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The Fantasy of Information and Communication Technology as Means to State Development

通訊科技作為經濟發展必要方式之迷思

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Abstract

Introduction of smart phone opened a gate to a new era where people's dependency on Information and Communication Technology (ICT) in everyday life is stronger than ever. With its paradigm shift to the rapidly-growing data communication, industrial reform was made while more information flows in and out of handsets and devices.

It is widely accepted that the development of ICT is a key factor for establishing foundation for a state development. The main idea is that the devices and digitalization of systems will increase the performance efficiency in almost all aspects, which will result in a general increase in outputs of those sectors with ICT implementation. Especially with possibilities of skipping the infrastructure establishment of 3rd Generation communication technology and leapfrogging to the 4th Generation, the belief became a taken for granted; ICT reform is a panacea for every development related problem. However, creating a smooth ICT environment from scratch requires a tremendous amount of financial investment and time, and it is strongly questionable whether such investment is worth betting for higher return.

This thesis will cover the impact of ICT on state development, and engage in a conversation whether ICT for Development is an effective tool.

Keywords: Development, ICT, Information and Communication Technology

摘要

智能手機的發明開啟了人類生活的新紀元，日常生活中人們對信息通訊技術（ICT）的依賴日趨嚴重。並且，隨著數據通訊的快速發展，越來越多的信息通過手機等電子設備傳輸，新的產業改革由此產生了。

人們普遍認為，信息通訊技術的發展是國家發展、公共基礎建設的關鍵要素。其主要理由是，在幾乎任何方面，電子設備及電子化系統都能提高效率，因此將使得任何使用電子通訊技術的產業得以提高產出。尤其是，當我們可以跳過第三代通訊技術的建立而直接建設第四代通訊技術，上述的觀點變得更加理所當然。信息通信技術改革成為任何與發展相關的議題之萬能藥。然而，從零開始建立一個通暢的信息通訊技術環境需要花費巨大的財政支出及時間花費，而這樣的投資是否會有大量回報，亦非常值得懷疑。

本文將討論信息通訊技術對國家發展的影響，及信息通訊技術是否是國家發展的有效手段。

關鍵詞：國家發展，信息通訊技術，通訊科技

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Chapter One: Introduction

1.1 Background Information and Research Motivation

With the advance of technologies, the life quality of average citizen around the world has dramatically improved over past few decades. Though physical and geographical shape of the world and the distance from one state to another remain the same, advance of technology has successfully linked citizens closer together, creating a global society.

The advance of technology not only became convenience and means to entertainment; it became one of the necessities of everyday life. Electronic devices and computers are almost always involved in most of the activities of daily patterns of average person, and dependency on machines grows larger day by day. By reducing process time and increasing productivity, one can maximize work efficiency once Information and Communication Technology (ICT) is properly implemented.

For such advantageous reasons, there recently has been heavy focus on the Information and Communication Technology for Development (ICT4D) and various attempts to adapt ICT into aiding developing countries for innovations and maximizing the productivity. However the investment in ICT infrastructures demands enormous financial spending that easily exceeds several years' worth of entire GDP of a developing country.[1] Naturally, it became one of the major debate topics on the table whether having ICT4D as the

[1] Think of number of base stations to provide sufficient coverage are, network switches and cables to connect them all, another set of infrastructure to power them, and engineers for operation and maintenance to each major sites

first priority for developing countries is really appropriate: How much economic growth the improvement of ICT4D effect, or even more, whether it has any sort of impact at all.

Communication industry, by its nature, is strongly a domestic-oriented business. Although multiple colossal Multi-National Companies (MNC) are easily encountered in many business industries such as automobiles, electronics, food and drinks and fashion, there seems to be difficulties if one was to asked what the most-global carrier today is. Three major reasons can explain such phenomenon.

1.1.1 High Government Protection

Wireless communication is achieved by emission and reception of electromagnetic waves at specific frequencies. Most states issue special license for usage of such frequency bands with certain rental period, and this is strictly limited to either state-owned company or domestic private companies for security reasons. Because of this, foreign corporates, regardless of its size, have no opportunity to take part in the bidding process of frequency licensing.

1.1.2 High Investment

Establishment of communication infrastructure is not cheap. It would involve tremendous amount of Foreign Direct Investment (FDI) on target states to purchase and establish the network including cables and base station, power supplies and maintenance, and the real estates for such facilities. It will involve multiples of operating profit for even solid-big-size firms in global market.

1.1.3 High Risk

Communication business is extremely long-term oriented. With massive capital expenditure (CAPEX) at the beginning of business, corporates usually profit from a long-term business from its subscribers with low operation expenses (OPEX): That is to say once the investment is made, the profit is slowly generated over a long period of time without much risk. Even if above two conditions are resolved and it would attract some foreign carriers to launch business, the business structure may hinder the final investment. The government must be showing an absolute political stability in order to gain trust, but such government is likely to already have a good economy established, with its own incumbent telecommunication carrier domestically.

Therefore in order to establish a smooth communication environment, it must prosper within a state domestically.[2] However this is controversial because establishment of communication infrastructure only applies to those without existing infrastructure, therefore target states are likely less developed ones. Consequently, as less developed countries, they must bear high economic burden when a decision is made towards ICT4D.

Unfortunately, this is just the foundation infrastructures of ICT. Even if the enormous OPEX and CAPEX seem terrifying, it actually is the easiest step as establishment of infrastructure can be completed with sufficient financial resources. The missing part is the systematic designs and implementation of reformation policies, the proliferation of handsets and computers that each citizen gets access to, and the promotion and education towards individuals for adaption to the new environment. This part is not a mere matter of allocation

[2] Meaning that the domestic government would have to be willing to make investments and take risks of reforming in order to establish the foundations of or lead to the development of ICT, since foreign-driven forces face the obstacles mentioned in the previous pages.

of financial resources, it will require time and constant assessment and revision as policies and systems are updated.

Nevertheless there are active movements regarding ICT4D throughout developing countries today, whether the investment is derived from domestic or outer sources. Also some of the least developed countries such as Zambia and Rwanda participate in ICT4D activities in attempts to make big changes. Therefore it leaves a significant question: “Does ICT4D come in priority, even if a state faces other concerns such as food and water security, education and healthcare? Presuming the decision was made rationally, the answer to the question must be a ‘yes’: Investment towards ICT comes first, before any other issues.

This thesis briefly discusses whether ICT development effectively impacts on socio-economic growth of developing countries, especially focusing on the access to information and wireless internet, and whether it is truly worth focusing interest and investment into ICT development as a priority for state development. Once the riddle is solved, it must provide more clear directions to sustainable state/regional cooperation and development, by providing a guideline as to how one state could most efficiently benefit from the same amount of investment.

1.2 Purpose and Research Question

The United Nations sub-branch International Telecommunication Union (ITU) publishes ICT Development Index (IDI) based on internationally agreed ICT indicators. IDI becomes an important tool for measuring information society for governments, companies, development agencies and researchers to compare the ICT performance within and across countries, as well as measure the digital divide. Although there are many categories, the

foremost significant candidate is the wireless internet, as today's trend is heavy usage of data communication rather than conventional voice and Short-Messaging-Services (SMS).[3] However, because the wireless communication, CT in general, and ICT are tightly linked together, it would be meaningful to expand the findings to next step. That is to find whether ICT4D itself would have any meaning to a state development. And because socio-economic progress is a significant factor of state development, these variables must connect and prove to be in a positive relationship in order to clarify that ICT4D is in accordance with state development in general.

Therefore simply put, the main research question of this thesis would be "Is ICT for Development an effective tool towards economic development of developing countries?" Moreover, this question can be further split into three sub questions,

1. Does proliferation and access of ICT devices, education to utilize them and digitalization of systems lead to an economic development of developing countries?[4]
2. What are the impacts of the access to wireless internet, the basic-most foundational requirement for any ICT devices to function, on the same matter?[5]
3. What are other considerations and suggestions for above two questions, and are there any alternative options for ICT4D?

Using longitudinal approach, since different regions develop under different phases, the main purpose of raising and answering to these questions is to help understand whether such huge investment is worthwhile and if so, how effective it is. By doing so, this thesis will

[3] Most handsets and digital devices today will lose its significance without access to wireless internet. Further elaboration will follow in the next chapter.

[4] In other words, would ICT in general impact the overall development of a country?

[5] Wireless internet is the most fundamental reason why networks are built today. This indicator may also refer to measure individuals' access to information, for more usage of wireless internet would imply more communication opportunities they face.

engage in a conversation in a dichotomy between arguments supporting and against ICT4D. If the variables do not co-relate with one another, the investment priority perhaps should be placed upon other sectors that are more directly related to basic necessities of life such as agricultural, education, or healthcare.

1.3 Research Method

Further research method and organization of chapters and its contents will be as below.

1.3.1 Variable Layout

There would be many candidates for each dependent and independent variable for there are multiple ways to analyze this question.[6] For dependent variable, there must be an index to measure socio-economic development. Although there would be many suitable on the list, GDP per capita would be the most direct and easy candidate out of all to measure and compare how much a state has been progress over a period of time. There are two main reasons as to why GDP per capita is a better indicator than others: first, it gives us better opportunity to have an easier glance at increase in average income of each individual that would help us measure how much rough impact it made on the individual level, and also it could be further utilized to see if any wealth distribution curve is on acceptance level to determine income gaps between higher and lower income groups. Therefore the GDP per

[6] How should we define "development?" would be the question to begin with. Depending on the definition, many could be the candidate: Changes in GDP, GDP per capita, Unemployment rate, infant mortality rate, level of democracy, gender equality, and the list goes on.

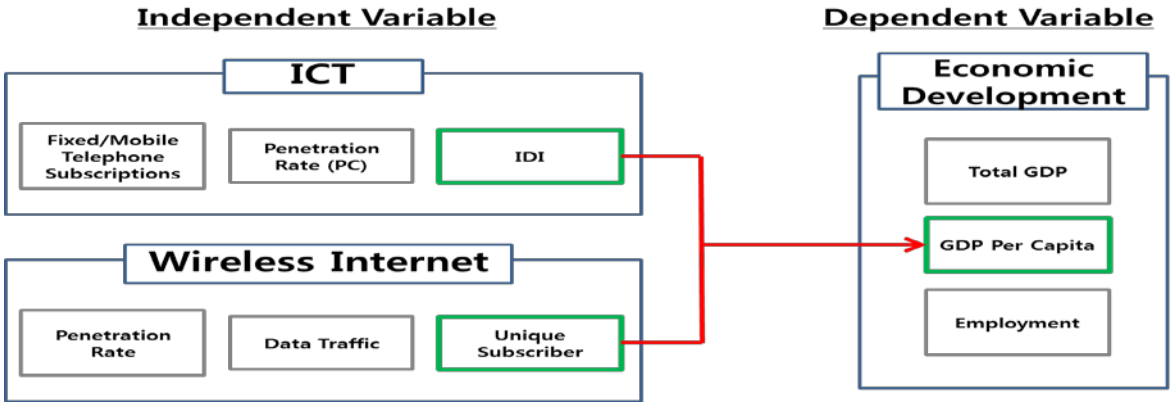
capita is fixed as dependent variable. This is easily obtainable in multiple sources, extraction from any raw database such as World Bank or IMF would work just fine.

Independent variables are subdivided into two categories, measuring the level of ICT and wireless communication respectively. As mentioned above, ITU provides annual IDI for each member state based on roughly 11 standards and indicators, which is the simplest and most straight forward indicator. If fixed or mobile telephone subscribers are to be taken into consideration, it would miss the information regarding the IT perspective of ICT, such as devices, handsets, software and system. Whereas if penetration rate of personal computers are chosen, it would lack information regarding CT perspectives of ICT, such as the subscribers for fixed, wireless and mobile internet or broadband users. Therefore IDI could be compared with the dependent variable, GDP per capita, to measure how much of an impact it leaves on the economic growth.

It is slightly more complicated for the wireless communication, as there are several major categories to measure this. However I will use the number of unique subscribers in this thesis, because a simple penetration rate could overlap the data of single individual with multiple lines. And as briefly introduced previously, we are only interested in data communication, not conventional voice and SMS as today's ICT4D and advancement of Internet of Things (IoT) severely focus on usage of internet data based on Internet Protocol (IP) communication, only 3G and LTE subscribers will be taken into consideration. The raw data will be extracted from GSMA Wireless Intelligence as they provide definitive data and analysis for the mobile industry.

Brief flowchart and summary concerning variables are as below.

