A LITERATURE SURVEY OF THE GLOBAL DIGITAL DIVIDE AND INDIGENOUS PEOPLES

BY

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DEDICATION

I dedicate my dissertation to my wife, Susan and my children Frances and Anton, who encouraged and supported me through this long journey of over 15 years. A special gratitude to my parents Marie and Anton (recently deceased) who never stopped asking about my progress and their wonderment at the challenge that was being pursued. Their encouragement and support were necessary for this completion.

I also dedicate this dissertation to my friends and colleagues at Manitoba's Universities, Colleges and IT sector, with whom I have worked over a long career and who supported me through this process by answering and engaging in a multitude of questions. The initial motivation to pursue this program is engrained in the work carried out here.

I dedicate this dissertation to my computer refurbishing volunteers, including Larry Wucherer, and the Ma Mawi Wi Chi Itata Centre in Winnipeg, for their encouragement and support.

I dedicate my work and give thanks to my colleagues at Western Diversification and our Senior Managers for supporting my study plan during the early stages of this program.

ABSTRACT

This study has been prepared to review the digital divide as it impacts the indigenous people in the global context. Standard definitions are used to consider the digital divide and The United Nations Declaration on the Rights of Indigenous Peoples (2007) is used to identify the indigenous people in this study. As this study was carried out there were as many as 350 million indigenous people in the world. Indigenous peoples are understood to have the lowest standards of living in their host countries; therefore, this study reviews the collective impact of government programming, community attitudes and technology access on the lives of indigenous peoples. The study also examines the various institutions which monitor the digital divide.

This essay uses the systematic literature review process and addresses the four key databases used in the Information Systems research. In the first phase, Over 750 papers were identified based on certain features of interest; these were then reduced through further review to 41 studies based on which this review of literature was conducted. The papers were reviewed and analyzed on a continent by continent basis. The surprizing results indicated firstly that the digital divide is ever persistent and secondly that limited progress is evident in the recent five-year period through which the literature survey was conducted.

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CHAPTER I

Introduction

The advances made in computing technologies and the access to such technologies across the globe is proceeding an unprecedented pace. Indigenous peoples however have yet to overcome the multiple challenges of poverty as well as geographical, and economic isolation before they can reap the benefits of these technologies. Solutions for many indigenous nations may well be to build the necessary infrastructure and turn over sufficient assets to solve these digital divide challenges. For a marginalized community, these measures are not met with ease, nor are they necessarily welcomed. Among some indigenous populations, the infrastructure required for information and communication technologies (ICT) becomes a cost prohibitive parameter due to distances involved. In the indigenous micro economy, family earnings may be stagnant, limited or even subsistence-based, thereby preventing individual access to these technologies, even where connectivity may not be an issue.

Statement of Purpose

The purpose of this paper is to review the research carried out on the topic of the Digital Divide during the past five years as applicable to the global Indigenous population and to provide, from this work, a synthesized view of existing challenges. As this essay follows from a series of published research papers, a broad view of the meanings, reasons, facts, theory building, and consequences of the digital divide will be presented. In the end a view will present itself of the various means that have been pursued, or remain to be undertaken to address the challenges that indigenous peoples face across the globe.

Research Problem

Research into the digital divide, as it affects indigenous people is fragmented and sparse. Compounding any such research efforts are the fact that many indigenous peoples are found in rural and remote ancestral locations where modern telecommunications systems present many challenges in deployment, while elsewhere such systems are taken to be the norm. The goal of this research is to carry out a systematic literature review and present a global perspective of how indigenous populations are affected by the challenges arising from the digital divide. By global perspective it is meant that a collection of instances from all relevant continents will be examined. The period of coverage for the project is from 2008 to 2013. As a result, this systematic literature review will study the digital divide context for indigenous peoples in the age of fibre optic cabling, satellites, smartphones and multiprocessor systems. The study is conducted by consulting and using the databases of major scientific publications. The research will examine whether the digital divide still exists for the indigenous people and if so the context in which it is found.

Definition of Terms

Because this is essentially a bimodal search, few specialized terms are used in this study which require clarification for the concepts they represent. In the context of this paper, "indigenous" is used in compliance with the "*U.N. Declaration on the Rights of Indigenous Peoples*" and an earlier report to the UN, circa 1983, wherein the term indigenous is defined in part as the following:

> *"Indigenous communities, peoples and nations are those which, having a historical continuity with pre-invasion and pre-colonial societies that developed on their territories, consider themselves distinct from other sectors of the societies now prevailing in those territories, or parts of them.*

> *They form at present non-dominant sectors of society and are determined to preserve, develop and transmit to future generations their ancestral territories, and their ethnic identity, as the basis of their continued existence as peoples, in accordance with their own cultural patterns, social institutions and legal systems."* [1]

Further refinements of this definition are enabled and recognized by the United Nations wherein indigenous people have their own right to define what and whom is indigenous. Article 33 of the United Nations Declaration on the Rights of Indigenous Peoples (2007) provides the following statements:

> *1. Indigenous peoples have the right to determine their own identity or membership in accordance with their customs and traditions. This does not impair the right of indigenous individuals to obtain citizenship of the States in which they live.*
>
> *2. Indigenous peoples have the right to determine the structures and to select the membership of their institutions in accordance with their own procedures.*

Indigenous people, for the purposes of this study, are therefore viewed and considered in this context. In many parts of the world, the term "indigenous" is used to identify peoples with historical continuity and pre-colonial histories.

Associated with the term indigenous is the related term "aboriginal." For the most part, this is a common term and is used to identify the indigenous peoples of Canada, although references to this term are also made in Australia and elsewhere. Australia historically referred to its aboriginal peoples as "Aborigines". In recent years that use has declined significantly in favour of the terms - aboriginal or indigenous.

In the United States, indigenous peoples are referred to as Native Americans, or American Indians. Elsewhere, in South America, their indigenous people are referred to as Indians or South American Indians.

The term “Indians” is a historical misnomer and is related to the first Spanish visitations to the Americas in search of India and their pursuit of the spice trade. The Spanish, having concluded that they had arrived in India, proceeded to identify these peoples as “Indians.” This historical misnaming has persisted for over 500 years in official and unofficial communications in the Americas.

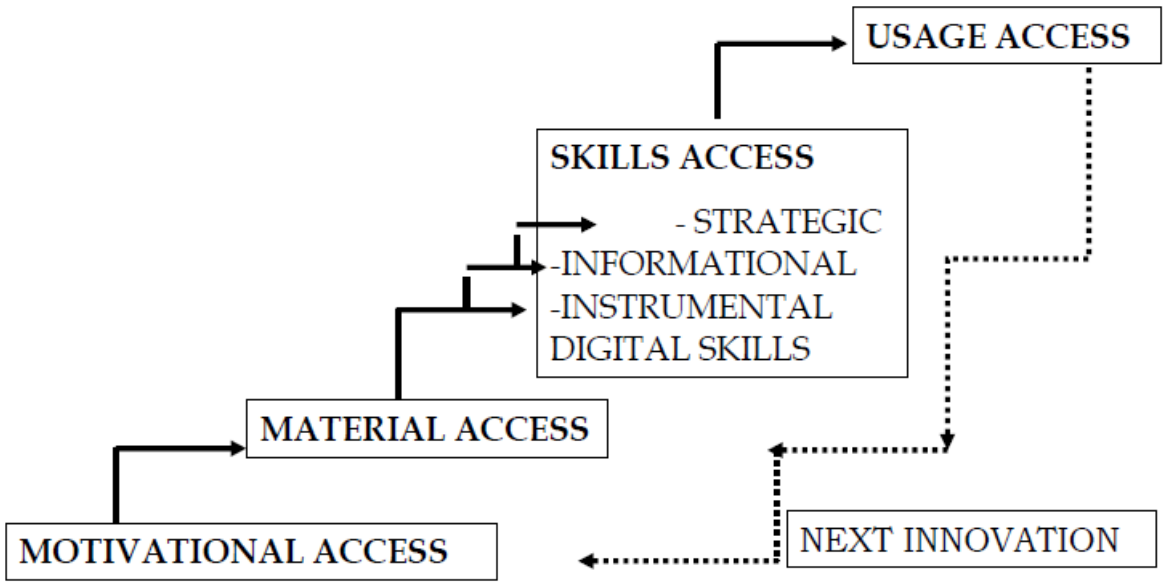
Another major term used in this study is “Digital Divide.” In its simplest form, it identifies an inequality in digital resources between segments of a population. This term is less commonly used since about 2010 due to the proliferation of smartphones and cell tower structures in many parts of the developed world. However, when the term digital divide was first used (circa 1991) [2], it implied at that time the simple distinction between having access to a computer or lack thereof. The principal focus following that period shifted to the link between rural communities and urban Information and Communication Technologies (ICT) infrastructure.

Today, the term “Digital Divide” has to do with access to technology and access to information resources through the use of the internet. With escalating information demands, lack of the latter has introduced a larger challenge. Nevertheless, the challenges posed in 1991 are just as meaningful today in certain populations. The affected groups are principally

the ethnic minorities as well as poor and marginalized citizens. While the technological capabilities of many communities are improving, and certain gaps in the digital divide are closing, others persist due to the scope of challenges posed.

By 2005, through many interventions [3] the digital divide was considered to be disappearing in the developed nations. This may have been the case for many of their citizens; however, universal access to information via internet was not accomplished in these nations for many reasons. At the time, in less developed nations, these problems had only begun to be addressed. While comments such as these regarding the digital divide often deal with the technological aspects, van Dijk points out that the digital divide has human – motivational components as well. An incentive is almost always necessary to spark an interest in digital technologies which may or may not lead to initiate access. These motivations are at times reinforced through civic governments, educational intuitions, and the media. The following Figure 1 by van Dijk provides a motivational model for access to digital technologies.

Figure 1: A cumulative and recursive model of successive kinds of access to digital technologies.



Source: van Dijk, 2005. p.22

Following motivational access, material access is of paramount importance. There is a misgiving that once everyone has a computer and an internet connection, the digital divide is resolved. The problem is that in many areas affected by the digital divide, where the internet connection may be available, the computer may not be as readily available or serviceable. To address challenges such as these, the previous decade saw a lot of effort being put towards providing computers for children in undeveloped countries. One such prominent program in that landscape is “One Laptop per Child.” This program brought together extensive senior hardware and software interests (i.e. AMD, Google, Red Hat and others), with a view to creating a new computer technology that would provide considerable computing depth to the developing world - a technology with a reduced energy footprint and a robust design. It was hoped that this initiative would introduce a suitable and cost-effective technology for undeveloped countries. As of 2011, over 2 million laptops with similar qualifications have been delivered to countries in North America, South America and Africa. [4]

The third part of van Dijk's model relates to skills access. Three skill areas, collectively called digital skills, are considered as necessary to support access to digital technologies. The first order of these skills are the instrumental skills set required to manipulate the basic hardware and software operations. A second set of skills are comprised of the informational skills which are necessary to understand and extend the capabilities of constructs such as hyperlinks and file structures, as well as how to evaluate information returned from the internet. The last set of desired skills support goal-seeking capabilities. These relate to the ability to define and implement personal goals through ICT technologies.

In van Dijk's model, a box introduces the Usage Access. This relates to the purpose of accessing the technology, the patterns of behaviour in use, the bandwidth available, and active interaction through Web 2.0 products (such as Facebook, LinkedIn, YouTube, and others). These elements define age group and gender-influenced parameters in technology use, the effect of bandwidth available on the choices made, and other considerations in the engagement with Web2.0 products in particular social media.

The four states recognized in van Dijk's model (Motivation, Material Access, Skills Access and Usage Access) are recursive and create the conditions which support emerging ICT innovations. Van Dijk's model makes no accommodation for minorities such as indigenous peoples, which may observe other challenges to crossing the digital divide.

The problem that the digital divide presents through models such as Van Dijk's is called the Matthew Effect (coined by sociologist Merton, 1968) [5], wherein those having access to digital resources benefit more from them. With this effect, those lacking access to these resources fall behind even further, leading to the ever-widening gap in the digital divide.

As a last consideration on the definition of digital divide, research for this project indicated that the term ICT4D appeared at times as a proxy for digital divide. While these two terms do not map perfectly one over the other, they have some resemblances in usage and implication. Information and Communication Technologies for Development (ICT4D) refers to supporting the closing of the digital divide using digital technologies, in underdeveloped countries/regions to create economic development opportunities. Thus when a case gives rise to an ICT4D project, the digital divide may be said to be under active consideration. A principal source of support for ICT4D comes from the United Nations. [6]

Organization of the Remaining Chapters

This essay is divided into six Chapters which are presented as follow:

Chapter 1: Introduction

The introduction section contains a Statement of Purpose, the Research Problem, a Definition of Terms, and the Organization of the Remaining Chapters.

Chapter 2: Review of Related Literature

In this section, background and formative materials are discussed in three particular areas, namely systematic review, the digital divide and indigenous elements concerning the digital divide.

Chapter 3: Methodology

The research questions are framed in this chapter. These three questions are progressive in nature and are meant to be applied, in turn, to each research study under consideration. The sample size and survey outcomes of the literature review are also presented in this chapter. The research method selected for this study is the "Systematic Literature Review."

Chapter 4: Issues, Analysis, and Results

In this chapter the findings from the related literature review are explained in detail and survey results are organized to provide comparisons between the research findings.

Chapter 5: Conclusion

This chapter provides a further commentary on the findings, using a continent by continent approach. Comparisons are made between the various findings in the area of the study, and these findings are then summarized. Also, as this paper presents a systematic literature review the original author's voices are distinctly presented.

Chapter 6: Recommendations and Ideas for Further Research

As this essay is a literature survey, the writer's own ideas and recommendations are now discretely presented in this closing section.

CHAPTER II

Review of Related Literature – Digital Divide

This essay is based on the Systematic Review system designed by Barbara Kitchenham [7]. The systematic review considers primary research and in the process becomes a secondary research study. These processes are generally viewed as rather exhaustive and take a fair bit of time to assemble. The laboriousness of the exercise is often compounded by the need to arrange for a second opinion to verify decisions or to accept or decline the inclusion of data and findings into the research set.

In the course of the primary research project, a review was made of the previous literature in the field. This process was less systematic. At the time of this project, no studies were identified which offered a systematic review of the "Digital Divide" as it relates to the "Indigenous People." Therefore, the topic of digital divide is reviewed out of context for the review process. However this should not be viewed as a misdirection, for a survey of the digital divide has lessons which can be applied across a spectrum of related projects and fields. As it pertains to the ICT projects within indigenous people's communities, a survey of literature was carried out for the era preceding the coverage in this study (i.e. pre 2008). A case study source covering a considerable geography was located during the literature review. Again, it should be noted that comparison studies or synthesis studies were not found for the review period.

Addressing the question of the digital divide is possible through two approaches, a needs-based approach and a capacity-focused approach. The difference between the two approaches is rather straightforward: the needs-based approach focuses on the deficiencies and reinforces the stigma that people are not in control of their own future and therefore require ICT services. [8] This approach is considered to build dependencies and relinquishes the problem solving capabilities of the citizens, turning these matters over to others such as professionals who in turn now serve the target population as clients. Capacity-focused approaches consist of a bottom-up process which inherently presupposes that the capabilities for change management are found within the target group. The choice of the approach has a profound effect on how ICT is received and supported in marginalized communities which are affected by the digital divide. The solutions proposed in this paper include community technology centres, reduced local networking charges, and the building of web based community content. These features support simultaneous learning opportunities and promote the expression of the user's cultural identity as it maps into a community of interest. The result is the emergence of the community members as change agents.

Amongst the First Nations (Canada's Indigenous people), the digital divide is seen, by Bredin [9], to reflect both the economic divide as well as the socio-cultural divide. The resultant information revolution is seen to reproduce existing inequities. One conspicuous inequity has to do with the generation of culturally-relevant content. In the mainstream media, considerable content has already been developed without prior access and

opportunity to mobilize talents within the First Nations. Bredin is concerned with this event and comments:

> *"…the homogenizing potential and centralizing force of the Internet must be actively resisted if First Nations communities are to use it to share local knowledge and produce culturally relevant content"*

Bredin further argues for local circulation of information to support social and political empowerment. Following the policy and network support from US Office of Technology Assessment, the author makes similar arguments on behalf of Canada's First Nations. Two program initiatives are studied from their creation in 1995 to 2004; these were aimed at providing network access to remote and underserviced regions of Canada. One of the results of these initiatives was the profiling of ICT resources and needs for 153 First Nations communities. Subsequent to this experience, other instances of information projects in Canada for its indigenous peoples were enlisted, all of which were initiated from similar programs: the creation of a national Aboriginal television station, the establishment of a remote ICT service provider, and the initiation of a software firm, to name a few.

Moving from the social issues, policy aspects of the digital divide are raised in a study by Camacho [10]. Three policy aspects in particular are considered as paramount for this study: a focus on infrastructure, a focus on capacity-building, and a focus on resource usage. Infrastructure relates to the IT backbone, capacity building relates to client skills, and resource usage relates to the new opportunities that the web offers. According to Camacho, national policies regarding the digital divide are focused primarily on connectivity (i.e. the first aspect). Furthermore, Camacho identifies a quandary relating to the digital divide

represented by optimists and pessimists. The former believe that “more user-friendly technologies will diminish the impact of the digital divide going forward,” [10] while the pessimists disagree with any positive impacts of the sort. Nevertheless, Camacho concludes that the digital divide represents an “asymmetry” which will map itself onto the present social divides. By this he means that the imbalances found in the digital divide also reflect the social divide.

Computer penetration over the period ending in 2002 is evaluated by Chinn [11]. This study indicates that computer ownership was strongly correlated with income and education during the said time. Urbanization and youth also have high impacts on the acquisition of computers. In 2001, North America had the highest PC penetration with 61.1 computers per 100 people. This figure contrasts sharply with developing nations which demonstrate a low figure of 1 computer per 100 people. Internet penetration yields similar results. It needs to be mentioned that in 2001, computers were not viewed as necessarily linked to the internet, hence computer penetration and connectivity to the web are studied as discrete advantages. Performing a micro-economic survey, Chinn sets out to define the digital divide. Low per capita income is considered to be the largest determinant, but insufficient telecommunications infrastructure also plays a significant part in the divide. Between them, these two causes explain over 90 percent of the gap in the digital divide on a global scale. Other factors such as scope of urbanization, aging population, and education penetration demonstrate impacts on the digital divide. These three factors would be rated as secondary causes of the digital divide. Chinn’s study questions the impact of trade liberalization on the

digital divide; however, there seems little if any impact to evaluate, as by the time the study was carried out most countries had dropped their trade barriers. The conclusion made in this regard is that trade does neither inhibits nor supports the digital divide.

Van Dijk provides an accurate origin for the term digital divide as having some currency in the mid 1990's. The terms is said to have been formally recognized for the first time in a US Department of Commerce National Telecommunications and Information Administration publication in 1999 [12]. Van Dijk provides a straightforward definition of the digital divide in the following statement:

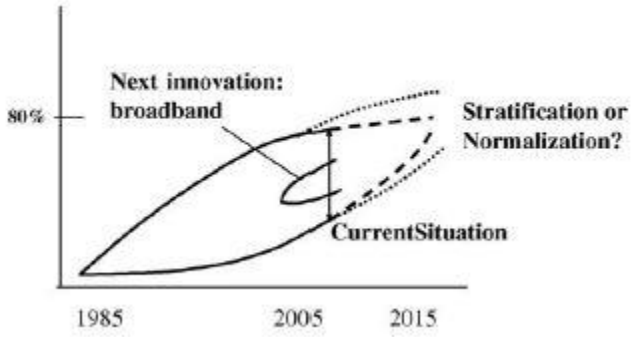
> *"…the gap between those that do and those who do not have access to new forms of information technology. Most often these forms are computers and their networks but other digital equipment such as mobile telephony and digital television are not ruled out by some users of the term."*

This definition of the digital divide allows a progressive application of the term with the current shift to wireless and mobile devices from the generally understood state in 1999. At that time, the desired access was perceived in terms of the availability of a desktop processor with perhaps broadband connectivity. It is with this concept of equipment as a desktop computer that the developed countries, as noted before, concluded that the problem of digital divide was largely solved in their communities by 2005.

Addressing the digital divide resolution of 2005, Van Dijk then suggests that technology adoption rates between the social strata (i.e. rich vs. poor) shows as wide a gap as 50 percent. He notes that adoption rates are slower among the poorer citizens. Today, mitigating factors such as the ready access to broadband and availability of mobile devices allow for

various interventions and acceleration of technology adoption by the poorer citizens. Figure 2 presents a digital divide trend chart with stratification considerations. Interestingly the chart depicts the effect of broadband Internet on both strata components (rich and poor). Figure 2 shows a step function with the introduction of broadband, and presumably the closing of the digital divide. Van Dijk's work is largely focused on the European and American experiences.

Figure 2: A real and potential trend of the digital divide in terms of physical access to computers and the Internet according to a stratification model of development



Source: van Dijk [13]

Van Dijk concludes by stating that there are several shortcomings in digital divide research. Firstly, the field lacks a theory on which to build. As an example he comments that digital divide research to 2005 is based largely on personal and communal descriptors. Secondly, interdisciplinary research is minimal, and the field of study could be enriched by contributions from such fields as sociology and economics. Thirdly, and somewhat surprisingly, qualitative research on the subject is absent. The author points to one community project which is rich in narrative while working through the motivation, access and skills challenges. A fourth limit for the field is that it is seen to be static, with the same terms and elements represented,

resurveyed, etc. A suggestion is made for longitudinal research, which could provide evidence of key elements and methods which reduce the digital divide. The fifth flaw, follows from the second and third flaws, Van Dijk believes that little effort is being made to draw attention to the consequences of the digital divide. It would seem clear here that sociological impact studies on the prolonged digital divide could play a role in identifying lost opportunities and community marginalization challenges. The last component to be raised is the dearth of definitions within digital divide research. This last notion presents a problem in that new technologies, user interfaces and applications continue to emerge, raising new paradigms for the digital divide which in turn escalates the differences between the groups of users and non-users even further.

