where

I= IT_Awareness,

GD= Geographical_Difficulty

GP=Government_Policy_Effectiveness

At a particular time *t* values for these parameters define usage of IT services. We propose to estimate the usage of IT services as a function of above three variables. For this we suggest a mathematical model based on multiple regression analysis in traditional statistics with following assumptions:

1. The estimated value for usage of IT services by an individual village at time *t* is the outcome of research and represented as independent value Y (IT-utilize).
2. There are three independent or predictor variables identified during study phase of research.
3. Independent variables can be binary, ordinal, continuous and parametric measurement of data.

A generalized multiple linear regression model for data of our field study can be written as:

Y(IT_utilize)=βo+β1Xi(IT_Awareness)+β2Xgd(Geographical_Difficulty)+β3Xgp(Government_Policy_Effectiveness)+u.................. (1)

Where βo is *intercept* and β1 is parameter associated with Xi (IT_Awareness), β2 is parameter associated with Xgd (Geographical_Difficulty) and so on. Since in Equation (1) there is one intercept and three predictor variables hence contains total K+1 (i.e. 3+1 = 4) unknown parameters. Parameters other than intercept are referred as *slope* parameters [9]. Since data dependent models are subjected to some error due to human interference, measurement errors e.t.c hence *u* is introduced as *error term* or *disturbance.* The observations can be made at different times t1, t2, t3.......tn and equations for these observations may be written as:

Y_1(IT_utilize)=$\beta_o+\beta_1 X_{i1}$(IT_Awareness)+$\beta_2 Xgd1$
(Geographical_Difficulty)+$\beta_3 Xgp1$(Government_Policy_Effectiveness)+u_1.................. (1)

Y_2(IT_utilize)=$\beta_o+\beta_1 X_{i2}$(IT_Awareness)+$\beta_2 Xgd_2$
(Geographical_Difficulty)+$\beta 3 Xgp2$(Government_Policy_Effectiveness) +u_2.................. (1)

Y_n(IT_utilize)=$\beta_o+\beta_1 X_{in}$(IT_Awareness)+$\beta_2 Xgdn$
(Geographical_Difficulty)+$\beta 3 Xgpn$(Government_Policy_Effectiveness) +u_n.................. (1)

The parameters $\beta_o, \beta_1, \beta_2, \beta_3$ can be estimated using the least square procedure, which minimizes the sum of squared residuals and leads to a closed-form expression for the estimated value of the unknown parameter β:

$$S = \sum_{i=1}^{n}(y_i - \beta_o - \beta_1 X_{ii} - \beta_2 X_{gdi} - \beta_3 X_{gpi})^2 \text{........................(2)}$$

Minimizing the sum of squares leads to the following equations, from which we can calculate values for β:

$$\sum_{i=1}^{n} y_i = n\,\beta_o + \beta_1 \sum_{i=1}^{n} X_{ii} + \beta 2 \sum_{i=1}^{n} X_{i\,gd} + \beta 3 \sum_{i=1}^{n} X_{igp}$$

$$\sum_{i=1}^{n} x_{ii} y_i = \beta 0 \sum_{i=1}^{n} X_{ii} + \beta 1 \sum_{i=1}^{n} X_{ii}^2 + \beta 2 \sum_{i=1}^{n} X_{ii} X_{igd} + \beta 3 \sum_{i=1}^{n} X_{ii} X_{igp}$$

$$\sum_{}^{n} x_{igd} y_i = \beta 0 \sum_{}^{n} X_{igd} + \beta 1 \sum_{}^{n} X_{ii} X_{igd} + \beta 2 \sum_{}^{n} X_{igd}^2 + \beta 3 \sum_{}^{n} X_{igd} X_{igp}$$

i=1 i=1 i=1 i =1 i=1

n n n n n

$$\Sigma X_{igp}yi=\beta0\Sigma X_{igp} + \beta1\Sigma X_{ii} X_{igp} + \beta2\Sigma X_{igd}X_{igp} + \beta3\Sigma X_{igp}^{2}$$

i=1 i=1 i=1 i=1 i=1

These equations will lead to leads to a closed-form expression for the estimated value of the unknown parameter β:

$$\hat{\beta} = (\mathbf{X}^{\mathrm{T}}\mathbf{X})^{-1}\mathbf{X}^{\mathrm{T}}\mathbf{y} = \left(\tfrac{1}{n}\sum \mathbf{x}_i\mathbf{x}_i^{\mathrm{T}}\right)^{-1}\left(\tfrac{1}{n}\sum \mathbf{x}_i y_i\right).$$