<Figure 1.1>



Source: Compiled by Author

<Table 1.1>

		Variable	Remarks
Independent Variable	**ICT**	Fixed/Mobile Subscribers	- Lacks info regarding IT perspective of ICT (Devices, handsets, software etc…)
		Penetration Rate (PC)	- Lacks info regarding CT perspective of ICT (Fixed, wireless/mobile internet, broadband etc…)
		IDI	- Level of ICT development - The simplest and most straight forward
	Wireless Internet	Penetration Rate	- Number of users (services) / 100 inhabitants - May have overlaps (single user w/ multiple lines)
		Data Traffic	- Activeness of internet usage - May limit its targets to specific social class
		Unique Subscriber	- Number of unique subscribers - No overlaps (real penetration level of access)
Dependent Variable	**Economic Development**	Total GDP	- Economic capability of a state as a whole - No indicators regarding population
		Employment	- Economic vitality of given state - Modern standards may not apply to developing states
		GDP per Capita	- Average economic vitality of each population in a given state - May be used to have a glance at increase in income of each individual - Expandability (measuring wealth distribution curves, income caps etc…)

Source: Compiled by Author

1.3.2 Quantitative Analysis

Because all the variables introduced are numeric and quantifiable, quantitative research method will be applied thoroughly. The process is straight forward, matching one set of variable to another and generation regression result would give us brief idea of whether there are any linkages between two sets of variables. As target states for analysis are developing and non-OECD member countries, each variable would contain raw data set of approximately 120 entries.

1.3.3 Qualitative Analysis

For the general ICT4D for sake of socio-economic advancement of state, qualitative analysis would be applied. As briefly covered above, there are two major camps in this field: the Transfer and Diffusion approach and Social Embeddedness approach.[7] Because the Transfer and diffusion camp presumes that technologies and associated practices practically flow independent from the social and cultural circumstances and hence automatically leave a positive impact on society, it would be helpful to find some case studies in Africa and South Asia to prove that this is oversimplifying, misleading and hence does not work as a taken-for-granted manner. The result would give us an idea whether the ICT4D in these regions left disruptive transformation impact, broadening the income gaps between social classes and digital divide.

[7] Avgerou Chrisanthi, *"Discourses on ICT and development"*, LSE Research Online 2010. Author suggests that some takes Transfer and Diffusion approach that once ICT is implemented, it will automatically smudge into the society and leave a positive impact over time. Whereas Social Embeddedness approach suggests that we should consider society's local problematizations into the consideration.

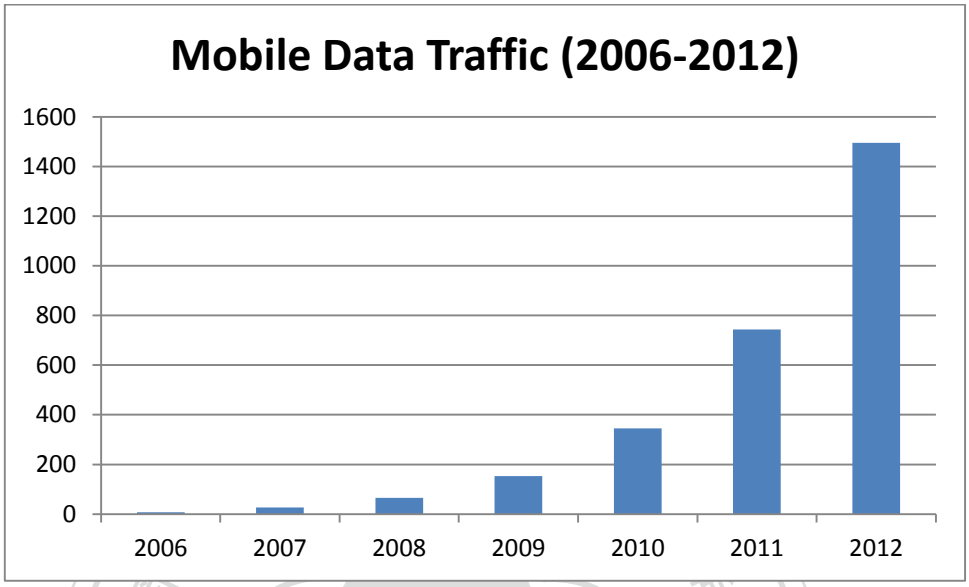
Chapter Two: ICT for Development and Literature Review

I have briefly discussed technological background of ICT and its development history in the introduction, and it would be worth mentioning its applications and why it is significant in terms of globalization and development. Many IGOs today such as UN and ITU with cooperation from many MNCs participate in numerous projects to pursue its goal. The foremost important outer frame is that the ICT4D aims to offer equitable access to ICT and bridge digital divide, bringing social, economic and political development, especially those marginalized and less fortunate people and societies in least developed countries. Because of its nature of strongly being tied with technology (particularly in engineering and ICT related fields including networks, encryption, construction and signals and data processing), development studies, and social sciences (sociology, economics and politics), ICT4D covers wide range of theories, knowledge and practices from multiple scholarship and disciplines.

2.1 ICT and Global Trend

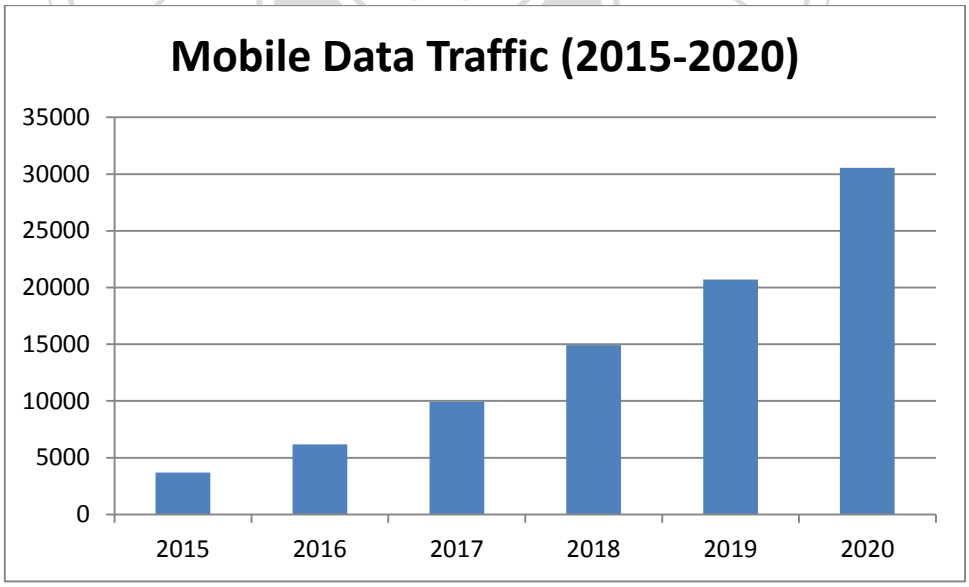
ICT, as the term it stands for explains itself, is simply combination of two industries: Information Technology (IT) and Communication Technology (CT). Though convergence of two terms may sound strange, it is rather a quite natural phenomenon when a closer analysis is taken. Figure below represents the Global Mobile Data Traffic between 2006 and 2020. Notice that this was two sets of forecast data generated by Cisco in the year of 2008 (for 2006-2012) and 2015 (for 2015-2020): Two sets of raw data are assimilated and the data from 2016 to 2020 is a prediction, not an actual recorded value.

<Figure 2.1>



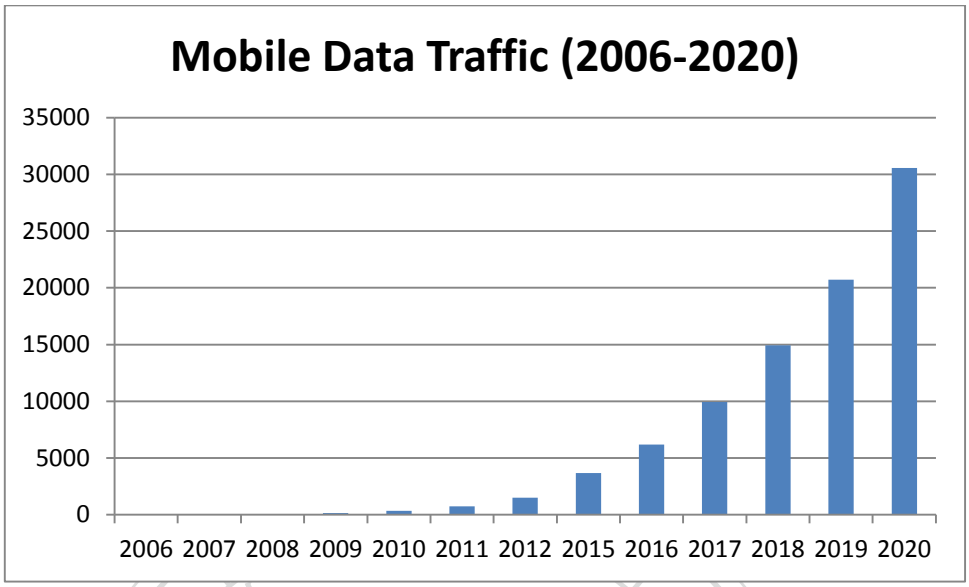
Source: Cisco Visual Networking Index, 2008

<Figure 2.2>



Source: Cisco Visual Networking Index, 2015

<Figure 2.3>



Source: Cisco Visual Networking Index, 2008 & 2015

It is observed that the global data usage has been growing exponentially throughout the years. We can see ever since the beginning of the smart phone era in the year of 2009 where iPhone was introduced, the increase in data usage in various sectors has been monstrous. Data usage is a direct indicator for the flow of information. From text messaging, up/downloading photos and other contents, streaming videos, sharing information via SNS, we are heavily engaging in exchanges of information. Including cellphones to digital cameras, music players watch and computers, everything today seems to be connected to the "net", with active engagement of file sharing. Such phenomenon is a dramatic transformation, when comparison is made even with just a decade ago: There were not much inter-device connections. A CD player was merely a music player, Cellphones were used to make/receive calls and text messages and not anything fancier, digital cameras were not required to have internet connections, and who would have guessed today's watches would have been connected to the internet? Yet everyday usage and dependency of devices not only increased notably, its involvement with

the network is even heavier: Device optimization and updates are offered via net, we text and share our files with friends (and even with strangers) and playing games become incomparably more fun when played online with multiple others.

2.2 Convergence of Technology

Despite the bright side of the legacy of IT development, the development of IT alone is not sufficient enough. Advantages mentioned in previous paragraphs are only good and available when provided a strong and stable internet connection. Think of it as cars and roads: One can have the nicest and the fastest car in the world, completely state of the art, but it would lose entire purpose without well-established roads. Therefore the construction of communication infrastructure that guarantees wide coverage area with sufficient bandwidth, that is the transfer speed of the data, is necessary when it comes to the development of modern technology. Therefore the international technological trend became that the development of IT and CT must be co-aligned with one another, in order to maximize the synergy effects and hence became the birth of the term ICT and the convergence of technology. Despite the fact that well-established communication infrastructures providing enjoyable technological environment sounds charming, the CAPEX for the construction of communication infrastructure is enormous. It will be far beyond affordability of vast majority of developing countries, where it would take several years' worth of their entire national GDP to cover for the network establishment. Luckily as the goddess of fortune smiles upon this planet, the global society has found an answer to the problem, and there was a small hope in making a gambit that would shift the paradigm of national development and foreign aid.

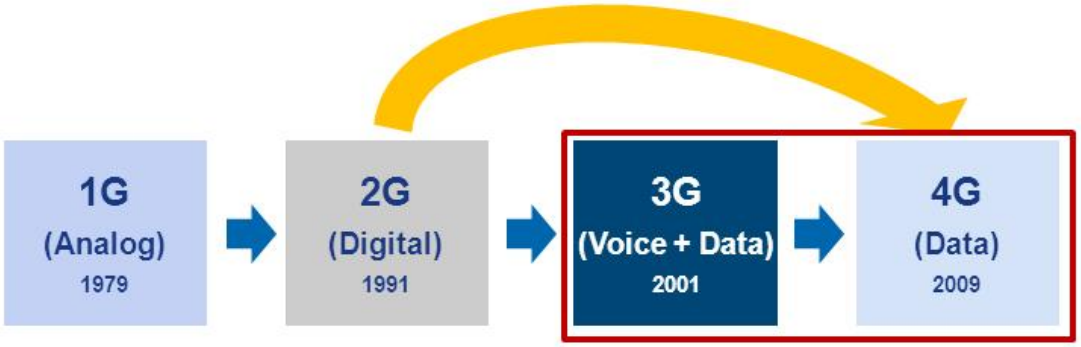
2.3 Leapfrogging Towards the 4G Communication

Analog wireless communication was first introduced by Nippon Telephone and Telegraph (NTT) in 1979. In 1991 a 2nd generation wireless communication technology was launched to the market that used digital signals and in 2001, the first commercial introduction of 3rd generation wireless technology was seen. It was during this 3G era, where the transmission of voice and data via single type of network infrastructure was established. This meant the genesis of the smart devices era, the beginning of the proliferation of mobile internet. Starting with the introduction of iPhone and Android O.S-based devices, the global data usage has been exponentially growing with proliferation of smart phones. In 2009, Long Term Evolution (LTE) is introduced to the market to successfully bear the burden of exploding data usage of 3G line. There was a slight problem in 4G wireless communications: that it consisted sorely data lines, which meant that the separate establishment of voice line via 2G or 3G technologies must have been implemented in parallel. This means every 4G phones were still relying on 3G infrastructures to make/receive calls, and it was observable that while LTE technology was used to enhance data transmission speed during internet usage, the signals switched to 3G when phone calls were received or made.