Several definitions for the digital divide are introduced by Gurstein [14]. He raises unique and unprecedented criticisms against the very term, the digital divide. Gurstein claims that digital divide is a patronizing term which has "welfarist" connotations. Despite making this criticism the author then points to several sources such as the World Summit on the Information Society (WSIS) and various governments and other organizations which attempt to deploy ICT technologies for purposes of building civil societies. In essence, these are projects aimed at closing the digital divide. Several global digital divide challenges are identified by Gurstein, for instance, the fact that one-third of humankind has never made a phone call. The prevalence of the English language as a standard tool for ICT deployment is mentioned as another challenge, when 90 percent of the world population does not speak the language. Despite the efforts made in many communities to close the digital divide, Gurstein makes an "Effective

Use" argument. He believes that providing an access system which enables social facilitation and internet governance as well as providing developmental services and content, along with other elements of immediacy, are extremely effective techniques in closing the digital divide gap. The reason this argument is raised is due to the ubiquitous nature of the internet, along with escalating technological implementations and disruptors which provide for a poor prescriptive approach in solving the digital divide.

Shade [15] provides a history of global efforts addressed towards the problem of digital divide. In 2000, the G8 sanctioned the creation of the Digital Opportunities Task (DOT) Force to recognise the "international information and knowledge divide". This encouraged many nations to plan strategies and systems for closing their digital divide gap. Additionally, the author takes into account variants of the term digital divide. Social Divide is one of these variants and may occur when ICT technologies offer access to information resources for employment and learning while enhancing creative opportunities. Another variant of the digital divide is the Global Divide, which indicates that the developed world has far more ICT resources, such as internet hosts, when compared to developing nations. A final term, the Democratic Divide, refers to the ability of citizens to inform themselves on various political issues. Shade now identifies the skills that are needed to function in society (numeracy, prose, interpersonal communications and others), and adds as well, technological capabilities. These skills are currently referred to as the requirements for social literacy, which include technological skills as an intrinsic component. A concluding argument is made by Shade for research into the impact of ICT technologies on children and young adults. This is a rather

novel point in that internet penetration rates in Canada were just starting to rise in 2000 [16] whereas Web 2.0 only came into existence in 2002. It is well understood that early adopters of ICT technologies and Web 2.0 are children and young adults.

Review of Related Literature – Digital Divide and Indigenous People

The textbook -- *Information Technology and Indigenous People: Issues and Perspectives* serves as a literature reference of relevance to this essay. The textbook is a compilation of 17 chapters and is arranged in four thematic areas: Indigenous People and Information Technology: Issues and Perspectives, Technology in Education, Cultural Preservation and Revitalisation, and Applications Transforming Communities [17]. Each chapter of the book is separately authored. As a collection of papers, the book covers the globe. These papers are out of date compared to the 2008 -2013 timeline for this research, surprisingly, this book only became available after the core papers for this essay were already identified. From each thematic area one proxy paper is selected for this next phase of the literature review. The literature review moves to a new phase by bringing the indigenous people into the discussions.

The Latin American ICT and indigenous community are discussed by Salazar [18]. This work covers the period of 2000 to 2005. The political context is an important element of ICT and digital divide discussions in this source. The author finds that ICTs are used by indigenous organizations throughout the Latin American region for intra-communal communications, which leads to a pan-indigenous discourse. According to Salazar, by 2005, about 55 million users, out of a total population of almost 430 million, had internet access, with urban Brazil taking up 50 percent of the total. The opportunity to develop and promote original materials is deemed as important in supporting indigenous people's ethnic citizenship and political autonomy. It needs to be said that Latin America had, in the mid 90's, three mobilized

revolutionary groups: the Zapatistas, Mapuche and Ashaninka. All three groups persisted in their confrontations against central governments and large enterprises. Political advocacy remains a high priority in this region, and it is supported through ICT technologies. Support for computer literacy and telecentres in some locations was provided through regional initiatives and included support from Canada. A key concern about the internet in the region is that it undermines indigenous intellectual property rights. On the positive side the author also claims that it is important to demonstrate through e-commerce and other digital divide initiatives that trade is a bilateral activity.

Kinuthia [19], in her chapter discusses ICT deployment in educational settings in Africa. The author argues that the term "indigenous" is not readily applicable to Africans, given the continent's highly diverse demography. Nevertheless, the lifestyle of indigenous peoples sets them apart from the rest of African society, resulting in economic and political marginalization. About 30 million indigenous people, many of whom are still nomadic, are found in Africa. The author identifies several reasons for the lack of indigenous knowledge (IK) integration within the formal educational system: lack of political motivation, limited funding, foreign aid dictates, and macro planning control which ignores local needs, amongst other related reasons. Stating that a minority community is highly influenced by the majority community, it is argued that IK as well undergoes change in definition and content over time as the result of this influence. As IK has no particular standard, Kinuthia claims that there is a need for consideration of distinct "knowledges" in the context of African "peoples." The introduction of ICT in the education of indigenous peoples comes with two main challenges:

first the challenge of educating the educator on available technologies and second the task of developing appropriate lessons. This provides an opportunity to “re-set” Africa’s educational paradigm in a shift from older, perhaps colonial-based, educational systems to modern ones. CD-ROMS are mentioned as one contemporary medium for learning indigenous languages. Such a shift in the educational paradigm requires a project methodology, a sponsor, and a number of subject matter experts. It is also acknowledged that more strategies and opportunities need to be placed into the current curriculum to raise critical thinking and awareness regarding IK. The author makes no effort at segmenting IK elements throughout the educational process in her discussion. Such elements are yet to be designed and tested.

A third topic appearing in other related literature and identified from various sources, also discussed in *“Information Technology and Indigenous People: Issues and Perspectives”* is Cultural Preservation and Revitalization. Hughes et al [20] attend to this aspect of digital divide in one of their projects carried out in remote Australia. The Anangu population comprises 3000 aboriginals who are found on homelands which cover over 102,000 square kilometers. As part of their community building activities there came a recognition that significant amounts of culturally-relevant materials such as photos, videos, documents and artifacts were no longer in their possession. Coupled with this awareness was a realization that preserving any such materials presented a challenge in their harsh climate, especially in the absence of museums and similar public facilities. The project introduced a plan that came with some technical support, and efforts were made to identify and retrieve significant artifacts. In the end, about 60,000 items were identified and digitally archived. Access to this

collection is available through the Anangu villages and even from beyond their lands, where many of their members reside. The design and interface of the database/software required the approval of the community members. Community members were given the opportunity to not only add to the archives but also create metadata to reflect their own knowledge of digital objects. This project was completed in 2002. One of the unique features of this database is that in certain tribal areas, database access is segregated according to the sexes, such that male and female viewers are presented with different portions of the database, and these separations must be respected. Classification of materials which require certain restrictions is also possible through the intervention of the community elders. The developers of this system anticipated the extension of the service to a total of 1216 indigenous communities in Australia, of which almost 80 percent are not on the electrical grid. Computers were re-designed for this project, to be mobile and also to operate outside villages in preferred "campsite" locations. As indicated earlier, these sites are not-electrified and offer harsh service conditions. Hughes decided at the project's conclusion that this project was not scalable and could not include other indigenous communities, thereby not allowing others to use and share this database. The reasons for this were primarily that information about the community, it's history and artifacts were viewed as an internal matter and not something that would be distributed on any scale. A distrust was identified which was directed at both non-indigenous and indigenous people themselves. One of the key lessons learned here had to do with that despite having transferred knowledge of computer management and software literacy to adult learners, a single solution does not work

everywhere. In this case a unique archival solution was created, but in the end it was not possible to transfer it to other locales or situations.

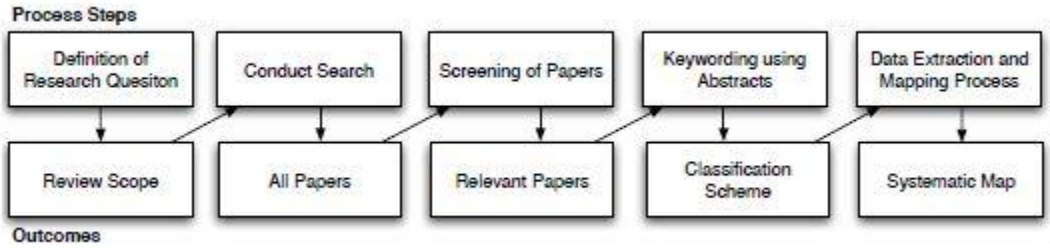
A final chapter, *Applications Transforming Communities*, discusses the use of Geographic Information Systems (GIS) and advances a strong argument against this technology. The author, Palmer [21] proposes that American Indians should be wary of their sponsoring government agency, the Bureau of Indian Affairs (BIA), and the deployment of Geographic Information Systems. Palmer claims that the BIA's historic record of the abuse of indigenous people over a long period of time, opens a new venue of abuse through this GIS technology. GIS does not attempt to represent the American Indian's view of space, time, and place, and while this new technology would seem to be able to add to that knowledge, the author believes that the BIA is in control of these resources and outcomes. As a result, the author claims that GIS becomes a new act of colonialism, but this time it is not the missionaries of old preaching a new religion, it is the business establishment, the service providers of the technology. He believes that GIS technology will become a means of controlling the American Indians through BIA and federal government policies, in an effort at homogenizing their culture. With indigenous people striving to maintain their uniqueness and having little need to assimilate or homogenize their culture, this method of bridging the digital divide is seen to be an effort to divide and conquer.

Review of Related Literature – Systematic Review

As a last element of the literature survey the use of a "systematic review" is considered in these following discussions.

Petersen [22] suggests the deployment of a Systematic Map. Figure 3 provides the process steps for this methodology.

Figure 3: The Systemic Mapping Process



Source: Pedersen [22], pg. 2.

Several challenges are presented in the selection of Systemic Mapping as a research tool. First , the source content for this original work included medical papers. From this source content the author was able to assemble a considerable set of working papers with over 100 papers in that data set. Many systematic reviews are not able to muster such large data sets to progress to the larger systemic mapping research projects. Second, a classification scheme is suggested. As we noted earlier, the digital divide does not have a working classification scheme which makes mapping a very difficult, if not impossible task. Other inherent issues regarding digital divide research relate to the general low amounts of quantitative data. This matter will be discussed more completely later, but for the time being, having non-quantitative data and followed by small data sets makes systemic mapping impractical.

Biolchini [23] provides a history of the Systemic Review, suggesting that the field of medicine used systematic reviews at the beginning of the 20th century, in an effort at evaluating the techniques in various disease cases. This author then makes some comparisons between the fields of medicine and software engineering. It is argued that the double blind experimental methodology in medicine has no parallel in software engineering. At the opposite end, life cycle considerations in the software engineering field are said to have no parallel in medicine. The link between cause and effect in technique is also difficult to evaluate in software engineering, while it is central to medical research. Nevertheless, Biolchini presents a detailed plan for a Systemic Review in software engineering.

Dyba presents an empirical study of Agile Software Development in his paper *Empirical studies of agile software development: A systematic review* [24]. A key component of Agile development is its ability to respond to change during the project development phase, while preserving the requirement to produce working software. Advocates of Agile come from different perspectives and areas, and the technique is now used by both large and small technology-driven organizations. Dyba uses eight known databases, along with three specific conference proceedings, to produce a collection of 1,996 papers, all of which are selected based on nine unique search terms. A four-stage review and separation process is then undertaken, which concludes with 36 studies that provide meaningful information on Agile software development. The point raised here is that for a systemic literature review, a multi stage process is necessary, and by using validated sources, it is possible to achieve a final

working set of informed papers. From that final set of papers one can then accurately compile data and make conclusions for the topic at hand, by using the systematic review process. Invariably, the draw down to a relatively small set of final papers leads the author to conclude that more comprehensive research is necessary in the field. Dyba provides a further paper [25] which outlines the general methods for a systematic evaluation and concludes that while certain errors are eliminated in this process, the presence of systematic and random errors needs to be taken into consideration. Dyba's two papers are used in this essay solely to provide a background for the literature search using a systematic review. There is no linkage in these papers to the digital divide.

CHAPTER III

Research Methodology

Databases Reviewed

For this research, four major databases of scientific literature which contained software-use discussions and supported related search keywords were selected.

The four databases that were used were the following:

1. IEEE Xplore Digital Library (http://ieeexplore.ieee.org/)
2. Association for Computing Machinery (www.acm.org)
2. Wiley Online Library (www.onlinelibrary.wiley.com)
3. Springer Link (www.link.springer.com)

As these databases represent the key scientific databases in use today, they are most appropriate in any discussion regarding research into Information Systems. Furthermore as this essay is intended for the completion of work towards a Master of Science in Information Systems, these database selections are most appropriate.

The terms that were used for this search exercise were:

{aboriginal AND “digital divide”} OR
{indigenous AND “digital divide”} OR
{Indian AND “digital divide”} OR
{Native American AND “digital divide”} OR
{indigenous AND “ICT4D”} OR
{aboriginal AND “ICT4D”}
{indigenous AND “ICT”} OR
{aboriginal AND “ICT”}

As this project refers to research papers which are current, these literature searches must refer to publications since 2008. Additionally, the project search function, identified previously, is also performed over the entire text.

The introduction of the term “ICT4D” (Information and Communication Technologies for Development) came up during the research phase. Initially during the planning phase this term was not used or considered. Upon review of some of the papers from the database searches, some research papers seemed to be readily using the term and in reasonable context. As a result, the data search was slightly adjusted in the hope the more papers could be found with the now revised search terms. There is a subtle difference in the direction of service and discourse, between the terms digital divide and ICT4D. The digital divide is a relative term, regardless of the era. Digital divide refers to the condition in which one group in the society has significantly greater access to digital technology than another, and when this gap in access inhibits development and opportunities for others. The digital divide is resolved through the commitment of human resources and leadership from the unprivileged group. ICT4D seems to be more solution based, with some level of community development activity to accomplish technology acceptance, familiarity and sustainment. However as one can imagine, ICT solutions need to be upgraded regularly, and thus ICT4D becomes a cyclical process, with government intervention typically at its core.

Because each of the four key scientific databases have a unique way of responding to the search keywords, several attempts or runs were necessary to build a complete list of suggestions from each database. Results were saved and collated into a matrix, so that the

research papers could be inspected at a later point. Kitchenham [7] suggests at this point to download of all papers secured at this time however, with each database search indicating research papers identified and providing the respective doi (digital object identifier) numbers, it was convenient to merely record these doi numbers and other important citation data. Using this approach it is always possible afterwards, to refer back through the doi numbers to retrieve the relevant material.

Challenges with the Responses

While the term ICT4D seemed to be a promising keyword, results were minimal in the final analysis, with less than 2 percent of additional results achieved. ICT4D did not stand up too well with these searches; the term often co-occurred with the term digital divide, thereby not adding any significant additional value.

Another complication in the search phase was the term 'Indian.' As can be imagined with India being a G-20 country and an important member of the BRIC (Brazil, Russia, India and China) Group, its people and its government demonstrate interest in resolving their digital divide. While India has an indigenous population, none of the research papers (~ 5 percent of the entire lot) provided any information about the indigenous presence in India. This subset of papers offered promising research but were rejected as they did not consider the indigenous people of India. A smaller problem found is found with the term "indigenous", which can be applied to many things, not only people. Considerable rejection of papers during

sorting and selection process resulted because of the problem arising from many other meanings of indigenous.

Search and Sorting Results

The first order of results achieved from the search requests were:

Table 1: Database Source and Resultant Search Returns

1. IEEE: 411 results
2. ACM: 85 results
3. Wiley: 106 results
4. Springer Link: 151 results

A total of 753 papers were identified containing the term “digital divide” and one of the other key terms.

While these results in Table 1 indicated that many papers were found, for reasons indicated earlier, it was necessary to manually sort through these search returns.

The terms identified earlier were required to be included. The inclusions would be any one item from the list of words: Indian, Indigenous, Aboriginal, Native American. The inclusions also required one item from the list of words: digital divide, ICT, and ICT4D.

From the four databases the final number of papers that were found acceptable are listed in Table 2.

Table 2: Database and Vetted Returns

1. IEEE: 15 results
2. ACM: 14 results
3. Wiley: 3 results
4. Springer Link: 9 results

The final result was then that 41 papers were found which met the search criteria. At this time, it was also decided that a sufficient set of papers were found from which to conduct a systemic literature review and the writer could proceed with the formal analysis of the topic at hand.

From the initial 753 results which were returned, several were discarded based on the following criteria :

1. Both search terms were missing (original search return indicated that search terms were found, but on inspection both of the search terms were missing).
2. The first term (digital divide or ICT, or ICT4D) was missing.
3. The second term (aboriginal, indigenous, etc.) was missing.
4. References to either term was particularly weak (for instance, indigenous technology does not translate to indigenous people).
5. The paper was date excluded by being published earlier than 2008.
6. The result returned was not a research paper or was otherwise unobtainable. (i.e. indexes and summaries rather than research papers)

The results from all of the database reviews are now collated in the following table:

Table 3: Collation of Results from Databases

Criteria for exclusion	IEEE	ACM	Wiley	Springerlink
Both search terms are missing	327	55	31	112
Missing Digital Divide, ICT or ICT4D	25	4	61	8
Missing aboriginal, indigenous, etc.	13	2	0	10
References to both terms is very weak	27	10	11	3
Date Excluded	4	0	0	1
Other Reasons*				7
Items included	15	14	3	10
Total reviewed in database	411	85	106	151

*__Other reasons__: book chapter, material unobtainable, poster, not a research paper

During the sorting process, an attempt was made to determine the geographic dispersion of these papers to ensure a relatively complete coverage of the estimated 370 million indigenous people across the globe [26]. Initially, sorting papers by continents seemed a reasonable approach, and it worked for the most part. Some papers readily provided their geographic location, others were more challenging to determine, and still others were geographically indeterminate. A Global category was created to capture all those papers which did not fit into one specific continent.

The research papers were then assembled into their geographic regions of reference as follows in Table 4.

Table 4: Collation of Database Search Results by Continent

1.	Asia	10 papers
2.	Africa	4 papers
3.	North America	7 papers
4.	South America	3 papers
5.	Oceania and Australia	11 papers
6.	Global	6 papers

The reader will note that there are no papers addressing the digital divide among indigenous communities in Europe and Russia, while both have indigenous peoples in their demography (9 groups). The question of why these large regions have no papers published in the searched databases requires an answer. One explanation could be that seven of these indigenous groups live in Russia and Ukraine, where English publications are generally not supported.

Research Questions Posed

Three research questions were posed at the beginning of this project. The questions were meant to probe the topic of "The Global Digital Divide and Indigenous Peoples":

RQ1: What are some of the problems identified with respect to the digital divide which affect the indigenous population? Which of these problems should be investigated further?

RQ2: With regards to the identified problems, what solutions are being proposed? How may the identified problems be categorized effectively to provide a fresh look into the topic?

RQ3: Why did the researchers believe that the solutions that were proposed regarding the resolution of the digital divide were effective or otherwise? What evidence of the effectiveness or lack thereof was provided by the researchers for the solutions they proposed to address the digital divide in the indigenous community?

These three questions qualify the scope of this research project into the digital divide. The research questions provide the researcher's reasons for conducting research and possibly relate the work amongst various researchers.

The responses to these research questions which were identifiable in each paper were marked and recorded, and a running list of responses was prepared for the entire set of papers. At this point, two sets of documents were created: a marked-up PDF of the research paper and a document with identified responses to the research questions. These documents are cross-referenced in the analysis section of this project. The research questions are addressed, individually or collectively, with appropriate responses as this paper proceeds.

A second discussion is also presented for each paper. Here, a five-part topical approach as developed by Hilbert [27] and others on the constituents of the digital divide, controls and guides that narrative as each paper is represented. The five questions that are asked are as follows:

1. Who are the subjects covered in this paper?
2. What are the important characteristics of the connectivity in each case?
3. By what important means is connectivity accomplished?
4. How pervasive is the connectivity?
5. What is the purpose of the connectivity?

These points are covered to the extent that there is information to work with, to better bring out the digital divide elements of interest to the indigenous peoples presented in the research. Also following from this line of review, a table is presented at the end of each review by continent, to summarize the digital divide questions which were considered by the researcher.

