Technology Adoption and Disability Digital Divide: an Empirical Study on Sri Lanka

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*Abstract— **Disabled** people are not having equal opportunities in accessing Information technology and Internet access compare to the non-disabled working population in Sri Lanka. The differently-abled population in the country has increased due to the 30 years of civil war. Most of them are working in national security forces of the country. Information and communication technology (ICT) infrastructure is also developed as part of the Sri Lankan nation. After ending humanitarian operations in 2009 Sri Lankan development strategy focusing on rebuilding the nation. However, still differently-abled community experiences difficulties in use of ICT based services due to various reasons. This is known as the disability digital divide. Taking necessary steps to reduce the disability digital divide will positively impact on national development in the country. This study proposes a framework to develop technology focused model to bridge the disability digital divide in the country aligning with the e-government strategy. The study consists of two phases. The first phase of the study examined the current technology adaption among differently-abled community in Sri Lanka. The second phase examines the problems and issues faced by them. Issues in the three different technologies were analyses to reduce the disability digital divide such as web, mobile and personnel computer tools. This model focuses on evaluating the factors affecting perception on technology by differently abled community, problems in technological factors and other critical factors relating to disability digital divide.*

Keywords—Disability Digital Divide, Technology Adoption, Educational Model

I. INTRODUCTION

A. Background to the Study

Accessibility issues for disabled people are a pertinent issue take into consideration in the modern globalised world. In Sri Lanka also this is a very influencing topic because many people suffered due to the civil war. In Sri Lankan civilian who was born without any physical disability became disabled because of civil war in the country. This adds a severe disadvantage for the Nation. Due to their disability many young people who contribute to the national economy also facing difficulties. This especially happens when they are using new technologies in their office work. Modern organizations many strategies are more align with technology. Rapidly developing technologies which are daily added into office environment. But the main problem is adoption on those tools and technologies are low among the community. There is a requirement of finding the factors which causes for this issues and bridging this gap.

Objective of this study is to propose a model to measure the critical factors which influence for disability digital divide in Sri Lanka.

This research basically divided into three different research questions. First question is to finds out on the different level of basic, intermediate and high technologies used by this community. Second question is to find out the technology adoption among this community. Third question is to finds out a proper model to measure the disability digital in the country.

Outcome of the research propose a web, mobile and computer technology framework to measure the disability digital divide.

II. LITERATURE REVIEW

A. Definitions

According to the Charloton (1998) and Driedger (1989) study disability is complex, dynamic, multidimensional, and contested. Over recent decades, the disabled people's movement together with world report on disability numerous researchers from the social and health sciences– have identified the role of social and physical barriers in disability (Barnes, 1991).

According to the Roger et.al(anon) Digital divide is a latest evocative term that refers to differences in access to uses of information technology that are correlated with income, race and ethnicity, gender, age, place of residence, and other measures of socioeconomic status. According to them some people have the most powerful computers, the best telephone service and fastest Internet service, as well as a wealth of content and training relevant to their lives. Another group of people do not have access to the newest and best computers,

the most reliable telephone service or the fastest or most convenient Internet services. The difference between these two groups is called the Digital Divide.

According to the Sen (2009) Disability is a development issue, because of its bidirectional link to poverty: disability may increase the risk of poverty, and poverty may increase the risk of disability.

This disadvantage group of community also face some difficulties of access computers, mobiles and Internet. It causes for many reasons such as poverty, lack of awareness, language issues, Social and ethical background and lack of Interest.

B. Theory used for this study

In the Innovation - Diffusion Theory the status of Digital Divide of a disabled community was specified by means of an Index. This theory is basically used to identify the technology adoption among the people by many researchers. Therefore this theory used to analysis to measure the disability digital divide.

