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The best among you are those who have the best manners and character.

Prophet Muhammad (Peace Be Upon Him)

USC-MSA web (English) reference. [Sahih al-Bukhari, Vol. 4, Book 56, Hadith 759]

ABSTRACT

ICT and wellbeing are fundamental concerns in information systems science but seem to have an uncertain place in policy and academic groups. Recently, a considerable deal of literature has emerged around the theme of the digital divide; admittedly, weaving an intricate web of hypothetical assumptions about the nature of the problem. In spite of the six decades of critical research that has been conducted on the digital divide, misconceptions about the phenomenon still abound, even within prominent research groups, as witnessed by inconsistent definitions of the term.

While the shrinkage in prices of basic ICT equipment has enabled ICT access to masses, the trend of the digital divide has wandered into another direction: a constellation of divides based on skills, type and quality of ICT tools. Simultaneously, a new form of the digital divide related to elderly people is actively raising its head globally, which has been labelled as the grey digital divide in the literature.

To remedy these limitations, this research assigns itself a mandate to rethink the phenomenon of the digital divide critically and arrive at a solution. The prime narrative constructed throughout the body of this dissertation centres on the solution to the long awaited problem of the digital divide. To understand this multilevel phenomenon, Finland and Pakistan were taken as reference countries to represent ICT situation in one developed and one developing country.

Holistic research design was best suited to address the nature of research questions raised in the research design. The World Bank was a major source of data, in addition to systematic literature review on the digital divide. To bridge further gaps in existent literature, an ongoing literature review which was actively conducted throughout the dissertation writing process continually provided new insights into the topic. Multivariate regression analysis was used to examine large chunks of World Bank data from 191 countries.

Results indicate that the digital divide is a much more complex phenomenon than previously understood. Although developed countries have overpassed developing countries in terms of ICT penetration and infrastructure, there are considerable digital divides in developed regions. Results of empirical investigation clarified the quite confused debate between socio-economic indicators and ICT relationships worldwide.

Based on analysis of findings and literature, a systematic solution to minimise the digital divide in Pakistan has been proposed. It is premature to conclude that the digital divide can ever be fully bridged. It is an enduring phenomenon that will continue in various forms. However, multilevel efforts can be directed to minimise it as much as possible. Role of ICT in healthcare and social welfare should be a key practical agenda worldwide. Future work on this topic must continue globally and procedures to form a universal assessment mechanism for the digital divide should begin in earnest.

TIIVISTELMÄ

Tietotekniikka ja hyvinvointi ovat keskeisiä kiinnostuksenkohteita tietojärjestelmätieteessä, mutta niiden asema politiikassa ja akateemisissa piireissä vaikuttaa vakiintumattomalta. Viime aikoina merkittävä määrä kirjallisuutta on kasvanut ”digitaalisen jaon” teeman ympärille, mikä on luonut kompleksisia hypoteettisia oletuksia ongelman luonteen ympärille. Huolimatta runsaasta määrästä digitaalista jakoa koskevasta kriittisestä tutkimuksesta, jota on tehty kuuden vuosikymmenen ajan, ilmiöstä on edelleen havaittavissa runsaasti väärinkäsityksiä, jopa merkittävissä tutkimusryhmissä, kuten termin yhtäpitämättömät määritelmät osoittavat.

Samaan aikaan kun tietotekniikan hintojen lasku on mahdollistanut tietotekniikan saatavuuden massoille, digitaalisen jaon kehitys on mennyt toiseen suuntaan: on olemassa joukko jakoja, jotka perustuvat tietotekniikkatyökalujen taitoihin, tyyppeihin ja laatuun. Samanaikaisesti digitaalisen jaon uusi muoto ”harmaa digitaalinen jako”, joka liittyy ikäihmisiin, on aktiivisessa kasvussa maailmanlaajuisesti.

Nämä rajoitukset ja haasteet silmällä pitäen, tämä tutkimus arvioi kriittisesti ja ratkaisukeskeisesti digitaalisen jaon ilmiötä. Tämä tutkielma keskittyy ensisijaisesti pitkään odotettuun digitaalisen jaon ongelman ratkaisuun. Jotta olisi mahdollista ymmärtää tätä monitasoista ilmiötä, Suomea ja Pakistania käytettiin vertailumaina edustamaan tietotekniikan tilannetta kehittyneessä ja kehittyvässä maassa.

Kokonaisvaltainen tutkimus oli sopivin tapa käsitellä tutkimuskysymyksiä. Tutkimus perustuu Maailmanpankin tietoihin sekä systemaattiseen kirjallisuuskatsaukseen digitaalisesta jaosta. Koko väitöskirjaprosessin jatkunut kirjallisuuskatsaus lisäsi jatkuvasti ymmärrystä aiheesta pyrkien täyttämään aukkoja olemassa olevassa kirjallisuudessa sekä antamaan uusia näkemyksiä teemaan liittyen. Monimuuttujaregressioanalyysiä käytettiin tilastollisena menetelmänä Maailmanpankin 191 maata kattavavan suuren tietoaineiston analysoinnissa.

Tulokset osoittavat, että digitaalinen jako on paljon monimutkaisempi ilmiö kuin mitä aiemmin on ymmärretty. Vaikka kehittyneet maat ovat kehittyviä maita edellä tietotekniikan levinneisyyden ja infrastruktuurin suhteen, kehittyneillä alueilla on huomattavia digitaalisia jakoja. Empiirisen tutkimuksen tulokset selkeyttivät hyvin sekaantunutta väittelyä yhteiskunnallis-taloudellisten indikaattoreiden sekä tietotekniikan suhteesta maailmanlaajuisesti.

Analyysiin ja kirjallisuuteen perustuen ehdotetaan systemaattista ratkaisua minimoimaan digitaalista jakoa Pakistanissa. On ennenaikaista päätellä, että digitaalista jakoa voi koskaan täysin poistaa. Se on ikuinen ilmiö, joka jatkuu eri muodoissaan. Kuitenkin monella tasolla voidaan ryhtyä toimiin sen minimoimiseksi. Tietotekniikan roolin terveydenhoidossa ja sosiaalihuollossa pitäisi olla käytännössä pääosassa keskusteluissa globaalisti. Aihetta koskevan tutkimuksen on syytä jatkua maailmanlaajuisesti. Erityisesti pitäisi aloittaa toimenpiteet, joilla pystyttäisiin arvioimaan digitaalista jakoa kansainvälisesti.

DEDICATION

This dissertation is dedicated to my parents, my mother Nusrat Mubarak and my father Mubarak Ali, and my sister Khadija Mubarak and her adorable children Muhammad Saad and Muhammad Yousuf, who have supported me through thick and thin. My sincere dedication is also due towards my grandparents who bestowed tremendous love upon me and constantly encouraged me to attain higher education. Thank you for your patience, support, encouragement, and love in this and in all other areas of my life.

PREFACE

"What is the digital divide, and what are the risks associated with it?" is a fundamental question in the discipline of information systems science. I argue that a new generation of research in this area needs to address the extended question: What exactly is the digital divide, what forms does it take, what are the associated risks, and how it can be effectively bridged?

The digital divide, as understood by many, is the gulf between those who have access to digital technologies and those who do not. However, new understandings have established that the digital divide is not only a matter of access but also of beneficial usage.

Information and communication technology (ICT) is spreading at an unprecedented rate, but the digital divide continues to affect millions of lives worldwide. Although it has been widely studied, the digital divide, as a research theme, still remains largely misunderstood or over-understood.

A recurring theme in the digital divide research is explanation of the nature of the digital divide and its causes. Often, new advances reshape the arguments, which are essentially recasting the similar message into a new arrangement. Despite all this, the prime question remains where it is: the digital divide persists, has even deepened on variety of levels, and is unresolved at large.

Discussions about bridging the digital divide often rest on a flawed assumption that closing the information gap means providing people with physical access to information and technology. In practice, much more is at issue. The digital divide is becoming increasingly complicated. Perhaps it is an indication of shortcomings in research on this very complex topic. As such, the digital divide has been an abstract concept, conjuring up a mystical structure without any pillars. Several inconsistent definitions of the digital divide suggest that this topic is presently in a state of flux.

I challenge the widely held view that the digital divide can solve itself over time. It strikes me that a considerable theme of the digital divide is predicated on premise that the divide will solve itself over time. In practice, if market forces close one digital divide, a new one soon replaces it, and this phenomenon continues in accordance with the rate of change of technology.

Many would argue that ICTs such as tablets and smartphones are not pervasive in the lives of many people, especially younger people who tend to buy the latest ICTs mainly for entertainment purposes. Why then is the digital divide so important to address, since most people already seem to be using mobile phones and computers? In this light, the idea of the digital divide may sound obsolete to them, since ICT is spreading globally at such a rapid rate.

However, as I will argue in detail, this assumption is highly disputed, since recent research supports the idea that the digital divide is deepening across the

world. This development is based on numerous factors, ranging from quality of ICT equipment to individual competence and state control of internet and content. It should be apparent that new ICT equipment refutes existing ones at the present unprecedented rate.

Recent examples of the persistence of the digital divide can be seen in disparities among quality of hardware and software coupled with other individual factors. There is often a fine line between low-cost, low-speed internet versus high-cost, high-speed internet access. In the same sense, one can achieve much more with the latest hardware, which is capable of running the latest software, than with a slow and old computer. Rate of change of ICT is so rapid that the purchase of new models of ICT every year certainly becomes difficult for most people. This means in particular that there is a segment of the population that benefits from the latest ICT every year, and the rest lose out on the benefits of the latest hardware and software.

This closely parallels the idea that having access to ICT is no longer a guarantee that the digital divide is solved. ICTs can be appealing to play with, or they can be used for various other, more productive purposes. Despite having high quality ICT access, if one does not gear it towards beneficial usage, many researchers consider it a form of the digital divide. ICTs themselves are morally neutral; it is the use to which they are put that has moral significance. The present research posits that the digital divide is inevitable. It cannot be fully bridged, but can be controlled and minimised with meditation of governments.

I originally wanted to conduct a monograph dissertation, because focus is much centralised on thesis compared to thesis by publication or article-based dissertation. An article-based dissertation is apparently beneficial for both students and research institutions as it promotes a publication-focused research culture. Furthermore, it offers the opportunity to learn the best principles of publishing with supervisors. Co-authorship with dissertation supervisors in publications is an effective way to enhance student's learning (Kamler, 2008, pp. 288–289). Peer reviews and feedback on papers in academic settings are exceptionally beneficial and they also increase the examiner's overall confidence in reviewing the dissertation.

The only major drawback of conducting a monograph thesis is that it does not allow a researcher to develop specific skills for publishing research papers. The dissertation by publication, on the other hand, is effective in the sense, as Francis, Mills, Chapman, and Birks (2009, p. 99) suggest, that it effectively and broadly disseminates research findings.

Nevertheless, to create a monograph dissertation I extended the chapters, especially the systematic literature review article, for further depth and breadth. Certain crucial components of the dissertation are covered in detail, which include rationale, significance, and contextualising the research problem.

Metaphorically, a quality research premised on sound justification and usefulness is equivalent to a hiker traversing rough terrain strewn with challenges left and right. With a bit of passion, the end result can be a success. My prime motivation behind this work emanates from an intensely felt desire to trace the resolution of the digital divide and leave behind useful research footprints for future generation.

Although intended for an academic audience as a requirement, this composition is an open message to all concerned in the havoc posed by the digital divide. In general, there is reason to be confident that the digital divide can one day be essentially resolved on a broad level, but never in its entirety.

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I am very grateful to University of Turku Foundation, Liikesivistysrahasto, Turun Kauppaseura and Tukki Säätiö for their support. Your support has enabled me to focus fully on my dissertation and complete my studies in time.

My deepest thanks are to my parents, my mother Nusrat Mubarak and my father Mubarak Ali, who went out of their way to support and encourage me and bear with me during my years of study. My father had a dream of seeing me highly educated, and I am fulfilling it today. Your prayers, love, and support have helped me tremendously.

Farooq Mubarak

Tuesday, May 15, 2018. Turku, Finland.

LIST OF PUBLICATIONS RELATED TO THE DISSERTATION

1. Mubarak, F. (2015). Towards a renewed understanding of the complex nerves of the digital divide. *Journal of Social Inclusion 6*(1), 71-102.

2. Mubarak, F. (2014, August 18-20). Revitalizing the quantitative understanding of the digital divide: an uptake on the digital divide indicators. In: ed. Saranto, K., Castrén, M., Kuusela, T., Hyrynsalmi, S., Ojala, S. *Safe and Secure Cities.* Paper presented at WIS 2014: 5th International Conference on Wellbeing in the Information Society, Turku (pp. 121-126). Cham: Springer.

3. Mubarak, F., Suomi, R. (2015, October 13-15). A visual uptake on the digital divide. In: ed. Janssen, M., Mäntymäki, M., Hidders, J., Klievink, B., Lamersdorf, W., van Loenen, B., Zuiderwijk, A. *Open and Big Data Management and Innovation.* Paper presented at I3E 2015: 14th IFIP WG 6.11 Conference on e-Business, e-Services, and e-Society (pp. 398-415). Cham, Switzerland: Springer.

4. Mubarak, F., Suomi, R., and Kantola, S.P. (Manuscript under review). Socioeconomic indicators and ICT: The forgotten chapter of the digital divide, *Journal of Global Information Technology Management.*

5. Mubarak, F., Nycyk, M. (2017). Teaching older people internet skills to minimize grey digital divides: developed and developing countries in focus, *Journal of Information Communication and Ethics in Society 15*(2), 165-178. http://dx.doi.org/10.1108/JICES-06-2016-0022

6. Mubarak, F., Suomi, R. (Manuscript under review). Digital Divide and Health Divide in Information Age: Cases from Pakistan and Finland, *Journal of Community Informatics.*

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Part I

OVERVIEW

1 INTRODUCTION

1.1 The topic, background, and context

While the industrial electronic giants were busy in developing state-of-the-art business computers in the wake of electronic computers in the previous century, a new revolution was taking place in the world, centred on the idea of electronic networking (Campbell-Kelly, 1987; Kim, 2005; Yates, 1997). Consequently, one of the most important events of the 1990s was the emergence of the internet, which caught the rapt attention of those in academia, the press, and policy domains. Ever since, rapid advances have been made in digital technologies and new digital landscape came upon the scene, globally but highly unevenly. That was when the issue of the digital divide emerged, creating widespread concern in the media and among policy-makers. To date, however, research on the digital divide has predominantly concentrated on explanation of the divide and its causes (De Haan, 2004, p. 67; Gunkel, 2003).

Information and communication technology (ICT) was historically taken as a significant driver of the global economy (Baliamoune, 2002, p. 1; Brynjolfsson, 1993, pp. 67, 72–73; Brynjolfsson and Hitt, 1998, pp. 51, 55; Kraemer, Ganley, and Dewan, 2005, p. 410; Mariscal, 2005, p. 410; Meng and Li, 2002, p. 275), as clearly apparent from ICT integration in a wide range of economic activities including banking, education, healthcare and other sectors. However, considerable evidence (David and Wright, 1999, p. 16; Lapointe, Mignerat, and Vedel, 2011, p. 102; Jones, Heaton, Rudin, and Schneider, 2012, p. 2243) highlighted the productivity paradox, arguing that economic and healthcare productivity have been low despite visible diffusion of ICT.

Sigala (2002) measured the impact of ICT on productivity in 300 hotels in the United Kingdom confirmed that productivity gains do not accrue from ICT investments, but rather from the full exploitation of ICT tools. A similar conclusion was reached by Samuel and Bakar (2006, pp. 5, 13), who interviewed 30 school teachers from three schools in Kuala Langat District in Malaysia and concluded that instead of increasing computer laboratories in schools focus must be on training ICT skills so that beneficial usage is possible. A survey of information professionals in Nigerian national and academic libraries revealed that 77 percent of respondents were not even using ICT resources due to lack of awareness and lack of ICT skills (Ashcroft and Watts, 2005, pp. 8–9, 11).

In general, the digital trend across various institutions and countries has been on ICT adoption solely, as was the case in Vietnam (Winley, Leung, Tsang, and Lau, 2016, p. 10). Although investment in ICT is shown to have a relevant degree of output growth when compared to non-investment (Atzeni and Carboni, 2006, pp. 147–148, 152), Zanfei and Seri (2016, pp. 6, 20) reviewed several contributions to confirm that ICT has a productive role when combined with skills. It then follows that investment in ICT alone is a poor indicator of productivity in a real sense, but is rather a combination of skills and intended usage that can make any substantial difference.

Productivity appears to be a function of ICT skills and usage. At present ICT is fast becoming a key instrument in a wide range of disciplines across developed countries merited to the privilege of connectivity. However, developing countries are lagging far behind. Across a range of academic, press, and policy disciplines, the issue of the digital divide comes under intense scrutiny due to various serious concerns.

Along with the rapid diffusion of ICT worldwide, there is an increasing concern that several individuals are disadvantaged and unable to benefit from the digital technologies. This concern is intensifying, since in terms of ICT skills the division is reportedly expanding its foothold (Rahim, Pawanteh, and Salman, 2011, p. 4). There are growing fears of global division regarding inequality of access to digital technologies.

Advances in ICT are surging throughout the developed world, but making their way to developing countries rather slowly (Norris, 2001, p. 3). Correspondingly, the beneficial usage of ICT in developed countries is growing significantly faster than in developing countries (Nulens, 2003, p. 69). To make matters worse, the influence of the digital divide is seemingly coextensive with the troubled global world economy.

By the start of the 2000s, the digital divide became a significant research issue, but no profound solutions have been made that can bring closure to this socio-economic phenomenon. Instead, in real terms the digital divide has deepened despite visible diffusion of ICT (Hsu et al., 2005, pp. 169–170; Mossberger, Tolbert, and Stansbury, 2003, p. 1) across an ever-increasing range of sectors embracing ICT. In his overview of this concept, Thierer (2000) questions the persistence of the digital divide despite widespread availability of computers and the internet. It appears that parallel to cutting-edge ICT, digital disparities are continuously evolving in various forms and effecting individuals and societies on socio-economic fronts.

The digital divide now appears to badly affect the quality of healthcare services. Many studies (Bakker, 2002; Chetley, Davies, Trude, McConnell, and Ramirez, 2006; Cocosila and Archer, 2010; Healy, 2004; Kimaro, 2006; Kwankam, 2004; Lin et al., 2015; Marschollek et al., 2007; Mattila et al., 2007;

Moahi, 2009; Punamäki et al., 2007) have inspired the inverse connection between digital divide and effective healthcare provision. This evidence, while still accumulating is strong enough to support the conclusion that healthcare sector is a new victim of the digital divide in information age. Although the healthcare sector is currently undergoing a revolution in the developed economies (Kalogriopoulos, Baran, Nimunkar, and Webster, 2009) apparently in the wake of the unsurpassed potential of ICT, Rotich et al. (2003) point out that traces of similar advances in developing economies are extremely rare or even non-existent. This can be linked to high digitalisation patterns in developed economies (Billon, Marco, and Lera-Lopez, 2009, p. 608; Norris, 2001, p. 4) compared to developing economies where poverty has caused very low advances in digitalisation (Antonelli, 2003, p. 192; Fuchs and Horak, 2008, p. 102; Meng and Li, 2002, p. 175).

Although it is generally agreed that poverty is one of the main causes of the digital divide (Billon, Lera-Lopez, and Marco, 2010, p. 65; Fuchs and Horak, 2008, p. 108; Skok and Ryder, 2004, p. 425), there are also other causes, such as psychological aversion to using ICT and distrust in its beneficial usage; Ragnedda and Muschert (2015, p. 37) call this “technophobia”. Therefore, the digital divide is a multilayered concept that is not only evolving but also becoming increasingly complex. There has long been concern about gender disparities in ICT usage. In their empirical evidence from Oxford Internet Survey Liff, Shepherd, Wajcman, Rice, and Hargittai (2004, pp. 5–6) note that women are less likely to use ICT than men.

Although gender disparities in connection to ICT usage appear to be diminishing in developed countries, Lang et al. (2016, p. 37) indicate that the percentage of females pursuing ICT education is very low compared to males in developed economies. In general, despite the apparent narrowing of the gender gap in ICT acceptance, there are general variations in usage. For example, Jackson et al. (2008, pp. 339–440) and Punamäki et al. (2007, p. 576) found that males used ICT for entertainment, whereas females generally used it for communication. However, a study by Akçayır, Dündar, and Akçayır (2016) did not find any gender-related digital divide after analysing a sample of 560 university students in Turkey and Kyrgyzstan.

A number of studies (Hoffman and Novak, 1998; L. A. Jackson, Ervin, Gardner, and Schmitt, 2001; Lorence, Park, and Fox, 2006; Prieger and Hu, 2008) drew attention to the racial aspects of disparities in access and usage of ICTs. Logistic regression analysis (Ono and Zavodny, 2008, pp. 1459, 1470) on a sample of 402,778 observations in the United States confirmed that immigrants face a considerable digital divide mainly due to inadequate English skills. Coleman (2015, p. 101) confirmed a digital divide in small-scale businesses between people of Caucasian background in the Unites States and minorities.

However, the data Coleman used was from 1998, and therefore different results would likely be found in more recent years. There are still ethnic and economic disparities that influence usage of ICT among youth populations, which indicates a need to address these issues on a global level, where the younger generations are ethnically diverse (Alper, Katz, and Clark, 2016, pp. 107, 111–112).

Ervin and Gilmore (1999, pp. 404, 406) reported following a mixed group of students based on race, and concluded that African-American students use internet equally when compared to non-African-American students. Similarly, Katz, Rice and Aspden (2001, p. 415) note that the digital divide related to demographic factors such as race is shrinking. Jackson et al. (2008, pp. 439, 441) dispelled these views by finding that African-American male students usage of ICT is considerably less than white American males. However, contrary results were reported in case of African-American females, who used ICT more than white American females.

Conclusions drawn by Prieger (2015, pp. 396–397) suggest that a racial digital divide still persists in the United States, with white Americans being more likely to use broadband internet than minorities. Park (2015, pp. 982, 987) reports differing results, however; in a sample of 800 teens aged between 12 and 17 in the United States, it was found that females and non-white teens were better equipped with ICT skills than male natives. These confusions make it clear that there is a need for a better understanding of the digital divide.

ICT has now a growing set of implications for healthcare practices. For example, Kelly, Kennedy, Britton, McGuire, and Law (Kelly, Kennedy, Britton, McGuire, and Law, 2016, p. 158) have demonstrated a clear significance of ICT for people suffering with aphasia. Urban-rural disparities regarding ICT in developing countries (Guillén and Suárez, 2005, p. 681) are apparently coextensive with health divide disparities in urban and rural settlements in the developing world (Malik, 2007, p. 90). Pakistan is one example of this: many rural areas of the country are not part of the digital revolution (Shafique and Mahmood, 2008, p. 76), and not surprisingly the country suffers from urban-rural healthcare disparities (Malik, 2007, p. 90).

In light of the aforementioned evidence, the role of poverty in the digital divide is significant. A study by Mäkinen et al. (2000, p. 62) of inequality of healthcare provision among eight developing countries concluded that the wealthy segment of the population is more likely to receive healthcare than the poor segment.

One factor that all these issues have in common is poverty, which causes a large part of the digital divide. This view is exemplified by Fuchs and Horak (2008, p. 108) in the case of Ghana, who note that despite market liberalisation and privatisation strategies the digital divide still persists, with poverty as one of the major barriers. Haight, Quan-Haase, and Corbett (2014, pp. 510–514) showed

that the digital divide has only expanded. Higher costs of internet access in developing countries compared to their developed counterparts (Brooks, Donovan, and Rumble, 2005, p. 271) make it even more difficult for the average person to have reliable internet connectivity.

This is not to suggest that the digital divide is a problem only in the developing world, as there is plentiful evidence of a digital divide in the developed world also (see e.g. Cruz-Jesus, Oliveira, and Bacao, 2012, p. 289; Forman, 2005, p. 641; Klimaszewski and Nyce, 2009, p. 220; Kyriakidou, Michalakelis, and Sphicopoulos, 2011, p. 268; Rao, 2005, p. 364; Van Dijk and Hacker, 2003, p. 316; Vicente and López, 2011, p. 233; Weiss, Yates, and Gulati, 2016, pp. 3848, 3855). One example is the United Sates, where millions of students are deprived of high-speed internet access, which consequently affects their academic performance (P. Johnson, 2013). As Companie (2001, p. 14) notes, in addition to the age factor it is unclear whether people on the wrong side of the digital divide are just poor or also less educated. Despite this, differences in internet access between rich and poor regions continue to grow (Pick and Azari, 2008, p. 93), particularly if variations of quality of internet connection are in question. It is important to bear in mind that besides costs, the quality of internet connections also varies technically, and requires some level of ICT skills.

The digital divide therefore involves interplay among several components at various depths, making it a complex phenomenon of research. This is confirmed by Gunkel (2003, p. 516), who maintains that the digital divide does not name just one problem but a changing constellation of various concerns. Moreover, critiques of research on the digital divide is rather scarce (Gunkel, 2003, p. 500). This might mean that research conducted on the digital divide generally suffers from a lack of constructive criticism. For this reason, the complexity inherent in the digital divide can be best unfolded by tackling the issue from multiple perspectives.

Rapid but uneven distribution of digital technologies worldwide had led to a proliferation of studies with a recurring theme of the hazards posed by the digital divide on global economy. The term *digital divide* has been used in various senses across academic, press, and policy domains, highlighting the urgency to resolve the issue. The traditional interpretation for the causes of the digital divide indeed points to poverty. However, there are other important factors responsible, as is identified by later research. For instance, lack of skills is one of the crucial causes of the digital divide (L'Hoest, 2001, p. 48; S. M. Smith, 2005, p. 15; Vodoz, Reinhard and Giauque, 2007, p. 88). Another example is the conclusion of Lee, Park, and Hwang (2015, p. 54) that owning multiple ICT devices does not in itself guarantee any beneficial usage; on the contrary, it is the skills

required to beneficially operate the ICT that is a significant predictor of beneficial usage.

During the past decade, the ICT industry has greatly advanced with cutting-edge innovative solutions that in perspective can been seen to have altered the economic conditions of individuals by offering them opportunities for online learning. For instance, Annetta and Minogue (2004, p. 492) found that the internet can be a good medium for distance learning for professional development, as the participants had historically travelled longer distances for professional development training and workshops. The significance of participation in the digital world is now equivalent to participation in the physical world (Elman, 2001, as cited by Kelly et al. (2016, pp. 134–135)).

Traditionally, the digital divide had been defined as a gap between those who have access to ICT and those who do not. The conventional perspective on the digital divide has now shifted to include beneficial usage along with access in recent definitions, however, the concept overall is still misunderstood today. Researchers still seem to focus on physical access to ICT when defining the term digital divide. For instance, the digital divide is taken to mean the gap between those who do and do not have access to information (Brock, 2014, p. 871). Hoffman and Novak (1998, p. 11) centre their research on hoping that rendering a computer access will solve the digital divide. They base their claims on the notion that access to ICT automatically translates into usage. However, the digital divide is still likely when one does have access to ICT equipment if it is not geared towards beneficial usage.

Because I come from Pakistan, with almost 25 years of experience with culture and various subcultures in that country, the case of Pakistan is taken into account wherever appropriate to reflect on the digital divide from a third world perspective. Simultaneously, the case of Finland is taken into consideration for reference to information age and understanding of the digital divide in a developed country. The rationale behind the choice of Finland is twofold: first, it is increasingly being recognised as a knowledge society, having progressed beyond the stage of information society, and second, I have over six years of study and research experience in Finland. I grant that there are cultural and subcultural differences between Finland and Pakistan that affect examination of the digital divide. However, the intent here is not to present Pakistan and Finland as case studies, but rather as reference points due to my own experience of these two countries.

1.2 Research gaps

Current literature on the digital divide abounds with the chain of isolated descriptions on the nature of the digital divide, accounting for most of the research that is qualitative in nature. Quantitative accounts in research in the digital divide are reported to be scarce (Quibria, Ahmed, Tschang, and Reyes-Macasaquit, 2003, p. 811). Quantitative research is needed to assess the digital divide and to gauge progress of campaigns against it.

Insights drawn from the literature highlight the vague understanding of the digital divide, and suggest that the concept itself is somewhat confused. As a result, the concept of the digital divide is misconstrued across readers and general public. This is confirmed by Butcher (2009, p. 67), Hilbert (2011, p. 715), and Van Dijk (2006, p. 222), who consider the research field on the digital divide to be confused. Keeping in mind abundant literature on the digital divide, it can be safely argued that a series of recursive uptakes on the digital divide research has at its best contributed to the crowded understandings of the concept. However, the solution to the problem remains far from clear.

The notion of the digital divide as a complex phenomenon has not been explained conclusively in prior research attempts. The digital divide appears to be much more complex than was previously assumed. It seems that providing access to ICT has some role to play in bridging the digital divide. Nevertheless, when placed alongside other various evolving factors responsible for the digital divide, it is by no means the most significant. However, most of the research on this area has concentrated on the digital divide based on access factor.

The inconsistencies in the research have made the theme of the digital divide highly controversial in the research community. For example, ever-increasing advances in ICT have created new controversy among researchers as to whether it expands or closes digital divide (H. Lee et al., 2015, p. 45). As some researchers argue (e.g. Hargittai, 2003, pp. 822–823), much of the digital divide research still concentrates on differences between the haves and have-nots rather than on differences in how people use digital media. For example, Jones and Bridges (2016, p. 327) consider the digital divide predominantly as a question of access to ICT. Nevertheless, the focus on the haves and have-nots still has some relevance to research on the digital divide, and particularly in the present context, since poverty is historically the main cause of division.

To date there has been little agreement on what actually is meant by the digital divide. For example, there is no consensus on a universally agreed definition (Helbig, Ramón Gil-García, and Ferro, 2009, p. 90). Instead, the definition of the digital divide has been seeing variations over time (Malisuwan, Kaewphanuekrungsi and Milindavanij, 2016, p. 42), which indicates the evolving nature of the digital divide.

Previously published studies on the causes of the digital divide are not consistent, which significantly underplays the heterogeneity of the topic, and creates controversy among researchers. Following this line of argument, one possible reason for this discrepancy might be insufficient understanding of the concept, which is evident from the inadequacy of many policy documents.