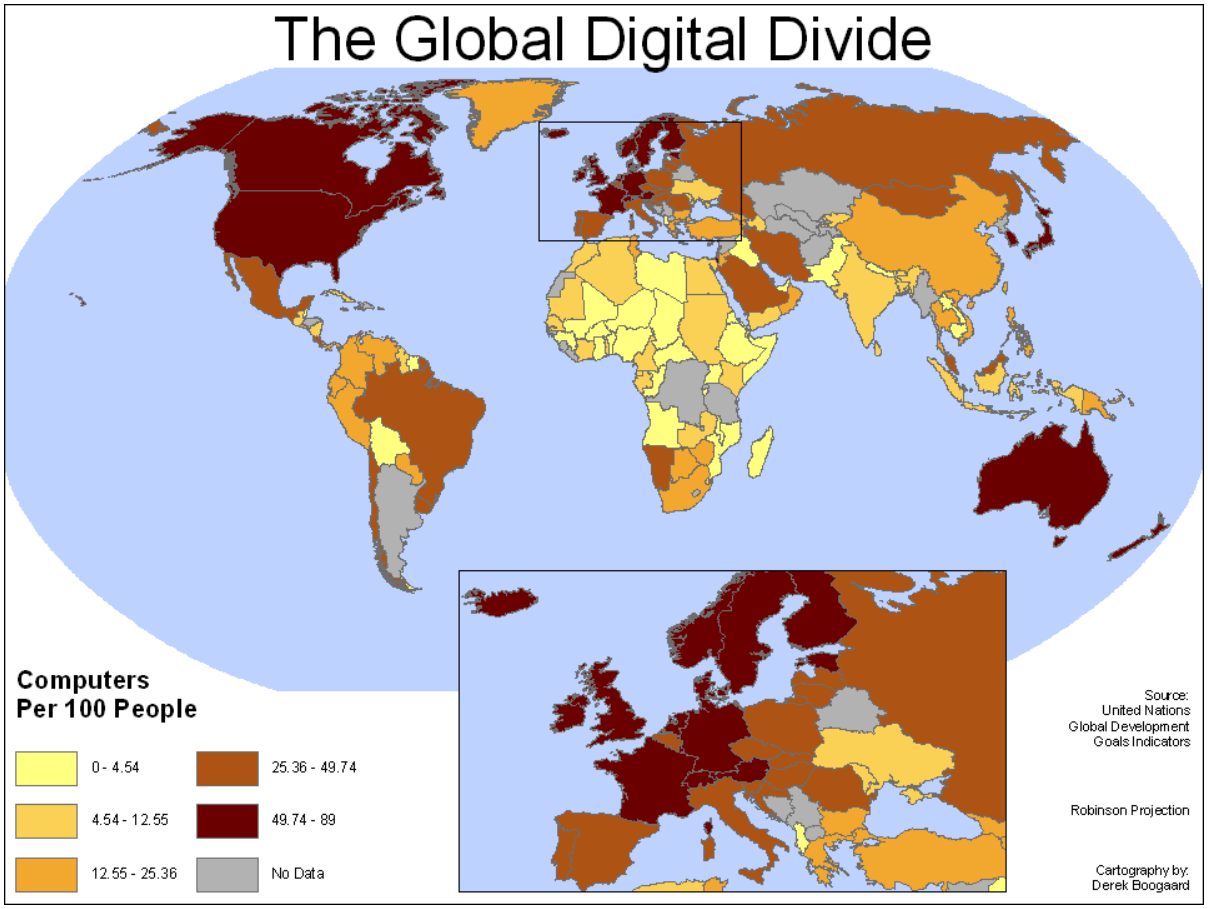
CHAPTER IV

Analysis and Results

Three figures are first presented to provide context for developments in digital and related technologies. The first figure provides a descriptive map of the Global Digital Divide. This map sets the stage for the discussions as this essay proceeds across the globe, continent by continent. A second figure provides a graphic of the internet users from 1997 – 2007, with an emphasis on showing the differences between the developed and the developing world. The third figure shows a graphic of how a satellite link works in connecting a remote or isolated community.

Figure 4 demonstrates the Global Digital Divide at a national level. Countries in North America, Europe and Australia have between 50 - 100 computers per 100 people. South American countries show a mixed set of circumstances each with considerable geographical coverage ranging from little/no data to a maximum of 50 computers per 100 people. African countries indicate a generally poor coverage, with most of the continent having a distribution rate of less than 25 computers for every 100 people. Asia has a middle ground with many regions standing at the 12 – 25 computers per 100 people level.

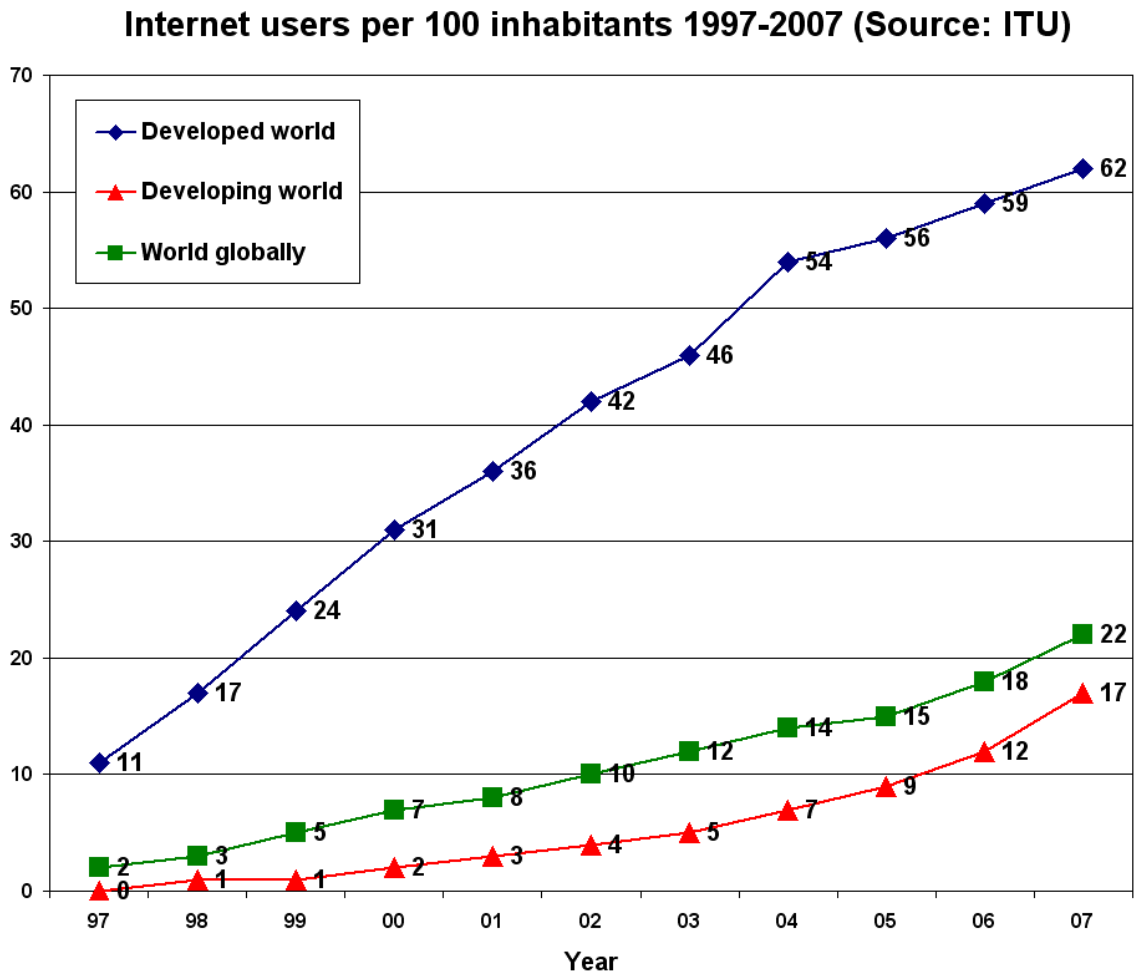
Figure 4: A descriptive map showing the computer technology disparities between nations, circa 2009.



Source: United Nations Global Development Goals Indicators

Figure 5 shows a more aggregated view of the digital divide, separating nations only on the basis of internet users per 100 people. The developing world is seen to have tripled its internet users over the past decade to arrive at 17 users per 100 people while the developed world has more than triple that number of users at that time (62 users per 100 people).

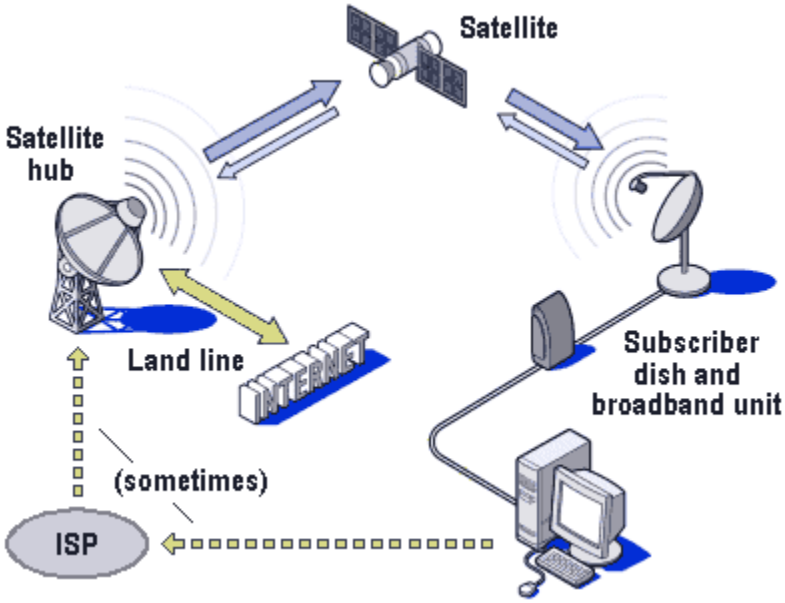
Figure 5: Internet users per 100 inhabitants 1997 – 2007



Source: The International Telecommunication Union

Figure 6 visualizes a solution currently touted as a way to link many of the world's remote locations to internet. In this solution, a series of satellites receive ground signals of internet page returns and subscriber requests which are first collected through wireless means in a rural or remote location, where many of the world's indigenous peoples live. As shall be discussed later, the K-Net project is an example of initiatives which use this model of deployment.

Figure 6: A model for the O3b service delivery, and also an approximation of the K-Net Project.



Source: pctechguide.com/images/62satellite.gif

Decision to Organize By Continents

During the review stages of the materials which supported this essay, it became clear that organizing the papers by continent seemed most logical. In some of the reviewed papers, some authors discuss identical indigenous peoples in certain regions, but approach this population from different topical aspects and for various purposes. In many cases, the continental facts in the research papers were similar by virtue of history, challenges, their common familiarity, etc. Therefore, it is possible to organize the research papers by continent. The one exception to this approach was Oceania and Australia, which together comprise a continent. These two geographical regions are quite distinct, hence two subcategories were created under this continent's name to discuss the regions separately.

Reference by Naming Convention of Authors

Discussion pertaining to indigenous peoples in this paper is made in a manner consistent with the researcher's terminology. References to indigenous peoples are made through four possible means. Most writers use the term Indigenous or Aboriginal in their papers. For clarity's sake, whichever term is raised by the writer is now maintained in this essay when referring to those papers. In one researcher's case, the terms Native Americans, Tribes, and American Indians are used; these terms are also maintained in this essay when referring to that paper. In the last set of research reports, the researchers refer to the indigenous people by their tribal name. To maintain integrity with the original case study, the tribal names are used in this project.

Lastly, as several tribes or indigenous peoples are referred to in this essay, a search/test was done in each case to determine the presence of said indigenous people in the particular territory. United Nations websites and www.refworld.org were consulted to verify that any one group was indeed indigenous in accordance to UN's protocols for the recognition of indigenous peoples.

Oceania and Australia

As mentioned earlier, this continent breaks down into the two subcontinents, Oceania and Australia. While there are common historical elements throughout these two subcontinents, there are also key reasons why they are separately covered. Australia has a significant land mass and many indigenous people, however, there is one federal government that governs all the territories of Australia. In Oceania, conversely there are many island nation states with challenges and approaches quite different than those of Australia's. To assist with the digital divide challenges of Oceania, the United Nations has a special office: the UN Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States (UNOHRLLS). There is no such UN counterpart for Australia.

Oceania

Oceania's territory is generally considered to be the islands between Asia, Australia and the Americas. For purposes of this essay, a separate heading is presented treating Australia as a distinct region from Oceania. For a better affiliation with the domain of Oceania, one case consisting of a remote Hawaiian Island is bundled into this group. In Oceania, one sees vast distances between these islands, with limited robust linkages and inter-island travel. Populations are sparse in some areas and dense in others. The smaller isolated islands have less than 100 people per square kilometer while the developed islands have over 300 people per square kilometer. A total of 6 million indigenous people live in the Oceania region, which has an overall population of about 11 million indigenous and non-indigenous people. From a geo-political perspective, Oceania is comprised of 14 countries and 15 dependencies. This

island continent consists of 10,000 islands, many of which are uninhabited, as shown in Figure 7.

Figure 7: Oceania with relationships and adjacencies to Polynesia, Micronesia, Melanesia and Australia

Source: https://encrypted-tbn2.gstatic.com/images?q=tbn:ANd9GcQ0TSUqddz2H_AETj-6PWjWY2KF_dKVys6Fo7Yw0YqVkwAmkDKiaw (July, 2013)
Scale 1” =~ 1850 km

Iding et al [28] in their paper “Going beyond access: On-line education in Hawaii and the Pacific Islands” provide a general background to the work of the University of Hawaii. This paper recognizes the challenges in serving the sparsely populated and geographically isolated islands of Hawaii and its indigenous communities. The geographic and technological challenges are considerable with seven islands being inhabited across a distance of 2,400 km.

The paper raises several issues, the first dealing with the maintenance of contact with the indigenous diaspora throughout the higher populated areas and the less populated out-islands. The authors' principal focus is on web based learning and the educational support provided for various Pacific Island communities in this regard. The University of Hawaii has participated in this developmental activity since the onset of an ARPA project in 1971 and provides ongoing review of the initiative's subject materials.

Iding's first point is reiterated, he understands that Indigenous peoples worldwide are recognized to be in a transition state. Many have relocated, in most cases permanently, to large communities for the sake of education, employment and other advantages that most often urban spaces offer. This presents certain personal choices which lead to the relocation or migration of people from rural and remote areas and which eventually separates them from their cultural roots.

The author's second point is further discussed through an initiative where the University of Hawaii developed educational promotional DVD's and sent these materials to the other islands to demonstrate the success of their program and to encourage post-secondary student recruitment. The target audience and potential learners would, through this DVD medium ideally identify with the presenter and would be encouraged to pursue a post-secondary education. DVD's are viewed on both private computers or school computers with the focus of this project being on attracting high school students and young adults to enrol

and continue in a post-secondary education. On-line instruction has also been developed for courses that are now distributed to other islands.

In addition, Iding states that the University supports the general community, by encouraging everyone to join in on-line projects. Some of these on-line events examine and discuss topics related to certain cultural artifacts. These are artifacts which the University has obtained and for which on-line access now makes these available to the inhabitants of other islands. Through such initiatives, it is possible to both co-create discussion and co-curate cultural repositories with the help of the Pacific's indigenous people, for whom they are intended and to whom they belong.

Connectivity is an issue in this case and for these dispersed islands. The National Science Foundation provided the University in 2000 with an award (NSF Award #9876406) to upgrade their research link to the mainland via a DS3 link (i.e. Defense Department Carrier) which has T3 (45 Mb) capacity. Through this investment, inter-island communication is also conducted via telephony and radio/video signals.

As we see in this example, digital divide considerations extend beyond the Hawaiian islands into other Pacific islands, which have low annual incomes ($2,445) and need to deal with intermittent electrical outages or have no access to electricity. Limited bandwidth and obsolete computers are challenges on many of these islands. One community college in this

study for instance, is identified as having a few such older computers. Despite all these limitations, youth interest in computers is high, where they are available.

Solutions and outcomes from this island digital bridging case would indicate that the University plays a central role in many respects in reinforcing people and other institutions in resolving the digital divide. The University ‘s curriculum and courseware support digital divide resolution with appropriate methodology and delivery approaches. Lastly, Iding suggests that resolving digital divide matters requires a long term view for reasons of meeting the needs of advancing technologies and providing for the general advancement of citizens.

Oceania’s extreme limitations in dealing with IT are discussed by Hudson [29] in her paper “Reaching the cloud: Broadband strategies for small states and developing regions”. The author’s references to services and software are current; for instance, the references to cloud computing and storage of information is noted. Hudson identifies the major problem for small states in Oceania is that many comprise such small markets that ICT investors would rarely if ever be interested in bringing the technology to that market. Hudson makes reference to the UN Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States (UNOHRLLS), which focuses on these developing countries in terms of broadband availability, usage and affordability. For instance, were better connections available in some places, back-office information service employment could be provided in these home locations. This would reduce the need for islanders to leave for career and employment opportunities. In one instance, a case is

presented where an indigenous community (Sarawak, Malaysian Borneo) used available telecommunications services to open a telecentre and a website to promote eco-tourism in their region.

In the digital divide discussion for this case, despite certain intrinsic challenges, mobile phones are now generally available to 60% of the public on most Oceanic islands. Remote islands on the other hand have less than 10% mobile phone penetration rates. In addition to personal requirements, ICT and telecommunications are deemed important in these islands for purposes of emergency warnings relating to floods, tsunamis, and typhoons.

In island locations where these ICT technologies are sufficiently developed, regional networks have been formed to support community needs in healthcare, development of teachers, and delivery of post-secondary education. Other benefits for the connected islands would be their ability to support e-commerce applications such as web services and VOIP, and educational programs are enabled to find reference materials related to curriculum development and support. International connectivity in Oceania is accomplished via submarine cable and in instances such as Niue, via satellite link service such as PacTel.

The author states that broadband in Oceania is limited to 3.3 subscribers per 100 population. In 40 percent of these countries, there is less than 1 broadband subscriber per 100 persons. Costs are a concern as well; typical broadband costs are about 20 percent of monthly income, thus limiting access for many.

Hudson brings up the specific case of Niue (see Figure 8), which is an independent nation but is freely-associated with New Zealand. Niue is located approximately 2400 km NE of New Zealand. In this case the indigenous peoples and islanders established a free Wi-Fi (see Figure 9) network for an on-island population of 1800 people. This is quite a contrast to the situation found in other island states, but nevertheless provides some proof of what is possible in small communities.

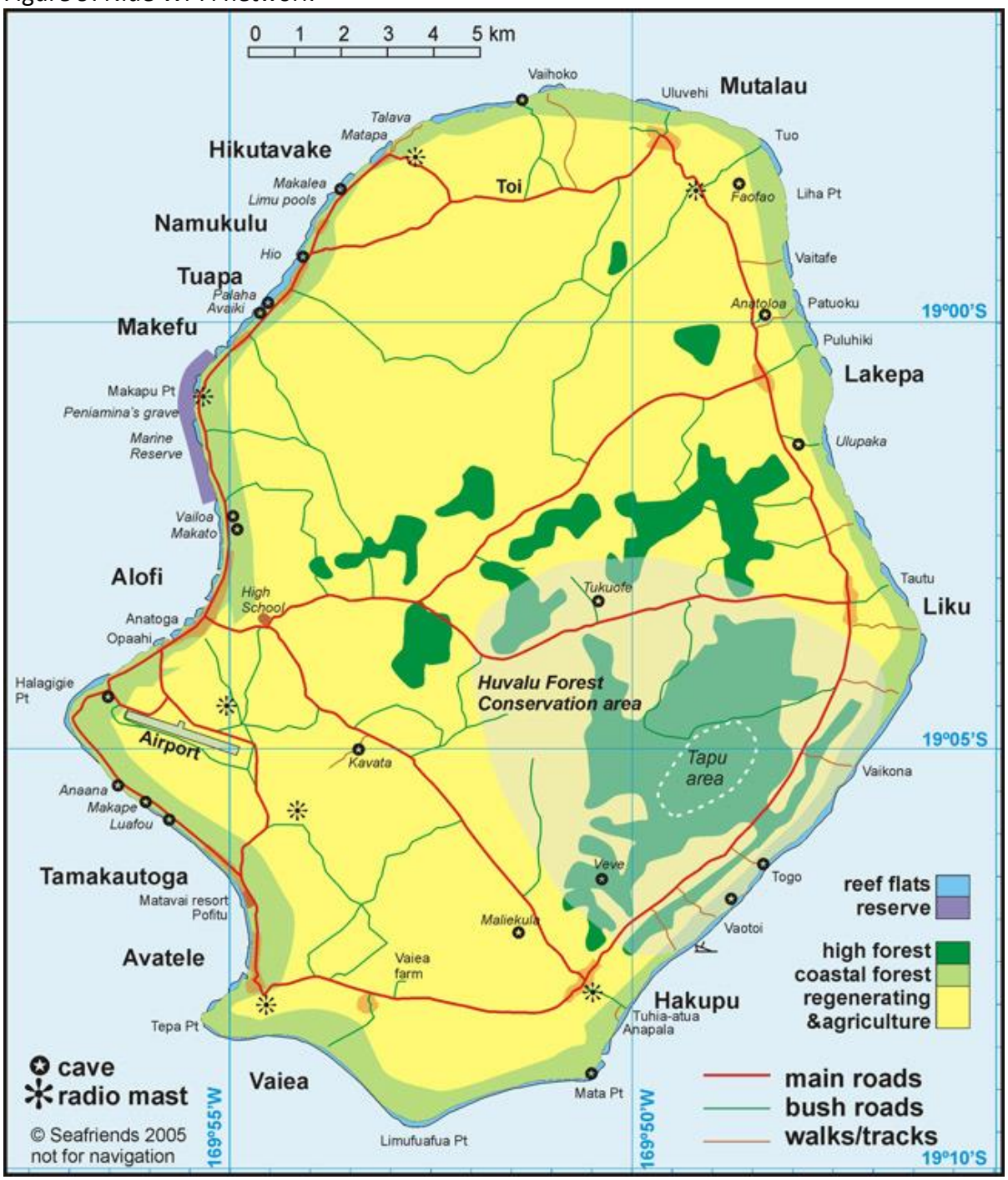
One of the key issues the author identified in this study was the question of the affordability of broadband and other services, given the low monthly incomes of inhabitants in many places. The availability of community or publicly owned services can mitigate these connectivity costs, however, the necessity for competition to maintain access to current technology is also important. In the case of Niue, the proposed solution was effective, as a Wi-Fi initiative covers the entire island with minimal challenges. It did help that one indigenous couple were ICT service providers in Niue.

Figure 8: Location of Independent Nation of Niue in S. Pacific

Source: Google Maps
Notes to Figure 8: Distances – 12,000 km east to South America; 5,800 km west to Australia; 2,400 km SW to New Zealand.

