Creating an Instrument of Measurement for the Evaluation of the Digital Divide: A Methodological Challenge at a Global Level

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ACC: Access

APEC: Asian Pacific Economic Cooperation

ARD: Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland

BRICS: Brazil, Russia, India, China and South Africa

CFA: Confirmatory Factor Analysis

CID: Center for International Development

CSPP: Computer System Policy Project

CTC: Community Technology Center

DAI: Digital Access Index

DD: Digital Divide

DIDIX: Digital Divide Index

DSF: Digital Solidarity Fund

DSL: Digital Subscriber Line

ECOWAS: Economic Community of West African States

EFA: Explorative Factor Analysis

EU: European Union

G7: Group of seven countries including USA, Canada, Germany, Great Britain, France, Japan, Italy

G8: Group of seven countries including USA, Canada, Germany, Great Britain, France, Japan, Italy and G8 since 1997 with Russia

GDP: Gross Domestic Product

HDI: Human Development Index

IBM: International Business Machines Corporation

ICT: Information and Communication Technology

IDI: ICT Development Index

IFLA: International Federation of Library Associations

IGI: ICT Global Index

InfoDev: The Information for Development Program

INSEAD: European Institute of Business Administration

IS: Information Society

ISDN: Integrated Services Digital Network

ISP: Internet Service Provider

IT: Information Technologies

ITU: International Telecommunication Union

KADO: Korean Agency for Digital Opportunity and Promotion

KAM: Knowledge Assessment Methodology

KMO: Kaiser-Meyer-Olkin Measure of Adequation of Factorial Solution

MAR: Missing At Random

MCAR: Missing Completely At Random

MDG: Millennium Development Goals

MI: McConnell International's Risk E-Business

NGO: Non-Government Organisation

NRI: Network Readiness Index

NTIA: National Telecommunications and Information Administration

OECD: Organisation for Economic Co-operation and Development

ORBICOM: International Network of UNESCO Chairs in Communications

SCONUL: Standing Conference of National and University Libraries

SIBIS: Statistical Indicators Benchmarking the Information Society

TOP: Technologies Opportunities Program

TV: Television

UC: Unified Communication Technologies

UN: United Nations

UNCTAD: United Nations Conference on Trade and Development

UNDP: United Nations Development Programme

UNESCO: United Nations Educational, Scientific and Cultural Organisation

USAID: U.S. Agency for International Development

VoIP: Voice over IP

WEF: World Economic Forum

WWW: World Wide Web

XML: Extensible Markup Language

ZDF: Zweites Deutsches Fernsehen

ICT4D: Information and Communication Technologies for Development

SPSS: Statistical Package for the Social Sciences

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To Niya Bernardes Kouadio

In memory of Isabel Sousa Bernardes Kouadio and Nguessan Kouadio

Foreword

The digital divide has long been and continues to be a subject of critique and interest among researchers from different disciplines and policy makers. As an information scientist, it hardly needs to be mentioned that my origins (I was born in the Ivory Coast) and background influenced my interest in this topic as well. In fact, it was as I was writing my master´s thesis in the e-learning area some years ago and examining the impact of the new technologies on education and research in developing countries that I first crossed paths with the issue of the digital divide. Since then, I have endeavoured to investigate the topic whenever the chance arose. I was more concerned with the legal and ethical basis of the distribution of ICTs (Information and Communication Technologies) worldwide, particularly after the world summits of the Information Society in Geneva (2003) and Tunis (2005), where some promising decisions were made in relation to developing countries. While the situation for the mobile phone penetration can generally be rated as good ten years later, the internet situation in this part of the world is still worrying. Despite the efforts of NGOs (Non- Government Organisations) and other stakeholders, the situation has generally not changed. In this thesis, I investigate the real reasons behind the status-quo and question whether the situation has been described profoundly enough so far. An evaluation of the state of ICTs is absolutely essential for finding the appropriate solutions. In this vein, I see the need for a global measuring instrument. I really hope that this dissertation thesis will contribute to future research on the digital divide. My main focus concerns the methodology, which is often neglected, so that more clarity can prevail in the digital divide research field.

Abstract

The call from the international community to join the struggle against the digital divide began around the year 2000, with some decisions taken at different summits such as the G-8 summit in Okinawa (Japan), the WSIS (Geneva &Tunis) and also the UN Millennium Goal summit in New York in September 2000. More than ten years later, the time has come to see whether the diffusion of ICTs worldwide has been a success or a failure. In order to ascertain the state of the different initiatives and undertakings against the digital divide, an evaluation is more than necessary. This dissertation thesis offers answers to the methodological issues surrounding the measurement of the digital divide. Besides the IGI (ICT Global Index), which indicates the state of the ICTs in 200 countries in the year 2010 using the factor analysis method. This thesis also shows clearly the steps which must be followed by any analysis or attempt to measure the digital divide. The digital divide has changed globally with the emergence of the mobile phone, but there has been no notable change in the situation of the internet. The reasons are, among others, the absence of skills and a real ICT policy, particularly in some so-called developing countries. As it has been attested that ICTs could sustain the development in developing countries, the efforts should be concentrated on the individual rather than on the technologies. Regardless of the place of residence, everyone should have the opportunity to access information, no matter what the communication channel is.

1 Introduction

1.1 Problem statement

In the last two decades, the world has undergone a digital revolution in which the internet has undoubtedly played a prominent role. Amiel (2006, 235) noted that no information and communication technology has swept the globe with greater speed than the internet and has the potential to promote vast social, economic and political transformations. In addition, the importance of the mobile phone and other elements of new information and communication technologies (ICTs) has also been rising. ICTs and especially the internet are, according to Schleife (2008, 82-83), becoming important as more economic and social interactions are digitally performed. Today it is hardly conceivable to live without these technologies in so-called developed countries, where the omnipresence of ICTs changes the management of affairs, consumer habits and the dynamics of growth profoundly. Individually, the use of the ICTs brings privileged access to information and greater efficiency at work and, thereby, to better job opportunities and better income. At a country level, the impact of the ICTs generates a gain in productivity and strong growth. But according to Schleife (2008, 83), the use of information technologies is expected to reinforce or increase existing social and economic inequalities between population groups due to the digital divide. Furthermore, the accelerated upward gain of ICTs and their advantages again sparked the problem of inequality between developed and developing countries. In fact, there is a so-called digital divide which describes a gap between the ones who have the possibility to benefit from ICTs and the others who do not. The international community, according to Camacho (2005, 1), also became aware of this situation and reacted first at the G8[1] in Okinawa, where it defined the development of a global information society and created the Dot Force with the objective of integrating international efforts and finding effective ways to reduce the digital divide. The international community continued to react at the World Summit of the Information Society (Geneva, December 2003), where heads of state and government from all over the world declared that the global challenge for the new millennium was to build

[1] A group of seven countries including USA, Canada, Germany, Great Britain, France, Japan, Italy and, from 1997, Russia.

an information society for all, where everyone could access and share information (Cuervo & Menendez 2011, 1). The second World Summit of the Information Society took place in Tunis two years later in 2005 and, in addition to the decisions at the summit of Geneva, underlined the importance of removing barriers to bridging the digital divide, particularly those that hinder the full achievement of the economic, social and cultural development of countries and the welfare of their people, particularly in developing countries (ITU)[2]. At the UN-Millennium Summit in September 2000 in New York, heads of state adopted the United Nations Millennium Declaration, committing their nations to a global partnership to reduce extreme poverty and setting a time-bound-target with a deadline of 2015. This time-bound-target is also known as Millennium Development Goals.[3] Furthermore, at the G-8 summit in in Okinawa in 2000, the digital divide was rated as important as poverty or famine during the international debate.

The WSIS (World Summit of Information Society) Forum 2010 took place at the ITU Headquarters in Geneva Switzerland from 10–14 May 2010 and was organised by the UNESCO, ITU, UNCTAD und UNDP. Representatives of governments, UN, NGOs and other stakeholders were present. At this forum, the members of the United Nations Group on the IS (UNGIS) discussed the goals to be attained by 2015. UNESCO (2010, 193). Topics included ICT access for persons with disabilities, and ICTs to strengthen access for women, the overall poor access to ICTs in Africa and what could be done to change the status-quo.

One of the last undertakings of the UN was no doubt the Lyon Declaration on Access to Information and Development in 2014. After the MDG (Millenium Development Goals), this was another action of the UN aimed at producing a declaration in which some important decisions should be consigned. This declaration was launched at the IFLA World Library and Information Congress on 18 August 2014 in Lyon France. The declaration states that access to information supports development by empowering people to:

- Exercise their civil, political, economic, social and cultural rights
- Learn and apply new skills
- Make decisions and participate in an active and engaged civil society
- Create community-based solutions to development challenges

[2] http://www.itu.int/wsis/docs2/tunis/off/7.html (11.07.2013)
[3] http://www.un.org/millenniumgoals/bkgd.shtml

- Ensure accountability, transparency, good governance, and empowerment
- Measure progress on public and private commitments on sustainable development.

For Camacho (2005, 1), the digital divide is obviously one of the first concepts considered when reflecting on the theme of the social impact caused by ICTs. So far, several research initiatives have been undertaken to explain the acuity of the issue and some solutions to deal with the digital divide have been proposed. Most of the research pointed out the technological aspect, the problem of literacy and also the political decisions. Thus, Peacock could state the following"[…] studying the digital divide covers issues on technology implementations as well as social behavior." (Peacock 2007, 9).

Therefore, the problem of the digital divide has not yet been solved. The principal target which must be followed, according to the international community, is the participation of everyone in the information society (see ITU). The main issue is how to bring all the people who are still outside into the information society. This challenge, which seems somehow utopic or ambitious, may perhaps be possible to meet if the right decisions are taken. Thus, the identification of the barriers has to be the first step. Further, the evaluation of the digital divide is also important and must be taken into consideration. This implies the measuring of the digital divide, an issue that has often been discussed over the last few years, resulting in multiple, differing viewpoints . This, incidently, is another important challenge that must be met in order to reach the main goal cited above. Although, according to KADO (2004, 8), measuring the digital divide may involve some criteria concerning network access, human capabilities, knowledge and application, IT expertise and IT usage in the business sector, the way in which the technological disparity is reckoned can vary in different perspectives with a reasonable fundament. Despite the past years of research, a standardized method to measure the digital divide is yet to be developed. Even a common definition of the digital divide is not available (Corrocher & Ordanini A. 2002, 1), which makes the situation even more difficult. Sciadas (2005) lamented the absence of an instrument capable of quantifying the digital divide and claims that a reliable measurement and analysis of the digital divide is desperately needed. However, one must fairly recognize that few efforts have been undertaken since then. Corrocher and Ordanini (2002), Sciadas (2005), OECD (2001), the ITU (2003) and

more recently NRI (2011, 2015), IDI (2010) note that a few more scholars and organisations have proposed solutions to measure the digital divide. The first question to ask is how reliable and consistent the proposed measuring instruments are, and secondly, if the referred instruments are good enough to cover the whole problem of measuring the digital divide. The aim of this dissertation is to create a reliable and consistent instrument of measurement to evaluate the digital divide. Quantifying the digital divide is not the only focus, but rather its evaluation and, above all, the methodological approach. A further goal of this thesis is to view the different measuring instruments and propose an alternative solution to work out the differences between them as well as to analyse their utility and importance through a particular framework.

1.2 Structure of the dissertation

Is the global digital divide measurable? If yes, how should one proceed? The answers to these questions will carry over into the following task schedule below.

However, before searching for the answer to the principal research question, some groundwork concerning the discussion about the necessity of the topic and its scientific nature has to be clarified. Thus, Chapter two will be dedicated to the definition and the theoretical background of the digital divide. The diffusion theory of Rogers and the knowledge gap hypothesis will be explained and its relation to the digital divide will be clarified. As often mentioned in the literature, e.g., Castells (2005) and Trkulja (2011), Pick & Sakar (2015) it is difficult to speak about the digital divide without referring to the information society, which is why the importance of the digital divide in the information society will be addressed in the third Chapter. As stated earlier, the existing propositions for the measurement of the digital divide will be analysed in the fourth Chapter, whereby particular focus will be placed on the NRI (Network Readiness Index) and IDI (ICT Development Index) because of their actuality, the frequency of their publication and their coverage. Furthermore, they are similar to the index that will be implemented in the framework of this dissertation. The fifth Chapter will deal with a framework for measuring the global digital divide, which will present an index based on secondary data and the explorative factor analysis method. Chapter six will be dedicated to the interpretation of the outcomes while Chapter seven will serve as the focus for discussion as well as conclusions and recommendations.

2 Definition and theoretical background of the digital divide

The importance of the digital divide has been increasing since the mid-90s when it first became a political issue. It began with the G8 summit in Okinawa, Japan in 2000[4], where the decision was made to view the digital divide as a serious matter. In September 2000, leaders came together in New York to adopt via declaration the MDGs (Millennium Development Goals)[5]. The principal goal was to reduce extreme poverty with an eight-target plan and a 2015 completion deadline. It was a great challenge for the United Nations, who also considered the diffusion of ICTs worldwide as an important element, among other things, for the eradication of extreme poverty and also to contribute to a global partnership for development. In order to attract attention, the first publications about the digital divide focused on accessibility and ICT infrastructures and, above all, at the global stage, with the North-South and rich-poor countries difference. These early interventions were aiming, according to Barzilai, N. Gomez, R., Ambikar R. (2008, 2), to narrow the gap between the digital haves and have-nots and focused on access to computers and technologies, in the hope that such access would bring about more equitable distribution of resources, knowledge and solutions to people's problems. For DiMaggio P. & Hargittai (2001), this dichotomous view of the digital divide was natural and appropriate at the beginning of the ICTs´ diffusion process. Other publications later pointed out the use problem in the digital divide debate. Meanwhile, with every new publication, a new definition emerged. The digital divide is a vast and complicated issue with different views. With its complexities and ambiguities in analysing the digital divide, one must take into account the context (Durampart, 2007). Compaine (2001), (Warschauer (2003), Dijk, Jan A. G. M. van (2005) and Barzilai, N. Gomez, R., Ambikar R. (2008), Kizza, 2013 provide a handful of definitions for the digital divide. These different views might be an indication of difficulties, which will be discussed later. One can say that there is no single definition of the digital divide, but that a few different definitions exist. Therefore, as Anthony G. Wilhelm (2000, 3) stated: *"The term digital divide has shifting qualities and has been appropriated by many different groups with diverse agendas–in short, it is protean in definition and meaning."*

[4] G8 Summit with France, Germany, Italy, Japan, United States of America, United kingdom, Canada and Russia

[5] http://www.undp.org/content/undp/en/home/sdgoverview/mdg_goals.html

In fact, as indicated in the introduction, the digital divide debate has also attracted the interest of scientists and scholars as well as politicians and organisations. Furthermore, the interdisciplinary nature of the issue pleads for a clear definition as each observer is, of course, influenced by his analytical experience as viewed through his own lens.

2.1 Definition of the digital divide

The digital divide has progressively become the focus of many scientists in different areas and organizations which are also greatly polarized. Again, there is not one common, but a few separate definitions of the digital divide according to the orientation of the topic. Thus, the digital divide generally follows two different main views: The first concerns the accessibility to ICTs—definitions which concern only the physical access—and the second is the problem of usage of these devices or definitions, which takes both viewpoints into account.

2.1.1 Digital divide as lack of access

For the UN ICT Task Force[6], the digital divide results from the gap between developed and developing countries in accessing ICTs as information and communication technologies have become the backbone of the global information economy in the information society. Birdsall (2000, 1) also defined the digital divide as the distinction between *"those who have access to the Internet from those who do not."* When speaking about the origin of the digital divide, Barzilai, N. Gomez, R., and Ambikar R. (2008) argued that in 1996, the Clinton-Gore administration was the first to introduce the concept and that it gained immediate popular acceptance as it showed the importance of access to ICTs among different populations and countries and also the fear that this gap between rich and poor communities and nations would increase even more. Pinkett (2002, 1), however, finds that the digital divide is the description of the gap between those who benefit from the new technologies and those who do not. Pinkett (ibid) adds that it was first popularized by the National Telecommunications and Information Administration (NTIA) in the U.S. Department of Commerce in its 1995 report, "Falling through the Net: A Survey of the

[6] The United Nations Information and Communication Technologies Task Force (UN ICT TF) was a multi-stakeholder initiative associated with the United Nations which is "intended to lend a truly global dimension to the multitude of efforts to bridge the global digital divide, foster digital opportunity and thus firmly put ICT at the service of development for all. (http://www.unicttf.org/)

Have Nots in Rural and Urban America." Even if Hoffman, D. L., Novak, T. P., & Schlosser, A. E. (2001, 3) argue that the president of the Markle Foundation, Llyod Morisett, was the first to introduce the term digital divide, which distinguishes the information-Haves and the Have-nots, for Baker (2001), the digital divide is the term commonly used to describe an individual's or community's lack of access to computers and online resources. More explicit is the definition of Matic (2006, 29), who declares that the digital divide is the gap between those who have and who do not have access to the technologies (telephones, computers, internet access) and related services. Another orientation could be observed by Moosberger, k., Tolbert,C., & Stansbury, M. (2003, 1), who indeed have a similar view but suggest that the digital divide has been the description of the patterns of unequal access to information technology based on income, race, gender, age and geography.

For James (2003, 23), the digital divide is the unequal distribution of computers, Internet connections, fax machines and so on between countries.

But even in 1999, the NTIA defined the digital divide as follow: *"disparities in access to telephones, personal computers (PCs), and the internet across certain demographic groups."*

All the definitions above point to a lack of access but the missing objects differ from one another. While the UN ICT Task Force and Barzilai et al. (2008) speak of ICTs access in general, Birdsall (2000) saw only internet access as the issue. Even the origin of the concept is to date not clear as different assertions have been made. But the lack of access alone does not seem to be enough to explain the digital divide, as Gunkel (2003, 504) claimed that access to technology is not the only, or even the most important determination and added that beyond access to equipment, individuals need to know how to use it. Van Dijk noted the same as he stated the following:

Digital divide research started with the observation of the number and categories of persons who have a computer and network connection at their disposal. This is a case of having a particular technological opportunity. The technological orientation of this early digital divide research led to the equalization of media or technology access with physical access. Currently, the majority of this research still focuses on physical access. However, since the year 2002, an increasing number of researchers suggests to go 'beyond access', to reframe the overly technical concept of the digital divide and to pay more attention to social, psychological and cultural backgrounds (Van Dijk, 2006, 223-224).

Beyond the discussion about the origin of the concept and also the lacking element in the definitions above, another aspect, namely the problem of usage, has been raised by scholars such as Gunkel (2003) or Van Dijk (2006), Pick & Sakar (2015) among others.

2.1.2 Digital divide as lack of access and use of ICTs

Among the myriad of definitions for the digital divide, some merited attention for their extent and precision like the one offered by Cullen, who stated:

> *The phrase "digital divide" has been applied to the gap that exists in most countries between those with ready access to the tools of information and communication technologies and the knowledge that they provide access to, and those without access or skills. This may be because of socio-economic factors, educational, attitudinal and generational factors, or it may be through physical disabilities. (Cullen, 2001, 311)*

For Barzilai, N. Gomez, R., Ambikar R. (2008, 2-3), the digital divide refers to disparities of access, use, skill background and environment in the context of ICTs. For Arquette (2001, 1), the digital divide is "*the gap between those who have access and the ability to use ICT, and those who do not."* If the definitions above justify the access and usage problem, the following from the OECD (2001) goes in the same direction but does so more extensively. In fact, the OECD (ibid) defines the digital divide as:

> *"…The gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities. The digital divide reflects various differences among and within countries."* (OECD, 2001)

Similarly, Warshauer (2011) views the digital divide as follows: *"[…] the digital divide refers to social stratification due to unequal ability to access, adapt and create knowledge via use of ICTs."*[7]

Dijk & Hacker (2003, 315-316), however, go further and distinguish four obstacles which are responsible for the digital divide:

1. *Lack of elementary digital experience* caused by lack of interest, computer anxiety, and unattractiveness of the new technology ("mental access").
2. *No possession of computers and network connections* ("material access").

[7] http://www.education.uci.edu/person/warschauer_m/docs/lit-approach.pdf

3. Lack of *digital skills* caused by insufficient user-friendliness and inadequate education or social support ("skills access").
4. Lack of significant *usage opportunities* ("usage access").

For some scholars, there are different dimensions, levels or stages of the digital divide which must be specified. Kling (1998, 226) pointed to the technical access, which means the availability of the technology, and the social access, which concerns the knowledge and technical skills required to deal with ICTs. Norris (2001) identified three different dimensions: 1) the global divide, which concerns differences between rich and poor nations; 2) the social divide combining the inequalities within one nation; and, 3) a democratic divide, which refers to the differences among those who do and do not use digital technologies to engage and participate in public life, stated in these terms: *"digital divide is understood as a multidimensional phenomenon encompassing three distinct aspects. The global divide refers to the divergence of internet access between industrialized and developing societies. The social divide concerns the gap between information rich and information poor in each nation. And finally within the online community, the democratic divide signifies the difference between those who do, and do not, use the panoply of digital resources to engage, mobilize and participate in public life."* (Norris 2001).

DiMaggio P. und Hargittai (2001), however, proposed five dimensions of the divide:

1. Technical means (software, hardware, connectivity quality);
2. Autonomy of use (location of access, freedom to use the medium for one's preferred activities);
3. Use patterns (types of uses of the Internet);
4. Social support networks (availability of others one can turn to for assistance with use, size of networks to encourage use); and,
5. Skill (one's ability to use the medium effectively).

These five dimensions proposed above reveal other important aspects besides the usage and the skills that are imperative. A further proposition comes from Warschauer (2002, 47-48), who suggested another understanding of the digital divide which is examined from the perspective of *technologies for social inclusion*, emphasizing the need to focus on

the social and cultural aspects of the implementation of technology in society. This revised notion is a function of four variables:

1. Physical resources, such as computers and other hardware
2. Digital resources or online available materials and software
3. Human resources, with education and literacy
4. Social resources, including community, social, and institutional structures.

Further he defined the digital divide as follows:

"The digital divide refers to social stratification due to unequal ability to access, adapt, and create knowledge via use of information and communication technologies."(Warschauer, 2011, 1).

This incitation of the creation of information society, which, in the long term, should walk out in a knowledge society, is the ideal requirement even if some preconditions listed above are necessary. According to Amiel (2006, 239), while providing access to hardware and software resources remains important, the real digital divide remains at the level of understanding. What has kept large sections of the population on the unfortunate side of every technological divide is an inability to comprehend the significance and role of these tools in their life and community. In the same vein, Kling (2000) argued that even if access were to be provided to all, there is a crucial need to understand the complex nature of technology before making use of it effectively. Moreover, Moosberger, K., Tolbert, C., & Stansbury, M. (2003, 1) added that: *"[…] having access to a computer is insufficient if individuals lack the skills they need to take advantage of technology."*

To take advantage of technology, the user needs to possess basic requirements such as skills, comprehension and understanding. Therefore, one can affirm that use is not possible without the skills associated with ICTs, and this subsequently creates the digital divide even if there is effective access to the technology. The (OECD, 2002) would seem to agree as it states that the digital divide can be seen as an abstract notion which can be defined as a gap between individuals and households at different socio-economic levels regarding their chances of accessing or using information and telecommunication technology. Finally, Peacock (2007, 409) argues that the first-level digital divide deals with problems of access to computers and the internet, while the second level focuses on the

profiles of users of new technologies. Some researchers also differentiate between horizontal and vertical digital divide. According to Sedimo et al. (2011) and Wei & Hindmann, (2011), there are two kinds of digital divide. The first is the vertical divide, which concerns the gap between users and non-users of the ICTs. The second digital divide is the horizontal divide, which represents the gap among ICTs users. Van Dijk & Hacker, (2003) also defined the vertical divide as a first level digital divide because it is an issue encountered at the beginning of the usage of the information technologies.

The horizontal divide also called second digital divide is related to the usage differences of the ICTs (Attewell, 2001; Fidan, 2016).

Recent publications about the digital divide such as those from Pick J.B., Sarkar A. (2015), James J. (2013) and Quereshi (2012) all define the digital divide under the different perspectives cited previously.

Kizza (2013) opted for a more general definition as he stated that the digital divide corresponds to "the *technological inequalities among people in one country and between countries*."

In fact, due to the different definitions and types attributed to the digital divide, Hilbert et al. (2016, 5) summed up this situation in the following terms: "… *the digital divide is one of the rare breeds of a concept that flexibly adapts to the meaning that the analyst decides to give it. This can lead to much confusion or at least, to tedious semantic quarrels*." They added, *"The digital divide is best defined in terms of a desired impact. Since those are diverse, so are the definitions of the challenge."*

2.1.3 Conceptualisation of the digital divide

Due to its complexities and ambiguities, it is almost impossible to deal with the digital divide without taking its context into account (Durampart 2007). Juanals B., Perriault J. (2005) assume that the concept of digital divide should also include socio-cognitive and socio-cultural aspects, which are often neglected despite their importance. A single view of the digital divide could also pose a problem when it comes to finding the best methodological and conceptual approach. Thus, Camacho (2005) pointed out that one of the most relevant aspects of the concept being analysed is its expression. To her, it is wrong to talk about the digital divide in the entire world, as if there were only one digital divide and as if it had the same characteristics at any time or in any social space. She believes that this has been one of the strongest, most unique aspects of the illusion behind the

definition. If there is not a single view of the digital divide, then all the factors such as cultural and socioeconomic conditions are to be included.

- One can note that the concept of the definition of the digital divide has changed over time. Early on, it basically referred to connectivity or access problems. Later, it began to introduce a concern for the development of capacities and skills required to use ICTs (IT-literacy and education) and finally, the effective use or participation including a social network or Web 2.0. (See Figure 1. below). One can affirm that the digital divide is its own research area, which however, lies in the frame of different disciplines (digital divide is in the field of several academic disciplines) and this fact influences inevitably the orientation of the research.
  The differentiation between the ones who have access to internet and the other who don't, adds a fundamental gap to the source of existing inequality and social exclusion (cf. Castells 2005, 261).

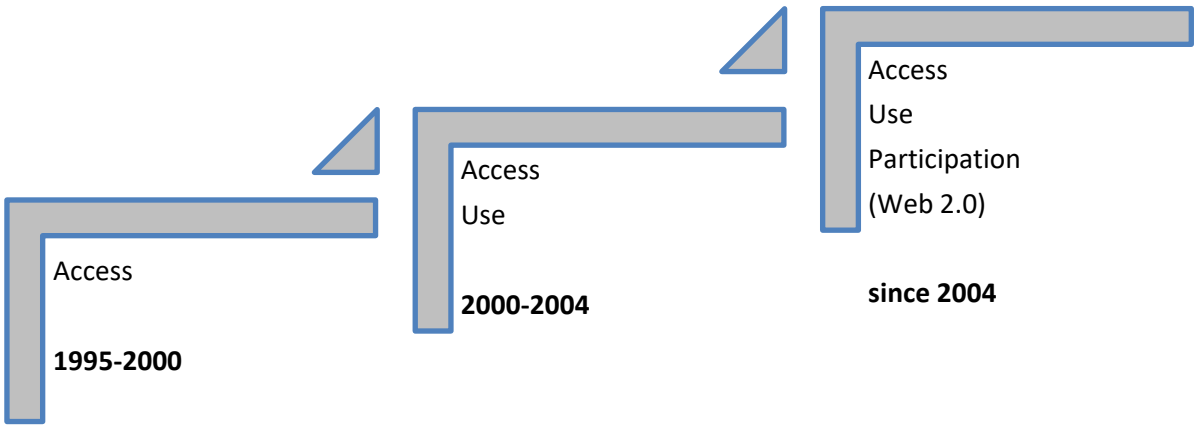


Figure 1: The evolution of the digital divide

Apart from the adjustment or evolution of the concept of the digital divide over time, there is also a conceptualization, which differs from the viewpoint and perspective of the observer. Figure 2, however, shows how this concept is perceived in the literature.

Hilbert et al. (2016, 17) note that the following categories are responsible for the various definitions of the digital divide: (1) the kinds of Information and Communication Technology (ICT) in question; (2) the choice of subject; (3) diverse attributes of the chosen subjects; and (4) levels of adoption, ranging from plain access to effective usage with real impact.

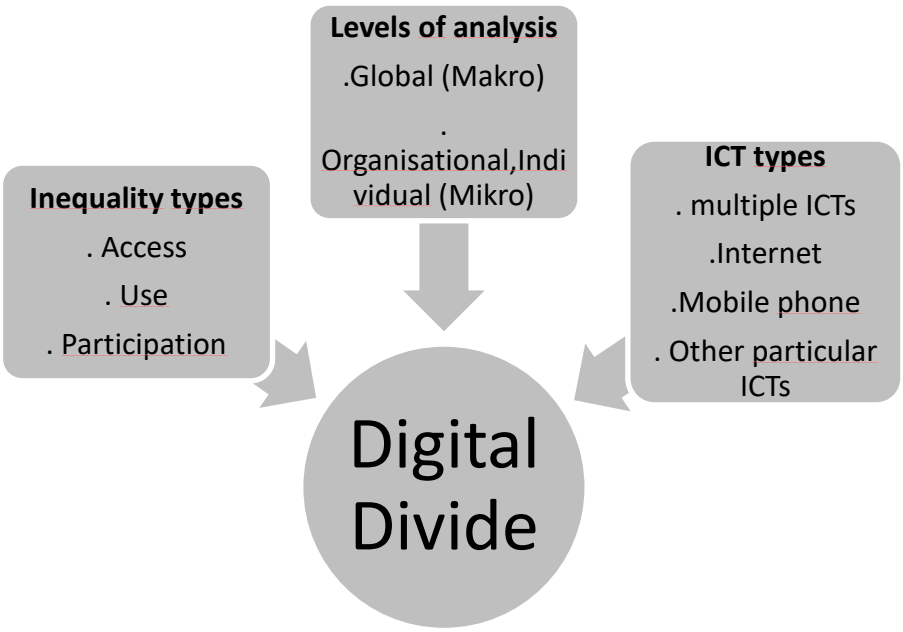


Figure 2: Conceptualisation of the digital divide

Overall, the literature on the digital divide distinguishes three different orientations or aspects: the inequality types, the levels of analysis and the ICT types.

1) The inequality types can only be the problem of access dealing mainly with ICT´s infrastructures, or access and use, which concerns the ICT´s skills and know-how. The last point is the effective use or participation, which is critical for the realization of the digital world.
2) The levels of analysis are either at the macro (global) level, such as developed and developing countries, or at the micro (the organizational or regional) level, such as the EU, the OECD or an individual (personal) level.
3) The ICT types are also an important aspect that often ranges from the single ICTs debate, such as the internet or a mobile phone, to the multiple ICTs and naturally other specific ICTs.

KADO (2004, 9-10) offers his definition of the digital divide by distinguishing three different definitions.

- The basic digital divide, which concerns the difference between users and non-users in access, ability and use,
- The dual digital divide, which concerns the difference between users and non-users with more than one obstacle, such as age or geographical situation
- The second digital divide, which deals with the differences within user groups, differences between productive users consuming users and the difference between power users and passive users.

KADO (ibid) further distinguishes two kinds of digital divide:

- A vertical digital divide, which is the gap between users and non-users (problem of equal opportunity or first level of digital divide),
- A horizontal digital divide, which concerns the gap among IT-Users (problem of social integration or second digital divide).

Both kinds of digital divide have to be taken into consideration when analysing this issue. The table below (Table 1) shows the types of digital divide, their significance and their description. The different stages of adoption presented in this table will be discussed in the next chapter. But a review of all the definitions above demonstrates, once more, that the digital divide is a multifaceted term.

Table 1: Types of the digital divide (KADO 2004, 6)

Stage	The digital divide		
	Type	Terminology	Description
Early adoption	Access divide	Early digital divide	Description based on the difference between persons who have access and who do not
Take-off	Usage divide	Primary digital divide	Description based on the difference between users and non-users
Saturation	Divide stemming from the quality of use	Secondary digital divide	Description based on the difference among users

According to Zillien & Haufs-Brusberg (2015, 76), the digital divide research can be temporally divided into three chronological items; (1) Access, (2) Use and (3) Impact.

As noted above, the digital divide is so complicated and complex that it is difficult to provide a common definition and model. So far, all of the proposed definitions have targeted a particular aspect of the issue; however, the goal of this dissertation is to find a model which will take into account the whole problem of the digital divide. A few questions must first be clarified for a better understanding. These questions are related to the "ICTs" and the "Information Society." Both expressions are often used when speaking of the digital divide. They are omnipresent in the literature and in almost every paper or article on this topic. What are they and what role are they playing? The answers to these questions will be offered in the third chapter.

2.2 Theoretical background of the digital divide

2.2.1 Rogers´ (1995) diffusion of innovation theory

The diffusion theory deals with the diffusion and use of innovation of new technologies and new media and examines the chronological adoption of an innovation in a social system (Cf. Rogers, 1995).

The diffusion theory also offers important aspects and theoretical ideas which the digital divide theory must take into consideration.

The diffusion theory, according to Peacock (2007, 10), maps out the way new technologies enter modern societies and how their use inter-depends on social interaction and human network ecology. Peacock (ibid) further adds that the two basic traits needed to understand this theory are: 1) the sigmoid curve, which depicts the time and shape of the process through which new technologies diffuse in a modern society, and 2) the users´ typology (from innovators to laggards), which are normally distributed in society. (See Adoption Theory, Figure. 3)

According to Peacock (2007, 11-12), the characteristics of these different stages are:

- The innovators, the first to try out new technologies are young wealthy and well-educated. In fact, good education is needed in order to be well informed and have sufficient resources to handle new inventions.

- Early adaptors who start using new technology after a successful initial trial period are supposed to have a leading opinion.
- The early majority, who are willing to try something new.
- The late majority.
- The laggards, who are at the end of the distribution and the last to adopt the new technologies even if some of them will not adopt them. They are elderly and socially isolated.

According to the diffusion theory, factors such as age of the user, economic situation and social network play an important role in the adoption of technologies. This fact was also underscored by Peacock in these terms: "*Thus according to the diffusion theory, the adoption of new technologies is determined by people´s age, the nature of their social networks and their socioeconomic background. These background traits, however, only influence swiftness of adoption. Over time, successful new technologies are adopted by every individual in the society*." Peacock (2007, 12). One example is an international comparative analysis from the OCDE in 2001 based on national statistics of OCDE countries. The analysis shows that internet access and use are more frequent for individuals and households with a higher income and a higher level of education (Schleife, 2008, 77).

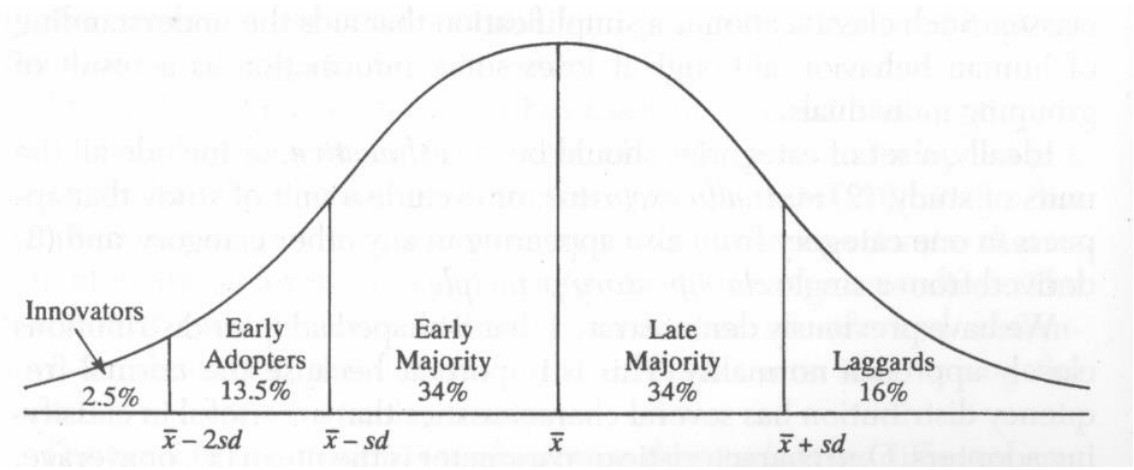


Figure 3: Adopter categories (Rogers 1995, 262)

Roger (1995, 35-37) identifies 5-steps of the diffusion process:

1- Knowledge—person becomes aware of an innovation and has some idea of how it functions.

2- Persuasion—person forms a favourable or unfavourable attitude toward the innovation.
3- Decision—person engages in activities that lead to a choice to adopt or reject the innovation.
4- Implementation—person puts an innovation into use.
5- Confirmation—person evaluates the results of an innovation-decision already made.