There still exists confusion about relationship of ICT with education. For instance, many authors (Billon et al., 2009, p. 609; Cruz-Jesus et al., 2012, p. 457; Pittman, 2007, p. 2017; Skok and Ryder, 2004, p. 425; Swain and Pearson, 2002, p. 331) have demonstrated a clear connection between ICT and education, while others (Cruz-Jesus et al., 2012, p. 289; Li and Ranieri, 2013, p. 202; Sims, Vidgen, and Powell, 2008, p. 440) rule out any significant effect of ICT adoption on education. Another recent study (Akçayır et al., 2016) ties a strong influence of education with digitalisation. However, Deursen and Van Dijk (2014, pp. 514, 521) took the contrary position after analysing 1481 survey responses in the Netherlands. They found that less-educated people used the internet more than highly educated people. Deursen and Van Dijk (2014) did notice clear differences in variations of usage among different individuals based on different socio-economic backgrounds.

Apparently, latest ICT has links to pedagogical benefits and learning enhancement of students, as it helps to disperse information. Gradual increase in using smart computers and tablets in schools embodies this notion accurately. However, new evidence (Cruz-Jesus et al., 2012; Middleton and Chambers, 2010; Reynolds, 2016, p. 25) affirms that there is no relation between ICT and education.

There are no profound proposals that can bridge the digital divide on a global scale. Admittedly, and as also acknowledged by Bagchi (2005, p. 48), work has been done on regional digital divides, but research is limited to small local regions. Currently, there are very few studies of the digital divide across a broad range of geographical territories (e.g. Billon et al., 2010; Cruz-Jesus et al., 2012; Vicente and López, 2011).

It cannot be denied that significant research attention concerning digital divide has originated from developed countries, but the fact remains that the divide still persists at skills level. Developed countries face a digital divide in rural and remote regions (Klimaszewski and Nyce, 2009, p. 220; Philip, Cottrill, and Farrington, 2015, p. 149; Van Dijk and Hacker, 2003, p. 316). Almost all developed countries have various forms of the digital divide (Verčič, Verčič, and Sriramesh, 2015, p. 147). Consider for example, a study by D. Johnson (2015) that reported educational digital divide in the USA. Kyriakidou et al. (2011, p. 268) reported significant disparities concerning broadband internet access across European countries.

Nearly six decades of academic research has assessed digital divide in small regions, its causes, consequences for the economy and wellbeing, and heavily alarmed policy makers. But aside from all this, it remains to be seen how the digital divide can be bridged between developed and developing regions. Research on the digital divide in developing countries is reportedly scarce. In addition, research on overcoming the digital divide between rich and poor regions is also rare. To date, there seems to be very little published research that offers a systematic solution to the digital divide between developed and developing regions.

1.3 The research problem and research questions

The digital divide has been a serious socio-economic problem over the last two decades. It has been debated as a research field since 1990s. Despite this, the risk associated with the negative correlation between digital divide and economic growth is continually increasing. Previous research has been deeply engaged with casual factors of the digital divide with a heavy focus on qualitative research. However, prior research rarely stresses solution of the problem. Instead, it concentrates on various effects of the digital divide on individuals and societies. This trend in the research on the digital divide continues. This can be seen in work by Lagacé, Charmarkeh, Zaky, and Firzly (2016), Mardikyan, Yildiz, Ordu, and Simsek, (2015), and Quaicoe and Pata (2015), which explain factors leading to the digital divide that have already been extensively investigated in different regions.

Recent research has claimed that the digital divide will close by itself through the effects of the market mechanism. However, recent studies (Bornman, 2016; Owen, 2016; S. Park, 2016) noting the persistence of the digital divide despite visible penetration of technology in developed and developing countries, heavily disprove this notion. The digital divide is usually considered a single entity representing lack of access to ICT, whereas it is a combination of several digital divides at various levels. As long as this is ignored, researchers are unlikely to fully understand this research area.

ICT has been on front agenda for many policymakers worldwide. Despite this, most of the policy efforts till date concentrate on providing physical access to overcome the digital divide, whereas connectivity does not guarantee elimination of the complex digital divide (Correa and Pavez, 2016, p. 249). Pakistan's standing on this front is remarkably low, with several regions that are severely underdeveloped and almost completely unknown outside the country. Finland, however, enjoys the variety the highly creative ICT industry brings to its citizens. The scale of the digital divide between these two world regions is a serious

socio-economic problem that issues challenges to economic and social prosperity of citizens. The question remains open as to what a new dimension of the digital divide, namely the grey digital divide, really is. Considering the issues outlined thus far, this research seeks to address the following questions:

1. What exactly is the digital divide?
2. How can the digital divide between Finland and Pakistan be bridged?
3. What is the grey digital divide?

1.4 Research rationale and significance

It is clear from the evidence reviewed so far that the digital divide places severe strain on the world economy, in addition to exacerbating socio-economic crises. For example, a new consequence of the digital divide now appears to be a health divide in the information age. Given this evidence for the presence of socio-economic threats arising out of the digital divide, an examination of the factors that impact upon bringing digital divide to account seems warranted. Most of the literature on the digital divide has emerged from developed countries (Vicente and López, 2011, p. 221), whereas too little research attention is paid to developing countries (Chen and Wellman, 2003, p. 156), despite the fact digital divide is serious in developing economies (Chen, Lin, and Lai, 2010, p. 5), compared to developed world.

Whereas a mounting volume of published research has investigated the digital divide as a serious social phenomenon, less importance is attached to conquering the digital divide. One might reasonably ask how the problem of the digital divide is not settled despite almost two decades of research and policy intervention. In part, this is because the phenomenon of digital divides has so far been understood in the singular, although in reality there are many digital divides. This is due to the complexity of the concept (Chen et al., 2010, p. 7; Ferro, Helbig, and Gil-Garcia, 2011, p. 10; Grubesic and Murray, 2002, p. 215; Hilbert, 2011, p. 736; Mansell, 2002, p. 327) which confused researchers for more than a decade. For instance, an emerging digital divide related to ageing commonly referred to as the grey digital divide (Bercovitz and Pagnini, 2016, p. 214; Friemel, 2016, pp. 315–317; Morris, 2007, pp. 13–14) is a new variation of the digital divide.

In a recent study Friemel (2016, p. 314) analysed the case of Switzerland and found that the digital divide between young and elderly people was far from being closed. As conclusions of Levy, Janke and Langa (2015, p. 288) indicate, grey digital divide carries consequences as elderly people continue to suffer from lack of health information. Senior citizens face a digital divide mainly because the internet was not widely integrated in their working lives and earlier education

(Loges and Jung, 2001, p. 542). This is in stark contrast to younger generations, which are increasingly exposed to ICT, particularly in developed countries. Because digital media is now rapidly influencing the nature of social connection (Baym, 2015, p. 1), the grey digital divide adds vow to the isolation of senior citizens.

The digital divide gained the attention of researchers (Gunkel, 2003, p. 499) when the phenomenon had begun to surface in academia, but currently the field is decaying to ambiguity as despite massive research this socio-economic phenomenon is still unresolved. With the onset of the third millennium, there is heightened need for ICT equipment as well as the latest ICT skills to meet the demands of emerging socio-economic spheres (for example, health, economic, and public sector). ICT has unsurpassed potential to create and expand economic opportunities by increasing labour skills and reducing production costs (Malisuwan et al., 2016, p. 42). For this reason, many organisations are now rapidly switching to digitising services particularly in developed world. ICT-assisted industrial change is understood as the next industrial revolution which is recently labelled in literature as industry 4.0 (but see Pfohl, Yahsi, and Kurnaz, 2017; Schweer and Sahl, 2017; Thuemmler and Bai, 2017). People from all age groups are expected to have knowledge of ICT, which is unfortunately not the case in underdeveloped and developing countries, but also to some extent in middle-income, and high-income developed countries.

The long-standing controversy about relationship of ICT with socio-economic indicators is another critical concern that affects practice and policy decisions. It is not yet clear that people on the wrong side of the digital divide are due to their low income or low levels of education. It is still widely believed among researchers that provision of ICT equipment can close the digital divide, whereas Warschauer's findings (2003, p. 302) confirm that mere provision of ICT access alone may leave the digital disparities intact. For instance, findings of Hargittai (2003, p. 3) suggest that there is considerable variance in the abilities of internet users. Therefore, it is probable that some internet users are disadvantaged as compared to highly skilled internet users. A decade ago, the rate of internet users had been the widely accepted indicator of ICT (Guillén and Suárez, 2005, p. 681), and is still the most commonly used indicator along with rate of computer users. This leaves open a possibility of the digital divide between internet users.

It is now clear that research on the digital divide is, in general, academically and politically predicated on a highly disjunctive structure. Although a considerable stream of authors disagree over the nature of the digital divide, they all share a deep concern over the sheer threat to the world economy caused by digital divide. Clearly, the problem is serious because it is affecting individual and societies at various fronts including healthcare, social, and economic opportunities.

Considerably high penetration of ICT in Finland marks a threshold into information society with transformation into knowledge society. This heavily contrasts with Pakistan, which suffers from chronic political unrest and economic crises that are related to the extreme forms of poverty throughout the region. This creates pessimism concerning the large scale of the digital divide between the two culturally and economically diverse countries. In order to parallel ICT experiences of Finland with that of Pakistan, major reforms are essential, such as government-led ICT diffusion campaigns at subsidised costs, national attitude towards ICT, blending ICT into nationwide education, and subsidised ICT training centres for people of all ages.

The digital divide as a field of information systems science has been studied heavily. Nevertheless, the digital divide research has not escaped criticism from academics, agencies, and the government. The attribution of the poverty to the digital divide has been authenticated in a series of understandings (Antonelli, 2003, p. 192; Dutton, Gillett, McKnight, and Peltu, 2004, p. 35; Haight et al., 2014, pp. 515–516; Meng and Li, 2002, p. 275; Romke, 2015, p. 112) on the subject. Although poverty is a key component of the digital divide phenomenon, it is widely considered insignificant by many researchers. For instance, it has been argued that human and social capital are more significant factors in explaining the digital divide than economic capital (e.g. Chinn and Fairlie, 2006, pp. 40–41; Korupp and Szydlik, 2005, pp. 416–418). The difference in focus concerning the digital divide research creates confusion, as real barriers to the digital divide remain disputed in the literature. From a practical perspective, taking either side is problematic because digital divide is a multilevel phenomenon and as authenticated by Gunkel (2003, 500) disparities in access to ICT are due to specific factors and cannot be universally applicable.

Policies regarding the digital divide hinge on biased constructs as indicated earlier, which is one reason for the problem not yet being settled across the globe. However, biases in research on the digital divide are not limited to what causes the digital divide. Some studies argue that market forces will eventually bridge the digital divide (Fuchs and Horak, 2008, p. 114), thus suggesting that the digital divide will solve itself over time. In contrast, findings of Erstad (2010, pp. 67–69) show that digital inclusion does not happen automatically on its own. This is consistent with an article published by the Brookings Institution think tank (Levin, 2016), arguing that market forces will not solve the adoption problem concerning ICT but may instead accelerate bridging the digital divide, if supported by prudent governments.

Contrary to Erstad's conclusions, it could well be argued that market forces have failed to close the digital divide for over a course of nearly two decades. The rate of change of ICT is so rapid that computing equipment a decade ago can be practically regarded as antique in current times. In the same vein, Verčič,

Verčič and Sriramesh (2015, p. 142) note that digital technologies evolve so fast that research on them is always playing catch-up.

This appeared as an example in their own study when Verčič et al. (2015, pp. 144, 152) conducted a systematic literature review on public relations and their connections with ICT. Through analysis of 155 studies, they found that none focused on emerging mobile technologies. Despite the fact that mobile phone technology has spread through most of the world including developing and underdeveloped regions, rising costs of reasonable speed data plans and engagement with a number of complex tasks on mobile devices remains a challenge to be addressed. Poeter (2012) confirms that mobile phone propagation has indeed narrowed digital divide but not for all. It is therefore self-evident that even if the market forces will bring the price down, the existing digital divide will be superseded with the new one. A practical example of this can be taken from the changing orientation of connectivity through birth of smart gadgets; the digital divide is taking new forms that appear to be overlooked by scholars. This view is exemplified by Lee et al. (2015, p. 47), who demonstrated the case of Korea indicating that latest smart devices are not distributed to most of the population, which can increase the already established digital divide in the country. This may also be the situation across other developed countries where most citizens do not own the latest models of smart devices. Similar is the case with software as various reports (Parry, 2017; Perez, 2016; Shankland, 2016) suggest that Apple intends to delete thousands of Apps in its next software update, due to compatibility issues with their latest hardware.

From an alternate perspective, Proffitt (2012) argues that increasing use of the internet on smartphones may create a new digital divide, as significantly fewer people than ever are using computers to create content and more individuals are acting simply as consumers (see also Poeter, 2012). In this light, a society of consumers is being actively developed instead of creators. ICT-manufacturers may focus on mobile-friendly content and cost-effective tablets, but this will come at a cost of corresponding decrease in content production for standard computers as well as a gradual decline in computer-related skills (Proffitt, 2012). When the digital divide is this significant in fast emerging economies, the gravity of the situation in developing regions becomes readily evident.

These observations lend support to the claim that bridging the digital divide requires rigorous reforms. This, in turn, requires rigorous research that can propose a workable plan or at the very least yield actionable findings. However, the existing scholarship generally offers the content that is peripherally related to the real problem of the digital divide.

The evidence presented thus far ostensibly alludes to a sense of general incongruence in the field, and suggests that there is very little understanding of the diverse aspects of the digital divide, which consequently opens a space for

further research. In particular, the phenomenon appears to be poorly understood at root level, which then weighs on the policies devised by governments. This argument alone opens up a considerable space for future research into this area.

The question on devising the suitable measurement phenomenon of the digital divide has been preoccupying experts for some time. Research interest towards the digital divide is apparently bordered on the descriptions and ill-judged quantifications that spark such criticism in academia. Existing accounts have thus failed to resolve the persistent digital divide by producing effective and measurable action plans.

The methodological errors in quantifying the digital divide interfere extensively with the conclusions arrived. Inaccurate research designs are seemingly feeding the policy makers disillusionment about formulating policies to conquer the digital divide. The literature on the digital divide is heavily dominated by descriptive (Van Dijk, 2006, pp. 231–232) rather than empirical materials.

A great deal is being written and said about inaccuracy of existing methods to quantify the digital divide. For instance, Pick and Nishida (2015, p. 1) maintain that prior studies on the digital divide employ ordinary least square regression analysis with sample sizes from 30 to 90 countries. When viewed from this perspective, a crucial constituent for quantifying the digital divide accurately lies in the principles of understanding the term itself on rigorous grounds.

The rate of research production on the digital divide has been too slow to catch up with emerging trends in ICT industry. This is because ICT revolution is introducing new ICT devices and services periodically each year both in a hardware and software sense. The resultant abrupt halt regarding progress in research on the digital divide paired with rising inequalities in ICT and consequently the catastrophic damage to the already endangered world economy constitutes an important challenge to the research and policy circles. In addition to this, naive solutions proposed to overcome the digital divide go unquestioned. It is possible to fairly argue that the digital divide is one of the fields in information systems science, which is most talked about but least understood.

While current concerns regarding the digital divide are valid and fully justified, there appears a sense of urgency to address the problem with solution-oriented research since the situation concerning the digital divide engenders massive fear on socio-economic grounds. The unanticipated costs of the digital divide crises are reportedly weighing on the world economy. This becomes further important when information and healthcare services are being increasingly digitised as also maintained by Deursen and Van Dijk (2014, p. 522). Entire healthcare industry is apparently undergoing challenges of maintaining optimal communication, which is possible through state-of-the-art ICT. Ruben (2016) gives an excellent overview of communication challenges in

healthcare discourses. Youyou, Kosinski, and Stillwell (2015, pp. 1038, 1039) demonstrate how ICT has outpaced humans in making personality judgements, unleashing the potential of ICT in cognitive sector of healthcare. Apart from economic risks, the digital divide can potentially trigger more underlying problems related to social exclusion.

Developing countries face high risks of missing out on latest offerings through ICT. For example, health divide as a new consequence of the digital divide appears to badly affect poor countries. In the same vein, Romke (2015, pp. 108, 112) argues that modern e-governance can create a digital divide in a developing country Bangladesh, where disparities between the haves and have-nots are continually growing. Similarly, promotion of ICT-induced healthcare systems becomes a significant challenge in developing countries.

Although extensive research has been carried on the digital divide, no single study exists with concentration on conquering the divide between broad geographical regions. However, the overriding consideration in the research on this subject has not been oriented towards solutions. Instead, much of the research has been on differences in access and usage of ICT for individuals (Van Dijk, 2012, p. 57).

Moreover, the research on the subject has been mostly restricted to limited comparisons locally, often projecting peculiar triumphs over the digital divide. Current literature on the subject abounds with examples of isolated descriptions of the digital divide problems and their effects on economy and individuals. The general dispute on research literature on the digital divide along with inconsistencies of results stymies any solution-oriented progress in this field. Despite six decades since the evolution of the digital divide concept, the problem still persists on a global level, as also noted by Huang and Cox (2016, p. 219).

It is clear that the widening of the digital divide, especially at time when the world is facing acute economic crises, warrants serious attention from policymakers, who appear to lack a rigid research-backed framework. The current discourse of the digital divide, if left unattended, is certain to adversely affect the global economy at both the micro and macro levels. It can be argued that research community had taken notice of the severe consequences of the digital divide, but did not propose any justifiable solutions to the problem.

It is also apparent that academic circles are poorly positioned to handle the digital divide from a standpoint of only investigating the nature of the phenomenon. Nevertheless, formulating a workable link between an elegant theory of strategy and complex reality is a challenge, which became the call of this dissertation.

Evidence reviewed thus far suggests that connections between ICT and socio-economic indicators are far from being well understood. Overall, these projections support the idea that the digital divide, as a social phenomenon, is

still poorly understood at the root level. One obvious reason for this is the evolution of the concept over time. The evidence presented thus far supports the view that a theoretical resolution of divergent arguments on the digital divide remains unresolved. It is also abundantly clear that the field of the digital divide has vivid links between theory and practice.

Taking this all into consideration, it is clear that the digital divide is a highly significant area for exploratory research. If the digital divide is not settled, the results can be disastrous for the world. Mastery of ICT is now a prerequisite for participation in digital cultures (Reynolds, 2016, p. 1), especially at time when almost all sectors of economy are increasingly being shifted to the internet. The weight of evidence reviewed thus far leads to fortify the argument that there is an urgent need to create an accurate understanding of the concept by taking into account as many as possible perspectives on the theme of the digital divide.

This research seeks to remedy these problems by centralising focus on conquering the digital divide between two economically and culturally diverse regions of the world: Finland and Pakistan, by weaving together a range of case studies, literature reviews, and statistical analysis. Part of the aim is to create a renewed conception of the digital divide by developing a comprehensive knowledge base on the topic to help understand it from varying perspectives.

Given the lack of critical attention paid to the qualitative aspects of the subject, the research will illuminate the holes in existing research by critically engaging with the existing theoretical underpinnings, while repressing some doubts and myths concerning digital divide thoroughly.

While previous work has mostly pioneered the field of causes and types of the digital divide; this research is unique in the sense that contrary to received wisdom it leans towards solutions in the form of high leverage systematic framework to conquer the global digital divide. This research will highlight implications and provide recommendations related to the digital divide.

The dissertation is therefore expected to bring the heightened matter of the digital divide to a resolution by yielding actionable proposals that may help levy the current policy action plans, introduce new dimensions by shifting the boundaries of the field, and suggest a direction for further lines of inquiry to the research trajectory in the field. This dissertation is expected to be a significant leap forward in understanding the socio-economic problem of the digital divide and how it can be minimised. Apart from transcending current limitations in research, it may serve as a useful primer for undertaking research assignments in different regions of the world with similar context.

Closure of the digital divide in Pakistan could, over the long term mean the narrowing of the educational divide. It has implications for remaining access barriers to education in rural areas of developing countries, as is also acknowledged by Kaware and Sain (2015, p. 28).

Against this background, the central concern that motivates this dissertation is the harmful effects of the digital divide on the lives of millions of people worldwide, both in the developing and developed world. Keeping this in mind, the central concern of this research is to propose a systematic solution and actionable recommendations to government and relevant institutions to conquer the digital divide.

A connected concern is to develop a systematic understanding of the digital divide from multiple perspectives in order to fully understand the confused concept. It is in this belief that intricacies of the digital divide research are suggestive of a problem pertaining to the understanding of the concept at root level. Adhering to the fact that much of the research on the digital divide is woefully inadequate on accounts of research design, this work will attempt to restore some measure of methodological rigor.

Bearing in mind the current inadequate understanding of the digital divide, this work is expected to advance the knowledge base towards a better understanding of the concept. This information can be used to develop targeted interventions aimed at assessing digital divide.

1.5 Purpose of the study

The core focus of this dissertation is geared to conquering the digital divide between developed and developing regions. In light of this, this dissertation pays explicit attention to effectively minimise the digital divide between Finland and Pakistan. The three aims are to:

1. Create a renewed understanding of the digital divide through a systematic literature review.
2. Understanding the grey digital divide and how it can be addressed in developed and developing countries.
3. Analyse the data currently available and suggest a framework to close the digital divide between Finland and Pakistan.

By addressing the inadequacies in prior research attempts digital divide will be critically reviewed to achieve a justifiable knowledge base on the topic. Once this understanding is established, this will lead to address the core aim of the dissertation, which is to suggest a systematic solution to the problem of the digital divide.

1.6 The political context

The research contributed by McGlynn and Sylvester (2010) ties the influential link of politics with the digital divide and notes how certain geographic areas have differential access to ICT. Although there is considerable consensus upon the threats inflicted by digital divide and its various causes, there is much less consensus upon how to resolve this socio-economic issue among policy and academic groups. It is self-explanatory that developing countries need to prioritise other pressing issues such as war, civil unrest, and poverty elimination instead of ICT infrastructure development. However, ICT infrastructure holds promises for improved healthcare services and socio-economic wellbeing, as well projected across a series of academic understandings. Tensions are escalating between Pakistan and India over various disputes (compare Adeney, 2016, pp. 1–22; see also Paul, 2005), which results in heavy military spending by the government. The digital divide is then at a low investment priority even if it is officially announced as a key area of improvement. In contrast, Finland adheres to the European Union policy of rapid digitalisation and is gradually moving its services to digital media.

It is being steadily accepted that narrowing of the digital divide would have an impact on politics. For example, citizens would be able to take part in transparent election procedures. It is also expected to enhance participation of people in political voting (‘The Digital Divide, ICT, and Broadband Internet’, 2017), from the added comfort of their own place in addition to a feeling of being safe. However, C. Lee, Chen, and Huang (2014) demonstrated that despite digital opportunities a considerable portion of citizens in Taiwan who had traditionally used paper-based system did not engage with e-petitioning.

The digital divide is influenced by politics in several developing countries. For instance, the political leadership in Pakistan and neighbouring countries prefers spending on military budgets than on ICT for the public good. War and conflict with its neighbouring countries are a prime cause of this. This trend may very well rest along other developed and developing countries of the globe. Regional peace may indirectly influence the minimisation of the digital divide along with other socio-economic problems. For instance, poverty remains an unsettled issue with millions of people living far below the poverty line. Corruption is one of the key components in the developing world that hinders infrastructure development.

1.7 Starting assumptions

Bloomberg and Volpe (2012, p. 98) point out that all researchers who enter a given field have certain assumptions and perspectives on their topic. Being aware

of what Turabian (2013, p. 6) emphasises that research must rest on shared facts that are independent of emotions and beliefs, it is even significant to acknowledge any assumptions upfront. In connection with the dissertation at hand, researcher endorses the following beliefs based on his prior educational and professional experience, and cultural background.

1. A very broad digital divide in varying forms exists in the developing world, which may very well be different from the digital divide in the developed world. This assumption is grounded on the premise that I have closely observed the situation personally in various parts of Pakistan. Several parts of Pakistan are rather unknown to foreign world. Policy documents often circulate the wrong impression to the foreign world that ICT is smoothly being diffused throughout the country. In reality, a number of rural and urban areas suffer from the very basic indicator of ICT - electricity - for hours, and sometimes days in a row. This basic ICT indicator is often taken for granted in the developed world, but in a developing country like Pakistan it creates new digital divides. Without sustainable availability of electricity, the problem of achieving widespread ICT distribution and adoption throughout the country then becomes obvious.
2. The narrowing of the digital divide will set the way for economic improvement, access to medical information online, and enhanced social connectivity across the entire world. This assumption is guided by the principle that developed countries have superior ICT infrastructure over developing countries that allows citizens to benefit from digitised services across various sectors including healthcare.
3. The digital divide still is misunderstood not only across academic discourses but also at policy level. This assumption is premised on the notion that prior policy initiatives of governments in developing countries like Pakistan and Bangladesh have failed. Apparently, governments were under the wrong impression that providing access alone to ICT will solve the digital divide. This concept is fast changing in academic world but policy circles in Pakistan are slow in catching up. This situation is likely in other developing countries also.
4. I fully recognise that combined role of public and private sectors under government assistance is acute for bridging the digital divide, particularly in the developing world. Neither researcher denies that governments are limited by funds in both developed and developing countries, nor are they ignorant of the political unrest in Pakistan that hampers the development work in rural areas of key provinces. On further consideration, I feel that it appears corruption and lack of law

and order situation inflicts indescribable tragedies on the lives of common people. Challenges created by this catastrophe of corruption ripple through government and private sectors alike that leaves a significant bearing on the digital divide. As a result, poor is usually suppressed compared to rich in the society. Voice of a common person against corruption is easily discredited through various means, some of which are unimaginable. To make sure that benefits of ICT revolution fully reach all sectors of economy, system-wise steps are imperative that ensure that officials discharge their responsibilities as they are meant. Corruption must end should impressive gains against the digital divide be desired in Pakistan and all developing countries. System-wise steps by government are imperative that ensure that officials discharge their responsibilities as they are meant.

5. Conventionally, Pakistani society is fraught with the view that ICT-related devices diverge students from their main purpose of studies. Various academic and non-academic experiments lend credence to these rumours as students distract from their assignments, and lose their focus on entertainment activities. While it appears partly true, researcher breaks with this tradition by raising question of visible success in western ICT-based education system. ICT has enabled new and improved forms of learning and research across developed world. I foresee that, in future, ICT has great potential to enhance learning practices in Pakistan. Similar to lethal weapons, ICTs in themselves are not good or evil but such suppositions are subjected to how they are used.

1.8 Connections between the research papers

The digital divide as a field of social science has become overly complicated over the span of two decades. Consequently, one of the most significant measures should be to understand the concept by using a rigorous methodology before embarking on any policy initiatives. The concept has expanded from its initial conception in the mid-1990s when personal computers became a major evolution of ICT. Over the past two decades ICT has expanded tremendously and therefore the concept of the digital divide in parallel. Existing literature on the digital divide does not cover accurately new aspects of the digital divide that are important to address for policy discourses. The need for a better understanding of the digital divide is apparent.

Paper 1 is a systematic literature review on the digital divide conducted critically. In understanding the phenomenon in-depth, it traces the roots of the concept and presents changing faces of the digital divide over years. It was learnt

that the digital divide is a group of divides attributed to the multifaceted concept. The concept is still a confused theme in literature with varying views on its definition. It has also been criticised for lack of methodological rigour. It was significant to give a comprehensive coverage of the concept with a critical perspective and rigorous methodology.

Having understood digital divide as a dynamic multidimensional phenomenon, next step was to understand the various indicators of the phenomenon. Paper 2 pulls together most important indicators of the digital divide from active organisations addressing this social problem. Twenty-seven of the most common indicators in the modern economy were presented. Some of the indicators used by International Telecommunications Union (ITU) and Organization for Economic Cooperation and Development (OECD) appear to be irrelevant in the present age. For example, TV and radio are taken as two important indicators of the digital divide. However, these devices have reappeared in digital formats on computers, smartphones and tablets. Therefore, quantitative errors are possible when assessing digital divide on these indicators. This phenomenon varies in developing countries where TV and radio sets are popular and other latest ICT devices such as smartphones and tablets are considered luxury and often unaffordable.

The main finding of Paper 1 was that the digital divide is disputed with regard to its links with socio-economic indicators. It was still unclear whether poverty leads to the digital divide, or whether other socio-economic indicators, such as education, influence the digital divide. Paper 3 focuses on exploring the links of various ICT indicators presented in Paper 2 with socio-economic indicators. A total of 21 countries were included in analysis. Countries were classified as either developed, developing, or middle-income. The findings revealed that poverty is the leading cause of the digital divide whereas education positively influences adoption of ICT. National corruption was found to be negatively associated with diffusion of ICT. Findings matched with the prior literature noting the strong correlation of GDP per capita with ICT diffusion. However, they negated with the prior findings claiming that education has little to no impact on ICT diffusion.

Feedback received from paper 3 encouraged to take the analysis further to the entire world and add further rigour in methodological approach. In Paper 4 a total of nine socio-economic and ICT indicators were taken into consideration. Multivariate statistics was used to explore relationships between ICT and socio-economic indicators across 91 countries, providing improved reliability in analysis than the one reported in Paper 3. The rest of the world was not included in the analysis, because the World Bank did not have complete data sets available for these countries. The findings in Paper 4 confirmed the prior reported findings in Paper 3 that poverty is indeed the leading cause of the digital divide

worldwide. In addition, ICT diffusion was significantly correlated with education, raising an implication to bring ICT-based educational revolution around the world.

Despite empirically validating the theoretical links in Paper 4 on a worldwide scale, the issue of the relationship of the digital divide with elderly people was still unclear. This issue surfaced in the present research in Paper 1 (systematic literature review). As the second literature review, the ongoing literature review, was being conducted all the time, it indicated few instances highlighting the importance of the digital divide related to elderly people. Being a relatively new phenomenon, this topic was not heavily researched. It was felt that without understanding of the grey digital divide, the understanding of the digital divide would be incomplete. Therefore, subsequently Paper 5 focused on this theme and presented the grey digital divide as a significant next front for the digital divide. In Paper 5, I argue that the grey digital divide depends on many factors, and governments and ICT manufacturers must work together to address this serious issue. The grey digital divide is rapidly becoming responsible for isolation of the elderly in the information age, as services including healthcare continue to move to digital platforms.

By the time Paper 5 was finished, the ongoing literature review and its analysis introduced another direction to phenomenon of the digital divide: the undeniable link between healthcare and digital divide. Global health divide appeared to be standing as an unresolved social issue at the forefront of digital revolution. It was significant to touch on this topic because of twofold reasons. First, healthcare services are rapidly transferring to digital media, and those on the wrong side of the digital divide are badly affected. Second, there is great potential of ICT for the healthcare industry, which is not fully recognised by either industry. Paper 6 takes up this topic by critically reviewing literature tracing the link between digital divide and health divide and thereby proposing a series of implications for researchers, practitioners and policy discourses. The term health divide is used in this paper to refer to disparities in healthcare among individuals, societies, and countries. Finland and Pakistan were taken as reference points to depict situation in developed and developing countries, with a belief that developed and developing countries often share common characteristics. It was noted that how ICT can save millions of lives in a developing country like Pakistan and how the lessons can be learned from Finnish healthcare and ICT industry and applied to various other contexts, keeping in mind cultural differences.