Hudson identifies that the community-state of Niue was able to provide broad coverage for its entire community, using Wi-Fi which is uploaded to a satellite for access to global ICT resources. The local wireless coverage provides services to both computer and mobile phones at a nominal cost, with users participating in retrieval and access activities. This island has a great demand for weather predicting resources as it suffered a major setback through Cyclone Heta in 2004. As a result of that event, as much as 80 percent of the buildings were damaged and many of Niue's people have relocated to New Zealand.

Figure 9: Niue Wi-Fi network



Source: Internet Niue www.internetniue.nu

Australia

In this section, a total of eight papers are reviewed for this sub region of the Oceania and Australia Continent.

The first study in this section is by Radoll [30]. In his paper, "The emergence of the indigenous field of practice: factors affecting Australian Indigenous household ICT adoption," the author examines the rural ICT household adoption rates of Indigenous and non-Indigenous families. While the former have a 31 percent ICT adoption rate, the latter enjoy a 46 percent adoption rate. For this study, a rural New South Wales community (Figure 10) was chosen. This area has an Indigenous population of 1200 people.

Figure 10 – Location of New South Wales, Australia

Source: Google Maps

The Radoll study shows that the Indigenous community lags behind the non-Indigenous community in schooling completion rates, unemployment rates, and average incomes, by margins as small as 20 percent and as wide as 60 percent. Indigenous people were

interviewed for their understanding of the inhibitions of ICT adoption. Inhibitors were stated to be financial limitations, lack of ICT training, substance abuse, preference for face-to-face communication and racism in the local employment market. Motivators for the adoption of ICT's were identified to include education, employment, contact with family and friends who have access to ICTs, school age children at home, flexible financing, and a stated purpose to use ICTs at home. Certain behaviours were noted as being difficult to change, suggesting that several motivating factors were needed to support ICT adoption. This study is only conducted in one stage, and as a result there is no ability to compare progress over time.

At the intersection of traditions and contemporary innovation are the youth. Singleton et al, [31] in their paper "Youth empowerment and information and communication technologies: a case study of a remote Australian Aboriginal community", approach a community cultural centre in Leonora, Australia (Figure 11) to examine ICT take-up. The authors recognize that youth are often first adopters of new technology, while still being linked to their cultures. This small rural community of 122 Aboriginal and 410 non-Aboriginal people had a digital divide. The rural town also had four distinct tribes living in it, the result of resettlement for employment, etc. The cultural centre of Lenore serves as the place where indigenous people often gather to bond, build kinship, and practise their culture, as well as sell their handicrafts - principally paintings. For this study, Singleton et al provide the community youth with access to the centre's computers for Skype and related services; they were also encouraged to use certain video equipment. The project was then linked to Singleton's base location via a broadband connection for support and instruction purposes. This video equipment was the means by which elders then engaged with the youth in outdoor activities, cultural practises,

storytelling, and similar activities. The ultimate intention here was to encourage each of the youth to produce a three minute video reflecting his/her cultural learning and relevant knowledge transferred through interaction with their elders.

Figure 11: Leonora, Western Australia

Source: Google Maps

This project was an attempt at creating an indigenous learning experience using ICT which linked youth to their elders. Computer assets in the region and in the number of community families were limited, therefore the cultural centre served as the base of operations. At the end of this project the video clips were copyrighted with the rights given to the cultural centre and left as the centre's property. The largest gain for the elders was that they were asked to participate and educate the younger people in their ways. For the younger participants, the primary advantage was that the opportunity to participate in a community

initiative while building their ICT skill sets. The cultural centre also found the opportunity to assert and exercise community leadership in the course of this project. The authors conclude by commenting that ICT's can support meaningful youth engagement without compromising their heritage.

Addressing the interaction between government information systems and Aboriginal education is the topic of a paper by Mohammad [32] titled "The implementation of government information systems and computer education within aboriginal community in Australia." The author identifies that certain schools in the Aboriginal homelands operate without qualified teachers, without technological resources, and at times without even minimal school supplies. The students of these schools have extremely limited access to ICT resources by the time they graduate. The school situation is further complicated with the self-perception of the Aboriginal people, that mainstream education programs are not designed or appropriate for them and that the traditional schooling programs are better suited to their needs.

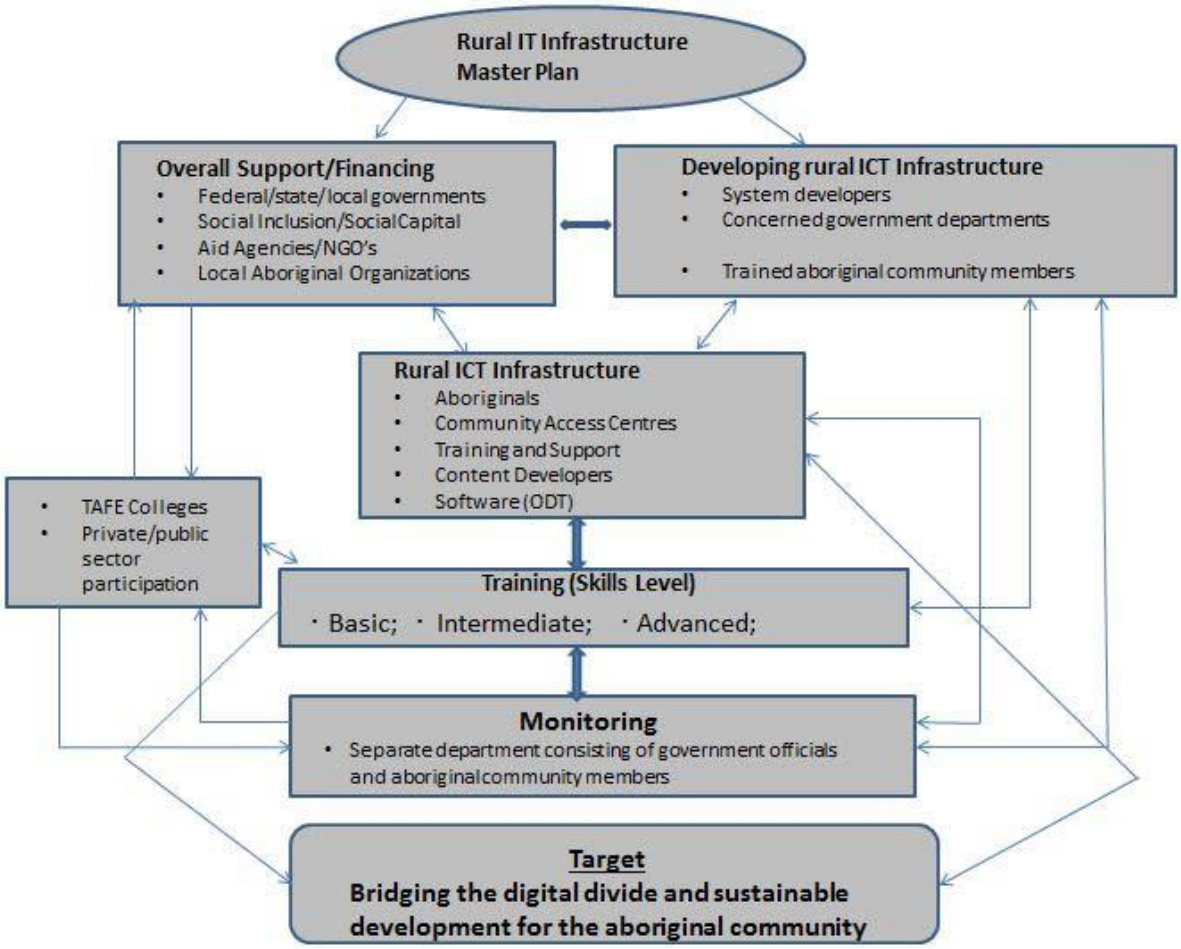
Issues which limit the Aboriginal people in engaging in mainstream education and employment often relate to previous negative experiences, which raise suspicions about further possible exploitation. Projects which are aimed at resolving the digital divide in education enjoy the support of community cultural centres which provide both ICT training and computer assets. Cultural centres support many other social development issues facing Aboriginal people. Other projects introduced by the Australian government are aimed at building governance capability through the establishment of local community councils. On the

federal level, electronic portals for interactions with government on various matters have been introduced. Despite these positive moves by the government, in some cases, officials are seen to doubt the necessity of these initiatives, especially those aimed at computer supported education - sowing doubt while attempting to move forward is not a promising approach. Mohammad proposes the use of a Capability Maturity Model, by which the user starts, if necessary, from a zero state of capability and then progresses through four stages of increasing capabilities. In the area of teacher support, a bonus-based system is recommended to mentor aboriginal students to aspire to improved career paths.

In a further study by Mohammad et al [33], "The dynamic business process development framework to bridge the digital divide among the aboriginal community in Australia," background issues affecting the digital divide of Aboriginal people in Australia are addressed. Low household incomes are the predominant factor limiting ICT usage while at home. Moreover, the intergenerational disadvantage, amongst other social challenges, decreases the employability of Indigenous people, which in turn deprives them of the resources required for ICT purchases. Despite these obstacles, the author believes that the extensive use of ICT along with making appropriate policies applicable to the Indigenous community are needed to overcome the digital divide. To support this belief, the Dynamic Business Development Framework (Figure 12) is introduced as a possible solution. This model provides an approach to bridging the digital divide and is particularly cognizant of rural people and rural challenges. It needs to be recognized that federal support is necessary for the deployment of this plan, and many unpredictable challenges that arise in the process of working through a presumably long-term project need to be resolved. The author concludes

by proposing the next step, i.e. finding a small and willing Indigenous community to participate in the project.

Figure 12: The Dynamic Business Process Development Framework



Source: c.f. Mohammad et al. (reproduced figure)

Vaughan [34], in "The importance of capabilities in the sustainability of information and communications technology programs: the case of remote Indigenous," pursues the sustainability of ICT programs in two rural Australian locations. (Figure 13 – Cape York Peninsula). A small community of 20 families participated in this research project which worked around several themes including a recovered land title for their indigenous

community, the prospects of business development, a telecentre operation, and a local governance structure. This community had interests in resettling on their tribal lands, as well as in establishing an alcohol and drug rehabilitation facility. The key ICT asset in this case was the telecentre which had fallen into disuse because the local know-how required to operate and maintain this resource was lacking. Vaughan also selected a second location for this research project. It had a slightly larger population of 800 people who comprised a mixed racial community. The ICT assets at this telecentre were successfully maintained over this period of study.

Vaughan's concluding comments are that the ICT assets need to contribute to the well-being and aspirations of the community in order for these assets to be sustained over a long period of time. The author also points out that critical mass issues are at stake, in that a relatively few ICT assets will serve a larger community better than a small community. ICT policy does not explicitly exist for indigenous people in Australia, and the process of gaining access to appropriate programs is claimed to be overly complex. As a result of these circumstances, Indigenous people have little agency in how these programs are deployed, and rather it is the significant investment by the federal government which is driving the ICT agenda forward.

Figure 13: Cape York Peninsula, Australia; Project Location near Hope Vale (SE Coastal location on map)

Source: tourismcapeyork.com

In “Aligning digital and social inclusion: A study of disadvantaged students and computer access,” Yelland et al [35] consider the digital divide in the context of social inclusion rather than one of technological content. A group of disadvantaged adult students are provided with refurbished computers, internet access and training on how to use this technology. Over 300 participants from 30 small communities throughout Australia participated in this project. Daily computer use doubled to over 50 percent with this group, and almost everyone used the computer at least once a week. The purpose of their online activities ranged from information gathering to online dialogue and Web 2.0 applications. Job seeking was also supported by having access to a computer. This project focused on only adults, but the computers were for available for general household use. The parent’s attitudes towards supporting their children’s personal development was thought to be important, and more importantly the parents perceived themselves through this initiative as a normal typical community member of the knowledge society. Overall, school achievement levels for parents and children increased as the result of having home access to computers.

Another study looking at the implications of a higher education for indigenous and disadvantaged students is provided by Chapman [36] in “Making the most of the mosaic: facilitating post-school transitions to higher education of disadvantaged students”. The author addresses the underrepresentation of equity groups in higher education in Australia. Education development policies are noted to be created nationally, rather than specifically target remote regions of the country and its indigenous students. Chapman notes that socio-economically challenged students are already dropping out in much higher rates in high

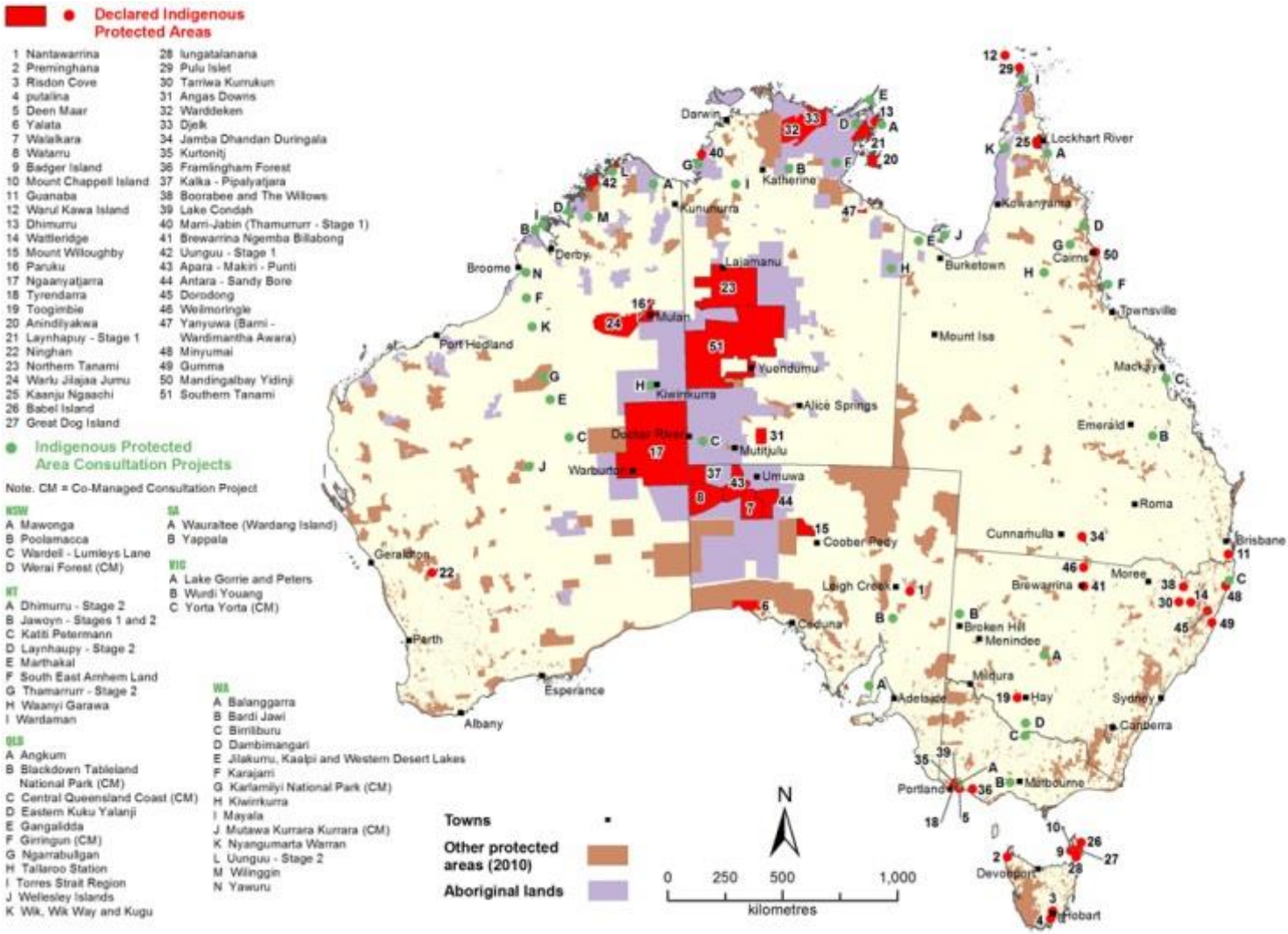
schools. It follows, that if these students do not graduate, then they are not available for higher education programs. These circumstances are recognized to have life-long implications with the resultant fragmentary pathways to careers. Chapman suggests a multi-pronged approach of student resilience, institutional responsiveness, and policy reflexivity to facilitate a school to work transition.

Some of the proposed solutions start with the suggestion to ensure the provision of more and better computers to rural high schools and the deployment of a national broadband network for online learning. Tutoring and changing curricula which better reflect the student's world and surroundings, as well as access to online learning programs for missed courses and remedial training, are suggested. Student resilience is supported through tutoring and more encouragement in the pursuit of personal aspirations. In general, the introduction of a positive approach is proposed by Chapman. Institutions need to reconsider their teaching and motivational approaches and implement the appropriate curriculum changes at the high school level and then again at the university level for success to occur. In the latter case, the introduction of support systems for adult students, particularly in the first year of post-secondary education, is very important. The last consideration in policy reflexivity (i.e. adjusting policy based on its results) deals with changing the practise of writing-off students that have dropped out. Instead, Chapman seeks to bridge the student to their communities through education policies and appropriate curriculum. Results over a three year period indicated academic gains and parity for the participating students who joined the program. From a broader policy perspective, students demonstrated little interest in

attending top-ranking universities and the professional programs of these institutions. Instead, Chapman notes that students preferred to remain in the smaller regional universities, suggesting that this will be a long term process to achieve the desired goals.

Ormond-Parker et al, [37] in "Local archives and community collecting in the digital age," take an archivist's point of view in the last presentation for this series. This research paper covers the implementation of a digital archive system which contains significant artifacts and related materials about the Aboriginal peoples of Australia. To provide some scope to this idea, Figure 14 demonstrates the breadth and width of aboriginal settlement and presence throughout Australia.

Figure 14: Locations of Indigenous Protected Lands in Australia



Source: www.environment.gov.au

Digitization of historical documents and artifacts is progressing at a very quick pace, but amongst the obvious artifacts are things such as death records. In these cases, families may wish to examine the records to identify members who died while in custody, or due to forced separations. Many online visits to the archives are claimed to be for purposes of rebuilding these family histories and considerable amounts of other serious matters have been uncovered by Australia's Aboriginal people through access to these digital archives. Access to

these archives was enabled through 32 Knowledge Centres. These centres allow citizens to access records, videos, pictures, and sound files of materials which may be stored elsewhere. Users are able to query a user-friendly database to complete their searches. While retrieving information in distant and distributed databases, aboriginal people are also encouraged to store their own stories in these archival systems. As a result, the archive becomes a living and growing initiative, and at times is referred to as a “living archive”.

Several problems exist in a system such as this: equipment is often located in a harsh environment, and technology breakdowns are common. Also, data organization is often not sufficiently precise because it follows locally developed protocols against a national and distributed archiving system. In addition, media formats are also constantly changing and, as a result, the ability to convert or playback older files and recordings has proved to be a challenge. The effort to revitalize older documents and records in order to preserve and present them in newer digital formats is still absent.

As users are allowed to input data to this archive, they can also modify it. As a result, the story telling of what really happened can be at times argumentative between some historians and aboriginal elders. On one major front, the Australian aboriginal people continue to press the point that the right to the information contained in these media files belongs to them, and hence they not only wish to control its dissemination but also request that they be compensated for its use. Nevertheless, Ormond-Parker et al believe that the archival project does much for the aboriginal people by helping them own their histories, particularly against a historical context in which they have been consistently disowned and dispossessed. As a

final point, the current generation of archivists recognize that these archival materials should be preserved and even curated by the Aboriginal people of Australia. However, there is no significant progress being made on this front, and aboriginal people are not entering the archival or IT professions.

A review of the digital divide elements (cf pg 36) which are considered in the continent of Oceania and Australia are presented in Table 5. From this table it is shown that all of the authors identify and discuss subjects and purpose of connectivity (DD#1 and DD#5) in their research. Authors consider children, youth, families, adults and communities (DD#1) in their research with a view to web learning, healthcare, e-commerce, VOIP, governance, amongst other elements (DD#5). Demographic and related characteristics of connectivity (DD#2) are also discussed fully and consider rural and isolated locations, poor family incomes, as well as educational and intergenerational disadvantaged family histories. Connectivity (DD#3) is less considered but this is accomplished via satellite, mobile phones and wireless systems, although broadband and fixed locations (i.e. PC's) were most commonly mentioned. Pervasiveness of the connectivity is also mentioned, but to a lesser degree. The common factor to pervasiveness of connectivity (DD#4) shows retrieval based activities, with one instance of innovation or creative contribution.