Rogers' diffusion of innovations theory is the most appropriate for investigating the adoption of technology in the disabled community. Much diffusion research involves technological innovations so Rogers (2003) usually used the word "technology" and "innovation" as synonyms. According to Rogers, "a technology is a design for instrumental action that reduces the uncertainty in the cause-effect relationships involved in achieving a desired outcome". It is composed of two parts: hardware and software. While hardware is "the tool that embodies the technology in the form of a material or physical object," software is "the information base for the tool" (Rogers, 2003). Since software (as a technological innovation) has a low level of observation and its rate of adoption is quite slow. The model is given in the figure 01
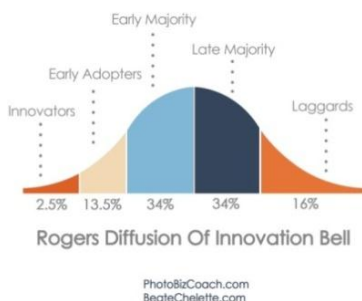

Figure 1: Rogers Diffusion Theory

III. METHODOLOGY AND EXPERIMENTAL DESIGN

The empirical model used to examine the relationship between the level of adoption of ICT in a disabled community, associated factors and the methods used to collect and analyse data are discussed below.

C. Research Strategy

This research consists of two phases. In the first phase technology adoption in the differently abled community is measure through a survey. Second phase included another field survey to find data related to problems and issues related to use of computers, Internet and mobile usage by the disabled community.

D. Data Collection

Primary data collected in this study via an observation and interviews. It was done at Sri Lanka Army CLI, unit Panagoda. Structured interviews were conducted. This study interviewed 314 differently abled people using a non-probability sampling method such as convenience sampling. Age group of the participants was between 20 to 50 years old. Participants for this study were selected from different communities, disabled categories and various geographical locations. Data is collected in under the different levels of technology usage under the three themes such as basic, intermediate and advance.

In the second phase of this study conducted at the Ranaviru Apparel Yakkala Branch. Study conducted with 180 disabled employees. Structured interviews were conducted. Participants for this study were selected again from different Age, Type of Work, Gender, Living arrangement, Employment status, Management Level and Income.

E. Data Analysis Framework

Level of Adoption of Basic ICT (B Basic ICT Facilities ICT) = Basic ICT Facilities/ 3

Level of Adoption of Intermediate ICT (I Intermediate ICT Facilities ICT) = Intermediate ICT Facilities/ 4

Level of Adoption of Advanced ICT (A Advanced ICT Facilities ICT) =Advance ICT Facilities/ 3

In the first sample set differently abled community adopts 2 out of 3 ICT facilities listed under the Basic category, its BICT would be 2/3 = 0.66. Similarly, if the same set adopts 2 Intermediate and 1 Advanced ICT facility, its IICT and AICT would be 2/4 = ½ = 0.5 and 1/3 = 0.33, respectively.

Table 1: Type of Variable Used for the Empirical Model in Phase 01

Notation	Type of Accessibility	Variable Description
B1	Basic	Telephone Use
B2	Basic	Web Access – Information Search and Email use
B3	Basic	Computer Use
I1	Intermediate	Office application Use
I2	Intermediate	Multimedia use
I3	Intermediate	Screen reader Software use
I4	Intermediate	Social media use
A1	Advance	IT Administration
A2	Advance	S/W Design Development related
A3	Advance	High-tech S/W Use (E.g. CAD/ CAM Operations)

Table 2: Dependent Variables Used in the Empirical Model

Type of Users	Dependent Variable	Range of the Digital Divide Index
1. ICT Innovators	DDI1	0.8 < DDI > 1.0
2. Early ICT Adopters	DDI2	0.6 < DDI > 0.8
3. Early Majority ICT Adopters	DDI3	DDI3 0.4 < DDI> 0.6
4. Late Majority ICT Adopters	DDI4	DDI4 0.2 < DDI> 0.4
5. Laggards in Adopting ICT	DDI5	DDI5 0.0 < DDI > 0.2

Phase 02 -
Collected data were analysed based on qualitative approach according to thirteen themes. Analysis techniques used in this research were co-relation on the above factors on disability digital divide. Factors analysed based on the three main viewpoints including perception on technology, Technical problems and issues and other Inhibit factors.

Following variables Identified as causes for disability digital divide. It is given in the Table 3, Table 4 and Table 5.

In order to identify the factors affecting to disability digital divide classify under three viewpoints. The first theme is perception on technologies. Under this five main factors were taken into consideration. Such as person income, education background, personnel interest on learning new technologies, use of technology to watching films, listing music and other entertainment activities. Finally it considers how the person culture effects to disability digital divide.

Technical problems and issues were taken in the second theme. Basically it discusses web standard issues and software incompatibility or the friendliness.

Next it explains the technical problems and issues. Under this it discusses web standards issues and software incompatibility or the friendliness.