The idea of tele-health in Pakistan is ironic, because currently the country suffers from the worst energy crises in its history. Objectives of various policy action plans concerning healthcare in Pakistan were only partially met. It was argued that absence of electricity and internet connections in rural areas would

cause tele-projects to fail. There are similar examples of failed projects in other developing countries due to similar mistakes. Although Finland has pioneered the state of its local healthcare, there are many areas to improve. Privacy issues and system errors remain an unresolved concern. Elderly must be motivated and trained to take advantage of state-of-the-art healthcare information systems. The dire need is now to initiate projects aimed at minimising digital divide and health divide simultaneously. Healthcare services integrated with ICT will become cost-effective in near future, if digital divide is not an issue. Paper has important implications for healthcare and ICT industries worldwide.

1.9 Organisations studied

The overall structure of the introduction to dissertation is organised into seven chapters, including this foregoing introductory chapter. Chapter 1 homes in on presenting the research problem, setting it into context, providing a detailed rationale for the significance of the topic and expected implications. The linkage of the research articles is presented upfront.

Chapter 2 is a detailed presentation of the detailed research design and its key elements. In doing so, various design features of the dissertation are presented in detail with logical justification and their appropriateness concerning the research objectives. Respective advantages and disadvantages of each method are also illustrated backed with literature resources.

Chapter 3 presents two separate reviews of previous research on the digital divide. This chapter first joins the current ongoing dialogue on the digital divide from a critical standpoint by systematically conducting relevant research material on the topic. The systematic literature review advances the dialogue further towards collective understanding of the digital divide. Based on this, I present the conceptual framework that I have developed for guiding the research process. Following the systematic literature review is an ongoing literature review that was conducted actively throughout the entire research process.

Chapter 4 is devoted to a comprehensive conceptual framework that guides the flow of overall research design. Based on expert guidance, one category per research question has been made an integral part of the conceptual framework. In addition, selection of theory is justified and a critical review of current state of affairs in research on the digital divide is presented at the end of the chapter.

Chapter 5 highlights a pattern in the research process from one article to another in line with the research questions at hand.

Consequently, chapter 6 considers general findings from the research from literature review, comparing them to findings from all the six articles that comprise this dissertation. Following the findings is a general discussion that

integrates all my published and unpublished research into a coherent discussion of the findings. This chapter also considers the main implications of the findings. I also propose the solution to the research problem of the digital divide, by developing and presenting a systematic framework to combat the digital divide.

Finally, chapter 7 draws argumentative conclusions of the research, presents actionable recommendations, and appends directions for future advancements in the present field of inquiry. In addition to summarising findings related to the overall research and findings related to the research questions, broader insights concerning digital divide are also highlighted. They should be useful to anyone motivated about further engaging the research topic around specific themes of interest. Empowering suggestions are geared towards research, practice, policy, and media discourses. Findings are matched with prior literature thereby noting consistencies and rationale for any possible discrepancies between current and prior research findings.

2 RESEARCH METHODOLOGY

This chapter addresses the need for a viable research design that seeks to uncover significant insights regarding the phenomenon of the digital divide. The purpose of this chapter is to offer a stepwise procedure and reflection on the research design and nature of the inquiry. This systematic approach is expected to help prospective readers and researchers replicate the research when desired. The chapter is organised as follows.

Next section offers a general view of research paradigm concerning the discipline of Information Systems science. This is followed by rationale for research approach that justifies that the research methodology decisions taken are in line with the research objectives at hand. Proceeding further, research design presents the various interrelated components of the research in a sequential manner that reflects the design of the methodology employed. It draws supporting evidence from the literature wherever appropriate.

The dissertation design is not only multi-method, drawing on data obtained through archival research and secondary sources, but also multi-level. In doing so, an overview of information required to conduct the research is first presented. Following sections describe how the research lends itself to a holistic approach and a sequential presentation of issues pertaining to research methods in the present context. The final section is a brief summary that ties together the chapter's main arguments.

2.1 Information required to conduct the research

To address the research aims of dissertation, three research questions were explored. First question sought to recreate a refined understanding of the digital divide in great depth, and the second question aimed to reach a solution to this socio-economic problem.

The third question was concerned with a new but increasingly important variant of the digital divide, the grey digital divide. Keeping in mind this is a relatively new area, the research question aimed at understanding it. The following areas of information were sought to address the research aims: Contextual, theoretical, and perceptual. This information is tabulated in Table 1.

Table 1 Foundations of the study

Type of information	***Research requirements***	***Research methods***
Contextual	Introduction to the field of the digital divide, historical overview of the digital divide and how it emerged, first serious academic advances made in research in the digital divide, identification of potential literature gaps.	Literature review
Theoretical	Supporting evidence for theoretical foundation of the data-collection methods, evidence for overall methodological approach, prior and current developed lines of inquiries in research in the digital divide to make an informed choice, theories related to the research objectives, links of the digital divide with other socio-economic variables, drawing sound comparison between the Finnish and Pakistani context on ICT diffusion, understanding the link between ICT and various socio-economic indicators.	Literature review of methodological issues involved in research in the digital divide, Focus group discussions, literature review on prior research methods on the digital divide, document analysis of Pakistani healthcare practices (printed and electronic), analysis of World Bank data, multivariate regression analysis.
Perceptual	Understanding digital divide from the standpoint of experts, opinions of academic community on ways to combat digital divide, examining the personal experiences of academic discussion participants regarding digital divide theories.	Co-discovery conference, panel discussion, focus group discussion.
Research question 1: What exactly is the term digital divide?	In-depth understanding of the digital divide, addressing various ideologies and operating principles in the digital divide field.	Triangulation, systematic literature review, content analysis, public documents review
Research question 2: How can the vast digital divide between Finland and Pakistan be bridged?	Examining the scope of the digital divide between Finland and Pakistan, obstacles standing in the way of effective ICT diffusion and adoption, examining various channels that can promote ICT diffusion as well as its beneficial usage in Pakistan, adapting the best practices in Finland in ICT adoption to Pakistan, taking account of the cultural differences and general business operating approaches between the two countries.	Literature review, statistical review, research analysis, public documents review, peer debriefing, panel discussion.
Research question 3: What is the grey digital divide?	How did the grey digital divide emerge? Why ICT adoption is so significant for developed world? How can the problem of the grey digital divide be resolved?	Literature review, peer debriefing, review of policy documents.

2.2 Rationale for the research approach

2.2.1 Rationale for the holistic research design

Johnson and Onwuegbuzie (2004, pp. 22–23) advise that for methodology selection purposes, researchers should apply contingency theory which accepts that various research approaches (qualitative, quantitative, and mixed-method research) are all superior methods but under different circumstances. Sole reliance on one particular mode of inquiry was unlikely to provide the adequate data required to address the proposed research objectives. In addition, combining methods provides an opportunity to triangulate data, as highlighted by Zohrabi (2013, p. 254), to increase the reliability of the research results.

In developing a conceptual framework for mixed-method research designs, Greene, Caracelli, and Graham (1989, p. 269) arrived at the understanding that mixed-method research approach offers expansion in scope of inquiry by using various methods for various inquiry components. Mixed-method research is a combination of qualitative and quantitative research methods with a core assumption that mixing the two forms of inquiry offers a more comprehensive understanding of a research problem than either method alone (Creswell, 2013, p. 4).

Social science often addresses challenging assortment of various theoretical issues, and correspondingly methodological diversity in researching a serious social problem is highly desirable (Baumeister and Leary, 1997, pp. 315–316). It was in this belief that a holistic research stance offering varied modes of inquiry fitted well with the purpose of the current dissertation. This is mainly because the digital divide threads on multiple layers of content with both qualitative and quantitative aspects; focusing purely on either one will undermine the other sides attached to the problem. This method would allow deeper insights into the digital divide in addition to examination of key variables linked to the problem. This selection of method in the present context, however, warrants supplementary justification.

The prior research on the digital divide has mostly concentrated on qualitative research design, and traces of any quantitative research uptakes are reportedly scarce. Despite massive qualitative research on the digital divide, the phenomenon is still poorly understood, and has rather become much confused. Critics have argued for the quantitative uptakes on the digital divide, which are much needed. However, ignoring the qualitative research design will affect the ability to answer the research questions that call for thorough empirical research design. Combining the various methods is expected to address this gap and inject variety in the research contribution made in the field, in addition to looking at the

phenomenon with multiple perspectives. Holistic research, then, can be understood as a series of interlocking analytic processes that therefore allow for holistic interpretation.

Triangulation method was employed in order to ensure data redundancy and generate multiple perceptions to clarify interpretation, in addition to lend credibility to the research. Nearly half a century ago, Jick (1979, p. 605) correctly projected the probable use of triangulation in doctoral dissertations. The process of triangulation involving multiple methods of data collection entails seeking multiple perceptions to clarify interpretation and is significant for in-depth understanding of the phenomenon of interest (Bloomberg and Volpe, 2012, pp. 72–73).

Multivariate statistics seem appropriate rigorous method to analyse large chunks of data and to draw meaningful patterns, depending upon the volume and type of data. In research on the digital divide, this may be seen as a critical quantitative method which may draw conclusive links between socio-economic and ICT indicators.

Although integrative literature reviews are often deemed as a proper way to conduct a literature review, systematic literature review may be deemed as superior to other forms of literature review in the sense that review process is much more scrutinised. This should be the case especially in research on the digital divide, which generally lacks methodological rigor.

Author was mindful of the repeated caution reflected in series of academic understanding that projected the pitfalls of relying upon a single research method (c.f. Jick, 1979, pp. 602–605; see also, M. Morse, 1991, pp. 120–121). It is however important to bear in mind that one research method is not necessarily superior to other. On the contrary, its usefulness lies in whether it can yield convincing answers to research questions (Thomas, 2003, p. 7). For instance, examining a diverse sample of research publications in an Australian university, Paltridge (2002, p. 136) found that published advice on research work and actual practice markedly differed. Burton and Steane (2004, p. 12) advise putting a substantial amount of time into deciding whether a chosen research method is appropriate for a particular dissertation. Therefore, the usefulness of any research method is a function of its relevancy to research question that has been the prime premise for selecting mixed-method research for present dissertation. This congruency of research methods with research questions is called “methodological coherence” (Morse, Barrett, Mayan, Olson, and Spiers, 2002, p. 18).

It has been observed that social science researchers who chose mixed-method research designs are likely to select research approaches with respect to their underlying research objectives rather than preconceived biases (R. B. Johnson and Onwuegbuzie, 2004, pp. 23–24). In addition to appropriateness of holistic

research design with respect to present research objectives, a holistic approach to research will facilitate new perspectives around the following: establishing a contextual understanding of the digital divide, maintaining an interpretive stance, and maintaining flexibility of the research design.

Johnson and Onwuegbuzie (2004, p. 17) and Patton (2002, p. 274) view mixed method research as a creative and expansive form of research that legitimates the use of varying research approaches in answering research objectives. Johnstone (2004, p. 260) and Patton (2002, p. 273) noted that mixed method research approach as a rigorous research method is widely accepted. This appears to be a continued practice today across varying research disciplines.

A mixed-method, holistic research approach combines inductive and deductive analytic processes. Therefore, primary concern for integrating holistic research approach is to bring diverging points of view into research objectives at hand, and base the knowledge claims on pragmatic grounds. Moreover, a holistic research approach is crucial to evaluation and the research process when the topic at hand is complex and disputed in nature, as is the case with the digital divide.

2.2.2 Rationale for the ongoing literature review

A thorough literature review with examination of strengths and weaknesses of existing studies is a precondition for a substantive and sophisticated research (Boote and Beile, 2005, p. 3). Torraco (2005, p. 356) sees a literature review integrative when a representative literature on the topic is reviewed, critiqued, and synthesised in an integrative manner such that new perspectives on the topic of inquiry are generated.

Because a key objective of a literature review is presentation of present leading concepts (Bloomberg and Volpe, 2012, p. 46); an ongoing review of literature was actively conducted throughout the span of dissertation writing process. This was done in addition to systematic literature review to encompass new relevant material to guide introduction and theoretical framework throughout the entire research process which Bloomberg and Volpe (2012, p. 47) call “progressive honing of the topic”. Literature review is thus a means to advance collective understanding of a phenomenon of interest.

In addition to identification of holes in existing work, a side benefit of conducting the literature review helps avoid duplication of research that has already been conducted (Bloomberg and Volpe, 2012, p. 47). Bloomberg and Volpe (2012, p. 49) advise researchers to represent the recent work in a literature review usually five year span as a tentative limit of coverage with exceptions of this limit when a historical overview of a topic is desired. Because the digital divide has been poorly understood for at least two decades, it was prominent to

cover most important works conducted in the field from the very beginning. Further to this, some of the leading empirical works on the digital divide were produced in the last decade.

Although not as robust as a systematic literature review (discussed in forthcoming sections), an integrative literature review allows adequate room for sound interpretation of current trends in the field. The literature review section was revisited several times to make sure that no new relevant research glossed over. This ongoing integrative literature review is significant for appropriate presentation of knowledge currently available and theoretical grounding of the overall study.

Topics identified for ongoing integrative literature review fell into three categories.

1. Bridging the digital divide
2. Direct and indirect factors relevant to the digital divide
3. Theories in research in the digital divide
4. Existing methods used to study and analyse digital divide.

2.2.3 Rationale for the audit trail

An audit trail is a process of maintaining an organised documentation comprising of research-generated data throughout the research process (Rodgers, 2008, p. 43; Rodgers and Cowles, 1993, p. 219). It is similar to the note-taking process during data collection which Strauss (1987, pp. 18–19, 110) refers to as “memoing”, which can lead to further insights and is an internal dialogue of the ongoing research process.

Being aware of this process of organised note-taking, a reflective journal was kept throughout the research process. Creating rigour in analysis places a high premium on credible and dependable results. A fundamental aspect of rigour involves performing confirmatory checks on the manuscript, particularly the cited references. This process of memoing helps in developing deeper engagement with the data, thereby facilitating progress from concrete to conceptual understanding (Birks, Chapman, and Francis, 2008, p. 69). In addition, it helps make the analysis phase more rigorous by making it easier to cross-check notes with current results.

2.2.4 Rationale for choice of keywords

Just as the wording is crucial in developing research questions to address new insights into a particular topic (Rojon and Saunders, 2012, p. 56), choosing the

right keywords for literature retrieval is instrumental to appropriately answering the research questions. From another perspective, carefully devised keywords help others to retrieve relevant research material, especially as the amount of research on the subject continues to grow. Therefore, appropriate identification of keywords serves a dual purpose: accurately addressing the research objectives, and improving the chances for readership as well as being identified as an author with similar research interests. The latter, however, may depend on specific publication channel´s guidelines, and maybe produced after completion of the manuscript.

In this research, this keyword list is specific to the keywords formulated to search relevant literature on the digital divide. As demonstrated earlier, the digital divide is an evolving concept, and is also described and discussed under different names in the literature. Relying solely on only a few terms is not likely to find content on the topic either directly or indirectly. The digital divide is often overlapping with other topics concerning information age. For instance, disparities in access and usage in information age may be discussed without mentioning the keyword *digital divide* at all. In addition, the digital divide is often interchangeably used with terms such as *digital inclusion*, *digital exclusion*, *e-inclusion*, *e-exclusion*, *information poor*, *information poverty*, and *information rich*, among others. Therefore, an appropriate strategy would have been to combine the various keywords to develop logical descriptors that can generate various publications on the topic.

As noted above, some relevant publications on the theme of the digital divide may not mention the digital divide at all in their title or abstracts. Instead, they may use words along digitalisation, ICT infrastructure, computers and internet to develop their title. Relying purely on keywords defining digital divide might result in overseeing valuable content that indirectly refers to the digital divide. Therefore, wherever appropriate, keywords were used standalone as well as in a variety of combinations to extract maximum relevant material suited to the theme of the digital divide.

Application of ICT across a number of socio-economic sectors has been the object of scholarly attention. In order to understand the significance of the digital divide as a research field, it is imperative to understand the significance of ICT in new global economy. Therefore, various socio-economic indicators were combined with ICT to form descriptors for retrieving literature on this theme.

Industry 4.0, which is taken as the next industrial revolution, was a significant keyword because promises of ICT in future industrial revolution highlight the need for confronting digital divide. This is related to a keyword *information age*, which can provide new insights into ICT-based processes.

Research question two asks whether it is possible to find a solution to the digital divide. For researching existing material on the digital divide as a step in

preparation for addressing research question 3, three keywords were considered: closure of the digital divide, bridging the digital divide, and digital divide solutions.

Research question 3 centred on exploring the conceptual aspects of the grey digital divide. Table 2 presents the keywords and descriptors used for literature retrieval. *Grey digital divide* is a relatively new term, and refers to the phenomenon of the digital divide related to elderly people. Four descriptors were used for finding relevant material for answering research question 3: the grey digital divide, the digital divide and the elderly, the digital divide and the elderly, and ICT and the elderly.

Table 2 Keywords and descriptors used for literature retrieval

Number	***Keywords and descriptors***
1	Digital divide
2	Digital inclusion
3	Digital exclusion
4	E-inclusion
5	E-exclusion
6	Information poverty
7	Information poor
8	Information rich
9	ICT and health
10	ICT and education
11	ICT and development
12	ICT and economic growth
13	Closure of the digital divide
14	Bridging the digital divide
15	The digital divide solutions
16	Information age
17	ICT infrastructure and development
18	ICT infrastructure
19	Industry 4.0
20	ICT-based learning
21	ICT-based healthcare
22	ICT and productivity
23	The grey digital divide
24	The digital divide and the elderly
25	ICT and the elderly
26	The digital divide and old people
27	ICT and old people

2.3 Overview of the research design

The steps taken to conduct the research are summarised below, followed by an in-depth discussion in subsequent sections.

A targeted literature review was performed to study the prior research contributions in the field of the digital divide. Preliminary emergent themes from the literature review revolved around confusion in the topic as a concept, lack of quantitative literature, and unsolved phenomenon of the digital divide over a span of two decades.

For a rigorous understanding of the digital divide, comprehensive literature review was performed systematically in accordance with the principles of

conducting a systematic literature review. A focus group was conducted with academic professionals in IRIS 2015 conference held in Oulu, Finland. In this discussion, the elements of research design were crosschecked with experts and various empowering suggestions were received. Panel discussion in I3E 2015 conference held in Delft, Netherlands enriched the research scope by yielding feedback on research objectives.

Sources of secondary data were searched for and compared with each other for accuracy and reliability. Propositions on links of ICT with various socio-economic indicators were tested with data available from the World Bank. The World Bank, although not without its own problems concerning publicly available data, was identified as a reliable source of collecting secondary data due to its widespread acceptance among academic and policy groups. Data from World Bank was collected at different phases of writing articles. In addition, secondary data was collected from most active organisations focusing on the digital divide.

Despite a thorough systematic literature review and other secondary forms of data collection at fixed time intervals, need for a continual influx of updated data was strongly felt. This need was achieved through an ongoing literature review that was conducted actively from beginning to the end of the research process. Ongoing literature review made sure that secondary data earlier collected was up-to-date, along with the arrival of new data.

Data collection and analysis was conducted simultaneously for each research article. Taking together the findings from each article, a combined synthesis of the findings and their implications was conducted. Rather than take the results at face value, multiple interpretations were taken into consideration. The findings and their implications led to actionable recommendations aimed at practice and policy discourses. Following this, conclusions were drawn and areas of further research inquiry were noted.

Bloomberg and Volpe (2012, p. 18) suggest that flip charts help to visualise the data during analysis phase of a research. Manual flip charts were used to visualise key patterns of data and identify any emergent meaningful patterns. The idea of flip charts led to the visualisation of research design that could aptly convey the flow of research process to the reader in a glance. Figure 1 illustrates the research design used in the present dissertation.

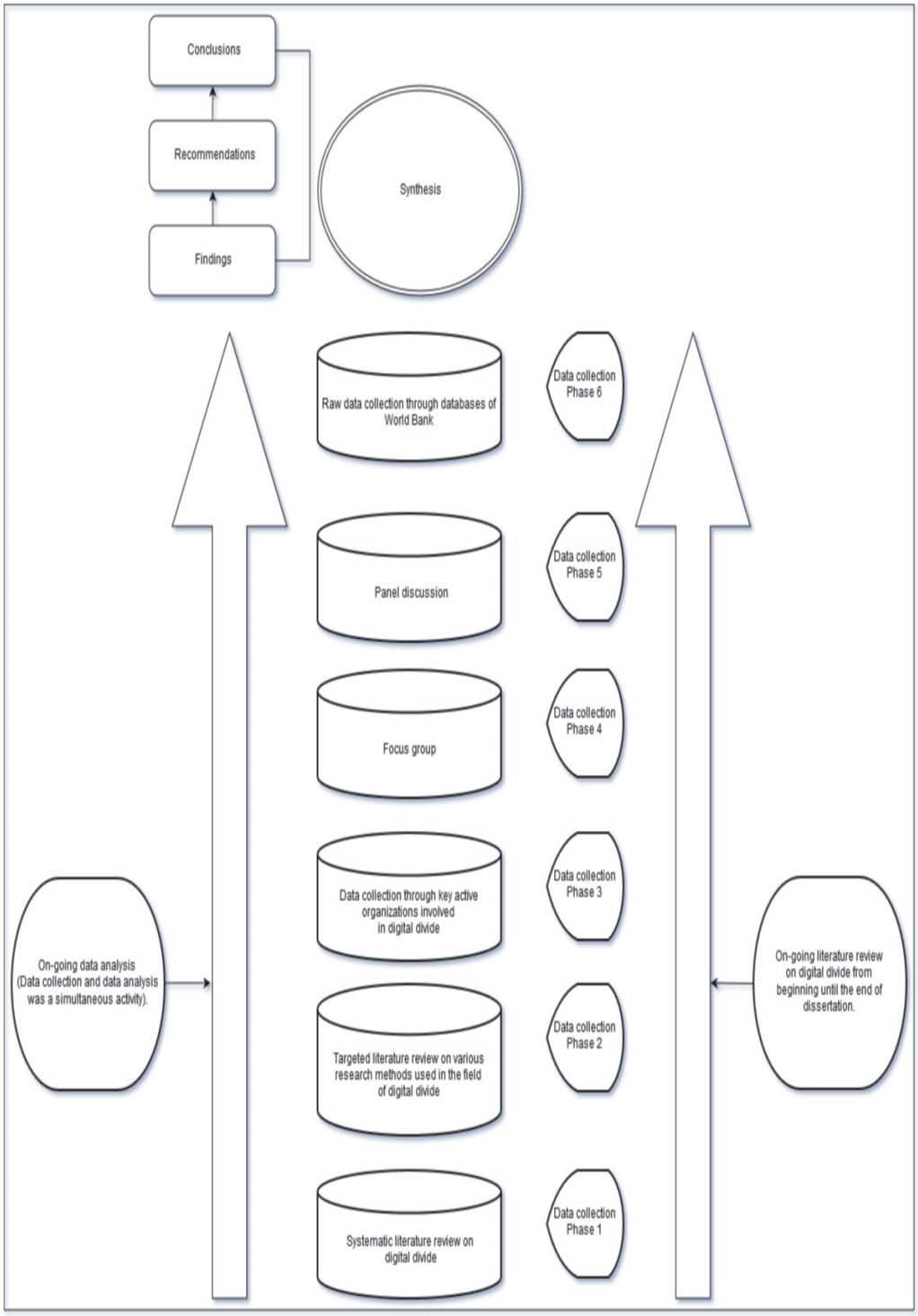

Figure 1 Flowchart of the research design

2.4 Data collection

2.4.1 Population and sample

Among various purposeful sampling strategies identified by Patton (1990, pp. 169–183, 173), maximum variation sampling strategy suited the present research aims. Maximum variation sampling strategy in addition to thick descriptions of each case aims at capturing the principal outcomes or themes that cut across a great deal of sample variation (Hoepfl, 1997, p. 52; Patton, 1990, p. 173). A strategy of maximum variation was therefore used to represent diverse cases of countries in order to display multiple perspectives on the digital divide.

Therefore, a wide array of countries was taken into consideration for analysis. In addition, Patton (2002, p. 273) inspires the use of information-rich cases which can yield in-depth understanding and information of prime importance to the research inquiry rather than empirical generalisations. Finland and Pakistan were identified as two information-rich cases, with a vast digital divide between them.

Data was gathered to the point of redundancy as advised by Bloomberg and Volpe (2012, p. 72). Sample selection to the point of redundancy holds that if the research goal is to maximise information then sample is selected until no new information is forthcoming from new data samples (Y. Lincoln and Guba, 1985, p. 202). Patton (2002) further recommends specifying a minimum sample based on reasonable coverage of the research problem and new sample may be added as fieldwork unfolds. Accordingly, researcher proposed initially working on a sample of countries from the Nordic region and the Indian subcontinent. Further countries were added into analysis from a range of developing, middle-income, and high-income OECD member states. This sample was then expanded to a worldwide coverage of countries for examining various statistical relationships.

The primary source of obtaining raw data for the present research was the World Bank, with all other sources being secondary. There are other institutions providing similar data, but the World Bank was chosen because it is known for its credibility as well it offers data for a considerable time span. In addition, the data was found to be comprehensive and more complete than the data provided by other institutions.

2.4.2 Overview of various data collection methods employed

A targeted review of literature preceded the data collection phases of the research to study the contributions delivered by other researchers in the broad areas of the

digital divide. As suggested by Bloomberg and Volpe (2012, p. 67) it is important to point out that targeted literature review preceding the data collection informs the research and such literature itself is not the data to be collected.

Researcher maintained a separate journal for identifying most relevant research methods that can be used to inform the research. This process is similar to conducting an audit trail.

The systematic literature review, ongoing literature review, collection of quantitative data from key ICT organisations, and collection of raw quantitative data from the World Bank were the various ways used to collect data.

2.4.3 Systematic literature review

To address the research question aimed at understanding the digital divide, a systematic literature review was carried out. A general literature review is a process of systematically identifying, locating, and analysing content related to the research questions (Bloomberg and Volpe, 2012, p. 46). When this process is further systematised from start to finish, it becomes a scrutinised process where only relevant high quality studies are selected for review, often from a pool of varying literature resources.

This draws a close link to the meta-analytic review described by Rosenthal (1995), and Patton's (1990) inspiration about evaluation research that engages a research in systematic examination of research through meaningful analysis and data collection.

The concept of evidence-based research emerged from medicine sciences as it was realised that medical advice based on experts' opinions was not reliable compared to accumulated evidence obtained from a series of scientific experiments, where evidence means synthesis of high-quality research on a given topic (Kitchenham et al., 2009, p. 8). In contrast to traditional literature reviews based on ad hoc selection of literature, a systematic literature review is a methodologically rigorous literature review (Kitchenham et al., 2009, p. 8; Mallett, Hagen-Zanker, Slater, and Duvendack, 2012, p. 445). A systematic literature review is therefore a reliable research method that offers heavier objective and critical appraisal of evidence than traditional literature reviews.

While discussing meta-analytic reviews, Rosenthal (1995, p. 183) points out that data analysis of any study can be a complex procedure in itself, and this complexity rises when data analysis is to be performed on a set of studies. Systematic literature reviews allow the creation of a summary of literature reviews in a single document (V. Smith, Devane, Begley, and Clarke, 2011, p. 6), but with a highly critical and analytical perspective. A systematic literature

review as a rigorous content analysis is used as a critical research method across a variety of disciplines.

A properly conducted systematic literature is an effective means to become familiar with the best research evidence available focused on a particular research question, and all decision taken to compile the information are meant to be explicit to the reader (Garg, Hackam, and Tonelli, 2008, pp. 253–254). A systematic literature review is a comprehensive and rigorous procedure to assess the most relevant research on a particular topic, whereby the review would help to contextualise the earlier reported research and draw new interpretations, links, and perspectives. A systematic literature review involves systematic identification, location, filtration, assimilation, and analysis of research material closely related to the research objectives. A systematic literature review therefore makes it possible to scrutinise the review process using rigorous research techniques. I considered this a significant research method for gaining a deeper understanding of the concept of digital divides.

Another reason of employing the systematic literature review was to source the reliable publications to construct the manuscript. This was done in the view of adding credibility to the research. Following the clearly defined research protocols, one can easily replicate the same results at the specific time frame when the study was conducted. This is in marked contrast to general literature reviews, which do not make it very clear which conclusions are a result of the researcher's own practical field experience, or the extensiveness of the literature review, or why certain publications were emphasised more than others (Garg et al., 2008, p. 253).

In this respect, a systematic literature review can be considered an organised narrative on a particular theme that integrates, synthesises, demarcates the scope of the research, critiques the existing research, and offers justifications to support such decisions. This line of inquiry permits new perspectives on the topic. Broadly speaking, a systematic literature review offers theoretical and methodological sophistication for the subsequent research.

A systematic literature review therefore offers a dynamic immersion into the subject where ideally, the substantiated arguments flow coherently following a logical order. The finely refined process of a systematic literature review thus helps in yielding the references that have a direct bearing on the topic and distinguishes the central from the peripheral. In contrast to a mere summative and descriptive account of the literature, a systematic literature review is highly analytical and critical. Results obtained from systematic literature review can therefore be more favourable than normal reviews of literature for practice and policy decisions.

Systematic literature reviews are limited in that they do not overcome problems inherent in research design and execution of selected publications

(Garg et al., 2008, p. 255). Mistake of combining rigorous studies with poor quality studies in a systematic literature review is another potential concern. Selecting a combination of poorly conducted studies and methodologically rigorous studies can lead to worse assessments of the underlying truth (Lau, Ioannidis, and Schmid, 1998, pp. 123–124, as cited by Garg (2008, p. 255)).

Being aware of the aforementioned pitfalls, researcher addressed these concerns by relying on manual analysis throughout the content analysis phase. In addition, researcher remained strictly bounded to inclusion and exclusion criteria for literature filtering. These criteria for inclusion and exclusion for literature filtration purposes are presented in Paper 1. It was made sure that all selected studies are methodologically rigorous and relevant to the research objectives defined in the systematic literature review. For this, researcher made double checks for every study included in the analysis after final selection of studies from a deep pool of publications. In this process, few studies had to be omitted from finally selected sample of studies on account of research rigour in order to comply with the norms of a competent systematic literature review.