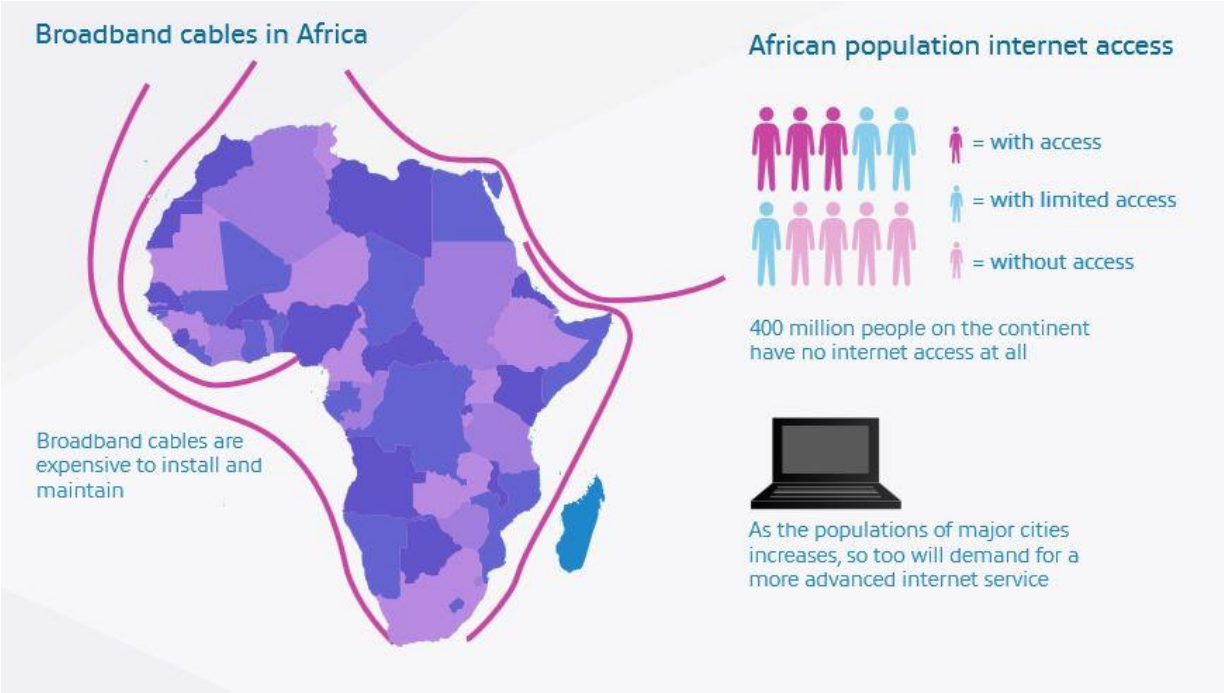
Table 5: Digital Divide Elements Considered For Oceania and Australia

Paper by:	DD #1	DD #2	DD #3	DD #4	DD #5
Iding et al [28]	yes	yes	yes	yes	yes
Hudson [29]	yes	yes	yes	yes	yes
Radoll [30]	yes	yes		yes	yes
Singleton et al [31]	yes	yes	yes	yes	yes
Mohammad [32]	yes	yes			yes
Mohammad [33]	yes	yes			yes
Vaughan [34]	yes	yes			yes
Yelland [35]	yes	yes	yes	yes	yes
Chapman [36]	yes	yes	yes	yes	yes
Ormond-Parker [37]	yes	yes	yes	yes	yes
Totals	**10**	**10**	**6**	**7**	**10**

Africa

Four papers were reviewed for the section that addresses the impact of digital divide in Africa. They cover such topics as indigenous knowledge, visualization, and early elements of mobile computing. The general ICT infrastructure context for Africa is poor as the continent has limited fibre optic connections (Figure 15) and broadband access, due to the expense of installing such services. Overall, about 30 percent of the continent's population have some form of internet access while 40 percent are altogether without any access of the kind.

Figure 15: Broadband Cable Network to Africa



Source: http://www.ses.com/14203140/Africa_Bridging_the_digital_divide

Khashman et al [38] in their paper "Digital Inclusion for Children in the Social Context of HIV/AIDS awareness "relate a case study in KwaZulu-Natal, South Africa (Figure 16), where children are engaged through an AIDS and HIV awareness program. In some of these cases, the children have family members who suffer from or have died due to this disease. The

children in these families are provided with simple cameras and encouraged to take photos which express their feelings at certain times. These photos are later scanned and stored into an archive, captioned by the children, and eventually annotated and meta tagged by librarians or others. These materials are then set up for retrieval for community members through a special website. Through this process, these photos then create a digital archive which documents the lives and times of the community.

Figure 16: Location of KwaZulu Natal, South Africa

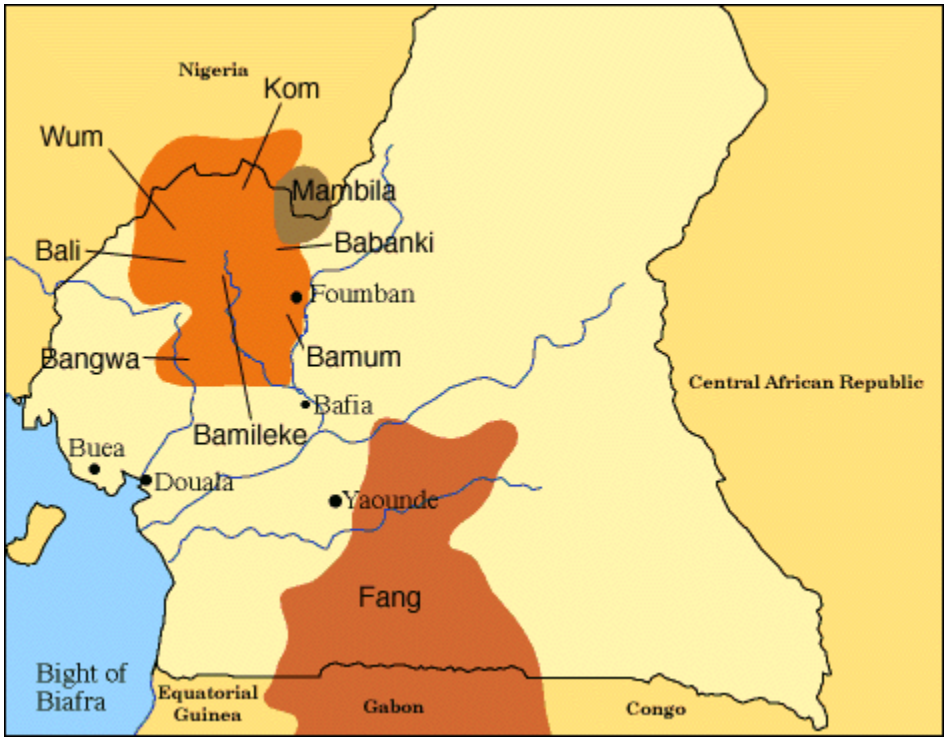
Source: Google Maps

This project could be considered as a visual-arts project which is led by rural indigenous children and is supported by adults. Through the initiative more than 3000 photos have been collected within the region while access is enabled through central community locations.

Using the five element conceptualization (c.f. pg 36 of this essay) for reviewing the digital divide it is noted that the intensity of connectivity is retrieval based for community adults, but it also has innovative elements for the children. The purpose of connectivity is to address the challenges that children experience when illness becomes a dominant part of their lives. The "Sick of Aids" phenomenon [39] is addressed when children are engaged in these issues which affect also their lives and this project provides them with an opportunity to seek solutions. Evaluating the success of this digital archiving project was not possible as this was a short term research project. Follow on activity is necessary.

In another community, researchers attempted to compare IT codification with traditional knowledge. Toukam et al [40] in "Contribution and Limits of IT-Enabled Codification and Dissemination of Traditional Knowledge: Case of Bamiléké People," compare certain community events in an oral-based culture with the advancement of the ICT world. Knowledge is orally related in the Bamiléké culture. This indigenous community is tribally organized and is composed of 3,500,000 people who speak in 17 dialects and live in West Cameroon (Figure 17). Efforts are being made to create a written language. This is a considerable task for it requires a three-step process that includes creating models, creating languages, and creating messages. Added to this complexity is that Bamiléké culture has two sides - the public side which is discoursed and displayed publicly and the private or secret side – which is not meant to be discussed at all, at least not with non-tribal members.

Figure 17: Location of the Bamiléké Peoples



Source: http://www.uiowa.edu/~africart/toc/countries/Cameroon.html

The authors interviewed some members of the Bamiléké to understand their knowledge and preparedness in dealing with ICT technologies. The respondents' answers were recorded and later evaluated. It was clear in following this case that an official language was used for this research as a paper survey was used. The interview respondents comprised of public servants, and some professionals. With English and French being the official languages of West Cameroon, they were most likely the languages used during this research. Respondents demonstrated a high degree of awareness regarding ICT technologies in this survey, with the telephone, internet and compact disc technologies being the most recognized tools. Amongst those interviewed, two-thirds agreed that ICT can support and assist in the dissemination of their culture's traditional knowledge. While this research project probed deeply into the topic

of ICT understanding and usages, the research project did however not transfer any ICT capabilities.

Problems respecting the digital divide in this case relate to the fact that the Bamiléké people will in the immediate future need another language to codify their thoughts and access the internet. This is clearly underway at present, given their high degree of knowledge and acceptance of available technologies. Despite the promises and opportunities arising from ICT's, the secret Bamiléké societies were found to be to be impervious by the researcher and community members were able to deflect efforts at codification. As it concerns the general language codification problem identified earlier, there does not seem to be a timeline here to transform the Bamiléké languages into written form. It should be noted that historically the missionaries often created a written language for the indigenous people, which arguably enhanced the colonization process. In this case it seems that this codification did not take place. Today Cameroon is an independent and self-governing nation after gaining its independence in 1960.

The case of bridging generations with ICT is considered by Rodil et al [41] in "A New Visualization Approach to Re-Contextualize Indigenous Knowledge in Rural Africa." South African indigenous youth from remote regions need to move to towns and urban centres in order to be educated, and in the process lose touch with their ancestral roots. The divide which faces this generation estranges them from their own communities. In this case, Omaheke youth (Figure 18, located east of Windhoek) in Eastern Namibia and their rural

families were engaged in a project which reintroduced village life, using the Otjiherero language (Herero). This language is Latin scripted, but not all of its users are necessarily literate. Youth typically spend their school year with relatives in Windhoek and return to their home villages when the school year concludes.

Figure 18: Namibia -Windhoek

Source: www.naturalearthdata.com

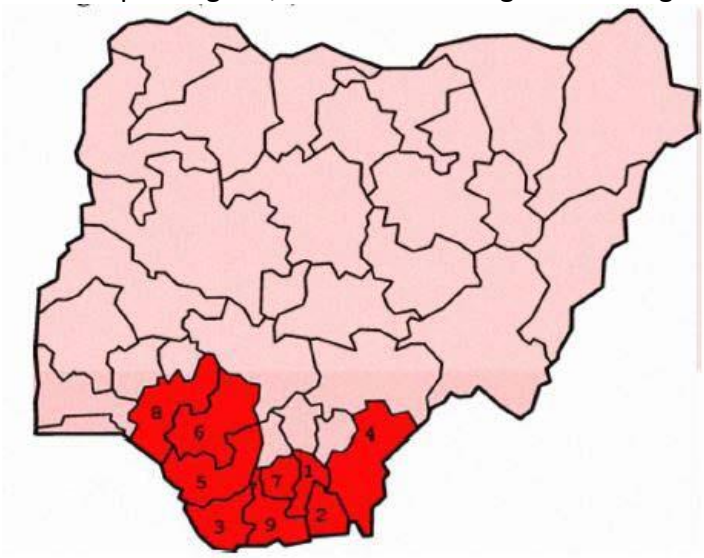
Researchers created an animation series, which began with videotaping village elders defining village life. The video tapes then required translation for the researchers to create the context and storylines. The storylines were then ported over to an animation technology. These animations were intended to “show” absent students certain elements of indigenous knowledge (IK) that was not taught in the formal schooling programs. Elders provided considerable context for these animations so as to provide authenticity for the initiative. The intent of this project was to preserve IK for succeeding generations of Otjiherero youth.

Retrieval of these animations was now through a computer. Youth, in this case, had minimal exposure to computers, while their elders had none. Youth were able to manipulate the computer to interact with certain village scene elements, and indeed much of this work was done in groups to support group knowledge building and interaction. This project did not indicate how these animations were stored or preserved over the long term. However, the project supported computer interaction and skills development.

The subject of sustainability and ICT technologies for indigenous people of Nigeria (Figure 19) is considered by Okon [42] in "Information communication technology and sustainable communities in Africa: The case of the Niger Delta region of Nigeria." The author points to a violent political system which intimidates its citizens, resulting in disenfranchisement and a growing disenchantment with the political system. Okon believes that ICT technologies can provide citizens with the opportunity to inform themselves. As this informing happens in alternate ways it would also not subject these indigenous people to the violence arising from

the political system and would enable citizens to advocate for their rights and needs. In short, ICT would assist the indigenous people of Nigeria to rebuild their democracy.

Figure 19: Map of Nigeria, with States of Niger Delta Region, of interest to this case



Map of Nigeria numerically showing states of the Niger Delta region depicted in red:
1. Abia, 2. Akwa Ibom, 3. Bayelsa, 4. Cross River, 5. Delta, 6. Edo, 7. Imo, 8. Ondo, 9. Rivers

Source: c.f. Okon

Okon's research demonstrates that a focus on people is absent in discussions on sustainability. Youth and young men are seen as the key communication network builders in small communities, through their message passing activities as they move between locales. Computers are evident in this research program as ICT technology is available in cyber cafes. The general use of the internet is measured at a little less than 10 percent. The author acknowledges that one outcome of this research is the understanding that ICT deployment can be hindered with intermittent power supplies, which is understood to be a governmental

responsibility. In addition to the infrastructure challenges in these locations, are the costs of connectivity and bandwidth. Literacy is also recognized as a community sustainability barrier, such that in the message-passing activities, those who are illiterate are often ignored or bypassed. In these cases, the message passer believes that the information could not be understood by these citizens and consequently does not engage with them. In this sense, ICT technologies seem to both enable and disable certain members of the same community.

As a last component, the key digital divide elements are that the key technology considered in this study is the mobile phone with voice and text capabilities. Radio is also a high demand device in these communities and the author identifies a stated preference for the native languages in this medium. This study helps us see connectivity as retrieval oriented (gathering information) and with a view to rebuilding indigenous societies while supporting the building of democratic societies.

A review of the digital divide elements found for the Africa, are presented in Table 6. In this table the authors all identify and discuss all digital divide elements in their studies. The purpose of connectivity (DD#1) considers children, youth, and adults. For the most part the demographic and related characteristics of connectivity (DD#2) are identified to be rural and poor indigenous peoples. Connectivity (DD#3) is basically accomplished via broadband systems and at fixed locations other than the home; one instance of cell phones is identified. Pervasiveness of the connectivity is mentioned (DD#4) shows access and retrieval based activities, with again one instance of an innovative contribution. The purpose of connectivity (DD#5) is however less typical and topics here ranged from social and healing matters, to

codification of indigenous languages, transfer of indigenous knowledge and lastly citizen enfranchisement.

Table 6: Digital Divide Elements Considered for Africa

Paper by:	DD #1	DD #2	DD #3	DD #4	DD #5
Khashman [38]	yes	yes	yes	yes	yes
Toukam [40]	yes	yes	yes	yes	yes
Rodil et al [41]	yes	yes	yes	yes	yes
Okon [42]	yes	yes	yes	yes	yes
Totals	**4**	**4**	**4**	**4**	**4**

South America

Three papers are presented which consider South America. These three papers indicate learning and democracy as their key themes.

Introduction of internet service into a municipal environment is covered by López-Bachiller et al [43] in "ICT for development and the MuNet program: experiences and lessons learnt from an indigenous municipality in Guatemala." In this study, a T1 (1 MHz) service was introduced to the rural community of Patzun, Guatamala (see Figure 20). This community consists of 94 percent indigenous people (Maya Kaqchikel), with the municipality having a total of 52,000 residents. The purpose of this internationally funded project was to improve governmental services and quality of life for all citizens. Community services were at the core of this project in the indigenous rural community. Thirty staff members were provided with computers, some having to create email accounts for the first time. Given the limited data connection, simple text emails were likely the best that types of information that could be transferred, including perhaps the content of smaller- sized webpages. Training of staff was initiated, but it was found that older staff would not adapt very well to this new electronic medium; therefore, younger, more technology-capable staff were eventually hired. For the community as a whole, community training was provided at a central location.

Some important lessons learned from this project were to establish local implementation teams. Also, technology implementation and generally a new way of working turned out to be a long and trying process. Organizational changes were also identified as part of the

requirement to support ICT systems for a sustained result. National leadership was absent in this project, requiring local leaders to define their own ways. To this end, the local leadership persevered and was able to generate local webpages of interest to its constituents. Several leadership awards were received for this perseverance. This four-year project was an expensive initiative overall-nationwide, but only about $32,000 USD was spent on the local ICT implementation.

Figure 20: Patzun, Guatamala

Source: Wikipedia

A longer term project of 15 years is considered by Sánchez et al [44] in "ICT & learning in Chilean schools: Lessons learned." In this case, the elementary school system was the focus of a nation-wide ICT project which made a total investment of $200 million from 1995 onwards. On average, $82 was invested in ICT technology and training for each student, and this was considered to be very economical. The introduction of computers soon illuminated certain

shortcomings of teachers in subjects such as math; therefore, remedial teaching and general teacher development programmes were implemented over a 24 month period. At the international level, Chilean students' scores started to be compared to other nations, and while the scores were generally poorer, they were improving over time. Computers were dispersed throughout 10,000 schools, and the result was a computer to student ratio of 1-30. Students reported that less than a half of them used computers up to 3 times a week, while the majority only gained access once a week.

Figure 21: Location of Mapuche people in Chile

Source: The Economist

Chile has about 700,000 indigenous people, representing less than 5 percent of the overall population. This indigenous population lives in central Chile in a considerably urban environment (See Figure 21) with the most dominant indigenous people being the Mapuche people. According to Sánchez, the instituted educational program was prescriptive and did not allow much for local program tailoring or development, thereby missing an opportunity, to better engage the indigenous citizens. While the teaching systems and learning outcomes were improved (i.e. teacher training and math scores), this teaching process needs additional

improvements. From these results, one can see that more ICT is still needed in schools, recognizing that long development periods and significant budgets that are required to support and build these programs.

The larger discussion of the role of ICT in promoting and sustaining democracy is discussed by Welp [45] in “ICT's for democracy in Latin America?” According to the author, democracy perseveres amidst recurring political and economic crises, institutional instability, political polarization and citizen dissatisfaction. Voter turnout is low, and electoral results vary significantly from election to election. Welp identifies one case in Ecuador in which electoral registration of rural and indigenous people was sustained through these crises with the result being increased voter turnout. E-voting is considered to be a reasonable approach to improving voter turnout and is practiced in several Latin American countries, starting with Brazil and Venezuela. Costa Rica, Paraguay, Ecuador and a few Mexican states are also considering this e-voting technology.

Overall, internet use ranges from 10 percent to 40 percent throughout the region, and certain countries have done much to present their programs and related government information and documentation on the web. While this is retrieval based activity, its intent is to keep citizens informed. Raising electronic participation levels (i.e. e-voting and electronic public feedback) is another step that is considered in new legislation. E-government is still an emerging area which needs more research.

A review of the digital divide elements found for South America, are identified in Table 7. Again, in this table the authors all identify and discuss all digital divide elements in their studies. The purpose of connectivity (DD#1) considers local government, adults and children. Demographic and related characteristics of connectivity (DD#2) are identified to be rural and elementary school pupils. Connectivity (DD#3) is accomplished via broadband systems and at fixed locations such as government offices. Pervasiveness of the connectivity (DD#4) shows access some interactivity, especially in one case which considers e-voting. The purpose of connectivity (DD#5) is however almost entirely government related with e-voting, education and the provision of governmental services.

Table 7: Digital Divide Elements Considered for South America

Paper by:	DD #1	DD #2	DD #3	DD #4	DD #5
López-Bachiller [43]	yes	yes	yes	yes	yes
Sánchez et al [44]	yes	yes	yes	yes	yes
Welp [45]	yes	yes	yes	yes	yes
Totals	**3**	**3**	**3**	**3**	**3**

North America

A total of seven papers are considered for this section of the essay. One paper is from Mexico while five are from Canada and a last paper is from the United States. The order of papers presented in this section will follow that pattern.

Smith et al [46] in "Using Participatory Research Mapping and GIS to Explore Local Geographic Knowledge of Indigenous Landscapes in Mexico," describe maps in a different light when it comes to their deployment regarding indigenous peoples. Maps are not objective instruments, rather, the author claims, they are subjective representations. Maps were used historically to expropriate land and restrict spaces and were a powerful tool in the colonization process. A significant point made by Smith and echoed in other readings for this study is that maps ignore or erase relationships that the indigenous people have with the land. The rules of cartography do not consider indigenous people's perceptions. The author presents a Participatory Research Mapping (PRM) project in the east Mexico. The indigenous population of the Teneek, Nahua and Zapotec is over 3.25 million people (Figures 22 and 23), who primarily participate in a subsistence agriculture.