The characteristic of data transmission is completely different from voice in a sense that they are transmitted in small units called packets. Where voice channels require a guaranteed connection between two devices regardless of how dim the signal is, data channels are not very dependent on the connectivity since lost data transmission during interfered signal can be transmitted again with other bundles of packets. This meant that the voice may crack or experience delay when data channel was used for transmission, and the best example of such phenomenon is when phone calls are made via various SNS or video chat messengers instead of default “call” option available on every device.

Such problem was solved with the introduction of a new technology called Voice over LTE (VoLTE). It was a simple approach to deliver voice data flows within the LTE data bear based on the IP Multimedia Subsystem (IMS) network that guaranteed no dependency on the legacy circuit-switched voce network to be maintained. This meant that clear transmission of voice over data channel, without dependency on voice network, was finally achieved, which meant the entire 3G communication technology may be put in the history just like 1st or 2nd generation infrastructures. Using pure 4G network was also advantageous in a sense that the Bandwidth of network was 3-4 times higher than 3G networks on average, which meant the data transmission speed is also proportionally greater by the same amount, and the use of fiber optics cable was economical in long term in terms of CAPEX and OPEX analysis compared to the usage of copper wires, especially with tremendous increase in the raw material prices. Therefore the idea of omitting the construction process of 3G wireless communication infrastructures and directly jumping into the establishment of 4G wireless communication from 2G or even from complete scratch was widely accepted, and such phenomenon is the leapfrogging of CT infrastructure, which has successfully filled the gaps between the developed and developing countries and abolishing the first-mover advantages, at least on the basic infrastructure level of analysis. Simply put in a short sentence, a new opportunity was given to everyone that granted equal power to access to information with cheaper and quicker way, and the question was whether to put the priority to ICT development and pour in the financial resources for the advancement of ICT.

<Figure 2.4>



Source: Compiled by Author

2.4 Organizations

Below are some attempts by organizations, governments and business to offer a better realization of ICT4D to the practice.

2.4.1 UN ICT Task Force

The United Nations organized a special task force to discuss various ICT4D related issues in 2001. The task force held semi-annual meetings to address specific themes, such as a Global Forum on Internet Governance (UN headquarters in New York, March 2004); a Global Forum on an Enabling Environment (Berlin, November 2004); and a Global Forum on Harnessing the Potential of ICTs in Education (Dublin, April 2005). The UNICTTF's was disassembled on December 31, 2005 with a new group called 'Global Alliance for ICT and Development' succeeding the legacy.

UNICTTF’s significance was that although there has been number of attempts from IGOs and many other international organizations previously, it was one of the first major

attempts launched by the UN, a system we have in contemporary world politics that is the closest to the world government.[8]

2.4.2 GAICT and WSIS

Kofi Annan launched the Global Alliance for ICT and Development as he was ending his tenure as the UN secretary general in 2006. GAID included a huge range of member of personnel from various fields such as government, development cooperation, foreign policy, finance, the social (health, education) sector, regulatory agencies, industry and laborer's associations, ICT producers and consumers, the media, NGOs, community social organizations, foundations, scientific, academic and ICT communities and even individuals who provides advocacy and oversights on today's issues in IT and implementing programs addressing the UN MDGs.

Also United Nations held summits in Geneva in 2003 and Tunis in 2005 to initiate an action called World Summit on the International Society. A plan of action is being followed, with a ten-year deadline ending in 2015 after Tunis. This parallels the timeframe for the Millennium Development Goals.[9]

[8] *"What was the UN ICT Task Force?"*, ITU, accessed Oct 25 2016, https://www.itu.int/net/wsis/basic/faqs_answer.asp?lang=en&faq_id=88

[9] *"Global Alliance for ICT and Development (GAID)"*, Internet Society, accessed Oct 25 2016, http://www.internetsociety.org/who-we-are/related-and-partner-organisations/our-community-and-partners/gaid

2.4.3 EU Funding

European Union has taken a countable role in ICT4D as well. The European Commission is investing in research and development projects to encourage the increased use of ICT for sustainable growth with the belief that the implementation of ICTs could play a significant role in maintenance of sustainable growth of developing and least developed countries. Significant EU funds have, therefore, been dedicated to driving research and development in this area. The main funding tools are the Seventh Research Framework Programme (FP7) and the Competitiveness and Innovation Framework Programme (CIP).

The total budget for research and innovation is estimated to be €10.8 billion, split along thematic priorities, and EU has announced an €8.1 billion package of calls for proposals under the EU's FP7 in 2013[10]. The CIP on the other hand runs from 2007-2013 in parallel to FP7, with total budget of nearly 4 billion euros, aiming for better adaptation and use of ICT, as well as development of the information society.[11]

2.4.4 Korean Trust Fund

As the dominant leaders of ICT with one of the top-tier scores in ICT development index, Korea has shown a degree of its obligations towards bringing the equality in ICT development of the world. In 2008, the Republic of Korea established the Korean Trust Fund on ICT4D that contributed 15 million US dollars trust fund towards World Bank projects that demonstrate cutting edge approaches to development problems, with specific focus on ICT.

[10] *"Research and Innovation FP7"*, European Commission, accessed Oct 25 2016, http://ec.europa.eu/research/fp7/index_en.cfm

[11] *"Competitiveness and Innovation Framework Programme (CIP)"*, European Commission, accessed Oct 25 2016, http://ec.europa.eu/cip/

The Korean Trust Fund is implemented to the World Bank operations, and helps the World Bank remain a force for transformative development outcomes worldwide. It supports activities that serve as input in the development of three main domains of ICT4D:

- e-Transformation Across Sectors: Using ICT to transform the efficiency and/or accountability of service delivery in various sectors and to monitor/track results , especially in food security, social services, and IT industry development.
- Green IT: Implementing environmental friendly solutions that improve

  (i) Energy efficiency of electricity and transportation networks of urban infrastructure

  (ii) Climate resilience of agriculture and water resource management systems
- Broadband Connectivity Infrastructure: Increasing access to affordable broadband infrastructure services via policy and regulatory interventions. Also playing a role as a catalyst in Public-Private Partnership investment, particularly articulating mobile broadband.[12]

2.4.5 Swedish Program (SPIDER)

Also as one of the top leaders of state of the art ICT technology, Sweden established its own program called The Swedish Program for ICT in Developing Regions (SPIDER) to provide resources for ICT4D in 2004, and is primarily financed by the Swedish International Development Cooperation (SIDA), with complementary funding from Stockholm University.

[12] *"The Korean Trust Fund on ICT4D"*, The World Bank, accessed Oct 23 2016, http://www.worldbank.org/en/topic/ict/brief/the-korean-trust-fund-on-ict4d

The center is administered by the Department of Computer and Systems Sciences (DSV) at Stockholm University.

Similar to the Korean Trust Fund, SPIDER is offering catalytic funding to innovative projects focused on ICT4D, especially on e-Transformation across sectors, crosscutting ICT issues that focus on low cost and high quality technology free and open source software, mobile technology for development and various crosscutting development issues in youth empowerment, cultural creativity and capacity development.

SPIDER especially provides support to projects implemented in any one of the twelve priority countries for Swedish development cooperation: Bangladesh, Bolivia, Burkina Faso, Cambodia, Ethiopia, Kenya, Mali, Mozambique, Rwanda, Tanzania, Uganda, and Zambia.[13]

2.4.6 Cisco Networking Academy (CNA)

As a part of Corporate Social Responsibility (CSR) program, Cisco, the leading manufacture of network equipment in the network industry, provides an academic institute around the world to enhance IT skills and knowledge. Offered courses vary from basic IT knowledge to advanced networks, and Cisco offers their own certificate system to provide standards in networking knowledge such as CCNA, CCNP and CCIA.

By providing over 9,000 institutions from secondary schools to universities and community organizations in more than 170 countries, Cisco attempts assist individuals to acquire IT skills and find career in relation to the IT industry.[14]

[13] *"Welcome to SPIDER"*, SPIDER, accessed Oct 23 2016, https://spidercenter.org/

2.5 Applications

Such attempts for various projects from various players aimed for similar sectors of ICT implementation that can be extracted out as common intersections, and they mostly put emphasis on 3 major sectors: Governance, healthcare and education. For most cases, sector's name is followed by the letter "E" that stands for "electronic" in order to represent the ICT involvement and convergence with such sector. And its applications are widely operated in numerous parts of the world, attempting to initiate the digitalization of conventional system, in hopes to bring higher efficiency and greater outcome

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2.5.1 E-Government

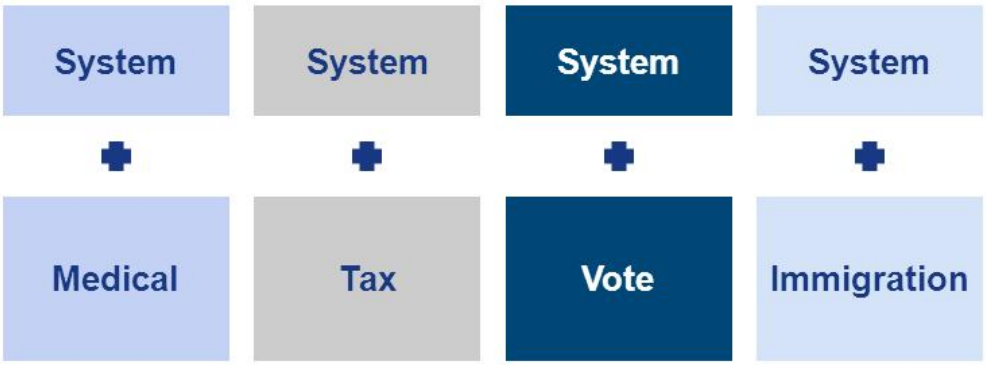
The first practice is the E-Government, application of ICT in Governance. This means that regulatory and personal information will be electronically managed, as well as keeping records of each activity between the sector and the involved personnel. For Easier understandings, fig 3.1 and 3.2 below may be taken as a reference. Let us assume an imaginary situation where there are 4 sectors: Hospital Patient management, Paying Taxes, Voting and Immigration offices. As shown on fig 3.1, they will each require their own management system attached to it, whereas implementation of E-Government may offer a common platform that can connect every sector at once for complete and total management and maintenance. By having electronic management of each sector, transparency is naturally promoted by taking away the discretion, thereby curbing opportunities for arbitrary actions and corruption. By enhancing exposure of detailed data on transactions, each action will be

[14] *"Cisco Networking Academy"*, Cisco, accessed Nov 11 2016, http://www.cisco.com/c/en/us/training-events/resources/networking-academy.html

trackable and link the corrupt with their wrongful acts, as well as boosting efficiency and encouraging citizen relations by making rules simple.

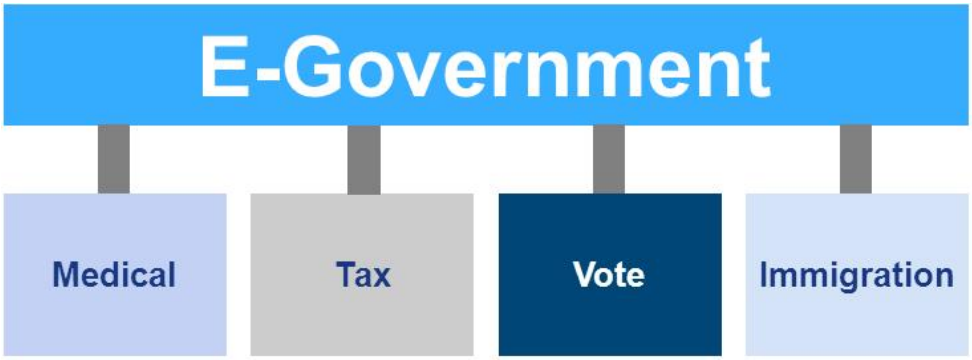
However there is also drawback or counter argument, that more corrupted regimes will deny implementation of such system, for responsible personnel might fear the exposure of their corrupted acts. Also security against cyber-attacks remain crucial, where fall of one E-Government system may result on exposure of personal information of every sector that are related, such as medical or financial transaction records.