Finally it concerns the other inhibiting factors which causes for disability digital divide such as cost of software technology and use of it. Awareness of the technology, Use only some basic technologies without proper direction. Some people have proper direction but due to disability they suffer with have lack of skills. Next it considers the resources issues. Most of the disabled users are facing with some financial difficulties. Therefore most of the assistive technologies cannot be purchased.

The above factors are summarised in the Table 03 as a summary.

Table 3: Factors to consider in the framework

Perception on Technology (Independent Variables)	Technical problems and issues (Independent Variables)	Other inhibiting factors (Independent Variables)
Income**(CPI)**	web standard issues**(CTW)**	Cost of Software Technology**(COC)**
Education**(CPE)**	Software incompatibility/user friendliness **(CTS)**	Lack of Awareness**(COLA)**
Desire for learning**(CPL)**		Lack of Direction**(COLD)**
Entertainment**(CPEN)**		Lack of Skills**(COLS)**
Culture**(CPC)**		Lack of resources**(COLR)**
		Lac of Training**(COLT)**

The above discussed factors are common when use of mobile, web/ Internet or computers. Therefore these factors were separately analyses with different technologies. In the table 04 the above factors were concern when using web technologies. Questioner were separately analysis the below factors separately analysis the below factors in order to identify the disability digital divide.

Table 4: Web related factors

Perception on Technology (Independent Variables)	Technical problems and issues (Independent Variables)	Other inhibiting factors (Independent Variables)
Income(**WPI**)	web standard issues(**WTW**)	Cost of Software Technology(**WOC**)
Education(**WPE**)	Software incompatibility / friendliness(**WTS**)	Lack of Awareness(**WOLA**)
Desire for learning(**WPL**)		Lack of Direction(**WOLD**)
Entertainment(**WPEN**)		Lack of Skills (**WOLS**)
Culture(**WPC**)		Lack of resources(**WOLR**)
		Lac of Training (**WOLT**)

The questionnaires were further analyses the above factors discussed in the table 03. When they using mobile technologies same consideration were further analyses which related to the mobile technology which is shown in the Table 05. Same factors also consider, finding the adoption for the computer usage.

I. RESULT AND DISCUSSION

Descriptive statistics of the sample, the general information of differently abled community (age, experience in technology), and the other details are reported in Table 4.

According to the descriptive statistics three main areas were taken into consideration such as current ICT knowledge, Relevance of IT for job related activities and Interest of ICT for future needs. Result of the study indicated that the level of Current ICT Knowledge is high among the age between 25 to 28.Reason for this could be that younger generation is using more smart phones and they are likes to incorporate new technologies. Adaption level is high among this community.

Table 5: Mobile related factors

Perception on Technology (Independent Variables)	Technical problems and issues (Independent Variables)	Other inhibiting factors (Independent Variables)
Income(**MPI**)	web standard issues(**MTW**)	Cost of Software Technology(**MOC**)
Education(**MPE**)	Software incompatibility/ user friendliness(**MTS**)	Lack of Awareness(**MOLA**)
Desire for learning(**MPL**)		Lack of Direction(**MOLD**)
Entertainment(**MPEN**)		Lack of Skills(**MOLS**)
Culture(**MPC**)		Lack of resources(**MOLR**)
		Lac of Training(**MOLT**)

English language issues among this community can be considered as a significant issue. 90 percent of the participant had English language issues and they are working in Sinhala language. As a result majority are having language barriers to use technology. Therefore Most of them are in the medium level .Most of the computer users are using office package in day today life at the same time some participants in young age like to use new innovative technology. But employees who are closer to retirement age do not like to learn new technologies. Their ambition is to have their pension and stay at home. But they are interested in giving IT education to their children rather than learning themselves.

On the other hand according the findings social media usage is 0% among the community. Restriction of social media with in the office hours and office computer are causes for this result. Most of them do not have a computer at home and as a result less usage of social media among the community.

Table 6: Use of Technology

Variable	Description	Respondent	Percentage
B1	Telephone Use	252	98 %
B2	Web Access	150	58 %
B3	Computer Use	155	60 %
I1	Office application Use	131	51 %
I2	Multimedia use	28	11 %
I3	Screen reader Software use	4	0 %
I4	Social media use	10	0 %
A1	IT Administration	2	0 %
A2	S/W Design Development related	1	0 %
A3	High-tech S/W Use	0	0 %

A.   Level of Adoption
According to the Rodgers adoption theory discussed above following calculations were done to identify the level of adoption.