2.5 Data analysis and synthesis methods

2.5.1 Pre-data analysis measures

It has been suggested that data collection and data analysis be a simultaneous process to avoid running the risk of duplication of data (Merriam, 1998, as cited by Bloomberg and Volpe (2012, p. 84)). Accordingly, the process of data analysis was ongoing throughout data collection phases. This process helped to effectively frame the final synthesis. Peer debriefing, a process where a researcher and an impartial peer carry out in-depth discussions about data and findings (Spall, 1998, p. 280) was employed. Some of these peers were from the academic institution where researcher carried out the research; others were academic peers with whom researcher linked in various academic conferences, seminars, and informal gatherings. After receiving valuable feedback a revised version of research instruments was developed.

Researcher actively looked for any useful patterns and trends that were linked together in the data. For example, GDP per capita was consistently tied with high rate of ICT diffusion across the entire world. Furthermore, it was observed that all developing countries were on the wrong side of the digital divide compared to developed countries. An upward trend towards digitalisation for all countries was observed over a span of nine years. Toward this end, researcher was able to critically think about data in light of existing empirical debates reported in prior

literature. Key points stemming from this empirical curiosity were noted down and preliminary flip charts for research design were developed. Flip charts are pieces of paper that can be used to write or illustrate key concepts, usually organised and affixed on a wall or whiteboard. These flipcharts helped researcher to creatively think about the research design. Flip charts can be especially helpful when presenting research design to impartial peers for collecting the feedback.

2.5.2 Methods pertaining to data analysis and synthesis

Regression analysis refers to statistical techniques for examining and modelling the relationship between given variables (Montgomery, Peck, and Vining, 2015, p. 1). Most statistical software generally summarise certain aspects of raw data and their apparent utility generate pressure on researchers to use them for their data analysis instead of taking a discursive approach (Harris, 2001, p. 1).

According to Draper and Smith (2014) multivariate regression analysis of model under assumption allows more careful analysis than singular regression because variance models often have many parameters. Another reason to employ multivariate regression analysis was the proposition that such statistical techniques will help to achieve conclusive results.

However, multivariate statistics are not without their disadvantages. For instance, Porter, Connolly, Heikes, and Park (1981, p. 398) demonstrate how multivariate regression analysis can often be misleading when interpreted for policy recommendations. Multivariate regression analysis are limited in that these techniques require considerably large set of data in order for analysis to be meaningful (Jackson, n.d.). If applied to smaller data sets, results of multivariate regression analysis would be unreliable due to the increased risk of standard errors. In addition, multivariate assumptive models are often not satisfied after complex analysis. Researcher addressed these limitations by incorporating large sets of data for all countries included in the World Bank database. In addition, the time range for socio-economic indicators was extended beyond 5 years.

As authenticated in a study by Derrick, Bates, and Dufek (1994), Pearson product-moment correlation is an easy to use and effective tool that has been conventionally used by researchers to compare time series data. This statistical tool was particularly useful when researcher grouped the countries into clusters based on their economic development and extracted the corresponding time series data from the World Bank.

Pearson product moment correlation can be defined as the degree to which two variables correlate with each other. This correlation is at the core of multivariate statistics (Archdeacon, 1994, p. 106). In combination with other analytical tools,

Pearson product moment correlation can help to visualise the relationship between two variables by means of a scatter plot.

2.6 Ethical considerations

Baez (2002, pp. 35–37) discusses the "convention of confidentiality", which involves giving priority to safeguarding the confidential information of every research participant. A researcher in information systems science must be responsible for both informing and safeguarding the rights of participants, who can also include peers.

Throughout the research, author has been aware that researcher must be morally bound to preserve anonymity of the participants or peers. All necessary steps have been taken to address any ethical issues that might arise from this research. The process of peer debriefing was based on mutual trust between researcher and impartial peer. There was absolutely no discrimination whatsoever based on gender, race, religion, ethnicity or beliefs. All those involved in the process of delivering impartial feedback on research design and findings were requested to do so based on their professional competence and integrity. They were treated as volunteers who could withdraw from their role anytime without any ramifications of any kind. In order to respect the anonymity of peers in their role as impartial feedback on data and analysis and certain panel discussants, the names of these insight providers have been kept hidden.

The research design was rigorously prepared to ensure quality in research. Various steps were taken to ensure that integrity of research is not compromised. The researcher was aware that research must be impartial and independently conducted. In light of this, researcher fully acknowledged any extent of personal interference with the study.

Personal assumptions related to the topic of research were fully disclosed by researcher in the beginning of the research. Personal observations and experience, as researcher himself belonged to a developing country, were disclosed impartially to reflect the reality in Pakistan. Researcher has sentimental value to poverty-riddled areas of Pakistan as well as across the world. Emotions have been strictly kept out from this research, although they did have a role in my selection of the research topic.

Furthermore, the inclusion and exclusion criteria developed in systematic literature review could have been further enriched. Despite rigidly following this inclusion and exclusion criteria, this is to say that my selection process may have affected the kind of publications reviewed for content analysis. This is likely to be the case in the ongoing review of literature and the targeted review of literature on research methods used in the digital divide field.

In conducting the research, I was fully open to sharing ideas, data, and results among academic peers and taking criticism in a constructive manner. Various stages of research and findings were fully disclosed in seminars and at conferences.

I conducted the research in compliance with copyrights, patents, and various other forms of intellectual property. This dissertation was based on country-level data, and did not engage with individuals. All the data used were publicly available, and no breach of data occurred throughout the research process. The results promote refined understanding of the digital divide, and suggest numerous actionable implications for research, practice and policy areas; as such this research, confessedly, does not engage in any act of brainwashing or misguiding the society.

2.7 Trustworthiness

2.7.1 Trustworthiness in a mixed method research design

Demonstrating trustworthiness in doctoral dissertations is considered an essential requirement (c.f. Angen, 2000, p. 378), regardless of the discipline. Credibility and validity of research methods is highly desired because without rigour research becomes fiction and valueless (see for example, Creswell and Miller, 2000, p. 124; Morse et al., 2002, p. 14). Evaluation of research is nearly inescapable and acknowledgement of it gives a control and assessment of research with respect to overall validity (Winter, 2000, p. 7), and this evaluation becomes critical when implications are to be directed towards practicality (Noble and Smith, 2015, p. 34). Having understood the clear significance of validity and reliability, the purpose of this section is to address issues related to trustworthiness in the present research with logical reasoning and acknowledgements. The present research uses a mixed-method research design to understand the digital divide in depth, and to propose a framework for bridging it. Addressing issues of trustworthiness in present research design will help readers to judge its usefulness in other possible contexts.

The method used to address the issues of trustworthiness is the one proposed by Guba (1981, pp. 84–88). The reason for this selection lies in its wide acknowledgement across academic circles. For instance, Guba's methods for establishing the trustworthiness of research are widely accepted (Shenton, 2004, p. 64). Assessment of research rigour of a study in evaluation report is a significant challenge that is often limited by technical difficulties (Y. S. Lincoln & Guba, 1986, pp. 73–74). Process used to test truthfulness of a research

revolves around four criteria including internal validity (credibility), external validity (applicability), consistency (reliability or replicability), and neutrality (objectivity) (Y. S. Lincoln and Guba, 1986, p. 74). Although the criteria proposed by Lincoln and Guba (1986, 73-74) are designed for qualitative research, it was researcher's contention that it can be applied to currently chosen mode of inquiry. In part, this belief is grounded in the premise that qualitative research is significant portion of chosen research methods. In addition, Golafshani (2003, p. 601) reminds that Lincoln and Guba (1985, p. 300) use the term dependability in qualitative research which closely relates to the concept of reliability in quantitative research. The concept of reliability can be applied to all kinds of research (Golafshani, 2003, p. 601). This process is an effort to maintain transparency in research design and to address any potential biasness that might arise in overall research design, data collection, and analysis of the research.

2.7.2 Credibility

A number of procedural safeguards were taken to strengthen the credibility of the present research. One strategy to address credibility and reliability of a research is triangulation which is believed to have originated from navigation science (Armstrong, Gosling, Weinman, and Marteau, 1997, p. 597; see also Denzin, 1978).

As Angen (2000, pp. 392–393) notes, a researcher's conclusions should remain open to expansive interpretations and reinterpretations, study design and analysis was discussed and reviewed with professional colleagues to gain additional insights and alternative ways of looking at raw data and results. These peers were knowledgeable about the discipline of information systems science. This process of member checks on research design is known as peer debriefing where researcher and impartial peers conduct extensive discussions on data and results of a research (Erlandson, Harris, Skipper, and Allen, 1993, p. 140; Spall, 1998, p. 280). Some peers had prior fieldwork experience relating to the digital divide, and helped greatly in improving the research design. A method of member checking proposed by Erlandson et al. (1993, p. 142) encouraged me to have formal and informal conversations with members of the Information Systems Institute, which helped significantly in shaping the overall research process.

In line with the recommendations of Guba (1981, p. 86) and Erlandson et al. (1993, pp. 139–140), I established referential adequacy. This involves analysing and comparing purposely archived data with research results to check consistency. The findings from analysis of data in notes matched with findings emerged from the present research. This included testing relationships between

ICT and socio-economic indicators across various countries grouped on basis of developing, middle-income, and developed countries.

Guba (1981, p. 86) further recommends performing member checks on a research by source group before finalising it (see also, Erlandson et al., 1993, pp. 42–43). Accordingly, peers were requested to overview the research before final institutional review. In addition, I clarified my own assumptions upfront to supervisor, and at panel discussions. Additional inferences from supervisors tremendously helped to refine data analysis methods.

2.7.3 Reliability

Dependability, or reliability, refers to the extent that research results can be replicated by someone else who employs the similar research design (Bloomberg and Volpe, 2012, p. 86). Y. Lincoln and Guba (1985, pp. 300, 317) relate dependability to reliability of research results, and suggest an "inquiry audit" process, which involves an in-depth evaluation of the research by external researchers to appraise whether research results are supported by the data. If research is reliable then two researchers observing the same phenomenon will come up with compatible findings (Bloomberg and Volpe, 2012, p. 76). Therefore, in order for research to be dependable, readers should be able to track the research design to arrive at similar results.

In the present research, issue of dependability was addressed by offering a thick description of research design, attributing literature references to particular research methods used, developing an inclusion and exclusion criteria to filter the literature, giving rationale for choice of keywords, and a detailed rationale on chosen research methods and its connection with the research aims. The findings of the systematic literature review in Paper 1 can be replicated by following the stepwise research design, keeping in mind the time range when the review was conducted. Inquiry audit advised by Y. Lincoln and Guba (1985, p. 317) was used to enhance dependability and findings were presented before statistical experts and external reviewers.

To achieve a reasonable extent of dependability professional peers were requested to comment on research instruments and elements of research design. Researcher then looked for any consistency in the feedback received. This process called inter-rater reliability minimises the bias of a single researcher interpreting the results (Bloomberg and Volpe, 2012, p. 78; consider also, Gwet, 2014, pp. 4–9). As Armstrong et al. (1997, pp. 597–598) inspire, inter-rater reliability tests may be useful in that they can support the status of research results. As suggested by Guba (1981, p. 87), a dependability audit was performed by an external auditor who was competent enough to comment on processes of

inquiry. In this technique for determining dependability, an independent auditor reviews the steps taken by the researcher by examining audit trail, field notes, and reports to establish how well the researcher followed the principles of maintaining credibility of research (Driessen, Van Der Vleuten, Schuwirth, Van Tartwijk, and Vermunt, 2005, pp. 44–45; Erlandson et al., 1993, p. 34; Guba, 1981, p. 87). Feedback received tremendously helped to improve the existing research design.

Guba (1981, p. 87) suggests maintaining a running account of the audit trail process, which involves taking and organising notes during the research process. This audit trail has also been referred to as transparency of method as a strategy for making research more reliable (Merriam, 2002, p. 21). I maintained an audit trail that helped in rethinking and reframing the synthesis by following the annals of a reflexive journal. With regard to observations in qualitative research, Merriam (2009, p. 129) advises transforming field notes into full notes in a narrative format. Although I did not use the observation, notes were actively taken and re-written to internalise key concepts and ideas.

2.7.4 Objectivity

Objectivity holds that research findings are a result of research rather than author's subjectivity and biases (Shenton, 2004, p. 72). Guba (1981, p. 87) advises triangulation of methods to acquire data from different perspectives to establish objectivity.

To address the issue of objectivity, I first acknowledged the assumptions upfront in the introduction to this dissertation. Next, a comprehensive reflexive journal was maintained throughout the research process, which assisted the thought process. Consistent with the suggestion of Guba (1981, p. 87), triangulation of methods was used as mixed-method research approach.

Any hand-written notes were continually recorded in electronic format. For this, a note management programme was used, which was found to be particularly useful. A machine-assisted method of documentation was favoured over conventional hand-written notes because the latter creates procedural difficulties in searching for a particular note. This was an exception to manually-drawn flipcharts, which help significantly in highlighting patterns in data. The usage of professional tools allowed me to effectively look for particular data instantly whenever there were any doubts about conformability.

References were professionally maintained using open source software Zotero. This allowed a systematic arrangement of article files, notes, page numbers and meta-data concerning cited material. PDF X-Change Viewer 2012 edition software was exceptionally helpful in working with PDF files. This allowed

editing, highlighting, and taking notes on PDF files. This was used in conjunction with Zotero for efficient record keeping. This process enabled navigation to any cited publication, including article file and page number, within seconds.

2.7.5 Transferability

Transferability holds that to what extent the phenomenon observed in this particular research can be transferred to another related context, from the standpoint of the prospective reader. Therefore, transferability is a conformance or match between the research context and other possible contexts as assessed by the prospective reader (Bloomberg and Volpe, 2012, p. 78). Although regardless of research method(s) used, no research can provide universally transferable results; a suitable degree of transferability to other contexts should be ascertained in research design (Malterud, 2001, p. 485). This can assist readers to judge transferability of results in other possible contexts. Patton (1990, pp. 489–491) suggests context-bound extrapolations, which are likely applicable to other similar situations under different conditions.

Although it was not the objective of this research to offer generalisations, the issue of transferability was addressed by giving detailed description of study methodology, "thick" description of research design, and the research context. Context-bound extrapolations are possible in other developing countries. This is because developing countries are mostly characterised by similar issues.

Following a rich description of research design, associations can be drawn between findings of the present research and other possible contexts. In light of this, boundaries of the research are made clear in section 2.7.6. Complete transferability of the present findings may not seem possible, nor was it intended. It is solely up to the readers to judge what conclusions can be applied to other possible situations.

2.7.6 Scope of the research and delimitations

In the literature section, causative factors of the digital divide were not reviewed in great detail. This is because roughly two decades of research has heavily documented causative factors of the digital divide. Therefore, it is essential to understand that a coverage of these factors in-depth would essentially be a re-articulation of what is already known. What are most needed now are solutions to the digital divide. However, it was significant to highlight the multifaceted concept of the digital divide to arrive at the understanding that bridging it would in-turn require multilevel efforts.

The assumption that the digital divide will solve itself is one I have rejected, because the digital divide is apparently a phenomenon co-evolving with ICT. In part, this awakening has come about because the issue of the digital divide has become increasingly prominent and influential worldwide over the past two decades. Emerging forms of ICT are expected to demand new skills and adaptability to ever-changing nature of ICT infrastructure, and thereby creating emerging forms of the digital divide. In general, research appears to be too far from establishing that the digital divide cannot be totally eliminated. From this perspective, the digital divide will not be solved completely regardless of any effort; however, efforts can be directed at minimising it.

Fieldwork in remote regions in Pakistan could have been a window to understanding the uncovered regions or tribal belts in neighbouring developing countries in the Indian subcontinent and how ICT can play its role in such regions. This was screened out for three reasons. First, ongoing armed conflict in these regions where life security is the responsibility of the individual rather than the government places a significant mobility constraint on the researcher. Second, exploring this aspect would admittedly add new knowledge but is not relevant to research objectives at hand. Third, work in this remote region may not necessarily be extrapolated to other developing countries of the Indian subcontinent, because most of these areas have their own cultural traditions. This task is outside boundaries of this research but a worthwhile issue to explore for governments and ICT corporations operating in these countries.

2.8 Limitations

Certain caveats need to be acknowledged in this research, within which findings must be interpreted with caution. Some of these limitations are a common critique of quantitative and qualitative modes of inquiry, whereas others are inherent in the present research design itself. Careful consideration has been given to minimisation of the impact of these limitations. Features unique to qualitative research design impose potential limitations on its use. This is to acknowledge that qualitative research is generally limited by the unique thinking process and choices made by the researcher.

Aside from issues pertaining to criticism of holistic research methods, another major limitation is the lack of fieldwork to support the current findings. Fieldwork in remote and rural areas of Pakistan and Finland could have strengthened the results but was left out of scope due to resource constraints. The digital divide in remote areas is therefore an unresolved solution that may be addressed in future research attempts. Although developing countries often share similar characteristics and generalisability of findings is possible; however,

absence of fieldwork leaves limited possibilities for generalising the findings to other contexts.

Research addressed the aforementioned limitation by comprehensively reviewing relevant literature on the digital divide and empirical aspects of it. In practice, for fieldwork in Pakistan a considerably wide geographic coverage is essential, due to the large size of the country. With more than 80 languages and various cultures and sub-cultures, Pakistan is also extremely diverse. Focus on one city or province alone may not be deemed as nationally representative sample. Fieldwork across such a wide scope would have required far greater research funding than was available for this research.

Author has been cautious of not over-reaching the interpretation of positive relationship between ICT and education. However, there is a likelihood of incidents in Pakistan where students without computers have performed academically better than students with computers. Such is the case with cadet colleges in Pakistan, where students are deprived of some ICT tools (PDAs, smartphones, tablets, radio and TV sets, telephones, content-bound limitations in use of computers and the internet) compared to local educational institutions. A survey of these students could have added rigour to this particular finding of a positive correlation between ICT and education.

To address the limitation of generalisability, a thick and rich account of background context and research methods was offered with an anticipation that knowledge base could be further assessed for its appropriate applicability in other contexts.

In line with these limitations, a number of cautionary measures were taken. My assumptions are presented upfront in the introduction. Research design and plan was scrutinised by research advisor (supervisor), peer review process, and academic panel discussions.

Although the intent of this research was not to offer generalisations, the suitability of the research outcome in other contexts is subjected to cultural conditions. As was noted in the systematic literature review, most of the research on the digital divide is qualitative in nature. While quantitative aspects of the digital divide are important to address, qualitative aspects cannot be ignored either. This research thus avoids withdrawal into the discussion of qualitative aspects of the digital divide. These limitations present an opportunity to direct suggestions at future research discourses. I address these in the analysis and synthesis sections.

3 LITERATURE REVIEWS

This chapter places the research problem within the broader context of research on the digital divide. The aim of this chapter is to synthesise the relevant literature, critically review the arguments, and make new linkages wherever applicable. This chapter joins the ongoing dialogue on the digital divide with critique and justification, and generates various perspectives on the topic.

This chapter was aimed at presenting a coherent volume of the topic-specific literature and offering an analytical evaluation by systematically breaking down the content into its constituent parts, and then logically rearranging to arrive at a reasonable structure. This is especially useful in light of the research inconsistencies concerning the digital divide.

3.1 Systematic literature review

3.1.1 Introduction

The purpose of this section is to summarise the systematic literature review, which was reported in Paper 1. A new systematic literature review for the research would essentially be similar to the one reported in Paper 1, if the timeframe and inclusion and exclusion criteria are kept the same.

Therefore, instead of replicating the same information by conducting a systematic literature review on this topic again, I decided to summarise the systematic literature review that was already conducted and reported in Paper 1. All the papers related to this dissertation are attached as appendices.

3.1.2 Summary of systematic literature review reported in Paper 1

The past decade has brought rapid advances in the development of ICT across developed world (Drori and Jang, 2003, pp. 145–147), whereas too little progress in this sector is reported from developing countries (Chinn and Fairlie, 2004, p. 1). The outcome of this is a highly uneven global ICT landscape (Ya'u, 2005, p. 109), which creates the digital divide.

Despite the apparent emergence of ICT landscape across the world, the digital divide is deepening. For instance, Rahim, Pawanteh and Salman (2011, p. 4) argue that the digital divide is deepening globally in terms of skills and usage. However, there are other factors associated with the deepening of the digital divide such as various cognitive and individual reasons. Even when there is motivation and awareness of learning ICT, often the lack of time emerges as a barrier. The digital divide is a global problem, but developing countries are usually worse than the developed countries.

Equal distribution of ICT resources globally and improved global ICT infrastructure are fundamental concerns in information systems science but seem to have uncertain place among researchers. Although there is an abundance of literature on the digital divide, most studies have concentrated only on the technology access gap. Several controversies arise on the question of how to assess the digital divide. Consequently, the digital divide has become a confused theme in literature (Strover, 2003, p. 275), which affects policy directions. A theoretical solution of these divergent positions on the digital divide remains in critically understanding the phenomenon. This essentially means that there is a need to understand the digital divide as it is, rather than how it is perceived and projected. For this reason, conducting a thorough literature review systematically was crucial to understand the phenomenon itself and propose a set of recommendations for policy and research areas.

The process of systematic literature review on the digital divide began by consulting academic material on the best practices to conduct literature reviews rigorously and systematically. A list of keywords relating to the topic of the digital divide was prepared, as was a list of inclusion and exclusion criteria. Articles were searched electronically from reputable publication channels. Initial search resulted in 7306 articles that were filtered according to the inclusion and exclusion criteria. Multi-level filtration method resulted in a final number of 81 references that were deemed most relevant to the phenomenon of interest – digital divide. Out of these, 48 were qualitative, 20 quantitative, and 13 were mixed-method research articles.

Content analysis of the selected articles revealed that the digital divide is much more complex than previously realised. However, all too often digital divide is understood as a simple breach in access to ICT. Further to this, there existed significant differences among researchers on this topic. The digital divide was found to be heavily contested on its acute causes. Some established that poverty is the leading cause of the digital divide, others attributed digital divide to income, race, education, and cultural reasons.

The concept of a multilevel digital divide, proposed by Norris (2001, p. 3), refers to the occurrence of the phenomenon at various levels from individual to a global form. Findings of several other studies lend weight to this claim.

Understanding of this notion is the beginning of understanding of counteracting the digital divide. This is so because existing failed efforts to close digital divide concentrated mainly on providing ICT access. Experts were unaware that the digital divide is not a simple breach in access to ICT but rather a multi-faceted phenomenon with several layers of content making it a complex area of study. For this reason, assessment of the digital divide has always been a problem, since there is no universal mechanism to properly measure it.

Although poverty is chiefly responsible for various disparities in the world including digital disparities, there are other responsible factors. These include a range of psychological, cultural, and various cognitive and individual factors that account for global disparities in ICT resources. The time barrier has been identified a new factor hampering the use of ICT even when ICT skills and resources are available, in which case the digital divide affords understanding from an altogether different perspective. It is difficult to acquire a motivation for using or learning ICT, when there are competing demands on one's time in today's fast pace economy. In summary, the debates on causative factors of the digital divide remain confused. Consequently, the digital divide is a concept often misunderstood in academics, press, policy, and public circles. Articulating a universal definition of the digital divide is clearly apparent.

Although the large-scale diffusion of ICT worldwide suggests an improved ICT landscape over the past decade, as well the revolutionised social fabric through ICT use, the digital divide is reportedly deepening on ICT skills level. Despite apparent visible ICT infrastructure around the world, study after study has shown that the digital divide is getting serious globally. It follows that there can be a digital divide among individuals and societies regardless of ICT ownership.

Some propagate that free copyright software will help in reducing digital disparities, particularly in the developing world. At the same time, this can discourage content producers. It has also been suggested that current copyright conventions should be changed from "all rights reserved" to "some rights reserved". This may be useful in developing countries, where the cost of purchasing software is often much higher than family dietary needs.

The predominance of the English language in internet content has been cited as one key reason people have difficulties in acquiring digital literacy in non-English- speaking countries. This argument is debatable, since the dominance of English-language content can be seen as an opportunity to learn the language. Regardless, content in the regional language must be a top priority for ICT manufacturers, given that it facilitates the ICT usage, especially with regard to the elderly.

Solutions to the digital divide must be seen as multi-level efforts that include the intervention of governments in their own respective regimes. ICT reforms are

needed in various socio-economic sectors including education and healthcare. Subsidisation of education and ICT will play a key role in reducing digital disparities around the world. However, the digital divide must be tackled from multiple perspectives which include awareness, training in ICT skills, promoting ICT-assisted services, role of ICT manufactures in making user-friendly hardware and software, and content in local language etc.

Future research should assess digital divide across various regions and determine the impact of cultural influences on the digital divide. The grey digital divide is a growing problem due to ageing processes, which should inspire research into this area. There exists a great deal of controversy relating to the digital divide with respect to relationships of the digital divide with socio-economic indicators. This issue can be a worthy area of exploration in future trials.

3.2 Ongoing literature review

3.2.1 Introduction

The aim of ongoing literature review was to cover the relevant material on the topic of inquiry from beginning until the end of doctoral research process. This aim could not be achieved through systematic literature review because specific time limits and inclusion and exclusion criteria limited the coverage narrowed down to match the topic as much as possible. Although this is certainly a desired form of literature coverage, there is risk of losing broad picture of the topic and any relevant content that appeared after conducting the systematic literature review. Therefore, some of the information in systematic literature review might not be current by the time the dissertation is completed.

For this purpose, another stand-alone literature review was actively conducted throughout the research process. Intent has been to not duplicate what has already been conducted in systematic literature review but to bring in additional insights directly or indirectly attached to the topic of the digital divide. In some instances, significant points that emerged from the systematic literature review are further explored in detail. By carrying out the systematic literature review, a snowball effect developed that yielded various other academic insights related to the topic. These additional academic references could not be included in the systematic literature review due to strict inclusion and exclusion criteria. Nevertheless, they offered useful insights related to topic directly or indirectly. Ongoing literature review could take these additional academic references to reflect various perspectives on the topic. This is an attempt to build a comprehensive knowledge

base by critically reviewing arguments distilled from various academic resources as well as media and policy documents. The two literature reviews combined are thus expected to yield further in-depth understanding of the digital divide as well as presenting an up-to-date coverage of the research topic by the time the dissertation is completed.

However, the idea of ongoing literature review was not to just document the review under the dedicated heading of "Ongoing literature review". Instead, the review that was continuously conducted throughout the research process was also reported in the introduction, theoretical framework, and methodology sections. Introduction section was revisited several times that needed revisions and new relevant material. Ongoing literature review was very useful in these areas on top of providing appropriate coverage on the topic by the time the research was completed.

3.2.2 Cybercrime: impact on the digital divide

When internet first surfaced in mid-1990s, a great deal was being said about its revolutionary nature and effect on productivity. In the intervening years, however, divergent uses of internet gave rise to cybercrime. In the wake of hike in cybercrimes, there are two crucial dimensions to consider. First, the number of reported virus and hacking offensives began to grow exponentially starting from 1999, as was the case in Korea (Ueki, 2004, p. 130). According to another account (Broadhurst, 2006, pp. 412–413), computer viruses saw an increase in velocity and virulence since 2000. Second, ICT has the potential to facilitate terrorist activities with ICT-based training and communication to carry out attacks (M. Costa, 2004, p. 1). It is not surprising to expect a significant proportion of individuals who distance themselves from ICT due to growing security challenges concerning a range of issues from ID theft to potential viruses. This aspect of the digital divide is essentially under-researched, as no study existed at the time of research that will link digital divide with cyber-crime.

Debit and credit card fraud carried out via the internet as a component of cybercrime (Broadhurst, 2006, p. 413) appear to be a significant challenge worldwide (M. Costa, 2004, p. 2), with many refusing to trade on the internet or engage in financial transactions between family and friends. This digital divide related to ICT security challenges is a crucial aspect that must address policy attention worldwide. The intersection of organised crime and ICT is another potential concern for authorises (Broadhurst, 2006, p. 411), as ICT allows numerous ways to connect and facilitate crime.

Regulations in internet and cyber-crime laws are significant in that they are expected to reduce the digital divide in addition to providing a safe internet

experience. For instance, Broadhurst (2006, p. 412) suggests cooperation between private sector and law enforcement institution to tackle cyber-crime since most of the ICT products and services are provided by private sector. The National Response Center for Cyber Crime is a strict recent development in Pakistan to control cyber offensives. The aim has been to foster confidence among citizens to use cyberspace with peace and report any offense in a transparent manner. Controversies have surrounded this cybercrime bill as critics argue that bill is harsh and fits punishments for acts that cannot be considered as crimes. There is a general need of reconsideration what constitutes a cyber-crime and appropriate laws to handle it. Broadhurst (2006, p. 431) concludes that in order to fully realise the potential of ICT, developers must keep up with the public demand of safety and security. When seen from Broadhurst's perspective, ICT safety and security is a hindrance to maximum beneficial usage that causes a digital divide. The need for further research on this aspect of the digital divide is self-evident.

Another significant aspect of ICT in criminology is digital evidence. Digital evidence in criminal proceedings is often far more effective than manual records. Computerised evidence can be encrypted, shared effectively, and kept secure in a number of file formats. In other words, narrowing of the digital divide is likely to positively affect the entire legal system in terms of efficiency and transparency. Effective digitisation and latest ICT surveillance equipment in the developed world appears to be a key reason behind low crime rates, when compared to developing and underdeveloped world. The surveillance equipment such as CCTV camera may deter the crime rate in most situations. However, it is much more than just CCTV equipment that should be of concern. Practical success is contingent upon variety of factors such as data storage capacity, real time flow of information to concerned authorities, and quality of audio and video recordings etc. Therefore, there can be a digital divide between premises who use state-of-the-art ICT equipment to deter crime rate and those who do not take advantage of latest ICT equipment.

3.2.3 Internet of Things

The idea of an "internet of things" was inspired by members of RFID (Radio-frequency identification) development community who argued the possibility of tracing services by use of internet IP address that would correspond to a tagged device (Kosmatos, Tselikas, and Boucouvalas, 2011, pp. 5–6; Sheng et al., 2013, p. 91). The term *internet of things* (IoT), first coined by Kevin Ashton in the 1999, is an emerging technology referring to a growing network-based connectivity among various devices that can connect with each other (Khodkari,

Maghrebi, and Branch, 2016, pp. 437, 434; Kosmatos et al., 2011, p. 5). In this direction, numerous research and practice initiatives have surfaced which focus on identification services through a smart tag, digital keys, and a range of further daily life automation services. These smart devices are already floating in market including smart lights, smart washing machines, and smart automated cookers that can be controlled via smartphones. It is not far-fetched that the internet of things will be a new significant indicator of the digital divide.