Figure 22: Huasteca Region Mexico (Teneek and Nahua)

Source: Wikimedia.com

Figure 23: Oaxaca State, Mexico (Zapotec)

Source: eltuxtepecano.com

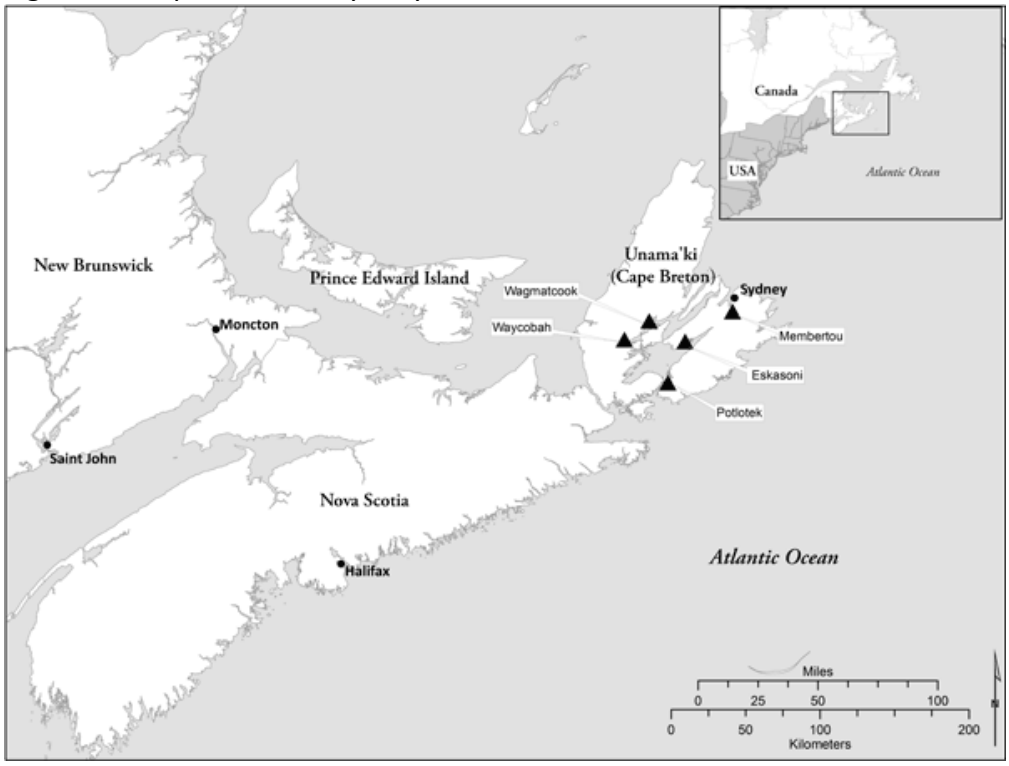
To initiate work in this region the researchers made several visitations to these areas and spent time in acquainting themselves with the communities they studied. The communities also added their local experts to this project team, which attempted to create an indigenous view of cartography. While the groundwork was conducted with GPS receivers and trained indigenous people, the entire process began with indigenous people making sketch maps on blank paper as the starting points for these exercises. As a result, local knowledge provided trail routes and indigenous names for hundreds of places which did not appear on formal maps of the area. This project was motivated by the central government's decision to follow through with constitutional changes in the national land certification program, which allowed the privatization of collectively owned lands.

Several outcomes of this project addressed problems of the sort that indigenous communities face because of digital divide. Up to 95 percent of the place names of the indigenous lands

were subsequent to this project renamed in the native language. Skills with ICT were transferred during the course of this project to indigenous people, and GIS mapping was accomplished with community input while corrections were made without political upheaval or confrontation. Communities themselves controlled what was to be included or excluded from these maps. Challenges from using the PRM indicated that the rich subjective and storytelling elements of the indigenous communities could not be transferred to this mapping project. As a result of this project, errors in previous mapping projects were also corrected. Smith et al considered this GIS project as an opportunity to empower indigenous communities to define their own maps and spaces and to use these results to address their own problems and desires.

The first Canadian case study focuses on two aboriginal communities, the result which appears in "Challenges for video communications in remote and rural communities" by O'Donnell et al [47]. The first aboriginal community studied in this project is located in a rural location in Nova Scotia (Membertou First Nation; Figures 24 and 25) while the other community comprising of several First Nations is situated in a remote region in North Western Ontario (Figure 26). Both networks (NB and NW Ontario) were supported in their capital development through federal government programs.

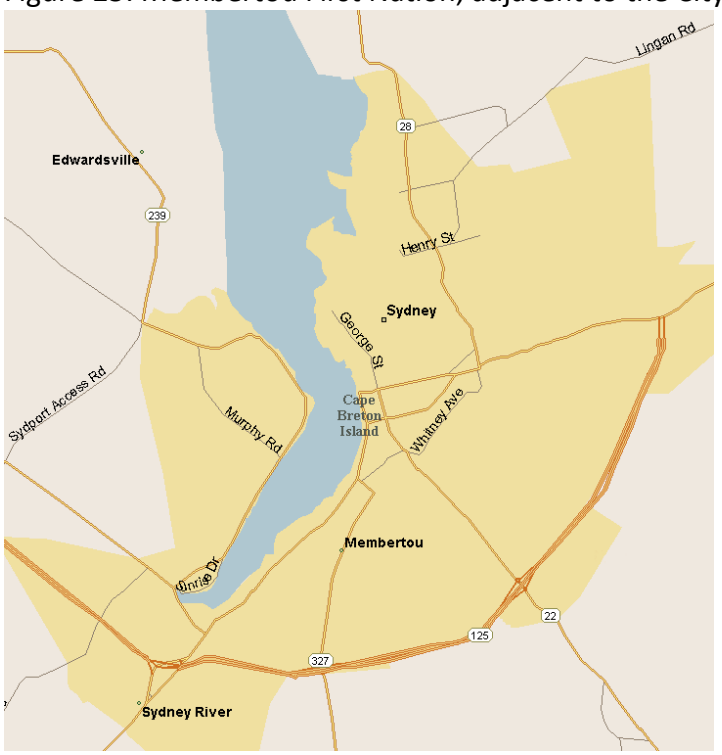
Figure 24: Cape Breton - Sydney, Nova Scotia



Source: cdc.gov

In both locations videoconferencing is used for purposes of education, professional development, distance learning, telehealth, community development and meetings. Crucial support to maintain the requisite "Quality of Service" (i.e. video linking) is provided by a Help Desk. A range of technologies such as cable, T1, fibre, microwave and satellite-related devices is used to support these inter community linkages. Connectivity intensity (c.f. Digital Divide Topics, pg. 35) is for purposes of this research oriented at interactivity (government to government, service provider to client, etc.).

Figure 25: Membertou First Nation, adjacent to the City of Sydney



Source: listingsca.com

Several challenges came up with the video technology application in these regions. One was that a trained person was needed at the point of service. Turnover issues were identified, and these needed to be managed to sustain the video links. Other challenges had to do with video presence itself – community members did not like appearing in a video. As a result practitioners and community members needed time to become adjusted to this new form of communicating. For purposes of archiving, certain video conferences were recorded, stored and made available for later retrieval. A further problem arose here when it became clear that the databases needed to store these archival materials were not well developed.

In the case of the remote region, served by K-Net in NW Ontario, a different mode of ICT delivery is found. Their network requires a satellite delivery system to send their signal to Sioux Lookout, which links into a backhaul T1 or better link to Winnipeg. In this case there are two key points of service for K-Net before information is sent to the main trunk. The first point of service is at the community site and the second site is at Sioux Lookout.

Both networks (NB and NW Ontario) reported that their federal counterparts were not able to link in, or otherwise appreciate the value of these video linkages, due to their own organizational service shortcomings (i.e. lack of video linkages). The reason for this disjunction is that one federal department provided the communications infrastructure financing while several other departments (with no video link capabilities) are engaged in the daily government-to-government interactions with the aboriginal communities.

Figure 26: K-Net served areas in NW Ontario

Source: knet.ca

O'Donnell et al follows the previous work with a subsequent paper [48] titled "Video communication roadblocks facing remote indigenous communities," with a closer look at certain elements of video conferencing challenges. The author states the need for improving bandwidth from 1 MHz to 10 MHz to better support video linkages. These video links are used primarily for educational, health, and governance purposes at peak hours, and for social purposes at off-peak hours. In this study, O'Donnell et al add a Cree (Aboriginal) community in Wedake, Quebec (near Quebec City, QC) to their research project. As a result, their work

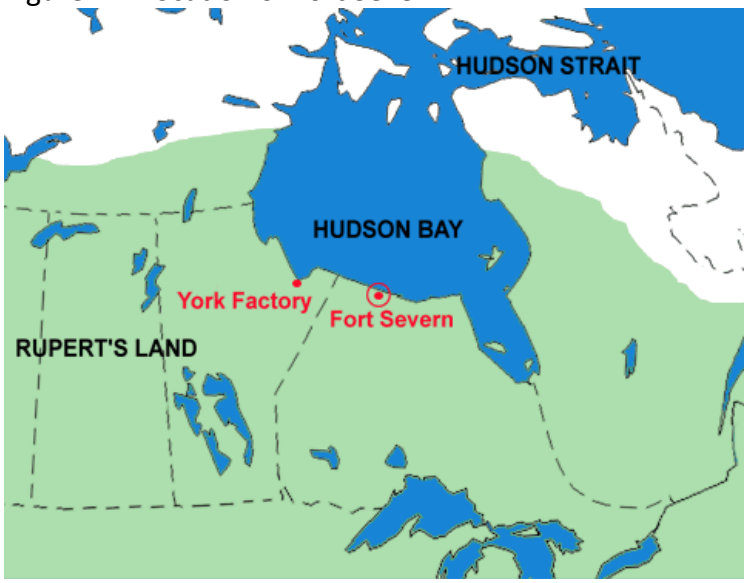
now covers three dispersed Aboriginal communities in Canada which each control their own links and related ICT assets in their indigenous regions.

O'Donnell observes that indigenous clients of the video conference system display an age reversal with younger people more willing to work with this technology verses the older residents being somewhat resistant to change and less willing to use, or participate as subjects in the video technology. The authors restate their earlier point, that certain stakeholders in (nearby as well as distant) urban centres neither appreciate nor have video conferencing capabilities. As well, there seems to be little if any movement afoot to resolve this situation. At the local scene, video communication champions played an important role in supporting local use and ensuring proper Quality of Service for the transmitted signals. Despite the need for champions and assertive types to support video conferencing, the authors recognize that the aboriginal people do not promote themselves or show off their talents, preferring to remain "one of the crowd" rather than being individually recognised for their efforts. This feature to their culture dampens certain ICT results at times when champions could improve outcomes.

In a unique research paper from the K-Net project, "A history of everyday communication by community members of Fort Severn First Nation: from hand deliveries to virtual pokes", Gibson et al [49] cover a special case in Fort Severn Washaho Cree Nation (Figure 27). Community considerations suggest that ICT services should benefit all. As a result, this indigenous community has partnered with six others in the K-Net project, which is non-profit

and community owned. Fort Severn pursues the principles of OCAP - Ownership, Control, Access and Possession. Rather than being burdened by the term “The Last Mile,” this community has followed the UN Declaration on the Rights of Indigenous Peoples (and adopted by Canada in 2010) and taken a new ICT policy development route – that of the “First Mile.” This approach suggests a holistic implementation policy, and a careful consideration of the technology opportunities. As various appropriate technologies have become available since the 1970 to the Fort Severn area, there has been excellent local interest in supporting ICT projects.

Figure 27: Location of Fort Severn



Source: bcheritage.ca

The Fort Severn community has now built up local communications infrastructure such that it has a local cellular network which is uplinked via satellite to the K-Net network in Sioux Lookout. Broadband is also available to 70 community homes, elementary school, high school, administrative offices, and health offices. As a result, when surveyed, 85 percent of the local people indicated that they had used the internet in the past week of the survey. But

at the same time, only 43 percent of the same population had a computer at home. This indicates that most likely a large portion of the population use school or work place computers. Adding to the purpose of connectivity – Web 2.0 products such as Facebook are used by 78 percent of the community - at least once a week. That product has also provided evidence of the need to address cyber-bullying within the community. Video conferencing is only used by about 8 percent of the community on a weekly basis and provides further context to the earlier research papers in this section by O'Donnell and others.

Gibson et al, provide some contrasting ideas from their long term research activities in this region. Time management and distraction have been identified as consequences of the internet, which diverts users from their traditional pursuits. However, the support that these new ICT tools provide, such as GPS and cell services in isolated locations, are deemed to be a significant benefit, particularly in regards to personal and public safety. Language issues have however occurred with the introduction of new ICT tools, with participants noting that the use of Cree in daily conversations has decreased. Overall, these and previous authors, point to unique digital divide solutions in challenging regions.

A final case for Canada is presented by Graham et al [50] in "Re-connect Canada: A Community-based e-development Strategy", which examines the lack of progress in addressing e-development policies. The researchers note that several programs that have sunsetted and with no new initiatives on the horizon, the ICT deployment area is becoming "stuck in the snow." The authors take issue with the telecoms, claiming that they have obstructed structural reforms in the telecommunications area with the result being

significantly less investment in telecommunications infrastructure. A series of ICT government programs are catalogued, all of which sunset about 2006, with no new replacements or program refinancing's. The authors suggests that this signals a change in government direction, as E-leadership has not been institutionalized at any point, nor is there any residual interest in government departments to build on that theme. The CANARIE program which deployed high speed optical-fibre networks for research institutions and other organizations throughout Canada is another example of programs discussed by the authors. These investments are viewed as considerable and necessary federal investments in support of the research community. The K-Net and Atlantic Help Desk projects (covered earlier in this section) have been both direct and indirect recipients of these special initiatives which were aimed at developing network-based services for Aboriginal communities.

To conclude, the author points out that Canada is becoming a fully-wired country and that its economy is now internet-based, hence the need to investigate and invest in future directions. One particular program which has supported the resolution of the digital divide in Canada is the Community Access Program. CAP has provided computers and help services in community locations throughout Canada. In Winnipeg, for instance, there are several of such CAP locations in the city's core area which have been largely oriented towards supporting Aboriginal people of all ages who cannot afford to purchase or maintain their own computers. The computers are used for job finding, Web 2.0 applications, and gaming as well as for connecting the urban Aboriginal diaspora with itself and its roots in the First Nation communities. The original CAP program ended in March 2006, but the former CAP locations

are now still operated by their hosts on a minimal budget as they struggle with maintaining those highly used and obsolete assets.

While cities are served with broadband services in Canada, rural and remote regions are still lagging behind. The impetus to make the necessary adjustments in these regions, the authors believe, needs to come from the federal government, as some of these service areas are not economical for the telecoms to support. Finally, the authors conclude that Internet policy is about socioeconomics and not technology. And while politicians and public servants continue to offload regulatory policies related to these matters, the citizens' indifference allows this state to persist, despite their own increased reliance on digital technologies in their occupations.

Lowen et al [51] in "The Need for Technological Innovations for Indigenous Knowledge Transfer in Culturally Inclusive Education", addresses the issue of disappearing Indigenous Knowledge as many indigenous people are still living in their own communities. The authors' solution proposes a four-part process which begins with a participatory design that creates a set of descriptors of the information to be stored. In the next step, an ontological definition of the knowledge is provided which will enable its retrieval at a later time and by other users. This step recognizes that unique indigenous cultures have their proprietary knowledge systems. Exemplary evidence for this claim is found in an aboriginal costal community in Canada, the Haida. The point of this second step is to enable the content to be reusable, interchangeable and interoperable. The third step deals with the creation of learning objects allowing educational modules to be built and reused. The last step of this process provides

integration with standard learning platforms and providing access to community members, via ICT tools. As a last point, Lowen and his colleagues make the case for a system of such qualities that would bridge the gap between the remote- rural indigenous communities, while providing authentic learning. It should be noted that this model was only a proposal, and so far no attempt has been made to develop a working solution.

As a last research case in this section, Qureshi et al [52] in "Transcending the Digital Divide: A Framing Analysis of Information and Communication Technologies News in Native American Tribal Newspapers", address the broader topic of the digital divide using a framing analysis that examines the newspapers of 561 Native American Tribes. The authors start their inquiry by asking a significant question: they want to know how ICT's may bring about sustained development, when in fact the American Indians are amongst the sickest, poorest and least educated in America. The population of reference here is over 4 million Native Americans, of whom 32 percent live in the three states of Oklahoma, Arizona and California. While their essay is focused on the digital divide, it reminds us that 60 percent of Native communities, as recently as 2003, were experiencing a dial tone divide, that is, lacking basic phone services. Even today, over 90 percent of tribal populations lack high speed internet. According to their research, ICT is seen as an empowering element by tribal members and tribes who are taking control of their ICT's as a basic premise to achieving their own destinies. The authors conclude with the comment that ICT and New Media should be cooperatively developed so that they reflect communal views and values.

Table 8 provides a review of the digital divide elements for North America. Authors all identify and discuss most of the digital divide elements in their research work. The purpose of connectivity (DD#1) for the largest part considers communities. Demographic and related characteristics of connectivity (DD#2) are identified to be largely rural and poor indigenous people. Connectivity (DD#3) is accomplished via very sophisticated systems such as satellite and fibre linkages; however some mobile and otherwise fixed systems are identified. Pervasiveness of the connectivity (DD#4) shows access with a high degree of interactivity – with video systems being used. The purpose of connectivity (DD#5) is found to be wide ranging from community building, mapping of indigenous regions, creating new public policy, communications with membership, and the creation and retrieval of learning objects.

Table 8: Digital Divide Elements Considered for North America

Paper by:	DD #1	DD #2	DD #3	DD #4	DD #5
Smith et al [46]	yes	yes	yes	yes	yes
O'Donnell et al [47]	yes	yes	yes	yes	yes
O'Donnell et al [48]	yes	yes	yes	yes	yes
Gibson et al [49]	yes	yes	yes	yes	yes
Graham et al [50]	yes	yes	yes	yes	yes
Lowen et al [51]	yes	yes			yes
Qureshi et al [52]	yes	yes	yes	yes	yes
Totals	**7**	**7**	**6**	**6**	**7**

Asia

In this section, 10 papers which address digital divide in the context of Asia are reviewed. There are two particular geographic regions discussed within the considerable continent of Asia – East Asia and SW Asia. Of the 10 papers found, 3 were focused on Taiwan, 6 were focused on Malaysia and 1 was focused on the Mid-East. The papers are presented in this same order with subtitles to maintain the regional geographic context.

Taiwan

The first paper by Chung et al [53], "An Comparative Analysis of the Current Status of Digital Divide in Taiwan", identifies the three different concepts which comprise the digital divide. These are the global divide, the social divide and the democratic divide. This structure has a top down impact flowing from the state to the society and then to the individual. Taiwan (Figure 28) ranks very highly in the digital opportunity index. With a high digital opportunity index it indicates that internet access is readily achieved, if so desired. The authors participated in a state-supported research project involving aboriginal people in rural areas and aboriginal areas. Their research examined the aboriginal people's personal digital divide by evaluating information access, information literacy and information application. As well, comparisons between the periods of 2005 vs. 2009 were made for the current survey. The four-year span seems especially relevant as it allows for an entirely new generation of related technology to emerge, largely wireless and smartphone technologies. Through their work, the researchers have been able to provide quite granular data and are able to gauge a modest increase in computer/internet access rates to above 50 percent rate. Despite these improved

findings, the researchers are aware that these ICT penetration rates are below the national average. Significant age discrepancy is observed here with over 90 per cent of young aboriginal people (<30 years old) accessing the internet versus only 30 percent for the 50 – 60 year old age group. This access rate dropped even further down to 8 percent for those above the age of 60. In this case the researchers make a comparison here to US internet access rates for over 60 year olds, which is significantly higher at about 30 percent. Educational differences were also very clear, with 95 percent of aboriginal people with a university education accessing the internet, as opposed to only 15 percent for those with only an elementary education. Internet use shows a high access to blogs (web 2.0) and a growing access to electronic commerce and electronic banking activity. The survey indicates that disabilities significantly hamper access to the internet due to the absence of functional user interfaces with visual impairment considered to be a key barrier. As a conclusion, the authors argue that the less educated among those over the age of 40 who live in less urbanized locations are more prone to be disadvantaged by way of the digital divide. One last key factor which limited access to the internet is the ability to read English, as only 55 percent of the overall targeted population in Taiwan can read English.

Figure 28: Taiwan

Source: Google Maps

The author's recommendations are made in reverse order, suggesting that English be made a critical factor to enable the Taiwanese economy to compete globally. Government is also encouraged to provide "one-stop" window services, through web portals, so that citizens can more easily access government services, and in the process increase public service efficiency. A general call for assistance is also made to help aboriginal families which have no computer at home. Lastly, a consideration for social justice is raised to ensure the participation of aboriginal people in Taiwan's digital economy.

The creation of a unique digital archive to preserve a traditional musical instrument is investigated by Ming-Chou et al [54] in "Digital Archives of Video Cases: Inherited Learning in Aboriginal Artistry". This case deals with knowledge transfer in making a musical instrument, a Jaw's Harp. In this case the information created is added to a digital archive to preserve the knowledge for the future. The authors created a Jaw's Harp and a learning

system for that instrument, which is created and played by the Truku people of Taiwan. This is a relatively small aboriginal group with a population around 25,000 who live in the North East part of Taiwan (Figure 29).

Figure 29: General Distribution of the Indigenous People of Taiwan, with reference to Truku people.

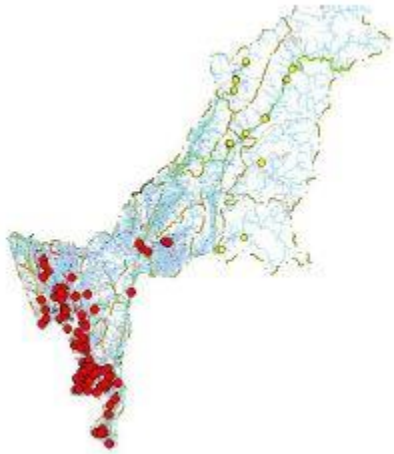
Source: commons.wikimedia.org

Ming-Chou et al prepared a 12-hour instructional program for 73 young aboriginal people as participants. The project aimed to test traditional instruction versus a web supported programme. One group of students were given access to supplemental training which was internet-based and which had been prepared by the researcher and aboriginal elders. The other group served as the control group and were provided typical classroom instruction. The digital archives that were created were comprised of a set of video and text files, a management system and an interface system. Users were able to navigate through the instructional pieces to review the more difficult and challenging lessons. After concluding the course, both groups of students were evaluated by a questionnaire, and in some cases by interviews as well. At least one group of students needed be computer literate at the onset to

properly complete the course. Thanks to this project, archival preservation of making a traditional instrument was accomplished. The participants in this case were aboriginal students only, and the web-mediated course proved to be a superior teaching product than the traditional textbook, PowerPoint and verbal instruction. The researchers conclude that the web-based traditional instruments workshop project has a great potential for preserving other traditional, and possibly extinct, musical instruments.