The mathematics used in calculating the x-coefficients minimize the difference of the sum of the squares between the n observed x and y pairs to determine an set of β such that

y(i) = β(i) X(i) +u provides a predictive method to estimate value of independent variable y or Y(IT_utilize) in our case.

III. CASE STUDY OF SAMALTA

The selection of village was done after a careful evaluation of many factors [10].

A. Proximity to the state capital: The geography in question i.e. village got to be near the capital of the state, Dehradun which is a thriving city of educational institutes; the hub of policy making and a comparatively developed city of Uttarakhand. We wanted to see the prevailing conditions in a village having proximity to the capital.

B. The Hilly State: Uttarakhand is a hilly state and hence the choice got to reflect the difficult geographical terrain comparable to the other villages of the state.

C. Agro Based: The village should be agro based and the primary occupation of the people residing there should be agriculture. ‘Samalta’ village, in the Kalsi Taluka, Vikasnagar near Dehradun satisfied all the conditions and hence was selected for the study.

We identified 100 stakeholders working in the governance and IT domains and asked them to provide rating to the components of the model from 1 to 100 based on their experience with any particular village or villages in general. A stepwise multiple regressions was then used to identify the best model.

Three models were framed from the analysis of the proposed model. The details of the model are given below

TABLE I. PROPOSED MODEL

Model	**Variables Entered**	**Method**
1	IT_AWARENESS	Forward (Criterion: Probability-of-F-to-enter <= .050)
2	GEOGRAPHICAL_DIFFICULTY	Forward (Criterion: Probability-of-F-to-enter <= .050)
3	GOVT_POLICY_EFFECTIVENESS	Forward (Criterion: Probability-of-F-to-enter <= .050)

To find the best model we checked for the model with highest R square value.

TABLE II. MODEL SUMMARY

Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.623[a]	.389	.386	8.32895
2	.693[b]	.480	.477	7.69101
3	.706[c]	.498	.493	7.57288
a. Predictors: (Constant), IT_AWARENESS				
b. Predictors: (Constant), IT_AWARENESS, GEOGRAPHICAL_DIFFICULTY				
c. Predictors: (Constant), IT_AWARENESS, GEOGRAPHICAL_DIFFICULTY, GOVT_POLICY_EFFECTIVENESS				

Model 3 has the adjusted r square of .49 which means that the model can explain 49% variation in dependent variable. The regression analysis of the three models are given below

TABLE III. REGRESSION ANALYSIS

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.140	1.628		3.158	.002
	IT_AWARENESS	.743	.054	.623	13.761	.000
2	(Constant)	15.050	2.032		7.406	.000
	IT_AWARENESS	.637	.052	.534	12.254	.000
	GEOGRAPHICAL _DIFFICULTY	.271	.037	.316	-7.245	.000
3	(Constant)	1.096	4.779		.229	.819
	IT_AWARENESS	.535	.060	.449	8.882	.000
	GEOGRAPHICAL _DIFFICULTY	.255	.037	.298	-6.872	.000
	GOVT_POLICY_E FFECTIVENESS	.124	.388	.161	3.215	.001
a. Dependent Variable: USABILITY						

Hence the third model is best. The regression equation is

Usability=.449IT_Awareness-.298Geographical_Difficulty+.161Govt_Policy_Effectiveness

The highest impacting factor for Usability is IT awareness followed by difficult geographies and Govt_policy_effectiveness.

Now consider the same data set when the regression analysis is conducted within the AMOS ***graphics*** environment. The initial step in this instance is the specification of the regression analysis as a path diagram.