RFID is becoming increasingly important in industrial sector as consumers demand easily accessible product or service information to help making a purchase decision (Penttilä, Pere, Soini, Sydänheimo, and Kivikoski, 2005, p. 353). The RFID technologies have major potential, particularly in healthcare industry to deliver secure services using limited human resources (D'Andrea, Ferri, and Grifoni, 2016, p. 15). For example, E.C. Jones, Gupta, and Balasubramanian (2015, pp. 1–2) inspire the use of RFID technology in healthcare industry for identification of pharmaceutical inventories and accurate dispensation of drugs to ensure safe healthcare delivery. In near future, the internet of things is expected to further expand dimensions of the digital divide.

3.2.4 Lack of native-language electronic content

The dominance of the English in internet content is one of the key barriers in accessing and using ICT (W. Chen and Wellman, 2003, p. 24), since a considerable portion of world population does not speak English. Local language content on the internet is likely to engage people with ICT who do not have skills in English. Much of the world does not speak English, and considerable portion of internet content is in English. There is however a paradox to consider: most people around the world were able to learn English due to their access to the internet. However, middle-aged and elderly people are generally slower to learn things than younger generations.

This appears to be a key problem in Pakistan where almost all internet content is in English, which many people do not speak. Poor knowledge of the English language has been identified as one of the key barriers linked to the digital divide (Hassan and Sajid, 2013, 56). As a result, significant proportion of population is at a high risk of being increasingly marginalised from knowledge society. Finland appears to have a similar problem, since internet content is heavily dominated by English. When drawing a comparison between Finland and Pakistan, Finland has clearly more local-language content. On the flip side, the dominance of English-language content in global internet offers considerable potential for incidental learning of English, as demonstrated by Kabilan, Ahmad, and Abidin (2010, pp. 180–181, 185) with the case of Facebook as an

opportunity to learn English. It is difficult, however, to ignore the vast majority of people suffering from the digital divide due to lack of internet content in local language, especially the elderly. This can be taken as a compelling argument for launching efforts, hard as it may be in some cases, to encourage production and translation of content in local languages.

3.2.5 Lack of information kiosks

The number of internet kiosks appears to be a future indicator of ICT as this technology is being heralded as a network-based interface among various actors of society. They are becoming an increasingly growing topic of concern in service industry. These internet or network-equipped kiosks are able to automate various services such as buying airplane ticket or checking-in a flight, hotel room, financial services etc. After apparent success of kiosks in areas of e-service, e-voting, and e-democracy, they are being considered a technology that can help governments in bridging the digital divide (Slack and Rowley, 2004, p. 369). Many kiosks have the feature to offer identification services required for e-voting or banking through a smart card (Slack and Rowley, 2004, pp. 373–374), which can create efficiency in self-service.

The emergence of similar uptakes also seems to appear in other developing countries. For example, Kisan Call Center, a payphone-based extension service, is a project in India that appears to be an effective initiative to connect local farmers with university experts to answer basic and advanced questions related to agriculture (J. James, 2004, p. 174). James noted, however, that extension services have been long criticised for being ineffective in developing countries.

Various self-service kiosks are gradually appearing throughout Pakistan. NADRA e-Sahulat, a multiservice kiosk is a government initiative in Pakistan that allows citizens with bill payment services, financial transactions services, and identification services (‘e-Sahulat NADRA’, 2016). Content is offered in the local languages as well as in English. NADRA reported that it processes on average seven million transactions every month with over 11000 kiosk units currently installed throughout the country (‘e-Sahulat NADRA’, 2016).

3.2.6 Role of ICT associations

ICT associations are detrimental to the concept of promoting ICT infrastructure in a given country. This section reviews key ICT associations in Pakistan and Finland. Internet Policy Observatory Pakistan conducts research on IT policy and regulations in Pakistan with aims to foster a sustainable ICT infrastructure in

Pakistan. The key premise behind this third sector ICT channel is to leverage the country towards economic growth by investing in ICT sector. The issue of prime concern faced by this organisation is lack of funding, with reliance on limited government funds. When noting the significance of competitive funding for research and development projects, T. Knight and Routti (2011, p. 94) postulate that independence of funding agencies from government organisations lessens the chances of political favouritism. This is yet another example of how the digital divide is in large part related to income.

The Pakistan Computer Association (PCA) is an active organisation aiming to provide technological assistance to IT business community as well to suggest reforms to government regarding ICT infrastructure in the country.

The Pakistan Software Houses Association (P@SHA) is a platform for promoting the software industry in Pakistan. Association struggles to promote software exports of Pakistan as well as looking after the stakeholders of this industry.

Low rate of success in ICT infrastructure regardless of numerous ICT associations operating in the country suggests that Pakistan-s system is polluted at various levels. On surface, it appears that Pakistani government has never gone out of its way nor even interested in promoting a digital culture. Even when the government is serious in its efforts, corruption is one of the key impediments to the success of these ICT associations in Pakistan, as is commonly the case in developing countries.

Municipalities in Finland have a statuary obligation to provide welfare services (Kuusisto-Niemi, Saranto, and Rissanen, 2014, p. 28), and these services are being increasingly integrated with ICT over time. Due to the increased focus on research and development, coupled with a sophisticated innovation system, Finland has become one of the leading countries in the development of ICT (Hanna and Knight, 2011, p. 197). However, Finland recently appears to have lost its status as the absolute frontrunner (Knight and Routti, 2011, p. 80). The welfare system similar to Finland is absent in Pakistan and ICT is afforded by only rich and wealthy families with some exceptions to limited-scale government initiatives of providing ICT equipment to position holders in academic areas.

Despite the rise in ICT associations around the world, the digital divide has grown bigger. ICT associations admittedly mark the threshold into ICT infrastructure, but in overcoming the digital divide they are only part of the answer. This highlights that multilevel research efforts are required for understanding the multilevel phenomenon of the digital divide.

3.2.7 Intellectual copyright and its effect on the digital divide

The founder of Free Software Foundation, Richard Stallman, consistently maintained that copyright and patenting is a major issue hindering the narrowing of the digital divide (Stevenson, 2009, p. 16). Dynamics of propriety software often tie license fees for perpetual upgrades that are not always necessary and inevitably lead to a requirement for upgrading the hardware (Stevenson, 2009, pp. 16–17), which can be problematic for developing and under-developed countries. Contrary to the earlier understandings about copyrights, Randhwa (2012) contends that copyrights do not encourage creativity and create artificial restrictions on public information.

Arguably, making propriety software completely free will discourage the content producers and is against market mechanism, but licensing practices may be softened for developing countries. A recent trend is the practice of charging varying prices for varying countries, but it can still be a burden on developing countries to afford the already reduced prices. Open-source software can be a blessing if owners are offered feasible subsidies. This kind of software has considerable growth potential, as it allows pool of ideas and many content writers can produce new useful features.

3.2.8 Techno-stress and the digital divide

ICT-induced stress is known with various names, but it appears that, initially it was widely publicised as “technophobia” which referred to Obsessive Compulsion Disorder associated with ICT devices. The burden to keep up with growing demands of latest hardware and software inflicts various negative emotions to users, which leads to development of fear and anxiety with ICT (Qiang Tu 2011, 923-924).

The continuous burrowing of ICT at an unprecedented rate can mean that users will not be free from “techno-stress” (Qiang Tu 2011, 924). There is growing evidence of techno-stress in current information age. Repetitive compulsion to check smartphone for new messages, growing bombardment of advertisements on various ICT platforms, continuous distractions from beeping, endless system notifications etc. to name but a few. ICT hardware and software has also resulted in physical stress such as posture and eyestrain.

The technology acceptance model (Davis 1985, 24-26), which is widely recognised and most empirically tested model of technology acceptance based on psychological framework (Thatcher and Nadabeni, 128), suggests that ICT usage is also dependent upon perceived ease of use. It is therefore not surprising that the digital divide partly exists its digital usage is perceived too difficult by many.

Techno-stress symptoms may promote such deviances to use ICT and therefore the positive link between digital divide and techno-stress becomes all too clear.

Solution to techno-stress lies in provision of ergonomic hardware as well as software. For instance, while tracing digital divide related to elderly citizens over 55 years of age in Australia Seton and Mason (2016, p. 63) conclude that effective User Interface will enable the elderly to easily use ICT. This concept can also facilitate usage of ICT among young and middle-aged generations. Authors provide examples such as large screen font option so that senior citizens can easily read.

3.2.9 Cultural impact on the digital divide

It is worthwhile to touch on the culture since the reference countries under examination entail two very different cultures. What is considered acceptable norm by one society may be completely offensive to other. That being said, opinions on number of things vary intensively across the two regions. This is very apparent when perspectives on social norms are taken into account. For example, in Pakistan small talks are part of the business norms whereas in Finnish culture tendency is to get straight to the point. Similarly, culture has an effect on ICT adoption as ICT is conceptualised variously among different cultures. The intent in this section is not to dig deeper into cultural realities of Pakistan and Finland, for these are described in detail elsewhere.

Although there are subtle cultural differences among countries, and these affect attitudes towards ICT, there are also some similarities. For instance, Saton and Mason (2016, p. 54) argue that computers were historically much more expensive than current models and this affects the elderly, who attribute considerably high costs to ICT. Similarly, there appears to be a consistent fear among elderly that if they interfere with the ICT, they might damage it, which acts as a barrier to use ICT. However, there are certain country-level cultural characteristics that impact ICT usage and create a digital divide.

The level of ICT literacy in Pakistan is extremely low with no official policy to integrate ICT into teaching and learning (Hassan and Sajid 2013, 53). Despite number of innovative benefits ICT brings for educations including enhanced communication between students and teachers (Hassan and Sajid, 2013, p. 52), parents in Pakistani society feel that their investment on ICT for their children can demotivate them from their studies. In practice, it means that once parents purchase computers to their children for educational purposes, computer games become the intended focus of students. This tendency of negativity towards ICT is changing but rather slowly. Gradual introduction of ICT-embedded learning in some educational institutions confronts the premise underlying the tradition of

associating computers with game playing and leisure activities, including browsing the internet.

ICT is seen with general respect in Finland. Finnish society appears to realise the benefits drawn from ICT in their daily lives. In general, parents are likely to buy ICT equipment for their children at an early age. This is in marked contrast to Pakistan where parents see ICT as a problem for their children productivity. It bears emphasising that ICTs are in themselves not problematic, rather their usage can determine if someone benefits from them or not. Findings of Harigtaii and Valjko, while referring to participation divide, suggest that creating useful content through ICTs is related to socio-economic status of individuals (Hargittai and Walejko, 2008, pp. 252–253).

Censoring the internet is of heightened significance for a number of countries. For instance, China bans some websites including social media sites. A number of middle-eastern countries ban some content that is in conflict with their religious beliefs. It is outside the scope of the research to argue whether censorship is a good practice and eases lives of people. However, culture influences the ICT adoption as well as the usage.

3.2.10 Electricity crisis in Pakistan

Pakistan faces acute shortage of energy, a crises which badly affects the country's socio-economic development (Shaikh, Ji, and Fan, 2015, p. 1172). Pakistan has run out of fuel for generating electricity (A Malik, 2015), and currently is unable to meet rising demand from domestic and industrial sector. Supply of electricity has fallen to approximately 50 percent of national demand (Kugelman, 2015). Due to rising demand from industries, government periodically diverts the flow of electricity from domestic to industrial sector, a process referred to as "load shedding". The length of load shedding can be anywhere from few hours to a full day. This is a crucial indirect variable related to the digital divide that has not previously been explored.

Issue of power crises in Pakistan has roots in decades old policy decisions by miscalculation of future electricity demand (Aftab 1, 2). The government appears to have done little in recent years to cope with the nationwide rising demand of power or perhaps the policy plans were not adequately executed. A hint at corruption cannot be overlooked either. However, government is not to be fully blamed as Brock 2005 reminds that ICT infrastructures are very expensive and require enormous amount of capital to run. This is a challenge for developing and underdeveloped countries. As a sustainable solution Shaikh, Ji, and Fan (2015, p. 1176) suggest rebuilding energy resources such as nuclear plants, solar energy, biomass projects, and hydro power which is an apparent hint at the country's vast

reservoirs of coal. However, there are procedural and political challenges faced by the Pakistani government in making use of the country's natural resources. In 2015, intense heat wave struck Pakistan causing life damage of highly tragic proportions with more than 1,200 deaths reported in the city of Karachi alone (Kugelman, 2015). Absence of electricity played a considerable role in these deaths as patients struck by heat wave could not access the fans, cooling systems in households and as well as hospitals. This grin situation concerning energy crises offers understandable insight into why electricity is a key indicator and must be the first priority when developing ICT infrastructure.

3.2.11 Historical developments related to the digital divide

The advent of the internet in the 1990s made a giant splash in the following decades, revolutionising the way things were done across a variety of public and private discourses. Following the invention of internet, a voice was raised in the report published by National Telecommunications and Information Administration (H. Brown, J. Barram, and Irving, 1995) about the digital divide, raising concern that considerable segment of population is disadvantaged in terms of access to computers and internet. Ever since, the field of the digital divide has long been a food of thought for researchers and expanded rapidly over a course of few years before eventually drying down in the current decade, seemingly due to disappointment with results. This is not to suggest that the digital divide is a breed of late 1990s, the idea in its practical sense was already present in the world in the 1960s. It could be parsed as "electric divide" or "digital divide" pertaining to people who had access to electronic devices or not which later included telephones, radio sets, and TV. This is very much consistent with the idea of J.A. Van Dijk (2012, p. 60) that categorical inequalities in societies create inequality in distribution of resources.

Although exact inventor of the term "digital divide" remains unknown, it is believed to be popularised by Larry Irving and Allen Hammond (Bulger, 2007; Rapaport, 2009). However, according to another claim (Hoffman and Novak, 1998, p. 3), the term digital divide appears to be coined by the former president of Markle Foundation, Lloyd Morrisett. It remains unclear who coined the term "digital divide". Various accounts (Hoffman and Novak, 1998; Rapaport, 2009) suggest that the term dates back to the 1990s. In practice, however, the digital divide dates back to the 1960s and perhaps even earlier, when divides concerning basic digital products are taken into account. During the late 1960s, a group called "community memory" surfaced with the creation of first public terminal in Berkeley, California with an intention to link people with similar interests over a mainframe computer network (S. Levy, 2010, pp. 127–128). During the same

era, another group of engineers and programmers called “Peoples Computer Company” led by Bob Albrecht started a periodical with the main intention of bringing computing access to young people (S. Levy, 2010, p. 138). When fixed-line telephonic subscriptions emerged, there was a vast digital divide globally. Same logic applies to TV and radio services.

Therefore, the connection between digital resources and disparities is nothing new. It is a misleading impression that the digital divide is a breed of late 1990s. Debates regarding these digital gulfs were existent even before 1990s and might have been known with other names among policy and media circles. In this vein, Companie (2001, p. 3) reminds that before conception of the digital divide, the discussions were on the topicalities of “information have and have-nots.” However, serious academic discussions concerning the digital divide began to emerge during late 1990s. This was when the (National Telecommunications and Information Administration) report was published, sparking much interest from policy, public, and academic resources (Brown et al., 1995). Since then, the digital divide as a field of socio-economic science, has been extensively researched. The call to confronting digital divide saw quietness in early 2000 due to visible diffusion of ICT (Rapaport, 2009), which was largely mistaken for narrowing of the divide. However, US Department of Commerce issues a report in 2002 claiming fifty percent of the United States was online, which met with various reactions (Victory and Cooper, 2002).

Despite the US administration’s claim that the digital divide was weakening, it has in fact further deepened. Peter and Valkenburg (2006, pp. 298–304) empirically tested both theories on the digital divide concerning disappearing or deepening by performing multivariate analysis of internet usage by 749 Dutch adolescents, and found that the digital divide is indeed deepening on basis of differential usage. Table 3 attempts to capture most significant developments in the history of the digital divide since its inception in the 1960s.

Table 3 Significant developments relating to the digital divide from its inception

Era	Main aspects of the digital divide	References
1960s	Peoples Computer Company was established with an intention to bring computing access to people. This was an attempt to influence people positively with computer potential after post-war era.	(S. Levy, 2010, p. 138)
1970s-1980s	Various debates concerning digital disparities surface across public media and policy circles. The concept referred to the "digital divide" but terminology used was different then with various names.	(Van Dijk, 2012, p. 60)
1992	Famous web browser Netscape was launched which became widely popular. The web browser Mosaic was launched in the same year.	
1995	The National Telecommunications and Information Administration issues a report – "Falling Through the NET: A survey of the 'Have Nots' in Rural and Urban America". This report created intense public controversy, and practice circles and debates on the digital divide were heightened.	(H. Brown et al., 1995)
1996	New York times publishes an article – "A New Gulf in American Education, the Digital Divide." The digital divide in education officially attracts public and research attention. The term "digital divide" is officially born. This term is believed to be popularised by Larry Irvings and Allen Hammond. Other reports suggest that term "digital divide" was coined by the former president of Markle foundation, Lloyd Morrisett.	(Bulger, 2007; Hoffman and Novak, 1998, p. 3; Poole, 1996; Rapaport, 2009)
2002	US Department of Commerce publishes a report entitled "A Nation Online: How Americans Are Expanding Their Use of the Internet". According to this report, fifty percent of Americans are using ICT. The then Bush administration feels that addressing digital divide rigorously is no longer necessary. Various other accounts, however, see the issue of the digital divide very differently. Yet again, the digital divide is the subject of heated debate between academics and policy circles.	(Chakraborty and Bosman, 2005, p. 408; Cooper, 2002, pp. 2, 8; Martin, 2003, p. 2; Strover, 2003, pp. 275–276; Victory and Cooper, 2002)
2002-2004	Economies of scale cause market prices of computers to fall. It is being assumed that the digital divide will take care itself through market forces. Various academic debates start on this notion.	('Canyon or mirage?', 2004, p. 69; 'The real digital divide', 2005, p. 11; consider for example, Vance, 2004)
2003-2005	Income is being considered a strong affluent of the digital divide. A number of surveys reported that families with lower household incomes are less likely to adopt ICT. Simultaneously, effect of education on adoption of ICT is also reported both negatively and positively across various academic platforms.	(Brooks et al., 2005, p. 271; Gunkel, 2003, p. 514; Quibria et al., 2003, p. 815; Skok and Ryder, 2004, p. 425; Van Dijk and Hacker, 2003, p. 317)
2004-2008	Bush administration in the United States claims that the digital divide is diminishing. Same message is echoed across some academic publications.	(Cooper, 2004, pp. 1–2)
2009-2015	The digital divide emerges as a heightened issue across academic and public discourses, some arguing that the digital divide is intact, others claiming that it is deepening across the world. It is currently established that the digital divide is not weakening at any rate but is instead deepening in terms of skills, ICT services, device capabilities, and human cognitive factors among others. Effects of the digital divide are now prevalent in the healthcare. ICT has considerable potential to control potentially fatal diseases to a manageable level.	(Brown, Campbell, and Ling, 2011; Sarkar et al., 2010, 2011; Sui, Goodchild, and Elwood, 2013; Warf, 2013; Yamin et al., 2011)
2015-2016	Technology giant Apple issues a media release claiming their old ICT devices to be obsolete and vintage. According to Apple's public announcement, MacBooks, iPods, iPads and various other devices released in 2010 are considered obsolete. The devices before 2010 are considered as vintage. Apple added that it would no longer provide technical support regarding these devices to its customers anymore. This supports the argument that the digital divide is deepening on the basis of device capabilities, skills, and other factors.	(Fingas, 2015; Rossignol, 2016)
2017-2018	The problem of the digital divide remains intact and in real terms it is rather deepening, as ICT giants continue to release latest models of ICT equipment every year with several new and advanced features that cannot be run by old models. The global digital divide now appears to be mainly based on differences in ICT devices as well as their usage. The digital divide related to the elderly is the next key challenge from the digital divide and is gradually gaining significance in literature. However, it must be remembered that there is a significant portion of the people living in the world without any ICT equipment or exposure to ICT at all. The battle against the digital divide must continue from multiple angles, also taking into account ICT manufacturers and policy circles.	(Dodel and Mesch, 2018; Gounopoulos et al., 2018; Helsper and van Deursen, 2017; Moshe, Laor and Friedkin, 2017; Sánchez-Valle, Abad and Llorente-Barroso, 2017; Schradie, 2018; Yu et al., 2018).

4 CONCEPTUAL FRAMEWORK

4.1 The digital divide and information systems research

Future research vision of information systems science has been contested for decades based on past trends in the field (Allen, 2015). Although, it is a widely believed that information systems research is highly diverse (Banville and Landry, 1989; Benbasat and Zmud, 2003), a contrary position is taken by Allen (2015, p. 2) who argues that IS research has been heavily dominated by a single research paradigm he calls "IS acceptance". It appears that so-called diverse fragmentations of IS research can be consolidated into technology acceptance or IS acceptance. After all, the discipline as a whole primarily holds implications of IS fusion with socio-economic sectors for the common good. It is understood that the digital divide is no different, central premise of which is constructed around the notion of brining equal digital opportunity to everyone. The digital divide has been studied since the 1960s, and is an important future direction of IS research discipline.

The digital divide as a research area has existed even before the inception of the information systems research community in the 1970s (c.f. Benbasat and Zmud, 2003). The connections of the digital divide with Information Systems (IS) research discipline are vivid as ICT infrastructure is expanding its foothold worldwide. Examples of this view are afforded in the work of Kvasny, Sawyer, and Purao (2004) who caution IS researchers to go beyond pre-constructed artefacts to explore the problem of the digital divide. Discourse on the digital divide not only becomes pre-constructed, but often "racist in the use of science" by constructing and naming groups reflecting social and ethnic divisions (Kvasny et al. 2004, p. 3). Authors further encourage researchers to combine technological and social artefacts to pursue the socio-economic issue of the digital divide. Mixed-method research design was therefore deemed as an appropriate design to address the present phenomenon of interest.

The present study adheres to the direction suggested by Allen (2015), and situates the current research within broader horizon of IS acceptance. This is first achieved by building a coherent argument on the implications of ICT and bridging the digital divide. Next, a holistic research design was argued to be effective in answering the present research questions. As Kvasny, Sawyer, and Purao (2009) suggested, the digital divide was approached differently as opposed to following pre-constructed artefacts by clarifying the existing confusions and

bringing several new dimensions to the topic as well as proposing a solution to this inequity problem.

Socio-economic indicators and their relationship with ICT were integral parts of research inquiry. Benbasat and Zmud (2003) rightfully claim that most research papers have focused solely on IT adoption models, whereas what is badly needed is research uptakes on making the ICT infrastructure user-friendly. This is of particular relevance as the elderly are increasingly facing the digital divide in addition to general techno-stress caused by ICT usage. A third research question in this study concerns the effort to understand the grey digital divide and how it can be bridged. The emphasis is placed on system and design improvements on various levels, with the underlying logic being that ICT should not only be accepted but easily used by populations of all age groups.

4.2 Conceptual grounds

4.2.1 Introduction

The aim of this section is to go over the prominent theories of the digital divide critically and choose the ones relevant to present research objectives. Theorising has been deemed fundamental to scholarship by Boote and Beile (2005, p. 12) that leads to enhanced inquiry process through establishing connections between research questions and claims. Most important theories and concepts that advance the desired area of inquiry make an important place in conceptual framework. Therefore, articulation of conceptual framework behind the inquiry aids in presenting a direction of research as well as rationale to the prospective readers.

A conceptual framework is referred to as “the scaffolding of the study” by Bloomberg and Volpe (2012, p. 58, p. 58). In essence, conceptual framework becomes a repository for findings of the literature review and pilot study findings (Bloomberg and Volpe, 2012, p. 51, p. 51). Conceptual framework for this dissertation was developed according to method proposed by Bloomberg and Volpe (2012, pp. 58–59).

Authors suggested preparing at least one category per research question. Accordingly, one relevant category emanating from each research question was formulated and discussed in the light of relevant literature. In addition, current affairs in research in the digital divide were critically reviewed with personal hunches wherever appropriate. Additional clues were taken from various studies (e.g. Ayers, Bond, Bertullies, and Wijma, 2016; Greene et al., 1989; Weinberg et al., 2016) following the development of a theoretical framework in action.

4.2.2 Defining the digital divide

As Bauerlein (2011, p. 11) notes, ICT as an online social connection is enabling new possibilities for strangers to connect and share ideas. This is in addition to the fact that increased social connectivity comes at a cost of being in effect bound to a digital machine.

Most of the prior research is consistent with the assumption that the digital divide is a breach in access to ICTs, which is well reflected in a series of definitions of the term. This view is naive on three counts. First, having access to ICT does not necessarily translate into its usage. Second, the rapid rate of change of ICT introduces new ICT hardware and software in the market continuously, which replaces or refutes the existing ones. Third, use of ICT over time may cause techno-stress, in which case a new digital divide is likely related to ergonomic disabilities. Likewise, ICT productivity paradox suggests that a new dimension should be added to the broader concept of the digital divide. For this reason, there is a need to define the digital divide beyond the matter of ICT access and usage. The key component of the definition should be *beneficial* usage of ICT rather than mere usage.

Traditionally, the digital divide was understood as a breach of access to ICTs as wide range of research concentrated on this premise. Definitions related to this premise saw criticality from a stream of academic research. Although currently, several definitions of the digital divide encompass the beneficial usage of ICT rather than only access, the concept is still poorly understood by many. For instance, Chang, Zhen, and Cao (Chang, Zhen, and Cao, 2016, pp. 51, 53) analysed a sample of 885 individuals in a Chinese district who were all internet users and found variations in terms of usage. Therefore, the digital divide based on the usage of ICT cannot be ruled out. Definition of a term has meaningful impact on research implications. The conclusion is that the persistence of the digital divide despite visible penetration of ICT in global village questions the implications, policies, and understanding of the concept at root level. Parayil (2016, p. 3) argues that digital disparities must be viewed as an equity issue rather than an issue of access.

4.2.3 Shifting focus from access to beneficial usage

Prior research on the digital divide has heavily concentrated on explanation of causative factors of the digital divide and their impact on economy, as was noted in introduction and systematic literature review. Despite abundant literature available on the digital divide (Mason and Hacker, 2003, p. 41), little attention has been paid to bridging it. Out of this large volume of published research,

much has been said about disparities in physical access to ICT (Mason and Hacker, 2003, p. 41; Park, 2015, p. 979).

However, the digital divide has now moved beyond the traditional definition of access disparities between the haves and have-nots as also noted by Deursen and Van Dijk (2014, p. 520). Instead, the beneficial usage of ICT is being argued across literature. For example, Dolan (2016, p. 16) notes that access to ICT for young students in the United States is complicated by various other factors beyond having a computer including skills and cultural misunderstandings between students and instructors. In a recent feasibility study following focus group discussions with 17 participants, Kelly et al. (2016, pp. 135–136) note how despite physical access digital divide remains a serious issue for people with complex needs due to aphasia, cognitive and various other impairments.

4.2.4 The digital divide as a disputed research theme

The digital divide is disputed on a number of factors ranging from its definition to various socio-economic indicators. These include age, race, education, purchasing power, and cognitive abilities. There is widespread recognition that bridging the digital divide will leverage the way for literacy (Malisuwan et al., 2016, p. 42). Whereas some studies (Akçayır et al., 2016; Kaware and Sain, 2015) promote the positive connection of ICT with education, others (Cruz-Jesus et al., 2012; Middleton and Chambers, 2010; Reynolds, 2016) deny any relationship between the two.

It is difficult not to side with the arguments (Kaware and Sain, 2015, pp. 25–26) labelling a positive connection between education and ICT. This is because the beneficial ramifications of this relation can be seen clearly when computers amplify textbook knowledge through interactive engagement. It must however be remembered that ICT alone cannot enhance learning practices, instead improved education is dependent upon how well ICT is accessed and used towards a beneficial goal as also noted by Hakkarainen et al. (2000, p. 104). Institutions worldwide are developing Virtual Learning Systems often combined with Management Information Systems to achieve Managed Learning Systems (Kaware and Sain, 2015, p. 29).

Of the various factors responsible for this divide, the most dominant in play is income disparity among people (Mandl, Katz, and Kohane, 1998, p. 219). The cost of internet is significantly higher in developing countries than in developed countries. For instance, Weiss et al. (2016, p. 3848) point out that average cost of internet subscription in developed countries is 27 percent of average income whereas in a sample of 48 developing countries the cost of internet is from 40 to 80 percent of average income. If the income is a major obstacle in poor countries

responsible for the digital divide then what explains the significant digital divide in developed countries? Review of literature gestures toward individual and other factors including skills, psychological resistance to ICT, disability, and impact of culture on adoption of ICT etc. Dobransky and Hargitaii (2016, p. 19) maintain that people higher in hierarchy with privileges have more autonomy, skills, and support to use internet than those lower in hierarchy. Chang, Zhen, and Cao (2016, 61) conclude that geographic location (for instance, based on socio-economic scales) from where people operate internet also affects the usage patterns. From these perspectives, the digital divide is for more complex than it is previously understood.

4.2.5 The grey digital divide

Although the science behind the grey digital divide is relatively new compared to the broad issue of the digital divide, it is becoming increasingly significant and relevant in the present age. For instance, Morris (2007, p. 15) argues that the grey digital divide is of vital significance as alarmed by the low usage of internet by the elderly in the United Kingdom, which is undergoing very extensive population ageing. This is mainly due to rapid societal changing processes due to improved health situation in developed countries. Considering the considerable proportion of elderly people in the workforce, the consequences of the grey digital divide can be catastrophic (Duchesne, 2004; Rizzuto, 2011 (as cited by Lagacé et al., 2016, p. 66)).

Some researchers have assumed that there will be no grey digital divide when the present younger generations grow old, on the grounds that elderly people would already be tech-savvy by then. However, two key concepts challenge this perception of the grey digital divide. First, one must have ICT skills together with ICT access to use ICT services. Second, one must be able to effectively apply the possessed ICT skills to benefit from ICT services. The question is not whether the elderly would be able to operate ICT equipment, but rather whether the elderly will be able to benefit from ICT. Another point to remember is that elderly people face common symptoms that come at the cost of ageing which hampers their ability to interact effectively with ICT especially when a comparison is drawn with young generation. Even highly ICT-literate elderly people may be affected with the digital divide due to ageing-related symptoms, which can result in their performance to sub-optimal levels. Therefore, a new digital divide is likely based on performance, even when quality access, ICT tools, and skills are present.

Taking counter-measures against the grey digital divide may include collaborative efforts from policy, public, and media circles. The role of ICT

manufacturing in developing elderly-friendly content is crucial here. Examples include ergonomic ICT devices with large fonts, graphic user interfaces (GUI), and technical support systems to facilitate ICT usage.

4.2.6 Theory selection for the purposes of research

Discourses on the digital divide seem to bear a connection with communication discourses in fifties and sixties when communication scientists argued for propagation of digital technologies in less privileged economies (Nulens, 2003, pp. 68, 71). In the last few years, research on the digital divide has relied heavily on communications theory. This can be attributed to the unsurpassed potential of ICT to remove barriers to long-distance communication in recent years. Social media tools such as Skype, Twitter, WhatsApp, Facebook and so on are good examples in this respect.