Building a national wireless system with inclusion for indigenous peoples is addressed in a paper by Chui et al [55] entitled "Kaohsiung County Broadband Mobile Network". This study presents the deployment of a $1.2 billion investment into national infrastructure for wireless communications in Taiwan (Figure 30). For the majority of the deployment, a WiMAX wireless system used over 90 base stations. In the remote regions, home to certain indigenous groups which included the three townships of Sanmim, Maolin, and Taoyuan, a Wi-Fi system was used. Backhaul was accomplished principally via fibre optic links. Considerable attention was paid during the development of this infrastructure program to implementing VoIP technology and supporting economic development, and including the rural regions.

Figure 30: WiMAX and Wi-Fi deployment in Taiwan



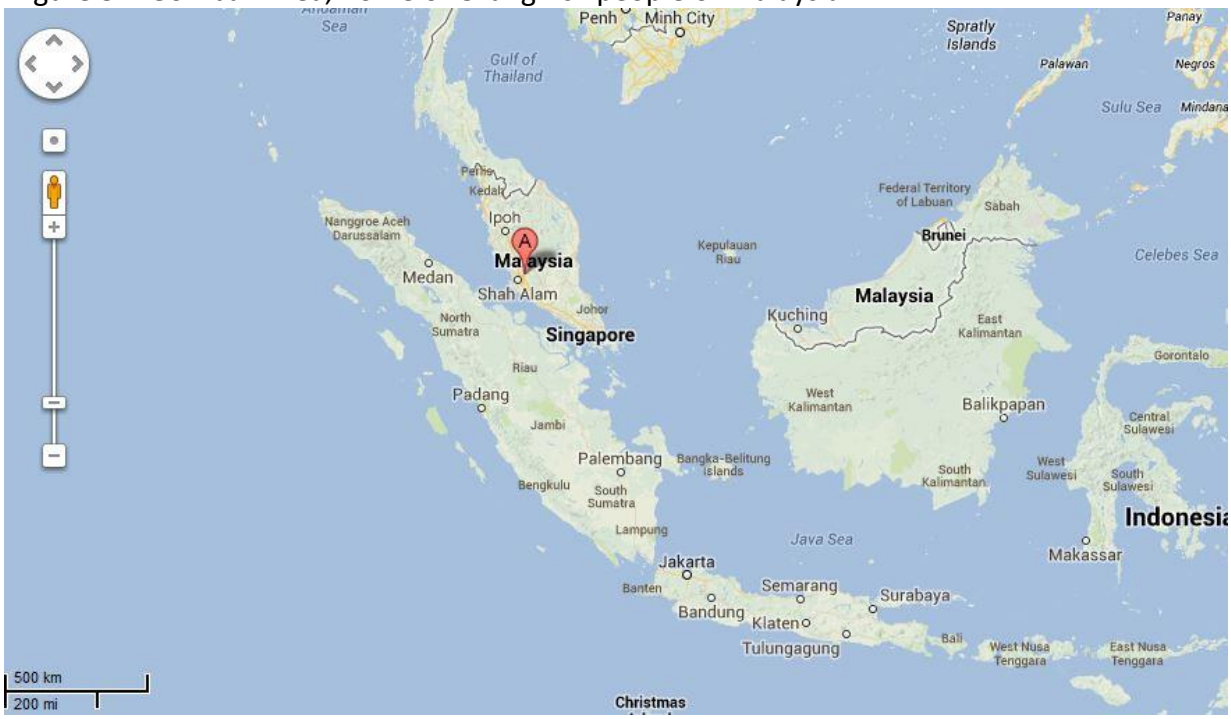
Source: c.f. Chiu
Notes: Red dots on this map denote a WiMAX deployment in the southern populated regions, while the yellow dots denote Wi-Fi deployment in the rural townships.

The rural deployments are centred within the local government structures which typically include the police station, administration buildings, schools and health facilities. Occupational patterns reveal that the parents often leave the rural regions for periods of time to go to the coastal regions and larger centres to pursue employment. Village residents remaining behind, can now access these Wi-Fi links for purposes of e-learning, internet access, job seeking, and communicating with distant family members. The structure of the wireless and the webpage levels are highly oriented at mobile services, and this includes both access management and building of materials for mobile learning as well as mobile government access. Chui and his colleagues are not able to estimate the technology take-up for the indigenous people. The estimate for the national coverage, however, is given at 79 percent in the WiMAX areas. Problems are identified with setting up more towers in rural locations: local resistance to the establishment of these towers persists due to the perception that radio waves represent a health hazard.

Malaysia

The Malaysian government has proposed a digital inclusion project which has been studied by Ahlan el al [56] in “The ICT Social Inclusion among Orang Asli Community in Gombak Area”. In this case, the authors are interested in the indigenous Orang Asli which number 148,000 people. This culture is comprised of 18 subgroups representing a diversity of subcultures within itself. For purposes of this study the researchers chose one particular location that is quite different from the indigenous traditional territories. An urban community of Orang Asli in the Gombak Area is surveyed (Figure 31).

Figure 31: Gombak Area, home of Orang Asli people of Malaysia



Source: Google Maps

In general, the authors find that the Orang Asli use the internet and computers for a range of purposes, such as texting, emailing, downloading and e-commerce. The authors’ primary purpose for this study was to define how Orang Asli school children were accessing the

internet and therefor they devised a survey to gather this information from a sample size of 55 students, ranging in age from 10 – 18 years of age. Of the responses provided only 1 student was able to access a computer at home while the rest of the students accessed computers via school or a cyber café. The access rate found was surprising as half of the surveyed students only accessed the internet once a week. When the students were interviewed regarding the frequency of their internet access, for such purposes as texting, email, homework, gaming, educational pursuits, and planning of advanced education, about half or more of the answers were "Never". This indicates an early-days view of the internet, with very few users and very limited access to ICT technologies. The researcher suggests that more computer deployment is needed here, including the provision of computers for home use. One last recommendation is made to add a server system and thin client computer to an Orang Asli community library, from which it would be possible to further observe computer usage. A recommendation is made for further research and the inclusion of other Orang Asli areas and territories.

A broader ICT literacy program is investigated by Malek et al [57] in their paper "The Digital Social Impact in ICT Literacy Program for Rural Community" which takes place in the rural state of Petrak, Malaysia (Figure 32). In this study, almost 600 people completed questionnaires regarding their ICT use. The survey was preceded with a regional computer training program that was provided over a period of several years in areas where internet connectivity was available. The population surveyed was ultimately very skewed with 75 percent of the respondents being between 12 and 17 years of age. According to the survey

results, almost all of the respondents used the computer for chatting, entertainment, gaming, software downloading, and current cultural exchanges. The survey indicated that a positive attitude existed regarding ICT resources and the training program itself. However, other evidence indicated that only about 10% of the region was computer literate after the training program. The authors recommend the provision of a more extensive internet service to this rural area, given the positive responses that were garnered.

Figure 32: Perak Region and Mapping of Indigenous Malaysian Peoples – Peninsular Malaysia

Source: egagah.blogspot.ca

A much more refined survey was conducted by Hashim et al [58] in "Assessing Digital Literacy among the Semai Tribe of Perak, Malaysia" which distributed a series of 40 questionnaires to a Semai Tribe in Perak, Malaysia. This research followed a dictate by the federal government to close the digital divide by 2010 in that nation and with the aim to transform the Malaysian economy to a knowledge economy by 2020. The government's policies were meant to be inclusive, and the authors in this study, as well as others, have indicated that little research

has been focused on the indigenous people. Moreover, the researchers emphasized that rural and remote areas were significantly disadvantaged when it came to digital inclusion.

Hashim's survey findings indicated that 31 percent of this tribe had never gone to school, and only 5 percent had completed high school (i.e. Form 6). The survey results also indicated an extremely low level of computer literacy (about 5 percent) for such applications as email use, word processing, computer hardware, mouse use, internet surfing, and search engine use. The authors recommend that computer training be provided to this tribe, regardless of their lack of education with the belief that learning will be engendered through the use of ICT devices. The authors also encourage the local government to engage in supporting this development.

Hashim et al [59] in a further work, "Digital inclusion among the indigenous people (Orang Asli Semai) of Perak, Malaysia" once again address the question of digital inclusion. In this case, the discussion begins with introducing Malaysia's National Broadband Initiative which has as its objective a 50 percent penetration rate as opposed to the current 33 percent penetration. The authors return to their previous data set indicating that only 5 percent of the surveyed population has ICT skills and that these skills are undermined by a lack of education. The authors recommend a change champion that will advance education and economic inclusion as a means of bridging the digital divide.

In “Application of GIS in Orang Asli community profiling,” Hamsan et al [60] propose the deployment of GIS applications to support the development of an Orang Asli community. This team of researchers studied a large group of 800 people from 9 Orang Asli villages in the Malaysian peninsula. Of interest to the study were five factors: human capital, social capital, economic capital, infrastructure and natural capital. Core to this project is a map building process that involved the village representatives. The indigenous community’s representatives were consulted throughout, particularly for the verification of the final village map. In the final stage, the digital map was made available to the communities for their strategic planning activities. The authors conclude by confirming that GIS assists the community by also being capable of presenting social information which can be used for the community and for local development planning.

Interested in the use of technology to preserve indigenous languages, Juan et al [61] present a unique proposal in “Adopting Malay Syllable Structure for Syllable Based Speech Synthesizer for Iban and Bidayuh languages”. The authors’ focus is on two major languages the - Iban and Bidayuh languages, which are the major indigenous languages of Malaysia. They propose a Text To Speech (TTS) system for these two languages. Through this project the authors propose to address the problem of loss of indigenous languages by using ICT to maintain these languages in the current era. Of the 46 known languages in Sarawak (Figure 33), only 44 are living languages, with 2 having no known speakers. These 44 living languages are largely practised in the rural tribal areas. The researchers indicate that some of these languages are also not scripted. They argue that if a TTS system is developed it could also benefit the visually

impaired, those needing speech therapy and those suffering from dyslexia. The base language for this project was the Malay language, which is related to the two indigenous languages. Considerable software related to speech development has already been developed in Malay and was purposed to this project.

Experimental results in the first version of the TTS indicated that 74 percent and 90 percent of the syllable lists comparisons between natural speakers and synthetic speech were similar for Bidayuh and Iban, respectively. In the categorical estimation of the TTS project, the listeners scored a mean of 3.1 on a 5 Likert point scale for each of the two languages for subjective measures such as pronunciation, distinctness, naturalness of speech and intelligibility. The authors conclude that their project needs improvement in certain areas of TTS. Most importantly though for this project, the authors provided a working proof-of-concept for their ideas.

Figure 33: Sarawak – Eastern Malaysia (island of Borneo)

Source: www.malaysiamap.org

SW - Asia

The last case study on the Asian indigenous world addresses the issue in the Kurdish community. Sheyholislami [62], in “Identity, language, and new media: the Kurdish case”, provides an interesting research perspective. The case of the Kurdish indigenous community presents a complex situation, for Kurds are spread across five countries and have a variety of linguistic identities that include different alphabets added to many dialects (Figure 34). Their status varies from country to country: in one or two they have an official status; in others they are either barely tolerated or suppressed and subjected to linguicide. Kurds were not able to communicate for over a century due to geopolitical events, and their lack of a common written/spoken language has added to challenges of illiteracy. The total Kurdish population is today estimated to be about 30 million among whom poverty is common. This group also represents the largest indigenous population covered in this essay. The Kurdish language is comprised of three main dialects and two minor dialects. Many regional dialects are also spoken which altogether make a total of 45 languages and dialects practised by the Kurdish communities.

Figure 34: Kurdish Inhabited areas, Western Asia

Source: http://www.washingtonpost.com/wp-srv/inatl/daily/feb99/kurdprofile.htm

The Kurdish identity recognized traditionally through their lands, known as Kurdistan, was only rebuilt and reemphasized through access to ICT resources since the 90's. The introduction of over a dozen satellite TV channels, thousands of websites, chat rooms, weblogs and social networking sites has begun the process of connecting these people to a their unique culture.

To support the Kurdish people with access to the digital world, several development initiatives were needed. Firstly, Internet Service Provider (ISP) services had to be secured by working through certain political challenges. Secondly, Kurdish fonts had to be developed which had to follow either Arabic or Latin-based fonts. The quintessential feature of the Kurdish language, identity and culture is that they are not homogenous entities. Access to some of these new ICT and digital resources is monitored by host states which mandate that taboo subjects need to be avoided. This is particularly the case for the TV broadcasters who are given some degree of support from their governing states. The causes of digital divide are two-fold in this context; firstly limited access to ICT resources and secondly, the impositions of state censorship on digital content. Despite these access and censorship challenges, information exchange and discourse amongst Kurds have been enabled with ICT technologies.

The author's research demonstrates that considerable TV programing has been dedicated to the history and demography of Kurdistan, giving rise to the promotion of Kurdish identity in the regional areas. But as many Kurds have also left the region, the reengagement of this diaspora provides certain leverage and opportunity to advance political arguments that are essentially novel to the community. Language diversity is supported and encouraged through various speakers on TV, although it has been noticed at times that these speakers at times do not understand one another due to the differences in their local dialects. The author concludes by pointing out that the Kurdish case provides an example of working through the digital divide to build a pluralistic, multilingual cultural identity.

In Table 9 a review of the digital divide elements for Asia are presented. Authors here discuss most of the digital divide elements in their research work. The purpose of connectivity (DD#1) for the largest part considers individuals – youth and adults and their communities. Demographic and related characteristics of connectivity (DD#2) are identified for the first time to be age related with youth more conversant with the technology and the older adults not participating in ICT's. Some urban discussion is generated in this research, however much of it is rural based research. Connectivity (DD#3) is accomplished via the traditional fixed PC's and broadband, however considerable discussion is raised for mobile systems using Wi-Fi and WiMAX. One unique case of digital satellite TV is identified. Pervasiveness of the connectivity (DD#4) shows access with a large amount of retrieval with some dialogue and interactivity. The purpose of connectivity (DD#5) is found to be wide ranging just as Asia is a vast region of the globe. Education, web 2.0, governmental imperatives and investments are identified along with the typical recreational and social elements. Cultural interests are presented as well such as creating an indigenous musical instrument, building a Test-To-Speech system to preserve indigenous languages and using GIS for community planning activities.

Table 9: Digital Divide Elements Considered for Asia

Paper by:	DD #1	DD #2	DD #3	DD #4	DD #5
Chung et al [53]	yes	yes	yes	yes	yes
Ming-Chou et al [54]	yes	yes	yes	yes	yes
Chui et al [55]	yes	yes	yes	yes	yes
Ahlan el al [56]	yes	yes	yes	yes	yes
Malek et al [57]	yes	yes	yes	yes	yes
Hashim et al [58]	yes	yes			
Hashim et al [59]	yes	yes			yes
Hamsan et al [60]	yes	yes	yes		yes
Juan et al [61]	yes	yes	yes	yes	yes
Sheyholislami [62]	yes	yes	yes	yes	yes
Totals	**10**	**10**	**8**	**7**	**9**

Global

Under this category, I review papers which spanned their work over several continents and did not limit their discussions to a specific geography. Of particular interest are observations on the O3b (Other 3 billion) satellite project and mobile computing. Seven studies are covered in this section which traverses the globe on the subject of digital divide, while at times adopting a more specific approach as the studies point to certain nations or situations.

The first of these papers is by Roy et al [63] in "The Relationship Of Technology, Culture, And Demography". This researcher's studies cover Hawaii, Australia, Continental USA and elsewhere. The authors consider the positive engagement of indigenous culture and technology but also comments:

> "Technology has contributed both to the loss of indigenous culture and empowered indigenous peoples to create their own culturally relevant content."

On the one hand, the digital age to indigenous elders can be seen as a warping of temporal relationships and events. What took a long time to explain or prove can now be digitally reproduced very quickly. Also, impostors can create messages in the IT realm which cannot be readily challenged or verified; therefore, accurate message exchange can represent a challenge. Thus IT technologies can alter communication and knowledge construction for indigenous cultures.

On the other hand, Indigenous culture is also enhanced through the use of ICT. For instance, cultural content can now also be created, developed, supported, and understood without message degradation or dilution.

Two particular examples are discussed in Roys' research, cartography and language preservation. Cartography, mapping, and GIS are represented by the author as a means to pass on knowledge of places. Places can now be referenced by their indigenous names, which would otherwise be lost or excluded. Oral knowledge can also be transferred through GIS technologies, especially in school-like settings, thereby blending the old and the new ways.

Language preservation is another advantage of IT. This is made possible through the use of audio/video programming and the development of online content. Corollary to the linguistic impact is the practise of story-telling which helps preserve lessons and cultural information deemed important by the elders. Several examples are provided in which, authors have engaged tribal leadership, elders in particular, to obtain permission and thereby establish boundaries on what can be said and on how it can be said.

Using the digital divide questions from pg. 35 and applying them to this study, the subjects at the granular level included elders, school age children and tribal leaders. At a higher level, communal organizations are consulted and studied. Connectivity is not addressed in this paper; it is presumed to be straightforward desktop technology with internet access and certain software. Intensity of connectivity was focused on retrieval of cultural messages, as

well as the development of storytelling and language arts. The primary purpose of a digital connection in this project was to create opportunities for indigenous peoples to learn their languages and inform themselves about their culture. The paper closes with a reaffirmation of the role of IT technologies in providing solutions for digital divide challenges in the indigenous world.

Keengwe et al [64] in "Factors influencing technology planning in developing countries: A literature review" approach the broader topic of technology planning in developing countries, with emphasis on educational support. Keengwe and colleagues point out that ICT development in developing countries is influenced by both internal and external factors. Internal challenges include the price (or affordability) of the technology, low quality of services offered by the technology providers and the priorities of the sponsoring agencies. The undesirable results are a range of unsustainable ICT programs, emerging uncoordinated ICT projects, and the dominance of the English language in the software. External factors have a lot to do with external organizations' pressures on the developing counties, global ICT viewpoints and the perspectives of technology providers, especially multinational corporations. The opportunities from external factors are the support of democratic practises, human resource development, alleviation of poverty, and the development of developing countries into viable markets for ICT's

The author's identify that support for developing countries' ICT programs often comes through foreign aid, which has an internal planning process typically led by the sponsoring

country. The role of rural and indigenous communities in this context is a passive one, they are most likely added into the deliverables package through various UN and NGO policies. These ICT policies are at times seen to be distracting or diverting of support and funds which may be otherwise spent on poverty eradication, educational systems development and similar social development projects. Host countries' ability to develop their own ICT policies are seen to be lagging in that their policies are only developed after the sponsor's programs are implemented. This type of programming now creates a sustainability issue, as the ongoing costs of maintenance are highly human derived and the ongoing program requirements are not fully understood. The technology providers are faulted by the authors for providing a particular solution without necessarily understanding the local conditions. One of the resulting challenges is that users and ICT teachers with English literacy and some level of proficiency are needed to understand the instruction set and the provided technology's interface. Most often there is little or no capability in the implementation team to work in the indigenous languages. Schools take a big brunt of these limitations, for while their curriculum is devised by the host country, the ICT technology which is provided is developed and influenced by external organizations from another country. This creates a gap in knowledge transfer and leads eventually to a sustainability challenge.

Wresch [65] in "Progress on the global digital divide: an ethical perspective based on Amartya Sen's capabilities model," provides another outlook onto the digital divide in the developing world. He notes that Latin America has an internet access ratio of 50-80 per 1000, while some parts of Africa show an access rate of only 2 users per 1000 individuals, compared to the

developed world which has over 500 people connected to the web among every 1000 people. A further point is made with a particular focus on webpages accessible to developing nations. Wresch indicates that there are two limitations here: first, that some of the information provided through these webpages is not necessarily related to the needs of developing countries; second that the number of websites in these countries is correspondingly very low. As an example he indicates that the ratio of population in US to the number of websites is about 6:1, while in certain developing countries this ratio is in excess of 100,000:1 (circa 2004). These ratios indicate an abundance of western world, English language webpages and a dearth of non-English, local language based webpages. It is noted that the annual growth rate in the number of the websites in the developing world is increasing very quickly with annual compound rates of about 15 - 20%, however while the developing world is building websites, so too is the developing world increasing its website count. A similar argument on the value of websites as information sources, as well as the low ratio of websites to users may be made for the global indigenous peoples. For instance, Dyson et al [66] estimate that Australia has about 400 indigenous based websites in 2001, which when compared to an indigenous population of about 450,000 gives the population to websites ratio of about 1000:1. In the USA, NativeSeek.com has identified about 400 websites of indigenous origin [67] (circa 2013), which support a population of 2.9 million Native Americans leading to a 7000:1 ratio. As websites are deemed as both sources of information as well as venues for cultural exchange, the minimal number of websites for indigenous people's points to the need to focus on and support these developments.

Evans et al [68] in “Symposium: ICT4D and the Learning Sciences,” are interested in how indigenous knowledge could be incorporated into the classroom with teachers using mobile technology. Worldwide, the ratio of mobile devices to computers (circa 2008) is indicated to be in the order of between 5 to 1 and 10 to 1. This outnumbering of computers by mobile devices is explained by the fact that mobile devices are less energy intensive compared to laptops or desktops. Other factors such as a reduced price, technology robustness and improved capability would seem to be important as well. Evans et al further argue that mobile devices can serve as learning tools by being push devices onto which learning materials can be sent. As well, mobile devices can be used anywhere, and more importantly after school hours. According to them, this approach may overcome the motivational barriers for learning. Learning, it is suggested, could be also be reinforced through MMS and SMS messaging and by feedback from the learner.

Another example of reengineering teaching is suggested by Evans et al. The researchers propose that the enhancement of scientific knowledge about sustainable agriculture is of import to three regions: Asia, Africa and the Middle East. The authors suggest that the influence of western science is compartmentalized and separated from culture and related environments. As a result, the students and teachers are now estranged from the topic of science. Instead, the authors propose that elementary schools make use of indigenous knowledge to create living archives to support their teaching programs. It is suggested that these instructional assets be comprised of websites and 2.0 technologies.