<Figure 2.5>: Before the Introduction of E-Government



Source: Compiled by Author

<Figure 2.6>: After the Introduction of E-Government



Source: Compiled by Author

2.5.2 E-Health

E-Health has 4 important components that must be well established and fully co-functional in order to be effectively operational. First of all, the electronic health records of patients, where the information may link to the E-Government system and may be applied not only to track medical records but may also be utilized for national health insurance system and taxation for tax returns. Then required is the computerized physician order entry. Patient and physician will be remotely connected via computer or other electronic devices that allows doctors to offer diagnosis to patients without arranging a physical visit of patients to remote hospitals. Next is e-prescribing system for preventing drub abuses and guaranteeing transparency. Lastly, there must be enough clinical supports, which means that there must be enough public health institutes or centers where minor diagnosis or simple treatments may be performed in place of hospitals. To help understanding, following scenario may be taken into consideration.

> A patient is remotely monitored by a doctor, for patient's home is geographically isolated from central city. This appointment is not merely a video chat, for it may include exchange simple diagnostic data such as body temperature, pulse, or blood sample analysis, depending on the tools patient has established at home from aids of nearby health center. Doctor then sends E-prescription to the patient and depending on the seriousness of patient's condition; patient can either visit nearby clinic and receive treatment or may have to visit doctor in the actual hospital for further analysis and even surgery. Luckily for this case, patient merely needs drugs and shots from nearby health center, and problem is solved.

Despite the tempting sound, E-Health system faces some difficulties as well. For the most obvious part, the reliance of remote diagnosis, as well as the linkage between the hospital and local public health institutes cannot be trusted just yet. It also faces great risk of

personal information, where electronic management of prescriptions and other personal medical records are simply too great to be taken or treated so lightly.

2.5.3 E-Learning

E-Leaning is also referred to as E-Studying or E-Education. This concept, unlike the previous two, is little more familiar to us, since some aspects of it has already been implemented in our lives. The advantages or offering online courses and lectures is that geographically remote students can participate in classes, and even if they are not able to attend the class in live session, they can still save the lecture material and review in their convenient time slot. Online courses may encourage heavier involvement such as class discussion and asking questions, or bringing in the aspect of fun by adding active features to the courses (such as drag and drop games or fun animations/sounds for children), which will eventually enhance learning opportunities. Also with digital libraries, students not only enjoy equal access to information, but the concept of intellectual properties and copy rights are also maintained. This will be beneficial to the government as well, in terms of saving space, time and cost from physical construction of an actual library.

The classic challenge E-Learning face is its efficiency. As one can imagine, there is only certain degree where digital education and books have to offer in places of actual lecture from real instructors with real books. The progress monitoring is also difficult for instructors in a sense that it will be extremely difficult to track all the students electronically without seeing their actual faces and class participations.

2.6 Why ICT4D

The question is, why then has there been so much emphasis on the ICT4D for past few decades? The answer may seem obvious as it is difficult to imagine living without technologies and devices today. However, it may raise a complex issue and many debates when same question is asked whether it would be worthwhile to utilize ICT as means to development for developing regions or third world countries. In order to answer this question, it may be helpful to cover a new phenomenon that was introduced not too long ago, a digital divide.

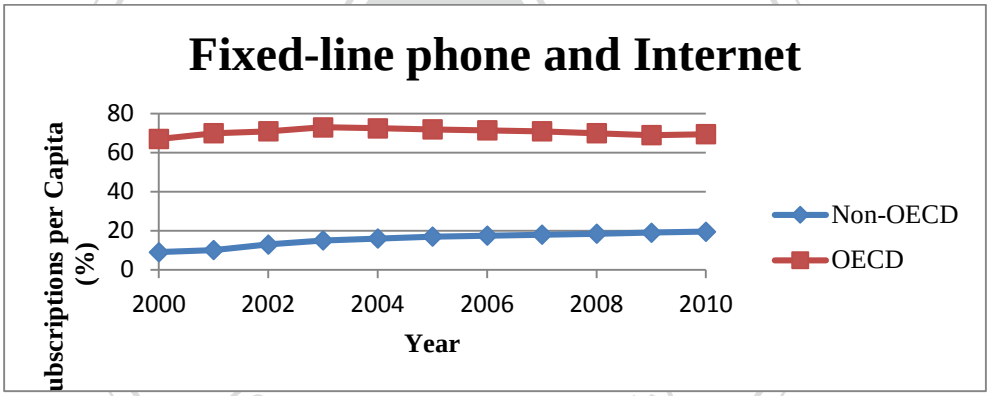
2.6.1 Digital Divide

Digital divide refers to the digital illiteracy and the restrictions to the access to and use of ICT, caused by the economic and social inequality. As shown in fig 4.1, subscriber gap between the OECD and non-OECD countries have been narrowing for the past decade, which indicates a positive sign that we have slightly more equality in terms of access to the internet and the information itself. The ration nearly halves from 7 to 3.5, which means almost double the improvement during set time period. However when fig 4.2 is taken into the consideration, the data usage gap, sadly, diverges as time passes. This means that the non-OECD countries cannot fully enjoy as much rights, even though they are capable of them. On fig 4.3, the distribution is even more easily visible, we can spot that global south is definitely using less internet than the north.

Where infrastructures are established, knowledge of operating devices, using internet freely, accessing the right web pages and even usage of applications might have caused such phenomenon. Similar to earlier days where often uneducated citizens were unable to read and

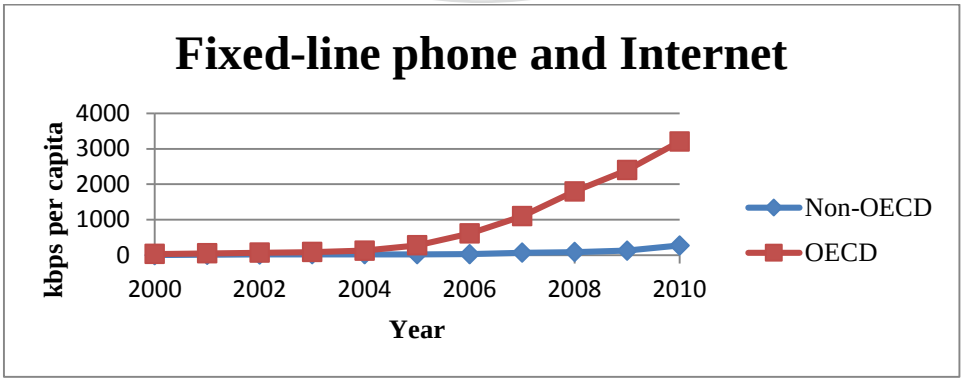
write, that has restricted them to the reading capabilities that restricted access to the information, digital illiteracy is often referred to digital divide. In other words, direct restrictions towards devices and availability of infrastructures may hinder individuals for convenience and greater efficiency, lack of education towards usage of them also play a big role. Therefore many projects and programs from various players such as mentioned above not only focus on aim to develop low-cost and high-performance devices, great amount of emphasis is on the education and exposing community to the ICT by introducing new platforms and systems.

<Figure 2.7>: Subscriptions for Fixed-line Internet per capita from 2000-2010



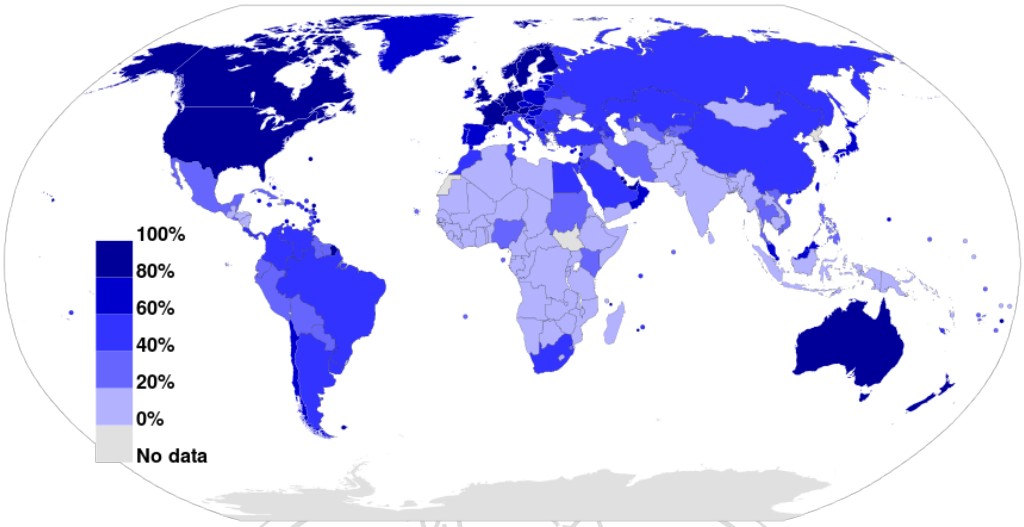
Source: Hilbert Martin, ITU, 2011

<Figure 2.8>: Data Usage for Fixed-line Internet per capita from 2000-2010



Source: Hilbert Martin, ITU, 2011

<Figure 2.9>: Internet Users in 2012 as a Percentage of a country's population



Source: International Telecommunication Union, 2012

2.6.2 Attempts

Some significant attempts were made. First of all, as mentioned previously in E-Learning section, one could take a close look at the establishment of digital libraries. In Durban South Africa, low access to technology and a lack of documented cultural heritage has motivated the creation of an "online indigenous digital library as part of public library services." This project has the potential to narrow the digital divide not only giving the people of the Durban area access to this digital resource, but also by incorporating the community members into the process of creating it.[15]

Another great example worth mentioning is One Laptop per Child project. Founded in 2005, the organization provides inexpensively produced so called "XO" laptops (the price is dubbed to be about 100 dollars) to children residing in poor and isolated regions within

[15] Greyling, McNulty articulates the significance of community members' involvement.

developing countries. Each laptop belongs to an individual child and provides a gateway to digital learning and internet access. XO Laptops are specifically designed to endure more abuse than average laptops, and also they are constructed to use as little power as possible to meet the conditions of remote villages where power sources are extremely rare and scarce.[16]

Lastly there exist attempts on the software level as well. Microsoft has launched a cheaper version of Windows called "Windows Starter Edition" for developing countries, as well as actively engaged in providing free distributions to public institutes and sectors. Although many open source operating systems such as Linux and Androids are used, for they are available for future application development stages as well, which will not only boost the capabilities or users, but also enrich the local software business and markets as well.[17]

2.6.3 Future Possibilities

Some of the latest trends in technology have drawn heavy world-wide attention, for its significance of not just advancement of technology, but due to its potential to becoming a revolutionary game-changer in industries.

The brightest spotlight shines upon 3D-printing. Where conventional printing technology was associated with imprinting pigments, mostly divided into Cyan, Magenta, Yellow, and Black, on loaded papers of various sizes, 3D printing allows users to "print" any products with given CAD design or related blueprints with prepared "elements" as toners. Most materials used today is limited to ceramic or plastic based materials, it could very well

[16] "*Mission*", One Laptop Per Child, accessed Dec 21 2016, http://one.laptop.org/about/mission

[17] "*Micro Windows XP Starter Edition Fact Sheet*", Microsoft, accessed Nov 13 2016, https://www.microsoft.com/presspass/newsroom/winxp/WinXPStarterFS.mspx

vary from metallic substances or even organic components in future. This means any individual will be able to produce, which directly indicates a revolutionary change in the industry of production. Given that individuals are provided with equal opportunity to be trained in CAD designing, citizens from some of the poorest countries may very well be able to produce innovative and mind-breaking products without having to invest heavily on factories and other infrastructures for production. It will then eventually lead into almost completely closing the gaps between the production industries of developed and developing states.

Other good examples are the Virtual Reality (VR) and Augmented Reality (AR). There is a difference in both technologies that VR focuses on some completely arbitrary and imaginary experiences, whereas AR heavily focuses its purpose to add in (augment) extra components to the reality. Development of Head-Mounted Displays (HMD) and other optical devices are strongly related to this, where most civilian users experience more joy in terms of gaming or watching movies, and most soldiers in precision attacks and combat skills. Where this may be viewed as visual extension or enhancement of human beings, endless possibilities are awaiting when other receptors and limbs are enhanced.