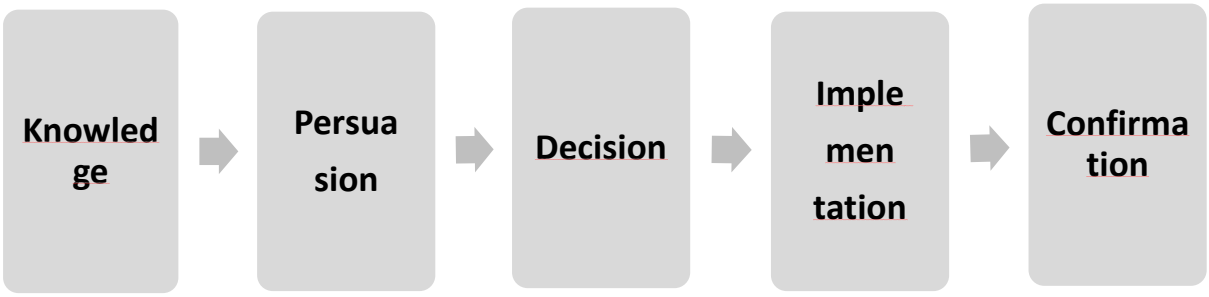


Figure 4: 5-steps of diffusion process (Rogers 1995)

An analysis of the first step (knowledge) shows that the literate and well-educated person would be the first to become aware of the innovation. This awareness would be possible thanks to established media such as print media, radio, TV and, of course, personal contact. As an illiterate, it is difficult to gain awareness through the media cited above. It should, however, be possible to find a way to forge awareness.

This 5-step process relies on four important factors: time, social system, a communication channel and, of course, the innovation itself (see figure 5). The path (time) from knowledge (awareness) to confirmation depends on the type of social system and the communication channel used.

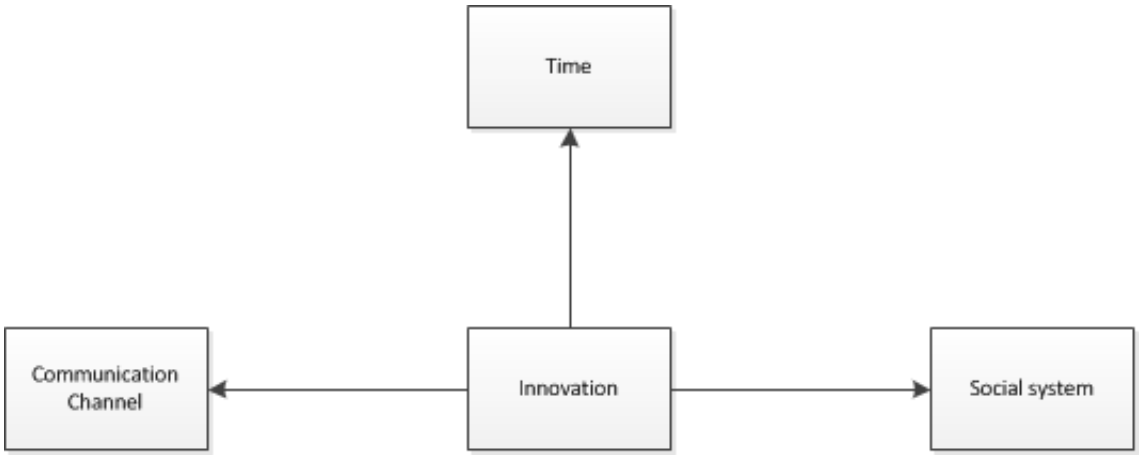


Figure 5: The pillars of the diffusion of innovation theory (Rogers 1995)

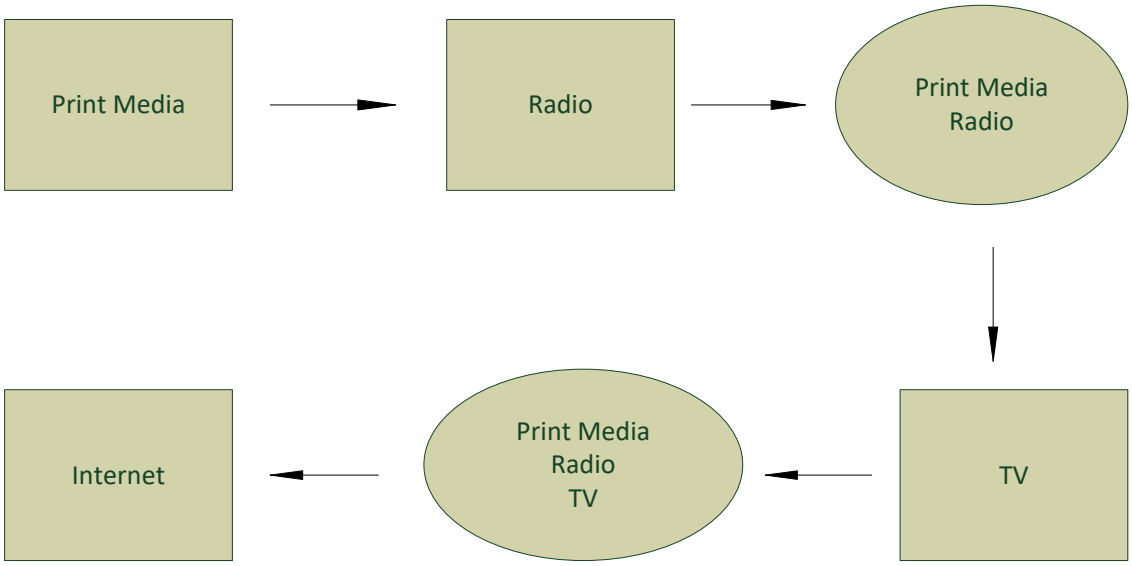


Figure 6: The diffusion of mass media

As has been indicated above, the diffusion from relying on a pillar such as a communication channel has to already include established mass media in order to diffuse each "new" technology. The diffusion of the internet as a new medium, for example, has to use print media, radio and TV (see Figure 6.).

Table 2: General diffusion steps of ICTs (KADO 2004, 4)

Types	Early adoption stage	Take off stage	Saturation stage
Penetration	Less adoption but rapidly increasing	Speedy adoption but not completed	Sluggish adoption but almost completed
Growth	So speedy	Sluggish growth or change in adoption speed	Stable status
Applicable Technology	Internet, PC, mobile phone	Cable, VCR	Telephone, TV

In order to make effective use of the internet, there are a few requirements which must be met first, and one of them is education or literacy. This is demonstrated by Compaine (2001, 3), who also recognized that before there was a digital divide, there were the information-Haves and Have-nots. Robinson, DiMaggio and Hargittai (2003) argued that a person's level of education provides a strong indication of how much he or she will benefit from the tools available through the internet. As Amiel (2006, 235) concluded, the debate on the digital divide must begin to focus on people rather than devices because technological divides have existed and will continue to exist as new devices are developed and adopted. Thus, for Servon (2002, 7), the digital divide depends on three essential aspects, which are the availability of internet access, literacy (mainly IT-literacy) and the content (must meet the desire of the user). In fact, the population must be ready to accept, to adapt and to use technology. This goal can only be reached if the population is at least literate or educated. This is when the former or established mass media must be considered. A classification of the available mass media will help towards a better understanding of Rogers´ diffusion of innovation theory (1995) with its 5-step process. As Roger (1995, 21) noted, the diffusion theory has been used to investigate diffusion of organisational and societal innovations. Therefore, the theory's application to information technology and organisational and societal relations make it an appropriate theoretical framework for this thesis. Besides the diffusion of innovation theory, another theory merits consideration when discussing the digital divide—namely, the knowledge gap hypothesis.

2.2.2 The knowledge gap hypothesis

The knowledge gap hypothesis, like the diffusion theory, contributes toward a better understanding of the digital divide, as both are closely linked. Accordingly, Lachmayr (2003, 15) assumes the study of the digital divide is the logical and consistent further development of the knowledge gap theory. The main hypothesis of the knowledge gap theory states that when the information is diffused, the groups with high social and economic status are likely to gain information faster than the groups with lower social and economic status. Consequently, the difference in knowledge inevitably facilitates a gap between the two groups (Bondafelli 1994, 89).

Social inequality is a principal characteristic of human society. Material resources such as income and wealth, and immaterial resources such as education and health are unequally shared. This means that a single social group owns more resources than another. In the case of the information society, there are three different factors which can explain the inequality:

- No connection to the ICTs because of financial and technical reasons.
- Connection to the ICTs is available, but the individual does not know how to use them (skills lacking).
- Can use them, but not optimally.

This situation above could be explained through the knowledge gap hypothesis which was formulated by Tichenor et al., (1970) in order to explain the relationship between social groups and the use of mass media. In other words, the gap between the social groups grows with the occurrence of information. For Bonfadelli (2002), this kind of knowledge gap is responsible for the new form of social inequality and a principal characteristic of societies nowadays. Bonfadelli (ibid.) adds that the basic factors and processes of the knowledge gap are communication skill, previous knowledge, relevant social contact, selective use and structure of media systems (see Figure 7.). If the causes of the knowledge gap are education and motivation by "old" media such as TV and press, the causes associated with the internet are access und skills (see Figure 7.). A correlation between socioeconomic background and computer literacy or internet use was found in some surveys. In this vein, Peacock stated the following:

-*"[…] considering the socioeconomic background of the users we observe a heavily lop-sided profile: native young males with a high education are much more likely to belong to the group of computer literates than, e.g., elderly foreign females with a low education background. "* Peacock (2007, 8-9). This supports the initial hypothesis of Tichenor et al., who stated: *"As the infusion of mass media into a social system increases, segments of the population with a higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease."* (Tichenor & al. 1970, 159). Further, their research showed that a person with a high education level uses more print media than the lower-level educated person. Hindman (2000, 551) and Schleife (2008, 83) went further and added that the differences in

use between status groups are very likely to grow as most of the internet content is designed for higher status groups. The digital divide and the knowledge gap share the same factors (see Figure 7).

Digital divide ⇔ knowledge gap
- Literate vs illiterate
- High income vs low income
- Rich countries vs poor countries

Figure 7: Knowledge gap and digital divide similarities

Bonfadelli (2002) illustrates clearly the consequences of the knowledge gap in relation to old media such as TV and press and Internet (see Figure 8).

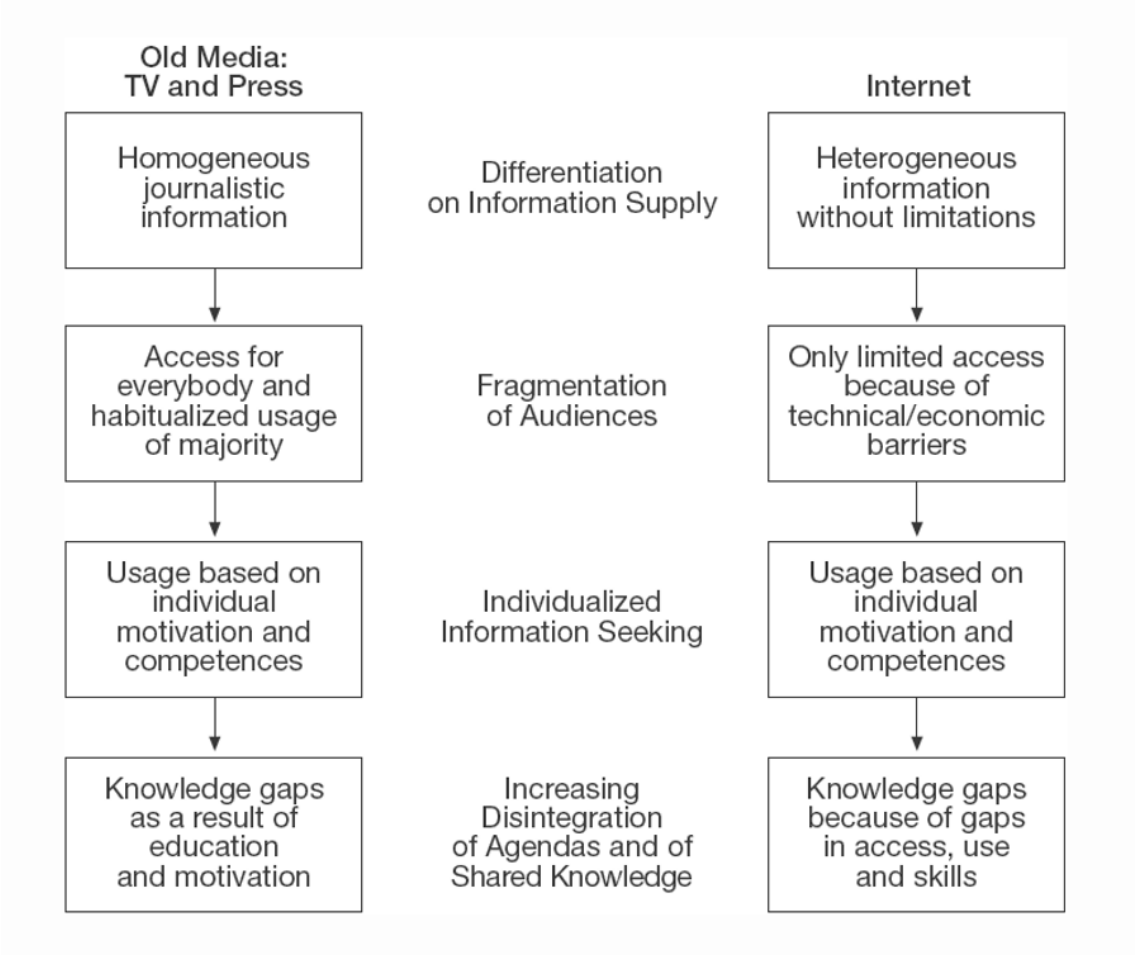


Figure 8: Consequences of the knowledge gap for the internet, Bonfadelli (2002,73)

Education appears to be vital for the acquisition of the information as Jeffres et al. (2012, 60) noted, education is supposed to be a key variable in the knowledge gap literature. Thus, Gaziano stated following: *"It appears that income, combined with conservatism, may now come to play an unexpected and complicating part in defining beliefs about the facts of issues*

or interpretations of the facts. High incomes may triumph high education in boosting some groups' social influence, including access to powerful interest groups" (Gaziano 2014, 13).

The emergence of the ICTs instead of helping to bridge the knowledge gap, participates to its deepening. In this vein Bondaffeli noted following: *"To sum up it can be hypothesized that in comparison to the traditional media the internet fosters audience fragmentation and individualized information seeking; and this could result in an increasing disintegration of individual agendas and amount of shared knowledge" (Bonfadelli 2002, 73).* Morever the SES (socio-economic status) can also influence the choice of the medium. Thus, Wei & Hindmann explain that: *"SES (socio-economic status) is more strongly associated with the informational use of the internet than with that of the traditional media (newspaper and television in particular). The higher the individual's SES, the higher his or her level of informational use. This relationship is stronger for internet users than for the traditional media users, resulting in more fragmented use patterns on the internet. The stronger association between SES and internet use warns that the digital inequality is more severe than its analog counterpart" (Wei & Hindmann 2011, 229).*

Van Dijk observed that education and social status are the key and noted that:

"A striking result is that those having a high level of traditional literacy also possess a high level of digital information skills" (van Dijk 2006, 229). Even differences by the purpose of the internet have been noticed by Bondafelli in this terms: *"People with higher education use the internet for informational and service-oriented purposes; people with lower education use the internet more for entertainment reasons" (Bonfadelli 2002, 79).* Besides education, the social structure also plays an important role in the acquisition of information.

"Web 2.0 applications like Wikipedia, video portal, social networks are meanwhile more used by young users" (Busemann/Gscheidle 2012, 381). There is social structural difference existing technically, digital lieracy and content using (Zillien/Haufs-Brusberg 2015, 85).

Not only the difference in access and use of the internet should be focused but also consequently the impact by the analysis using (Zillien/Haufs-Brusberg 2015, 85).

To conclude, Gillen (2010, 53) states that the widening of the knowledge gaps will split the world further not only as a result of disparities in capital and other resources, but also due to the disparity in knowledge.

3 The issue of the digital divide in the information society (IS)

3.1 Definition of the information society

The economist Machlup was one of the first to introduce the concept of the information society in his 1962 book entitled *The Production and Publication of Knowledge in the United States.* He measured the role of knowledge in the US economy by calculating the share of knowledge industry in the US GNP and the shares of knowledge producing occupation in the labour force (Crawford, 1983; Zelazny 2015). The work of Machlup inspired other authors like Drucker. In his 1969 book *The Knowledge Society*, which was based on Machlup's data and projection about the statistical investigation of knowledge production in the US, Drucker predicted that the by the late 1970s, the knowledge sector would account for one half of the GDP. So was born the *knowledge/information society (Crawford, 1983, 381)*. Daniel Bell followed few years later in 1973 with his book *The Coming of Post-industrial Society. "In the postindustrial society, the providing of services eclipsed agriculture and manufacturing as a portion of the GNP. Central to* the *postindustrial society are the emergence* of *knowledge, information and planning as the pre-eminent activities" (Crawford 1983, 381-382).*

The term information society is often associated with the problem of the digital divide. What kind of society is it and why it is important to the digital divide?

The online business dictionary defines the information society as a "post-industrial society in which information technology (IT) is transforming every aspect of cultural, political, and social life and which is based on the production and distribution of information. It is characterized by the (1) pervasive influence of IT on home, work, and recreational aspects of the individuals daily routine, (2) stratification into new classes those who are information-rich and those who are information-poor..."[8] In fact in the current information society, all aspects of human life such as social, political, economic and cultural are undergoing a mutation in every direction (see Figure 9.).

[8] http://www.businessdictionary.com/definition/information-society.html#ixzz2bSq0nxSn

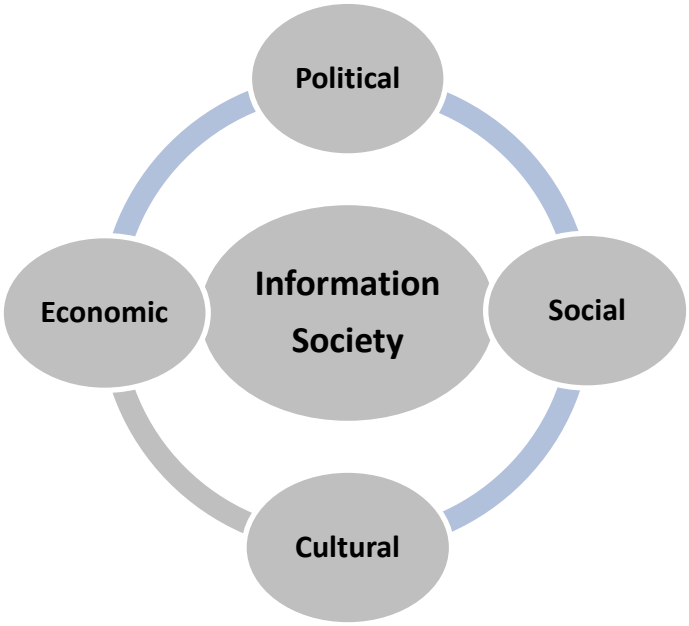


Figure 9: The Impact of the Information Society (IS)

In his book "Theories of the Information Society," Webster (2006) describes the information society as follows:

> *"It is acknowledged that not only is there a very great deal more information than ever before, but also that it plays a central and strategic role in pretty well everything we do, from business transactions, leisure pursuits, to government activi ties." (Webster, 2006, 261)*

For Rouse (2005), the Information Society is a term for a society in which the creation, distribution, and manipulation of information has become the most significant economic and cultural activity. An Information Society may be contrasted with societies in which the economic underpinning is primarily industrial or agrarian. The machine tools of the Information Society are computers and telecommunications, rather than lathes or ploughs[9]. The IBM Community Development Foundation (1997) underscores that an Information Society is a society characterised by a high level of information intensity in the everyday life of most citizens, in most organisations and workplaces; by the use of common or compatible technology for a wide range of personal, social, educational and business activities, and by the ability to transmit, receive and exchange digital data rapidly between places irrespective of distance.[10] According to Rouse (2005), the idea of a global

[9] http://whatis.techtarget.com/definition/Information-Society
[10] "The Net Result - Report of the National Working Party for Social Inclusion." Available at http://whatis.techtarget.com/definition/Information-Society

Information Society can be viewed in relation to Marshall McLuhan's prediction that the communications media would transform the world into a "global village."

For Burch (2005), due to the key role that communication technologies have played in the acceleration of economic globalization, information society's public image is more associated with the "friendlier" aspects of globalization, such as the World Wide Web, mobile and international phoning, TV via satellite, etc. Thus, the information society has assumed the role of the "good will ambassador" for globalization, whose "benefits" could be within the reach of all, if only the "digital divide" could be bridged.

The WWW (World Wide Web), Internet, the mobile phone …etc. have contributed to accelerating the emergence of the IS in the last decade. The route to the information society goes through access and the use of the ICTs (see Figure 10).

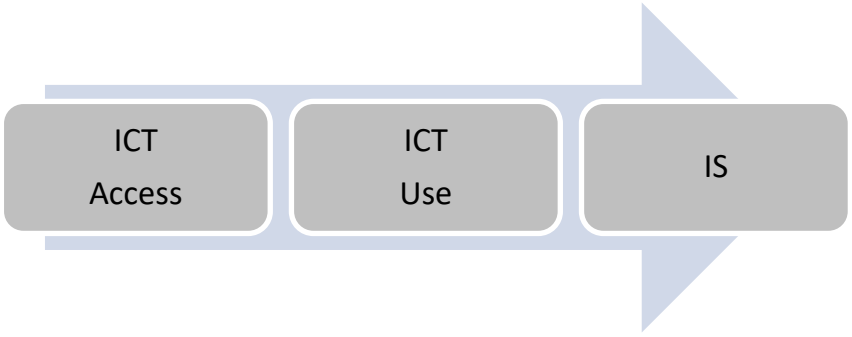


Figure 10: The way to the Information Society (IS)

The declaration of the principles established by the world summit of the information society made it clear that the purpose of all representatives was to help everyone to access and to use ICTs because of their possible advantages. In the November 14, 2003 draft, they declared:

> *"We, the representatives of the peoples of the world, assembled in Geneva from 10-12 December 2003 for the first phase of the World Summit on the Information Society, declare our common desire and commitment to build a people-centered, inclusive and development oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life."* World Summit on the Information Society, Declaration of Principles, Draft November 14, 2003.

It is hardly possible to speak about the global digital divide without mentioning the information society. That is why digital divide studies have a strict relationship with the

information society research that defines the whole social frame and is where the digital divide theory gains its relevance (Castells 1999b).

Early in the year 1995, the following statement was made at a G-7 Conference: "*Progress in the information technologies and communication is changing the way we live: how we work and do business, how we educate our children, study and do research, train ourselves and how we are entertained. The information society is not only affecting the way people interact but it also requiring the traditional organizational structures to be more flexible, more participatory and more decentralized." (Chair´s conclusions from the G-7 Ministerial Conference on the Information Society, February 1995.*) (http://europa.eu/rapid/press-release_DOC-95-2_en.htm?locale=en)

There is an economic-oriented information society and a social-oriented information society. Economically, it is the information society´s assessment of the transformation process of national economy where the information-based economy is considered as benchmark for the introduction of this kind of society. The social-oriented discussion aims to include the social impact of ICTs at a personal and a social level, whereby in each society, both social and economic, the factors of knowledge, information and communication play a central part and participate in the formation of a new elite.

For Castells (2006), the internet is the basis of the information society thanks to its interactivity, actuality and decentralization of the infrastructure which composed this society. Access to this media (internet) and the ability to use it, however, are the basic requirements for participation in the information society.

Another role of the Information society is to deal with information poverty and its consequences. That is why the International Community, NGOs and other stakeholders consider the matter seriously and try to find ways through initiatives like ICT4D or others to fight against information poverty.

Webster (2006, 261) expressed his opinion about the information society in these terms: *"It is acknowledged that not only is there a very great deal more information about than ever before, but also that it plays a central and strategic role in pretty well everything we do, from business transactions, leisure pursuits, to government activities."*

Therefore, a closer look shows that there is causality between non-access to ICTs and minor hypothetical chance or opportunities in the information society (Castells, 2005). This means that whoever does not have access or cannot use ICTs would certainly be in

a difficult position in the information society. Servon & Nelson (2001, 279) share the same view as they stated the following: "*Access to information technology and the ability to use it increasingly become part of the toolkit necessary to participate and prosper in an information-based society.*"

For Degele (2000, 28), however, the concept information society is, rather, the obsolete perceptions of technical determinism, while the concept knowledge society underlines more references to the human abilities for the knowledge transfer and production.

The information society which must be considered is the one which gives a place of honour to the information and to the individual and less to the technologies even if these are very important for diffusing the information. This information society should make no differentiation between "old" or "new" technologies because the focus is not the quantity of devices or information but the information itself and, of course, the receiver. The communication channel in this case should be second rate.

3.2 ICTs and their implication in the information society

It would have been effectively impossible to speak about the digital divide without ICTs. As the definitions of the digital divide reveal, it is generally the accessibility and the ability problem which generates the digital divide. Therefore, it is reasonable to question the nature of ICTs and their importance in the Information society and in the discussion about the digital divide as well.

For Murray (2011), ICT was originally another way to say IT. Now, that definition has expanded to include unified communication technologies (UC) and more. ICT refers to the integration of telecommunications, computers, middleware and the data systems that support, store and transmit UC communications between systems. ICT has also been associated with the convergence of audio-visual and telephone networks with data systems through a single media link. There are huge economic incentives in the convergence of systems. These savings come in several ways, including utilizing a common cabling media for data, voice and audiovisual systems.

Stevenson (1997) argued that ICT encompasses areas such as telephony, broadcast media and all types of audio and video processing and transmission in addition to the subjects that include the information technology (IT).

For Sallai (2012), ICT includes all types of telecommunication and broadcasting systems and services (wire line, wireless, mobile, satellite), computer hardware, software, networks and services, content producing and managing multimedia systems, Internet technologies, services and applications, machine-to-machine applications, etc. He (Sallai 2012) made some additional remarks on the usage of the term ICT. For him, ICT was originally only "information and communications technology" (with communications in the plural) and was considered correct since ICT refers to communications (in the sense of a technology of sending and receiving information), not communication (the act of sending or receiving information by speaking, writing, phoning, emailing, etc.). Nevertheless, the single form "information and communication technology" has recently become increasingly common and is now used in about half of the available literature. *In order to express these dual forms, we use "communication(s)." Sometimes the acronym ICT stands for a wider interpretation: "information, communication and technology," which includes "information" and "communication" as well as "information and communication technology."(Sallai 2012, 9)*

Sallai (ibid) explains that the Information and Communication(s) Technology (ICT) sector's products fulfil the function of information processing and communication by electronic means, including transmission and display. Recently, the usage of ICT for digital content management has also been included in the term.

Van Dijk & Hacker added another definition of ICTs as follows:

> *An important characteristic of ICT in this respect is its extended multifunctionality. Printed media, radio, television, and telephone have all been used differently by people with high and low education in particular. However, their (difference in) functionality is small compared to computers and the Internet. In the meantime, society is also differentiating at an unprecedented scale. Together those may create a usage gap that is somewhat similar to the knowledge gap described by Tichenor et al. a long time ago (van Dijk & Hacker, 2003, 325).*

Conceptually, ICT can be divided according to Hilbert (2016, 26) into three broad groups: *technologies that transmit and communicate information (the movement of information through space); technologies that store information (the movement of information through time) and technologies that compute information (the transformation of information).*

Despite the advantages that ICTs provide, according to the knowledge gap theory, they can also contribute to the inequalities in the society. This is yet more evidence of the relationship between ICTs and the digital divide.

More than ever before, ICTs will continue to play a very important role. They help companies organize their processes efficiently and swiftly in order to adjust them to individual needs. This potential of ICT and its strategic meaning have been recognized by some developed countries for years and thus settled the course.

The ICT is undoubtedly an essential component life nowadays. The mobile phone, the notebook, the internet and many other useful technologies have been integrated into our everyday life. ICTs will continue to support and influence our workplace and leisure time even more strongly. The economic productivity profit will rise in the future with the application of ICTs, and knowledge of these new media will become even more important. Furthermore, the infrastructure for these conditions of the future must be prepared for an environment in which citizens can make use of these services.

ICTs are the backbone of the knowledge society and an indispensable condition for interaction between economic, political and societal workings.

ICTs provide, wide access to basic task such as training, finance, health care, and developing national economies, and, at the same time, improve consumer´ channels to these goods and services. Through modern communication, such as Web 2.0 applications (Facebook, Twitter, etc.), the possibilities are extended to the social platform as well.[11]

For Mbatha B.T. et al. (2011, 251) "*ICT is a compound term that is used to refer to the convergence of a wide array of new technologies presently being developed and used in the creation, processing and transmission of information"*. Generally, the term ICT, as it has been defined and clarified above, concerns all the available elements. But the debate about new ICTs mainly involves the internet and mobile telephone and sustaining technology usage. Thus, it is easy to see why the term digital divide often "rhymes" with the term ICT. The link is obvious and might be connected in the same way to the "Information Society." In fact, due to the socio-economic and political facets of the digital divide favoured by the implication of ICTs, the term information society has also been closely scrutinized.

[11] 20http://whatis.techtarget.com/definition/0,,sid9_gci213588,00.html

To access the primary ICTs, technological infrastructures, hardware and software have to be available. Authors such as Warschauer have stated there is a "physical access" to ICTs, which means infrastructures such as the cable network, the fixed line telephone, the mobile telephone network, the internet connection network, the ISDN subscriptions, localities with telephone services and public payphones. With regard to the mobile network, mobile cellular subscriptions, mobile-broadband subscriptions and mobile population coverage were also examined. For the internet network, fixed wired internet subscriptions, fixed wired broadband subscriptions and international internet bandwidth were the main targets. Access to TV, computer and other devices were also considered. For Rouse, the ICT is "*an umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on as well as the various services and application associated with them, such as videoconferencing and distance learning."* (Rouse M. , 2015).

The importance of ICTs in the information society has frequently been demonstrated, and some organisations such as the European Union or, more specifically, the United Nations, have decided to promote ICTs in order to stop the already existing economic divide between technologically rich and technologically poor regions. Therefore, through its UNDP, the UN initiated the ICT4D (Information and Communication Technologies for Development) in order to bridge the digital divide (Rouse, 2011).

The implication of ICTs in today´s society is more than obvious. With new concepts like e-Government or e-Business, e-Education and so on, one can see that ICTs are currently intertwined in all human activities, particularly in developed countries (see Figure 10. below). This viewpoint is shared by the Ministerial Conference EU (2006), who stated: "*ICT contributes to improving the quality of everyday life and social participation of Europeans, facilitating access to information, media, content and services, to enhance and more flexible job opportunities."*[12]

The developments of the information technologies reveal personal, regional, organization and national changes and increase the social, political and economic interactions (See Figure 11). "…*These interactions called as synergy effect makes the information systems to be perceived among the top priorities*" (Melnikas 2011; Fidan 2016, 440). Thus, the usage

[12] Report „ICT for an inclusive Society" for the European Union

levels of the information systems in the sector and, accordingly, the sectorial efficiency increased (Grabara et al. 2014, Fidan 2016, 441).

Thus, for Wang, et al. (2010), the general impacts of the ICT sector on economic performance is considerable. The outcome of the ICTs are technological progress, output and productivity growth according to them.

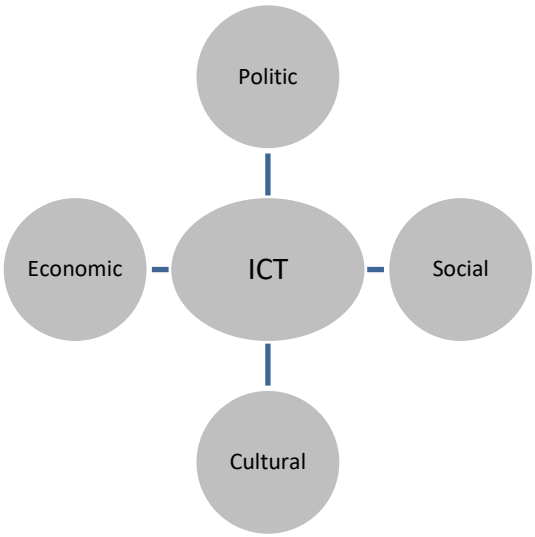


Figure 11: The ICT and its impact

3.3 E-Government as manifestation of ICTs Use in the Society

The emergence of the ICTs, as already mentioned, has in the meantime influenced all aspects of our society, as presented in Figure 11 above. This implies not only on the politic level but on economic, social and cultural levels as well. Some new possibilities thanks to the ICTs like E-Business, E-Learning, E-Government and many other have been created. In this chapter, attention will be paid to e-Government due to its importance in the research for more democracy. ICTs play a major role in organising and informing citizens in various forms of civil engagement. ICTs are used to enhance the active participation of citizens and to support the collaboration between actors for policy-making purposes within the political processes of all stages of governance. ICTs offer citizens not only the means to organise themselves, but also to produce cultural codes to represent themselves; ICTs can be seen as an important enabler of the empowerment of citizens or the emancipation of citizens Mishra (2012, 183).

What is e-Government and what are its goals?

E-Government is the use of ICTs to transform government by making it more accessible, effective, accountable and more responsible for the needs of their citizens. E-government provides greater access to government information; promotes civil engagement by enabling the public to interact with government officials, making government more accountable by making its operations more transparent and thus reducing the opportunities for corruption, and delivers services on line to save time and money. (Mishra 2012, 39).

According to Mishra (2012, 16-17), the goals of e-Government are (1) to create a better business environment by increasing productivity and economic growth, especially in rural and underserved communities. The use of ICT in government and the establishment of an e-Government infrastructure help create a business-friendly environment by streamlining the interaction and improving the interface between government and business. (2) to sustain the availability of customer to be online, this refers to the effective delivery of public goods and services to citizens accompanied by quick response government with minimal direct intervention by a public official. (3) to strengthen good governance and broaden public participation by promoting transparency and accountability in government through the proliferation of ICT in management and operation. As a result, the citizens will have the opportunity to be more actively involved in the policy and decision-making processes of the government. (4) To improve the productivity and efficiency of government agencies in facilitating delivery of services, increasing productivity of bureaucracy and increasing savings, which are benefits inherent in e-Government.

"Ultimately, the goal of e-government is to enhance the interaction between three main actors in society, government, citizens and business in order to stimulate political, social and economic progress in the country" (Mishra 2012, 18).

According to Wang et al. (2010), the acquirement of modern ICTs can be "*an equalizer for access to education, health and legal services, and to the government*."

ICT participates in the government processes and in the transformation of governance. The procedural requirements to accomplish are efficiency and effectivity of services. It is important to simplify government processes altogether. To sum up, we can say that ICT is an enabler of efficient and effective functioning of government. In turn, a more

efficient functioning of government allows for improved and better governance. (Mishra 2012, 53) What are the steps for designing an e-government? How can the digital divide affect the implementation of e-government? Despite its democratising potential, ICT can create a digital divide that results not only in the marginalisation of those individuals who do not have access to or the skill to use the technology, but also in reducing the ability of citizens to engage government in public debate Mishra (2012, 77).

Mishra (2012, 67) identifies five steps to enable e-government: (1) develop a vision, (2) conduct an e-readiness assessment, (3) identify realistic goals, (4) persuade the bureaucracy to buy-in and develop a change management strategy and (5) build public-private partnerships. Among the steps cited above, the second, (conduct an e-readiness assessment) will receive more attention because it will lead us to the next chapter, namely, how to measure the e-readiness or the digital divide?

4 How to measure the digital divide?

4.1 Some propositions to measure the digital divide so far

Having considered the theoretical discussion and a review of the implications of the information and ICTs in the digital divide debate, the next step is to determine the dimension and the dynamic of the global divide. Measuring the digital divide has been one of the most discussed issues in the last decade when addressing the development of ICTs. This concerns not only the global and, international perspective but also the individual or regional level. A not inconsequential number of articles have been published in which proposals and suggestions have been made on how best to measure or quantify the digital divide. Arquette (2001), Sciadas (2004), Garcia & Gomez (2009), Fuchs und Horak (2008), James (2009), Katz et al. (2013) and many others have tried to measure ICTs or the digital divide. The method used to evaluate the digital divide is quite different. In fact, there is no standard method or instrument for the evaluation of the digital divide, as Sciadas (2005) noted—and this fact has not yet changed, for reasons that will be discussed later. First, an overview of the research to date will be examined and analysed.

For years, scholars and organisations have tried and continue to search for ways to evaluate the digital divide. The measurement of the digital divide plays a key role in the struggle against the digital divide. As a disease can be treated after a serious diagnosis, so can an adequate solution be found for the digital divide after a thorough examination. In other words, a topical study of the measurement of the digital divide is required in order to ascertain and eventually promote the best recommendations. This evaluation must precede any actionable initiatives for success and, accordingly, is required in the case of the digital divide.

The different tools for measuring or quantifying the digital divide can be divided in three categories: local, regional and global (see chap. 2.1.3 Figure 2.). Barzilai-Nahon (2006, 271), however, distinguishes three categories of instruments to measure the digital divide: the ready to use questionnaire, the case study and the survey or report. She illustrated her viewpoint with the following studies or tools (see Table 3).

Table 3: Assessment Tools (cf. Barzilai, 2006)

Ready to use tool	Case Study	Survey or Report
CID (Center for International Development)	USAID (U.S. Agency for International Development)	KAM (Knowledge Assessment Methodology)
APEC (Asian Pacific Economic Cooperation)	InfoDev (The Information for Development)	MI (McConnell International´s Risk E - Business)
CSSP (Computer System Policy Project)		SIBIS (Statistical Indicators Benchmarking the Information Society)
		NRI (Network Readiness Index)

For the "ready-to-use questionnaire," she refers to the CID (Center for International Development), the APEC (Asian Pacific Economic Cooperation) and the CSPP (Computer System Policy Project).