Level of Adoption of Basic ICT (B Basic ICT Facilities ICT) = Basic ICT Facilities/ 3

According to the formula values for adoption in basic ICT is 72 % .Therefore this study conclude that level of adoption among the use of basic ICT Facilities are between 0.8 and 0.6. Therefore it is proved that this community are early users for basic level of ICT facilities. This is shown in the Figure 2.
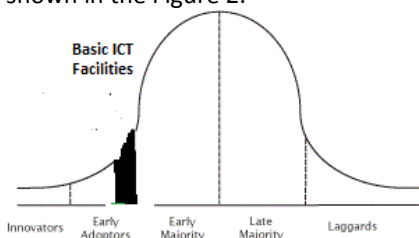
Figure 2: Adoption on Basic ICT Facilities

Level of Adoption of Intermediate ICT (I Intermediate ICT Facilities ICT) = Intermediate ICT Facilities/ 4

According to the formula, values for adoption in Intermediate ICT is 15.5% .Therefore this study concludes that level of adoption among the users of basic ICT Facilities are between 0.2 to 0.0.Therefore it proves that this community is Laggards in Adopting ICT for Intermediate level of ICT facilities. This is shown in the Figure 3.
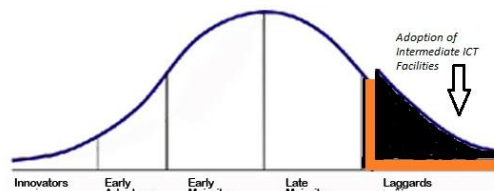

Figure 3: Adoption of Intermediate ICT Facilities

Level of Adoption of Advanced ICT (A Advanced ICT Facilities ICT) =Advance ICT Facilities/ 3

According to the formula values for adoption in advance ICT is 0 % .Therefore this study concludes that level of adoption among the use of basic ICT Facilities is between 0.2 to 0.0.Therefore, it is clear that this community is Laggards in Adopting for advance ICT facilities. This is shown in the figure 5.
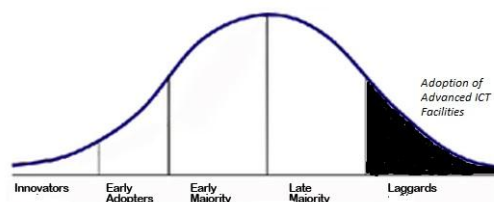

Figure 4: Adoption on Advance ICT Facilities

According to the analysis, 58 % are using web services including E-mail system, but it is noticeable that the usage of Social media is 0%. Reason for this deviation is that this community does not have social relationships with the use of high technology.

Mobile, Web and Computer Adoption- Phase II

In the phase II of this study different type of disabled participant were interviewed. It was included with 53 people with having serious difficulties in eyes, 05 hearing problems, and 06 people with upper Limbs and 06 with lower limbs. In addition to that 107 no of people with different complications of disabilities were involved. All together 177 no of participants were taken in to this research.

According to the phase II study findings it was indicated that among the three technologies mobile usage is high among the community and computers and web usage is not much popular among them. The following figures 6, 7 and 8 have shown about the technology adoption.

Similarly in the Phase 01, Phase 02 also analysis done to find the adoption of the different technologies such as mobile, web and computer. Out of 177 sample 78 % of them are using mobile technologies. Therefore according

to the technology adoption curve it is come under the range between 0.6 to 0.8 ranges. Then it concludes as these disabled users are early adopters when using mobile technology.
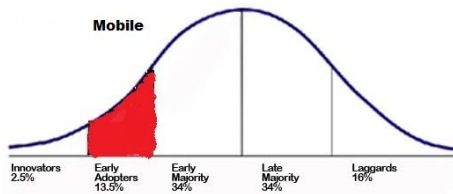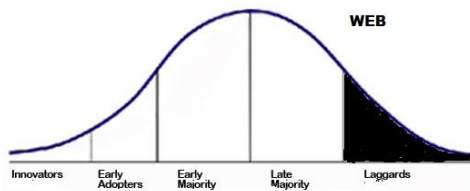

Figure 5: Mobile Technology Adoption

Out of 177 sample 16 % of them are using mobile technologies. Therefore according to the technology adoption curve it is come under the range between 0.6 to 0.8 ranges. Then it concludes as these disabled users are laggards when using web.