At present, communication has become increasingly personalised with individuals playing active role in production and transmission of multimedia content (Bennett, 2015, p. 152). Mason and Hacker (2003, pp. 45–52) applied communication theories to the digital divide research and noted various implications of ICT usage. Despite the vivid significance that ICT entails for socio-economic prospects, it is alarming that the digital divide is getting deeper on skills level.

The potential of communication with ICT, although fairly clear, is still being heavily researched. An example is the work of Landaeta Olivo, Guzmán García, Colomo-Palacios, and Stantchev (2016, pp. 513, 529–530), who analysed over 24,000 projects at a large ICT corporation (name held anonymous by authors) to design an enhanced communication framework for the organisation. Clearly, the central significance of ICT-assisted communication systems cannot be denied and hold numerous implications for various sectors of economy. Education and health are of prime importance here.

Communication theory currently has a significant role in healthcare research (Ruben, 2016, p. 9). Consequently, role of ICT becomes self-evident in arena of modern healthcare practices. Promises of improved healthcare and managing death-inducing diseases through benefits derived by ICT were already realised a decade ago (see for example, Kalichman, Weinhardt, Benotsch, and Cherry, 2002, p. 524).

Modernisation theory as reviewed by Nulens (2003, p. 71) conveys the message that developing economies should imitate the successful model in developed economies. Nulens (2003, p. 71) further argues that modernisation theory though transformed into its globalisation jacket is still strong affluent of most development policies (see also, Fögerlind and Saha, 1983, p. 17). Examples

of this are prevalent in education and finance sector in Pakistan, and developing countries in general which draw inspiration from success of developed countries in these sectors. Modernisation theory surfaced during 1950s and to a certain degree it was an intellectual answer to the world wars (Fögerlind and Saha, 1983, p. 15). However, a new theory subsequently emerged that disputed the theory of modernisation. Dependency theory argued that success of developed countries happened primarily because of their dependence on cheap raw material and labour from developing countries and attributed poverty in developing countries to capitalist developed countries (for instance consider, Amin, 1976, pp. 10–11, 381–382; see also, Grinin, Korotayev and Tausch, 2016; P. James, 1997, pp. 205, 209–210). Henceforth, dependency theory supports the idea that development in rich countries primarily occurs at the expense of poor countries. However, the transition of Taiwan to a developed economy challenged this notion as demonstrated by Amsden (1979, pp. 342, 375–376) (see also, Barrett and Whyte, 1982). It is researcher's contention that, current development in rich countries, in large part, can be tied to advances in ICT that are subsequently tied to a number of socioeconomic sectors such as healthcare and social welfare. Although it is difficult to side with either lexicon of development, it appears that lessons learnt from developed world may be applied to developing context, albeit with cultural and geographical considerations.

Researcher has relied on modernisation theory to encourage developing country Pakistan to succeed in ICT and consequently in all other sectors of economy as has been the case in Finland. A severe caution is however due here. Pakistan and Finland are two culturally diverse countries and therefore a complete imitation of ICT framework may not prove successful. Readers should bear in mind that progressive transition from a traditional economy to modern economy involves instructional changes, and ICT is one key part of it.

Author has come to realisation that the digital divide bears a clear connection with a health divide that is fairly visible in poor countries. Lack of instant communication in urgent treatments can prove fatal, and place heavy emphasis over demands of latest ICT. A recent news (Junaidi, 2016) uncovered that lack of sophisticated machinery in hospitals, undoubtedly digital equipment, is responsible for an estimated 300,000 deaths of infants every year in Pakistan. The highest numbers of infant deaths occur in developing countries, whereas in developed countries infant mortality is much lower, due partly to state-of-the art digital advances in healthcare. This is consistent with World Bank estimates (UN Inter-agency Group for Child Mortality Estimation, 2018), which indicate that the situation in developing countries is worse, and more so in Pakistan compared to other developing countries. It appears that the duplication of the successful ICT-based medical systems of developed countries to developing countries can

be a fruitful concept originated from modernisation. Modernisation theory is therefore particularly useful in the current context.

4.2.7 Bridging the digital divide

The spread of the digital divide has been greatly is aided by the introduction of various smart devices that allow connectivity. When viewed from this perspective, the digital divide has gone deeper than it is previously understood. Despite the widespread perception that the digital divide will close itself through market forces, the phenomenon is deepening in terms of ICT-related skills. As yet, research in the field has failed to offer any feasible solution for closing the digital divide.

Researchers have long assumed that provision of ICT access will bridge the digital divide. However, if this is so then one could ask why efforts aimed at providing access to ICT over the past two decades have not yet closed the divide. Such attempted explanations seem to be rooted in the belief that market forces will overcome the digital divide. This view is rebutted by Warchauer (2003, p. 302) and Chen and Wellman (2003, p. 25) who highlight the persistence of the digital divide despite the marked proliferation of ICT.

In essence, hopes that provision of ICT access will ever bridge the digital divide, which can now be better described in the plural, is an untested presumption, because whenever one digital divide is solved by access to basic ICT, a new digital divide will soon replace it. The unwarranted neglect to future deepening of the digital divide is problematic and may cause more chaos in already troubled world economy.

This is, in part, because the rate of change of technology happens faster than people acquire new skills. This factor complicates the debate on the digital divide because various forms of the digital divide are emerging parallel to ever-changing infrastructure of ICT. Because the continual refinement of ICT creates a need for acquiring new skills (Kelly et al., 2016, p. 135), it is highly probable that an individual who can operate a computer is unable to operate a smart tablet efficiently.

This concept becomes all too clear when individuals are unable to purchase a ticket through smartphones, although they can do it effectively from a desktop computer. From this it can be argued that theory on market forces as a medium to close the digital divide is naive. For example, the digital divide is still persistent (Park, 2016, p. 1; Park, 2015, p. 987; Prieger, 2015, pp. 396–397) despite visible diffusion of ICT across the globe. In this vein, Lee (2016a, p. 261) argues that due to saturation of smart ICT devices in the market, actual usage has more relevance than adoption.

Horrigan and Duggan (2015, pp. 2–4) show that broadband subscriptions in the United States have declined from 70 percent in 2013 to 67 percent in 2015, with costs being the major reason. However, market forces have influenced the dynamics of ICT manufacturing. For instance, ICT hardware was mainly produced in western countries as noted by Nulens (2003, p. 69), but currently a large amount of ICT hardware is being manufactured in the emerging economies of Asia.

The grey digital divide appears to have connections in education sector. Many of the current teachers grew up in a pre-ICT world navigating through the handwriting technologies of pencil (Abbott, 2001, p. 8). This trend continues to hold true as recently as in 2016 for most teachers around the world. This is especially so in Pakistan, where most of the population lives in rural areas, a characteristic common to all developing countries. In general, learning ICT skills for millions of ageing teachers is at present a significant challenge. Deursen and Van Dijk (2014, p. 521) argue that as a new generation using ICT grows older, there will be no age-related digital divide, and hence the grey digital divide will likely bridge itself. This argument, however, overlooks the possibilities of disabilities that may hamper ICT usage at older age. A new digital divide based on disability to use internet in old age is likely in the future, leaving the impression that the grey digital divide will continue to exist in future.

These clues lend support to the claim that conquering the digital divide needs rigorous reforms. This in-turn requires rigorous research that can propose or create a workable plan or yield the actionable implications at the very least. However, the existing scholarship generally offers the content that is peripherally related to the real problem of the digital divide. As a consequence digital divide is getting deeper throughout the world, notably in poor countries.

4.3 The current state of affairs

ICT has clear potential to advance socio-economic conditions of individuals who are skilled enough to operate the technology both on hardware and software ends. As the debates concerning the digital divide continued to sharpen, new sister terms of the concept have surfaced, calling attention to the digital divide with a strategic front. One increasingly acknowledged term is “digital inclusion” (For instance consider, Ekbia, 2016; Menger, Morris, and Salis, 2016; Rahim et al., 2011; Tsai, Shillair, Cotten, Winstead, and Yost, 2015). These terms appear with a strategic agenda to shift focus on including everyone in the digital arena rather than mere debates about exclusion risks. Another term increasingly being used is “social inclusion” aided sometimes with “e-inclusion”. Perhaps, it is implicitly assumed by some that research on “digital divide” so far has not proved

worthwhile undertaking, and new terms could divert the research attention to a productive front.

Upon reviewing the literature on the digital divide, it became clear to the author that the digital divide is posing severe threats to socio-economic circumstances of individual and societies worldwide. However, the acquisition and beneficial usage of skills have been undermined in most previous research attempts that are arguably central to the essence of the digital divide as a concept.

ICT was taken as a missing link in the process of economic development (Melkote, 2002, pp. 421–424, as cited by Nulens (2003, p. 71)). This view affords attention to current ICT-based services that are emerging at a fast pace across the globe, notably in developed world. Nonetheless, the persistence of the digital divide despite apparent diffusion of ICT questions the policies and investments in digital sector.

Similar to banking, shopping, and social communities, it is abundantly clear that ICT holds promises for changing the ways education is delivered through state-of-the-art ICT (Abbott, 2001, pp. 4, 6). Connections of ICT with enhancing quality of education have been authenticated in a series of academic understandings (Cheah and Lim, 2016; Cherian and Thampy, 2016; Dari and Yura, 2016; Ebrahim, 2016; Etudor-Eyo, Emah and Ante, 2012; Peeraer and Van Petegem, 2016; Pombo et al., 2016; Vieira, Pessoa, and Matos, 2016; Voogt et al., 2016). A positive relationship was found between school staff usage of ICT and their effectiveness in communication (Etudor-Eyo et al., 2012, pp. 133–134), thus suggesting a positive scope for overall effect on education. Ongoing efforts for development of proactive, portable, and intelligent ICT-based education systems (Griol and Callejas, 2016, p. 314; see also, Griol, Molina, de Miguel, and Callejas, 2012), is a testimony to future of ICT-assisted education. Nonetheless, considerable evidence (Cruz-Jesus et al., 2012, p. 289; Katz et al., 2001, p. 415; J. W. Lee, 2010, p. 84; Middleton and Chambers, 2010, p. 14) denies any measurable connection between the two.

As has been the case in educational institutions of a developing country Nigeria (Etudor-Eyo et al., 2012, p. 129), and overall impression of ICT usage in education in sub-Saharan Africa (Ottevanger, Akker, and Feiter, 2007, pp. 6, 50–51) the lack of ICT diffusion in poor countries, in large part, is explained by cost as well as skill barriers. It is on this note that poverty therefore appears to bear a leading connecting with the digital divide worldwide. Nonetheless, rich countries with the digital divide reported in the prior literature point to a myriad of reasons for complex digital divide.

The whole realm of the digital divide is academically and politically predicated on a highly disjunctive structure. While a considerable stream of authors disagree by expressing diametrically opposed views over the nature of the digital divide. They all share a deep concern about the threat that the digital

divide poses to the world economy. Further evidence indicating digital divide as a serious problem in modern economy can be seen in the emerging studies (Dolan, 2016; Erdiaw-Kwasie and Alam, 2016; Gonzales, 2016; Gray, Gainous, and Wagner, 2016; Hilbert, 2016; J. James, 2016; S. Park, 2016; Skaletsky, Galliers, Haughton, and Soremekun, 2016).

The course of the digital divide theme puts unique demands on its exploration as a dynamic and broad phenomenon. Significant advances in this direction of research are those of (Norris, 2001, p. 4) who tackles the digital divide on a rhetorical context, extending the discussion on multi-level digital divide. Norris's (2001) novel take on the digital divide remarks a seminal contribution to the field, clearing much of the ambiguity in understanding of the field. Norris cemented his spot as one of the few authors who inspired the research community worldwide and an array of publications on the digital divide initiated.

However, the work throws up several concerns in need of future research. For instance, work of Norris (2001) is innocent of a new form of the digital divide which has taken birth along the spectrum of smartphones and tablets that considerable number of people either cannot afford or find it difficult to use. For instance, Lee (2016b, p. 260) calls this as "smart divide" and argues that it can occur even when people have access to smart devices but there are variations in ability to use them fully. To this end, Norris's conceptualisation of the digital divide is generative for grasping how to bridge the digital divide by providing skills and access to the technology.

This notion of rendering access to ICT in hopes of overcoming the digital divide threads through most of the scholarship conducted on the topic. As is clearly evident, the digital divide persists despite the visible availability of ICT. This is true for all countries, whether they are developing, underdeveloped, middle-income, fast-emerging, or already developed.

5 SUMMARY OF THE RESEARCH ARTICLES

This chapter is an attempt to integrate the articles that comprise this research. An overview and logical linkage of these articles were demonstrated earlier in chapter 1. This chapter is a detailed analysis of the research conducted in each of the papers, and a further demonstration of the linkage between articles and the core topic of inquiry.

This research is comprised of six articles. Each article progresses logically to the next and at all times aligned with research questions. Table 4 tabulates the numbering sequence, publishing platform, citation and publishing status of each paper. Four of the six papers are published whereas two are under review and expected to publish in subsequent months.

Table 4 Publications related to the dissertation

Numbering sequence	**Publishing platform**	**Full citation**	**Current status**
Paper 1	Journal article	Mubarak, F. (2015). Towards a renewed understanding of the complex nerves of the digital divide. *Journal of Social Inclusion 6*(1), 71-102.	Published
Paper 2	Conference paper	Mubarak, F. (2014, August 18-20). Revitalizing the quantitative understanding of the digital divide: an uptake on the digital divide indicators. *In:* ed. Saranto, K., Castrén, M., Kuusela, T., Hyrynsalmi, S., Ojala, S. *Safe and Secure Cities.* Paper presented at WIS 2014: 5th International Conference on Wellbeing in the Information Society, Turku (pp. 121-126). Cham: Springer.	Published
Paper 3	Conference paper	Mubarak, F., Suomi, R. (2015, October 13-15). A visual uptake on the digital divide. In: ed. Janssen, M., Mäntymäki, M., Hidders, J., Klievink, B., Lamersdorf, W., van Loenen, B., Zuiderwijk, A. *Open and Big Data Management and Innovation.* Paper presented at I3E 2015: 14th IFIP WG 6.11 Conference on e-Business, e-Services, and e-Society (pp. 398-415). Cham, Switzerland: Springer.	Published
Paper 4	Journal article	Mubarak, F., Suomi, R., and Kantola, S.P. (Manuscript under review). Socioeconomic indicators and ICT: The forgotten chapter of the digital divide, *Journal of Global Information Technology Management*.	Under review
Paper 5	Journal article	Mubarak, F., Nycyk, M. (2017). Teaching older people internet skills to minimize grey digital divides: developed and developing countries in focus, *Journal of Information Communication and Ethics in Society 15*(2), 165-178. http://dx.doi.org/10.1108/JICES-06-2016-0022	Published
Paper 6	Journal article	Mubarak, F., Suomi, R. (Manuscript under review). Digital Divide and Health Divide in Information Age: Cases from Pakistan and Finland, *Journal of Community Informatics*.	Under review

5.1 Paper 1: Towards a refined understanding of the digital divide

In Paper 1, literature on the digital divide is critically reviewed with methodological rigour to understand the phenomenon. Summing up the knowledge based on available literature, it furnishes various multi-dimensional perspectives on the digital divide. It was significant to understand the historical roots of the concept and how it shaped overtime. There are mounting publications on the digital divide, but they are highly unstructured: the problem is presented with disputed and varying views across academia and the media. Therefore, the digital divide as a concept presented in literature projects not only confusion but is also far from straightforward.

Earlier understandings of the digital divide provided that the digital divide is a mere breach in access to digital technologies. Late back then in end of the 1990s digital technologies revolved around basic ICT infrastructure such as telephone lines, internet, and personal computers. ICT infrastructure has rapidly evolved over the past two decades that caused expansion in the digital divide concept. While digital divide is currently understood more than a mere breach of access to ICT among most researchers, some still reportedly mistake it for a simple division between the haves and have-nots. Confusion in defining the digital divide washes on research approaches to assess this issue. Overall, result is that the digital divide has become a confused theme in literature.

Paper 1 is a systematic attempt at understanding the digital divide from its roots level to current developments in the field. Tremendous material has been published on the digital divide, but no solutions to the problem have yet been found. Instead, the concept has earned itself a title of disputed theme in literature. Need for a methodologically rigorous literature review was significant here to understand the concept before engaging it deeper for possible solutions. Paper 1 is a systematic response to research question 1, which aims at understanding the digital divide, as it exists, rather than as it is perceived. The need for a systematic literature review was felt in a bid to produce a reliable knowledge base on the topic by sourcing most credible publications in leading journals through strict filtration criteria.

In the present millennium, the digital divide has now emerged as a multifaceted concept with several layers of content overlapping each other. Therefore, the topic is now overtly controversial among academic, press, and policy circles. One significant understanding made over the last decade among researchers concerned beneficial usage of ICT instead of having mere access to it. This aspect of “beneficial usage” was brought in the definition of the digital divide by leading researchers and active organisations.

Norris (2001) explored various dimensions of the digital divide on community, national and international levels. The digital divide is a multidimensional phenomenon of breach in access as well as beneficial usage of ICT among individuals, societies, and countries at various socio-economic and individual levels.

Various measures have been proposed to bridge the digital divide. Some authors suggested eliminating the copyrights of software in developing and underdeveloped countries for free propagation of ICT resources. This measure is significant but only relevant with the central assumption that poor countries have access to latest ICT hardware required to run the software in question. This certainly is not the case across most developing and underdeveloped world. Therefore first step must be towards provision of ICT access, albeit with training packages at the same time.

As also confirmed by prior literature, it must be remembered that provision of physical access to ICT alone may leave digital divide intact instead of solving it. A feasible solution may lie in governmental support of providing ICT access and training packages at the same time. Afterwards, copyright-free software in developing and underdeveloped world would become meaningful.

Insights gained from the literature suggest that there are other dimensions to the digital divide that the aforementioned measures cannot address. These revolve around individual factors such as lack of time, motivation, psychological constraints, fear of ICT including privacy issues and hacking of personal and financial data, fear of putting ICT out of order by using it etc. These factors constitute a significant portion of the digital divide, apparently worldwide. This is especially so with elderly people, and a new term the grey digital divide has recently surfaced in this connection. This issue is separately explored in article 4.

Individual causative factors of the digital divide are key challenges to address for policy makers. Moreover, utility value of ICT is perceived differently across different cultures and sub-cultures. For instance, ICT might be taken more significantly in urban than rural areas. There appears a justified need for further work on these factors of the digital divide – as it is these factors that influence digital divide to a considerable extent worldwide, even when the provision of both ICT and skills is made possible.

5.2 Paper 2: The digital divide indicators

Having understood the digital divide from a critical perspective, it was natural to understand the underlying indicators defining it. In part, this need was felt because existing research did not engage deeply with the digital divide indicators. Paper 2 addressed this research gap attributed to lack of academic

coverage on the digital divide indicators. It was significant to understand emerging indicators of the digital divide to support quantitative understanding of the phenomenon and assist in standardised measurement of this social problem.

In response to this need, Paper 2 looks at most relevant indicators of the digital divide as maintained by leading organisations active in the field of ICT. Organisation for Economic Co-operation and Development (OECD) and International Telecommunications Union (ITU) had released a list of the digital divide indicators for research and policy references. Some of these indicators were not relevant to current age due to fast changing ICT landscape. Examples include number of television and radio sets per 100 people. ICT infrastructure has now changed the way most people watch TV and listen to radio on latest smart devices such as tablets or smartphones.

A list of 29 digital divide indicators was identified presented by OECD and ITU. Indicators were structured according to their respective categories. These categories were dispersed along: ICT indicators by infrastructure and access, ICT indicators by access and usage, ICT indicators by businesses, ICT indicators by trade in ICT goods, and ICT indicators by education.

Most common among the identified indicators are computers per 100 people, fixed telephone lines per 100 people, internet subscribers per 100 people, and mobile phone users per 100 people. These indicators are categorised by ICT infrastructure and access. Percentage of fixed telephone lines has traditionally been an important indicator of ICT and hence digital divide. However, this phenomenon is changing rapidly and has almost entirely changed in developed world. A fixed line telephone connection is no more a priority for households due to cellular technology revolution. Fixed line telephone continues to be popular across organisations. It should be remembered that, in the developing world, fixed line telephone subscription is still an important indicator of ICT that cannot be ignored.

Various other indicators influence digital divide as the concept has expanded, as covered at length in Paper 1. For this reason, usage of ICT in addition to access is an important factor while addressing digital divide. Examples include indicators such as percentage of employees using internet, percentage of employees using computers, percentage of businesses using computers, percentage of businesses using internet, percentage of businesses using Intranet, and percentage of individuals who used computers in the last 12 months.

ICT has played an undeniable positive role in education, particularly in the developed world. ICT has enabled and encouraged new modes of learning. This link between education and ICT has been discussed in Paper 1. Few digital divide indicators are categorised by education. For example, percentage of ICT-qualified teachers in schools, percentage of schools with television for

educational purposes, percentage of schools with radio for educational purposes, and percentage of schools with electricity.

In developed world, schools often are equipped with latest ICT resources such as latest computers with high speed internet. By contrast, in the developing world many schools are without basic ICT infrastructure such as electricity. Pakistan serves as a good example in this respect where several public schools do not even have roof shelter, let alone the electricity. In some cases, students sit under a tree with a class teacher, which is of course a poor version of a classroom.

Paper 2 enhanced the quantitative understanding of the digital divide by presenting 29 digital divide indicators identified across active ICT organisations. Findings promote future work in this area by exploring a mechanism to assess digital divide in various locations through the indicators identified in this paper. It also adds to the collective understanding that the digital divide cannot be related solely to access of computers and internet. Instead, usage of ICT devices and software in variety of forms across variety of socio-economic spheres matters as well. For this reason, findings support the concept that the digital divide may be present regardless of visible diffusion of ICT. Percentage of computer users, in essence, becomes irrelevant when the usage is not geared towards any gain. This view, initially explored in Paper 1, is theoretically confirmed in Paper 2. One useful implication here is another confirmation of a finding in Paper 1, that confronting digital divide will need multi-level efforts at various fronts.

It was realised that further work on the digital divide indicators should begin in earnest. In particular, future trials may explore these indicators separately for developed and developing world. This is because ICT landscape is influenced not only by monetary resources but also culture and other individual factors. Therefore, the digital divide indicators might vary across different geographic places.

5.3 Paper 3: Link between ICT and socio-economic indicators

Findings from Paper 1 revealed the confusion around relationship between ICT and socio-economic indicators. Further, findings point out scarcity of literature on quantitative aspects of the digital divide, given that most of the research in this field has been qualitative in nature. These confusions on links between ICT and socio-economic indicators tend to wash on research and policy directions. For example, if there is a strong positive link between poverty and digital divide, it will imply provision of ICT resources to the poor to close the digital divide. Contrariwise, if poverty and digital divide are unrelated, implications will shift to provision of ICT skills and other factors to bridge the digital divide. As

documented in Paper 1 in detail, researchers do not have a firm consensus on these relationships. For some, poverty is marginally related to the digital divide, whereas others see it as a main cause of the digital divide. Similar confusion exists around the relationship between ICT and education.

Given the impact of these confusions over policy directions it was imperative to examine them. For this reason, in order to address research question 2, which focused on narrowing of the digital divide, these confusions had to be clarified. Therefore, Paper 3 warranted research attention to two issues: 1) clarifying the confusion about relationships between ICT and socioeconomic indicators. 2) contributing to quantitative research on the digital divide. In addition, prior literature has verified the relationships between ICT and socioeconomic indicators mainly theoretically. Statistical verification in these relationships was rare or even to non-existent at the time of conducting this research. Literature review and research questions prompted the creation of three hypothesis. 1) Income is positively tied to ICT adoption. 2) Education is positively tied to ICT adoption. 3) Corruption is negatively tied to ICT adoption.

Paper 3 explores the relationships between various digital divide indicators identified in Paper 2 and socioeconomic indicators including income and education. A sample of 22 countries at varying levels of economic development was selected, and included developing, middle-income, and developed countries. Reason for this heterogeneous sample was to inject variety in analysis and look at the phenomena of the digital divide from varying perspectives. Pearson product-moment correlation was used to measure the relationship between ICT and socio-economic indicators. The World Bank was chosen as a reliable source of data.

Income variable was represented by GDP per capita and by the GINI index. Prior research attempts have theoretically verified relationship between digitalisation and income factors such as GDP per capita. However, understanding inequality of income among population and its relationship with ICT can add rigour to test this verification. Another factor that has not been previously explored in relation to ICT was corruption. Effect of corruption over digital divide was also brought into analysis. Corruption was chosen to understand its impact on digitalisation and understand additional clues regarding the phenomenon of the digital divide. In other words, for a rigorous confirmation of a positive relationship between GDP per capita and ICT, other two variables, namely *Gini index* and *corruption*, must confirm inverse relationships with ICT. Education variable was represented by secondary school enrolments and PISA test results. ICT was represented by percentage of internet users. Visualisation approach was a key feature of methodology and was used to present the relationship between ICT and socio-economic indicators in easy to understand format. Furthermore, performance of any particular country in the sample could

be checked easily against any other country or countries. Another possible benefit was to predict any visible trend that could assist in analysis.

Results confirmed the three hypotheses tested in this paper. It was confirmed that both income and education bear a positive relationship with ICT. Income was a stronger predictor of ICT adoption than education as correlations suggested, but both had positive ties with ICT. As expected, inequality of income under variable GINI index bore an inverse relationship with ICT. Similarly, there was an inverse relationship between corruption and ICT. These negative relationships suggested that income factor is a strong predictor of ICT diffusion around various countries. This should be kept in mind however that education is now increasingly embedded with ICT, particularly in developed economies. It is probable that modern modes of education will encourage students and teachers to adopt latest ICT. In developing countries however this change is expected to arise gradually.

Whereas findings statistically confirmed the existing theoretical views on positive relationship between income and ICT, they denied that education has no or minimal impact on ICT adoption. This ICT-education relationship may be negative in underdeveloped or parts of the developing, but the role of ICT in education has been significant over the last decade. Apparently, ICT devices geared particularly towards students on special offers suggests am increasingly close relationship between the two.

These findings hold significant implications for governments in developing countries in particular to subsidise cost of ICT goods for educational purposes. This also entails equipping schools with modern ICT devices around the world, and even more so in poor countries, which remain unequipped even with the basic ICT indicators identified in Paper 2 such as electricity. Implications for research areas include examining the emerging forms of ICT indicators with socio-economic indicators especially in the developing and under-developed world, impact of free public ICT access on relationship between ICT and income, effect of cultural factor on ICT adoption across the world, and proposing a universal mechanism to measure the digital divide.

5.4 Paper 4: Worldwide analysis of socio-economic indicators and ICT

Feedback received from the paper 3 encouraged the methodological approach and research aims, thereby advising to extend the article towards a journal level article. Feedback highlighted the usage of rigorous multivariate statistics to verify the relationships explored in the Paper 3 across the entire world instead of a group of 21 countries at varying economy levels.

After an intense discussion about this feedback with peers and research supervisor, it was decided to perform multivariate regression analysis as a method to verify an extended set of ICT and socio-economic indicators across all countries. A total of nine ICT and socio-economic indicators were selected on which data was fully available from the World Bank. Time series data was chosen in order to represent the most relevant average values from each indicator. Few countries lacked the data on some key indicators, therefore they were dropped from analysis. In instances where data values were missing for few particular years in time-series data, average values were taken to substitute the missing spots. Data values from various ICT and socio-economic indicators were combined into a single weighted data set representing each variable: ICT and socio-economic.

Results confirmed all the hypotheses tested earlier in Paper 3, though this time rigorously, by adding more indicators, and using multivariate statistics. Prior research accounts theoretically verified these relationships, as already documented earlier. To the best of authors' knowledge no published study existed verifying such relationships statistically, at the time of writing this article.

The worldwide analysis allowed to direct a number of useful implications for practice and policy areas. First, there is an undeniable link between poverty and digital divide, which implies that subsidising costs of ICT worldwide may help poor to benefit from the ICT revolution.

Second, even if the ICT is subsidised, it does not mean that the digital divide can come to an end by itself. As explored in Paper 1, narrowing of the digital divide needs multiple efforts at multiple fronts. This includes providing ICT skills along with the ICT access, creating awareness in public media, and digitising services gradually in various sectors of the economy.

Third, the emerging role of ICT in education across the entire world suggests that there is a positive link between the two. This hypothesis was successfully verified confirming a considerable positive relationship between ICT and education. Partly, this is because new modes of ICT-assisted learning are increasingly being adopted worldwide, particularly in the developed world. This rate of transformation appears to be slow in the developing world, with understandably enough, expected instances where educational sector has even not heard of ICT promises in education. This raises an important implication for governments worldwide to subsidise ICT costs in educational sector and to play its role in transforming the educational sector with latest ICT tools. Prior research has attested efficiency in learning and managing education through usage of ICT tools. This implication also urges private sector to play its role in adopting ICT-assisted education, since many educational institutions are privately owned in many countries.

The data used to verify links in this Paper 4 was secondary, drawn from the World Bank. Admittedly, a fieldwork would have been helpful to select primary data but that would have been impossible to manage a fieldwork across 91 countries in limited time frame as well as lack of resources.

5.5 Paper 5: The grey digital divide

The systematic literature review presented in Paper 1 identified the significance of age-related digital divide and also noted that there is scarcity of academic material on this topic. Consequently, the grey digital divide was difficult to ignore as social and healthcare services are becoming fast digitised. Simultaneously, it was felt that without touching upon this topic, an accurate understanding of the digital divide would not be deemed complete, as elderly people are increasing in number across developed countries due to societal ageing processes. Therefore, elderly people are on the wrong side of the digital divide are prone to suffer in the near future as information technology spreads throughout the world more extensively. Paper 5 is a critical examination of the grey digital divide.

Although literature on the grey digital divide is scarce, it was uncovered that it is severely impacting the senior citizens worldwide. However, it is important to bear in mind what constitutes an old age in various cultures. For the purposes of the present paper, elderly people in developing countries were considered aged above 40 whereas in developed countries the threshold was set at 60 plus level. Regardless, this estimate may or may not fit well for various countries, as ageing is a phenomenon distinct to culture, both in a physical and mental sense.

The grey digital divide is becoming increasingly significant as healthcare services are continuously being digitised and integrated with various ICT devices. State-of-the-art ICT has made it possible to offer many services in effective manner such as eliminating human error, keeping track of health record, instant availability of medical history, and management of drug usage etc. The unsurpassed potential of ICT in healthcare services is benefitting only those who are on the right side of the digital divide. Most elderly people, who are often a prime customer segment for the healthcare industry, are unable to use these services due to the digital divide.