For instance, when remotely-controllable hands are produced that can be synced with operator's hands with precise feelings and control; it may be used to offer remote-operations or surgery in medical fields. In fact a device called Vein Viewer[18] that films, processes and projects the image of subcutaneous veins onto the skins to locate veins has been invented. AR has already taken part, and with future development, it may bring another revolutionary game-changer in terms of closing the gaps between service industries.

[18] *"VeinViewer Flex"*, Christie, accessed Dec 15 2016, https://www.christiemed.com/products/veinviewer-models/veinviewer-flex

Though the debate that interconnects the relationship between communication technology and economic development has always been a popular research list on the table dating back from decades ago, the research on relationship between ICT development and socio-economic development is arguably a new area.[19] Two main reasons are that the shift of axis in terms of the significance of communication was moved from voice to data, which accounts for the reason why we must disregard the conventional communication technologies and change the independent variable and this very phenomenon itself regarding data revolution is relatively new, indicating the fact that not enough time has passed to perform any accurate analysis.

Conventional communication technology, which mainly focuses on the prosperity of 2G technology dealing with cellular calls and SMS, was a disruptive technology that changed the way we communicated, surely introducing a socio-economic reform in many aspects. Despite the fact that this mobile communication brought socio-economic advancement it is difficult to find those who utilize mobile phones and its infrastructure merely to communicate with one another and exchange texts or voice based information. Vast majority of population focus the usage of their mobile devices on internet-based activities, which introduces completely different variables to come into consideration: This is not simple matter of interconnectivity among people anymore, we also need to consider how they interact with what kind of tools. This is why two distinguished industries, IT and CT, have converged into

[19] The introduction of smartphone was recent, and its impact and changes in industries and everyday life pattern was enormous; that there has been heavy reliance on data traffic rather than conventional phone calls and short messages. Therefore if the previous researches focused on the access to cellphones towards the development of a country, there are multiple aspects to consider in today's researches: Wireless internet coverage, data usage, access to smartphones and tablets, e-transformations, and the subscription numbers.

ICT and using mobile phones is completely different today than 20 years ago, which is why a new study and research must be introduced.

Also as for the time that has been concerned for the introduction of this new technology, ICT development is not an area which would produce an instant result: It will take years to smudge into society after launching and produce visible outputs from them. iPhone, which indubitably initiated the beginning of smartphone era, was introduced in 2009, and the VoLTE that grants users to sorely rely on data communication (4G Infrastructure) without using voice networks (3G Infrastructure) was recently introduced in 2014. Hence there are not many previous researches or studies that specifically target the linkage between the data communication and economic growth. Furthermore the major arguments of those few past studies almost represent unilateral voice, that the two variables are positively interconnected. Kala Seetharam Sridhar and Varadharajan Sridhar argue that

> "A number of researchers (Norton, 1992) have hypothesized that ICT infrastructure lowers both the fixed costs of acquiring information and the variable costs of participating in markets. They point out that as the ICT infrastructure improves, transaction costs reduce, and output increases for firms in various sectors of the economy (Roller & Waverman, 2001). Thus investment in ICT infrastructure and derived services provide significant benefits to the economy. Few relevant studies on the topic" (pg. 7)

Also a joint report by Deloitte, GSMA and Cisco, *What is the impact of mobile telephony on economic growth,* claims that "A doubling of mobile data use leads to an increase in GDP per capita growth of 0.5 percentage points" (pp. 7). Kvochko argues "10% increase in broadband penetration is associated with a 1.4% increase in GDP growth in emerging markets" in her article in World Economic Forum.[20] Senior economist in World Bank, Qiang, also states that

[20] Kvochko, Elena. *"Five ways technology can help the economy"*, World Economic Forum https://www.weforum.org/agenda/2013/04/five-ways-technology-can-help-the-economy/

"With 10 percent increase in high speed Internet connections, economic growth increases by 1.3 percent".[21] Although it is impossible to quote a statement from every article published regarding ICT development and its impact, it is not too far to presume that vast majority of the voices converge to a single argument: Better the ICT, higher the development. However most research are performed from perspectives of IGO, OECD/Developed countries and MNCs, and the voices from developing or least developed states are rarely heard of. This is problematic, because there is no way to prove that positive relationship between ICT4D and socio-economic development is merely an argument from advanced economies to expand their power rather than purely development concerns. Furthermore, even if the ICT4D is somehow determined as a guaranteed catalyst for promotion of development, it is impossible to determine whether the impact of the ICT investment kicks in momentarily after the construction is complete: It might take decades for educated personnel to play role in society for economic and industrial performances and productions of tangible outcomes, as well as all the system (that could include electronic government, health, tax, and education systems) to adapt into the given states: After all, it has not even been a decade since the data revolution sprung. Therefore it is not easy to provide fair judgment that outlines the general voice that explains the relationship between two variables, there are multiple other factors to consider and it is too soon to draw a single solid conclusion out of the obtainable data today. Therefore it is easily questionable and challenged that the ICT development is directly related to socio-economic development.

[21] Christine Z., Qiang. *"Information Communications Technology for Development"*, The World Bank, http://live.worldbank.org/information-communications-technology-development

2.7 Optimistic View

This perspective regards the ICT4D in developing states as a process of diffusion of knowledge from advanced economies to lesser ones. In summary, it assumes technologies and associated practices practically independent from the social and cultural circumstances and simplifies the correlation of ICT4D with state development in a taken-for-granted positive manner. Optimistic authors often focus their research on this transfer and diffusion approach to particularly good practice models and case studies for developing countries in particular regions. (Rose and Straub 1998; Al-Gahtani 2003; Davis 1989; Rogers 1995)

Arguments from this camp is unilateral and almost self-convincing: that regardless of the type of information system (IS) and ICT development, it will be fully transferred and adopted to any given states without extra conditions and restrictions. To most of us ordinary readers (at least considering this thesis was accessible), this argument is rather familiar, for the significance of science and technology, ICT implementation and education is almost always emphasized in the political agenda. Therefore it would seem natural to address similar voices towards developing countries, that ICT development is crucial and one of the first priority in order to progress state development.

Because transfer and diffusion approach covers flow of technology from developed countries to developing ones, it would inevitably attract attentions of related parties from developed economies. Most ICT companies and enterprises, that is, of course, including various electronics manufacturers, software developers and even telecommunication service providers, positions themselves in this camp and argue the benefits of technology diffusion and acceptance. Various IGOs including UN, ITU and GSMA are also major players in this camp, along with governmental projects and policy announcements regarding emphasis of

ICT4D is the evidence. Consider the Millennium Development Goal (MDG) for starters, any major state development plans, such as case of Tanzania and Slovakia (Twaakyondo et al, IT Asociacia Slovenska), would almost always include advancement of ICT.

2.8 Pessimistic View

This perspective finds the assumption of the transfer and diffusion perspective oversimplifying and misleading, therefore does not entirely adopt their arguments, requesting more validity of the underlying rationality of the transferred methods in their new context of practice. It instead focuses attention on the embeddedness of ICT innovation in the social context of various organizational settings. The basic argument of this camp, similar to that of the constructivist approach in IR scholarship, is that the social and cultural aspect of given countries play significant role in terms of adaptation and acceptance of technologies that will eventually lead to the socio-economic development of a country. They see the purpose of ICT innovation as arising from local problematizations and its course as being shaped by the way local actors make sense of it and accommodate it in their lives (Avgerou 2002). They also suggest few negative aspects of promoting of use of ICTs in developing countries, that it originates from the interests of power holders to accumulate more wealth and security, rather than concerns for the development: those with economic advantages contemplate utilization of developing countries by forcibly advancing the platform for their potential market.

This camp is mainly occupied by scholars and research institutes, whom does not have any economic ties and are merely interested in causal relationships of one variable to the other. Kaaya and Assey for instance, in their case study of Arusha and Manyara regions, argues that ICT solutions merely end up at the level of council and mostly in urban areas, ICT

development does not make a socio-economic impact on a state. Wilson also concludes his article by saying that the information and development has no interconnections, challenging supporters of ICT and development to be critically aware of assumptions and carefully review their thoughts. Even Avgerou, while carefully analyzing and discussing multiple discourses on ICT and development, still argues that "ICTD research, despite its remarkable theoretical capabilities to study technology innovation in relation to socio-economic context, remains weak in forming convincing arguments on IT-enabled socio-economic development" (pg1, Avgerou 2010)

2.9 Summary

Where ICT4D research has produced substantial body of knowledge on the efforts made in developing countries to exploit the potential of the never ending advances of ICT, doubts and questions still remain. In this thesis, I would position myself in the camps of questioning the positive impacts of ICT4D, and challenge the traditional belief that ICT4D is the panacea for poverties and any development related issues in the developing countries.

Chapter Three: Statistics Model - ICT and Wireless Communication Development and its impact on Economic Development

3.1 Overview - ICT and Economic Development

I have discussed the background information, the significance of, and the reason behind supporting argument of ICT4D. How then, would we be able to measure and determine the relationship between development of ICT and a country? First, there would be too many considerations to precisely define what development is for both variables. As for the ICT4D, which would be the independent variable, it may be viewed at too many number of angles: number of people with access to computers, telephones, cellphones, tablets, or maybe some specific candidates such as credit cards, audio players and video games. As for the country's development, the dependent variable, it could be viewed from every possible angle of social, economic and political aspects.

However, we could utilize some well-assimilated raw data and make comparisons to have a rough or brief outlines of two variables. ITU publishes annual report regarding IDI based on number of factors that measures level of ICT development in their *Measuring the Information Society*. Also, the GDP per capita is a reliable standard to measure economic aspect of performance of a country's citizens. Although it may not provide the most accurate and direct answer, the result will still be reliable to certain degrees in a sense two numeric values will be compared, and hence will generate a result that provides one of many views.

In this chapter of thesis, I will discuss the impact of ICTD on economic development by simulating a simple regression result.

3.1.1 Definitions

a. ICT: refers to the IDI extracted from ITU's annual report

b. Economic Growth Rate: is measured in the growth rate of GDP per capita

IDI raw data is from ITU as mentioned above, and the GDP per capita data will be extracted from GSMA Wireless Intelligence. Again, the purpose is not to limit our views to these two variables and draw a quick conclusion, but rather to provide a method to draw linkage between two variables.

3.1.2 Null and Alternative Hypothesis

The Null and Alternative Hypothesis are

$H_{0:}$ ICTD has no impact on Economic Growth Rate

H_A: ICTD does have an impact on Economic Growth Rate

Where initial assumption is that ICTD has no impact on economic growth rate of given countries, and it will be analyzed whether this can be rejected at any confidence level.

3.2 Raw Data and Data Layout - ICT and Economic Development

Countries taken into considerations are non-developed or OECD countries for two main reasons. First, it would seem obvious for developed countries with high economic capabilities to possess good ICT capabilities, which would prove nothing more than a direct relationship. Furthermore, it would be logical to purely take developing countries into

consideration so that 1. The direct observation of ICT implementation with Economic growth is observable and 2. To make the result into practical applications: That is to focus on other basic necessities such as healthcare and education if null hypothesis is determined to be true, or otherwise versa.

The ICTD, which is measured in the compound annual growth rate of the IDI between the year of 2011 and 2013, is set as independent variable, and the economic growth, measured in the compound annual growth rate of GDP per capita in the same given period, is set as the dependent variable. The raw data and the summary data layout are as below.

