Review and Use of Diffusion Theory to Define M-Health Framework Integrated With Geospatial Database for Mountainous Region in Uttarakhand

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Abstract—This paper aims to define the inseparable boundaries of technologies intervention for socio economic empowerment of societies and communities around the globe. The transmission of an innovation or any technical intervention in a well established society is a complex process whose success depends on various characteristics of the elements involved in this process: innovation, channels and society. Initially, this work looks into diffusion theory of innovation and explored the various variables which may impact the diffusion process. Next, study explored the endogenous variables of a society, specifically in difficult mountainous terrains of Uttarakhand state in India which may impact the diffusion of any technical intervention in this regime. Furthermore, arguments of above stated study used to define a conceptual model for mobile technologies intervention into health care sector. The exponential proliferation of mobile phones in society has interwoven the technological interventions with various socio-economic indicators as education, information and healthcare, which resulted into economical and quick access of services in timely manner. Timely access to healthcare services and cost optimization are major concerns in this segment. This paper explores various aspects of mapping technological advancement to health sector requirements. While recognizing that there exist many facets of mobile applications in health care, it identified the constraints and limitations which are equated with healthcare sector. The paper furnishes an innovative and inclusive conception of relationship between healthcare and mobile based technology (MBT), specifically in difficult and inaccessible geographies. As defining a technical convergence of MBT and spatial component of CBT (computer based technology) for healthcare issues is relatively new perspective, the persuasiveness of its impact will outspread over time as it is adopted used and extended. The paper has conceptual nature.

Keywords—HDI (Human development index), diffusion theory, geo-spatial, m-health, MSDG (Mobile services delivery gateway)

I. INTRODUCTION

People are the real wealth of a nation – stated premises sowed the seed of new determinants to measure the development index of a society. In early 80’s, the Gross development product (GDP), was the only prime measure of overall well-being of a nation. However, various researches, economists and policy makers argued for acceptance of GDP as an absolute measure of development. In 1990’s, the first human development report generated by UNDP introduced a new term “Human development index” (HDI) to measure economic and social development of a nation, in a single frame of reference. Acknowledging previous methods, Human development index defined the basic determinants of human development as greater access to knowledge, better nutrition and health services, more secure livelihoods, security against crime and physical violence, satisfying leisure hours, political and cultural freedoms and sense of participation in community activities [1]. Thus, the overall development of a community is much more than economical growth and highly dependable on human resource of community particularly, nation in general. This framework has highlighted the impact of health index and nutrition status as the prudent factors for the axis of development. Health is a fundamental human right, can be defined as a state of complete physical, mental and social well-being which is aimed to attain the status of a better quality of life. Availability of good healthcare services facilitates for better health to people. However, Asia pacific has witnessed significantly low quality healthcare as compared to western world. The resource unavailability, location and time limitations are major parameters influencing health services in those regimes. Quality, affordability and accessibility are some other major concerns in health sector. Mobile phones- an exponentially growing technology offers way to help with those challenges. With advancement of technology and its intervention in sociology and social issues introduced new terminologies in health sector. Convergence of wireless technologies through mobile phones into health sector encompasses use of mobile telecommunications and multimedia technologies into health care delivery system. M-health is the use of mobile and wireless devices to improve health outcomes, health care services and health research [2]. M-health was coined by Professor Robert Istepanian as use of “emerging mobile communications and network technologies for healthcare” [3]. M-health is entire domain of wireless technologies, sensor
technology along with ICT and its application used in health sector. In Himalayan region where accessibility of resources and difficult spatial patterns are major concerns, m-health characterized by timely, efficient and cost effective service delivery system can be potent tool for healthcare system. e-health which also leveraged healthcare sector in developing countries can be augmented with m-health due to its huge use base over 929.37 million users. e-health and m-health technologies are linked since m-health creates opportunities for health care professionals to access and collect data that otherwise would be impossible (United Nations Foundation and Vodafone Foundation, 2009) [4].