Apart from healthcare services, various socio-economic sectors are rapidly shifting their services to the digital realm to achieve cost-effectiveness and efficiency in transactions. These include e-democracy, online pension, online insurance claims, online social platforms, and online health services among a growing list of many others. Therefore, there are many situations where elderly people are prone to countries due to the grey digital divide.

The grey digital divide does not necessarily mean lack of access and usage of ICT. Various psychological and cognitive factors come into play as people reach old age, which can make it increasingly difficult to benefit from ICT. These include factors such as visual impairment, mental impairment, loss of memory, lack of motivation, various other diseases that restrict movement and focus, lack of social connections to gain knowledge about ICT services, and inability to learn ICT. This can be taken as a key argument against claims that there will be no grey digital divide when the current cohort of young people age. The grey digital divide will continue to exist irrespective of ICT access and skills.

To confront this problem of the grey digital divide, this paper proposes solutions from two angles. First, government-mediated ICT awareness and training programs are strongly suggested for the elderly. Second, various implications are placed on ICT manufactures to develop elder-friendly ICT content. Therefore, success of controlling the grey digital divide rests on mutual cooperation between governments and ICT organisations. Role of public media and academic awareness is nevertheless less important to further research in this area in various parts of the world.

The paper performs a content analysis of the most relevant publications centred on the theme of the grey digital divide. Among a various mix of approaches to tackle the grey digital divide, ICT training for elderly people often emerged as a viable solution. The present research explored ICT training through a critical lens and noted why it can be a failed approach, when government funding becomes an issue. The dire need is to prioritise the problem of the grey digital divide at national level through academic, media, and policy awareness.

A simultaneous crucial step along with government funded ICT training centres must be the production of elderly-friendly ICT hardware and software. Few examples in this respect can be devices with larger fonts, specially made ICT hardware and software for elderly people with impairments, user-friendly smart watches that can record and report diagnosis data to doctors in real time, etc. Most of the current ICT devices and services are geared towards young generation whereas elderly people are extensively ignored. Elderly is or will become a profitable segment for ICT in near future as ageing process is increasing in developed world.

This paper dispels the myth that the grey digital divide will take care of itself as the current ICT-adept generation ages. Solutions to the problem of the grey digital divide issue are at the intersection of cooperation between governments and ICT manufacturers. The grey digital divide must be prioritised on the national agenda, should a minimisation of this serious socio-economic problem be desired.

5.6 Paper 6: The intersection of the digital divide with the health divide

Paper 1 and Paper 5 reflected the foremost potential of ICT in various socio-economic services including healthcare. By the time Paper 5 was completed, the need was strongly felt for linking digital divide with the health divide. This link, though directly or indirectly talked about decades earlier, is becoming increasingly significant only now as latest ICT devices create vast potential for the healthcare industry. Numerous studies, especially in recent years, provide conclusive research on effective healthcare management through state-of-the-art ICT equipment. Among the growing list of possibilities are healthcare service delivery on the spot via smartphones, real time processing of diagnosis, responding to a call of emergency more effectively than before, keeping a digitised medical record, reducing waiting times, minimising paperwork, running efficient healthcare information systems to name a few (consider for example, Achampong, 2012, p. 11). Most important of these is perhaps the ability to control the death-inducing and chronic diseases such as malaria, hypertension, typhoid, and Human Immunodeficiency Virus (HIV) to a minimum through state-of-art ICT equipment (see for example, Scalvini et al., 2014, pp. 91–93). Therefore, life in most cases can be prolonged which was not possible earlier. In addition, ICT-based healthcare system can halt the spread of various viral diseases through rapid awareness, effective treatment, better control, and instruction.

To limit the scope of the paper, two reference countries were considered: developed Finland and developing Pakistan. The paper examined various aspects of the Pakistani healthcare system that were largely overlooked by researchers before. For instance, patients struck in ambulances due to traffic jams and in-turn consequent deaths are a common occurrence in Pakistan. Childbirth on the move is another unreported common occurrence. Corruption in public and private sectors most severely affects the poor, who cannot afford expensive medical treatment. Medical errors are still persistent to a high degree, tales of which often do not make to the public media. Various reports routinely suggest preventable loss of lives due to just mentioned reasons. Although these are common characteristics of developing countries, their intensity is much higher in Pakistan than rest of the developing world. It was important to highlight these aspects before international audience with reference to Finland's improved healthcare system to gain useful insights to what can be done in similar contexts. Healthcare in Pakistan is seen with a critical perspective. There were few initiatives taken by the government that failed due to various reasons including corruption.

Finnish healthcare system has been successful mainly due to seriousness and support of government. Statistics paint a despondent view highlighting high

maternal mortality rate in Pakistan compared to many other developing countries. In addition, millions of children die each other due to lack of sophisticated hospital machinery. These ratios are under control in Finland to a high degree mainly due to ICT-assisted state-of-the-art medical equipment.

Despite apparent implications of ICT in healthcare, government in Pakistan is slow to adopt any impactful policies. However, the blame does not rest entirely on government as escalating tensions with neighbours has undermined peace in the region. For this reason, the government prioritises military preparedness, with a vast budget for this purpose. Similar situation can be found in other countries of South-East Asia. Regional peace is crucial for the socio-economic sectors of the country to boom.

However, the regional unrest should not stop governments to focus on improving the quality of healthcare services. As already noted, the long-term consequences of expenditure in ICT-assisted healthcare system will wash on low public health expenditure. However, a major hindrance to eHealth is indeed also digital divide. It is possible to conjure an inverse relationship between digital divide and healthcare, which was the theme of Paper 6.

This is not to suggest that Finnish healthcare system is supreme and not without its own flaws. Despite state-of-the-art healthcare system in Finland, several citizens are unable to take full benefit of ICT potential. The blame is clearly tilted towards digital divide. Finland still has a lot to learn with regard to the production of elderly-friendly ICT equipment and software, general user-friendly ICT tools, ICT training centres for elderly people, awareness and education of ICT-assisted medical systems, privacy matters, and so on.

Therefore, it is clear that even state-of-the-art healthcare system may not achieve its intended goals when countries suffer from various digital divides. The digital divide and health divide must ideally be confronted together. Fighting both must be prioritised on national levels ideally in all countries.

An important lesson learned from this paper is that cultural differences must be kept in mind when signifying transfer of a sophisticated healthcare system from a developed country to a developing country. Some argue that provision of tele-health will be an indicator of improved health in Pakistan. Such arguments are promising in literary sense, but tend to fall short in practical sense. A profound argument against tele-health is absence of telephonic connections coupled with electricity in rural areas, where most of the Pakistani population still lives. Pakistan must first ensure that its poor citizens and those living below the poverty line have access to basic ICT infrastructure for any such projects to succeed. In this connection, example of a developing country Bangladesh was presented, where a tele-health project failed due to infrastructure and system disparities. Option of content in local languages should be a preferred choice when making such systems in various countries.

In some cases access to the correct medical information can save the life without requiring a visitor to a doctor. It becomes all the more meaningful when the system is connected with hospitals and real-time exchange of information becomes possible. This all can be achieved at the intersection of ICT-assisted health infrastructure and minimisation of the digital divide, without which expenditure on any sophisticated ICT-assisted system, in essence, is a waste of money, time, and effort.

There is apparent dire need to attach continued importance to the field of the digital divide as its link with health divide is becoming increasingly significant. In the coming decades, people on wrong side of the digital divide are likely to be affected more than ever before. The lessons learnt from this Paper 6 can be applied to other contexts, being mindful of cultural considerations. Particularly, state-of-the-art healthcare information system can save precious lives in the developing and underdeveloped world. There is now an opportunity for mutual cooperation between rich and poor countries on eHealth in that both can learn from each other. Developing countries may offer cheap labour, cultural lessons, and platform for pilot projects in eHealth to developed countries.

6 FINDINGS AND DISCUSSION

6.1 Consolidated findings from literature reviews and articles

After two decades of rapid advances in ICT development, research has generated a complex body of knowledge on the digital divide. It now appears that the digital divide is not just one divide but it is ever changing constellation of various divides. Several lines of evidence have indicated that the phenomenon is generally confused, and more complex than it appears in prior literature. Interestingly, ICT is expanding its foothold worldwide, but despite this increasing diffusion of ICT, the digital divide is reportedly getting deeper on various levels. A number of issues were identified in prior research that indicated that these levels revolve around individual factors and skills level. An extended list for consideration is skills, motivation, lack of time, fear of using ICT, fear of personal identity theft, and fear of breaking ICT devices or ruining software or network connections.

The digital divide is a disputed concept in the literature, and there is no universally agreed definition of it. However, the OECD's explanation of the digital divide has attracted widespread research and policy attention. Conventionally, the digital divide was considered to be a breach in access to ICT, but with time concept has expanded to include skills as well as beneficial usage of ICT. However, the digital divide is still understood to be a mere breach in access of ICT. My research findings address a controversial belief among practitioners that the digital divide can be solved in the same way as economic disparities are solved. This way of thinking carries a conviction that providing access to ICT will solve the digital divide which is clearly not the case in reality, as demonstrated by increased ICT diffusion without bridging the digital disparities.

Various ways have been proposed by researchers to bridge the digital divide. These include providing free software in developing countries and reconsidering removing limits on copyrights. It should be remembered that the digital divide is not only a problem of the developing, it is fast influencing developed world as well. Although free copyrights and open-source software are recommended for bridging digital divide in developing countries, free copyrights software in developed world may discourage content owners.

Parallel to ICT, concept of the digital divide is also evolving. New forms of ICT hardware and new skills set redefine the existing digital divides. At present,

the digital divide is understood to be a multifaceted concept, a multi-dimensional phenomenon occurring at various layers.

With regard to the experimental evidence on relationship between ICT and socio-economic indicators, the findings show a strong relationship between income and ICT diffusion. A positive relationship between ICT and education was also confirmed. These links have been theoretically verified in prior research attempts. Present findings have confirmed these links through rigorous multivariate regression analysis. These results added a new dimension to the quantitative understanding of the digital divide.

Data on some indicators is difficult to determine for the developing world. For example, the indicator "number of computer users per 100 people" is difficult to obtain when there is no data available on obsoleted computers, records of new computers purchased, and old computers sold etc. Similarly, the indicator "internet/broadband subscriptions per 100 people" is often misleading in the developing world. This happens when a household orders an internet subscription and then it is unofficially shared with neighbourhoods upon monetary agreements to share the invoices of subscription. It is highly probable that this indicator, when measured in the developing world is essentially underreported. Due to law and order situation in developed world, this case might not happen so often in developed world.

Links of income and education were theoretically explored in prior literature, but there was no agreement upon them. A growing body of literature appears to have some agreement that income bears a considerably strong relationship with ICT. Even so, growing number of public ICT access centres with facilities of free ICT for public use questions this assumption.

Moreover, there is widespread controversy about the relationships between education and income. Finding about the relationship between education and income dispels the view that education has no impact on ICT. Multivariate regression analysis suggests a considerably strong relationship between education and ICT adoption.

Lack of reliable electricity in Pakistan suggests that country is far from bridging the digital divide in near future. The plight of electricity crisis in Pakistan is not unique. As has been widely reported, this basic indicator of the digital divide, electricity, hampers emergency medical treatments along with hitting other daily live activities. Aftermath of the digital divide on health divide in Pakistan continues unabated, as several media reports suggest that lack of up-to-date modern machinery (ICT-assisted machinery) is the acute cause of patient deaths. In addition, poor infrastructure brings a halt to rapid access to treatment in times of intense traffic jams and poor pavements.

The digital divide appears to be deepening at skills level even when ICT diffusion is reportedly expanding across the world. At the same time problem of

the grey digital divide is becoming increasingly acute. This is especially so in the developed world, which is currently suffering, or will suffer in the near future, from societal ageing processes. Thus there is no doubt that addressing the grey digital divide should keenly attract research, press, and practice discourses for elderly e-inclusion movements.

There is a remarkable disparity between Finland and Pakistan over digitalisation patterns. The former is much more advanced in ICT than the latter. ICT is practically diffused in every part of daily life in Finland. When compared to Pakistan, the situation is worse, as is typically the case in developing countries.

There are no formal structured frameworks proposed to bridge the global digital divide in previous research. It is now abundantly clear that access to ICT would not translate into beneficial usage, leaving the digital divide intact. Findings suggest various individual steps to confront a multilevel digital divide. These steps are useful, but they are not enough to completely bridge the digital divide between Finland and Pakistan.

Role of ICT-assisted education has been recommended to reduce the digital divide. This finding is especially useful in Pakistani context because of its large population and proximity of basic primary educational institutions in rural and urban areas alike. However, opposing results were reported when there was no significant measured impact on the digital divide after a range of universities adopted ICT-assisted learning practices.

Propagation of wireless internet works have been recommended to bridge the digital divide due to low setup costs required in wireless infrastructure. This is a noteworthy finding in Pakistani context because Digital Subscriber Line (DSL) internet is still costly for most citizens. New ICT service providers are expected to level competition and bring down the connectivity costs.

Public initiatives to educate citizens on using ICT skills are essential worldwide to minimise the digital divide, since digital divide is reportedly getting deeper on skills level. The same logic underlies special training centres meant for senior citizens to narrow the grey digital divide. Ideally, these projects should be funded by government and run in cooperation with private ICT organisations.

Role of ICT manufactures is particularly relevant here to make user-friendly ICT products and services. This finding holds valuable insights for elderly people who require user-friendly graphic user interfaces (GUI) to operate basic ICT. This would help reduce the grey digital divide to some extent.

Role of government in bridging the digital divide has appeared repeatedly across academic understandings. This suggests that Pakistani government has the most prominent role to play in the battle against the digital divide. This is a finding that applies to any country.

Together these results provide important insights into evolving dynamics of the digital divide and present several areas for future research and practice. These are discussed in detail in the next chapter.

6.2 General discussion of published and unpublished work

6.2.1 Analysis and synthesis

Disparities among individuals on account of socio-economic prospects have existed since the dawn of humanity. When viewed from this perspective, the digital divide is nothing new. This even existed when the first electric bulb was invented. However, lately this divide has been responsible for worrisome of researchers worldwide as well as stirring a panic across policy circles in the globalised era. Two decades of combined knowledge has not helped to bridge the digital divide. Instead, the divide has deepened in real terms across the world and new forms of it have rapidly emerged with rapid emergence of ICT landscape.

The results drawn from systematic literature review were compared and contrasted with literature. It was found that the digital divide as a socio-economic phenomenon appears more complex than was reported in the literature. One reason that can be attributed to this increasing complexity is continuous evolution of ICT, which is hard for research to keep pace with. Another possible reason is gradual decline in research production over the core issue of the digital divide as no new research has been reported from seasoned researchers who contributed in early understandings of the digital divide, a decade ago.

Mounting research is highlighting the ever-increasing significance of ICT in variety of socio-economic spheres. Most noteworthy of these are education, wellbeing, health, and economic opportunities of individuals and societies. At the same time ICT is diffusing faster than most people can catch up with the latest ICT skills to operate latest ICT devices, causing an expansion to the digital divide crises. These skills are a key driver behind yielding maximum utility offered by emerging ICT hardware and software.

Remarkable work around ICT indicators has been reported from OECD and ITU. These organisations have been active in creating awareness about global digital divide. Twenty-seven indicators of ICT were identified from these organisations and presented in this research. Some of the indicators are becoming fast obsolete. Take for example, the indicator “fixed-line telephone subscriptions”. The introduction of latest wireless alternatives to telephone brought an end to the booming era of fixed-line telephone subscriptions. However, fixed-line telephone subscriptions are still popular in the business

sector. Nevertheless, their demand has seen considerable downfall in the last decade as far as household consumption is concerned.

Whereas the indicators presented in this research are fully valid for developed countries, caution needs to be exercised when examining them with reference to developing countries. There are two main causes for this difference. 1) Retrieving reliable and accurate data from developing countries remains a challenge due to poor structural management of ICT resources. 2) The number of internet subscriptions is prone to being underreported in developing countries because of unofficial sharing of internet subscriptions among different people to split costs of subscription. Developing countries often receive huge shipments of obsolete computers from developed countries however there are often no records of such computer sales. Same logic underlies sale of various ICT hardware including smartphones. Informal sharing of internet connections has long been a practice in Pakistan understandably enough to afford costs of subscription. In practice this means that one household orders an internet subscription, usually it is secretly shared among neighbouring households upon monetary arrangements.

By far the most common form of internet access in Pakistan is through Local Area Network (LAN) subscriptions. These networks are secretly shared with devices such as routers and repeaters among neighbouring households. Due to excessive unofficial sharing, the quality of internet is poorly affected and sometimes no content can be accessible through internet due to over-burden of sharing. This is another form of the digital divide that occurs in Pakistan and most likely in other developing and underdeveloped countries.

The indicator, “percentage of computer users” will need to be redefined when rapid expansion of tablet computers is changing the way people use the computers. Simultaneously, an exceptionally significant indicator regarding “tablet users” is missing from the current list of ICT indicators recognised by OECD, ITU, and across few other domains. More so, need for few other indicators relevant to tablet usage are apparent. These could possibly include percentage of mobile internet users, percentage of businesses using various ICT devices, percentage of employees using various ICT devices, percentage of students using various ICT devices in schools, percentage of teachers using various ICT devices in schools, and percentage of healthcare centres using various ICT devices. Future work around the emerging ICT indicators appears mandatory to underscore quantitative aspects of the digital divide, most important of which is measurement of this social inequality.

A broad body of literature was examined to seek any similar or divergent links between ICT and socio-economic indicators. The literature examined thus far offers scattered views about these relationships. Some have found positive links between ICT and income together with education, whereas others have reported negative ties. It was not clear which arguments hold credibility. Were these

findings meant to be region specific or could they be generalised across the globe? These confusions were reportedly weighing on policy circles. It was decided to conduct two separate studies in this regard. One aimed at exploring the aforementioned links across three distinct classifications of countries: developed, developing, and middle-income countries using Pearson Product-Moment correlations. The other was targeted across the entire world with rigorous multivariate statistics.

Results drawn from first study exploring links between ICT and socio-economic indicators confirmed that ICT and income bear a strong positive correlation. It was also confirmed that ICT and education were positively correlated. However, this relationship was less intense than ICT-income relationship. Results deny existing findings about negative relationship between ICT and education and contribute additional evidence that modern modes of education are likely to affect ICT diffusions positively. In addition, link of corruption with ICT was tested across all 22 countries in the sample. It was found that corruption is negatively associated with ICT diffusion across all countries. This was a noteworthy finding because prior research has not assessed corruption in regards to ICT diffusion. This trend was similar across all three country classifications, i.e. developed, developing, and middle-income countries.

Second study in this respect cemented the findings of earlier study and contributed additional evidence that ICT bears positive relationship with socio-economic indicators (income and education). Some argue that education and ICT are irrelevant to each other. But findings of multivariate regression analysis anticipate otherwise: advancements in modern education are likely to elicit an increase in ICT diffusion. Rapid adoption of electronic devices such as computers and internet in the education sector has been responsible for diffusion of ICT. A considerable portion of people exists who would buy ICT solely for educational purposes, although entertainment and fun is fast becoming a dominant reason.

During the ensuing decade relationship between ICT and income was solidified across research circles. However, fast emerging public access centres (PACs), including libraries and institutions with free ICT facilities, in the developed world for public usage is questioning this presumption. But despite opportunities of free ICT access and usage, considerable digital divide is reported in developed world. Beyond any shadow of doubt income alone is not the only factor responsible for global digital divide.

Pakistani society has traditionally subscribed to beliefs such as ICT damages children moral development and school productivity. With rapid emergence of ICT showcasing its benefits in productivity across developed countries, these speculations fell out of favour for a while before again being widely acknowledged. In part, this was because when parents bought their children ICT

instruments, computers were used more for entertainment rather than for schoolwork. In many instances, the academic performance of students began to decline sharply. Despite all this, however, ICT is gradually making its way into socio-economic spheres of life, including private organisations and government institutions.

Electricity crises in Pakistan have considerable influence on the digital divide. This point has not been engaged in prior digital divide understandings. This is yet another signpost that marks the way to how the digital divide in developing countries is significantly different from the situation in developed countries. In addition, most research on the digital divide emerges from developed countries and most often the implications are taken to fit perfectly well in the developing world. However, motivation, access, and skill in making beneficial use of ICT are not enough in a developing country like Pakistan. The main driver of ICT, electricity supply, is a serious obstacle. Absence of a reliable electricity supply causes a digital divide even if all the other necessary factors are present. This key indicator of electricity is taken for granted in the developed world. Energy crises may well be the case with other developing and underdeveloped countries.

There is another important element to consider regarding electricity crises, as is the case in Pakistan. Apart from frequent absence of electricity, voltage can fluctuate at any given interval that is outside the tolerable limits of ICT hardware. This has been the cause of several breakdowns of ICT equipment and a range of other household electronics. It is common for people to be scared to turn on their computers fearing that voltage may be too high or too low. Therefore, tasks like business and important scheduled internet meeting with a relative abroad may not be made just because of electricity issue.

In both developed and developing economies, young generations are more inclined towards using computers than elderly people, opening an era of the grey digital divide. The digital divide is already negatively affecting young and middle-aged population worldwide on socio-economic footing. At the same time the grey digital divide is becoming increasing significant. This is especially so in the developed world that has started suffering or will suffer in the near future due to societal ageing processes. The exceptionally significant mention here is of healthcare services via ICT, which elderly people are unable to avail of due to the grey digital divide.

The grey digital divide article and systematic literature review article issue the next direction in understanding the digital divide. The link between healthcare and ICT was realised many decades ago, but current information age has proven the potential for ICT revolutionising the healthcare industry. Various new ICT tools and software offer users health management through smart Apps and ICT devices. Possibilities of ICT use in healthcare maybe endless as ICT industry

itself is experiencing a revolution and many new smart devices are released every year.

There are various aspects of ICT-mediated healthcare practices that make eHealth a highly desirable system. Real-time diagnosis and connectivity with doctors for common medical questions are extremely useful features as they save time and cost of both patients and healthcare practitioners. Healthcare institutions can use more time in focusing on quality care services to emergency situations, Intense Care Unit (ICU) rooms, and the area of research and development. Reduction of unnecessary paper work is another added benefit. Management of patient history electronically can give access to rapid treatment in emergency situations.

An example of the above can be taken from Apple's own health-related apps and those developed by third parties. These apps allow users to input their personal health information, allergies, blood group, previous medical history etc. into one app. During an unfortunate event, when a person needs immediate medical help, such apps can provide healthcare practitioners rapid decision making and efficient treatment help. Issues around privacy still exist and confuse the users, but further developments in this area are expected to address this concern.

Pakistan and Finland are two distinct countries culturally and economically. Finland has advanced healthcare management through state-of-the-art ICT-assisted systems and there are visible benefits of improved health in the country. In contrast, Pakistan has a very poor-quality healthcare system, from which only the wealthy can benefit. Lack of electricity - the basic infrastructure even for ICT - has caused loss of a significant number of precious lives. Fluctuations in electricity also affect emergency treatments in Intense Care Units (ICUs) that often result in preventable deaths. Deaths of patients in ambulances struck in traffic jam suggest that country needs major shifts in its infrastructure (both ICT and general) before embarking on any eHealth initiatives.

There are a few failed tele-health projects in Pakistan apparently due to factors of the digital divide, lack of funding, and corruption. It is recommended that mutual win-win cooperation be started between Pakistan and Finland on devising and implementing ICT infrastructure as well as healthcare system. Finland can benefit from cheap labour and testing platform for their pilot projects whereas Pakistan can benefit from learning the advanced ICT infrastructure development and healthcare information systems.

Concerns in Finnish healthcare systems often revolve around privacy issues. Users feel concerned to input their sensitive data in healthcare apps or share it via internet to their physicians. Consequently, there is need of public awareness and laws governing the handling of patient data through smartphone devices and other ICT tools. For policy assessment purposes this means devising strict

regulations aiming at safeguarding privacy of individuals. There has been some progress with respect to these factors, but more public awareness is still needed. ICT manufacturers are typically not taught to deliver content to enable senior citizens to take advantage of an ICT-assisted healthcare system. Although it is an expensive investment decision from governments and private sector, the long-run advantages of cost-efficiency will override the initial investment, in a far broader sense than is currently apparent.

An analogy can be drawn here and extended to other developing and developed countries. This is because developing countries are characterised by common problems as well developed countries share common characteristics. Such measures, if successfully funded and implemented with the appropriate sensitivity to cultural considerations, will make it possible to address global health burden much more effectively than relying on traditional practices. Hence, the digital divide becomes even important in the information age as ICT will become an indispensable component of future healthcare. Those on the wrong side of the digital divide will now be isolated from social, economic, and health perspectives. Efforts against the digital divide must continue and call of confronting digital divide must be a heightened issue worldwide.

6.3 Answer to research question 1: defining the digital divide

Research question 1 considered the nature of the digital divide. Although a surfeit of definitions of the digital divide reflects wide disagreement in the literature, most researchers agree that the concept of the digital divide should include an element of effective “usage” together with “access” to ICT. Despite this, the “usage” effect of the definition appears to be overlooked by some researchers. It is significant to define the concept as accurately as possible, as having the correct mindset will enable the authors and readers to act appropriately towards this socio-economic disparity. Paper 1 clarified the concept of the digital divide and helped articulate a definition of the term. It is now possible to develop a definition of the digital divide that constitutes significant aspects.

The digital divide is a global socio-economic problem comprised of various complex layers and concerns disparities in access and beneficial usage of ICT hardware and software due to economic reasons, health issues, literacy rates, language barriers, government policies, cultural reasons, individual reasons, time barriers, and various cognitive factors. This divide can range from individuals, households, societies, towns, villages, cities, and countries to a global level.

6.4 Answer to research question 2

6.4.1 A solution to bridge the digital divide

Research question two centred on ways to bridge the digital divide between Finland and Pakistan. Synthesis of all six papers laid the foundation to suggest a framework for minimising the digital disparities in Pakistan in comparison to Finland. Various ways of confronting digital divide were explored which allowed insights into broad implications of this research. To respond to threats concerning global digital divide, a multi-level framework as a solution can be proposed. Based on the collective findings explored in the present research, it is now possible to suggest a structured framework that can assist in minimising the digital divide between developed and developing regions, in this case Finland and Pakistan. Below I present a six-tier framework that could combat the digital divide between developed and developing regions. Each step of the framework is further explained in the following sections.

1. Awareness
2. Subsidised integrated provision of ICT hardware, software, and skills
3. Strategic training units
4. Fusion of ICT in education at all levels
5. Role of ICT manufacturers for making hardware and software user-friendly and elderly-friendly
6. Strategic partnerships with ICT-rich countries.

6.4.2 Awareness

First step to combat digital divide is diffusing a wave of national awareness in the target country where digital divide is to be confronted. Albeit such an awareness campaign should be able to benefit developed countries as well where digital divide remains a prominent problem today. Here the role of government comes in useful, given the assumption that governments have control over state-run media as well as power to spread information on a national level.

These awareness campaigns will pave the way to public recognition of ICT role in enhancing productivity. Special emphasis should be made on ICT fusion in education sector starting from basic levels to foster a young ICT-literate culture. Awareness campaigns must cover all geographic areas including rural and remote areas. Repetitive exposure to such advertisements will play a leading role in clarifying public image about ICT.

Suggested media is widely accessible outlets such as billboards, newspapers, radio, and television advertisements, distribution of circulars in schools etc. It is recommended that this practice of public awareness remains a continuous task to inspire current and future generations. This is because Pakistan, like other developing countries, is a culture where communication is an integral part of society with exceptions to some remote tribal regions. Half a year would allow citizens to discuss ICT benefits in family circles and other social settings.

6.4.3 Integrated Provision of ICT hardware, software, and skills

The next significant step concerns provision of not only ICT but a combo package of ICT hardware and skills needed to operate the hardware. Prior attempts of ICT hardware provision have often repeatedly failed because of lack of ICT skills delivery. As research indicated in some instances reason for not using ICT hardware has been due to underlying fear of breaking it. Although some have fear of breaking ICT, others are annoyed by not being able to use it effectively. As such, the desire to use ICT across many households loses its appeal to complications related to use of the hardware and software. This is especially the case with middle-aged and elderly people, who often do not receive any feasible support for learning ICT.

When ICT skills are provided together with ICT, the aforementioned problems can be laid to rest. This is a challenging step, because it requires considerable government efforts. Governments can reconsider cash flows spent on devising ICT policies, seminars, and events to this step, which will outweigh the monetary costs in future.

To do so, governments must first identify areas of high significance regarding provision of ICT and skills packages. These may include the educational sector, healthcare units, financial sector and other possible units of socio-economic sector in the country. Because the provision at household level may seem next to impossible due to high costs involved, governments might consider opening up public ICT access centres across various localities with enough seating capacity and training instructors at dedicated times. These should ideally be free of charge, or offered at minimal charges, so that as many people as possible will be able to afford to become ICT-literate.

6.4.4 Training units

Training units strategically placed in various localities will play a key role in educating public about how to extract maximum benefit from ICT. It is

recommended that such training units be set up under administration of city governments. However, checks and balances are the responsibility of federal governments.

ICT literate individuals who are efficient in ICT skills as well as competent in speaking local languages should be hired on attractive wages. All such staff should undergo a standard training in order to provide standard ICT services to citizens. The most important skills to be taught include the ability to operate computers for a wide variety of socio-economic activities which include (job seeking) online, applying for work and filling forms online for various purposes, taking online courses online, using word processing software, learning languages online, searching for material online, hardware and software troubleshooting etc.

6.4.5 Fusion of ICT in education at all levels

Findings confirming the positive ties of ICT and education signify the ever-increasing role of ICT in education sector. This seems to be an effective means helping younger generations to become ICT-literate from the very start of their early education. This will help achieve the dual purpose of improving instructions and management, and creating awareness among students about the potential of ICT not only in education but also in other socio-economic sectors.

It must be ensured that students at primary levels are introduced to ICT. Ideally, all students should be taught to engage with ICT such as computers and internet. A good solution would be for each classroom to be equipped with smart clients (computers) for educational purposes. However, given the poverty levels of developing countries, it might not be possible. An alternative and perhaps feasible way is to introduce dedicated sessions for ICT literacy a number of times in a week where students go to computer rooms for instructions.