For the "case study," she cites the USAID (U.S. Agency for International Development) and InfoDev (The Information for Development Program); for "third party survey or reports," she references the KAM (Knowledge Assessment Methodology), the MI (McConnell International's Risk E-Business), the SIBIS (Statistical Indicators Benchmarking the Information Society) and the NRI (Network Readiness Index) from (Dutta et al.), which was sponsored by the World Economic Forum, INSEAD, InfoDev and the DIDIX (Digital Divide Index) Dolnicar et al. (2003), Husing & Selhofer (2004). The DAI (Digital Access Index), from the ITU (2003), includes technological and social aspects. Another method used to evaluate the digital divide emerged from the experience with the Gini Coefficient from Riccardini & Fazio (2002).

But in addition to the type of the tools to measure ICTs or the digital divide, the factors were quite different. Barzilai–Nahon (2006, 273) identified six different factors: infrastructures access, affordability, use, social and government constraints or support, socio demographic factors and accessibility (see Table 4.). She used these factors to construct a model of the digital divide (see Figure 12.). Even if, according to this model, the cited factors have a direct relationship with the digital divide, one has to recognize that two of them seem to have more impact than the others. These factors are namely "accessibility" and "use." The impact is materialized by the frequency of indirect relations with the other factors like socio demographic factors, affordability and infrastructure access. This fact sums up once more the problem of access and use of ICTs when debating the issue of the digital divide. In effect, access and use are indispensable in any attempt to measure the digital divide.

Table 4: Digital divide factors and measuring example studies according to Barzilai-Nahon (2006, pp. 274-275)

Factors	Example studies / Authors
Infrastructure access	DiMaggio & Hargittai, 2001 Norris, 2004 Bridges.org, 2001 Chen & Wellman, 2003 Husing & Selhofer, 2004 ITU, 2003 Warschauer, 2002 Horrigan & Rainie, 2004
Affordability	Martin, 2003 Norris, 2004 Bridges.org, 2001

	ITU, 2003 Cooper, 2002 Lenhart et al., 2003
Use	DiMaggio & Hargittai, 2001 Norris, 2004 Chen & Wellman, 2003 Husing et al, 2004 ITU, 2003 Warschauer, 2002 Crump & McIlroy, 2003 Hargittai,2002 Lenhart et al., 2003
Social and government constraints or supports	DiMaggio & Hargittai, 2001 Chen & Wellman, 2003 Warschauer, 2002 Crump & McIlroy, 2003
Socio demographic factors	Martin, 2003 Bridges.org, 2001 Hoffman et al., 2000 Martin, 2003 Donnermeyer, 2003 Mosaic Group, 1996–2004 Bell et al., 2004 Lenhart et al., 2003
Accessibility,	Luke, in press Perry et al., 1998 Kaye, 2000 Luke, in press; Waddell, 1999 Lenhart et al., 2003

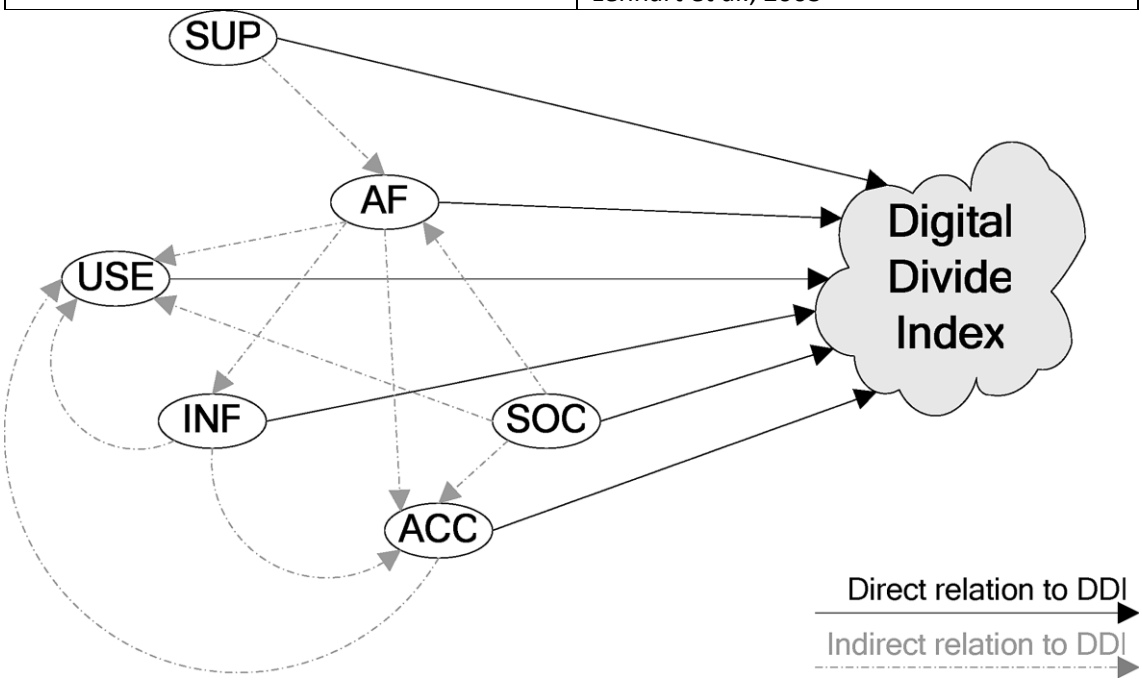


Figure 12: Digital divide indicators relations modeling (Barzilai-Nahon, 2006, 273)

SUP = social and government constraints/support; AF = affordability; USE = use; INF = infrastructure access; ACC = accessibility; SOC = sociodemographic factors.

Besides the view of Barzilai, additional, important contributions have also been made. Among them:

- The global information technology report from the WEF, INSEAD, which analysed the environment, readiness und usage for 102 countries in 2002.

- Monitoring the digital divide from ORBICOM, which analysed the infostate (info-density and info-use) for 139–192 countries from 1996–2001.

- The Digital Access Index (DAI), ITU analysed infrastructure, affordability, usage, quality and knowledge for 178 countries in 2002.

- ICT Development Indices, UNCTAD analysed the ICT diffusion through connectivity, policy, usage and access for 166–200 countries from 1999–2001.

- MC Connell International explored 53 countries e-readiness capacity in analysing connectivity, e-leadership, information security, human capital and the e-business climate.

- Mosaic dealt with connectivity infrastructure, organizational infrastructure, geographic dispersion, sectoral absorption pervasiveness to assess internet development through a framework.

- The Economist Intelligence Unit assesses e-readiness rankings of 60 countries based on connectivity and technology, social and cultural environment, supporting e-services and business environment.

- SIBIS, IST Program is based on an analysis of ICT access and usage, measurement of determinants and also benchmarks applications like e-government, e-commerce, e-health, e-science, and e-work from EU countries, Switzerland and the USA.

- The connectedness Index Conference Board of Canada focused on 10 OECD countries like France, Canada, Japan, US, Sweden, UK, Australia, Finland, Italy and Germany and was based on price, availability, use and reach.

-A composite index for Asia, UNDP 2003 targeted efficiency and speed, availability from nine countries and attempted to explore the links between ICTs and MDGs by using two different methodologies for composite indices. The table 5 below summarizes some of the efforts, which have been undertaken in this research area.

Table 5: International Benchmarking (Sciadas, 2004)

	Countries	Indicators	Year
WEF-INSEAD Global Information Technology Report	102	48	2002-3
ORBICOM Monitoring the Digital Divide	139-192	21	1996-2001
ITU Digital Access Index	178	8	2002
UNCTAD ICT Development Indices	166-200	12	1999-2001
McConnell International	53	several	2001
UNDP, ICT and Human Development	22	9	2001
Conference Board of Canada, Connectedness Index	10	42	2002
Economist Index	60	many	2001

The Gini Coefficient is another method used to measure the digital divide. The Italian statistician Corrado Gini developed the Gini Coefficient in 1912. It provides the opportunity to denote numerically the inequality caused by the different income distribution (Ceriani & Verme, 2012; Fidan 2016).

The Gini coefficient is obtained by taking as basis the Lorenz curve developed in 1905 by Max Otto Lorenz, which is the graphical display of the income inequality. The Lorenz curve depicts graphically the ratio of share received by the individuals from the total product income (Kakwani, 1977). The population is divided by the determined income levels, and the incomes of each segment are cumulatively determined (Chakaborty & Bosman, 2005). Figure 13 demonstrates the Lorenz curve, which shows the income distribution inequalities within the population segments.

The inequality is defined by the A area between the absolute equality line and the Lorenz curve. If the A area is larger, it means that the distribution inequality is higher and vice versa. On the other hand, in case of full inequality in which the total income is gathered under a single segment or individual, the Lorenz curve will be comprised of diagonals and the A are will equal the area of the right triangle (Maclahlan & Sawada, 1997).

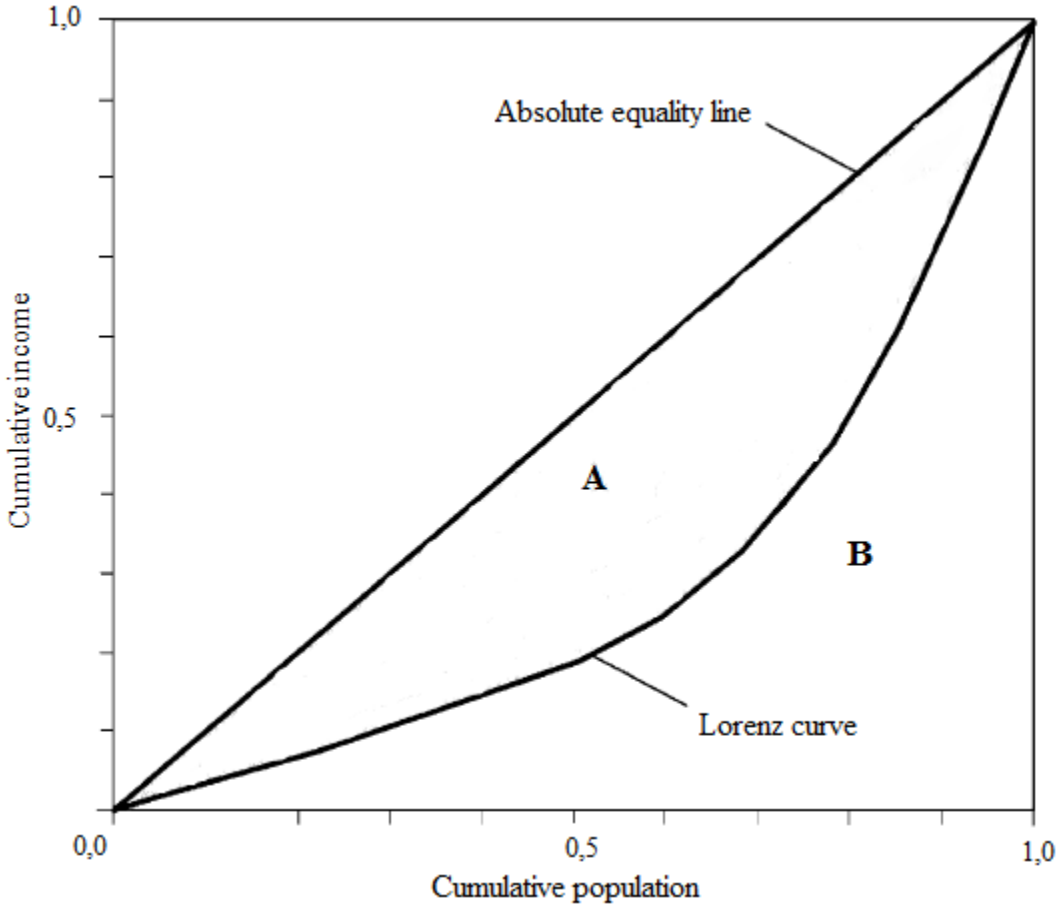


Figure 13: Lorenz Curve (Fidan, 2015, 444)

Also deserving of mention among the efforts to measure the information society or the digital divide are the HDI (Human Development Index) from the UNDP 2007, the IDI (ICT Development Index) from the ITU with three sub-indicators such as ICT infra-structure, ICT use, ICT skills and the NRI (Network Readiness Index) from WEF (World Economic Forum), which is also with three sub-indicators such as environment, readiness and use, according to Dutta & Mia, (2009). The studies regarding the digital divide are generally performed to determine the social, regional or global divide levels. Organizations such as the World Bank, United Nations and OECD are dealing with the global extent of the digital divide and offer solution recommendations. The studies in which different indexes, parameter and analyses are used emphasize that the digital divide is a global issue. Digital Opportunity Index (DOI), Digital Access Index (DAI), ICT Development Index (IDI), Network Readiness Index (NRI) and Digital Evolution Index (DEI) are the main indexes used by these institutions Fidan (2016, 443).

Particular attention will be paid to the NRI and the IDI because of the frequency of their publications and because of the level of observation. Both measure ICTs at a global level. In addition, attention will also be paid to the digitization index von Katz et al. (2013) because it is more recent and the chosen level of observation too.

4.1.1 The IDI (ICT Development Index)

The IDI is a measuring tool from the ITU (International Telecommunication Union) and is the successor of the DAI (Digital Access Index) and (ICT-OI) ICT Opportunity Index (see Figure 14 below).

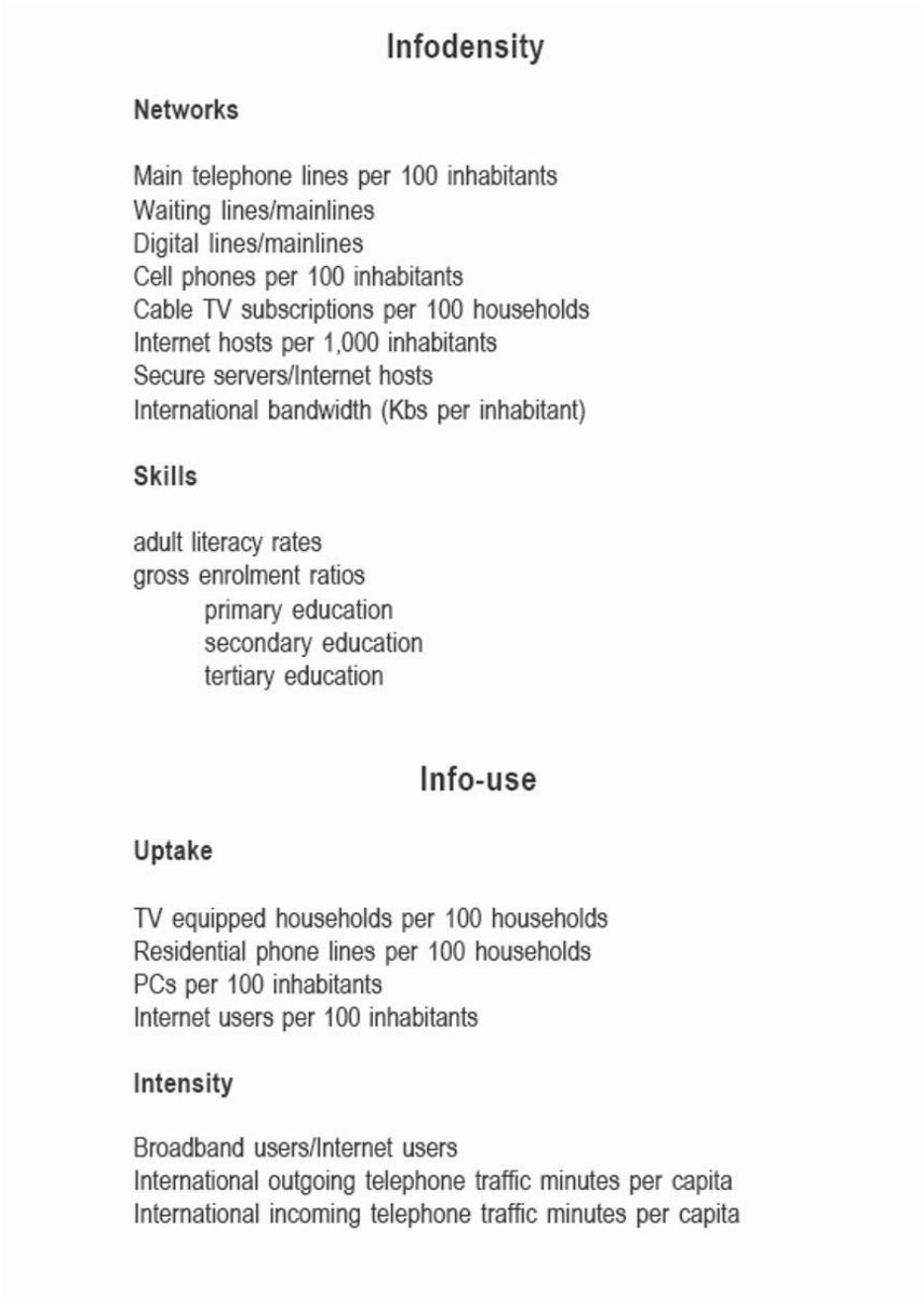


Figure 14: Info-state indicators for measuring the digital divide (ITU & UNESCO 2005, 6)

The IDI compares the development of the ICT in 159 countries in 2010. It used a combination of 11 indicators and took into account the state of ICTs´ development and also the dynamic of the development in the international society. Readiness, usage and the impact of ICTs on society make up the different stages. An index was performed, but the computation of scores for each country was quite demanding. It began with a principal component analysis in which the principal factors were extracted. The weighting of the sub-indices (access sub-index, use sub-index, and skills sub-index) was possible thanks to the outcomes of the principal component analysis. Therefore, the five indicators of the sub-index "access" weigh 40%, the three indicators of the sub-index "use" also weigh 40% and, finally, the three indicators of the sub-index "skills" comprise the remaining 20% (see Table 6.). The index score for each country is the product of the loading factor and the observed data. Further, the sum of these data will determine the index score. The objective of the IDI, according to the ITU, is to construct *a benchmark that serves to monitor and compare developments in information and communication technology (ICT) across countries* (ITU, 2011). In addition, the IDI should also measure the following:

- The *level and evolution over time* of ICT developments in countries and relative to other countries.
- The progress in ICT development in *both developed* and *developing countries*.
- The *digital divide*, i.e., differences between countries with different levels of ICT development.
- The *development potential* of ICTs or the extent to which countries can make use of ICTs to enhance growth and development, based on available capabilities and skills. (cf. ITU, ibid).

The conceptual framework of the IDI is based on three stages: ICT Readiness, ICT Intensity and ICT Impact (see Figure 15.).

Table 6 below shows the indicators and the allocated weights to the different sub indexes.

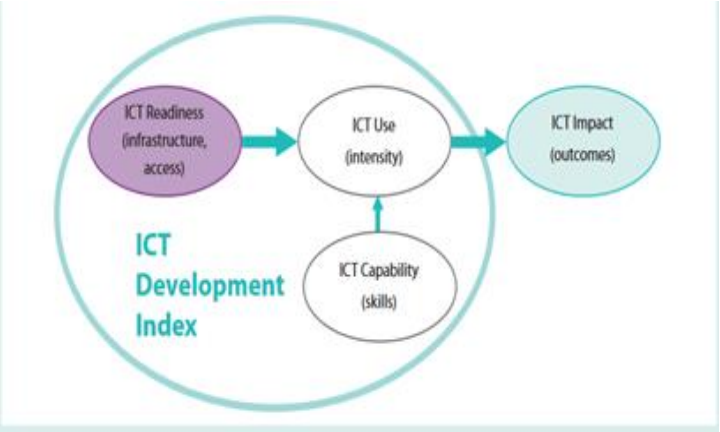


Figure 15: Three stages in evolution toward the information society (ITU, 2011)

Table 6: Parameter and weight from the IDI (ITU, 2011)

ICT Development Index: indicators and weights

ICT access	Ref. Value	(%)
1. Fixed telephone lines per 100 inhabitants	60	20
2. Mobile cellular telephone subscriptions per 100 inhabitants	170	20
3. International Internet bandwidth (bit/s) per Internet user	100'000*	20
4. Proportion of households with a computer	100	20
5. Proportion of households with Internet access at home	100	20

ICT use	Ref. Value	(%)
6. Internet users per 100 inhabitants	100	33
7. Fixed broadband Internet subscribers per 100 inhabitants	60	33
8. Mobile broadband subscriptions per 100 inhabitants	100	33

ICT skills	Ref. Value	(%)
9. Adult literacy rate	100	33
10. Secondary gross enrolment ratio	100	33
11. Tertiary gross enrolment ratio	100	33

40 40 20

ICT Development Index

* This corresponds to a log value of 5, which was used in the normalization step.

4.1.2 The NRI (The Networked Readiness Index)

The NRI is one of the most important indexes for measuring the equipment and the use of ICTs. The NRI is like a theoretical model which layers basic target groups such as private household, companies, and state and is based on three sub-indices: environment, readiness and usage. The sub-index environment, in which the penetration and development of ICTs is favoured, has 31 indicators. The NRI, which was first published in 2003, counts nine pillars: market environment, political and regulatory environment, infrastructure environment, individual readiness, business readiness, government readiness, individual usage, business usage and government usage (see Figure 16.). Here, the intervention of state government is very important. Readiness concerns the decision of all protagonists (state, companies and private users) to use ICTs. Usage takes into account the effective daily use of ICTs.

The NRI has a hierarchical structure, and the score of each country is the mean of the three sub-indexes. The score of the sub-indexes, however, is calculated from the mean of each three sub-indexes or pillars, which are composed of single indicators. More than half of the indicators (55%) result from a survey and the rest (45%) from different public statistical data. The indicators are meticulously detailed. The indicators are not weighted, so each carries the same weight. The computation of the NRI is based on successive aggregations of scores, from the variable level to the overall NRI score. In other words, the final score of the NRI is a simple average of the three composite sub-index scores, while each sub-index´s score is a simple average of those of the pillars comprised. The calculation of the country score is formulated as follow:

$$6 * (\frac{country\ score - sample\ minimum}{sample\ maximum - sample\ minimum}) + 1$$

Here, the sample minimum and sample maximum, respectively, are the lowest and highest country in the sample of economies covered by NRI. In some instances, adjustments were made to account for extreme outliers. (cf. Dutta & Mia 2011).

At the end, a ranking and classification of the countries were proposed.

The NRI has an information role and should be a tool for the advancement of ICTs for each country. The 2011 version concerns 138 countries and 71 variables. The main objective of the NRI (Dutta & Mia, 2011) is to assess the extent to which different economies across the world leveraging ICTs advance on the basis of the following three principles:

- *A conducive environment is the key precondition of networked readiness*

- *Network readiness requires a society-wide effort*
- *ICT readiness leads to ICT usage and increase impact*

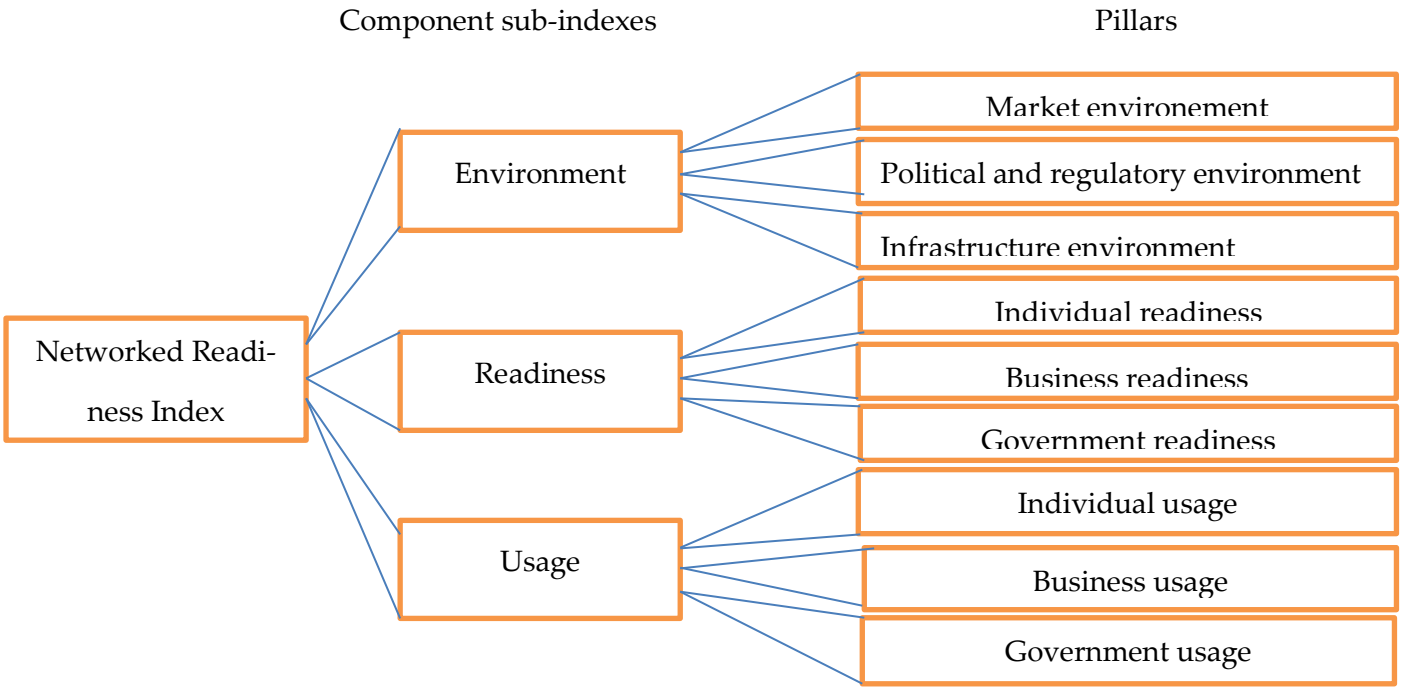


Figure 16: Networked Readiness Framework. Source: (Dutta & Mia 2009, 6)

4.1.3 The Digitization Index (Katz et al., 2013)

In the same vein as both indexes cited above, the Digitization Index is for Katz et al, (2013, 213) a measure of cross-country progress along the digitization development path. The index concerns 150 countries using 23 indicators. The method used is the factor analysis with the principal component analysis. The 6 variables used are affordability, infrastructure reliability, network access, capacity, usage and human capital. The data used are from the years 2004 and 2010. The digitization index can be seen as the process of converting analogue information to a digital format. Katz et al. (2013, 314) describe the components of their index as follows: "*Ubiquity refers to the adoption of mobile and fixed broadband networks accounting for broadband accessibility and ownership of data devices, such as PCs. Affordability is essential and derives from the relative access costs of providing such access. Reliability of networks depends on the annual network investment per subscriber and the faults reported per line. Speed is proxied by the performance of country level international links*

and the capacity of wireline' last mile' offerings. Usage is a key component of digitization and includes the utilization and adoption of all commercial activities, government services, social media adoption and data usage. Skills contribute to digitization both in terms of development of local service offerings and usage capacities." They used *a typical methodology for composite index validity assessment.* They selected first variables-components and subcomponents. To retain the adequate components and sub-components, a factor analysis was performed. (Katz et al. 2013, 318). Table 7 below shows the components und subcomponents used to create the digitization index. Figure 17 shows the outcome of the digitization index with log of GDP/capita in 2010.

Table 7: Indicators and sub-indicators of the digitization index (Katz et al. 2013, 315)

Components	Subcomponents	Sub-Subcomponents
Affordability	Residential fixed line cost adjusted for GDP/capita	Residential fixed line tariff adjusted for GDP/capita
		Residential fixed line connection fee adjusted for GDP/capita
	Mobile cellular cost adjusted for GDP/capita	Mobile cellular prepaid tariff adjusted for GDP/capita
		Mobile cellular prepaid connection fee adjusted for GDP/capita
	Fixed broadband Internet access cost adjusted for GDP/capita	
Infrastructure reliability	Investment per telecom subscriber (mobile, broadband and fixed)	Mobile investment/telecom subscriber
		Broadband investment/telecom subscriber
		Fixed line investment per telecom subscriber
Network access	Network penetration	Fixed broadband penetration
		Mobile phone penetration
	Coverage, infrastructure and investment	Mobile cellular network coverage
		PC population penetration
		3G penetration
Capacity	International Internet bandwidth (kbps/user)	
	% Broadband connections higher than 2 Mbps	
Usage	Internet retail volume	
	E-government usage	
	% Individuals using the internet	
	Data as % of wireless ARPU	
	Dominant social network unique visitors/month /capita	
	SMS Usage	
Human capital	% Engineers in labor force	
	% Skilled labor	

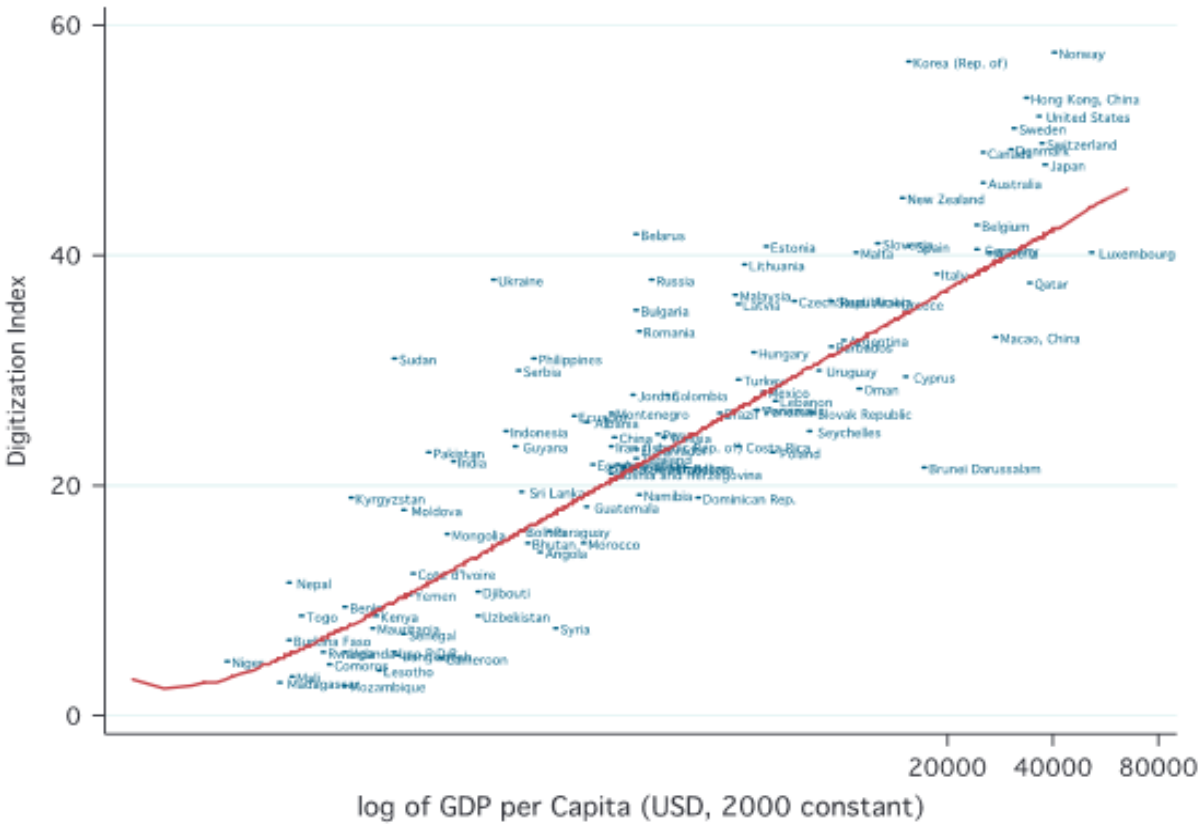


Figure 17: Digitization index with log of GDP per capita in 2010 (Katz et al. 2013, 317)

4.2 Limits of the proposed measuring instruments

The evaluation of the digital divide and, of course, the studies performed up until now are, unfortunately, not free of criticism pointed at the direction of the method used to analyse the data. Sciadas, (2004) therefore explains that the advantages and limitations of composite measures must be underscored. He also noted the importance of framework and linkages as well as the existing trade-off between breadth and depth of coverage. Further issues of weight, statistical matters and sensitivity and robustness checks have to be analysed. In addition, the real purpose of the measuring tool is sometimes unclear. One can see that some of the various frameworks proposed do not follow a clear methodology. Thus, the quality criteria such as validity, reliability and objectivity are somewhat questionable.

4.2.1 The IDI

In its conceptual framework, the IDI did not specify the context of measurement even if development in general seems to be the purpose. In fact, the specification of the context should help in the choice of indicators and, finally, in the assessment of the main goal of the tool. The sub-index "skills" has been used as pillar although it has been considered as a proxy that was given less weight compared to the other sub-indices. Moreover, there is not a plausible explanation of this fact. The method used to compute the score is also questionable. By using a reference value which is the arithmetic mean of the values by each sub-index, it may be difficult to evaluate the scores that are higher than the reference value. (Wittenberg & Cramer 2003; Bühner 2011; Churchill 1999; Bortz 2005; Eckey et al. 2002; Hatzinger & Nagel 2009).

James (2012) went further and criticized the IDI in these terms: "*the ICT Development Index is ill-suited to this task because it engages in double-counting, confuses means and ends, adds together dependent and independent variables and adds rather than multiplies its components.*"

While the IDI, as mentioned above, used another method and namely a factor analysis and not a multiple regression. Therefore, the criticism concerning the addition of dependant and independent variables must not be considered as the main weakness of the IDI.

The purpose of the tool is clear and the computation method with more detail is also available.

4.2.2 The NRI

The NRI is an integrative tool which considers the environment of ICTs, the readiness of the community key stakeholders (individual, business and government) and also ICT use (cf. Barzilai-Nahon 2006, 272). While the earlier edition of the NRI was criticised because fixed weights were assigned arbitrary to factors, the actual edition (2010) seems more consistent as no factor has been favoured as a result of no weighting. Here, a lack of clear methodology is a problem even if the computation method is really well detailed.

The NRI focuses on economic indicators such as market environment, business readiness and business usage. This is understandable as the NRI is a product of the WEF (World Economic Forum), which is committed to improving the state of the world and also the International Organisation for Public-Private Cooperation. In addition, the WEF engages the foremost politicians, businesses and other leaders of society to shape global, regional

and industry agendas (WEF, 2016). The economic background of the NRI influences the index heavily. Adding one´s own survey to the secondary data is a fact that must be seen positively. One can affirm without doubt that the NRI measures only one aspect of the digital divide, namely, the economic aspect.

4.2.3 Other propositions

Typical measurements of inequality distribution used to describe the digital divide are the Lorenz Curve and the Gini coefficient; however, the question of whether or not the digital divide is growing or closing is difficult to answer.

Although the Lorenz curve is a powerful tool for the graphical evaluation of the inequalities, it is insufficient for the comparison and interpretation of the inequalities. This insufficiency may be exceeded with the proportioning of the areas created with the Lorenz curve. The share within the triangle of the A area gives the numerical size of the inequality. The numerical calculation of the inequality levels will provide accurate information on the size of the inequality and ensure more efficient comparisons.

The ratio of the area between the Lorenz curve and the absolute equality line (A) to the right triangle located under the absolute equality line (A+B), as provided in Figure 13 is denoted as Gini coefficient and it is obtained with the equation below.

$$G = \frac{\mathrm{A}}{\mathrm{A+B}}$$

The Gini coefficient or the Gini-index can measure the inequality, but as noted above, its weakness lies in the objective interpretation of the inequality. However, an advantage of using the Gini coefficient to measure the digital divide is that each variable of ICT could be measured separately instead of using a composite variable (Fidan: 2016, 447).

Other attempts or propositions to evaluate the digital divide or to measure the information society share the same problem of the absence of a clear methodology. Without a clear methodology, it will be difficult to offer a satisfactory response to the evaluation issue of the digital divide. The computation method can differ and should not be the primary problem, even if, as Sciadas (2004) noted, the weighting, breadth and depth and coverage should be examined with caution. As a project of the European Union, the SIBIS, for example, has indeed been very ambitious in enlarging the scope of indicators.

However according to Barzilai-Nahon (2006, 4), it omitted social and behavioural indicators. DIDIX, on the other hand, took into account the social aspect but omitted clarification of the context.

Generally, the proposed tools or instruments to measure the digital divide all have both positive and negative aspects. The method or methodology used, even if not free from criticism or question, must not remain the main issue. Moreover, the methodology und especially the context, though often imprecise, should be introduced in every attempt to measure the digital divide.

Although there is no conciliation concerning the selection of indicators at the global stage, a general requirement for measuring the digital divide was formulated in 2003 by the WSIS in Geneva.

5 A framework for measuring the global digital divide

The purpose of measurement is to determine the actual state as well as a target or desired state. This could be accomplished through a comparison with other measuring instruments. The measurement of ICTs must take into account different indicators, including weighting or loading, and the quality of the criteria. According to Moosbrugger (2012), the quality of criteria of the measurement have to be:

- Objectivity: independency from external impacts such as the tester or devices.
- Reliability: repeated measures should give the same outcomes and consistency of the results. Test-retest reliability for longitudinal data and parallel-test reliability for cross-sectional data.
- Validity: measures indeed what it is supposed to measure.

In addition, a precise methodology must be available in respect to the chosen model of the digital divide. A framework is definitively needed to measure the digital divide. Morever, answers to the following questions should help to assess both the methodology and the correct method of measurement:

- What are you measuring? The technical process, organisation, system…
- Why are you measuring? To describe, to compare or to predict something…

- For whom are you measuring? For experts, organisations, stakeholders, politicians…

5.1 The methodological challenge and the different steps

Many scholars such as Arquette (2001) and Sciadas (2004) have criticized the digital divide concept because of the conceptual incoherence or lack of a universally accepted conceptual definition. The main reason of this critic is the absence of methodology in the digital divide research area. In addition, the interdisciplinary approach of that concept is somehow not only a small hurdle but also a big challenge. In fact, when analysing publications about the digital divide, one can assume that these publications originate from different research areas such as economics, social sciences, psychology, information sciences, and geography.