II. LITERATURE REVIEW

Literature review of digital intervention in healthcare states, internet use has also increased substantially in recent years; in 2011 26% of the people in developing countries had internet access, whereas 79% had mobile or cellular phone subscriptions [5]. Indian government has already proposed MSDG (Mobile service delivery gateway) framework in 2012. MSDGis proposed to be used as a shared infrastructure by the Central and State Government Departments and Agencies at nominal costs for delivering public services through mobile devices [6]. It is supposed to incorporate various channel as voice, text (e-mail and SMS), GPRS, USSD, SIM Toolkit (STK), Cell Broadcast (CBC), and multimedia (MMS) to deliver citizen centric services. Healthcare services are most important requirements of a society. Previous studies shows health services in Asian countries are not good as western world and scenario is worse in difficult geographies. It has limited access to basic amenities and survival is rigorous. Mountains, coastal regions, deserts, islands form difficult geographies for one reason or other. This work tries to explore various aspects of using mobile technology for delivering healthcare services, especially in difficult geography. Previous studies explored the most important issue for digital health applications and providers as to attract and keep their users, precipitating the understanding on users’ mobile health service adoption behavior and other indigenous variables effecting healthcare interventions for research studies. Furthermore, the studies analyzing impact of exogenous variables as location of user, spatial pattern as difficult geographies where network and accessibility of resources are major concern, etc of digital intervention in healthcare sector are very rare. This lack produces prevalence of health technology or services for consumers who receive medical care. Thus, this study fills the gap by explicating the impact and importance of geographical conditions on implementation of policies and delivering citizen centric services through any digital intervention, particularly in mountainous region of central Himalayas in Indian Himalaya. Technological interventions in general and IT-Interventions in particular have a tremendous role in combating the issue of inaccessibility in this region however, two main reasons why IT-initiatives mostly fail in difficult geographies is that first the initiatives are often poorly designed. The second is that they are difficult to implement. Hence, the initiatives like implementation of MSDG need to consider those issues for successful implementation of such inclusive initiatives in mountainous regions. The remainder of this paper is organized as follows. Healthcare theories, communication theories, technology diffusion theories in difficult geographies are first reviewed, and then characteristics and limitations of those theories are articulated which are used to define a unified model for m-health initiatives in difficult geographies. Therefore the research question is stated as “to analyze various interdisciplinary theories in healthcare sector and ICT inclusion theories and integrate alternative models with local constraints to define M-health initiatives needs in difficult geographies.

III. DIFFUSION THEORY OF TECHNOLOGY

Diffusion theory of technology (Primarily given in communication theory by E.M. Rogers in 1962), explains adoption of an innovation, idea or technology as a process, over time, when an idea or technology gains momentum and diffuses (or spreads) through a specific population or social system. As a result of diffusion process, people adopt a new technology or innovation. Previous researchers revealed that diffusion theory for technology defines adoption of technology as a function of people’s attitude towards technology adoption. There are five well established adopter groups as follow: innovators, early adopters, early majority, late majority, and laggards. Uncertainty is an important impediment to the adoption of technology. Diffusion of technology is a process which must have some effects; the consequences of technology implementation may create uncertainty: “Consequences are the changes that occur in an individual or a social system as a result of the adoption or rejection of an innovation” (Rogers, 2003, p. 436) [7]. In case of Difficult geographies like Uttarakhand the impact of positively correlated uncertainties arise due to diffusion of technology may be transformational. Heterogeneity is another important character which influences diffusion of technology. Diffusion of innovations requires at least some degree of heterophony, which is “the degree to which two or more individuals who interact are different in certain attributes.” In fact, “one of the most distinctive problems in the diffusion of innovations is that the participants are usually quite heterophilious” (Rogers, 2003, p. 19). In Himalayan villages major variable which causes heterogeneity is “division between haves and have not’s”. To diffuse technology to every individual in society in presence of heterophony we can talk about associative model. Ghansala and Pant defined Associative informatics as technological sharing model to facilitate comparatively subdued member by relatively stronger memberi [8]. Rogers (2003) described the innovation-decision process as “an information-seeking and information-processing activity, where an individual is motivated to reduce uncertainty about the advantages and disadvantages of an innovation” (p. 172). Another important aspect of Diffusion theory is decision making procedure at individual or community level for diffusion or acceptance of technology. Decision making is a psychometric variable.
Rogers (2003) defined the innovation-decision process involves five steps:
- **knowledge**
- **persuasion**
- **decision**
- **implementation**
- **confirmation**