This step also depends upon how serious governments are in fostering an ICT climate in their respective regions. However, it must be remembered that not all governments have the capability to invest heavily in enabling the widespread adoption of ICT on their own. The first step of public awareness identified in this six-tier framework is therefore significant. In such situations, a tax plan may be devised or modified carefully, where public would pay reasonable taxes to compensate the costs. This comes down to priorities at national level. As has been the case with Pakistan, most of the national budget goes to military institutions. Apparently, peace in the region would allow Pakistan and neighbouring countries to spend budget on most important sectors of the economy. That is why confronting digital divide is essentially a multi-level process that requires the contribution of state actors.

6.4.6 Role of ICT manufacturers in making hardware and software user-friendly and elderly-friendly

ICT manufacturers must make ICT hardware and software both ergonomically viable, user-friendly and especially elderly-friendly. Prior research has reported that most of the ICT products and services are geared towards younger population. Elderly including middle-aged population is missing out on ICT notably both in the developing and developed world.

One practical way is to arrive at universal consensus that ICT manufactures continuously strive to make their hardware and software user-friendly. Content in local languages appears promising, because most elderly people in developing countries do not speak English. This is one way to bridge the grey digital divide, together with technical training and support.

In what follows, I argue that a universal institution should be formed for guiding the standards of ICT goods and services regarding usability. A comprehensive framework similar to CoBit or Cobalt is suggested for this purpose.

6.4.7 Strategic partnerships with ICT-rich countries

Strategic partnerships with countries that are technically and theoretically advanced in ICT leadership are significant to cut the learning curve of widespread ICT adoption in developing countries. Mutual win-win cooperation is suggested in areas of education, healthcare, banking, public and government institutions, and other various socio-economic sectors.

Large ICT companies can also make specific agreements with developing countries to grant their services at special prices affordable to locals. Student packages are especially recommended. In return, students can make agreements to participate in surveys or other forms of data collection useful to ICT corporations.

These ICT partnerships can bring great deal of advantage to developed countries in various ways. For example, these present excellent opportunities of data collection from developed countries. Cross-cultural learning is another side-benefit. Both developing and developed countries can learn from each other's working culture. Developed countries can also hire skilled people from developing countries for various projects.

6.5 Answer to research question 3: the grey digital divide

The grey digital divide is a rising variant of the digital divide related to elderly people. Paper 5 and 6 yielded insights to answer the research question 3. In addition, these papers also argued various solutions to minimise this divide. It is relatively new compared to the broad concept of the digital divide. Elderly population is already suffering with lack of rapid access to urgent information especially medical information. While some researchers allege that the grey digital divide will close itself when the current cohort of young people ages, it is unlikely that the grey digital divide can be eliminated.

At old age one is prone to various disabilities that can hinder the usage of ICT even when high skills and ICT access are provided. These include weak eyesight, memory loss, cognitive dysfunction, lack of energy, and lack of focus among others. Currently, the focus of the ICT industry is overwhelmingly geared towards the young generations, and elderly people continue to be largely ignored. ICT manufacturers must work in collaboration with healthcare experts to deliver elderly-friendly ICT solutions.

The most significant implication is for healthcare industry that can provide cutting-edge healthcare services assisted with ICT. However, provision of ICT-assisted medical services is not enough. The question is whether elderly people in general would be able to use it. This question highlights the importance of the role of governments in establishing ICT training programs for elderly people in both developed and developing countries. The synthesis of literature review in Paper 5 suggests that ICT training programs, as tested in a few developed countries, should be run in other countries as well.

6.6 Objections to the theory that the grey digital divide will solve itself

Some researchers tend to hold the belief that when current young generation becomes older there will be no digital divide, at least the grey digital divide. These researchers have bought into the myth that the digital divide is now a problem of skills only, after having clarified that it is not limited to access. Both propositions – that the digital divide will be solved if skills are provided, and if access is provided – are flawed in that there will always be a digital divide, due to market mechanisms. This argument is a complete opposition to the previously (and still in recent times by some) held belief that the digital divide will solve itself due to market forces. The logic was that demand and supply forces will make the prices of computers affordable, as really became the case in last decade.

Despite this, the digital divide was found to be persistent and in many cases deepening throughout the world.

In practical sense, market dynamics will also introduce the continuous injection of new models of ICT devices and services that will consequently refute the existing ones. Therefore new digital divides will be made whenever previous ones are closed. In light of this, the digital divide is a never-ending phenomenon, but it does not mean that there must be no efforts to confront it.

When current young generation becomes older, it will have its own problems that come at older age such as various cognitive disorders. Motivation to use ICT at an older age is still a significant factor to consider. Therefore, the digital divide will remain regardless of forthcoming generations, although ICT infrastructure can be foreseen as massively improved.

There is still great potential in old models of ICT to extract beneficial usage from them. Universal access to ICT skills should be a topic under consideration of research and policy circles. Governments may consider subsidising ICT as they did in food and education in some countries. These measures may control the digital divide to a reasonable extent.

6.7 Objections to the methodological approach to the digital divide

As was evident from the systematic literature review, most of the research publications related to the digital divide theme are exploratory and qualitative in nature. Researchers appear to attach importance to explaining the value of the topic, whereas little focus is spent on understanding quantitative aspects of the phenomenon.

It is currently more than clear to the research and policy circles that the digital divide is a serious socio-economic phenomenon to be confronted. The world needs solution to the problem. Practical work on the digital divide can be traced as far back as the 1960s, but nonetheless more than half of century research has failed to show a conclusive solution to the problem of this global digital divide. It appears that public awareness campaigns will suffice to attach heightened importance to the core issue of this problem.

What is now needed is preferably a mixed-method approach to tackle this problem and bring a firm quantitative approach to the inquiry process alongside the qualitative approach. It remains to be seen in what aspects digital divide can be properly assessed. A standardised quantitative framework to assess the digital divide will enable to help policy circles to appropriately respond to the problem in various regions.

7 CONCLUSIONS

7.1 Summary of findings

This dissertation had embarked upon a mandate to minimise the great digital divide by rigorously undertaking a deeper and detailed empirical research, proposing various recommendations to governments and institutions in respective regions. The long-range objective of this research was to bring the matter of global digital divide to resolution. Owing to the prevalent distorted concept and claims constructed around biased opinions regarding the digital divide at large, a secondary aim of the research was to develop an understanding of the digital divide through a systematic procedure, which finally met a longstanding need. Subsequent to this, a connected aim was to furnish the implications through this research that will constitute an efficient means through which the digital divide can be minimised.

A systematic literature review on the digital divide was necessary to cut through existing misconceptions and foster a reasoned dialogue that could help shape the action plans. The literature review advances our collective understanding of the digital divide, thereby offering critique together with substantive opinions. The objective has been achieved by first rebuilding the concept of the digital divide on pragmatic constructs to gain a better understanding of the phenomenon, and then centralising the focus on conquering the digital divide between Finland and Pakistan.

This dissertation set out to gain a better understanding of the digital divide, and to consider how to bridge the digital divide between Finland and Pakistan. With the invention of internet, the 1990s marked a dramatic escalation of digital disparities, and digital divide surfaced as a heightened issue across the academic and policy discourses. The digital divide has historically been a subject of several popular misconceptions.

Under closer inspection, the digital divide can be seen as a multi-dimensional and multi-layered concept that ranges from the individual level to a global perspective. The qualitative nature of the digital divide is an area of concentrated interest in academics, whereas quantitative understanding of the topic has been extensively ignored.

A row over the lethal consequences of the digital divide across academics and policy domains has highlighted the extent of the rising threats it is posing on socio-economic fronts. The digital divide is intimately linked to the poverty with

a high degree of correlation. However, the digital divide is not only about poverty, lack of ICT skills, willingness to learn ICT, and lack of access. Emergence of techno-stress due to ICT usage brings a new perspective in this narrative. ICT-induced techno-stress creates short or long-term disabilities, in which case a new digital divide related to ergonomic issues surfaces.

This dissertation has shown that conquering the digital divide will require multi-level efforts from a variety of perspectives. This is because digital divide is a complex phenomenon apparently based on several layers of content that are evolving parallel to ever-changing ICT infrastructure. As a proposed solution to the digital divide, a systematic framework was suggested to minimise it in Pakistan. Because the developing countries share many characteristics in common, this framework might also be applied to other developing countries. The same framework may also be of interest to developed countries with cultural modifications.

Under intensive research of nearly six decades since the conception of the digital divide, there is little success in bridging the divide. Although widespread adoption of ICT has visibly increased significantly around the world, the digital divide is reportedly persisting. Concerns have been raised by several relevant bodies about the victims of the digital divide and its effect on world economy. The leading cause of the digital divide indeed is largely tilted towards income factor due to which developed countries merited the privileges of ICT connectivity and poor countries suffered from the lack of same. Results indicate a common theological thread in the form of poverty linking the various digital divides, consequently establishing that poverty is the leading cause of the latter.

Bridging the digital divide brings numerous implications for healthcare, education and other socio-economic sectors of the economy. Implications concern research, practice, media and policy circles to play their respective part in fight against the digital divide. Healthcare industry needs rigorous reforms to deliver the healthcare services in variety of new ways through ICT-assisted procedures. Several cost-cutting benefits are expected through ICT-based reforms in the healthcare sector. Research shows that educational sector can be significantly improved through the integration of cutting-edge ICT with learning practices. In future, this can mean cutting the costs of learning, which will particularly help the poor to avail of education services. Similar benefits are expected in other areas of economy such as banking and various other socio-economic services.

The grey digital divide, an emerging variant of the digital divide, is currently affecting elderly populations more severely than their younger counterparts. Although this is certainly not decisive evidence, it supports the conclusion that the digital divide is deepening in terms of skills in developed world. By the same token, the digital divide is getting deeper in developing and underdeveloped

countries as well. Although the digital divide exists in both the developing and developed world, the situation in the developed world is usually worse.

A systematic framework to combat the digital divide as developed and suggested in this dissertation is needed with serious input from government. Public awareness should be a first step to confront digital divide in any given country. This is especially so in developing and underdeveloped countries, where the public at large is unaware of the serious consequences of the digital divide.

Bloomberg and Volpe (2012, pp. 6–7) emphasise the need for consistency in the findings. Table 5 illustrates that various elements of research design are aligned by tracking the findings through interpretations to conclusions. Table 5 lists the findings, interpretations and conclusions in order to help in shaping a logical discussion. Table 6 summarises the answers to the research questions.

Table 5 Consistency of findings, interpretations, and conclusions

Key findings	***Interpretations***	***Conclusions***
The digital divide is a much more complex phenomenon than previously understood.	The term digital divide denotes a combination of several different divides at various socio-economic levels. It must be tackled systematically whether engaging in research or practice.	Conquering the digital divide would require a systematic framework with cultural considerations unique to areas where digital divide is confronted.
The digital divide is deepening worldwide.	Despite visible widespread adoption of ICT across the world, the digital divide is deepening on skills level. Rate of change of ICT is so fast that it rarely matches the pace of research on the area of the digital divide.	Emerging ICTs require new skills to use them that are acquired slower by masses than the rate of change of technology. At the same time new software developers are releasing state-of-the-art versions that are a challenge for hardware developers to keep their ICT devices up to demands. On the other hand, it takes time for individuals to adapt to new ICTs and fully benefit from them.
A new form of the digital divide related to elderly people is emerging globally.	The grey digital divide is badly affecting elderly people in developed countries where ICT-based healthcare solutions exist but they are not usually elderly-friendly. Elderly require new set of skills to learn mobile-based applications and healthcare services online which is a significant challenge, given the other challenges elderly people face in last stages of life. Societal ageing processes in the developed world should encourage the researchers and all relevant bodies to tackle this issue. The phenomenon of the grey digital divide exists in developing countries as well. However, it is usually forgotten behind other pressing aspects faced by developing societies. Examples include malnutrition, family burdens, and changes in physical and mental abilities that come at the cost of old age. What constitutes an old age also varies across the world.	Conquering grey digital divide will depend on variety of factors. These include educating the elderly in government-funded programs and making the healthcare and other online services elderly-friendly. The grey digital divide can be a challenge to bridge if cultural attitudes of citizens do not motivate them to engage with ICTs regardless of costs, training programs, and government efforts.
Income and education bear considerably strong positive relationship with worldwide adoption of ICT.	Income, to a large extent, is tied to ICT acquisition. In other words, poverty explains a major share of the digital divide worldwide. New forms of education delivery are encouraging people to invest in ICT. This could also be taken to mean that modern education is deriving the use of ICT worldwide.	Eradication of poverty to an extent will help bridge the digital divide without any shadow of doubt, but only to a limited extent. Increase in attaining modern educational opportunities is expected to derive usage of ICT. Investment in education will therefore serve dual purposes: achieve literacy rates and indirectly reduce the digital divide.
Electricity is a significant indicator of the digital divide which is often ignored in list of the digital divide indicators across literature.	A reliable electricity supply that is adequate for ICT hardware remains a prime issue in Pakistan and other developing countries. Electricity remains absent for a number of hours for several reasons. Therefore, the availability of ICT hardware and skills is a no guarantee that the digital divide can be solved.	Provision of reliable electric supply at all times will considerably bridge the digital divide to an extent. This is further proof that conquering digital divide requires a range of direct and indirect efforts. Same logic underlies that the digital divide can be addressed to an extent by providing electricity to all households in other developing and underdeveloped regions of the world.
The digital divide as a field of information systems science is heavily dominated by qualitative rather than quantitative research.	Researchers have routinely focused on describing the digital divide and its causes without regards to major empirical quantitative work. One interpretation that draws on this finding is lack of consensus over measuring the digital divide.	Currently there is need for quantitative empirical work on the topic of the digital divide. This includes developing the instrument to measure the digital divide, work around defining measurable ICT skills and research on emerging digital divide indicators etc.

7.2 Findings related to research questions

Table 6 Findings related to research questions

Research question	***Findings***
Research question 1. What exactly is digital divide?	A range of evidence has illustrated the breadth of this topic specifying it as a multifaceted complex area of study. It is not simply a breach in access to and use of ICT technologies. Rather, the digital divide is situated on interwoven complexities involving a mix of factors ranging from an individual to a global level. Therefore, the digital divide is a constellation of many digital divides. The digital divide needs to be looked at with "digital divides". The term detonates differences in acquisition, skills, and beneficial usage of ICT among people, societies, and countries at different socio-economic levels.
Research question 2. How can the digital divide between Finland and Pakistan can be bridged?	Multilevel reforms from multiple perspectives, role of government is crucial, and a systematic framework to close this gap was developed and suggested.
Research question 3. What is the grey digital divide?	It is a new variant of the digital divide that refers to the elderly. This kind of the digital divide differs greatly between countries due to cultural attitudes that determine which age groups are considered "elderly". Although there are various understandings of what constitutes an old age, for this dissertation the lower threshold is set at 60 years in developed countries, and 40 years in developing countries. Chronic loneliness, various levels of poverty, being abandoned from family, contracting physical and mental health issues, and personal resistance are all various hindrances which shape the understanding of the grey digital divide.

7.3 Further remarks

Provided that disputes at a policy-making level can be overcome, the problem of ensuring a comprehensive and reliable electricity supply in Pakistan will eventually be solved, at least to a tolerable level. Until then, it is too early to hope for a full-fledged remedy to the digital divide in Pakistan since electricity is the basic infrastructural component needed to drive most ICT devices. It also calls for structural changes at policy level to address the digital divide so far as Pakistani politics is concerned. It bears emphasising that the whole future of ICT

culture rests largely on firm organisation of reliable electricity throughout the Pakistan, including distant villages and remote tribal belts. It is therefore suggested that an electricity revolution be started in the country with a sense of urgency.

In developing countries due to malnutrition, middle-aged parents often suffer from various health problems that draw most of the family's income and savings. Spending on ICT goods is thus put before spending on life-saving drugs and basic necessities. This is also the case with Pakistan that in part explains the prevalence of the digital divide in the densely populated country.

As long as material income derives the usage of ICT resources, the digital divide is difficult to fully bridge. This conclusion is based on dynamics of market forces. ICT will continue to be upgraded as previous trends of ICT corporations in the recent past have proven that ICT products are becoming vintage and replaced by new ones at a much faster rate than ever before. An ICT device is functional to meet demands of latest requirements of latest software, usually the time span ranges anywhere from one year to couple of years.

Heavy government investments in ICT-assisted healthcare infrastructure to replace old-fashioned healthcare system have failed in some developed countries. Similar mistakes are expected to haunt footsteps of policymakers in making future investments. A stepwise procedure to minimise the digital divide, as discussed in this dissertation, can be helpful for avoiding costly mistakes. It bears re-emphasising that the digital divide is a multi-level phenomenon, and therefore multi-level framework can best address it.

Although science behind the grey digital divide is still in its infancy, when combined with numerous studies, results support the conclusion that the grey digital divide is badly affecting developed and developing countries. Developed countries are likely to suffer intensively in the near future due to societal ageing processes. This variant of the digital divide will be in addition to the digital divide already evident in the developed world. Therefore research and policy efforts are needed now before the grey digital divide becomes a major burden in the coming years. This specially holds implications for ICT-assisted healthcare services meant for elderly people.

If the digital divide is to be fully tackled, access and skills must be granted globally on the broadest possible scale, since a significant proportion of the world's population continues to be deprived of basic human needs. Addressing digital divide at global level then becomes a critical concern. Narrowing of the digital divide is expected to have positive impact on reducing poverty. Looming large is the concern that the digital divide and health divide are now related as shown in this research. Therefore, there is a clear need to fully realise deep implications of the digital divide and initiate multi-level efforts to bring ICT costs down to levels that are accessible to the poor. It must be seen significantly

parallel to food and shelter, should a global digital divide be considerably bridged.

7.4 Implications and recommendations for theory

The present study makes several noteworthy contributions to the areas of research. The work contributes to existing knowledge by confirming theoretical claims about ICT-socioeconomic relationship with rigorous statistical means. Owing to the lack of quantitative research on the digital divide, these statistical verifications can also be taken to mean a contribution towards quantitative uptakes on the digital divide.

The digital divide has been contested heavily among researchers, and until now there has been no universally agreed definition of the digital divide. Furthermore, as the concept of the digital divide expanded over six decades, need of new definitions constantly arose but without any consensus on what actually is digital divide. This long-standing need was met through the present research that articulated a new universal definition of the digital divide. The new definition covers emerging aspects of the digital divide from an individual to a global level.

To remedy the currently insufficient understanding of the digital divide, this research has chased digital divide from its beginning to the current state of affairs critically and synthesised several arguments from prior literature. The systematic literature review and ongoing literature review have clarified the narrative of the digital divide and one can easily understand what digital divide is and what constitutes it.

It is very much hoped that this theoretical clarification of the digital divide concept will now enable researchers to move beyond debates on nature and sanguine assessments of the digital divide to solutions and emerging dimensions of the digital divide. Some researchers believed that the digital divide is significantly over due to widespread distribution and adoption of ICT. This view is challenged in the present research with the counter-view that the digital divide is not over, it is deepening. This message is clearly articulated throughout the research, and implies that the digital divide should be seen as multilevel challenge, but most importantly multilevel systematic frameworks should be worked upon to minimise the digital split in the world. Simultaneously, it is also hoped that research funding will be released for minimising the digital divide instead of conducting narratives on its dangers.

The dissertation clarifies the confusion about ICT-socioeconomic relationships by running multivariate regression analysis on a vast dataset from 91 countries. There appears to be a strong positive relationship between income and ICT, as well as between education and ICT. These results contradict some claims that

ICT has no influence on education. The relevance of education with ICT is clearly supported by the current findings. This finding has significant implications for understanding how ICT can enhance education, and support the idea that ICT-assisted learning processes should be given consideration in educational institutions. The finding also suggests the role of ICT in other areas such as professional and technical training.

Being able to bridge the digital divide is far from a forgone conclusion. Past research repeatedly argued about dangers of the digital divide but no precise and systematic mechanism was proposed to challenge this socio-economic problem. Efforts of rendering access to masses in hopes of closing the digital divide have already failed. Running ICT-training programs is only part of the answer. In the present research, I have attempted to develop a systematic framework to minimise the digital divide in an information-poor country, Pakistan, with reference to an information-rich country, Finland. This systematic framework could be used in other developing and developed countries, with cultural modifications.

This study extends the existing knowledge of the digital divide and how it is spread among various populations. An emerging variant of the digital divide related to the grey digital divide has proven the rising consequences of the digital divide in developed and developing countries alike. The present study should prove to be particularly valuable to the policy discourses aiming at improving ICT distribution and adoption in their respective regimes. The methods used for gaining the insights into the digital divide and exploring statistical relationships can be used in future research to understand other dimensions of the digital divide and assessment of different set of indicators.

7.5 Implications and recommendations for practice

Consequences of the digital divide as explored in prior and identified in present literature imply that governments must take digital disparities seriously on their respective national agendas. There are various ways this can be done. Cost subsidisation of ICT resources is the most significant one that should help poor citizens to purchase ICT tools. National campaigns may play their role in educating citizens about ICT-driven benefits.

Action research aiming at narrowing the digital divide in remote regions of the world is strongly recommended. Fieldwork will help to illuminate the cultural clues regarding ICT in various remote regions of the world. Poverty, apparently, is one main cause hindering ICT access in remote areas, particularly in developing parts of the world. However, ICT training together with ICT access

should be on high agenda at research and policy level when devising any solutions to combat the digital divide.

Provision of ICT access will enhance ICT literacy and is expected to reduce economic disparities among individuals and societies. However, ICT training must be made available together with ICT access. At any rate ICT training is not less significant than the ICT access. The digital divide cannot be bridged solely by providing ICT access, however subtle this promise may seem on the surface.

Although economies of scale has led to a price crash of basic ICT equipment in the open economy, the digital divide continues also based on type and quality of ICT equipment. ICT industry should keep end consumer in mind instead of prioritising profits. Current trend indicates that ICT annually rolls out new devices in the market with significant hardware and software improvements. These latest devices are often costly and common public cannot afford to purchase new ICT equipment every year. However, there is pressure to upgrade hardware as new content providers simultaneously release improved software to keep up with demands of improved hardware. It leaves open implication for Government – Industry cooperation to provide new ICT improvements at reasonable price points.

Although high-speed networks such as 3G, 4G, and broadband internet provides many more conveniences on us than traditional fixed-line networks, the human cost of these elements has started to gain prominence as witnessed by a series of medical reports. Techno-stress due to ICT access and usage is a challenge to human health and has been proven alarming by many critics. High-speed networks dissipate electromagnetic fields that are unnatural for the human body, and have been shown to disrupt biorhythms. Rapid advances in ICT have surely polluted our natural environments. It is of utmost significance that ICT industry starts work on this area and keep human safety in mind when producing ICT equipment and services.

Simultaneously, another implication for vendors is to produce safety equipment as well as ergonomic ICT equipment to deter the threats of techno-stress caused by ICT devices. For instance, prevention of dangerous blue light emitted through LCD screens of computer monitors and smart devices is one growing concern at present. ICT manufactures and third-party vendors must work together preferably with healthcare experts to design future products and services.

Implication for ICT in education should attract attention of education sector. It is especially important for Pakistan and other developing and underdeveloped countries that are long at odds with poverty and corruption. ICT has been proven to enhance learning process. It can provide transparent conduction of examination, submission of assignments, and gain new knowledge through learning forums. Cooperation between ICT manufacturers and education sector is

highly recommended. Customised ICT solutions made for education system can provide a breakthrough in national learning and carry promise for improved economy in the long haul.

Another important practical implication is the introduction of ICT-assisted healthcare system in poor countries to put death-inducing diseases under control. As Paper 6 suggested, introduction of ICT in healthcare system can improve the overall quality of the healthcare systems in the developing world. Maternal mortality rates in developing countries are in stark contrast to those in the developed world. Prior research suggests that this is mainly due to lack of sophisticated medical equipment in poor countries. The promises of ICT-assisted healthcare in this sector are also clearly evident.

7.6 Limitations

The present research has sacrificed some detail on the section on cultural attitudes towards the digital divide. It would have been worthwhile to assess the impact of culture on the digital divide in further detail, preferably with the aid of empirical research. Pakistan is a vast country with various cultures and sub-cultures, and they all can affect digital divide in various ways. An empirical investigation of this kind would have required a fieldwork in various parts of the country.

This could not be done due to the lack of funding, as well as security challenges in various parts of the country where there is armed conflict between insurgents and security forces. Nevertheless, Pakistan and Finland were taken as reference points in the present research instead of full-scale case studies. However, the implication here is that cultural differences among various countries should be taken into account when addressing any socio-economic problem such as the digital divide. This limitation was addressed by conducting two in-depth literature reviews to find the most relevant material related to the topic and by providing some examples demonstrating the influence of culture on the digital divide.

Although every effort has been taken into account in maintaining the quality and achieving rigour in the research, research results are contingent upon a variety of factors. For instance, these may include whether researcher engaged in face-to-face communication with study participants. Limited access to electronic journals is another potential factor that can skew results. Fieldwork on the topic could provide primary and new data that can shape results. Because fieldwork was not possible owing to practical and financial barriers, I undertook the following measures to ensure the viability of the research design.

1. A separate section was set aside for filtering out any potential bias in my own research assumptions. Alternatively, these can be seen as additional insights that led back to the research design due to my prior cultural and academic experience in a developing country. In this connection, my own role as the researcher was separately described.

2. Holistic research design was selected as it offers researcher valuable directions to engage various data and present various conclusions. In other words, a holistic or mixed-method research design offers more than approaching a research problem from a single perspective.

3. In addition to the aforementioned two steps, researcher offered thick and rich description of research design documenting every useful detail from start to finish that comprised a viable research strategy. This research strategy can be used to replicate similar results keeping in mind time horizon of the study.

Although many potential indicators of the digital divide were identified in this research from key organisations researching them, some of them were irrelevant and obsolete. There are fast emerging new indicators of ICT parallel to the propagation of ICT. Therefore, research on new indicators could have been beneficial in understanding further quantitative aspects of the digital divide. This limitation was addressed by identifying possible new ICT indicators with a brief explanation of their significance related to research, policy, and practice circles.

7.7 Future research and policy proposals

Present research has raised many questions related to the need for future research. A natural progression of this work is to conduct similar work in other developing and underdeveloped countries, comparing their progress with developed countries. Continued research on the digital divide appears fully justified because new variants of the digital divide are affecting world economy and socio-economic realities. Researchers should evaluate existing methodologies to assess and quantify the digital divide.

As potential of ICT in various sectors of economy continues to evolve, new theoretical and empirical concerns emerge regarding their role in healthcare industry. Deteriorating healthcare conditions in the developing world should evoke a strong response from governments in their respective jurisdictions. This

could encourage the integration of ICT-assisted solutions with lessons learned from the healthcare industry in the developed world.

Another possible focus future research would be to investigate the reasons behind the digital divide in developed countries, especially when GDP per capita is significantly higher in the developed world than in the developing world. This would point to individual factors such as lack of motivation, skills gap, time constraints, and cultural attitude towards ICT. The grey digital divide could be one possible area that needs further investigation. These trials can be run across different developed countries to identify any useful patterns that may assist in bridging the digital divide in developed countries.

Several remote regions around the world are isolated owing to geographic nature as well as abject poverty. Residents often have to travel many kilometres for medical assistance, which can have fatal consequences in emergency situations. This may open up avenues for future research in this area, in order to create solutions for remote areas of the world through state-of-the-art ICT. The proposed extension of part of this research to remote regions could pave the way for solving many socio-economic difficulties faced by people in such regions, probably worldwide if the initial phases are successful.

However, the precise universal mechanism of measuring the digital divide remains to be clarified. Currently there is the Digital Opportunity Index, developed by the OECD, which assesses countries on a scale of 1 to 0 based on the digital opportunities they provide their populations (International Telecommunications Union, 2007, pp. 34–57). However, construction of a precise instrument to gauge worldwide digital divide will be helpful for further research and policy areas. To explore this further, researchers should first examine new, obsolete, and emerging indicators of ICT.

ICT indicators are evolving parallel to rapid evolution of ICT. New indicators of the digital divide may include statistics on ownership of smart devices, ownership of varying broadband services, ownership of variations in ICT hardware and software etc. Future research could assess these indicators in various classifications at country level. It would be worthwhile to examine what ICT indicators are relevant for developing countries, but already obsolete for developed countries.

Researchers should keep abreast of developing research initiatives related to the digital divide, as the new digital landscape is continuously evolving. Further advances in research on the digital divide in other areas are strongly recommended, as research is successful in reducing the remaining variance (please check this sentence too). Examples of these areas could include impacts of the digital divide on mental and physical health, trading, microeconomics and macroeconomics in various areas of the world.

The Pakistani government should now fully realise the gravity of the situation concerning digital divide, which is affecting other sectors of the economy such as education, wellbeing and healthcare.

Future research trials could include adding more indicators to the current list of indicators, and hopefully the data will be available for the left-out indicators in the World Bank in the coming years. For the countries for which no data is available with the World Bank, fieldwork could be carried out to understand the dynamics of the digital divide in under-reached areas of the world. This also opens the possibility of fieldwork in remote areas of the world for which the World Bank and other data banks do not sufficiently provide enough data. Understanding the digital divide in remote areas of the world is highly significant, especially in the developing world, where the health divide strongly intersects with the digital divide. Several recent studies make it clear that the digital divide badly affects remote areas. For instance, lack of basic ICT indicators such as electricity can be life-threatening for patients, and can also affect education and other daily activities.

Future trials should aim at advancing the quantitative understanding of the digital divide by exploring the impact of various other indicators on ICT indicators and vice versa. Currently, there appears to be limited understanding of an assessment mechanism to gauge the scale of the digital divide. The OECD's Digital Opportunity Index, explored in Paper 2, is useful to the extent that countries can be compared on a scale from 10 (extremely good digital opportunities) to 0 (no digital opportunities). However, this should be developed further to better understand and develop a universal measurement mechanism for the digital divide.

Empirical work related to the elderly population is very significant in understanding the grey digital divide. Examples include examining factors such as personal resistance to computers, loneliness, and being abandoned by the family. This subject has not been considered in this research, but should be explored further for understanding the grey digital divide.

Literature on the digital divide is widely scattered across books, academic journals, periodicals, electronic media, and policy documents. Hence it echoes a need for conducting more recent systematic literature reviews on the emerging variants of the digital divide to organise knowledge for the purposes of supporting research, policy and practice decisions.

7.8 Concluding comment

The implications of this research should help to inform the development of policies for action. However, it is equally significant to bear in mind that the

digital divide, like any other disparity, will continue to exist. This is because if one digital divide related to skills or physical resources is closed, a new one will take its place in the form of new skills and new psychical resources that will potentially supersede the existing skills and resources. From this perspective, the digital divide is a gulf that can never be fully eradicated. It is in this light that the idea of fully conquering the digital divide does not exist in practice; only the appearance of it does. However, what is possible through a framework suggested in this research is to minimise its effects as far as can be done to foster the development of a better world.

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