Barzilai-Nahon (2006) belongs to the few scholars to first question the conceptualisation issue in the digital divide research. According to Barzilai-Nahon, three main pillars, the purpose of the tool, the level of observation and the method of approaching the data, must be clarified in advance. Barzilai-Nahon (2006) also added that the purpose of the analysis or measuring tool must be clearly defined. Indeed, great attention must be directed toward the context.

Beside the three pillars proposed by Barzilai-Nahon (2006), Jin & Cheong (2008, 3) proposed that any research concerning the digital divide has to begin with the level of analysis, the kind of inequality and the types of ICTs. The starting point of the methodology to be proposed here are the three pillars, which are the purpose of the tool, the level of observation and the method of approaching the data. The three pillars are not sufficient to design a clear methodology of a complicated issue like the digital divide. Obviously, certain modifications will be added. The proposal above is, admittedly, correct and acceptable, but it should be completed in order to garner additional consistency. In addition, thanks to the conceptualisation of the digital divide, a methodology for its measurement can occur. In other terms, without a real conceptualisation, it will be difficult to propose a suitable methodology for the measurement of the digital divide. Beside the conceptualisation, one has to design a digital divide model. The methodology for the digital divide research in the frame of this thesis is as follows:

Methodology of DD Research	**Level of Analysis** (global, micro, organisational, individual)
	Types of Inequality (Access, Use, Participation)
	Types of ICT (Internet, Mobile phone, multiple ICTs, particular ICT)
	Context (Ethic, economic, politic...)
	Types of Analysis (static or dynamic)
	Choice of Indicators and collecting data
	Data Analysis and Method
	Result (Conclusion)

Figure 18: Digital Divide Research Methodology

- Level of analysis

There are different levels within which the researcher can focus her analysis in order to avoid the confusion that often surrounds the issue of the digital divide. These levels are:

- The global level: The analysis concerns the international or the macro level. All countries or the majority of the countries are involved in the analysis.
- The organizational level: The analysis could be done at any organizational level like the OECD (Organisation for Economic Co-operation and Development), BRICS (Brazil, Russia, India, China and South Africa) or the (EU) European Union.
- The regional level: Analysing the ECOWAS, the South American region or the Bavarian region could also be an option for the researcher.
- Personal or individual level: Instead of a regional or international level, the analysis can occur on the personal level. Generally, this type of analysis usually requires an empirical study.

- Types of Inequality

Precision resulting from the analysis of the digital divide is also very important. The types of inequalities have to first be indexed and cleared for a better understanding. Besides the social-economical and geographical inequalities, the analysis can be on either the ICT´s skills, the access to ICTs or the use of ICTs.

- Types of ICT

The types of ICTs are among the confusing elements which are often observed in the literature when speaking about the digital divide. In fact, the analysis can concern only mobile phones, the internet, several ICTs or a particular ICT. The specification of the types is also a very important step for the clarity of the analysis.

- The context

Analysing the digital divide is not trivial. That is why the context has to be identified and underscored. The purpose of the analysis must be formulated so that an ethical perspective of digital divide is different from an economic or political one. As Vaughn Jr et al. (2002, 3) recognize, three important questions have to be asked in order to orientate the research:

- What do you need to measure? The type of object (technique process, organization or system).
- Why do you need to measure it? The purpose (describe, compare, predict).
- Whom you are measuring it for? The intended audience (technical experts, decisions makers, stakeholders, policy makers).

Motivations for the measurement and also the purpose have to be defined as well. Thus, the three questions above could help to find the adequate response.

- Types of analysis

After the context has been clarified, the researcher must choose either the static or the dynamic analysis, or a longitudinal or a cross-sectional study:

- The static analysis focuses on a given date or year from where the data of the analysis has been extracted.

- With a dynamic analysis, however, the researcher concentrates the analysis within a given scope of time.

- Choice of indicators

With all the information received above, the researcher will be able to choose the right indicators. This choice will surely be dictated by the availability of the indicators. An empirical research or databases cited above, or a combination of both, represent the path to the indicators.

As the methodological issue has been clarified, the challenge now is to develop a measuring instrument. This is possible in a special framework regarding the digital divide model (see Figure 19.).

As the definition of the digital divide attested, the lack of access and use of ICTs has to be analysed. Therefore, it is advisable to first identify the main indicators which are the consequences of the factors of the digital divide. These are the "ICT Readiness," "ICT access" and the "ICT use" as well as the corresponding necessary skills.

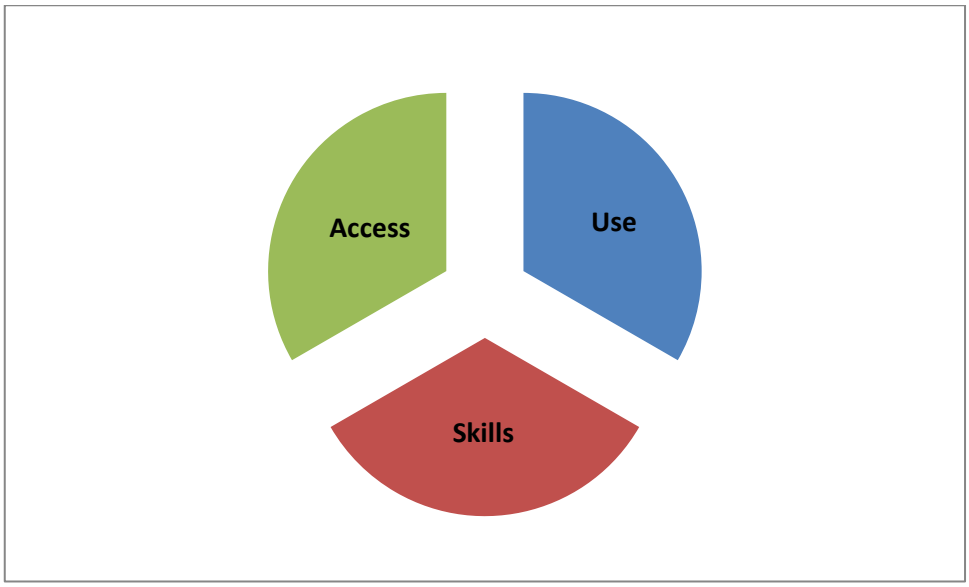


Figure 19: Digital divide model

5.2 Data collection

As with any empirical research, the collection of data is a very important component because it may be scientifically difficult to construct an analysis without data. There are

different ways to obtain data for empirical research. According to Eid et al. (2015), the choice of the data collection method depends on several criteria such as:

- The content of the issue or empirical hypothesis.
- The characteristics of the object of study.
- The drawing limits of timing, financial and also personal resources.

Considering the criteria cited above, the researcher in the case of this thesis is somehow constrained to reach for secondary data. As stated above, the chosen level is global, and that means that more than 100 countries are concerned. Moreover, the number of variables is also an indication that a self-conducted empirical study is hardly conceivable. Therefore, the only and best alternative is to include secondary data, even if this choice is also not free from criticism.

The data used for the analysis have been extracted from various sources. Most data come from international and regional institutions and the rest from national statistical offices and also from reliable online databases.

The United Nations (UN) and its related organizations are, and remain, the largest supplier of data and information concerning ICTs.

5.2.1 The international organisations

- The ITU is the first source when it comes to finding indicators that concern the global digital divide or ICT. In fact, as an organization of the UN, the ITU has the advantage of collecting related information directly from the respective states or governments. These data are compiled annually in various databases. The extent of the database changes yearly based on the review of the indicators and also on the circumstances in the respective countries and their willingness to send timely data to the ITU. Further, the ITU listed in its statistical yearbook more than 100 indicators concerning ICTs worldwide. As Arquette (2001) said, the ITU lists about 120 different ICT indicators for nations worldwide.

  The current or new data are not easily or freely accessible, and the PDF format in which the data are compiled is not easy to process. The advantage is that these data are accessible, although the ITU as an organisation has no influence over the integrity of the data.

- The World Bank is an important source for the digital divide discussion as the social and economic environment must also be considered when referencing the development of ICTs. The World Bank also offers reliable data which are freely accessible and easy to navigate. In fact, it offers three different formats: Microsoft Excel (XLS), Microsoft Access and XML files.
- Like the World Bank, UNESCO is another important source of information because of the educational indicators that it provides. These indicators are important for the understanding of ICTs. And as in the case with the World Bank, UNECSO offers costless data in very common formats such as those cited above.
- Regional organizations, such as the European Union, the OCDE, ECOWAS, are also alternative sources which offer reliable data. Even if these data are mostly limited to a geographical area, they are useful for the goal of this dissertation. It is also important to mention that the information or data are freely accessible and also easy to work with thanks to the formats.

5.2.2 The national statistical offices

The national statistical offices of various countries or governments provide information or data concerning the ICTs in different formats. Unfortunately, there are countries whose data were not available, particularly the so-called developing countries. They have been useful in some cases, however, when needed.

5.2.3 Other sources of data

Besides international and national data sources, there are also non-affiliated sources which detail information about ICTs worldwide and can be accessed online at no cost, such as internetworldstats.com. The CIA Factbook website also provides information about countries worldwide and is also freely accessible online.

Using secondary data seems to pose a great challenge in the area of social sciences research (Churchill, 1979). The reasons for this include the lack of control over the data collection process, the reliability of the data, the quality of the data, the integrity or completeness of the data all have to be questioned. But one must also underscore the advantages that they provide, such as time, accessibility, and low or no cost. In fact, secondary data use theoretically allows the researcher to save time. In practice, this depends

on the quality of the data. The accessibility of the data is, thanks to the internet, an enormous advantage. The costs which could be generated by such empirical research also should not be underestimated. The inconvenience is that the data may be inappropriate for the target goal, or the lack of control over the quality of the data unfortunately cannot be influenced by the researcher. As Churchill (1979, 129) noted:

> "*Since secondary data are collected for other purposes, it will be rare when they fit perfectly the problem as defined*."

Furthermore, Churchill (ibid.) detected three problems with using the secondary data: units of measurement, the class definitions and the publication currency.

The problems noted by Churchill have been solved within the framework of this thesis. Thus, the units of measurement and the class definition have been adjusted. Additionally, the problem concerning the currency of the publication is not an issue here as the main suppliers of the data (the UN and its affiliate organisations) publish their data on a regular basis. All in all, the data extracted from the different sources cited above are quantitatively and qualitatively good enough and useful for purposes of this dissertation, namely providing a measuring instrument for the digital divide. Furthermore, the ITU database, the primary resource here, has already completed the groundwork concerning the classification of indicators. However, Sciadas, (2004) noted that the data in this research area need some improvements because a severe gap has been identified between cross-sectional and time-series data. As data is available for only a few countries, the study of the internal digital divide requires very detailed data by ICTs and interest groups. The international digital divide study indicators at a national level offer a good starting point and could be more effective if they were complemented by detailed national data as in case of the NRI (see Chapter 4.1.2).

5.3 The method used and its implementation

Constructing a composite measure for inequality poses several methodological and substantive challenges (Atkinson, 1970; Berrebi & Silber, 1985; Gastwirth, 1972; Martin, 2003; Tichenor et al., 1970). Accordingly, the purpose here will be first to determine a methodological schema and to avoid the mistakes or omissions, which have been cited above.

The challenge here is to design a method suitable to the methodology by avoiding the failures or omissions criticized by the contributions above. For a better understanding, four categories have been selected: the assumptions, the purpose, the approach and the researcher´s role (cf. Schowdhury G. & Schowdhury S., 2011). The assumptions here are that the quantitative variables, which are clearly identifiable, should be measured. The purpose of the research here is not a prediction but more generalisation or causal explanation. The approach here is based on hypothesis and explorative analyse. Further using a factor analysis will help to conduct to data reducing to numerical indices. The three aspects cited above should be surrounded by the impartiality and the objectivity of the researcher. Obviously, other alternative methods such as SEM (Structured Equation Method), Gini Coefficient, Cox-Regression could have been chosen.

Due to its complexity and its various interpretations, the digital divide seems to be better captured only in a particular framework. For the consistency of the analysis and the targeted measuring instrument, the different steps proposed above will be strictly followed. To recap, the basic information for the framework is as follows:

- The digital divide model
- The methodological steps
- Purpose of the research tool
- What should be measured?
- Why it should be measured?
- Whom it should be measured for?

5.3.1 The level of analysis

As one of the research questions was whether a global measurement of the digital divide was possible, it is obvious that the targeted level here must be the global one. All countries worldwide will be involved when their data concerning ICTs are available. The willingness to target the global level is also due to the so-discussed North-South divide, as is often pointed out. Does it make sense to reference a digital divide at a global level despite the differences in other gaps in society? Or is it opportune to speak about the

digital divide at global level despite the growing number of mobile phones in developing countries[13]? The answers to these questions will surely carry the author in the right direction.

5.3.2 The types of inequality

As the definition in the previous chapter stated, the digital divide is the gap between access to the ICTs and the inability to use ICTs due to various reasons. Therefore, the focus will be on the access, the use of ICTs and also the social-economical, geographical indicators.

5.3.3 The types of ICT

The ICTs concerned here are all potential types which are available in the various sources of data. However, the focus was on the internet, the mobile phone, the other ICTs such as TV, computer and many others that have been included. This research concerns all types of ICTs that are available.

5.3.4 The context

The context in which this measuring instrument is provided is an ethical one. The issue of the digital divide has been treated as an ethical issue in the information society by scholars such as Kuhlen, (2004), Kizza, (2013) and many others. It is not only a social problem, but moreover, an additive cleft within the information society which deserves a particular attention considering the acuity of the matter. The purpose here is not only to describe or to compare, but also to evaluate the technical progress of the ICT worldwide. The audience targeted here is in first line the academic body even if this could also be useful for decisions makers, stakeholders or policy makers.

5.3.5 The types of analysis

The analysis here will be the static one. This choice is due to the fact that the dynamic analysis could contribute to a loss of information. In fact, several ICT components, such as computer or other devices, have a limited value today. For example, a ten year-old computer may not be useful today if it has not been upgraded. With the rapidity of the growth of ICTs recently, it is risky to attempt a dynamic analysis. In addition, due to the high number of items (countries) and their relative variables, it is difficult to attempt a

[13] http://www.itu.int/en/ITU-D/Statistics/Pages/default.aspx

dynamic study with a particular time-scope as the problem of missing data should also not be underrated. The static analysis from the year 2010 was selected because it is, by far, the year which offers the most available data in the consulted databases.

5.3.6 The choice of the indicators

The choice of indicators depends on their availability in the different databases, the types of inequality, the types of ICTs and, above all, the model of the digital divide. The access indicators such as fixed telephone network, mobile network and internet, TV or computer users and internet users all have been taken into account. Besides the social-economic indicators such as GDP per capita, Gini coefficient, the literacy rates have also been included. The choice depends on the previous knowledge in the digital divide research area. Therefore, Castells (2005) finds eight different inequalities which are associated with the digital divide. These are:

- The income divide: high income earners have more and are more often online than low income owners.
- Geographical divide: urban areas are more connected to the internet than the rural areas are.
- Ethnic divide: Caucasian people use the internet more than other ethnic group.
- Education divide: highly qualified people are online more often than others.
- Gender divide: men are online more than women.
- Age divide: young people are more often online than the elderly.
- Technological divide: differences between ISDN and DSL with high bandwidth and analogue.
- Global divide: fewer internet users in developing countries than in richer countries.

The developing countries tend to have fewer internet users than the highly developed countries. However, a mobile phone revolution has been evidenced by a penetration rate that reached 50 percent in 2008. The mobile phone is growing faster and is more widespread. The internet, by contrast, is growing more slowly, especially in developing countries where, by the end of 2007, only 13 of 100 persons have used it. Access to the internet via fixed connection is rare in developing countries and is often too slow and costly even when available (ITU, 2009).

Despite past years of struggle against the digital divide, the global digital divide, according to the ITU (ibid), has not been reduced as expected for the internet. As the international community starting in 2000 in Okinawa undertook several initiatives to bridge the divide in order to avoid adding another inequality to the long list of readily existing social inequalities, the result more than 10 years later does not seem to be generally satisfying. Could one understand and explain the often-cited North-South divide concerning ICTs without a strong analysis? Only seriously conducted research with a clear methodology, a defined context and also a clear defined purpose could help to find the right answer to assess suitable solutions. In other words, the evaluation of the state of the ICTs worldwide is necessary for the implementation of solutions. This is possible in a particular framework and will be the case in this thesis.

According to the model of the digital divide chosen in the framework of this thesis, and also based on their availability here, the following indicators concerning access infrastructures have been chosen: fixed telephone subscriptions, ISDN subscriptions, ISDN voice-channel equivalents, VoIP subscriptions, localities with telephone services, public payphones, mobile-cellular telephone subscriptions, mobile population coverage, active mobile- broadband subscriptions, fixed wired internet subscriptions, fixed wired internet broadband subscriptions, and international internet bandwidth per internet user.

For ICT usage, households with a TV, households with a fixed line telephone, households with a mobile telephone, household with a computer, households with internet access at home, mobile-cellular telephone users, computer users and internet users were chosen. The indicators chosen for literacy are adult literacy, completed primary education, completed secondary education and completed tertiary education.

5.3.7 The statistical analysis of the data and method

The choice of the statistical analysis depends on the context and the purpose as well as and the main goal of the evaluation of the digital divide. As the author here did not perform his own empirical study, the only possible alternative was to study the databases and secondary data. The sources of these data come mainly from international institutions or organisations. What is the suitable method in this case? Considering the methodology announced in the Chapter 5.1, the author has relatively few alternative'

methods. In fact the review of the up-to-date methods used to create a measuring instrument for the digital divide regarding the context offer several alternatives.

- The Gini coefficient

The Gini Coefficient has been used by several researchers. Fidan (2016) studied the intersectoral digital divide between Turkey and Lithuania by using the Gini coefficients. Chakraborty & Bosman (2005) analysed the digital differences between the states in the USA by also using the Gini coefficient. Jin & Cheong (2008) studied the demographic variables such as age, gender, background and income by using the Gini coefficient. The Gini is a well-known standard measure of inequality and has surely its advantages in the digital divide research.

- Coefficient of variation or ratio of deviation to mean

The ration of deviation to mean is another method, which has been used in the past to quantify the digital divide. Corrocher & Ordanini (2002) used the ratio of deviation to mean to evaluate the magnitude of the digital divide for 10 countries and created the synthetic index of digitalization. Jin & Xiong (2002) used the same method to assess the level of the digital divide in China by creating the NIQ (National Informatization Quotient). Dewan & al. (2005) used the ratio of deviation to mean as indicator of the digital magnitude. This method however tend to disappear as it has been rarely used in last years.

- Regression analysis

Several researchers went for the multiple regression analyses with different regression models to explain or to quantify the digital divide. Bollou et al. (2006) analysed the case of the ICTs in five West-African countries by using the stepwise regression analysis. Chin & Fairlie (2007), Billon et al (2010) used a regression analysis, Lin & al. (2016) used the spatial quantile regression model to explore the effect of digital divide on the income inequality.

There are other methods, such as SEM (Structured Equation Method) or cluster analysis, which have been used in some cases. However, the cluster analysis is most of the time used to classify the items.

The cited methods above have all their advantages in the measurement of the digital divide. The choice of the method however depends of the assigned methodology (see

Figure 18). The author in the frame of this thesis, want to measure the digital divide at a global level by examining several ICTs. Regarding the level of analysis and the context and the number of items (200 countries) and for a better analysis and comprehension of the data, the clear choice was to pursue a factor analysis.

5.3.7.1 The exploratory factor analysis (EFA)

The factor analysis, according to Churchill Jr. (1979), has two main purposes: data reduction and substantive interpretation. Summarizing the important variables in a set of p variables by a set of less than p factor is the first purpose while the second concerns the search for and testing of constructs that underlie observed variables. In others words, the purpose of the factor analysis is to build new variables named factors based on the correlations among them. The factor analysis has the advantage of reducing the data and also exploring them. The goal of the EFA is the bundling or grouping of variables.

For Schumacker and Lomax (2010, 164), the factor analysis aims to find out which set of observed variables share common variance-covariance characteristics which define theoretical constructs or factors (latent variables). According to Schumacker and Lomax (2010), factor analysis presumes that some factors that are smaller in number than the number of observed variables are responsible for the shared variance-covariance among the observed variables. In practice, however, one collects data on observed variables and uses factor-analytic techniques to either confirm that a particular subset of observed variables define each construct or factor, or explore which observed variables are related to factors.

For Kerrouche (2008), the factor analysis is a method to measure the concepts which are not directly measurable and has three different main usages:

- The understanding of the structure of a set of variables. Spearman (1904) and Thurstone (1931) used this technique for the understanding of the latent variable "intelligence."
- To construct a questionnaire for measuring a latent variable.
- To reduce an important quantity of information into a few points.

They are two different factors analyses: the exploratory factor analysis and the confirmative factor analysis.

For Timm (2002), "*the exploratory factor analysis (EFA) is a causal modelling technique that attempts to explain correlations among a set of observed (manifest) variables through the linear combination of a few unknown number of latent (unobserved) random factors*." The EFA is a method of generating hypotheses through correlation of variables.

Schumacker & Lomax (2010, 164) stated that the researcher in EFA explores the number of factors and their correlation´ status as well as the variables which are better suited to each factor.

Performing a factor analysis must take into account different stages:

1. **Determining a matrix which is a matrix of correlation**

   If the groups of the correlation´s coefficients are high, that supposes that measuring latent variables, which would be named factors, is possible.

2. **Choice of the method**

   Method of generalizing the outcomes of a sample to a given population or the method of exploring the data or testing hypotheses.

3. **Communality**

   Searching the communality among the variables means calculating the total variance and the unique variance.

   Total Variance = Common Variance + Specific Variance + Error Variance.

   Performing a factor analysis, there is no distinction between the specific variance and the error variance. Both are combined to make the so-called unique variance whereby here only the common variance will be used.

   It is also important to mention that the factor analysis is seeking a solution to the covariance of the measured variables. It also tries only to explain the variance which is common to at least two variables and assumes that each variable possesses a unique variance representing its own contribution.

4. **Factor extraction**

   There are two well-known methods for the extraction of the factors.

   - The Kaiser criterion: The eigenvalues which are higher than 1.00 are selected. The eigenvalue is the proportion of the explained variance by a factor. This method is recommended when the number of variables is less than 30 and the average communality is about 0,7 or when the sample is more than 250 and the average communality is about 0,6.

- The scree plot: can also be used to determine the number of factors to extract.

5. **Rotation**
6. **Initial considerations**

   The sample size could be an issue if the communalities are low. Generally a more than 300 sample size is satisfactory.

7. **Interpretations**

   The KMO (Kaiser-Meyer-Olkin) is a measure of adequation of a factorial solution. It states how the retained variables are coherent and can be suited to a given model. So a KMO less than 0.5 is not acceptable, less than 0.7 is average and higher than 0.9 is very good.

   Figure 20 below illustrates the different stages of the factor analysis:

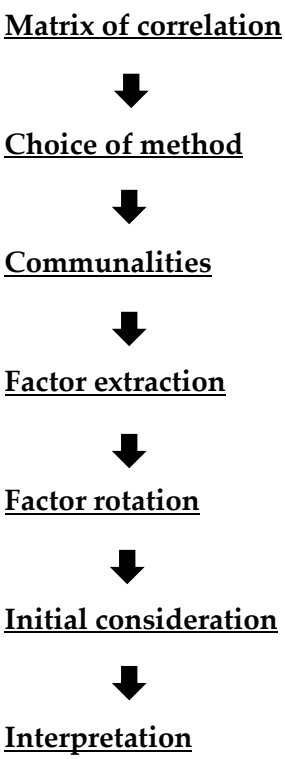


Figure 20: The different steps for the exploratory factor analysis

The basic problems of the factor analysis are the communality, the number of factors and the rotation. There are, fortunately, existing methods to resolve these problems. These include the principal component analysis (Pearson), the Maximum-Likelihood-factor

analysis, the canonical factor analysis, the centroid method. And according to the methods used, the objectives of the analysis could be settled upon.

The procedure for the factor analysis is as follows:

- Choice of the variables.
  Which variables should be factorized, which scale of measurement and which measure of correlation? Are the correlation´s coefficients high enough to make a factor analysis worthwhile?
- Calculation of the factor loading (allocation to the communality and the rest, appointing the rotation criteria and determining the number of the factors).
- Rotation of the factors
- Interpretation of the factors
- Calculating the factor´s weight

5.3.7.2 The confirmatory factor analysis (CFA)

While in the EFA the purpose was to find a model that fits the data, the task of the CFA is to test the significance of a hypothesized factor model (Schumacker & Lomax, 2010). Further, (Schumacker & Lomax, (ibid) added that the researcher has to specify a certain number of correlated factors which measure each factor. The researcher here relies on an a priori specified theoretical model. The CFA tests whether the empirical collected data confirm or reject a theoretical model. The CFA is also a component of structural equation modelling.

The procedure of the CFA

Backhaus et al (2011, 527-530) describe four different steps of the CFA:

- Formulation of the model

  The user has to set the measuring model according to the theoretical considerations. There are two different ways to set the model. The first is the reflective measuring model. Here it is supposed that changes to the measuring values of the indicator variables are caused by the latent variables. Changes by the hypothetical construct leads to changes of the indicator variables.

With the second measuring method, called the formative model, it is supposed that the indicator variables describe the parameters of the regarded latent variables. Changes of an indicator variable lead to changes in the shape of the hypothetical construct.

- Specification of the model

The model´s specification is possible thanks to the system of equation. One has the choice between a priori defined parameter or fixed parameter and the free parameters.

- Determining the parameters
- Examination of the estimated results

The examination will occur thanks to the quality criteria such as validity and reliability.

Table 8: EFA vs CFA (Backhaus et al. 2011, 527)

	EFA	CFA
Purpose	Detecting of factors as causality values for high-correlated variables.	Testing relationship between indicator variables and hypothetical values.
Assignment of variable indicators to the factors	Will be done through statistical criteria method.	From the user, a priori is predefined.
Number of factors	Will be determined through statistical criteria.	From the user, a priori predefined.
Estimation of the factor´s loadings	A complete factor loading matrix will be determined.	Generally, a simply structure of the factor loading matrix will be determined.

Interpretation of factors	A posteriori is possible in using the factor loading matrix.	From the user, a priori is predefined.

In this chapter, the results of the factor analysis will be presented and an index will subsequently be built.

For the implementation of the factor analysis, a question must first be answered. Should it be an explorative or a confirmative analysis?
The issue of the digital divide has frequently been discussed, thematised and also conceptualized over the last two decades. Both scholars and pundits like Warschauer (2004), Compaine (2001), and Hargittai (2003) and organisations like the OECD, European Union, the ITU and many others have given their opinion about the concept and its implications for the so-called information society. According to the literature available, it is somehow possible to design a model of the digital divide, but this certainly should take into account the data and also the main purpose of the analysis. Both explorative and confirmative methods could have been chosen, but based on the data, the explorative one is the best choice. In fact, the purpose here is to detect the factors first and also the correlation among the variables. Firstly a matrix of data must be completed by using the secondary data in order to perform the factor analysis as recommended above. It was a tedious and complex process as the data are from different sources with different formats that have been merged together. The data matrix is composed of 200 countries with 50 variables. The data matrix will be added as an attachment CD to this thesis.
What alternative methods could have been used in the frame of this thesis? Beside the CFA (Comparative Factor Analysis), the multiple regression analysis, the Gini Coefficient and Lorenz curve, cluster analysis, regression analysis are the main methods which have been chosen in prior studies. Thus, Chinn & Fairlie, 2007; Dewan et al., 2005; Billon et al, 2010 employed a multiple regression analysis to measure the digital divide. Several researchers like Ricardini & Fazio, 2002; Chakraborty and Bosman, 2005; Jin & Cheong, 2008; Fidan, 2016 opted for the Gini Coefficient and Lorenz Curve as main method to quantify the digital divide. It is important to mention that the methods cited above were

not exclusively used. By some studies, one could notice a mix of EFA (Explorative Factor Analysis) and multiple regression like the one of Billon et al. (2010). Vicente & Lopez (2006) used both the factor analysis and the cluster analysis to measure the digital divide in 15 European countries. The choice of the suited method depends on the purpose of the tool. For instance, studies, which aim a prediction, will likely opt for a multiple regression analysis.

The choice of the explorative factor analysis as main method here is guided first by the purpose of the tool and secondly by the designed methodology. The factor analysis is one of the most methods used to quantify the digital divide. In the following studies or indexes such as Digitization index from Katz et al. (2013), IDI from ITU (2010), NRI from-Dutta & Mia (2011, 2015) the explorative factor analysis has been chosen as the main method.

Succinctly the design of the method here is as follow:

(1): 3 different factors analyses have to be run by using the set of variables relating to ICT__ACC, ICT_USE and Literacy. By running the explorative analyses, one has to be sure that the best practice concerning KMO (measure of sampling adequacy) and Bartlett Test of sphericity are respected.

(2): Factor extraction: the method here is the principal component analysis. Communality and Eigenvalue criterion greater than 1, the total explained variance and a scree plot would help to select the number of factors.

(3): Computation of each Sub variable by using the factor scores.

(4): Computation of the IGI (ICT Global Index) by aggregating the sub variables

(5): Run of a cluster analysis by using the K-Means Algorithm method to facilitate the interpretation of the outcomes.

5.3.7.3 Outcomes of the exploratory factor analysis

To perform the factor analysis as the procedure recommended for the EFA, the choice of variables must be the first step. According to the definition of the digital divide, beyond the problem of access and use, the economic, and social and geographical aspects also play a very important role. Considering the availability of the variables, three different

factor analyses have been performed. The first analysis concerns the access to ICTs, the second focuses on "use" of ICTs and the third explores the "literacy" or skills variables. A huge asset of the ICT in every society is nonetheless the solid economic, social, geographical and, above all, the educational pattern. The magnitude of their impact on the access and use of ICT´s can be seen later.

To sort out which indicators are important and useful for our purposes here, an explorative factor analysis (EFA) has been performed using SPSS (Statistical Package for the Social Sciences) for each part with the following outcomes:

The outcome of this first EFA includes 200 items (countries) and 50 variables for social economic, and geographic variables for "literacy," "access" and "use."

The first step is the selection of variables for each inequality (access, use, literacy). Three different EFAs were performed. Table 9 below shows the different variables and their categorisation. Other variables not included here will be useful for the later interpretation of the outcomes.

As seen above, one of the purposes of the EFA is to reduce the amount of data. The reduction of variables gives the following outcome: for the variable "access," 11 variables; for the variables "use," 8 variables; and for "skills," 4 variables. A detailed description of the retained indicators may be consulted in the appendix.

The different steps of processing the EFA described in Chapter 5.3.7.1 have been strictly followed.

Table 9: Selected variables for the EFA (Source: own table based on ITU database)

Access	Use	Education
. fixed telephone subscribers . ISDN subscribers . ISDN Voice channel equivalents . VoIP subscribers . localities with telephones services . public payphones . mobile cellular telephone subscribers	. households with TV . households with a fixed line telephone . households with a mobile telephone . households with a computer . households with internet access at home . mobile cellular telephone users	.literacy Adult (15+) . primary schooling completed . secondary schooling completed . tertiary schooling completed

. mobile population coverage .active-mobile broadband subscribers . fixed wired internet subscribers . Fixed wired broadband . subscribers . international internet bandwidth pro user	. computer users . internet users	
11 Variables	8 Variables	4 Variables

With respect to the suggested best practices for the EFA by authors such as Bortz (2005), Churchill (1999), Costello & Osborne (2005), the following four recommendations have been approved here. The correlation matrix, the KMO, the rotation and, of course, the factor extraction method (the scree plot or the eigenvalue >1) have been included.

For the sub-variable access: The SPSS output (see Appendix) shows an overall correlation among the variables, and so the data are applicable for a factor analysis. The KMO, which is 0.89, is high and suitable. The output (SPSS) of the total variance explained offers 66% of the variance explained. The rotation method used is the varimax method in order to obtain a simple structure of the data (cf. Moosbrugger 2012).

Table 10: SPSS-Output Sub-variable ICT_ACC

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			**Rotation Sums of Squared Loadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,008	54,616	54,616	6,008	54,616	54,616	5,039	45,813	45,813
2	1,284	11,675	66,291	1,284	11,675	66,291	2,253	20,479	**66,291**
3	,985	8,955	75,246						
4	,682	6,204	81,450						
5	,551	5,007	86,457						
6	,412	3,746	90,204						
7	,365	3,314	93,517						
8	,350	3,181	96,699						
9	,147	1,337	98,036						
10	,122	1,113	99,149						
11	,094	,851	100,000						

Extraction Method: Principal Component Analysis.

This means that each variable should load highly at only one factor. Moreover, the best-known orthogonal rotation method, varimax, whose postulate is based on uncorrelated factors, favours the independency of the factors in order to facilitate the interpretation. With the eigenvalue method, one could determine two factors. In order to ascertain the choice, a scree plot also has been consulted to find out the number of factors which must be extracted. The scree test, which is the examination of the graph of the eigenvalue, looks for the break point in the data where the data flatten out (cf. Costello & Osborne, ibid). Two factors could be extracted according to this method as the break of the curve appears just before the breakpoint (see Figure 21). The first factor concerns the fixed telephone network and the second factor the mobile network. Both have been aggregated in order to form the sub-variable access.

The next EFA concerns the sub-variable use.

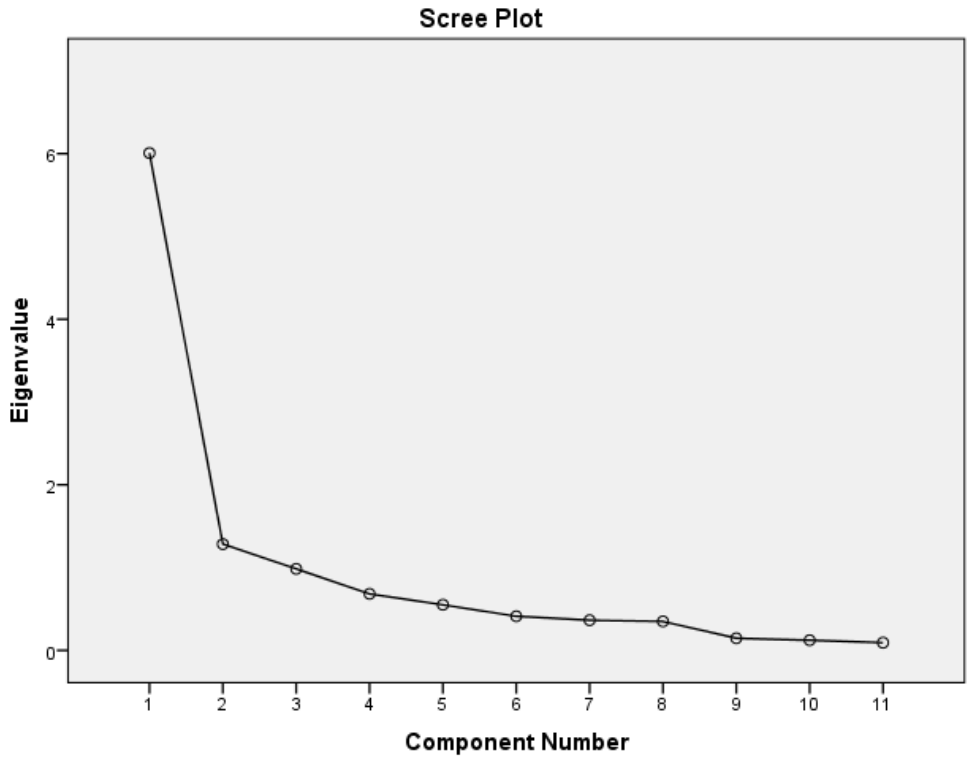


Figure 21: Scree Plot for the Sub-Variable Access

The same procedure described above has been followed for the sub-variable use and one factor has been extracted which represents 80% of the total variance explained. A rotation was not necessary here as only one factor could be selected. All variables in this case correlate highly with only one factor. Also here the scree test and the method of eigenvalue give the same result, exactly one factor (see figure 22).

Concerning the sub-variable skills or literacy, here also one factor has been extracted and the factor rotation was not necessary. All variables altogether represent 60% to only one factor (see Figure 23).