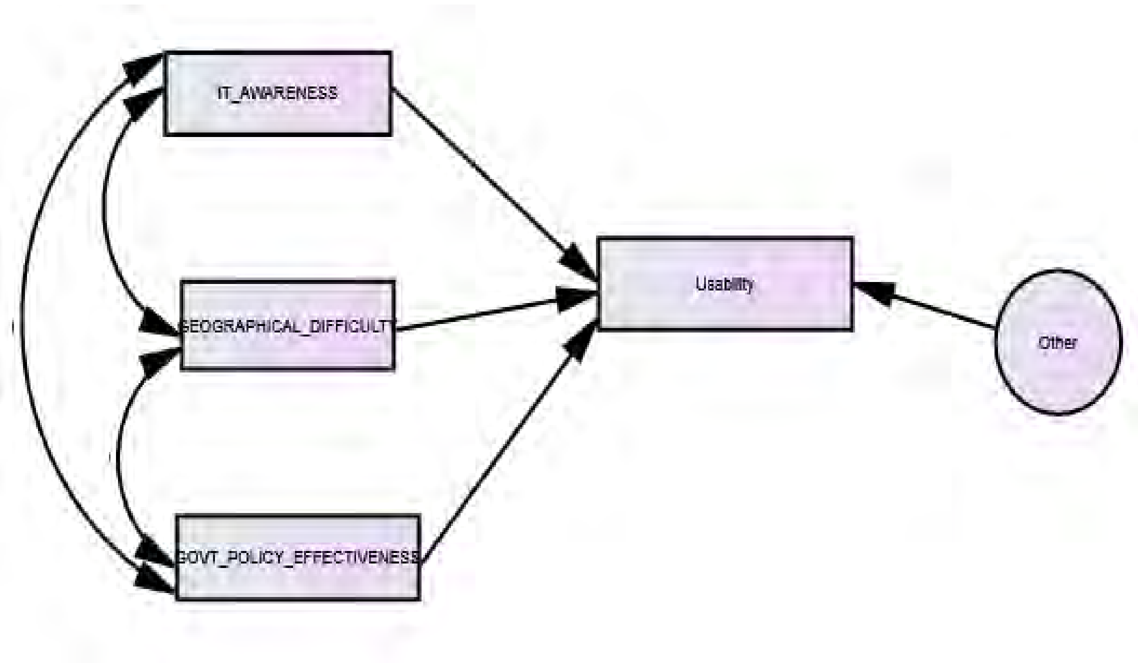

Figure. 1 Path diagram for regression analysis

Importantly, to be correctly specified, the model must include a residual or error term (e) as an ellipse which indicates an unmeasured variable.