<Table 3.1 The Raw Data Table>

Country	Subscriber (%)	GDP/Capita (%)	Country	Subscriber (%)	GDP/Capita (%)
Albania	6.330138449	2.873333333			
Angola	34.35147014	1.176666667	Nicaragua	5.64582058	3.586666667
Armenia	27.97230336	4.98	Nigeria	8.322953223	3.316666667
Azerbaijan	8.616538451	1.353333333	Pakistan	5.548090698	2.546666667
Bangladesh	76.39323471	5.07	Panama	2.955457565	8
Belarus	7.16479719	2.81	Paraguay	5.210328331	3.746666667
Bhutan	11.77603905	4.286666667	Peru	4.429475274	4.763333333
Bolivia	6.846059156	3.98	Philippines	8.494700003	4.066666667
Bosnia and Herzegovina	4.633406662	0.466666667	Poland	2.558615862	2.33
Botswana	8.849056977	4.536666667	Romania	4.555400571	2.536666667
Brazil	7.65550721	1.203333333	Russian Federation	4.25647506	2.74
Bulgaria	6.009241445	1.7	Rwanda	6.342724238	3.536666667
Cambodia	7.824770567	5.43	Senegal	8.773831162	0.226666667
Cameroon	7.296283389	2.11	Serbia	5.057203362	1.43
Chile	6.387272211	4.156666667	Seychelles	4.396114979	4.06
China	7.122739434	7.683333333	Solomon Islands	7.701010723	3.933333333
Colombia	7.359519748	3.586666667	South Africa	8.895321224	1.286666667
Congo	7.929168647	0.88	Sri Lanka	5.844955379	7.58
Congo, Democratic Republic	6.935126465	4.6	Suriname	32.54035912	3.606666667
Costa Rica	9.491169234	2.913333333	Syria	2.944358033	4.836666667
Dominican Republic	5.955567816	2.836666667	Tanzania	3.668200501	2.856666667
Ecuador	7.121868529	3.98	Thailand	10.25385372	5.9
Egypt	5.045837225	0.346666667	Togo	5.110622619	1.013333333
El Salvador	7.763152944	1.27	Tunisia	6.700635717	3.66
Ethiopia	5.873751217	7.286666667	Turkey	5.99847785	10.57333333
Fiji	7.050188404	1.47	Uganda	6.941056058	1.806666667

Gambia	8.239819623	-0.746666667	Ukraine	4.484165807	2.713333333
Georgia	6.961037573	5.24	Uruguay	6.500878141	4.776666667
Ghana	16.59426968	7.926666667	Vietnam	4.649673572	4.533333333
Guatemala	41.73220668	1.03	Zambia	5.922384105	3.48
Guinea	12.07182707	0.833333333	Zimbabwe	8.93996684	3.603333333
Guyana	3.862120304	4.6	Thailand	10.25385372	5.9
Honduras	4.206542974	1.35	Togo	5.110622619	1.013333333
India	6.320599792	4.14	Tunisia	6.700635717	3.66
Indonesia	5.532431673	4.86	Turkey	5.99847785	10.57333333
Jamaica	4.342887836	0.933333333	Uganda	6.941056058	1.806666667
Kyrgyzstan	41.30763395	3.763333333	Ukraine	4.484165807	2.713333333
Latvia	4.303049429	6.77	Uruguay	6.500878141	4.776666667
Lebanon	8.883422815	0.733333333	Vietnam	4.649673572	4.533333333
Liberia	9.160706959	7.276666667	Zambia	5.922384105	3.48
Lithuania	3.784186695	6.76	Zimbabwe	8.93996684	3.603333333
Macedonia	4.375488769	1.753333333	Thailand	10.25385372	5.9
Madagascar	1.379831936	-0.98	Togo	5.110622619	1.013333333
Malawi	3.281149232	0.8	Tunisia	6.700635717	3.66
Malaysia	4.967342981	3.423333333	Turkey	5.99847785	10.57333333
Maldives	5.32113461	1.866666667	Uganda	6.941056058	1.806666667
Mali	12.35340994	-1.506666667	Ukraine	4.484165807	2.713333333
Mauritania	6.232103967	3.293333333	Uruguay	6.500878141	4.776666667
Mauritius	6.492747983	3.016666667	Vietnam	4.649673572	4.533333333
Mexico	5.387395206	1.766666667	Zambia	5.922384105	3.48
Moldova	6.503052458	5.03	Zimbabwe	8.93996684	3.603333333
Mongolia	8.274489656	12.17	Thailand	10.25385372	5.9
Montenegro	11.26413157	1.34	Togo	5.110622619	1.013333333
Morocco	6.980190772	2.546666667	Tunisia	6.700635717	3.66
Mozambique	7.631692251	4.586666667	Turkey	5.99847785	10.57333333
Namibia	8.47900782	3.763333333			

Source: ITU and GSMA Wireless Intelligence

<Table 3.2 Summary Data Layout>

Variables	**ICT Development**	**Economic Growth**
Variable Type	Independent	Dependent
Measured in	Compound Annual Growth Rate of IDI (%)	Compound Annual Growth Rate of GDP Per Capita (%)
Years Observed	2011-2013	
Number of Observations	90	138
	90 Common Entries Were Selected	

Source: Compiled by Author

Out of 90 and 138 states' raw data on IDI and GDP per Capita respectively, 90 common entrees were selected for the analysis. IDI is based on 11 ICT indicators, grouped in three

major categories: the access itself, the usage and necessary skills. Detailed indicators are as follows.

The access sub-index (measuring ICT readiness, including five infrastructure and access indicators)

i) Fixed-telephone subscriptions/100 inhabitatns
ii) Mobile-cellular telephone subscriptions/100 inhabitants
iii) International internet bandwidth (bits/s) per user
iv) Percentage of households with a computer
v) Percentage of households with Internet access

The usage sub-index (measuring ICT intensity, including three ICT intensity and usage indicators)

i) Percentage of individuals using the Internet
ii) Fixed (wired)-broadband subscriptions per 100 inhabitants
iii) Wireless broadband subscriptions per 100 inhabitants (includes satellite, terrestrial fixed, and active mobile with a minimum download of 256 kbit/s)

The skills sub-index (measuring ICT capability of skills as indispensable input indicators with three proxy indicators. This is given less weight in the calculation of the IDI compared to above two indicators)

iv) Adult literacy rate (% population 15 and older who can read and write simple statements with understanding and do simple arithmetic calculations)
v) Gross enrollment ratio secondary level (total enrollment in a specific level of education as a percentage of all eligible)
vi) Gross enrollment ratio tertiary level (total enrollment in a specific level of education as a percentage of all eligible)

It will now be worth to see detailed statistical results as well as the scatter plot graph to have a closer look at the relationship between two data.

3.3 Statistical Results - ICT and Economic Development

The statistical results are as below.

<Table 3.3 Summary Statistics>

Variable	Observation	Mean	Std. Dev	Minimum	Maximum
ICTD	90	9.064981	10.144	1.379832	76.39323
Economic Growth	90	3.378519	2.382423	-1.506667	12.17

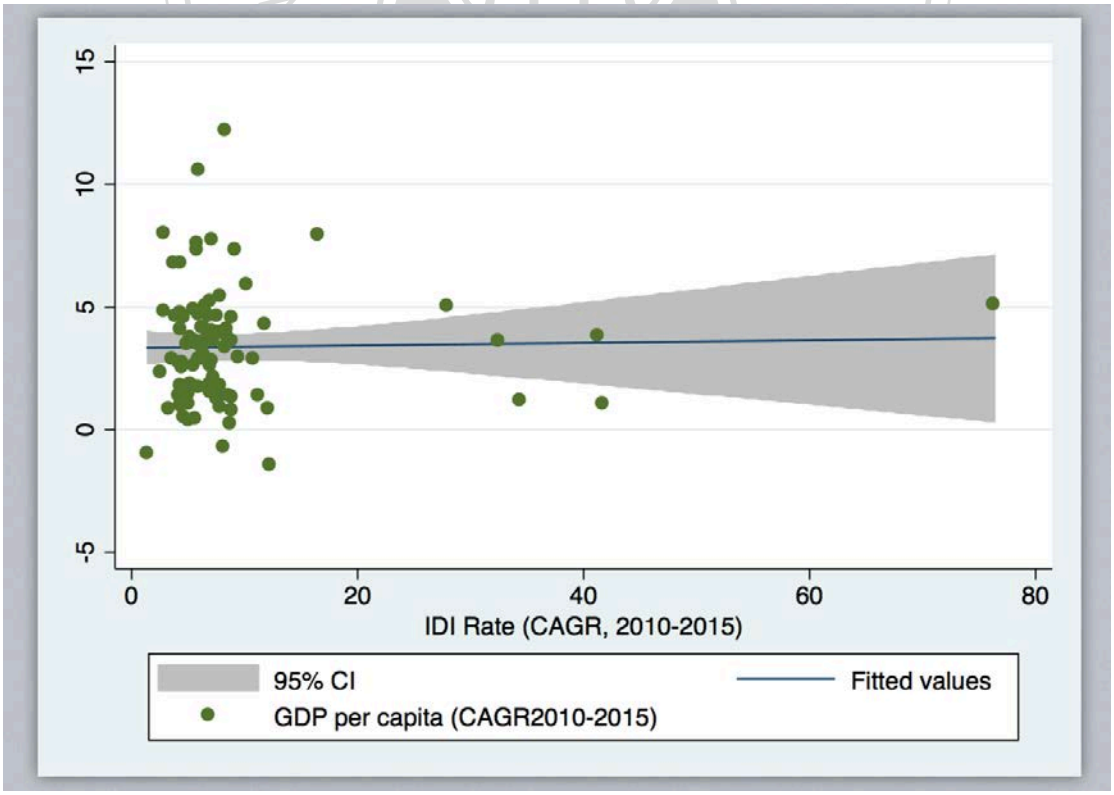
Source: Compiled by Author

<Table 3.4 Regression Results>

Variable	Coefficient	Standard Error	p-Value
ICTD	0.0050756	0.0250303	0.840
Intercept	3.332508	0.3394647	0.000

Source: Compiled by Author

<Figure 3.1 Scatter Plot>



Source: Compiled by Author

As calculated p-Value is 0.840, larger than 0.10, the standard probability value when confidence level is taken at 90%, the result is not significant at 90% Confidence level. And because 90% Confidence Level is the minimum standard that can be taken into consideration, it can be concluded that the null hypothesis cannot be rejected at all levels.

Furthermore with acquired information the linear regression equation is induced as

$$\text{Economic Growth} = 0.0050756^{*} (\text{ICTD}) + 3.3325$$

Although the co-efficient has a numeric value of 0.0050756, this may be disregarded and considered as 0. That concludes that two variables are statistically independent of each other, which again confirms the null hypothesis.

It is possible to argue that increase in one unit of ICTD will impact on augmentation of Economic Grow Rate by 0.0050756%, and two variables have a positive relationship, but the numeric value is too small that this argument seems irrelevant.

Therefore it is safe to presume that the ICTD has no impact on Economic Growth, using the given data for analysis.

3.4 Analysis - ICT and Economic Development

ICTD is determined to have no impact on economic growth using the data set above. However before taking a quick interpretation of result, there is still one more variable worth looking at: the wireless communication. In next chapter, a closer analysis regarding the CT's impact on the country's development will be discussed.

3.5 Overview - Wireless Communication and Economic Development

Although the main topic of this thesis is the impact of ICT development on state development, ICTD numeric mean practically nothing when a state barely possesses any developed infrastructures to make use of them. Therefore more raw form of data needed to be evaluated, which is the number of users of mobile internet, since the usage of mobile internet is a direct indicator of access to information, as well as to enjoy the basic necessity of ICT. If usage of ICT may be compared to driving a vehicle (whether fancy or not), sufficient communication infrastructure may be compared to construction of road: Any vehicle is meaningless without roads to drive upon, same goes with any ICT devices and services. In addition, tracking the number of unique subscribers is equivalent to tracking individuals with drivers' license, which will provide not only direct impact of ICT development, but also how ICT exposure to the citizens' level may impact to the economic growth, measured in the growth rate of GDP per capita, as a state level of analysis. Details on data measurements and methods applied are as below.

Therefore as a round 2 run up, we will now have a glance at the development of wireless communication and its impact on a developing economies.

3.5.1 Definitions

a. Mobile Internet: refers to the usage of 3G (Data & Voice) & 4G LTE (Data) Communication Technology.

b. Unique Mobile Subscribers: refers to unique user who is subscribed to mobile services at the end of the period, excluding M2M (Machine to Machine)

services. This differs from connects such that a unique user can have multiple connections

c. Economic Growth Rate: is measured in the compound annual growth rate of GDP per capita

Both sources are from GSMA Wireless Intelligence, one of the most reliable sources in wireless communication industry. Having data extracted from same source pool increases credibility and accuracy while making linkage between observations.

3.5.2 Null and Alternative Hypothesis

The Null and Alternative Hypothesis are

$H_{0:}$ Access to Mobile Internet has no impact on Economic Growth Rate

H_A: Access to Mobile Internet does have an impact on Economic Growth Rate

Where initial assumption is that the access to mobile internet has no impact on economic growth rate of given states, and it will be analyzed whether this can be rejected at any confidence level.

3.6 Raw Data and Data Layout - Wireless Communication and Economic Development

Similar to previous chapter, countries taken into considerations are non-developed or OECD countries

The access to mobile internet, which is measured as the compound annual growth rate of the number of unique subscribers between the year of 2011 and 2013, is set as independent variable, and the economic growth, measured as the compound annual growth rate of GDP per capita in the same given period, is set as the dependent variable. The raw data and the summary data layout are as below.