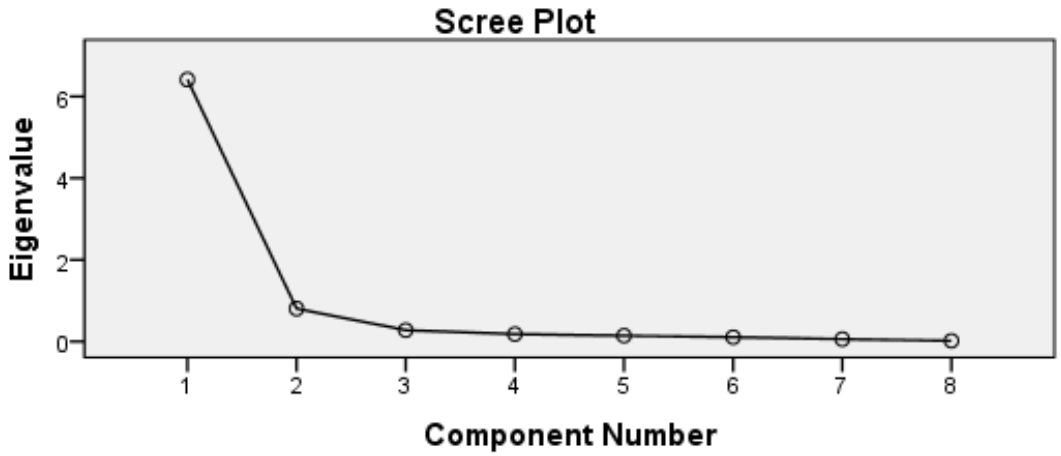


Figure 22: Scree Plot for the Sub-Variable Use

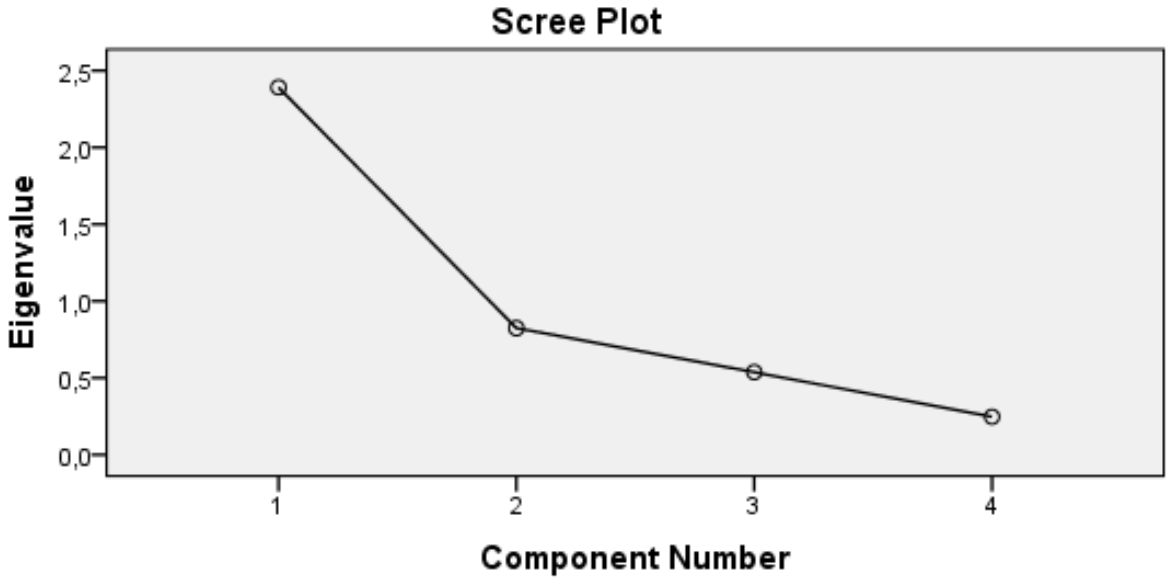


Figure 23: Scree Plot for the Sub-Variable Skills

5.3.7.4 Computation of IGI (ICT Global Index)

Creating a measuring instrument would force one to consider different steps. The first step is the reduction of the variables through a factor analysis. Several factor analyses would be performed. The second step is the building of sub variables or latent variables.

The aggregation of these sub variables would help to calculate or determine the development of the ICT or the magnitude of the gap of the digital divide. However, the construction of an index would be welcomed as another option. The factor analyses concern the ICT indicators globally. Fortunately the ITU, the main database, has already completed the groundwork concerning the classification of ICTs in fixed telephone network, mobile network and internet, and the other ICTs.

After performing the factor analysis by using the principal component analysis method, the next step is to determine the sub-variable for each category. The computation method of the IGI is very simple but follows two principal steps:

1) Calculation of factor scores for each item and for each sub-variable

Sub-Variables	ICT-Access	ICT_Use	Literacy Skills
1. Factor extracted	Fixed Telephone / Internet	ICT Use	Literacy Skills
2. Factor extracted	Mobile Network	none	none

- Sub variable: ICT_ACCESS

Two factors extracted:
- Factor_1: Fixed telephony and Internet
- Factor_2: Mobile network

Outcome sub variable ACCESS = Factor_1 + Factor_2

Outcome sub variable ICT_USE (one factor extracted)

Outcome sub variable Literacy Skills (one factor extracted)

2) Aggregation of sub variables to calculate the IGI

$$IGI = \sum ICT\_Acc + ICT\_Use + Skills$$

There was no need for a further weighting as the factor scores are basically weighted values (cf. Nunnally & Bernstein 1994 p. 507). Indeed, additional calculation was not necessary to build the IGI. The critical point concerning the use of factor scores has been cleared as the method used here is the principal component analysis and not the maximum likelihood or principal axing factoring method. The critical point of view of Russell (2002), considering the factor scores cannot be accepted as the factor score, unlike the cumulative coefficients, recommended by Russell (ibid), are easy to calculate exactly but also give the valuation of a variable or indicator in relation to each item.

A normalisation of the data before the computation was not necessary as the indicators selected here all have the same unit of measurement. The IGI Index and the ranking of the different countries can be consulted in the appendix. How can the different outcomes be interpreted?

6 Interpretation

6.1 General overview

The outcome of the IGI attests to the often-named North-South difference in the acquisition and use of ICTs. Recent studies from Kouadio, 2014; Gui & Argentin (2011), Sedimo (2011) attested this domination of the so-called developed countries in the access to and use of ICTs. In fact, eight European countries are among the top 10 and nine African countries among the 10 at the bottom (see tables 11 and 12). The top ten are all western European countries except Korea, with the first rank, and Singapore, which occupies the fifth place. Switzerland, Sweden, Denmark, Norway, Germany, Finland, the Netherlands and Luxembourg are the other countries constituting the top 10 (see Table 11).

For a better interpretation of the outcome, the countries have been classified through a cluster analysis according to their scores. The K-Means Algorithm method was used to build the different clusters.

Table 11: Outcome IGI Top-ten countries (see appendix)

Ranking	Countries	Scores
1	Korea	5,79
2	Switzerland	5,41
3	Sweden	5,4
4	Denmark	5,28
5	Singapore	5,24
6	Norway	5,23
7	Germany	5,22
8	Finland	5,08
9	Netherland	4,99
10	Luxembourg	4,97

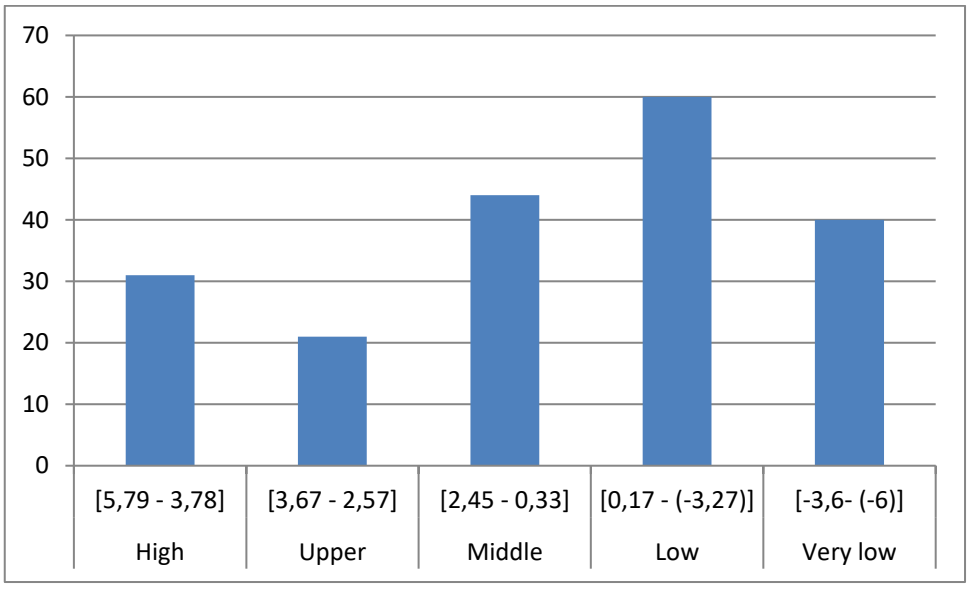
Table 12: Outcome IGI Last ten countries (see appendix)

Ranking	Countries	Scores
191	Chad	-5,11
192	Burkina Faso	-5,23
193	Ethiopia	-5,25
194	Central African Rep.	-5,55
195	Niger	-5,59
196	Madagascar	-5,6
197	Tanzania	-5,62
198	Mauritania	-5,74

199	**Nepal**	**-5,9**
200	**Mozambique**	**-6**

Five clusters could be determined through the cluster analysis. The first group or class concerns the forerunners or highly developed ICT countries, into which, unsurprisingly, all developed countries fall. This first group of high ICT developed countries comprises 31 members and begins with Korea and ends with Bahrain. The second group is the one of upper-developed countries and is comprised of 21countries. The third group is made up of middle ICT developed countries with 44 members in all. The fourth cluster is dedicated to the low-developed countries, with 60 members, and the last group encapsulates the very low developed countries, with 40 members (see Table 13).

Table 13: Repartition of the countries according to their classes



An analysis of the sub-variables is helpful for a better understanding. There is a strong correlation between the sub variables. The sub variable ICT_ACC has a very strong correlation with the sub-variable ICT_USE. The value of the Pearson correlation coefficient is 0.92. This fact demonstrates that ICTs are effectively used when they are available. That also means that when one looks for the ICT access, it is almost certain that this individual is going to use the ICT(s) as well. This high correlation can also be explained by the fact that some ICTs like Mobile phones or TV are so-called "push & go" devices, as the use of such devices does not require particular skills. The first rank of Korea is

deserved. Following initiatives have been taken in order to bridge the digital divide in Korea (Kang, 2009; Sedimo et al., 2011).

- Creation of a people-oriented and inclusive information society
- PPP (Public-Private-Partnership) programme which facilitates high-speed infrastructure initiatives such as "Cyber Korea 21" or Korea Vision (2006) or "U Korea Masterplan".
- Promoting global broadband internet access

The combination of high education technological competence and access to the ICTs justify the rank of Korea.

Table 14: Sub variable ICT_ACC and Sub variable ICT_USE (Top 20)

Ranking	Countries	Scores
1	France	2,79
2	Gibraltar	2,57
2	Hong Kong	2,5
4	Cayman Islands	2,49
5	Monaco	2,46
6	Luxembourg	2,45
7	Korea	2,43
8	Denmark	2,37
9	Switzerland	2,18
10	Liechtenstein	2,16
11	Sweden	2,16
12	Singapore	2,1
13	Finland	2,08
14	Germany	2,07
15	Netherlands	2,05
16	UK	2,05
17	Japan	2,04
18	Macau	2,01
19	Taiwan	1,97
20	Norway	1,95

Ranking	Countries	Scores
1	Norway	2,01583
2	Sweden	1,91771
3	Netherlands	1,85966
4	Qatar	1,81002
5	Luxembourg	1,75947
6	Finland	1,74839
7	Denmark	1,70247
8	UK	1,70109
9	Iceland	1,69502
10	Korea	1,64532
11	Canada	1,60118
12	Switzerland	1,57749
13	New Zealand	1,57588
14	Germany	1,56499
15	Singapore	1,50611
16	Austria	1,46774
17	Liechtenstein	1,45513
18	Australia	1,44489
19	Belgium	1,4318
20	Faroe Islands	1,43027

More than half of the countries ranked in the top-20 are present in both tables of the sub variables ICT_ACC and ICT_USE (see Table 14).

The ranking of small countries such as Gibraltar (rank 2) Cayman Islands (rank 4) by sub variable ICT_ACC and Qatar (rank 4) and Faroe Islands (rank 20) by subvariable ICT_USE might be surprising. However, these small countries benefit from their low population size so that both coverage of mobile phone and fixed telephone are very high. In behalf of the database of the ITU (2011), Gibraltar has 82.07 % fixed telephone subscribers, 102.59% mobile telephone subscribers, 97.95% mobile population coverage, 100% localities with telephone and a population of 29244 inhabitants. Cayman Islands have 66,43% fixed telephone, 177,65% mobile telephone subscriptions, 100% mobile population coverage and 100% localities with telephone and with a population of 56230 inhabitants. With a population of 1759000 inhabitants in 2010 and a GDP/capita in 2010 of 71510 USD Qatar occupies the rank four (see table 14). Following data can surely help to understand this rank. In fact, in Qatar, 94.9% of household have TV, 98.5% have mobile telephone, 98.57% have Internet and 84.57% are mobile cellular users. In Faroe Islands 95.87% household have TV, 94.9% household have mobile telephone, 83.58% household have internet and 75.2% mobile telephone users and have a population size of 48708 inhabitants. While Qatar can justify its high rank with its economic' force and relatively with its low population' size, the other small countries can rely on both their population size and obviously the easy adoption of the ICTs.

Table 15: Subvariable ICT_ACC (Last 20) and Subvariable ICT_USE (Last 20)

Ranking	Countries	Scores
181	Sierra-Leone	-1,95
182	Mali	-1,98
183	Eritrea	-1,98
184	Guinea Bissau	-2,01
185	Togo	-2,02
186	Niger	-2,04
187	Burundi	-2,06
188	Burkina Faso	-2,07
189	Comoros	-2,1
190	Chad	-2,11
191	Somalia	-2,13
192	Lao P.D.R.	-2,15
193	Timor Leste	-2,29
194	Ethiopia	-2,36
195	Mauritania	-2,5
196	Congo (D. R.)	-2,55
197	Central Afri-can Rep.	-2,77
198	Madagascar	-2,99
199	Mozambique	-3,14
200	Nepal	-3,29

Ranking	Countries	Scores
181	Burundi	-1,34514
182	Somalia	-1,35001
183	Eritrea	-1,35063
184	Mali	-1,35342
185	Myanmar	-1,35488
186	Timor Leste	-1,35493
187	Guinea	-1,36408
188	Chad	-1,36886
189	Ethiopia	-1,36953
190	Congo (D. R.)	-1,37528
191	Mauritania	-1,38035
192	Benin	-1,3875
193	Liberia	-1,41753
194	Uganda	-1,42903
195	Burkina Faso	-1,4305
196	Tanzania	-1,49908
197	Madagascar	-1,5339
198	Sierra-Leone	-1,54471
199	Rwanda	-1,62705
200	Niger	-1,63099

At the bottom of both tables (ICT_ACC and ICT_USE), one can find without any surprise many African countries. For ICT_ACC we have 16 African countries and for ICT_USE 18. A look at the last 20 tables reveals that 13 out of 20 countries belong to both tables ICT_ACC and ICT_USE (see Table 15).

The correlation coefficient between ICT_ACC and Skills is 0.74. It can also be seen as high even if it is less than the case above. The acquisition of the technology depends somewhat on one´s awareness. Here, there is no difference between the styles of the technology. As stated above, it could have been different if the type of the technology had been named.

The correlation coefficient between ICT_USE and Skills is 0.77. This fact shows that even if all the people in the world have access to ICTs, only the literate individuals would be able to make use of the non-push & go devices. Without literacy, it is extremely difficult to speak about a membership in the Information Society or knowledge society, which can be seen as a "digital society." Literacy is, and remains, a key factor besides the economy and policies in developing ICTs in each country.

As Gartner (2001) said, there is a strong correlation between socio-economic status (lower education and poorer income) and participation in the digital economy through the ICTs. That is why the GDP has been used first to classify the countries in the frame of this thesis.

Table 16: Suvbvariable Literacy (Top 20) and Subvariable ICT_USE (Top 20)

Ranking	Countries	Scores
1	Kazakhstan	1,94476
2	US	1,77568
3	Czech Rep.	1,73641
4	Korea	1,71418
5	Armenia	1,67915
6	Hungary	1,66987
7	Slovenia	1,65333
8	Switzerland	1,64743
9	Singapore	1,63255
10	Ukraine	1,61731
11	Slovak Rep.	1,61608
12	Estonia	1,58456
13	Germany	1,57725
14	Kyrgyzstan	1,56369
15	Mongolia	1,50693
16	Canada	1,46538
17	Lithuania	1,42978
18	Australia	1,34418
19	Russia	1,3415
20	Moldova	1,33277

Ranking	Countries	Scores
1	Norway	2,01583
2	Sweden	1,91771
3	Netherlands	1,85966
4	Qatar	1,81002
5	Luxembourg	1,75947
6	Finland	1,74839
7	Denmark	1,70247
8	UK	1,70109
9	Iceland	1,69502
10	Korea	1,64532
11	Canada	1,60118
12	Switzerland	1,57749
13	New Zealand	1,57588
14	Germany	1,56499
15	Singapore	1,50611
16	Austria	1,46774
17	Liechtenstein	1,45513
18	Australia	1,44489
19	Belgium	1,4318
20	Faroe Islands	1,43027

The top 20 of the subvariable Literacy is at first glance questionable or surprising. Why does this table 16 contain unexpectedly countries in top 20? Kazakhstan is leading in front of US (rank 2), Czech Republic (rank 3) and Korea (rank 4). A look at the data and indicators used to run the factor analysis will surely be helpful. The main indicators, which explain the ranking of the sub variable literacy is the rate of adult literacy and the secondary schooling. Primary and tertiary schooling were not decisive. In that database, (source UNESCO) Kazakhstan has 99.73 % adult literacy and 66.25% secondary schooling. The other unexpected countries such as Armenia, Ukraine, Kyrgyzstan, Mongolia, and Moldova have all high rate of adult literacy and secondary schooling. Looking at the last 20 of the sub variable literacy 'table, one can detect that 17 African countries. The

other three countries are Cambodia, Afghanistan and Papua New Guinea (see Table 17). There is this time no surprise like by the top 20. Ten countries are available in both table of sub variable literacy and sub variable ICT_USE (See Table 17).

Table 17: Sub variable Literacy (Last 20) and Sub variable ICT_ACC (last 20)

181	Cambodia	-1,39392
182	Central African Rep.	-1,4377
183	Zambia	-1,439
184	Guinea	-1,50749
185	Ethiopia	-1,5269
486	Mozambique	-1,53915
187	Somalia	-1,56713
188	Cote d´Ivoire	-1,57608
189	Burundi	-1,57769
190	Chad	-1,62591
191	Mali	-1,63259
192	Senegal	-1,64177
193	Afghanistan	-1,64884
194	Sudan	-1,65922
195	Burkina Faso	-1,73428
196	Rwanda	-1,81569
197	Mauritania	-1,85896
198	Niger	-1,92656
199	Papua New Guinea	-2,24539
200	Tanzania	-2,39589

Ranking	Countries	Scores
181	Sierra-Leone	-1,95
182	Mali	-1,98
183	Eritrea	-1,98
184	Guinea Bissau	-2,01
185	Togo	-2,02
186	Niger	-2,04
187	Burundi	-2,06
188	Burkina Faso	-2,07
189	Comoros	-2,1
190	Chad	-2,11
191	Somalia	-2,13
192	Lao P.D.R.	-2,15
193	Timor Leste	-2,29
194	Ethiopia	-2,36
195	Mauritania	-2,5
196	Congo (D. R.)	-2,55
197	Central Afri-can Rep.	-2,77
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Table 18: Subvariable Literacy (Last 20) and Subvariable ICT_USE (Last 20)

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187	Somalia	-1,56713
188	Cote d´Ivoire	-1,57608
189	Burundi	-1,57769
190	Chad	-1,62591
191	Mali	-1,63259
192	Senegal	-1,64177
193	Afghanistan	-1,64884
194	Sudan	-1,65922
195	Burkina Faso	-1,73428
196	Rwanda	-1,81569
197	Mauritania	-1,85896
198	Niger	-1,92656
199	Papua New Guinea	-2,24539
200	Tanzania	-2,39589

Ranking	Countries	Scores
181	Burundi	-1,34514
182	Somalia	-1,35001
183	Eritrea	-1,35063
184	Mali	-1,35342
185	Myanmar	-1,35488
186	Timor Leste	-1,35493
187	Guinea	-1,36408
188	Chad	-1,36886
189	Ethiopia	-1,36953
190	Congo (D. R.)	-1,37528
191	Mauritania	-1,38035
192	Benin	-1,3875
193	Liberia	-1,41753
194	Uganda	-1,42903
195	Burkina Faso	-1,4305
196	Tanzania	-1,49908
197	Madagascar	-1,5339
198	Sierra-Leone	-1,54471
199	Rwanda	-1,62705
200	Niger	-1,63099

Another important aspect which is often neglected is the fact that the use problem is quite different from a regional perspective. In other words, the use of ICTs depends on the social system or social structure and status of a given society. Thus Roger (1995, 25) noted that it is unthinkable to study the diffusion without some knowledge about the social structures in which the potential adopters are located and added that it is like studying blood circulation without adequate knowledge about veins and arteries. In Africa or in developing countries, as many studies have attested, the use of the ICTs is more common. In the developed countries, by contrast, the use of ICTs is more individual. Therefore, Chéneau-Loquay (2010) notes that the internet café is the preferred place of access to the internet due to the low level of living standard of the population in lesser developed countries.

Many economic research studies find evidence that the economies of counties, states and countries benefit from investment in the local telecommunication infrastructure (Parker, 2000). As such, investments in local telecommunications could provide rural areas many

advantages, and barriers, such as the large distance and economy of scale due to smaller markets that could be erased (Parker, 2000).

Besides the economy, the geographical situation and the population could also have a positive or negative influence. Parker (2000) further affirmed that rural areas without internet connectivity could lose part of their attractiveness to (highly qualified and wealthy) individuals and businesses. The density of the population can also influence the development through ICTs. Thus, Schleife (2008, 84-85) states that the relationship between population density and internet use rates can be positive or negative depending on which function outweighs the other. Schleife (2008, ibid) further added that the population density itself is not the crucial factor, but the regional size of specific population groups that have specific preferences regarding communication consumption.

6.2 Characteristics of the different classes

6.2.1 The high developed countries

This class represents the assembly of the frontrunners which regroups nearly all members of the OECD countries. The highest ranked in this group is South Korea with a score of 5.79 and the last is Macau with 3.78.

Except for Singapore, all the top-ten countries are members of the OECD. All the Scandinavian countries (Sweden, Denmark, Norway, and Finland) maintain their position as advanced countries concerning ICTs. The other European countries are Germany, the Netherlands and Luxembourg. These top-ten are followed by six more OECD countries, which are the UK, the US, France, Japan, Canada, and Australia. All members of this class are ranked either in the high class or upper class by the different sub-variables. So their rankings are entirely deserved. 21 of the 31 come from Europe. The rest are mainly from North America (USA, Canada) and Asia. The domination of Europe over the other parts of the world is noteworthy. All countries in this class are technologically advanced countries, and with this technological achievement, it was easier for these countries to conserve or to extend their advance toward the others (particularly from Africa and South America).

6.2.2 The upper class

The upper class comes immediately after the high class and is composed of 21 countries. The dominance of European countries continues in this group as more than half, namely

13, come from Europe. Other countries of this class are from other continents except for Africa, which is not represented. Besides the technological advantage, most of the countries in this class, such as Qatar, United Arab Emirates, Brunei, Kuwait and Bahrain, are economically strong, so they succeeded in ranking more highly on the list.

6.2.3 The middle class

This class is composed of 44 members and, unlike the both classes above, has only 14 European countries. All continents are represented in this class—even Africa is represented with two members, which are Libya, occupying the 78th rank, and Equatorial Guinea with the 81th rank. The most highly ranked in this class is Barbados with a 2.54 score index and the lowest ranked is Colombia with a 0.33 score index. Most of the countries in this class are classified in the middle class by their sub-variable ICT access and ICT use.

6.2.4 The low class

This class represents the so-called developing countries. It is also the class with the most members (60 countries), and Georgia is the only European country in this class. The members are divided among the other continents. Africa is well represented with 16 countries in the group. The others members are shared by the other continents such as South and Central America and Asia.

6.2.5 The very low class

The very low class is the last class and concerns the very poor countries economically and technologically. Most of the members located in this class are from Africa. Thus, 31 out of 40 members are African countries. The other nine are Myanmar, Cambodia, LAO PDR, Papua New Guinea, Bangladesh, Comoros, Timor Leste, Afghanistan, Haiti and Nepal, which are all extremely poor countries. There is no surprise concerning the low ranking and IGI of these countries as the scores of the sub-variables are also very low or low.

Briefly, one can note that the repartition of ICTs worldwide is uneven as the outcome of the IGI attested. Countries with low education and technological deficits are, unsurprisingly, at the bottom of the ranking. The well-ranked countries at the top are developed countries and have a huge technological asset in common, so it was easier for them

to adopt and adapt to ICTs. Moreover, the diffusion of ICTs is at ease in a society where over 90% are literate and which also has a solid technological basis. Even if the sub variables give some information or explanation about the development of ICTs in each country and the position in the ranking, only a real analysis taking into account other aspects individually, such as political decisions, cultural realities could help to better appreciate the situation.

6.3 IGI versus IDI

The Spearman correlation between the IDI is 0.96 which is a very high correlation. This fact is stunning as the IGI is based on a different method. But one must note that both used the same database. The finding here is that, the frontrunners in the IDI by the IGI are all developed countries. The following countries are in the top ten in both indices: Korea, Sweden, Denmark, Norway, Finland, the Netherlands and Luxembourg. The dominance of the Scandinavian countries is obvious in both indices. Both indices share common countries in their last ten at the bottom such as Chad, Nepal, Niger, Ethiopia, Burkina Faso and Mozambique. The IDI used for the literacy the enrolment of primary, secondary and tertiary as variables but the IGI used in this case the completed primary, secondary and tertiary education. The minimum skills required are the ability to read and to write and that cannot be guaranteed by the simple act of enrolment, but rather by an effective completed primary education.

6.4 IGI versus NRI

The IGI also has a high correlation with the NRI. Here the Spearman correlation amounts to 0.86. As it has been explained in the previous Chapter 4, the NRI used, besides the secondary data, a self-conducted empirical study. It is different from the IGI and IDI, which used secondary data exclusively. Seven of the top ten countries of the NRI are also represented in the IDI. These countries are Switzerland, Sweden, Denmark, Singapore, Norway, Finland and the Netherlands. As stated in the previous chapter, using a self-survey to complete the secondary data is a very good initiative in general, but the problem is that the NRI is economically oriented, which is obvious by the choice of the different variables.

Table 19: The top-ten countries by the indices IGI, NRI, IDI

Countries	**IGI**	**NRI**	**IDI**
Korea	1	15	1
Switzerland	2	4	12
Sweden	3	1	2
Denmark	4	3	4
Singapore	5	2	11
Norway	6	10	5
Germany	7	14	17
Finland	8	6	6
The Netherlands	9	9	7
Luxembourg	10	17	8

The IGI as an index could easily be compared to the other measuring instruments like the NRI or the IDI. It provides a general view of the repartition of ICTs worldwide, but it gives limited information about a single country. How to consider the IGI and its limitations will be discussed in the next chapter.

7 Discussion

7.1 Assessing the measurement of ICTs through the IGI

As the outcome from the IGI illustrates, basic infrastructures and education are key in the development of ICTs, which, in turn, will favour a decrease of the digital divide. The international community has taken some initiatives in order to help developing countries, in particular, to boost their development by using ICTs. The eight purposes of the Millennium Goals is one such initiative. The result after 10 years, however, is somewhat unexpected. The developed countries maintain their advance particularly in internet access and use. Even if some reasons could be seen by the limits of measurements (which will be discussed later), one has to recognize that apart from the mobile phone, where the developing countries have made huge progress, the situation has not notably

changed. Thus, the UN states that there is a strong penetration of mobile phones in developing countries but a low growth rate of internet users, which is also slow and costly, ITU (2009, 1).[14]

Are there more investments in the mobile telephone network than in the fixed telephone and internet networks in developing countries?

A study of this question could surely offer elements to provide the right answer. However, an analysis of the data could also help highlight some explanations. As stated above, education or literacy is a key factor to enter the digital world successfully. In addition, as the data (see attachment CD) confirm, some developing countries have poor rates of literacy, especially in African countries. Even Bonfiglioli et al. in their working paper, which concerns the European population, stated the following:

"Digital literacy is the skills required to achieve digital competence, the confident and critical use of the ICT for work, leisure, learning and communication. (…) It is underpinned by basic skills in ICT and the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via internet." (Bonfiglioli et al., 2008, p. 4).

In fact, digital literacy seems to be a very important hurdle even in developed countries as the skills required are somehow very high. Figure 24 below shows the attributes of the medium (internet) as well as those of the user. Technological readiness, perception of risks, social motives, style of the user and information needs are the attributes which a user must have in order to fully benefit from ICTs.

[14] International Telecommunication Union (2009): Measuring the international society: The ICT development index. Geneva

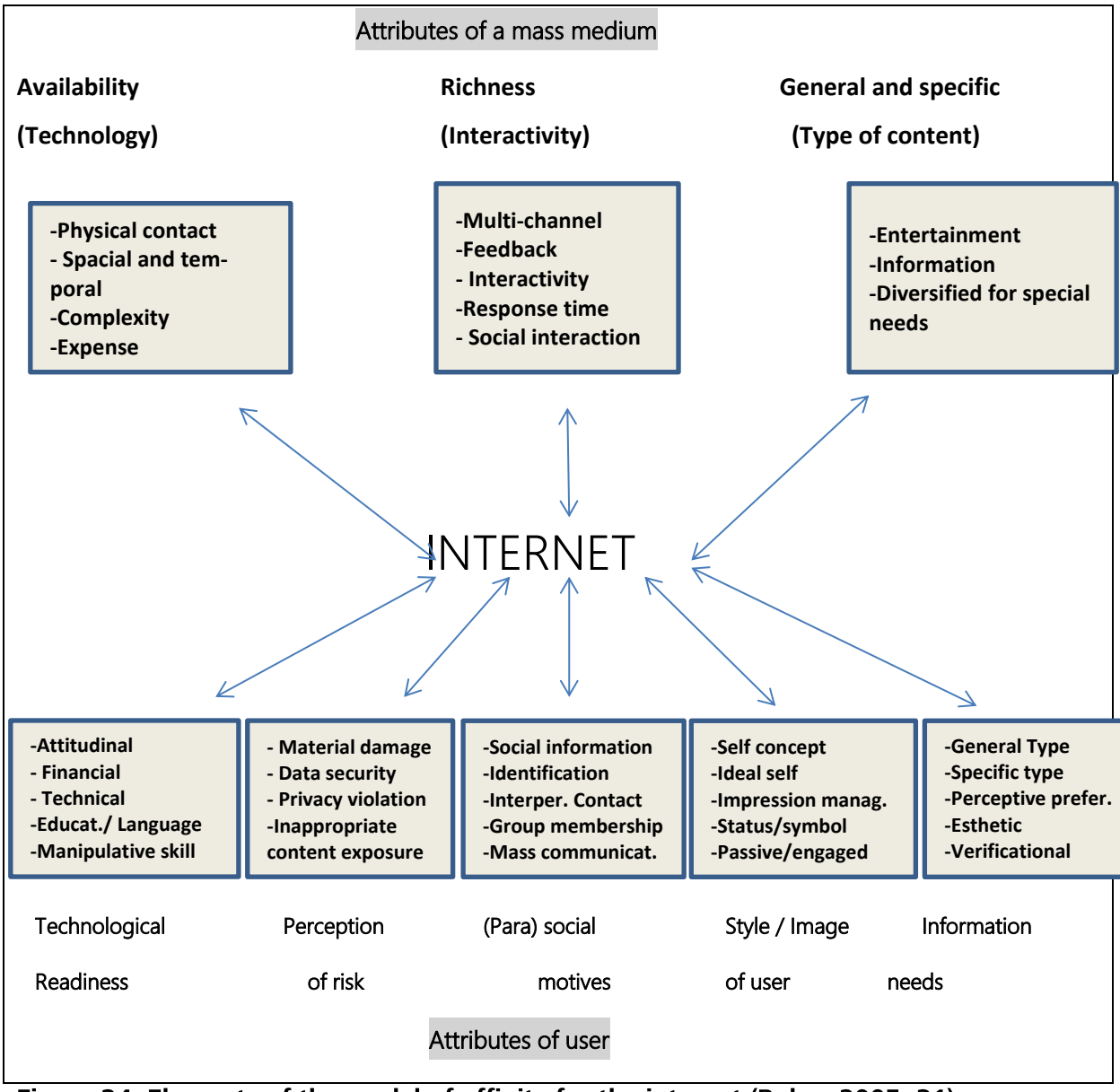

Figure 24: Elements of the model of affinity for the internet (Bubas 2005, 31)

Information literacy is also another hurdle to decreasing the digital divide as the requirements are rather high as well. Accordingly, the American Library Association (1989, 1) stated following: *"To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate and use effectively the needed information."* In the same vein, the European Information Society Thematic Portal[15] stated: *"To participate and take advantage, citizens must be digitally literate – equipped with the skills to benefit from, and participate in the information society. This includes both the ability to use new ICT tools and the media literacy skills to handle the flood of images, text and audiovisual content that constantly pour across the global network."*

[15] http://ec.europa.eu/digital-agenda/

The figure 25 below shows what information literacy requires.

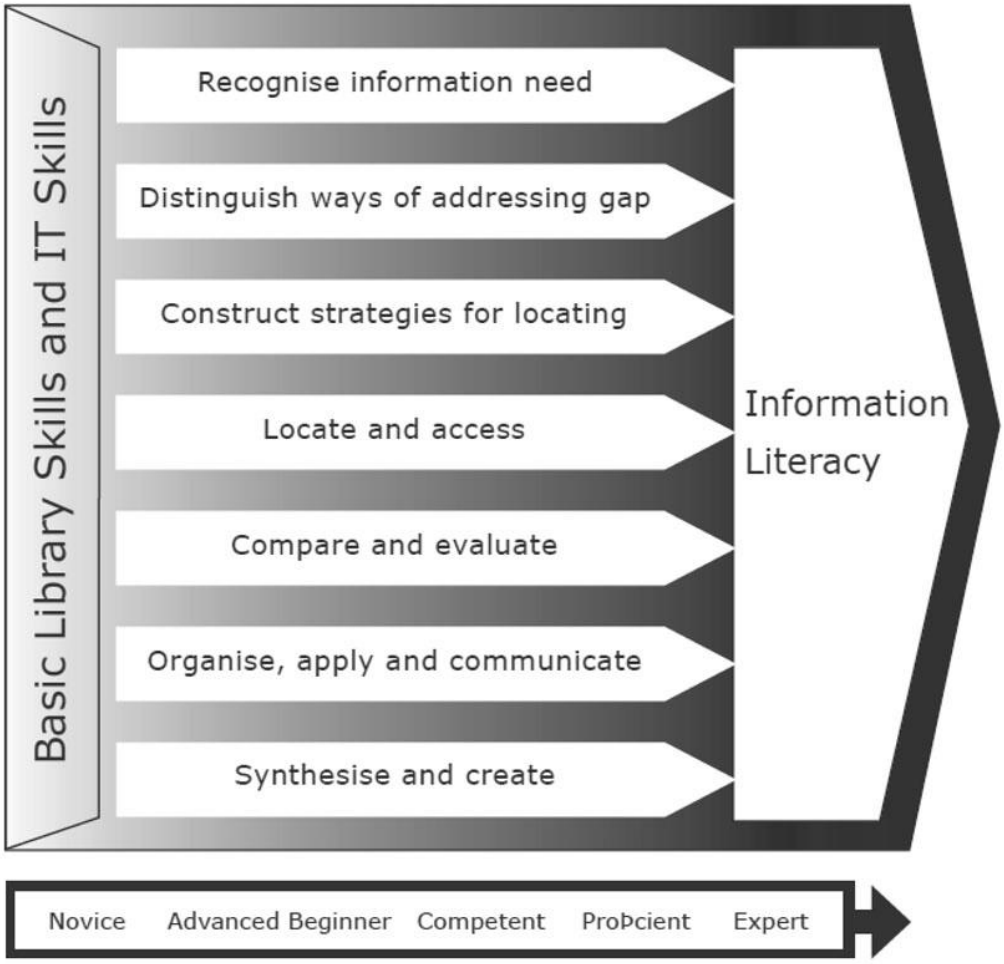

Figure 25: The pillars of information literacy model (SCONUL)[16]

Even Lennox and Walker (1993) stated that a qualified information user is the one *"who has an analytical and critical skills to formulate research questions and evaluate results and the skills to search for and access a variety of information type in order to meet his or her information need."* Moreover, this view is shared by the IFLA (2005), as they stated the following: "*Information literacy empowers people in all walks of life to seek, evaluate, use and create information effectively to achieve their personal, social occupational and educational goals. It is a basic human right in a digital world and promotes social inclusion of all nations."*[17]

If the standard even in developed countries cannot be easily reached, what possibly could be the case in developing countries with a higher rate of illiteracy? Designing a model of requirements with lower standards could be the solution. The focus would not

[16]Standing Conference of National and University Libraries http://www.sconul.ac.uk/
[17] http://www.ifla.org/publications/beacons-of-the-information-society-the-alexandria-proclamation-on-information-literacy

be directed toward so-called new ICTs, but focused on all available ICTs and basic literacy.