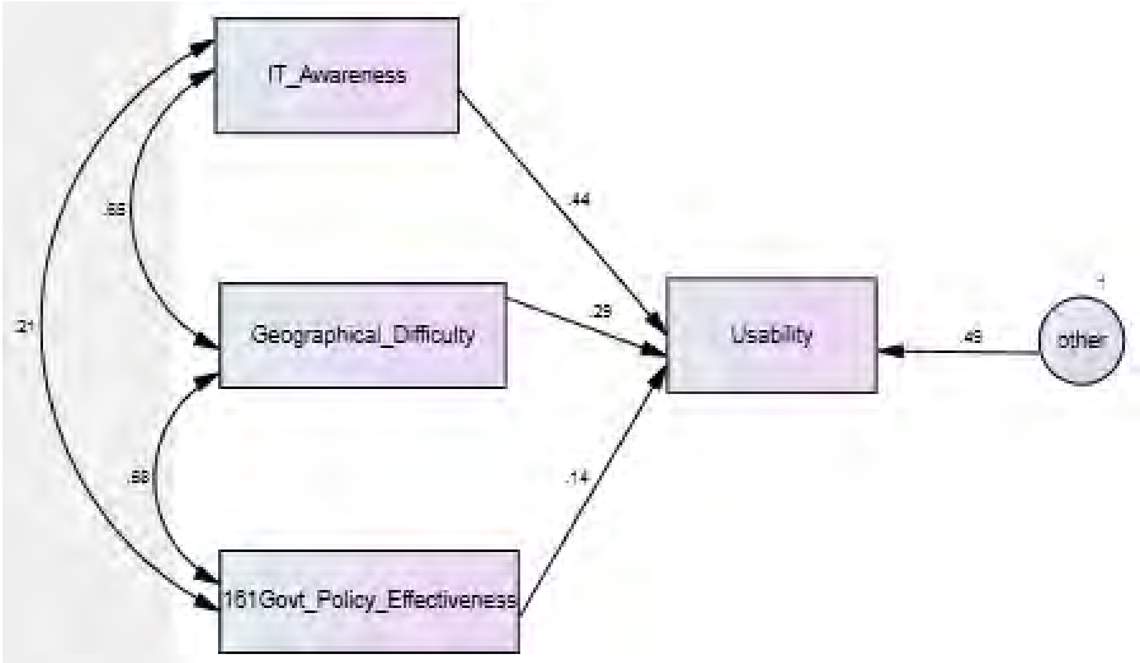

Figure. 2 Standardized regression coefficient

The parameter estimates shown in Figure 2 may be directly compared to the output from the SPSS analysis. The standardized solution displays standardized regression coefficients as the same as the Beta values in Table 5 and R^2value of .40.

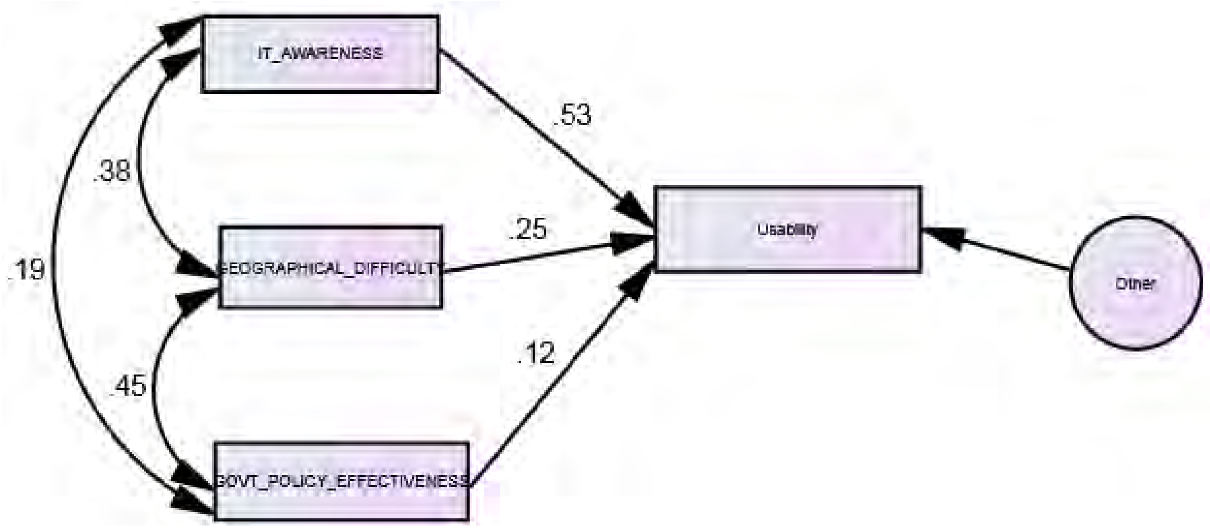

Figure. 3 Unstandardized regression coefficient

Similarly, the unstandardized regression coefficients are the same as those reported in theTable5. More importantly, Fig. 2 and Fig.3 presents the derived parameter estimates of the multiple regression analysis in a visual form using AMOS graphics that is explicit about the analysis under consideration.

IV. CONCLUSION

The introduction of IT- initiatives in remote areas can simulate the entire domain of rural milieu. Technology gaps have been serious hindrance of development of rural India. Lack of technologies prevented communities in remote and difficult geographies to make use of their knowledge, resources and skills for economic upliftment which otherwise flow down to mainland. Decentralized IT- initiatives for geographically tough places can lift the face of any region. This study indicates the need for a novel approach to use IT services for rural areas and the importance of government policies and IT awareness for successful implementation of e-governance services in these areas. This is the need of hour the policy makers and government has to take deliberate measures to reinvent the trajectory for technical interventions in difficult geographies. A new model of village e-governance therefore, is vital for the usability of IT-services and electronic engagement at the grass root level.

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