<Table 3.5 The Raw Data Table>

Country	Subscriber (%)	GDP/Capita (%)	Country	Subscriber (%)	GDP/Capita (%)
Afghanistan	235.91	5.65	Malaysia	27.29	3.42
Albania	144.02	2.87	Maldives	89.80	1.87
Angola	66.19	1.18	Mali	148.29	-1.51
Armenia	97.57	4.98	Mauritania	123.45	3.29
Azerbaijan	153.84	1.35	Mauritius	50.08	3.02
Bangladesh	97.13	5.07	Mexico	57.98	1.77
Belarus	88.44	2.81	Moldova	40.14	5.03
Belize	47.23	-0.43	Mongolia	89.95	12.17
Bhutan	196.63	4.29	Montenegro	48.82	1.34
Bolivia	201.42	3.98	Morocco	55.59	2.55
Bosnia and Herzegovina	57.11	0.47	Mozambique	118.13	4.59
Botswana	86.73	4.54	Namibia	91.65	3.76
Brazil	85.28	1.20	Nepal	571.40	2.82
Bulgaria	59.74	1.70	Nicaragua	91.68	3.59
Burundi	349.08	0.94	Niger	349.97	1.70
Cabo Verde	83.07	1.13	Nigeria	57.68	3.32
Cambodia	31.40	5.43	Pakistan	49.03	2.55
Cameroon	31.52	2.11	Panama	126.17	8.00
Chile	101.97	4.16	Papua New Guinea	424.91	5.16
China	139.45	7.68	Paraguay	63.15	3.75
Colombia	49.41	3.59	Peru	105.32	4.76
Congo	127.75	0.88	Philippines	48.77	4.07
Congo, Democratic Republic	63.18	4.60	Poland	27.46	2.33
Costa Rica	236.14	2.91	Romania	26.90	2.54
Dominican Republic	89.47	2.84	Russian Federation	46.70	2.74
Ecuador	38.77	3.98	Rwanda	74.23	3.54
Egypt	91.35	0.35	Samoa	921.10	0.55
El Salvador	49.37	1.27	Senegal	283.00	0.23
Ethiopia	139.64	7.29	Serbia	51.05	1.43
Fiji	173.81	1.47	Seychelles	76.61	4.06
Gambia	306.52	-0.75	Sierra Leone	563.10	11.63

Georgia	28.16	5.24	Solomon Islands	173.09	3.93
Ghana	135.03	7.93	South Africa	41.97	1.29
Grenada	160.39	-0.13	South Sudan	108.27	-11.17
Guatemala	48.40	1.03	Sri Lanka	79.39	7.58
Guinea	1991.33	0.83	Sudan	56.46	-0.46
Guyana	146.23	4.60	Suriname	393.16	3.61
Haiti	119.53	2.80	Swaziland	225.65	-0.20
Honduras	49.70	1.35	Syria	90.74	4.84
India	181.61	4.14	Tajikistan	87.00	3.60
Indonesia	64.63	4.86	Tanzania	76.36	2.86
Iraq	23.48	4.89	Thailand	157.00	5.90
Jamaica	100.23	0.93	Togo	205.43	1.01
Jordan	375.95	0.44	Tunisia	223.86	3.66
Kazakhstan	681.24	4.66	Turkey	46.06	10.57
Kenya	33.68	1.77	Turkmenistan	609.71	3.07
Kyrgyzstan	197.69	3.76	Uganda	120.32	1.81
Laos	197.12	6.10	Ukraine	32.18	2.71
Latvia	37.73	6.77	Uruguay	57.59	4.78
Lebanon	143.58	0.73	Uzbekistan	56.93	6.13
Lesotho	103.13	3.96	Vanuatu	253.86	-0.33
Liberia	162.53	7.28	Venezuela	36.92	2.14
Libya	34.69	10.08	Vietnam	57.75	4.53
Lithuania	44.88	6.76	Yemen	88.48	-5.05
Macedonia	67.19	1.75	Zambia	253.36	3.48
Madagascar	99.52	-0.98	Zimbabwe	1661.93	3.60
Malawi	253.84	0.80			

Source: GSMA Wireless Intelligence

<Table 3.6 Summary Data Layout>

Variables	**Access to Mobile Internet**	**Economic Growth**
Variable Type	Independent	Dependent
Measured in	Compound Annual Growth Rate of Number of Unique Subscribers (%)	Compound Annual Growth Rate of GDP Per Capita (%)
Years Observed	2011-2013	
Number of Observations	188	138
	111 Common Entries Were Selected	

Source: Compiled by Author

Out of 188 and 138 states' raw data on Access to Mobile Internet and Economic Growth respectively, 111 common entrees were selected for the analysis. As mentioned above, having both data from of GSMA Wireless Intelligence enhanced credibility of linking the

relationship between two data: Two raw data set, with high possibility, were measured using similar methodology, as well as institute representing each country.

It will now be worth to see detailed statistical results as well as the scatter plot graph to have a closer look at the relationship between two data.

3.7 Statistical Results - Wireless Communication and Economic Development

The statistical results are as below.

<Table 3.7 Summary Statistics>

Variable	Observation	Mean	Std. Dev	Minimum	Maximum
Access to Mobile Internet	113	170.74	267.15	23.48	1991.33
Economic Growth	113	3.15	3.01	-11.17	12.17

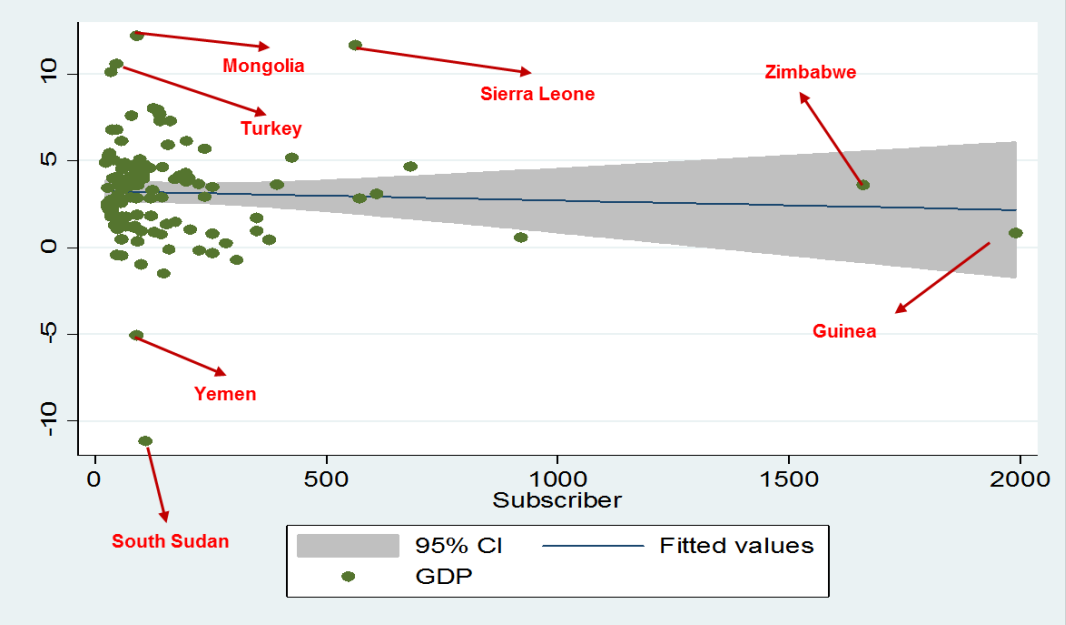
Source: Compiled by Author

<Table 3.8 Regression Results>

Variable	Coefficient	Standard Error	p-Value
Access to Mobile Internet	-0.000547	0.00107	0.609
Intercept	3.242	0.337	0.000

Source: Compiled by Author

<Figure 3.2 Scatter Plot>



Source: Compiled by Author

As calculated p-Value is 0.609, which is larger than 0.10, the standard probability value when confidence level is taken at 90%, the result is not significant at 90% Confidence level. And because 90% Confidence Level is the minimum standard that can be taken into consideration, it can be concluded that the null hypothesis cannot be rejected at all levels.

Furthermore with acquired information the linear regression equation is induced as

Economic Growth = -0.000547 * (Access to Information) + 3.242

Although the co-efficient has a numeric value of -0.000547, this may be disregarded and considered as 0. That concludes that two variables, again as determined in the previous chapter, are statistically independent of each other, which double confirms the null hypothesis.

It is possible to argue that increase in one unit of Access to Mobile Internet will impact on decline of Economic Grow Rate by 0.000547%, and two variables have a negative relationship, but the numeric value is too small that this argument seems irrelevant.

Therefore it is safe to presume that the Access to Mobile Internet has no impact on Economic Growth, using the given data for analysis.

3.8 Analysis - Wireless Communication and Economic Development

Implementation of ICT for innovation and productivity has been widely discussed among governments, organizations, policy makers, enterprises and even individuals. Despite the optimist view of maximizing the efficiency and bridging the divide between the developed and developing states, realistic problem lies with economic burden and practical applications of implementation. The amount of investment required for establishment is beyond the economic capabilities of developing nations, and where gigantic amount of investment is spent towards the construction of communication infrastructures, purchases and distribution of devices, establishment and development of software and system, and the education to make uses of them, they may be directly spent towards resolve various more imminent issues such as food security, construction of schools and hospitals, providing basic necessities and shelters.

Access to Mobile internet is determined to have no impact on Economic Growth using the data set above. Therefore it could be argued that the prior investments should not be focused on the establishment of ICT infrastructures and proliferations of mobile handsets and implementations of new technology, but to more basic necessities such as healthcare, education, food and water security and construction of residence areas. However it is

undeniable that there are some other factors to consider for further and careful analysis. For example, it would take time for children with strong ICT education to graduate from schools and take part of society in various fields, or the time it requires for people to adapt to the access to handsets and mobile internet and apply its applications to various economic activities. Also, some other variables apart from the access to Mobile Internet could have been taken into consideration. Perhaps the capital expenditure of communication technology infrastructures or actual numerical amount of data usage and its growth could have been a better indicator of measuring the development of ICT. Above all, it is impossible to measure and apply numeric standards to the idea of happiness. Access to ICT grants equal rights to enjoy various entertainments contents such as movies, music and games to everyone across the borders. This entertainment aspect of citizens may be linked to the welfare and improvement of quality of life, which has no economic value regardless of its significance.

In either case, it is too early to draw a rigid conclusion that nails rising question down with one solid answer, because the history of data usage and ICT convergence and development is too short to be analyzed accurately whether the implementation of ICT has direct impact on the increase in productivity and economic growth. It must be carefully review and analyzed in near future, as this new technological innovation fully settles into everyday life of majority of global population, where we might have more solid numerical data to make comparisons to and draw close analysis upon. Therefore in simple words, ICT does not necessarily help towards economic development. There could exist some other factors beyond merely the introduction and enhancement of ICT.

Chapter Four: Case Studies

We have discussed the background and foundation stories regarding how the concept of ICT4D and the argument for significance and promotion of it arose and proliferated, and despite the fact, how it may not be much of a significant factor towards the average lives of citizens living in a developing countries or rural area by simulating simple regression results based on few indicators. However, theories and numbers may be insufficient to explain the reality. There may be other lacking significant factors that may change the result drastically in real applications. Therefore it may be worthwhile to put the theoretical part of the debate off the table briefly and evaluate the actual outputs by covering practical examples.

Before we dive into the main issues, we need to further break the scenarios into possible outcomes. As shown below, the relationship between ICTD and state development can be organized into 4 pairs.

<Table 4.1>

	Development	**No Development**
ICTD	1	2
No ICTD	3	4

Source: Compiled by Author

Quadrant 1 would be a combination of good ICTD that resulted in a notable state development, that is to say any cases where ICTD did have a positive impact on the state development and thus determined to be successful. Quadrant 2 would be a scenario where heavy ICTD program was introduced but no positive outcome was made. Any failures of ICT4D projects fall under this category. Quadrant 3 would apply to those cases where significant state development was made despite the fact that no form of ICT4D program was

adapted. Lastly, any least developed countries would be candidates for quadrant 4, where they have no ICTD and thus has no state development. However because this thesis is regarding impact of ICTD on state development, quadrants 3 and 4 will be neglected.

This chapter will cover successful and failure case studies, and discuss possible factors that may have played role in terms of leading ICTD to an actual tangible outcome of state development by comparing the two.