7.2 Alternative requirement model for ICTs

The situation of Africa, as the IGI remarked, is alarming as the number of internet users was quite lower. Therefore, the 4th point of the declaration of principles of the WSIS 2003 added the following: "***We reaffirm,*** *as an essential foundation of the Information Society, and as outlined in Article 19 of the Universal Declaration of Human Rights, that everyone has the right to freedom of opinion and expression; that this right includes freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers. Communication is a fundamental social process, a basic human need and the foundation of all social organization. It is central to the Information Society. Everyone, everywhere should have the opportunity to participate and no one should be excluded from the benefits the Information Society offers."*[18]

Despite the ambitious and audacious action plan of the WSIS 2003[19] and the Tunis commitment,[20] which followed the declaration of principles above, the situation of developing countries regarding ICTs—particularly the internet—has hardly changed (see Table 12). In addition, the proposed *digital solidarity fund* (DSF), a plea of the rich countries to help the developing ones, unfortunately did not find the expected approval (cf. Kuhlen, 2004, 145). Richer countries did not want to contribute to binding financing measures to help bridge the digital divide.

Basing his argument on the diffusion´s theory, Compaine (2001) refuses the intervention of the state or government and stated: *"First, there is no need to act precipitously. Technology casts a long shadow. Thus, there is time for society to see how some technology or combination of technologies move towards their natural markets and costs."*

The proponents of normalization, like Compaine, believes that the diffusion of the internet will be similar to other innovations such as the telephone, electricity, TV, etc, but the problem is the complexity of the internet. The internet is more than a "push-and-go" device, as it requires special skills beyond simple literacy, in particular (See Figure 24). It would be risky to predict its diffusion´ process. Moreover, the diffusion theory with

[18] http://www.worldsummit2003.de/en/web/586.htm
[19] http://www.worldsummit2003.de/en/web/586.htm
[20] http://www.itu.int/net/wsis/docs2/tunis/off/7.html

the sigmoid curve, according to Roger (2003, 260), describes the ideal process and states: *"It describes only cases of successful innovation, in which an innovation spreads to almost all the potential adopters in a social system."* He also added that many innovations are not successful. That is why normalization must be approached with caution.

There were a few critics concerned with the need to try to bridge the digital divide with different measures as well. Warschauer (2003), criticizes the one-sided solution, which focuses only on providing hardware and software. In fact, it is not enough to merely struggle against accessing ICTs. The user must be taken into account. Warshauer (2002), Hargittai (2002), underlined this in stating that: "it is not enough to wire all communities and declare that everyone has equal access to the internet. People may have technical access, but they may not know how to extract information for their needs from the web. "

For Kubicek (2003), the internet should be considered as a social equity good but should not be a "must." In other words, everyone should be given the option to use it or not. For Kubicek (ibid), reading, writing and the skill to evaluate information is more important and the support measures should move in that direction while taking into account the relative social system.

The pertinence of bridging the digital divide is that the internet contributes significantly to socioeconomic and political activities. Using the internet generally has a positive impact on individual.

Full attention has been devoted to the Internet and mobile phone use, while other media have been neglected. The example of a potential user in the information society below will help to clarify the situation. This is why all attempts to bridge the digital divide should take into account the diffusion of innovation theory of Roger.

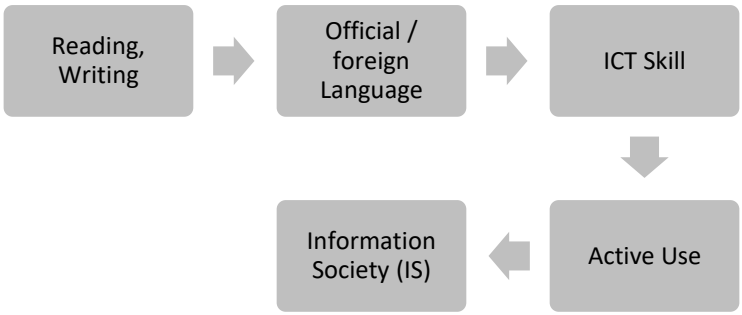

Figure 26: The way to the Information Society

There are four main hurdles which must be overcome in order to reach the information society or to be considered as a member of the IS where the internet plays a big part. These hurdles are:

1- Reading and writing

The ability to read and to write is the first step forward of the information society. This is, in fact, a basic handicap for those who are illiterate.

2- Official or foreign language

These days, the most-used language in the internet is, without question, English. But the alternative can be other very well -known and often used languages such as French, German, Spanish, Portuguese, and others like Chinese, Russian, etc. Another option could be the official, or national, language, which is common in the case of most African countries due to colonization. Most of them have French or English as official language (See figures 32, 33). But the problem is that only the literates have the ability to navigate most of the official languages in Africa. Therefore, a local language or national language would be welcomed, but unfortunately, these languages are difficult to find frequently on the internet. This is a definite disadvantage for those who do not have the ability to manage in English or in the familiar languages cited above.

3- ICT skill

Even a literate must be able to use ICTs before he can be considered as a member of the IS. This is the crucial handicap which concerns all potential internet users. The complexity of the hardware and software configuration often constrains one from securing the necessary ICT skills.

4- Active use

The last condition is active use, meaning that effective participation must be available and frequent. Social media like Facebook, Twitter, Google and many offer the opportunity to users to give their opinion and to participate actively to the information society. The design of the information society also relies on the participation of all users. However, it is difficult to maintain the necessary ICT skills without active, regular use of ICTs, particularly in richer countries where ICTs—especially the internet—are almost omnipresent.

The table 20 below shows a model of the potential user profile and membership in the information society. The profiles A, B, and C are often localized in developing countries. The Profiles D and E are found mostly in developed countries. Richer countries are better educated with greater literacy, and they also have more and better infrastructures, which explains their larger representation in the information society.

Table 20: Potential user Profiles and their Membership in the Information Society

	Reading	**Writing**	**Foreign /Official Language**	**ICT Skills**	**Active Use**	**Information Society Member-ship**
Profile A	No	No	No	No	No	?
Profile B	Yes(Local Lan-guage)	Yes (local language)	No	No	No	?
Profile C	Yes	Yes	Yes	No	No	?
Profile D	Yes	Yes	Yes	Yes	No	Yes (with re-serve)
Profile E	Yes	Yes	Yes	Yes	Yes	Yes

Is it legitimate to deny following Profiles A, B, or C the membership in the information society? If the information society is seen strictly as a digital world, where the focus is on the internet, then perhaps so. But if the concept of the information society goes beyond the digital world and the internet, then there is a chance that Profiles A,B, and C could be seen as members of the information society. Certainly, this membership must be preceded by other media or communication channels such TV, radio or local radio.

7.3 The limits of the IGI

Despite all efforts to perform the IGI, both methodic and methodological, this index unfortunately, is not free of criticism and has its limits.

7.3.1 The problem of secondary data

The problem of secondary data has already been mentioned in the previous chapter and remains an issue as this has a direct impact on our outcome. Even if it is rare to conduct a study perfectly, errors can occur, because in self-conducted surveys the researcher is aware of the method used to obtain the data and the source of the data. This cannot be the case with secondary data.

7.3.2 The missing values

Missing data are another problem, which has been solved, but it would have been better if all the data were available. Dealing with missing data was not an easy task for such research where the purpose was to build an index; therefore, a complete database was necessary. Different data analyses were completed and the suitable procedure here was the mix of the Hot-Deck and the mean imputation method. As the GDP per capita has a high correlation with the variables concerning ICT access and ICT use, a classification of the items (countries) has been created. Further, some classes regarding the GDP per capita as an object donor have been built and the mean of each class has been computed. The missing data were substituted by the mean of the class to which the country belongs. The Cold-Deck method, which favours external object donors (cf. Bankhofer,2011), could have been used here, but it was not necessary.

- ➔ Choice of donor object (GDP/capita)
- ➔ Building of classes
- ➔ Computation mean of each class
- ➔ Replacing the missing data through the belonging class mean

7.3.3 The integrity of the database

The absence of some important variables in the databases is also a problem. Some data which could have been useful for purposes here were unfortunately unavailable, such as the number of internet cafés and their daily attendance. The availability of this data would have been very useful to determine the real number of internet users, especially in developing countries where there is a more common use of ICTs.

Radios, especially local radios, would have been very useful particularly in developing countries as they are the best-suited communication channel mainly in poor regions

where the illiteracy rate is higher. The quality of the research institutes and political decision making-process could have also been useful for the data analysis if they were available.

There is not one correct index, but a variety of indices which, according to the methodological orientation and focus, must be included and analysed.

To respond to the questions concerning the quality criteria, one can say that the IGI included in its conception and its elaboration these aspects.

Objectivity: considering the conceptualisation of the digital divide, the chosen model and the context in the frame of this thesis, the IGI meets the criterion of objectivity. In fact, the selection the data, the factor analysis, the computation of both, the sub variables and the IGI could not be affected by any external impact.

Reliability: in order to be ascertain, that the IGI is reliable some tests retests have been done by using SPSS. The purpose of this thesis is to create a consistent measuring instrument. Thus, the author was forced to consider this important quality criterion. The computed Cronbach´s alpha reliability coefficient is 0,687 and is acceptable. The discrepancy between rich countries and very poor countries concerning particularly ICT_USE, ICT_ACC explains the value of the Cronbach Alpha. This value however has to be taken with caution. Considering the context here and the number of items (countries) and the heterogeneity among them, it is not surprising. A study of OECD countries or European countries could offer more consistency.

Validity: there is no doubt, that the IGI measures the digital divide. The selected indicators and the computed sub variables (ICT_ACC, ICT_USE, Literacy) also the defined framework testify that the IGI measures what it is supposed to measure, namely the digital divide.

7.4 Some propositions to bridge the digital divide so far

It is believed that the use of new ICTs is important for individuals and for their social development. This means that every "offliner" might be socially and economically disadvantaged. Some type of relevant social task must be secured so that the equality of opportunities for development by person, groups and countries remains possible.

Cammaerts & Carpentier, (2005, 33) criticize the position of the WSIS: On the one hand, they assert that the WSIS deals with non-political, technological and economic matters, which implies that from a liberal perspective, the states should not intervene. On the other hand, they contend that the WSIS is 'not political enough,' whereby the political is defined in a minimalist, state-centred way, excluding civil society. From both perspectives, civil society´s role is discredited. The former interpretation excludes civil society as the market is supposed to regulate itself, and the latter interpretation excludes civil society because it is considered 'not representative,' and thus not politically legitimate. The dilemma described above is well known by Compaine and Norris, who have different views toward the intervention by the states or governments.

For Compaine , (a critic of the concept digital divide), the diffusion of ICTs is a natural process and he based his argument on the diffusion theory of Rogers (1995).

Norris (ibid), however, classifies the diffusion of innovation in two theoretical models: The normalisation and the stratification.

A for early adopters

B for intermediate adopters

C for late adopters

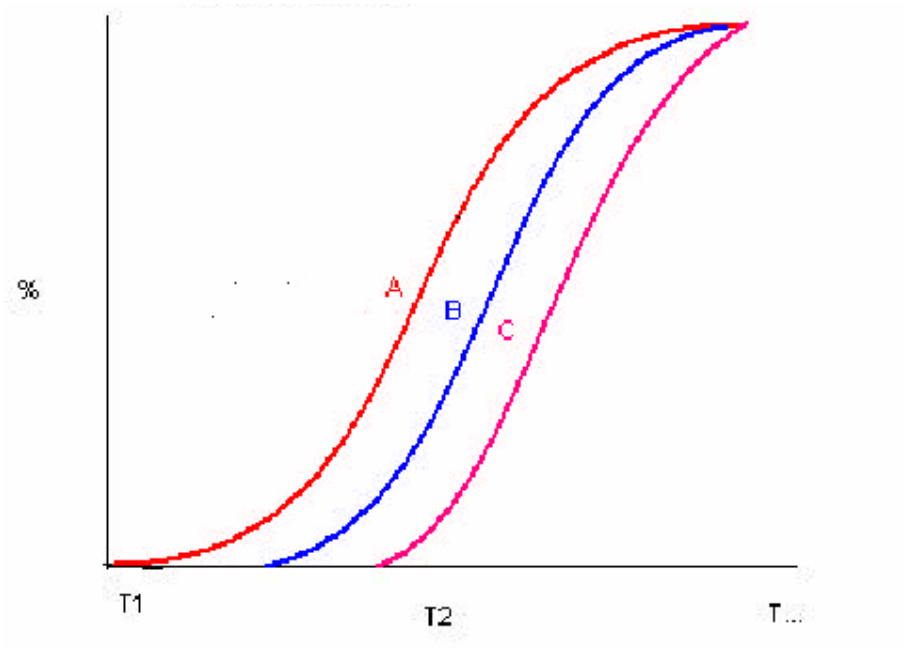

Figure 27: The normalisation model (Norris, 2001, 31)

A for early adopters

B for intermediate adopters

C for late adopters

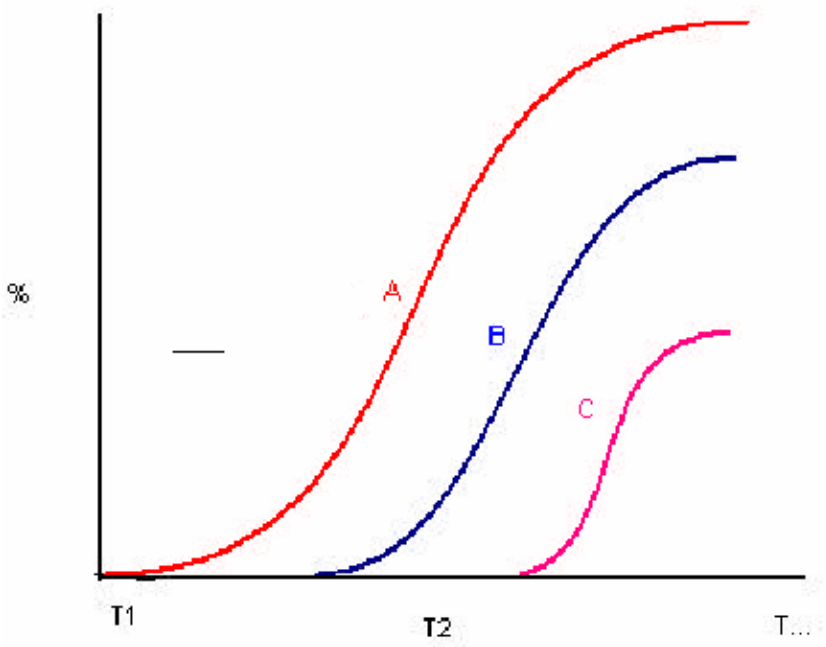

Figure 28: The stratification model, (Norris 2001, 31)

Norris (2001), however, sees uniformity by the normalization over time. Early adopters and late adopters will have the same level by saturation and, consequently, the fees will fall away and the innovation will be accessible to everyone. There is no uniformity over time by the stratification model, explained Norris (ibid.). This means that the early adopters will conserve and focus their advantages toward the late adopters. That is why social policies and development measures are needed in order to reduce digital inequalities.

Nonetheless, Compaine, an advocate of normalization, thinks that the digital divide is a temporary issue which does not need external regulation. On the contrary, he sees self-regulation through diffusion.

The USA, for example, has gained experience with both models. While the Bush[21] administration privileged normalization, the Clinton[22] administration favoured the stratification model by initiating programs like *Technologies Opportunities Program (TOP)*[23] or *Community Technology Center* (CTC)[24] whose *purpose is to create or to expand community technology centers to provide disadvantaged residents of economically distressed urban and rural communities with access to information technologies and training to use it.*(http://www2.ed.gov/programs/comtechcenters/index.html). The Technology Opportunity Program (TOP) *supported demonstrations of new telecommunication and information technologies to provide education, health care or public information and non-profit sectors*. (http://www.ntia.doc.gov/legacy/otiahome/top/index.html).

Even if the theory of diffusion is applicable to ICTs in general, and especially the internet, the choice of the most appropriate model depends on the type of social system and ICTs. This is because the diffusion of radio or TVs cannot be compared to the internet, which is a more complex medium and whose saturation stage would be difficult, if not impossible, to predict.

Furthermore, (Moosberger, K., Tolbert, C., & Stansbury, M. (2003) added that the "*computer and the internet are, amongst other things, tools for participation in the economy and political arena*." Due to the role that ICTs and the internet play in the today´s society, it would be risky to rely on a perfect diffusion (normalisation) of ICTs where the factor of time must be taken into consideration. Moreover, the factors and the resources described by Djik, Jan A.G.M. van (2005) are additional reasons that normalization could be a success in the diffusion of ICTs. In fact, he enumerates two categories of factors and their associated features (see Figure 29):

[21] George W. Bush was US President from 2001-2009
[22] Bill Clinton was US President from 1993-2001
[23] http://www.ntia.doc.gov/legacy/otiahome/top/index.html
[24] http://www2.ed.gov/programs/comtechcenters/index.html

Individual Factors	Position Factors
Age	Activity
Gender	Country
Race	Household
Intelligence	Education
Personality	

Figure 29: ICTs diffusion factors (cf. Dijk, 2005)

These factors all play a decisive role in the acquisition and the adoption of ICTs.

Further, Dijk, Jan A. G. M. van (2005) names five different resources that influence the use of ICTs. These resources are temporal resources (remaining time), material resources (income, computer devices), cognitive resources (knowledge, social and technic skills), social (social network and relationships) and cultural (cultural assets) resources.

As stated previously, the quest for adequate solutions must inevitably go through a measurement process. Therefore, the realization of a desired knowledge society is consequently related to the availability of the data and of the choice the indicators. This was underscored by Trkulja (2010) as she states: "Without reliable data and without conciliation about the choice of the indicators it would be difficult to transform the information society into a knowledge society."

In addition, due to the importance of ICTs in socioeconomic development, a consensus about adequate specific values has been found for the determination of the information society, so the UN marked it with this view: *"comparable access to and use of, information and communication technologies (ICTs), are critical to formulating policies and strategies concerning ICT -enable growth, for social inclusion and cohesion, and for monitoring and evaluating the impact of the ICTs on economic and social developments. However, internationally comparable information society statistics are very limited, in particular in the developing world (UN, 2005)."*

The indicators describe the infrastructures, the production and the use of ICTs in different social domains such as household, education, etc. The advantages of uniform data are the description of trends and structural and social comparisons, particularly regarding the extent of the digital divide in developing countries.

In order to avoid the data gap concerning ICTs, the UN, OECD, EU, and ITU have brought together a set of basic indicators for a standardization and harmonization of global ICT statistics (UN, 2005).

ICTs are currently one of the driving forces in the world economy. Thus, the World Bank, 2007, 307) stated: *"The digital and information revolution has changed the way the world learns, communicates, does business, and treats illness. New information and communication technologies offer vast opportunities for progress in all walks of life in all countries – opportunities for economic growth, improved health, better service delivery, learning through distance education, and social and cultural advances."* This assertion is more a wish than it is a fact. It may be verifiable for developed countries, but for developing countries with literacy rates of less than 60% (see data on attachment CD), it may be quite difficult to prove. ICTs have clear economic and social potential and are also innovation drivers for their own sector and for other markets. They are, according to Trkulja (2010), the most important sector and can change business through their development. The importance and the necessity of ICTs is once more underscored as the point number 12. of the Charta on global information society has tried to explain the necessity of IT and stated: *"**IT** represents a tremendous opportunity for emerging and developing economies. Countries that succeed in harnessing its potential can look forward to leapfrogging conventional obstacles of infrastructural development, to meeting more effectively their vital development goals, such as poverty reduction, health, sanitation, and education, and to benefiting from the rapid growth of global e-commerce. Some developing countries have already made significant progress in these areas."*[25]

In fact ICTs can be a huge support for farmer in rural areas. As farming activities are dependent on the weather, every initiative including ICTs, which could facilitate the acquisition of weather information, is welcomed. Besides the weather, medical assistance via ICTs is also can also be very useful. In order to avoid price fluctuation and to also favour a fairer product price, ICTs can help farmers by bringing them the right information about the respective products. Further, general information of government programs can be brought to the farmer via the ICTs. All activities in rural areas, particularly in developing countries, can be sustained by ICTs.

[25] http://www.mofa.go.jp/policy/economy/summit/2000/documents/charter.html

Other propositions to overcome the digital divide have been made, such as the project "One Laptop per Child." As a partial solution to the global digital divide, this project tends to rely heavily upon open standards and free open source software.

8 Conclusion

8.1 The necessity to find solutions through the evaluation of ICTs

The starting point of the debate concerning the digital divide begins with the sharply rising economic, social and politic impact of ICTs in society. Society is displaying a rising interest in the impact and mechanisms of the technologies and the number of publications addressing the concept of the digital divide have increased significantly in recent years. For Warschauer (2004), the digital divide is one of the most discussed social phenomena of our era. Still, there is no common theory, nor consensus on a formal position regarding the concept. Different parts of the concept have been defined or merely described. Thus, Kizza (2013), states that: "*Much of the debate is the result of a lack of understanding about the digital divide, its origins, inputs, and responses to inputs."* Developed countries with less than 15% of the worldwide population comprise approximately 88% of all internet users in the rest of the world (see ITU).

Due to its complexity, the digital divide is seen as a multi-level model which cannot be captured and sufficiently defined with access criteria. Its most important theoretical foundations are the diffusion theory and the knowledge gap hypothesis.

A monumental step toward the eradication of the global digital divide is inevitably its evaluation. This evaluation, or measurement of the digital divide, is only possible in a predetermined framework as it is impossible to create a global measurement instrument without a predefined framework. This framework must follow a clear methodology. Therefore, the selection of the level of analysis, the inequalities and ICT types, the context, the style of analysis and the choice of indicators must be strictly followed. Subsequently, the method used to analyse the data must also be quite clear. The creation of the ICT Global Index (IGI) within the framework of this dissertation has been possible thanks to the methodology mentioned above. The IGI, as the instrument of measurement of the digital divide, presents a clear structure and a simple, detailed method, which facilitates easier comprehension. The comparison with other indices like the IDI and the

NRI shows that there is not a huge difference as the Pearson correlation coefficient is equal to 0.96 for the former and 0.86 for the latter. Moreover, the purpose of the tool and the principal questions such as why to measure, what to measure and for whom are you measuring, make the difference. Although the same indicators in some cases were used by the others indices, the ethical context of IGI lends a particular orientation to the tool. In fact, instead of ICT skills as defined by the IDI and NRI, the IGI only considers skills such as literacy, as the ICTs concerned were not all required to be "digital." The IGI is definitely individual-oriented and not infrastructure- and device-oriented.

8.2 Recommendations and outlook

The use and adaption of the information technology is a critical factor to generate and access wealth, power and knowledge today (cf. Castells, 1999, 92). This means that ICTs are a crucial tool for economy development, which explains why both the G8 and the United Nations, through programs like DOT Force and ICT Task Force, have been seriously considering the issue of the digital divide since 2000. The UN ICT Task Force wants, among other things, to fight against information poverty.

As the difference in accessing and using ICTs between rich countries and poor countries is vast, the ICT Task Force proposed public internet access as an effective solution to help reduce the gap. This is precisely the case in Africa, where Jensen (2003, 86) thinks the digital divide matters the most. Thus, the current data from Internetworldstats[26] confirms this view where only 9.8% of African were internet users in 2014.

Even if the situation of mobile phones in Africa can be rated as positive (Internetworldstats), as more than 50% (see ITU) of the population in Africa are mobile phone users, one must recognize that the situation of ICTs, in general, is still worrying or critical. A basic infrastructural condition such as mobility and a communication network must be identified. Socioeconomic parameters such as education and revenue also must be evaluated. To find solutions, one must look in different directions, as Warschauer (2003) said: *"the reasons for disparity in internet access rate are multiple and involve issues of economics, infrastructures, politics, educational and culture."*

[26] http://www.internetworldstats.com/stats1.htm

Because the issue of the digital divide concerns not only access to technology, the search for a solution looks in other directions as well, namely, to the skills divide. Next, simple ownership of technology is good, but knowing how to use it is better. Further, Warschauer(ibid), stated: *"Education also helps to determine how people use the internet and what benefit they achieve from it"* and added that the availability of the ICTs is not the most important issue, but rather the ability of the people to make use of them. Hargittai (2002, 13) added in the same vein that: "*Policy decisions that aim to reduce inequalities in access to and use of information technologies must take into consideration the necessary investment in training and support."* Thus, basic literacy is the minimum required key to ICT use. Without basic literacy, ICT use is hardly possible. Even if possibilities exist for illiterates to use ICTs, one has to recognize that optimal use of ICTs requires the simple ability to read and to write; literacy cannot be overrated. As Warschauer (2003) says, "literacy and education affect online access at both macro and micro-levels." In undeveloped countries, where more than 50% of the populations are illiterate, one cannot expect that ICTs would be efficiently used, such that the digital divide could be bridged even if the problem of access to technologies were resolved. The World Development Report of the World Bank online (http://www.worldbank/wdr/wdr98/) pointed out following: "If we can narrow knowledge gaps and address information problems… it may be possible to improve incomes and living standards at a much faster pace than previously imagined." And the outcome of the IGI attested that a strong correlation between ICT use and literacy does exist. Moreover, Warschauer (ibid), goes further and states that even literacy alone is not sufficient enough—for the optimal use of ICTs namely, the internet—and added that users have to master the English language or one of the important web - languages such as French, German, Chinese, Russian, Spanish or Portuguese, because, it is difficult to find contents in local languages in the developing countries. This fact is also underscored by Servon (2002), who finds three different aspects by defining the digital divide: access to the internet, education or IT-literacy and content. Unfortunately, she also noted that: "*When disadvantaged groups do log in, they often find that there is no content there. The kind of information they seek—information that is directly related to their lives and communities and cultures does not exist."*

In addition, physical and cognitive resources are both important for effective use of the internet. Hargittai (2004, 13-14) highlights the situation with this quotation: *"[…] it is*

not enough to wire all communities and declare that everyone now has equal access to the internet. People may have technical access, but they may not know how to extract information for their needs from the web." In fact, there is also, according to Warschauer, a geographic imbalance of internet content production and that means that the content needs of diverse communities are not being met. The consequence of this is that large portions of online content more often target the interests of developed countries' populations. So for him, the improvement and extension of telecommunication´s infrastructures, reduction of fees for equipment and connections and public access, especially in developing countries, should be the solution.

As Hilbert et al. (2016, 26-27) argue, the progress of the technology will inevitably cause new inequalities so that each new technology will create a new divide through its diffusion in the social network.
ICTs are so important that there is an obvious need to determine the state of the ICT-policy and the measures which have been undertaken, the investments, user behaviour of the ICT goods and services and how the development of the ICT has been completed. The issue of ICTs must not be seen as the so-called "race to development," where some countries should try to be faster than the others. One should not see the development of ICTs as a competition. The question instead should be how each country must approach its own situation. Several aspects of the digital divide should be rigorously checked and priorities especially defined.

The solutions are:

- Reconsider the mass media, by beginning with the new one and progressively eliminating the unsuitable one. For example, if the given population or region doesn't fit the preconditions for the supply of internet and mobile phone technology, then look to other possibilities such as television. If television is not possible, then the other possibility may be radio and, finally, local radio.

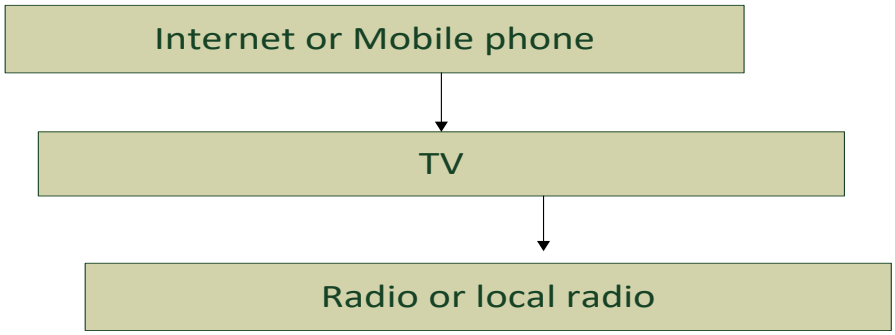

Figure 30: Rollback by selecting the suited media

As Cullen (2001) said, new technologies should not automatically replace the old. Both old and new could achieve the same purpose, but differently. Basic technologies as cited above could be more useful for these populations. Formerly common media such as telephone, radio, and television should have public opportunities for use in the early stage of diffusion. A local radio could be more useful for an illiterate individual than internet access.

Information should be the key, not the technology. The technology should serve merely as a vehicle for the information.

Therefore, the propagation of associate technology should not be absolutely even with the diffusion of the information because only a fractional part of the society will otherwise benefit from the information. Parker (2000) suggests that public programs should be launched that increase the financial incentives of firms to invest in the internet infrastructures in the remote regions.

There may be other alternatives to those cited above, but these have to be implemented first.

Due to its complexity, the fight against the digital divide must take into account the particularities of single regions. This means that besides Internet users, other indicators such as international bandwidth, political decisions, ICT infrastructures, providers and access possibilities must be considered.

One has to be certain that ICTs will not be able to settle all problems of the developing countries. But if the suitable technology and the right decision are chosen, then it can be a huge support for their development. It is, of course, the technically oriented solu-

tions which the NGO or the international institutions, firms and governments are trying to achieve. But another important asset will be the implementation of public networks. This was the case, according to Haseloff (2007), in China, India and Peru, where public access to ICTs is the most important access model alongside home and office access. He also noted that in 2004, there were 75,000 cybercafés in China and 50,000 in India, with an attendance of six million users daily.

Although a suited infrastructure is a sine qua non condition for usage, the ICT is not an end in itself, but a vehicle of content in the information society. And it is difficult to speak about the information society when omitting the digital component of the information and communication. The UN Task Force and the G-8 Dot Force pressed for the intensification of the implementation of the public access model in order to expand the internet.

There is an obvious use pattern of ICTs that can be identified: there is more common and shared usage in developing countries as opposed to developed countries, use of ICTs is private and individual. As such, the evaluation and further proposed solutions must take this fact into account. Moreover, following a systematic analysis, each region or country should preferably have a three-step model from the short-term, mid-term and long-term perspective to implement suitable solution for its own needs. A default or pre-defined solution must be avoided, as regions and countries have their own characteristics. And as Cullen (2001, 311) notes, the problems of the digital divide are both technologic and socioeconomic, so all aspects must be taken into account by searching solutions to bridge this gap.

Countries with a wide availability of internet access can advance the economics of that country on a local and global scale. In today's society, jobs and education are directly related to the Internet in that the advantages that come from the internet are significant so that neglecting them would leave a company vulnerable in a changing market. (Mishra 2012, 210).

In countries where the internet and other technologies are not accessible, education is suffering, and uneducated people and societies that are not benefiting from the information age cannot be competitive in the global economy Mishra (2012, 210) This leads to these countries, which tend to be developing countries, suffering greater economic downfall and richer countries advancing their education and economy.

Such technologies, according to Albert & Flournoy (2010), "*are now widely perceived to be not just a nice amenity among corporations and such non-profit organizations as universities but a* ***social and economic necessity for communities struggling to find their place in a rapidly changing world****. Today, citizens want and expect their local communities to be "wired"* ***for broadband digital transactions, whether for family, business, education or leisure."*** In addition, to attain maximum benefit from the wired and wireless network, the suitability between local strategies and local needs must be taken into account by the implementation and applications. Because ICTs are allowing local communities to contribute to the global markets**.**

The advantages offered by the telemedicine, which is according to Datta et al (2010) "*an information systems intensive method concerning the remote delivery of healthcare..."* have to be checked. They also noted that "*Telemedicine to any healthcare solution in the sub-Saharan Africa (SSA)- A starved society, home to 33 of the 48 least developed countries of the world, and suffering from a dire shortage on medical professionals."*

Therefore they plea "*the IS community to get involved in research that can help disadvantaged societies benefit from the tremendous potential of contemporary information* technology by *adopting an information systems approach to address these ongoing problems".*

While Zulu S. F.C. (2010) noted that:" A review of current ICT policies of selected African countries indicates that the policies are geared towards application of ICTs other than their production. The review also reveals a lack of appreciation for emerging ICTs in Africa, both at the national as well as the sub-regional economic bloc levels".

Future research must include the failing variables cited in the previous chapter, but in addition, the prevalence of today´s smartphone must be taken into account. This means that each measurement attempt of ICTs requires regularly updated variables regarding the chosen methodology. To complete the analysis, a regularly updated index also must be incorporated.

References

Albert, S. & Flournoy, D. (2010): Think Global, Act Local: How ICTs are Changing the Landscape in Community Development. International Journal of Sociotechnology and Knowledge Development 2 (1), p. 21. Available online at https://www.igi-global.com/gateway/article/39095#pnlRecommendationForm, checked on 6/26/2020.

Amiel, T.: Mistaking computers for technology: Technology literacy and the digital divide. In: *AACE Journal, 14 (3)* 2006, pp. 235–256.

Arquette, Toby J. (2001): Assessing the Digital Divide. Empirical Analysis of a Meta-Analytic Framework for Assessing the Current State of Information and Communication System Development,, 15.09.2001.

Atkinson, A. B. (1970): On the measurement of inequality. In *Journal of economic theory* 2, pp. 244–263. Available online at http://lib.cufe.edu.cn/upload_files/other/3_20140520031551_43.%20measurement%20of%20inequality%20of%20income.pdf.

Attewell, P. (2001): Comment: The First and Second Digital Divides. In *Sociology of Education* 74 (3), pp. 252–259. Available online at http://dx.doi.org/10.2307/2673277, checked on 6/25/2020.

Bagchi et al. (2007): Global diffusion of the internet IX: The internet growth in Africa: some empical results. In *Communications of the association for information system,Vol. 19 pp. 325-351.*

Bankhofer & Joenssen (2011): Hot-Deck-Verfahren zur Imputation fehlender Daten, available from http://www.db-thueringen.de/servlets/DerivateServlet/Derivate-24508/ilm1-2011200564.pdf

Barzilai-Nahon (2006): Gaps and bits: Conceptualizing measurements for digital divide/s. in *The information Society*, October 2006.

Barzilai, N. Gomez, R., Ambikar R. (2008): Conceptualizing a contextual measurement for the Digital: using an integrative narrative. With the collaboration of Ferro E.,

Bell, Daniel (1973): the coming of the post-industrial society: A Venture in Social Forecasting. New york: Basic Books.

Berrebi, Z.M. & Silber, J. (1985): Income inequality indices and deprivation: A generalization. In *The Quarterly Journal of Economics*, pp. 807–810.

Birdsall, W.: The digital divide in the liberal state: a Canadian perspective. In: *The First Monday* 5, 12 (2000). Available from http://pear.accc.uic.edu/ojs/index.php/fm/article/view/820/729.

Bonfadelli H. (1994): Wissenskluft-Perspektive: Massenmedien und gesellschaftliche Information. Konstanz: UVK Verl.-Ges.

Bonfadelli, Heinz (2002): The Internet and Knowledge Gaps: A Theoretical and Empirical Investigation. In *European Journal of Communication* 17 (1), pp. 65–84. DOI: 10.1177/0267323102017001607.

Bonfiglioli, Elena et.al. (2008): Digital Literacy Report: a review for the i2010 eInclusion initiative. COMMISSION STAFF WORKING DOCUMENT. Inclusion Ministerial Conference & Expo. Vienna / Austria.

Bortz, Jürgen (2005): Statistik. Für Human- und Sozialwissenschaftler, sechste Auflage. Wien: Springer.

Bollou et al. (2006): Is there a relationship between ICT, Health, education and development? An empirical analysis of five West African countries from 1997-2003, *The Electronic journal on Information Systems in Developing Countries*, 23 (5), pp. 1-11. Available from http://www.ejisdc.org

Bubaš, G. (2005): Competence in Computer-Mediated Communication: An Evaluation and Potential Uses of a Self-Assessment Measure. Manuscript submitted for presentation consideration. University of Zagreb, Croatia.

Bühner, Markus (2011): Einführung in die Test- und Fragebogenkonstruktion. 3., aktualisierte und erw. Aufl. München u.a: Pearson Studium (PS Psychologie).

Burch, S. (2005): The Information Society, the knowledge Society. In: *Word Matters: multicultural perspectives on information societies*. May 29, 2006. available from http://vecam.org/article517.html?lang=en, retrieved on 25 March, 2012.

Busemann K., Gscheidle C. (2012): Habitualisierung der Social Communitys. In *Media Perspektiven* 7 (8), pp. 380–390.

Camacho, K.: multicultural perspectives on information societies. In: *Word Matters: multicultural perspectives on information societies.* November 5, 2005. available from http://vecam.org/article549.html.

Cammaerts, Bart and Carpentier, Nico (2005): The unbearable lightness of full participation in a global context: WSIS and civil society participation. London, UK.: Media@LSE.

Campbell, Duncan (2001): Can the digital divide be contained? In *International Labour Review*, Vol. 140 (2)

Castells, Manuel: The network society. A cross-cultural perspective. Available from http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10471673.

Castells, Manuel (1999a): End of millennium. Rev. and updated ed. Massachusetts, Mass: Blackwell (The information age, economy, society and culture.).

Castells, Manuel (1999b): The rise of the network society. Repr. Massachusetts, Mass: Blackwell (The information age, economy, society and culture.).

Castells, Manuel (2005): Informationalism, Networks, and the Network Society: A Theoretical Blueprint. Network Society. A Cross-Cultural Perspective. Edited by Edward Elgar Publishing. Cheltenham [England], Northampton, MA, USA.

Castells, Manuel (2006): The Theory of the Network Society. Cambridge: Polity Press.

Ceriani, Lidia; Verme, Paolo (2012): The origins of the Gini index. Extracts from Variabilità e Mutabilità (1912) by Corrado Gini. In *J Econ Inequal* 10 (3), pp. 421–443. DOI: 10.1007/s10888-011-9188-x.