These stages typically follow each other in a time-ordered manner.

The procedure of technology diffusion revolves around two elements: social system and technology. In order to reduce the uncertainties in innovation-diffusion technique it is important to identify the basic attributes of both the elements. According to Rogers, an innovation has five fundamental characteristics as:
- **relative advantage**
- **compatibility**
- **complexity**
- **trialability**
- **observability**

Rogers (2003) stated that “individuals’ perceptions of these characteristics predict the rate of adoption of innovations” (p. 219). Rogers (2003) defined relative advantage as “the degree to which an innovation is perceived as being better than the idea it supersedes” (p. 229). In case of, Planning and implementing policies like m-health in difficult geographies where doctors or other medical persons resist going and to work, it is required to define relative advantages in form of direct or indirect incentives. Incentives are part of support and motivation factors. According to Rogers theory “compatibility is the degree to which an innovation is perceived as steady with the existing values, past experiences, and needs of potential adopters” (p. 15). Uttarakhand being a mountainous region has witnessed frequent disasters including the recent massive catastrophe in 2013. The entire regime is characterized by tough mountainous terrains which are difficult to access and historically reinforced the native people to develop their own traditional practices for sustaining their lives in difficult geography according to their geography and environmental situations. Any scientific and technical intervention may refer those traditional livelihood practices in different sections as agriculture, health practices using local medicinal plants, local artesian practices, for successful implementation and to reduce uncertainties may arise due to diffusion process. A lack of compatibility in IT with individual needs may negatively affect the individual’s IT use (McKenzie, 2001; Sherry, 1997). Similarly complexity can be defined as “the degree to which an improvement is perceived as reasonably difficult to understand and apply”. Tough terrains cause to inaccessibility of resources in this regime which impact awareness level of people. Low awareness level causes difficulty in understanding hence increases uncertainty due to complexity. Finally, observability of an innovation is defined as “the degree to which the results of an innovation are visible to others” (p. 16). In this paper, we explored different factors which may impact diffusion of technology in mountainous terrains of Uttarakhand using diffusion theory. Various geographical and socio-economical parameters of Himalayan state and societal pattern are used to map the diffusion theory for introducing technical intervention in this zone. Technology acceptance has become of vital importance not only for industrial and marketing purposes, but also for policy makers who should formulate effective measures in the light of overcoming the existing and even growing digital inequalities (Verdegem & Verhoest, 2009). Furthermore, we used this mapping to define a conceptual model for diffusion of m-health practices in hilly using mobile technology. Mobile devices can be used to access health information, to collect data, to collaborate with health care professionals, and gain interactive support from friends, family, and health providers (Allen et al., 2011; Klasnja & Pratt, 2012). The increase in cell phone use across populations provides accessible tools for delivering health interventions (Klasnja & Pratt, 2012).

Fig. 1 Conceptual model for m-health initiative

### IV. Conclusion

Induction of IT- initiatives for social transformation may accelerate the public service delivery system in rural gamut of state. However, any technical intervention in region require insight study of local variable like difficult geography and spatial patterns, frequent disaster, inaccessibility of tangible and physical resources, different socio-cultural patterns, traditional livelihood practices according to local geography for strategic implementation and effective use of technology in mountains.

**References**


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