4.1 India

With its enormous population and territorial size, India has been receiving keen attention from the world as one of BRICs country and with one of the highest potential to become a major power of the international society. The case of fishing industry in Kerala is probably the most well-known successful story of ICT implementation towards state development. It would be meaningful to reflect on this case to have a glance at how this positive impact was achieved.

According to Omar and Chharchhar, the fisheries sector takes a significant part in developing countries in terms of food securities as well as economic prosperity.

> "The fisheries sector plays a vital role in developing countries. The fishermen community all over the world is playing crucial roles in the development of economy. This community brings dynamic source of animal protein as well as fish product in country which is also helping rural development by creating employment opportunities. The contribution of this community grows in the national Gross Domestic Product (GDP)."[22]

[22] Omar Siti Zobidah and Chhachhar Abdul Razaque, *"A Review on the Roles of ICT Tools towards the Development of Fishermen"*, Journal of Basic and Applied Scientific Research vol 2, TextRoad Publication (2012), pg. 9905

In northern part of Kerala, a notable impact was made in the fish market with the introduction of mobile phones and the community's application towards their fish business. The core idea is that the introduction of mobile phones improved flows of information, which decreases search costs of the market for the fishers and retails that leads to the contribution of the market efficiency. According to Abraham, India owns the second largest network in developing countries after China and the subscription increased to 156 million from less than a million between 1999 and 2007.[23]

Despite the fact that fresh fish, as an extremely perishable commodity, require the shortest and the most efficient process, the reality differed. Abraham argues

> "The owners of the boats hire fishermen to man their boats. In some cases, the fishermen or a fisherman's co-operative could themselves be the owners. In most of the cases, the boat also has an investment from the commission agent, who thereby ensures control over the sale of the catch. On landing the catch, the commission agents auction the fish to both retail and wholesale merchants, who then sell the fish to consumers either directly, in the case of retail merchants, or through other retail merchants, in the case of wholesale merchants. After the sale is concluded, the agents then pay the owners after subtracting between 5-10% of the total value as their commission. After paying for the variable costs of the trip, the owners then split the remainder among the fishermen."[24]

Unnecessary additional steps of the chain resulted in commission, which decreased the final marginal profit of fishermen. However, according to Abraham's survey, 80% of the total respondents had positive perception of mobile phones. 48% of the respondents answered they would still use mobile phones even if the prices/tariffs went up,[25] and 93% and 92% positive answer was received from merchants sector that the price fluctuation of intraday and across markets respectively has decreased.

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[23] Abraham Reuben, "*Mobile Phones and Economic Development: Evidence from the Fishing Industry in India"*, Information Technologies and International Development vol. 4, (2008) p.g 8

[24] Abraham, p.g 9

[25] According to Abraham's survey, the number was 82 out of the 172 respondents

The introduction of mobile phones affected practically the entire industry. It enabled different sectors of business to keep in touch with the other, allowing the sharing of precise information regarding the consumer demands and local prices. The wholesaler is able to monitor the demand at the retailer's end, which allows him to purchase fish only when the retails have demands. As for bulk buyers, it became easier for them to bulk purchase the fish in lowest possible rates after confirming the local market information.

Abraham also argues that the impact of ICT was not only on economic aspects, it increased efficiency in terms or usage of time and resources. Many respondents from fishermen and owners in his survey answered the search costs for fish has decreased with the introduction of mobile phones. 94% of owners and fishermen utilized mobile phones to alert other boats to the presence of shoals of large amount of fish, thus reducing the time spent out at the sear searching for fish. Also it reduced the number of fishermen spending time idling on shore. All the idle resources were utilized after news of large shoals was communicated. This is significant factor because according to Jenson, fishers were only able to visit a market per day. The market was only open for few hours, and the distance between markets were too long that the transportation cost would have been beyond their affordability. Plus because fish cannot be stored overnight and resold on the land, any surplus would have been directly abandoned as waste.

Therefore in northern Kerala's case, it can be argued that the ICT can be used to spur economic development and hence those two variables possess a positive relationship. It brought more even supply across markets, closed price gaps, decreased waste and transportation cost, and increased productivity and efficiency by reshaping business strategy for every sector of business.

4.2 Zambia

For the second case, we will look at e-Government implementation plan in Zambia. As a landlocked country in southern Africa, Zambia implemented an ICT4D program regarding e-government transformation, striving for socio-economic development. The initiative was supported by two components: The National ICT Policy in 2007 and the Sixth National Development Plan between 2011 and 2015. The Republican President Mwanawasa articulated the significance of creation of an effective ICT industry. With its goal to achieve an information society by2030 by allowing every citizen to have access to and enjoy ICT, the government initiated a project to transform Zambia with e-government, focusing on four areas: Improving ICT infrastructure, reforming public service, encouraging PPP, and promoting the efficiency of e-government applications delivery.

According to Banda's survey of 121 respondents, citizens' assessment for e-government transformations in Zambia was unsatisfactory. Although 79% of respondents considered the project was beneficial to the citizens, positive scores on sub-sectors all marked below 50%, as low as government portal section with 3% strongly agreeing and 2% agreeing. The overall projects' rating was also 55.10/100, indicating a negative outcome of complete or partial failure. Such negative assessment for the project can be divided into three major factors.

First of all, self-interest of two sides of a coin: the supplier and the recipients. Respondents pointed out the lack of change agents to drive projects, as well as their self-interest in political goals, which means promoted sector of e-government project was merely to meet the demands of organizations, businesses and agencies in terms of political agendas or profits. Also from the recipients' side, resistance to the transitional cost, to adapt to the

new system and environment, was a major obstacle. Without consistent will and interest by the government and nation-wide transformational initiatives, it would be difficult to introduce such gigantic change.

Secondly, the project design was poor and unrealistic. One of the major issues was the out-dated project policies. Zambia not only went through change in government as new president came to the office a year after the initiation of the project, the new office failed to monitor the progress and revise any necessary sections where it may have needed an update. The human factors, such as citizens' values and local culture are also significant. The Banda's survey result reflects respondents did not find the project to be beneficial or useful, and the initiatives and policies were aimed at wrong directions. Without consistent input from key local stakeholders and revision of policies in the process reforms, projects like this cannot remain stable.

Last issue was on the project management. ZICTA (Zambia ICT Agency) is criticized to have weak control over the project, where the project ownership was unclear or dispersed. Weak foundation was also a factor. The technical and data assessment infrastructure was inadequate, and it was difficult to further carry on the project without well-established foundations. The financial investment to establish a nation-wide full coverage network is demanding, and it takes time to collect data and make performance analysis. Because it is not a form of short-term and low budget project, the goal could have been set clear with sufficient period of time and budget, with good assessment system to evaluate performance of project in any given periods of time.

Zambia's case was an unsatisfactory from citizens' perspective. We must also consider that this survey was taken from among those who had access to ICT, with high probability of at least some degrees of understanding regarding ICT transformation. It is safe

to argue this ICT4D project left no impact on country's development, both on the socio and economic perspectives. Although the survey pool could have been increased and other sectors may have been looked at to draw a more positive assessment, the chances to change the view that this project was ineffective are low. Why would, then, results differ in two cases? Of the two cases discussed, one turned out to be successful and the other not. However, it must be carefully reviewed whether this is a relevant case study to analyze the impact of ICT development on a country.

The first major factor is the simplicity. Citizens in both cases had to accept the new technology and adapt to it, but it was much simpler and cheaper in India's case where the public merely needed to purchase a conventional cellphone and start calling each other for sake of communication. On the other hand, in Zambia's case, it would inevitably take more time for the education of citizens to adapt to the new system, as well as the government's engagement for constant assessment and revision of policies and plans in their operation. Hence we still need to question whether two cases may be evaluated on the equal level.

The second factor is the reformation of ICT itself, which raises the issue and the question that was addressed at the beginning of this thesis. We cannot apply traditional belief that the technological advancement will work as a panacea to cure every development related issues, because unlike the previous era where conventional IT and CT were two very distinctive fields, we now have a convergence of two technologies, which works together alongside one another. Smartphone takes huge part of our daily life, it now works not only as conventional cellphone to communicate with one another, but also utilized as camera, video recorder, internet browser, checking and sending emails, enjoying games, conducting simple documentation, web searching and even music player. Because multiple industries and

aspects and emerged into one field, it requires wider coverage for governments or any players for implementation of ICT to the society nowadays.

Third factor, then naturally, is the government capacity. In other words, we may raise another question regarding two case studies, that if it was the ICT that leads to the economic development of a state, or if the variables should be reversed, and the true question should be whether it is developing countries with strong capabilities to make investments on infrastructure and policy making that are likely to have successful ICT implementation projects that leads to the development. In other words, I am not arguing the ICT has nothing to do with a state development, I am simply challenging that ICT would not work as a miracle that will magically solve poverty and development issues instantly once adapted. When such projects are to be implemented anywhere, the government policy is extremely significant and ergo a state should be careful upon making moves, whether they can truly afford long-term plans and maintain the sustainability of their plans to achieve goals.

Chapter Five: Conclusion

This thesis discussed the background of ICT4D and author's data analysis regarding the impact of ICT and wireless communication on economic development of developing countries, with two cases of India and Zambia. Although the scope of analysis and case studies may have been limited to draw a quick statement, I argue that the ICTD is not an effective tool for state development. Therefore based on chapter 4 and 5, and the case studies in chapter 6, answers to the first two research questions[26] proposed in chapter 1 are both same, that the ICTD has no impact on the development of economic development of developing countries. It requires tremendous amount of financial investment to establish networks, supply devices, create new system to set up the foundation of ICT to start with. Next follows sufficient time for educations, where it would guide citizens to adapt to the new system and utilize the infrastructure. Yet, the outcome is unpredictable; there is no guarantee that such efforts will make fruit in the end. Therefore the return for the investment is too risky and tiny.

There are number of arguments that may rise to question this. For instance, the time scope is the most significant factor. Perhaps the impact of ICTD is not reflected immediately on the state development. It may take years for citizens to adapt and learn the new method in order for a society to benefit from the reformation. It could be possible that children with sufficient ICT environment may play an important role in the future society that may

[26] Whether the development of

a. ICT and

b. Wireless communication

have an impact on economic development of developing countries.

introduce multiple tangible outcomes in terms of economic performance and socio-political engagement.

Significance of bridging digital divide and providing equal opportunity to everyone to access and make use of information is also debatable. This is in regards to human rights and humanitarian issues, which the value cannot be evaluated and simply measured with numbers. It would be ridiculous to contemplate putting a price tag on such qualitative issues, such as citizen's comfort, happiness, quality of life and social stability.

However, there are many realistic issues developing countries face in terms of medical access, food and water security, and education. It would cost significantly less, both in terms of finance and time, to construct more hospitals to provide medical care, build and purchase agricultural facilities and tools to enhance productivity, and increase schools to provide more education. These factors not only produce immediate output, they also meet the direct need and demands of citizens: they are either the most basic rights everyone should enjoy, or direct factors of survival. It would not require as much precise plans and special projects to make sure it reaches out and citizens adapt.

Furthermore, successful ICT implementation will further increase dependencies of developing countries to the developed economies. From the purchases of network infrastructures and facilities to end-devices such as computers and mobile phones, it would be highly unlikely that the developing countries will launch an independent domestic market and business to meet the public demands. And these are just the hardware perspectives of ICT, the OS programs and from inner applications and programs to the cultural contents that may be enjoyed such as movies, music, games and websites, it is not too difficult to imagine that successful ICT4D projects will benefit the global north much more both in short and long term scenarios.

It still leaves an open opportunity for the future research, which is in regards with the 3rd research question[27]. For the dependent variable to begin with, the economic development may have been a narrow scope. Political and social stabilities, infant mortality rate, employment rate and any other measurements for citizens' well-being may also work as a suitable candidate. As for the independent variables, more specific sections of ICT could have been extracted, such as access to computers as they are most frequently used ICT devices. Or for the wireless internet part, personal data usage, domestic/international traffic flows or number of online access instead of number of subscriptions could have been compared.

Lastly, as for the alternative solutions, the main point here is not to argue that the developing countries should remain digitally illiterate and preserve the conventional systems, the prioritization of goals should be organized in a different order. It is also dangerous and impetuous to presume that the ICT4D would be the panacea for all solutions and the belief that the poverty and other issues will automatically be solved once ICT is implemented. It would be logical to follow the footsteps of industrialization models of developed countries and focus on the sustainable and consistent state development goal, ICT revolution should not leapfrog and come on the top priority.

[27] What some other considerations and suggestions are, and if there are any alternatives for ICT4D.

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