Chakraborty, Jayajit; Bosman, M. Martin (2005): Measuring the Digital Divide in the United States. Race, Income, and Personal Computer Ownership. In *The Professional Geographer* 57 (3), pp. 395–410. DOI: 10.1111/j.0033-0124.2005.00486.x.

Chéneau-Loquay A. (2010): Africa: On the Verge of a Telecommunications Revolution. Broad Trends in the Dissemination of Information Technology. In *Afrique contemporaine* 234 (2), pp. 93–112. Available online at URL: https://www.cairn.info/journal-afrique-contemporaine-2010-2-page-93.htm

Chinn M. & Fairlie R. (2004): The determinants of the global digital divide: A cross-country analysis of computer and internet penetration. *In Social Science Review Network*. Available from http://ssrn.com/abstract=519082

Chinn M. & Fairlies R. (2006): ICT Use in the Developing World. An analysis of Differences in Computer and Internet penetration. Working paper 06 (3), *Net Institute,* Sept. 2006. Available from www.NETinst.org

Cho Jaeho et al. (2003): Beyond access: The digital divide and the internet uses gratifications. In IT and Society, Volume 1, Issue 4, Spring 2003, pp. 46-72. Available from http://www.ITandSociety.org

Chowdhury, G. G.; Chowdhury, Sudatta (2011): Information users and usability in the digital age. New York: Neal-Schuman Publishers, Inc.

Churchill, Gilbert A. (1999): Marketing research. Methodological foundations. 7. ed. Fort Worth, Tex: The Dryden Press (The Dryden Press series in marketing). available from http://www.loc.gov/catdir/enhancements/fy1505/98071246-b.html.

Cilan et al. (2008): Analyzing digital divide within and between members and candidate countries of European Union. In *Government Information Quarterly*, 26, (2009), pp. 98-105.

Compaine, Benjamin M.: The digital divide. Facing a crisis or creating a myth? Available from http://site.ebrary.com/lib/academiccompletetitles/home.action.

Constantin et al. (2006): Measuring and comparing changes in the "digital divide" through time: A structural equation modelling approach. Paper proposed at the 16th Biennial Conference of the International Telecommunications Society, Beijing June 12-16 2006.

Corrocher, N.; Ordanini A. (2002): Measuring the digital divide: a framework for the analysis of cross-country differences. In: *Journal of Information Technology* 2002, S. 9–19.

Costello, A. B., & Osborne, J. W. (2005): Exploratory Factor Analysis: Four recommendations for getting the most from your analysis. In *Practical Assessment, Research and Evaluation* 10 (7), pp. 1–9.

Crawford, S. (1983): The Origin and Development of a Concept: The Information Society. In *Bulletin of the Medical Llibrary Asociation* 71 (4), pp. 380–385. Available online at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC227258/?page=1, checked on 7/16/2019.

Cuberes, David (2008): The diffusion of Internet: A cross-country analysis. *MPRA paper* n° 8433, April 2008. Available from http://mpra.ub.uni-muenchen.de/8433/.

Cullen, R. (2001): Addressing the digital divide. In *Online Information Review* 25 (5), pp. 311–320. Available online at https://doi.org/10.1108/14684520110410517, checked on 7/24/2019.

Datta P, et al. (2010): Extending the Social Identity of Information Systems: Telemedicine Transfer to Sub-Saharan Africa. In *Journal of Information Technology Research* 3 (2), pp. 18–33. Available online at https//www.igi-global.com/gateway/article/42104, checked on 7/4/2019.

Degele, Nina (2000): Zur Transformation von Wissen durch Neue Medien. Neue Medien im Alltag. Wiesbaden: VS Verlag für Sozialwissenschaften.

Dewan S. et al. (2005): Across the digital divide: A cross-country multi-technology analysis of the determinants of IT penetration. In *Journal of the Association for Information Systems,* 6(12), pp. 409-432.

Dewan S. & Riggins F. (2005): The digital divide: current and future research direction. In *Journal of the Association for Information Systems*, 2005

Dijk, J., van & Hacker, K. (2003): The Digital Divide as a Complex and Dynamic Phenomenon. In *The Information society* 19 (4), pp. 315–326. Available online at http://dx.doi.org/10.1080/01972240309487

Dijk, Jan A. G. M. van (2005): The deepening divide. Inequality in the information society. Thousand Oaks, Calif: SAGE. available from http://www.loc.gov/catdir/enhancements/fy0658/2004022909-d.html.

Dijk, Jan A. G. M. van (2006): Digital divide research, achievements and shortcomings. In *poetics* 34 (4-5), pp. 221–235. Available online at https://doi.org/10.1016/j.poetic.2006.05.004, checked on 24.072019.

DiMaggio P.; Hargittai, E. (2001): "From the 'digital divide' to 'digital inequality': Studying Internet use as penetration increases,". Working Paper, Princeton, N.J. Center for Arts and Cultural Policy Studies.

Dimaggio, P., Robinson, J. P., & Hargittai, E. (2003): New Social Survey Perspectives On The Digital Divide. In *Information Technology & Society* 1 (4). Available online at http://www.ITandSociety.org, checked on 7/25/2018.

Dolnicar, V. et al. (2003): Advanced measuring of the digital divide: Multivariate interactions and digital distance, Vol. 2004, University of Ljubljana, Slovenia.

Durampart, P. (2007): Les TICE à l'épreuve de l'interculturel, entre modèle du Nord et pratiques du Sud. Sommaire. Université Lyon, Lyon. Etudes Politiques. available from http://doc.sciencespo-lyon.fr/Signal/index.php?r=article/view&id=135813&highlight=durampart.

Dutta, Soumitra; Jain, Amit; Meyer, Arnoud; Richter, Gérard (2006): The Information Society in an Enlarged Europe. Available from http://dx.doi.org/10.1007/3-540-33156-5.

Dwivedi Y.K., Ramon G, Williams M.D. In: *Constructing an Equitable and Competitive information society*, September 2008. Available from https://www.researchgate.net/profile/Karine_Nahon/publication/242513480_Conceptualizing_a_contextual_measurement_for_digital_divides_Using_an_integrated_narrative/links/5555030a08aeaaff3bf45807.pdf

Eckey, Hans-Friedrich; Kosfeld, Reinhold; Rengers, Martina (2002): Multivariate Statistik. Grundlagen - Methoden - Beispiele. 1. Aufl. Wiesbaden: Gabler (Gabler-Lehrbuch).

Eid, Michael; Gollwitzer, Mario; Schmitt, Manfred (2015): Statistik und Forschungsmethoden. 4., überarbeitete und erweiterte Auflage. Available from http://www.content-select.com/index.php?id=bib_view&ean=9783621282482.

Fidan Huseyin (2016): Measurement of the Intersectoral Digital Divide with the Gini Coefficients: Case Study Turkey and Lithuania. In *Engineering Economics* 27 (4). Available online at https://doi.org/10.5755/j01.ee.27.4.13882, checked on 7/25/2019

Fuchs, Christian (2008): The Role of Income Inequality in a Multivariate Cross-National Analysis of the Digital Divide. In Social Science Computer Review Vol. 20 (10), April 2008. Available from http://online.sagepub.com

Fuchs, Christian; Horak, Eva (2008): Africa and the digital divide. In: *Telematics and informatics : an international journal* 25 (2), S. 99–116.

Gapski, Harald (2009): Jenseits der digitalen Spaltung: Gründe und Motive zur Nichtnutzung von Computer und Internet. München, Dusseldorf, HH Verlag, Medienkompetenz NRW, Band 9. Available from http://www.grimme-institut.de/schriftenreihe/downloads/srmk_leseprobe_band_9.pdf

Garcia-Jimenez & Gomez-Barroso (2009): Universal Service in a Broader Perspective: The European Digital Divide. In *Informatica Economică* 3 (2). Available online at https://core.ac.uk/reader/27259938.

Gartner Group (2001): The Digital Divide and American Society Information Policy Summit.

Gastwirth J. L. (1972): The Estimation of the Lorenz Curve and Gini Index. In *The Review of Economics and Statistics* 54 (3), pp. 306–316. Available online at doi:10.2307/1937992.

Gaziano, Cecilie (2014): Components of the Belief Gap. In *SAGE Open* 4 (1), 215824401351805. DOI: 10.1177/2158244013518052.

Gillen Martina (2010): for All of our languages We are not natives here: challenging the Idea of the digital native, Rethinking the digital divide. In *International Journal of Innovation in the Digital Economy* 1 (3), pp. 40–45. Available online at DOI:10.4018/jide.2010070103, checked on 6/25/2020.

Grabara, J., Kolcun, M., & Kot, S. (2014): The Role of Information Systems in Transport Logistics. In *International Journal of Education and Research* 2 (2), pp. 1–8. Available online at https://www.ijern.com/journal/February-2014/25.pdf, checked on 6/25/2020.

Grigorovici et al. (2004): InfoMetrics: A structural equation modelling approach to information indicators and "e-readiness" measurement. Paper proposed for the presentation at the 15th Biennial Conference of the International Telecommunication Society. Berlin, 5-7 September 2004.

Gui M. & Argentin G: (2011): Digital skills of internet natives: Different forms of digital literacy in a random sample of northern Italian high school students. In *New Media & Society* 13 (6), pp. 963–980, checked on 7/11/2019.

Guichard, Eric (2003): Does the digital divide exist? Available from https://halshs.archives-ouvertes.fr/halshs-00343373/document

Gunkel, D. (2003): Second thoughts: Toward a critique of the digital divide. London, Thousand Oaks, CA and New Delhi: SAGE (5), S. 499–522.

Hargittai, E. (2002): Second-Level Digital Divide: Differences in People's Online Skills. In *First Monday* 7 (4). Available online at https://doi.org/10.5210/fm.v7i4.942.

Hargittai, Eszter (2003): The digital divide and what to do about it. In: *New economy handbook*, S. 821–839.

Hargittai, Eszter (2004): Internet Access and Use in Context. In *New Media & Society* 6 (1), pp. 137–143. DOI: 10.1177/1461444804042310.

Haseloff, Anikar Michael (2007): Public network access points und der digital divide. Eine empirische Untersuchung der Bedeutung von öffentlichen Internetzugängen für Entwicklungsländer am Fallbeispiel Indien. Univ., Diss--Augsburg, 2006. available from http://www.opus-bayern.de/uni-augsburg/volltexte/2007/570/pdf/Haseloff_Internetzugaenge.pdf.

Hilbert, M., López, P., & Vásquez, C. (2016): Information Societies or "ICT Equipment Societies?" Measuring the Digital Information-Processing Capacity of a Society in Bits and Bytes. In *The Information society* 26 (3), pp. 157–178. Available online at doi:10.1080/01972241003712199, checked on 6/25/2020

Hatzinger, Reinhold; Nagel, Herbert (2009): PASW Statistics. Statistische Methoden und Fallbeispiele. 1. Auflage. München: Pearson Studium (Scientific Tools).

Hindman, Douglas Blanks (2000): The Rural-Urban Digital Divide. In *Journalism & Mass Communication Quarterly* 77 (3), pp. 549–560. DOI: 10.1177/107769900007700306.

Hoffman, D. L., Novak, T. P., & Schlosser, A. E. (2001): The evolution of the digital divide. Examining the relationship of race to internet access and usage over time: B.M.

Hüsing T. & Selhofer H. (2004): DIDIX: A digital divide index for measuring inequality in IT diffusion. In *IT & Society*, Vol. 1 (7) Spring/Summer 2004, pp. 21-38. Available from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.137.4016&rep=rep1&type=pdf

Ifinedo & Davidrajuh (2005): Digital divide in Europe: assessing and comparing the e-readiness of a developed and emerging economy in the Nordic region. In *Electronic Government: An International Journal*, Vol 2, February 2005.

Isko et al. (2005): Differences in Computer Usage - Social inequality and informal education. In *Social Work & Society* Vol. 3, Issue 2, 2005. Available from http://www.socwork.net/IskeKleinKutscher2005.pdf ITU (2003):

ITU Digital Access Index: World's First Global ICT Ranking. Available online at https://www.itu.int/newsarchive/press_releases/2003/30.html, checked on 7/24/2019.

ITU (2005): Building digital bridges. Geneva, 2005

ITU (2006): World Information Society Report, first edition, 2006 available at www.itu.int/wist

ITU (2009): HRD/HRM Survey on Current and Future Needs and Priorities in a Converged, Competitive Telecommunications/ICT Environment,. ITU. Geneva.

ITU (2011): Yearbook of statistics, telecommunication, ICT indicators 2001 - 2010.

Available from http://www.itu.int/ITU-D/ict

James, Jeffrey (2003): Bridging the global digital divide. Cheltenham, UK, Northampton, MA: Edward Elgar.

James, Jeffrey (2009): From the relative to the absolute digital divide in developing countries. In *Technological forecasting & social change* 76 (8), pp. 1124–1129. https://www.sciencedirect.com/science/article/pii/S0040162509000195

James, Jeffrey (2012): The ICT Development Index and the digital divide. How are they related? In *Technological forecasting & social change : an international journal* 79 (3), pp. 587–594. https://doi.org/10.1016/j.techfore.2011.08.010

James, Jeffrey (2013): The diffusion of IT in the historical context of innovations from developed countries. In *Social indicators research* 111, pp. 175–184. Available online at https://doi.org/10.1007/s11205-011-9989-0, checked on 7/18/2019.

Jeffres, Leo W.; Neuendorf, Kimberly; Atkin, David J. (2012): Acquiring Knowledge From the Media in the Internet Age. In *Communication Quarterly* 60 (1), pp. 59–79. DOI: 10.1080/01463373.2012.641835

Jensen, M. (2003): The Evolution of the Internet in Africa. New Delhi: Tata McGraw-Hill.

Jin, J., & Cheong, A. W. H. (2008). Measuring Digital Divide: The Exploration in Macao. *Observatorio (OBS) Journal*, 2(3), 259–272. Available from http://obs.obercom.pt

Juanals B., Perriault J. (2005): «Les systèmes d'information en milieu désorganisé: pour une mobilisation de ressources en ligne dans des situations d'urgence». Bordeaux: Presses Universitaires de Bordeaux (Enjeux et usages sociaux des T.I.C: aspects sociaux et culturels) (1), pp. 21–35.

KADO: How to measure the digital divide? available from https://www.itu.int/osg/spu/ni/digitalbridges/presentations/02-Cho-Background.pdf, retrieved on 15.11.2013.

Kakwani N. C. (1977): Applications of Lorenz curves in economic analysis. In *Econometrica: Journal of the Econometric Society* 45, pp. 719–727.

Kang, B-S. (2009): Bridging the Digital Divide between Urban and Rural Areas: Experience of the Republic of Korea, IDD/TP-09-07 (Version 1.0.), Technical paper, ESCAP, Bangkok.

Katz R.L. & Koutroumpis P. (2013): Measuring digitization: A growth and welfare multiplier. In *Technovation* 33 (10-11), pp. 314–319. Available online at https://www.sciencedirect.com/science/article/pii/S0166497213000667, checked on 7/5/2019.

Kerrouche E. (2008): L'analyse factorielle, France, P20.

Kizza, Joseph M. (2013): Ethical and social issue in the information age. London, Springer.

Kling, R. (2000): Learning about information technologies and social change: The contribution of social informatics. (16). In: *The Information society* (3), S. 217–232.

Kouadio (2008): The Digital Divide Still an Issue: Regensburger Bibliothek, available from urn:nbn:de:bvb:355-opus-9420

Kouadio (2014): Digital Divide Study: ICT Access and Use by International Students at the University of Regensburg. SSRN, available from http://ssrn.com/abstract=2577205

Kovačić & Caramat (2005): An alternative measure of the digital divide between arab countries. The Second International Conference on Innovations in Information Technologies (IIT′ 05).

Kubicek, Paul (2003): The European Union & Democratization. Reluctant States. 1st ed. Florence: Taylor and Francis (Europe and the Nation State).

Kuhlen R. (2004): Informationsethik: Umgang mit Wissen und Information in elektronischen Räumen. Konstanz: UVK Verlag-Gesellschaft.

Lachmayr, Norbert (2003): Digital divide und kommerzielle Internetcafés. Utopie der unbeschränkten Zugangsmöglichkeit. Teilw. zugl.: Wien, Univ., Diss., 2002 u.d.T.:

Lenox, M.F. & Walker, M.L. (1993): Information literacy in the educational process. In *The Educational Forum* 57 (3), pp. 312–324.

Machlup, F. (1962): The Production and Distribution of Knowledge in the United States. Princeton, N.J: Princeton University Press

Maclachlan I. & Sawada R. (1997): Measures of income inequality and social polarization in Canadian metropolitan areas. In *Wiley Online Library* 41 (4), pp. 377–397. Available online at https://doi.org/10.1111/j.1541-0064.1997.tb01322.x.

Margarita Billon, Fernando Lera-Lopez, Marco (2010): Differences in digitalization levels: a multivariate analysis studying the global digital divide. Review of World Economics, Springer Verlag, 146(1). pp. 39-73 10.1007/s10290-009-0045-y . hal-00563602

Martin S. & Robinson J. (2007): The income digital divide: Trends and predictions for levels of internet use. In *Social Problems*, Vol. 54, Issue 1, pp. 1-21.

Martin, Steven P. (2003): Is the digital divide really closing? A critique of inequality measurement in a Nation Online. In *IT & Society*, Vol. 1, Issue 4, Spring 2003, pp. 1-13. Available from http://www.ITandSociety.org.

Matic, I. (2006): Digital Divide in Istria. Dissertation. Ohio University, Ohio.

Mbatha B.T. et al. (2011): Diffusion and adoption of ICTs in selected government departments in KwaZulu-Natal, South Africa. In *Information Development* 28 (4), pp. 251–263, checked on 7/18/2019.

Melnikas, B. (2011): Knowledge Economy: Synergy Effects, Interinstitutional Interaction and Internationalization Processes. In *Engineering Economics* 22 (4), pp. 367–379. Available online at http://dx.doi.org/10.5755/j01.ee.22.4.712, checked on 6/25/2020

Mishra J.P. (2012): Encyclopaedia of eCommerce, eGovernment and Digital Models for Business Vol. II. New Dehli: Mohit Publications (II).

Moosberger, k., Tolbert,C., & Stansbury, M. (2003): Virtual inequality: Beyond the Digital Divide. Washington D.C: Georgetown University Press.

Moosbrugger, Helfried (2012): Testtheorie und Fragebogenkonstruktion. Mit 66 Abbildung und 41 Tabellen. 2., aktual. und überarb. Aufl. Berlin: Springer (Springer-Lehrbuch).

Murray, J. (2011): Cloud network architecture and ICT. Available from http://itknowledgeexchange.techtarget.com/modern-network-architecture/cloud-network-architecture-and-ict/, retrieved on July 08, 2012.

Ngwenyama et al. (2006): Is there a relationship between ICT, health, education and development? An empirical analysis of five west African countries from 1997-2003. In *the Electronic Journal on Information Systems in Developing Countries*, Vol. 23, (pp 1-11).

Norris, Pippa (2001): Digital divide. Civic engagement, information poverty, and the Internet worldwide. Cambridge: Cambridge Univ. Press (Communication, society and politics). available from http://www.loc.gov/catdir/description/cam021/2001025407.html.

NTIA (1995): Falling through the Net: A Survey of the "Have Nots" in Rural and Urban America. Available online at https://www.ntia.doc.gov/ntiahome/fallingthru.html, checked on 7/24/2018.

NTIA (1999): Falling Through the Net: Defining the Digital Divide. A Report on the Telecommunications and Information Technology Gap in America. Available online at http://www.ntia.doc.gov/ntiahome/fttn99/fttn.pdf, checked on 7/24/2018.

Nunnally, Jum C.; Bernstein, Ira H. (1994): Psychometric theory. 3. ed. New York: McGraw-Hill (McGraw-Hill series in psychology). Available from http://www.loc.gov/catdir/description/mh022/93022756.html.

OECD (2001): Understanding the Digital Divide. Paris: OECD

OECD (2001): Measuring the Information Economy. Paris: OECD

Osborne & Costello (2005): Best practices in exploratory factor analysis. In *practical assessment, research and evaluation*, Vol. 10 (7), July 2005. Available from http://pare-online.net/pdf/v10n7.pdf

Parker, Edwin B. (2000): Closing the digital divide in rural America. In: *Telecommunications policy : the assessment, control and management of developments in telecommunications and information systems* 24 (4), S. 281–290.

Perkins R. & Neumayer E. (2005): The international diffusion of the new technologies: a multitechnology analysis of latecomer advantage and global economic integration. London: LSE Reasearch Online. Available at: http://eprints.lse.ac.uk/605/

Peacock, Sylvia E.: Challenges to modernity: the digital divide. Die digitale Spaltung. Univ., Habilschr.--Erfurt, 2007. available from http://www.db-thueringen.de/servlets/DerivateServlet/Derivate-11901/peacock.pdf.

Peña-Lopez, I: (2007): Unpeeling the layers of the digital divide: catagory thresholds and relationship within composite indices. Available from http://ictlogy.net/presentations/20070724_ismael_pena-lopez_unpeeling_layers_digital_divide.pdf

Pick J. & Azari R. (2007): Worldwide digital divide: Influence of education, workforce economic, and policy factors on information technology. *SIGMIS-CRP*, April 19-21 2007, St. Louis Missouri.

Pick J.B., Sarkar A. (2015) Historical Background. In: The Global Digital Divides. Progress in IS. Springer, Berlin, Heidelberg

Pinkett, R. (2002): The digital divide. San Diego, CA: Academic Press.

Qureshi, Sajda (2012): As the global digital divide narrows, who is being left behind? In *Information Technology for Development* 18 (4), pp. 277–280. Available online at DOI: 10.1080/02681102.2012.730656, checked on 7/25/2019.

Rhee H. & Riggins F. J. (2007): Development of a multi-factor set of country-level ICT Human resource capacity indicators. Incheon City: UN-APCICT. Available from

http://www.unapcict.org/ecohub/resources/development-of-a-multi-factor-set-of-country-level

Riccardini & Fazio (2002): Measuring the digital divide. IAOS Conference, Draft, London 2002.

Roger, E. (1995): Diffusion of innovation. 4th ed. New York, London, Free Press

Roger, E. (2003): Diffusion of innovation. 3th ed. New York, London, Free Press

Rouse, M. (2005): whatIs.com. Available from http://whatis.techtarget.com/definition/Information-Society, retrieved on 20.07.2012.

Rouse, M. (2011): whatIs.com. Available from http://whatis.techtarget.com/definition/Information-Society, retrieved on 20.07.2014.

Rouse, M. (2015): whatIs.com. Available from http://whatis.techtarget.com/definition/Information-Society, retrieved on 25.07.2019.

Roycroft T. R. & Anantho S. (2003): Internet subscription in Africa: policy for a dual digital divide. In *Telecommunications Policy* 27, (2003), pp. 61-74. Available from http://www.sciencedirect.com/science/article/pii/S0308596102000915

Russell, Daniel W. (2002): In *search of underlying dimensions*. The use (and abuse) of factor analysis in Personality and social psychology bulletin. Thousand Oaks Calif: Sage Publ.

Sallai, G. (2012): Defining infocommunications and related terms (9). In: *Acta Polytechnica Hungarica* (6). Available from http://www.uni-obuda.hu/journal/Sallai_38.pdf, retrieved on 08.03.2013.

Saltelli, Andrea (2006): Composite indicators between analysis and advocacy. Social Indicators Research, 2007, pp. 65-77.

Schleife, Katrin (2008): Empirical analyses of the digital divide in Germany. Age-specific and regional aspects. Techn. Univ., Diss--Darmstadt, 2008. Available from http://tuprints.ulb.tu-darmstadt.de/1086/1/Schleife_diss_final.pdf.

Schowdhury G. & Schowdhury S. (2011): Information users and usability in the digital age, London, Facet Publ.

Schumacker R.E. and Lomax R. G. (2010): A beginner's guide to structural equation modeling. New York: Routledge.

Sciadas, G. (2004): International Benchmarking for the Information Society. Busan: ITU. Available online at http://www.itu.int/osg/spu/ni/digitalbridges/docs/background/BDB-intl-indices.pdf, checked on 7/26/2015.

Sciadas, G. (2005): Unveiling the digital divide, Science, Innovation and Electronic Information Division,. research paper.

Sedimo, N. C., Bwalya, K. J., & Plessis, T. D. (2011): Conquering the Digital Divide: Botswana and South Korea Digital Divide Status and Interventions. In *SA Journal of Information Management* 13 (1), Art, #471. Available online at http://dx.doi.org/10.4102/sajim.v13i1.471, checked on 6/25/2018.

Servon L. J., Nelson M. K. (2001): Community technology centers: Narrowing the digital divide in low-income, urban communities. In *Journal of Urban Affairs* 23 (3-4), pp. 279–290. Available online at https://onlinelibrary.wiley.com/doi/pdf/10.1111/0735-2166.00089, checked on 7/26/2015.

Servon, Lisa J. (2002): Bridging the digital divide. Technology, community, and public policy. Available from http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10232863.

Stevenson, W. (1997): The information and telecommunication technology in UK schools: an independent inquiry. London. Available from http://rubble.heppell.net/stevenson/ICT.pdf, retrieved on 07.07.2012.

Tichenor et al. (1970): Mass media flow and differential growth in knowledge. In *Public Opinion Quarterly* 34 (2), pp. 159–170. Available online at https://doi.org/10.1086/267786, checked on 7/25/2014.

Timm N.H. (2002): Applied Multivariate Analysis. New York: Springer-Verlag.

Trkulja, Violeta (2010): Die digitale Kluft. Bosnien-Herzegowina auf dem Weg in die Informationsgesellschaft. Univ., Diss.--Düsseldorf, 2009. 1. Aufl. Wiesbaden: VS Verl. für Sozialwiss (VS Research).

Vaughn, R. B.; Henning, R.; Siraj, A. (2003): Information assurance measures and metrics - state of practice and proposed taxonomy. In : Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS-36). (36th Hawaii International

Conference on System Sciences (HICSS-36) Hilton Waikoloa Village, Hawaii Jan 6-9, 2003).

UNESCO (2010): Information development news. In *Information Development* 26 (3). Available online at DOI: 10.1177/0266666910376355, checked on 7/12/2018.

Vehover et al. (2006): Methodological challenge for digital divide measurements. In *the Information Society*, Vol. 22, pp. 279-290

Vicente Cuervo & López Menéndez (2006): A multivariate framework for the analysis of the digital divide: Evidence for the European Union-15, *Information and management*, 43 (6), pp. 756-766. Available online at https://www.sciencedirect.com/science/article/abs/pii/S0378720606000486

Vicente Cuervo & López Menéndez (2014): Inequalities in the information society: A statistical approach to the digital divide. Departamento de Economía Aplicada Universidad de Oviedo. Available online at https://www.researchgate.net/publication/228337139, checked on 7/24/2019.

Wang, J. et al. (2010): Assessment and Contrast of the Effects of Information and Communication Technology. In *International Journal of Information Communication Technologies and Human Development* 2 (1), pp. 18–42. Available online at doi:10.4018/jicthd.2010010102, checked on 7/5/2019.

Warschauer, Mark (2002): Reconceptualizing the digital. In *The first Monday. Vol 7, Issue 7, july 2002.*

Warschauer, Mark (2003): Technology and social inclusion. Rethinking the digital divide. Available from http://site.ebrary.com/lib/academiccompletetitles/home.action.

Warschauer, Mark (2011): A literacy approach to the digital divide. M. A. Pereyra. Malaga (Las mulialfabetizaciones en el espacio digital). Available online at http://www.education.uci.edu/person/warschauer_m/docs/lit-approach.pdf.

Weber R. H. & Menoud V. (2009): The information society and the digital divide: legal strategies to finance global access. In *International Journal of Communications Law & Policy*. Issue 13, winter 2009.

Webster Frank (2006): Theories of the information society. Third edition, London: Routledge

Webster Frank (2014): Theories of the information society. Third edition, London: Routledge

WEF (2016): The Global Competitiveness Report 2016-2017. World Economic Forum. Geneva, Switzerland

Wei, L., & Hindman, D. B. (2011): Does the Digital Divide Matter More? Comparing the Effects of New Media and Old Media Use on the Education-Based Knowledge Gap. In *Mass Communication and Society* 14 (2), pp. 216–235. Available online at http://dx.doi.org/10.1080/15205431003642707, checked on 6/25/2020.

Welsch Johann (2002): Die schleichende Spaltung der Wissengesellschaft. In *WSI Mitteilungen*, 4. 2002.

Wittenberg, Reinhard; Cramer, Hans (2003): Datenanalyse mit SPSS für Windows. Mit zahlreichen Tabellen. 3., neubearb. Aufl. Stuttgart: Lucius & Lucius (UTB, 1841).

Wilhelm, Anthony G. (1998): Closing the digital divide. Enhancing Hispanic participation in the information age, Claremont, CA: Tomás Rivera Policy Institute.

Wilhelm Anthony G. (2000): Democracy in the Digital Age: Challenges to Political Life in Cyberspace. Routledge.

Wilhelm Anthony G. (op. 2004): Digital nation. Toward an inclusive information society. Cambridge (Mass.), London: MIT.

World Bank (1999): World Development Report 1998/99: Knowledge for Development. World Bank. Washington, D.C. Available online at http://go.worl.org dbank /F80RASFGQ0, checked on 2/25/2012.

World Bank (2007): World Development Report 2008: Agriculture for Development. Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/5990 License: CC BY 3.0 IGO Available online at http://hdl.handle.net/10986/5990

Yu Liangzhi (2006): Understanding information inequalities: Making sense of the literature of the information and digital divides. In Journal of Librarianship and Information Science, 2006. Available at http://lis.sagepub.com/cgi/content/abstract/38/4/229

Zelazny, R. (2015): Model of Information Society Measurement – Framework and Selected Outcomes. In *Economics and Sociology* 8 (3), pp. 245–259. Available online at DOI:10.14254/2071-789X.2015/8-3/17, checked on 7/15/2019.

Zillien, Nicole; Haufs-Brusberg, Maren (2014): Wissenskluft und Digital Divide. 1. Ed. Baden-Baden: Nomos (Konzepte, 12).

Zulu Saul F.C. (2010): Emerging Information and communication Technology policy Framework for Africa. In *International journal of ICT Research and Development in Africa* 1 (3), pp. 46–64. Available online at https://www.igi-global.com/gateway/article/51589#pnlRecommendationForm, checked on 7/4/2019.

Appendices

Appendix A: ICT Global Index (IGI)

Ranking	Countries	Scores
1	Korea	5,79
2	Switzerland	5,41
3	Sweden	5,4
4	Denmark	5,28
5	Singapore	5,24
6	Norway	5,23
7	Germany	5,22
8	Finland	5,08
9	Netherlands	4,99
10	Luxembourg	4,97
11	UK	4,97
12	US	4,95
13	France	4,86
14	Japan	4,73
15	Canada	4,71
16	Hong Kong	4,65
17	Monaco	4,64
18	Liechtenstein	4,56
19	Cayman Islands	4,42

Ranking	Countries	Scores
20	Australia	4,39
21	Slovenia	4,34
22	Israel	4,31
23	Faroe Islands	4,27
24	Gibraltar	4,18
25	Andorra	4,14
26	Slovak Rep.	3,99
27	Estonia	3,95
28	Iceland	3,94
29	Belgium	3,84
30	Hungary	3,84
31	Macau	3,78
32	Ireland	3,67
33	Austria	3,67
34	Czech Rep.	3,57
35	Croatia	3,47
36	Taiwan	3,37
37	Lithuania	3,36
38	Cyprus	3,28
39	Russia	3,13
40	United Arab Emirates	3,11

Ranking	Countries	Scores
41	Italy	3,08
42	Poland	2,98
43	Greece	2,94
44	Spain	2,91
45	Antigua & Barbuda	2,9
46	Latvia	2,85
47	New Zealand	2,84
48	Qatar	2,8
49	Kazakhstan	2,71
50	Brunei	2,68
51	Kuwait	2,66
52	St. Kitts & Nevis	2,63
53	Bahrain	2,57
54	Barbados	2,45
55	Greenland	2,39
56	Aruba	2,25
57	Malta	2,25
58	French Polynesia	2,24
59	Bahamas	2,17
60	Romania	2,17
61	Ukraine	2

Ranking	Countries	Scores
62	Bulgaria	1,99
63	Malaysia	1,76
64	Serbia	1,74
65	Oman	1,7
66	Portugal	1,68
67	Moldova	1,64
68	Chile	1,62
69	Suriname	1,62
70	Saudi Arabia	1,6
71	Seychelles	1,58
72	Montenegro	1,54
73	Trinidad & Tobago	1,52
74	Armenia	1,51
75	China	1,39
76	Belarus	1,33
77	Puerto Rico	1,32
78	Libya	1,23
79	TFYR Macedonia	1,2
80	Bosnia & Herzegovina	1,03
81	Equatorial Guinea	1,02
82	St. Vincent & Grenadin	1,01

Ranking	Countries	Scores
83	Dominica	0,9
84	Azerbaijan	0,89
85	Lebanon	0,86
86	Albania	0,84
87	Panama	0,81
88	Venezuela	0,8
89	Uruguay	0,77
90	Iran	0,75
91	Mauritius	0,71
92	Argentina	0,7
93	Grenada	0,6
94	Mexico	0,58
95	Brazil	0,57
96	St. Lucia	0,39
97	Jordan	0,36
98	Colombia	0,33
99	Tonga	0,17
100	Kyrgyzstan	0,1
101	South Africa	0,06
102	Jamaica	0,05
103	Gabon	-0,01

Ranking	Countries	Scores
104	Nauru	-0,07
105	Fiji	-0,07
106	Turkey	-0,11
107	Maldives	-0,11
108	Tunisia	-0,26
109	Botswana	-0,3
110	Turkmenistan	-0,31
111	Egypt	-0,36
112	Mongolia	-0,38
113	Peru	-0,54
114	Georgia	-0,54
115	Morocco	-0,57
116	Sri Lanka	-0,75
117	Cuba	-0,76
118	Thailand	-0,8
119	Belize	-0,8
120	El Salvador	-0,82
121	Vietnam	-1,04
122	Dominican Rep.	-1,09
123	Philippines	-1,09
124	Cape Verde	-1,23

Ranking	Countries	Scores
125	Costa Rica	-1,24
126	Samoa	-1,24
127	Algeria	-1,26
128	Bolivia	-1,3
129	Paraguay	-1,32
130	Guyana	-1,47
131	Uzbekistan	-1,48
132	Angola	-1,49
133	Vanuatu	-1,55
134	Tuvalu	-1,58
135	Nicaragua	-1,58
136	Ecuador	-1,62
137	Tajikistan	-1,68
138	Namibia	-1,72
139	Kiribati	-1,73
140	Iraq	-1,75
141	Syria	-1,79
142	Micronesia	-1,92
143	D.R.P. Korea	-1,95
144	Honduras	-1,96
145	Guatemala	-1,99

Ranking	Countries	Scores
146	Kenya	-2,01
147	Marshall Islands	-2,02
148	Bhutan	-2,03
149	Indonesia	-2,16
150	Congo	-2,29
151	Solomon Islands	-2,29
152	India	-2,58
153	Djibouti	-2,63
154	Ghana	-2,75
155	Yemen	-2,79
156	Nigeria	-2,8
157	Swaziland	-2,85
158	Cote d´Ivoire	-3,13
159	Pakistan	-3,27
160	Zambia	-3,6
161	Lesotho	-3,79
162	Myanmar	-3,79
163	Senegal	-3,83
164	Cambodia	-3,87
165	Gambia	-3,87
166	Haiti	-3,95

Ranking	Countries	Scores
167	Sao Tomé & Principe	-3,96
168	Benin	-3,97
169	Lao P.D.R.	-4,04
170	Sudan	-4,05
171	Papua New Guinea	-4,13
172	Rwanda	-4,19
173	Bangladesh	-4,23
174	Uganda	-4,27
175	Comoros	-4,28
176	Eritrea	-4,34
177	Zimbabwe	-4,4
178	Cameroon	-4,54
179	Malawi	-4,57
180	Liberia	-4,57
181	Guinea Bissau	-4,62
182	Guinea	-4,7
183	Togo	-4,73
184	Congo (Dem. Rep.)	-4,74
185	Timor Leste	-4,83
186	Sierra-Leone	-4,87
187	Afghanistan	-4,89

Ranking	Countries	Scores
188	Mali	-4,96
189	Burundi	-4,99
190	Somalia	-5,04
191	Chad	-5,11
192	Burkina Faso	-5,23
193	Ethiopia	-5,25
194	Central African Rep.	-5,55
195	Niger	-5,59
196	Madagascar	-5,6
197	Tanzania	-5,62
198	Mauritania	-5,74
199	Nepal	-5,9
200	Mozambique	-6

Appendix B: Sub Variable ACCESS

Ranking	Countries	Scores
1	France	2,79
2	Gibraltar	2,57
2	Hong Kong	2,5
4	Cayman Islands	2,49
5	Monaco	2,46
6	Luxembourg	2,45
7	Korea	2,43
8	Denmark	2,37
9	Switzerland	2,18
10	Liechtenstein	2,16
11	Sweden	2,16
12	Singapore	2,1
13	Finland	2,08
14	Germany	2,07
15	Netherlands	2,05
16	UK	2,05
17	Japan	2,04
18	Macau	2,01
19	Taiwan	1,97
20	Norway	1,95
21	Faroe Islands	1,91
22	Portugal	1,9
23	Iceland	1,85
24	Andorra	1,77
25	US	1,76
26	Israel	1,75
27	Italy	1,71
28	China	1,69
29	Canada	1,65
30	Austria	1,63
31	Australia	1,6
32	Slovenia	1,58
33	Greece	1,55
34	Antigua & Barbuda	1,5
35	Kuwait	1,47
36	Croatia	1,44
37	St. Kitts & Nevis	1,44
38	Malta	1,42
39	Barbados	1,41
40	United Arab Emirates	1,4
41	Spain	1,4
42	Belgium	1,36
43	New Zealand	1,33
44	Estonia	1,25