Figure 6: Web Technology Adoption

Out of 177 sample 19 % of them are using computer technologies. Therefore according to the technology adoption curve it is come under the range between 0.0 to 0.2 ranges. Then it concludes disabled users are laggards when using computer technology.
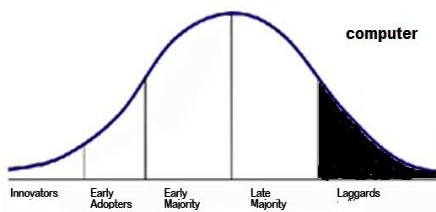

Figure 7: Computer Technology Adoption

V. CONCLUSION AND RECOMMENDATION

According to the above phase 1 and phase II findings indicate that technology adoption on different technologies and different facilities are low in the normal bell shape curve. Therefore overcome the digital divide issues among the disabled community need to consider in multiple perspectives.

To identify the disability digital divide this proposed two dimensional model will use as a benchmark and could be used as a model when bridging the disability digital divide in a country. Following figure 8

Disability Digital Divide Index (Web, Mobile and Computer)		
Perception on technology	Technological barriers	Other inhibiting factors
*Income *Education *Desire on learning *Entertainment *Culture	*Software Incompatibility Issues /User friendliness *WEB Standards Issues	*Lack of Awareness *Lack of Training *Lack of direction *Lack of resources *Cost of technology

Figure 8: Framework to measure the disability digital divide

To overcome the issues different variables were proposed to measure the adoption on disability digital divide. This model was covered with the three different technologies such as mobile web and computers related factors.

A. Changing Perception on IT

Under this indicator five different variables were considered to measure the disability digital divide.

Low Income – A Persons income factor is a main benchmark to identify the technological usage. According to analysis it is prove that among the low income people technology usage is comparatively low with comparing to high income community. This is a common factor for disabled or non-disabled. But comparatively high among the disabled community. Therefore low income could be considered as a one benchmark factor to identify the disability digital divide.

Education –Education level of disabled person is another considering factor to measure the level of disability digital divide. This is again common factor for disable and non-disabled community but comparatively disabled person education is highly considering factor on the disability digital divide. Perception on technology will base on disabled community.

Desire in Learning – Some people is getting education by default due to Sri Lankan free education system. But desire in learning is coming as a different aspect in this

model. It considers willingness on learning new technologies also effect for disability digital divide.

Entrainment - Many of this community is disadvantage of accessing current entertainment available in mobile, computers and internet. People much more use entertainment such as listen music in YouTube, web surfing and use of social media are directly effect to the disability digital divide.

Culture – Culture of the disabled people and the technology ideas, customs and social behavior are considered under this factor.

B. Technological problem related factors

Web standard issues – Issues with technologies in web is directly effect to disability digital divide. This factor is highly co-related because most of the screen reading software which is used by blind users is facing some converting text to voice. In addition to that lack of transition facilities to brail or other devisers also a make inaccessible to disabled community. Therefore this factor also takes into consideration.

Software incompatibility/user friendliness –
When software is designed to run mobile applications or a normal standalone machine or as a web page in the www, all functionalities need to be executable in a keyboard. Accessibility features need to be developed and documentation is a requirement. The meaning assign to images need to be meaningful to convert in the screen readers. Colour selection for the systems is necessary to consider about colour blindness issues. Non Animation presentation mode is necessary to include in any mode. Software need to avoid or using blinking text or any flash or blink frequency greater than 2 Hz and lower than 55 Hz. The above identified each problems could be identified and use a benchmark to release the software.

C. Removing other inhabiting factors

Lack of Awareness– The level of awareness is a needing indicator to measure the disability digital divide. Three different level of technology awareness can be measure.
Lack of Directions – This factor could be measure on the proper directions to use web, mobile and computer for their job related activities.
Lack of Skills and training -
Different destabilise are having different problems and issues and they need with different skills and training

requirements to overcome the disability digital divide. This factor is also necessary to measure.

Lack of resources -
By checking whether the People with having vision issues could be equipped with refreshable brail system, screen magnifier or equipment used to different disabilities will be more effective way to measure in this model. Overall performance could be measure by use and adoption of technology after used this technologies.

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