Ranking	Countries	Scores
45	Ireland	1,23
46	Cyprus	1,23
47	Hungary	1,21
48	Russia	1,2
49	Uruguay	1,16
50	Brunei	1,07
51	Aruba	1,05
52	Slovak Rep.	1,03
53	Greenland	1,02
54	Bahrain	0,99
55	Bahamas	0,98
56	Montenegro	0,96
57	Lithuania	0,95
58	Libya	0,94
59	Belarus	0,91
60	Qatar	0,88
61	Saudi Arabia	0,88
62	Czech Rep.	0,86
63	Venezuela	0,86
64	Poland	0,85
65	Suriname	0,82
66	Mexico	0,78
67	Romania	0,74
68	Chile	0,71
69	Seychelles	0,71
70	Argentina	0,71
71	Oman	0,69
72	Dominica	0,68
73	Latvia	0,65
74	Brazil	0,64
75	Bosnia & Herzegovina	0,64
76	Trinidad & Tobago	0,62
77	Panama	0,6
78	Maldives	0,59
79	Malaysia	0,57
80	Bulgaria	0,48
81	Kazakhstan	0,47
82	St. Vincent & Grena-dines	0,47
83	Albania	0,45
84	Grenada	0,42
85	Ukraine	0,42
86	Serbia	0,41
87	Tunisia	0,39
88	TFYR Macedonia	0,31

Ranking	Countries	Scores
89	St. Lucia	0,29
90	Turkey	0,26
91	Azerbaijan	0,25
92	Morocco	0,22
93	Gabon	0,2
94	Colombia	0,15
95	Armenia	0,13
96	Iran	0,09
97	Mauritius	0,08
98	Vietnam	0,08
99	Equatorial Guinea	0,05
100	French Polynesia	0,04
101	Lebanon	0,01
102	Jordan	0,01
103	Botswana	0
104	Moldova	-0,01
105	Jamaica	-0,03
106	Georgia	-0,1
107	Sri Lanka	-0,12
108	South Africa	-0,14
109	Guatemala	-0,14
110	Nauru	-0,16
111	Thailand	-0,17
112	Algeria	-0,18
113	El Salvador	-0,2
114	Fiji	-0,22
115	Turkmenistan	-0,25
116	Puerto Rico	-0,26
117	Paraguay	-0,26
118	Egypt	-0,26
119	Philippines	-0,33
120	Belize	-0,39
121	Honduras	-0,39
122	Namibia	-0,4
123	Bhutan	-0,4
124	Syria	-0,42
125	Peru	-0,46
126	Ecuador	-0,47
127	Samoa	-0,48
128	Guyana	-0,49
129	Vanuatu	-0,51
130	Indonesia	-0,51
131	Tonga	-0,53
132	Kyrgyzstan	-0,54
133	Nicaragua	-0,56

Ranking	Countries	Scores
134	Congo	-0,66
135	Angola	-0,67
136	Uzbekistan	-0,7
137	Rwanda	-0,75
138	Cote d´Ivoire	-0,76
139	Dominican Rep.	-0,86
140	Bolivia	-0,86
141	Kiribati	-0,86
142	Tuvalu	-0,91
143	Cape Verde	-0,92
144	Nigeria	-1,02
145	Micronesia	-1,05
146	Yemen	-1,1
147	Papua New Guinea	-1,1
148	Marshall Islands	-1,15
149	Djibouti	-1,15
150	Costa Rica	-1,16
151	Iraq	-1,19
152	Cuba	-1,2
153	Zambia	-1,2
154	D.R.P. Korea	-1,24
155	Solomon Islands	-1,25
156	Cambodia	-1,25
157	Ghana	-1,29
158	Pakistan	-1,34
159	Mongolia	-1,35
160	Benin	-1,37
161	India	-1,39
162	Senegal	-1,5
163	Swaziland	-1,53
164	Tajikistan	-1,55
165	Gambia	-1,58
166	Lesotho	-1,61
167	Myanmar	-1,62
168	Kenya	-1,62
169	Sao Tomé & Principe	-1,72
170	Tanzania	-1,72
171	Sudan	-1,78
172	Uganda	-1,82
173	Guinea	-1,83
174	Cameroon	-1,86
175	Zimbabwe	-1,86
176	Bangladesh	-1,87
177	Afghanistan	-1,9
178	Haiti	-1,91

Ranking	Countries	Scores
179	Malawi	-1,91
180	Liberia	-1,92
181	Sierra-Leone	-1,95
182	Mali	-1,98
183	Eritrea	-1,98
184	Guinea Bissau	-2,01
185	Togo	-2,02
186	Niger	-2,04
187	Burundi	-2,06
188	Burkina Faso	-2,07
189	Comoros	-2,1
190	Chad	-2,11
191	Somalia	-2,13
192	Lao P.D.R.	-2,15
193	Timor Leste	-2,29
194	Ethiopia	-2,36
195	Mauritania	-2,5
196	Congo (Dem. Rep.)	-2,55
197	Central African Rep.	-2,77
198	Madagascar	-2,99
199	Mozambique	-3,14
200	Nepal	-3,29

Appendix C: Sub Variable USE

Ranking	Countries	Scores
1	Norway	2,01583
2	Sweden	1,91771
3	Netherlands	1,85966
4	Qatar	1,81002
5	Luxembourg	1,75947
6	Finland	1,74839
7	Denmark	1,70247
8	UK	1,70109
9	Iceland	1,69502
10	Korea	1,64532
11	Canada	1,60118
12	Switzerland	1,57749
13	New Zealand	1,57588
14	Germany	1,56499
15	Singapore	1,50611
16	Austria	1,46774
17	Liechtenstein	1,45513
18	Australia	1,44489
19	Belgium	1,4318
20	Faroe Islands	1,43027
21	France	1,41882
22	Andorra	1,41611
23	US	1,40789
24	Japan	1,38085
25	Macau	1,36928
26	Slovak Rep.	1,34832
27	Ireland	1,32445
28	French Polynesia	1,29453
29	Brunei	1,28839
30	Spain	1,27107
31	Israel	1,25632
32	Monaco	1,24187
33	Kuwait	1,23884
34	Hong Kong	1,22549
35	United Arab Emirates	1,21693
36	Estonia	1,11358
37	Slovenia	1,11181
38	Malta	1,08704
39	Gibraltar	1,03247
40	Italy	1,02775
41	Bahrain	1,01911

Ranking	Countries	Scores
42	Cyprus	1,00503
43	Cayman Islands	1,00441
44	Latvia	0,98309
45	Lithuania	0,97928
46	Czech Rep.	0,97495
47	Hungary	0,96184
48	Poland	0,94395
49	Barbados	0,85015
50	Portugal	0,82116
51	Greece	0,81933
52	Croatia	0,81304
53	Puerto Rico	0,81052
54	Taiwan	0,79183
55	Antigua & Barbuda	0,78147
56	Greenland	0,72928
57	Malaysia	0,70366
58	Saudi Arabia	0,69495
59	TFYR Macedonia	0,64408
60	Bahamas	0,62566
61	Aruba	0,62048
62	Oman	0,60845
63	St. Kitts & Nevis	0,59744
64	Russia	0,59554
65	Trinidad & Tobago	0,53731
66	Libya	0,47542
67	Morocco	0,45465
68	Turkey	0,44701
69	Uruguay	0,44122
70	Equatorial Guinea	0,43398
71	Argentina	0,41317
72	Lebanon	0,399
73	Seychelles	0,37709
74	Azerbaijan	0,3379
75	Moldova	0,32075
76	St. Vincent & Grena-dines	0,31812
77	Montenegro	0,30915
78	Kazakhstan	0,29495
79	Brazil	0,29227
80	Serbia	0,27334
81	Chile	0,26784
82	Suriname	0,25695
83	Venezuela	0,23856
84	Jordan	0,23597
85	Romania	0,22123

Ranking	Countries	Scores
86	Bulgaria	0,21191
87	Costa Rica	0,19223
88	Mauritius	0,19021
89	Belarus	0,12694
90	Bosnia & Herzegovina	0,12423
91	Iran	0,09623
92	Colombia	0,02832
93	Dominica	0,02764
94	Gabon	0,02066
95	Panama	-0,01021
96	St. Lucia	-0,01096
97	Maldives	-0,01626
98	Ukraine	-0,03091
99	Grenada	-0,04484
100	Egypt	-0,07717
101	Albania	-0,08307
102	Dominican Rep.	-0,13611
103	Tunisia	-0,13848
104	China	-0,13951
105	Belize	-0,14566
106	Fiji	-0,14631
107	Iraq	-0,15602
108	Tonga	-0,15602
109	Nauru	-0,1871
110	Algeria	-0,19675
111	Mexico	-0,20688
112	Jamaica	-0,2308
113	Armenia	-0,29652
114	Thailand	-0,29951
115	El Salvador	-0,29993
116	Cape Verde	-0,32235
117	Syria	-0,32871
118	Turkmenistan	-0,34709
119	Cuba	-0,35261
120	Georgia	-0,35852
121	Botswana	-0,37738
122	South Africa	-0,41117
123	Ecuador	-0,43371
124	Paraguay	-0,46019
125	Namibia	-0,47376
126	Mongolia	-0,53433
127	Peru	-0,53498
128	Tuvalu	-0,56666
129	Angola	-0,57148
130	Micronesia	-0,59257

Ranking	Countries	Scores
131	Sudan	-0,60603
132	D.R.P. Korea	-0,60603
133	Guyana	-0,60694
134	Bolivia	-0,61003
135	Sri Lanka	-0,64883
136	Kiribati	-0,64956
137	Vanuatu	-0,65474
138	Samoa	-0,65992
139	Solomon Islands	-0,67028
140	Guatemala	-0,67608
141	Marshall Islands	-0,67779
142	Senegal	-0,68206
143	Honduras	-0,68229
144	Philippines	-0,68474
145	Uzbekistan	-0,6877
146	Bhutan	-0,69312
147	Swaziland	-0,70636
148	Yemen	-0,72172
149	Lao P.D.R.	-0,73232
150	Papua New Guinea	-0,78229
151	India	-0,78802
152	Cote d´Ivoire	-0,79297
153	Djibouti	-0,81087
154	Ghana	-0,84165
155	Vietnam	-0,88359
156	Nicaragua	-0,90087
157	Kyrgyzstan	-0,92766
158	Zambia	-0,96183
159	Nigeria	-0,99425
160	Indonesia	-1,01866
161	Congo	-1,02147
162	Pakistan	-1,02198
163	Gambia	-1,08554
164	Kenya	-1,0894
165	Cambodia	-1,22558
166	Sao Tomé & Principe	-1,25888
167	Zimbabwe	-1,27486
168	Tajikistan	-1,29619
169	Haiti	-1,31266
170	Comoros	-1,31389
171	Mozambique	-1,31645
172	Bangladesh	-1,31912
173	Cameroon	-1,32492
174	Togo	-1,32832
175	Nepal	-1,33177

Ranking	Countries	Scores
176	Afghanistan	-1,3353
177	Lesotho	-1,33602
178	Guinea Bissau	-1,34333
179	Central African Rep.	-1,34411
180	Malawi	-1,34431
181	Burundi	-1,34514
182	Somalia	-1,35001
183	Eritrea	-1,35063
184	Mali	-1,35342
185	Myanmar	-1,35488
186	Timor Leste	-1,35493
187	Guinea	-1,36408
188	Chad	-1,36886
189	Ethiopia	-1,36953
190	Congo (Dem. Rep.)	-1,37528
191	Mauritania	-1,38035
192	Benin	-1,3875
193	Liberia	-1,41753
194	Uganda	-1,42903
195	Burkina Faso	-1,4305
196	Tanzania	-1,49908
197	Madagascar	-1,5339
198	Sierra-Leone	-1,54471
199	Rwanda	-1,62705
200	Niger	-1,63099

Appendix D: Sub variable: Literacy Skills

Ranking	Countries	Scores
1	Kazakhstan	1,94476
2	US	1,77568
3	Czech Rep.	1,73641
4	Korea	1,71418
5	Armenia	1,67915
6	Hungary	1,66987
7	Slovenia	1,65333
8	Switzerland	1,64743
9	Singapore	1,63255
10	Ukraine	1,61731
11	Slovak Rep.	1,61608
12	Estonia	1,58456
13	Germany	1,57725
14	Kyrgyzstan	1,56369
15	Mongolia	1,50693
16	Canada	1,46538
17	Lithuania	1,42978
18	Australia	1,34418
19	Russia	1,3415
20	Moldova	1,33277
21	Sweden	1,32084
22	Japan	1,30527
23	Israel	1,30369
24	Bulgaria	1,30278
25	Norway	1,26676
26	Finland	1,24697
27	UK	1,21515
28	Croatia	1,21258
29	Latvia	1,20862
30	Denmark	1,20826
31	Romania	1,20611
32	Poland	1,18351
33	Tajikistan	1,1688
34	Ireland	1,11962
35	Netherlands	1,08798
36	Serbia	1,05845
37	Belgium	1,0429
38	Cyprus	1,04096
39	Liechtenstein	0,9485
40	Andorra	0,9485
41	Monaco	0,93381
42	Faroe Islands	0,93014

Ranking	Countries	Scores
43	Cayman Islands	0,9283
44	Hong Kong	0,92171
45	French Polynesia	0,91177
46	Tonga	0,85204
47	Cuba	0,79595
48	Puerto Rico	0,77033
49	Luxembourg	0,7614
50	Kenya	0,70335
51	France	0,65549
52	Greenland	0,64181
53	Chile	0,64055
54	Antigua & Barbuda	0,62344
55	South Africa	0,61528
56	Taiwan	0,6104
57	St. Kitts & Nevis	0,6014
58	Aruba	0,58344
59	Gibraltar	0,58113
60	Austria	0,56864
61	Iran	0,56425
62	Greece	0,56376
63	Bahrain	0,56341
64	Bahamas	0,56098
65	Suriname	0,54408
66	Equatorial Guinea	0,53049
67	United Arab Emirates	0,49405
68	Seychelles	0,49118
69	Malaysia	0,48664
70	Albania	0,46824
71	Lebanon	0,45077
72	Peru	0,44719
73	Mauritius	0,43949
74	Oman	0,40191
75	Macau	0,39783
76	Iceland	0,39366
77	Trinidad & Tobago	0,35793
78	Italy	0,34413
79	Brunei	0,31795
80	Jamaica	0,31086
81	Fiji	0,29863
82	Azerbaijan	0,29818
83	Belarus	0,29451
84	Turkmenistan	0,29451
85	Nauru	0,28349
86	Montenegro	0,2743
87	Bosnia & Herzegovina	0,26328

Ranking	Countries	Scores
88	TFYR Macedonia	0,25226
89	Spain	0,23755
90	Grenada	0,22838
91	St. Vincent & Grena-dines	0,22838
92	Panama	0,22773
93	Barbados	0,19635
94	Dominica	0,19164
95	Bolivia	0,16771
96	Colombia	0,149
97	St. Lucia	0,12
98	Qatar	0,11
99	Jordan	0,10935
100	Botswana	0,07633
101	Saudi Arabia	0,02023
102	Sri Lanka	0,01764
103	Cape Verde	0,01328
104	Mexico	0,00558
105	Egypt	-0,03048
106	Kuwait	-0,0526
107	New Zealand	-0,07012
108	Philippines	-0,07152
109	Georgia	-0,08256
110	Uzbekistan	-0,08862
111	Dominican Rep.	-0,09186
112	Tuvalu	-0,09597
113	D.R.P. Korea	-0,09597
114	Samoa	-0,09965
115	Nicaragua	-0,11309
116	China	-0,16346
117	Marshall Islands	-0,18782
118	Libya	-0,18809
119	Gabon	-0,22448
120	Kiribati	-0,22455
121	Vietnam	-0,23905
122	Angola	-0,24664
123	Malta	-0,253
124	Belize	-0,26897
125	Costa Rica	-0,27575
126	Micronesia	-0,27966
127	Venezuela	-0,29208
128	El Salvador	-0,32048
129	Thailand	-0,32889
130	Brazil	-0,3597
131	Solomon Islands	-0,36967

Ranking	Countries	Scores
132	Guyana	-0,37755
133	Vanuatu	-0,3862
134	Iraq	-0,40774
135	India	-0,41109
136	Argentina	-0,42759
137	Tunisia	-0,5084
138	Paraguay	-0,59909
139	Swaziland	-0,61149
140	Congo	-0,61686
141	Ghana	-0,62081
142	Indonesia	-0,62675
143	Djibouti	-0,66724
144	Maldives	-0,68584
145	Ecuador	-0,71835
146	Haiti	-0,72567
147	Nigeria	-0,78777
148	Congo (Dem. Rep.)	-0,81292
149	Myanmar	-0,81799
150	Turkey	-0,82296
151	Uruguay	-0,83019
152	Lesotho	-0,84601
153	Namibia	-0,84888
154	Comoros	-0,87407
155	Algeria	-0,88046
156	Honduras	-0,89027
157	Pakistan	-0,90671
158	Bhutan	-0,94461
159	Yemen	-0,96973
160	Sao Tomé & Principe	-0,98116
161	Eritrea	-1,01662
162	Uganda	-1,02225
163	Bangladesh	-1,03709
164	Portugal	-1,0395
165	Syria	-1,04073
166	Madagascar	-1,07668
167	Lao P.D.R.	-1,15763
168	Guatemala	-1,17201
169	Timor Leste	-1,19038
170	Gambia	-1,20623
171	Benin	-1,21241
172	Liberia	-1,23167
173	Morocco	-1,24075
174	Zimbabwe	-1,25774
175	Guinea Bissau	-1,26619
176	Nepal	-1,28707

Ranking	Countries	Scores
177	Malawi	-1,31338
178	Cameroon	-1,35267
179	Sierra-Leone	-1,37596
180	Togo	-1,38032
181	Cambodia	-1,39392
182	Central African Rep.	-1,4377
183	Zambia	-1,439
184	Guinea	-1,50749
185	Ethiopia	-1,5269
486	Mozambique	-1,53915
187	Somalia	-1,56713
188	Cote d´Ivoire	-1,57608
189	Burundi	-1,57769
190	Chad	-1,62591
191	Mali	-1,63259
192	Senegal	-1,64177
193	Afghanistan	-1,64884
194	Sudan	-1,65922
195	Burkina Faso	-1,73428
196	Rwanda	-1,81569
197	Mauritania	-1,85896
198	Niger	-1,92656
199	Papua New Guinea	-2,24539
200	Tanzania	-2,39589

Appendix E: Description of the indicators used

http://www.itu.int/net/pressoffice/backgrounders/general/pdf/5.pdf

Fixed-telephone subscriptions

Refers to the sum of active of active number of analogue fixed-telephone lines, voice-over-IP (VoiP) subscriptions, fixed wireless local loop (WLL), ISDN voice-channel equivalents and fixed-public payphones.

Analogue fixed-telephone lines

Refers to the number of active lines connecting subscribers terminal equipment to the PSTN (Public switch telephone network) and which have a dedicated port in the telephone-exchange equipment. It includes all post-paid lines and those prepaid lines that have registered an activity in the past three months.

VoiP subscriptions

Refers to the number of voice-over-internet protocol (VoiP) fixed-line subscriptions. It is also known as voice over broadband (VoB), and includes VoiP subscriptions through fixed wireless, DSL, cable, fibre optic and other fixed-broadband Internet platforms that provide fixed telephony using IP.

ISDN subscriptions

Refers to the number of subscriptions to the integrated services digital network (ISDN). This can be separated into basic-rate and primary-rate interface service.

ISDN voice-channel equivalents

Refers to the sum of basic-rate and primary-rate voice-channel equivalent. Basic-rate voice-channel equivalents is the number of primary-rate ISDN subscriptions multiplied by 2, and primary-rate voice-channel equivalents is the number of primary-rate ISDN subscriptions multiplied by 23 or 30, depending on the standard implemented.

Mobile population coverage

Refers to the percentage of inhabitants within range of a mobile-cellular signal, irrespective of whether or not they are subscribers or users. This calculated by dividing the number of inhabitants within range of a mobile-cellular signal by the total population and multiplying by 100.

International internet bandwidth, in Mbit/s

Refers to the total used capacity of international Internet bandwidth, in megabits per second (Mbit/s). It is measured as the sum of used capacity of all internet exchanges (locations where Internet traffic is exchanged) offering international bandwidth.

Mobile-cellular telephone subscriptions

Refers to the number of subscriptions to a public mobile-telephone service that provide access to the PSTN using cellular technology. The indicator applies to all mobile-cellular subscriptions that offer voice communications.

Fixed (wired) internet subscriptions

Refers to the number of active fixed (wired) internet subscriptions at speeds less than 256/Kbits (such as dial up and other fixed non-broadband subscriptions) and total fixed (wired) - broadband subscriptions.

Fixed (wired)-broadband subscriptions

Refers to the number of fixed (wired)-broadband subscriptions to the public internet split by technology used.

Household with a computer

Refers to the proportion of households with a computer by household composition and urban/rural location.

Household with internet access at home

Refers to the proportion of households with internet access at home by household composition and urban/rural location.

Computer users

Refers to the proportion of individuals who used a computer from any location in the last 12 months.

Internet users

Refers to the proportion of individuals who used the internet from any location in the last 12 months.

Mobile cellular telephone users

Refers to the proportion of individuals who used a mobile cellular telephone in the last 12 months.

Adult literacy rate

Is defined as the percentage of the population aged 15 year and over who can read and write with understanding a short simple statement on his/her everyday life.

Completed primary schooling rate

Percentage of all participant in all components of a primary educational programme (including final exams if any), irrespective of the result of any potential assessment of achievement of learning objectives.

http://glossary.uis.unesco.org/glossary/en/term/2681/en

Completed secondary schooling

Percentage of all participant in all components of a secondary educational programme (including final exams if any), irrespective of the result of any potential assessment of achievement of learning objectives.

Completed tertiary schooling

Percentage of all participant in all components of a tertiary educational programme (including final exams if any), irrespective of the result of any potential assessment of achievement of learning objectives.

Appendix F: Languages Maps

F. 1 Language repartition worldwide

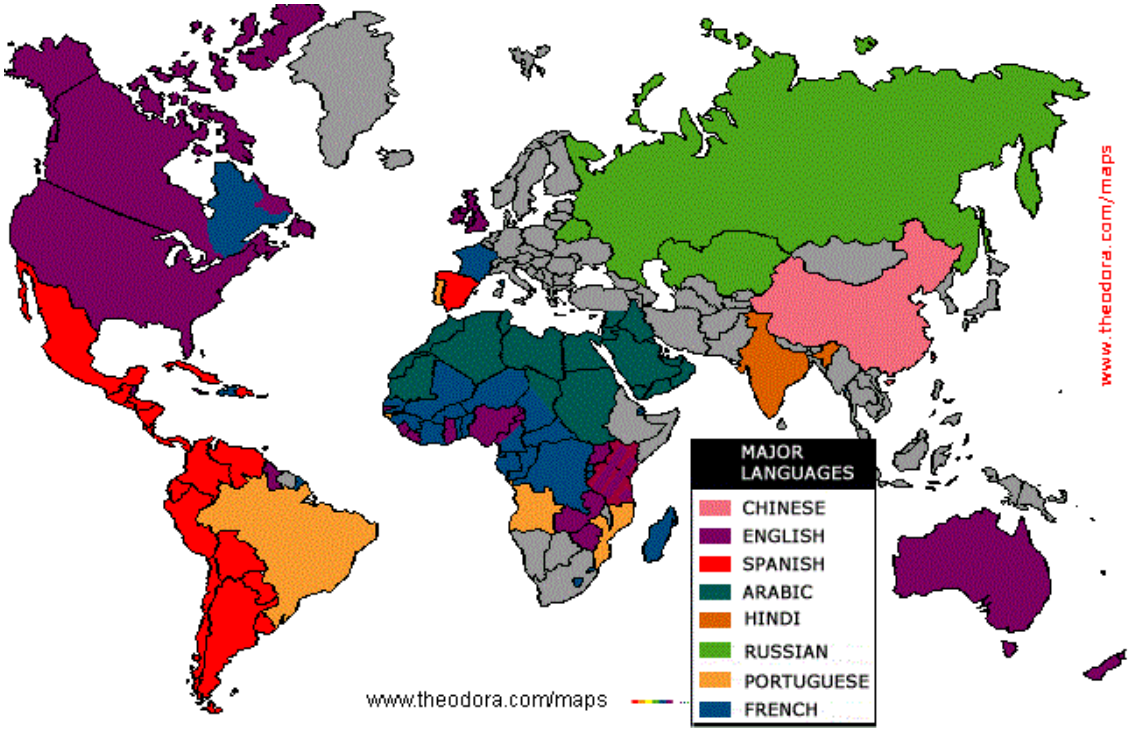

Figure 31: Language repartition worldwide

F. 2 Official Languages in Africa

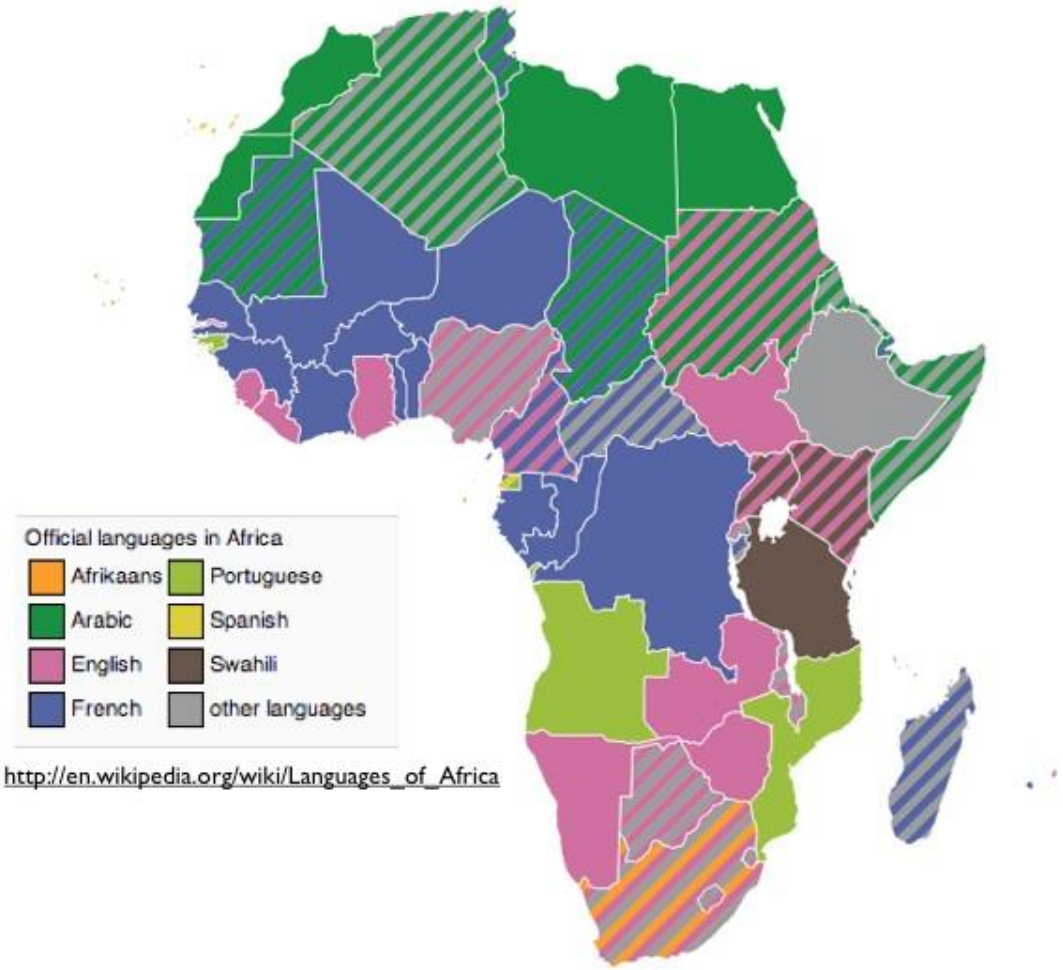

Figure 32: Official languages in Africa

F. 3 Colonial Languages in Africa

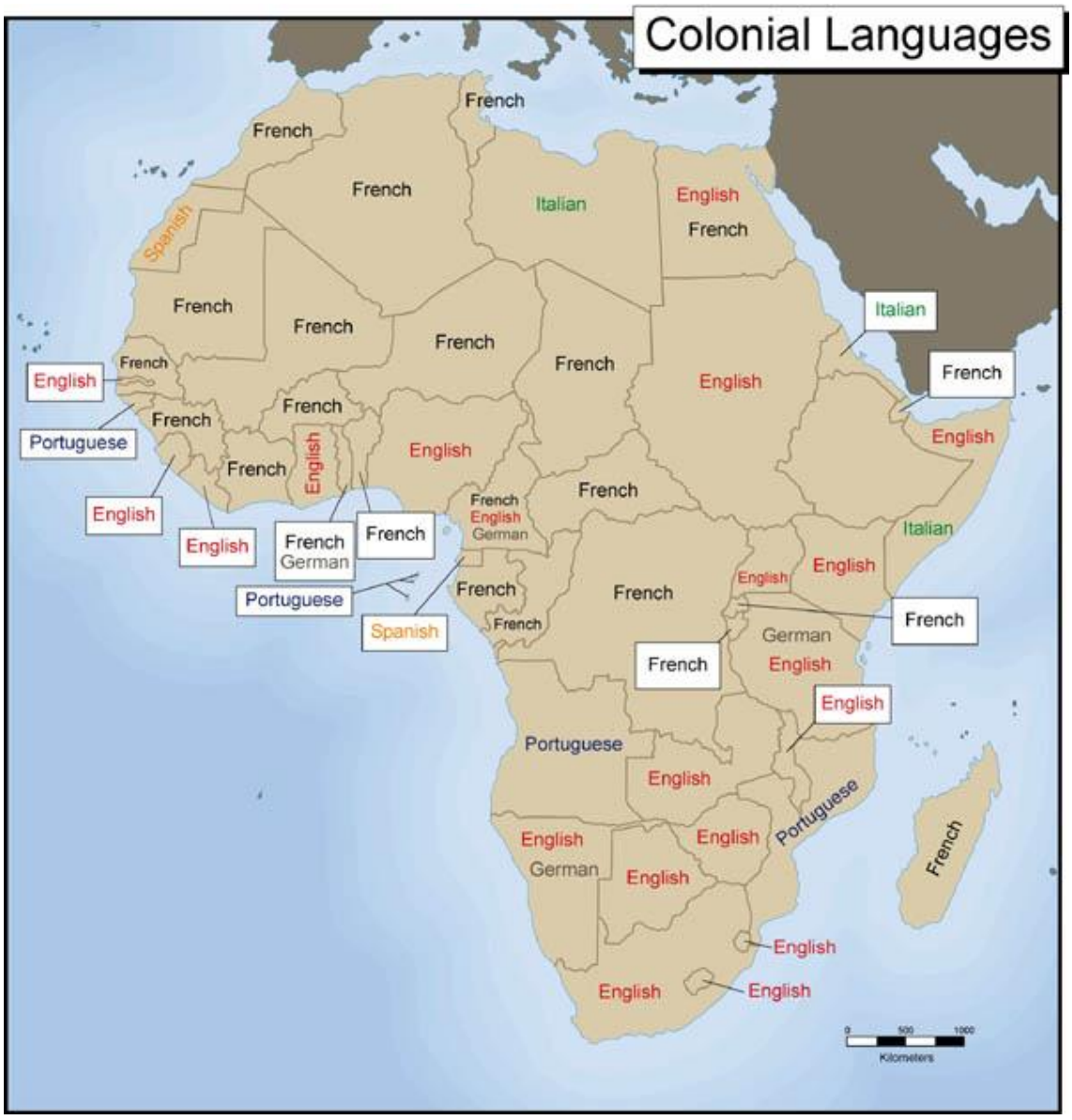

Figure 33: The influence of colonial languages in Africa

(Source: http://exploringafrica.matrix.msu.edu/3061-2/)

Appendix G: Outcome of the Exploratory Factor Analysis (EFA)

Subvariable: ACCESS

SPSS Output: Correlation matrix, KMO und Bartlett´ test and total variance explained

Correlation Matrix

	Fixed-tel sub per 100	Mobile-cel sub per 100	ISDN_Sub	ISDN_Voice_Ch_Eq	VoiP_Sub	Local_Tel_Serv	Public_Payphone	Mob_Pop_Cover	Act_Mob_Broadb_Sub	Fix_Wired_Inter_Sub
Fixed-tel sub per 100	1,000	,548	,582	,604	,676	,616	,075	,519	,507	,857
Mobile-cel sub per 100	,548	1,000	,303	,349	,393	,586	,044	,594	,393	,507
ISDN_Sub	,582	,303	1,000	,852	,492	,390	,021	,296	,461	,650
ISDN_Voice_Ch_Eq	,604	,349	,852	1,000	,523	,424	-,008	,314	,529	,658
VoiP_Sub	,676	,393	,492	,523	1,000	,499	,084	,405	,461	,720
Local_Tel_Serv	,616	,586	,390	,424	,499	1,000	,108	,618	,491	,548
Public_Payphone	,075	,044	,021	-,008	,084	,108	1,000	,146	-,073	,005
Mob_Pop_Cover	,519	,594	,296	,314	,405	,618	,146	1,000	,397	,454
Act_Mob_Broadb_Sub	,507	,393	,461	,529	,461	,491	-,073	,397	1,000	,548
Fix_Wired_Internet_Sub	,857	,507	,650	,658	,720	,548	,005	,454	,548	1,000
Fix_Wired_broad_Sub_Perc	,878	,480	,659	,670	,710	,544	,040	,442	,566	,898

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**,898**
Bartlett's Test of Sphericity	Approx. Chi-Square	1610,727
	df	55
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			**Rotation Sums of Squared Loadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,008	54,616	54,616	6,008	54,616	54,616	5,039	45,813	45,813
2	1,284	11,675	66,291	1,284	11,675	66,291	2,253	20,479	**66,291**
3	,985	8,955	75,246						
4	,682	6,204	81,450						
5	,551	5,007	86,457						
6	,412	3,746	90,204						
7	,365	3,314	93,517						
8	,350	3,181	96,699						
9	,147	1,337	98,036						
10	,122	1,113	99,149						
11	,094	,851	100,000						

Extraction Method: Principal Component Analysis.

Sub-variable: Use

Correlation Matrix

		Household_TV	Household_Fix_Line_Tel	Household_Mob_Tel	Household_Computer	Household_Internet_Home	Mob_Cel_Tel_Users	Computer_Users	Internet_Users
Correlation	Household_TV	1,000	,776	,868	,700	,640	,418	,752	,670
	Household_Fix_Line_Tel	,776	1,000	,791	,843	,825	,609	,866	,795
	Household_Mob_Tel	,868	,791	1,000	,747	,692	,485	,835	,704
	Household_Computer	,700	,843	,747	1,000	,979	,749	,922	,912
	Household_Internet_Home	,640	,825	,692	,979	1,000	,768	,904	,907
	Mob_Cel_Tel_Users	,418	,609	,485	,749	,768	1,000	,749	,717
	Computer_Users	,752	,866	,835	,922	,904	,749	1,000	,882
	Internet_Users	,670	,795	,704	,912	,907	,717	,882	1,000

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**,904**
Bartlett's Test of Sphericity	Approx. Chi-Square	2430,683
	df	28
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6,413	80,158	80,158	6,413	80,158	**80,158**
2	,805	10,065	90,224			
3	,277	3,459	93,683			
4	,181	2,257	95,940			
5	,143	1,785	97,725			
6	,106	1,323	99,048			
7	,059	,734	99,783			
8	,017	,217	100,000			

Extraction Method: Principal Component Analysis.

Sub-variable Skills

Correlation Matrix

		Literacy Adult (+15)%	Completed primary schooling	Completed secondary schooling	Completed tertiary schooling
Correlation	Literacy Adult (+15)%	1,000	-,212	,638	,533
	Completed primary schooling	-,212	1,000	-,547	-,333
	Completed secondary schooling	,638	-,547	1,000	,476
	Completed tertiary schooling	,533	-,333	,476	1,000
Sig. (1-tailed)	Literacy Adult (+15)%		,001	,000	,000
	Completed primary schooling	,001		,000	,000
	Completed secondary schooling	,000	,000		,000
	Completed tertiary schooling	,000	,000	,000	

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		**,621**
Bartlett's Test of Sphericity	Approx. Chi-Square	263,582
	df	6
	Sig.	,000

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,391	59,771	59,771	2,391	59,771	**59,771**
2	,824	20,609	80,379			
3	,537	13,434	93,814			
4	,247	6,186	100,000			

Extraction Method: Principal Component Analysis.

Appendix I: Data CD

- Data_Matrix
- ITU_Sources extract from www.itu.int
- UNESCO_Sources extract from www.uis.unesco.org
- World Bank_Sources extract from data.worldbank.org