Hilbert [69] in "The end justifies the definition: The manifold outlooks on the digital divide and their practical usefulness for policy-making," reviews the alternative digital divide policies of Chile, South Korea and the United States. He provides evidence that different approaches towards the digital divide are taken, each with sound reasoning from the host nation. Despite these differences, state-derived digital divide policies are considered to be important, as perhaps specific desired effects are being pursued in each nation. Three categories determine the author's definition of the digital divide and the scope of application for the term:

> *"…technologies that transmit and communicate information (the movement of information through space); technologies that store information (the movement of information through time); and technologies that compute information (the transformation of information)*

Hilbert argues that when it comes to the mobile phone, the gap in digital divide is rapidly closing. With respect to broadband technology, however, that same gap is widening because while a noticeable acceleration in broadband adoption is taking place in certain population segments, the same is missing in the case of others. At the time this paper was written, (i.e. before the introduction of the iPhone in 2007), this seemed to be a reasonable perspective. However, the combination of telecommunications, data transformation and storage capabilities in smartphone technology seriously questions this approach, especially in that currently smartphones constitute 90 percent of the global sale of mobile phones [70].

Hilbert identifies income and education as the key indicators for the acceptance of digital technologies. Research indicates that in Latin America, for instance, the threshold for ICT affordability is $10/month (or $120/yr.). This presents a challenge for 40 percent of the world

population which lives on $2 US per day and cannot afford to spend such a high proportion of their income on ICT services. The author however suggests that a price level of $1.80 per month is all that this group of low income people can afford to spend on ICT services, which is considerably less than the affordability threshold indicated earlier. To accomplish these low cost ICT services, cheap mobile phones will be needed. Furthermore, the focus of placing computer technologies in schools would be a significant effort at supporting the diffusion of ICT. Indigenous peoples would be amongst the beneficiaries of these digital divide investments. In the US, the Federal Communications Commission manages $8 billion annually to fight the digital divide. Despite these programs, both government and NPO sources confirm that 90 percent of tribal areas do not have access to high–speed internet, and where this access is available, the usage rates are as low as 5 percent. [71]

Digital Activism is considered by Elwood et al [72] in "New spatial media, new knowledge politics." The role of blogs and social networking regarding electoral and protest politics is considered, with indigenous people as an area of research interest. The new web instruments (blogs and social networks) are defined as "weak ties" which are created to facilitate communications. Users have redefined these web 2.0 technologies, and now it is clear that increased access to the internet, as demonstrated in this research, is positively related to increased anti-government protests. In Canada, the "Idle No More" movement is an example where aboriginal people use social media to organize and build a protest movement, in an effort at holding their federal government accountable. The authors make a second suggestion that participatory GIS can also be used in this way too, to enable communities to

define their needs and to rebut government plans. Lastly, the authors argue that for these new technologies (blogs and social networks) to demonstrate their effectiveness, they need to be more actively deployed and transformative rather than passively receiving and passing content.

As a last paper in the Global section, Resta et al [73] in "Issues And Challenges Related To Digital Equity," present some ideas about information access, artifact identification, and investment limits respecting the digital divide. The authors point to the exponential growth of information and the doubling of all knowledge every 2 – 3 years, which is paralleled by the information available on the internet. While information is doubling, illiteracy persists at about 15 percent for men and 25 percent for women across the globe. Therefore, resolving the digital divide will require assets, access and education, amongst other supports. Having come this far in identifying the necessity of ICTs for social and economic growth, there is no return on investment (ROI) data providing such proof. It is doubtful that an ROI argument could be made in the first place that could ever be understood in a government setting, given that needs and outcomes of digital divide policies are largely social-based.

The study of the issue of access and information quality follows the above discussion. While the accessible web provides 167 terabytes of information, the deep web, which represents parts of the web that are inaccessible to search engines contains 91,000 terabytes of information. To wit, this information is by far (68 percent) written in English. When the European, Japanese, Chinese and Korean languages are added to that sum, less than

5 percent of this web information is in “other” languages. Indigenous languages are part of this last category; therefor, these languages need the internet in order to support their preservation. Projects involving creation of content in local indigenous languages are at times urgency-based, due to their failing numbers of fluent speakers, and the urgent need to script these speakers’ knowledge before all is foregone. The authors conclude by stating that failing to move towards an information society will only result in greater social and economic exclusion.

While the internet is a source of knowledge, it is also recognized by Resta to be an opportunity for the repatriation of various elements. Indigenous historical articles are cited here and elsewhere in this essay as being misplaced. Indigenous peoples often call for a repatriation of these artifacts back to their homelands, both for display and at times for consignment to the earth. In this way, ICT assets support the identification, search and repatriation of ancestral articles, consistent with the indigenous people’s desires.

In Table 10 a review of the digital divide elements for the remaining Global papers are presented. Authors here discuss only some of the digital divide elements in their research work. The purpose of connectivity (DD#1) for the largest part considers individuals and their communities. Demographic and related characteristics of connectivity (DD#2) are identified to be elders, rural indigenous and with limited income. Connectivity (DD#3) is identified on only two papers as having mobile and broadband elements. Pervasiveness of the connectivity (DD#4) has limited discussion and centres around a few cases of retrieval and interactive

activity. The purpose of connectivity (DD#5) is however found to be highly policy based with a wide arrangement of topics which include: GIS community planning, language and culture preservation, public policy, foreign aid matters, teaching, social discourse, political action and the preservation of indigenous languages.

Table 10: Digital Divide Elements Considered for Global

Paper by:	DD #1	DD #2	DD #3	DD #4	DD #5
Roy et al [63]	yes	yes			yes
Keengwe et al [64]	yes	yes			yes
Wresch [65]	yes	yes		yes	yes
Evans et al [68]	yes	yes	yes	yes	yes
Hilbert [69]	yes	yes	yes		yes
Elwood et al [72]	yes				yes
Resta et al [73]	yes			yes	yes
Totals	**7**	**5**	**2**	**3**	**7**

CHAPTER V

Conclusions

The identification of indigenous peoples by continent provides a background and a set of distinct contexts to alternative circumstances regarding the Digital Divide. Conclusions drawn from these papers are drawn into this section, using the authors' own words. The following conclusions are now drawn from these papers, which comprised this systematic literature search.

Oceania and Australia

The need for telecommunications infrastructure, particularly for broadband, in developing regions, such as Oceania, is clearly evident. In fact, these regions face more substantial challenges than those in developing countries. In order for these island nations to compete in the global economy, affordable and reliable telecommunications services are necessary (Hudson [29]). Elsewhere it was shown that learning can be promoted through on-line services and that these services can be deployed in multicultural settings, such as with indigenous peoples (Iding et al [28]). Socioeconomic challenges underlie the digital divide to a considerable extent due to the affordability of services and lack of a population base. Technology is used to promote higher order thinking and critical evaluation skills so as to support students in the use of ICT.

In the case of Australia, one model indicated that the practice of using ICTs in everyday activities demonstrated that indigenous peoples would adopt ICTs in the household (Radoll [30]). Moving beyond the household, it was found that meaningful ICT strategies can

enable young people to respond to the complex challenges of contemporary life, without compromising their cultural heritage (Singleton et al [31]).Pilot studies were recommended by others to survey the digital divide as it exists in rural spaces, both among the indigenous and non-indigenous peoples. Following from the modelling developed, a broader based rollout of programs is considered (Mohammad et al [33]). It was suggested elsewhere that disparities in education, for instance, can be addressed through the education of Aboriginal students and teachers, based on gender equity in ICT technology and the individual skills which inform oneself in the technology (Mohammad [32]). In a broader context, ICT programs are shown to explicitly contribute to community well-being aspirations. Participants need to achieve a state of ICT comprehension such that they are able to actively participate in both social and educational contexts in their communities (Vaughan [34]). Lastly, with respect to archival information, the curation and management of this data is another challenge that needs more attention (Ormond-Parker et al [37]). These challenges can be supported through nationally distributed collections, community-generated protocols, and community-based management regimes. All of these would be supported within a national framework.

Africa

Case studies demonstrated the social effects of digital inclusion where digital archives were built by children as a means to improve public education and address social issues about HIV/AIDS (Khashman [38]). In another research project it was shown that ICT's are not able to penetrate the inner knowledge domain of some indigenous peoples (Toukam et al [40]). Certain IK will remain secret and unknown, such that while indigenous languages are being

codified, these elements will remain hidden from common view. Youth were demonstrated to be willing learners through ICT media where IK was embedded in videos narrated and overseen by community elders in their home villages. Elders and youth were able to relate to those representations which transferred IK at a distance with the elders remaining at home and the youth away at school (Rodil et al [41]). This last case demonstrated ICT adoption in its early stages with the introduction of mobile phones and the general interest in radio which delivers programming in the indigenous language (Okon [42]). Overall, considerable attention to IK and interest in support of indigenous languages was observed.

South America

From the three case research reports for this continent, it became evident that e-Inclusion is actively pursued in South America. Websites which gave governmental processes more visibility were seen at the municipal level to reduce the digital divide. A long-term program lasting 17 years traced the integration of computers into school curriculum and required considerable and sustained support from government". Here the education system was initially considerably challenged by the introduction of ICT technology and the required retraining of the teaching cohort (López-Bachiller et al [43]). A planned outcome of improving both ICT capability and student performance and scores was achieved. Two significant issues were raised: first, that ICT policy needs to be articulated together with other reform policies, and second, that local curriculum elements, particularly teaching indigenous languages, needed to be considered in these reforms (Sánchez et al [44]). Lastly, ICT's are seen to be contributing to the reduction of the political gap as Latin America is seen to need better

institutions for a better democracy. Developing appropriate participatory initiatives is not an easy task. At this time, the process of law making and budget presentation has been made available online, but the project of engaging citizens in local politics by encouraging them to voice their concerns and ask questions is still in unknown territory (Welp [45]).

North America

At least one research paper was available from all three nations of North America, thereby providing important and necessary coverage to this continent. In Mexico, the key objective of using GIS was to provide indigenous communities with geographic tools. Maps were produced which included the indigenous people's own information, and are now available to them to use as they see fit. Participation of local people in this process adds to the likelihood that research findings will be applied. Through these technologies, indigenous communities are empowered to generate their own maps to address their own problems and pursue their own dreams (Smith et al [46]). In the north, video technology projects in Canada have demonstrated the need for capacity building in the communities so as to use video communications technology effectively to meet community needs (O'Donnell et al [47]). A second and related theme is for urban organizations, government departments, and related institutions, to understand and validate the need for video communications in these communities. Adding the role of researchers to this mix, the authors concluded that R&D projects should be conducted in full collaborative partnerships with Indigenous organizations and communities (O'Donnell et al [48]). Another study, focusing on one specific community, demonstrated that ICT's are used as tools in reaching community goals and delivering

community services. Community members have found many benefits for using ICT in their daily lives, including facilitating tasks and administrative duties, connecting people with leaders and health professionals in other areas, keeping family members connected, accessing resources information and education, and using ICT to complement traditional knowledge when out on the land (Gibson et al [49]). The last case from Canada emphasizes a nation-wide position of “strategic elements” which comprise the Canadian identity: egalitarian, able to balance relations of individuals to groups, delight in relational complexity, capable of negotiating consensus and compromise, acceptance of differences, and emphasizing obligation over authority. The elimination of digital divide support programs are seen to be contradicting these elements of the Canadian identity (Graham et al [50]).

Following a framing analysis of a selection of 214 stories from the USA, a set of themes and frames were coded. These frames expand the understanding of the perceptions of ICT use in Indian Country in particular and among underserved communities in general. A research model on the effects of ICTs and Media on the Digital Divide suggests that in order to address the digital divides separating Native American Communities from the rest of the USA, the effects of ICTs and new media should be focused on empowering tribal members to develop their shared norms and values (Qureshi et al [52]).

Asia

Through the diverse nature of Asia, three regions are identified with digital divide and indigenous research in this essay. The regions which are studied in the papers for this section were Taiwan, Malaysia and Kurdistan. The first two regions are found with recent and considerable ICT investments, with the purpose of this research largely to determine if national goals were being achieved. In the third case of Kurdistan, a compelling narrative is provided on how to link people through ICT whom have only recently discovered their considerable domain.

"Taking a closer look at the individual regions Taiwan's interest in addressing the digital divide has to do with increasing its competitiveness in the global marketplace. The authors recognize that the issue of digital divide cannot be solved overnight. One researcher advised that the government should focus on social justice and national competitiveness. This could be accomplished by encouraging or helping minorities such as low-income students, those with disabilities, and the Aboriginals, to participate in the digital world (Chung et al [53]). Other suggestions which were made here include improving the public's internet literacy, providing affordable internet access, and reducing the threshold of entering the online world in order to promote equal opportunities and national competitiveness.

A second research paper provided a new model of applying Aboriginal digital archives for pedagogical use, ultimately leading to the preservation of valued indigenous assets. An online video workshop elaborated the knowledge and essential technical skills required for making

Jaw's harps. The program proved to be effective in raising aboriginal students' self-efficacy in technical skills learning. It also demonstrated the potential of the new online learning initiatives to replace traditional face-to-face instruction. This experience can be widely duplicated for preserving knowledge about other types of traditional musical instruments and artifacts (Ming-Chou et al [54]). Through this initiative, digital archives of cultural assets can be built which will help ancient traditions to survive the test of time.

The last research project on Taiwan reviewed in this study argued for the benefits of affordable high bandwidth mobile services to the county's residents, businesses, and government agencies. As the wireless network is established across the nation, local services and hot zones will gradually boost the county's tourist business, especially in the indigenous townships. This will create local jobs and improve the standard of living for the first nation communities (Chui et al [55]).

Six reports studied the benefits of ICT services over the lives of Malaysian indigenous people. The first project served as an impetus for other community service projects that included indigenous groups as one of the direct beneficiaries of this research and related ICT services. This study followed the placement of two personal computers in a community library, and, through the usage studied in this pilot project, the suggestion is raised that the project can be rolled-out to other indigenous regions (Ahlan el al [56]). The training programs which preceded this ICT initiative are viewed for their social impact on the rural community. Obstacles are noted in the absence of internet access to rural areas. The authors' view is that,

should this problem continue, bridging the digital gap among rural communities is not possible. In a survey which was conducted for Malek et al [57], only 5.2 percent of the respondents were computer literate. The wide gap in the digital divide among the indigenous people and other minorities substantiates the argument on digital exclusion and provides justification for policy analysis on technology adoption for social inclusion. The tribe under study is viewed as marginalized, and the need to promote internet access for social inclusion and citizen development seems greater than ever. Computer training is recommended regardless of the lack of proper education, because the development of information literacy will gradually lead to usage of these services. In another case study covering the Semai Tribe, Hashim et al [58] traced the digital exclusion of indigenous people compared to other communities and ethnic groups in Malaysia. The researchers confirm the existence of both an educational divide as well as the digital divide. The author believes that since the Malaysian land area is small compared to the United States and Australia, that socioeconomic inclusion is possible in Malaysia with time, training and consistent support.

In a GIS project, the blending between hard science (technologies) and soft science (social research) is emphasized. Using GIS technology, indigenous people are able to locate, track, position and mark communal items of interest. Through providing and supporting this unique technology, a digital map containing the social information of that community can now display human strength (human capital) for local development planning (Hamsan et al [60]).

In a language reconstruction project, Juan et al [61] developed a Text-To-Speech system for two indigenous languages in Malaysia. This was done through adopting the linguistic information of the Malay language. The key technique used was to segment syllable structures for words used in the two common languages. The syllabification algorithm results showed more than a70 percent accuracy in identifying syllables, besides reducing time for manual syllabification. While some of the indigenous languages here were seen to no longer have living speakers, the TTS was an effort at bringing ICT tools to support two of most used indigenous languages.

In Kurdistan, both KTV (Kurdish TV) and the internet have been used by the Kurds in their struggle to reconstruct their identities and to represent themselves, not only in dialects of the Kurdish language, but also in non-Kurdish languages. These two media sources have augmented the role of language in identity construction. Discursive practices in these types of media indicate that Kurdish language is indeed one of the most important and salient indexes of Kurdish identity. Furthermore, these new media seem to have enabled Kurds from different regions and all walks of life to share and discuss cultural, social and political ideas, publicly and dialogically. This has in turn helped Kurds in reconstructing and redefining their identities discursively and with relative freedom and ease. The new media have allowed millions of Kurdish speakers to exercise negative rights, and to some extent positive rights, regardless of whether or not those rights are recognized by the states in which they live. The internet is not as accessible as satellite television for economic, socio-political, and infrastructure reasons. The digital divide certainly then applies to Kurdistan. In addition, those

who have access to the internet in Kurdistan suffer from censorship imposed by their host states (Sheyholislami [62]).

Global

This last group of papers covered several regions all at once through narratives and theoretical arguments. The first paper identifies several contexts in which indigenous peoples are employing IT to preserve, share, and interpret their cultural expressions. These efforts are conducted in a maelstrom of challenges and opportunities. Even where electronic resources are ample and consistent, IT project partners must create processes that respect the local tribe's sense of etiquette and propriety. Above all, cultural protocols must be learned and respected so that IT applications might be steeped in cultural tradition and respectful of the indigenous world view (Roy et al[63]).

A second paper in this section discussed education focusing on factors that impact the development of educational technology plans within the educational system of developing countries. Largely, technology plans are influenced by factors that emanate from within the country (internal) and those that emerge from outside of the borders (external). Such factors could determine the leadership and participation of ministries of education and other stakeholders, such as the indigenous people. Keengwe et al [64] conclude that most developments that influence technology planning in schools are initiated, planned and implemented by organizations other than government agencies.

A further paper reports on progress that is being made on reducing the global digital divide. The 60 percent growth in the number of African websites over a 33 month period is a significant step in the right direction (Wresch [65]). A detailed review of specific national sites indicates a growing body of information that is becoming available online. Although still clearly short of optimal, the situation is far superior to that of a decade ago or even the less than three years since the inception of the project. At least as reflected in national website counts, the capabilities of citizens in developing countries appear to be improving.

In another research study, Evans et al [68] states that currently there is a significant divide between learning technology developments and their resonance within the everyday settings in which they might be deployed. This is particularly evident where multi-national participants are involved and also serve as focal points for intervention. The author believes that working out the significance of the social and cultural components is a central problem for learning sciences if the digital divide is to be bridged.

Another literature review showed that there is a vast combinatorial array of ways to define the digital divide. These diverse definitions influence the choice of agency in confronting the digital divide (Hilbert [27]). At the same time, each authority has a different outlook on the challenge. Empirical evidence shows that a large and heterogeneous group of authorities with diverse thematic priorities is invested in the challenge. This is believed to be good news, since it is generally accepted that real impact and gains from ICT demand sector-specific expertise in fields in which ICT is employed. Given the diversity of the potential benefits and impacts of

a versatile technology as ICT, the findings in this study argue in favor of a flexible definition of the digital divide that considers specific ends with actual final impacts.

The last study in this series concludes that the global challenge of the digital divide and certain critical conditions must first be addressed to enable any move toward digital equity (Elwood et al [72]). As daunting as these tasks may be, the effects of doing little or nothing to move toward digital equity can only result in greater social and economic exclusion and more instability across the globe.

A summary of the digital divide questions by continent is presented in Table 11. This table indicates that while the subjects and characteristics (DD#1 and DD#2) of the digital divide are very strongly responded to, other elements are less well covered. In particular the means of connectivity and the pervasiveness of connectivity (DD#3 and DD#4) are less well considered. Lastly, the purpose of connectivity (DD#5) is fully considered, pointing to the focus of many of these researchers on the communities and not on the technologies.

Table 11: Summary of Digital Divide Elements by Continent:

	DD #1	DD #2	DD #3	DD #4	DD #5
Oceania and Australia	10	10	6	7	10
Africa	4	4	4	4	4
South America	3	3	3	3	3
North America	7	7	6	6	7
Asia	10	10	8	7	9
Global	7	5	2	3	7
Totals	**41**	**39**	**29**	**30**	**40**

This essay began with the presumption that in many places in the western world that the digital divide has been solved. We see in that in the indigenous communities across the globe, that this is not so and that significant challenges are still found. The ability to address and understand the importance of these technologies is evident, however affordability, connectivity and other factors limit the adoption such that many locations reported access rates much below their national averages. In the overview it is also clear that a global perspective, supported by an appropriate theory has not been manifest. Much more work remains in this area and much more effort at supporting digital divide initiatives for indigenous peoples remains.

CHAPTER VI

Future Ideas and Recommendations

This systematic literature survey has identified only a small fraction of the challenges facing the indigenous peoples of the world because of the digital divide. Forty-one papers, covering various indigenous groups, demonstrate that the scale and scope of this problem is not well understood at this time. Future prospects for research should be addressed at identifying, at a national level, the extent of computer capabilities, per capita computer assets, and bandwidth availability that can benefit indigenous citizens. In short, a recommendation is made for an ICT development index for indigenous peoples. Comparisons would be made in these cases between urban and rural/remote communities. Such a research program should parallel the development theme as Australian archivists have suggested elsewhere in this essay. The essence of this proposal would encourage the introduction of a research program that engages and supports a cohort of aboriginal IT- Information System researchers.

The current literature survey indicates that no particular programs capable of closing the digital divide in North or South America are available at this time. Australian research indicates that perhaps many projects were underway, and that a national broadband strategy is on the verge of being developed to link its rural and indigenous communities. Oceania has its own connectivity problem that requires large capital investment for small populations – likely involving the O3b infrastructure. Africa also has many problems to consider, the digital divide being just one of them. The choices here would best be left to the individual African nations and its stakeholders to prioritize. Asia, it seems, has developed much ICT of recent.

Considerable ITC infrastructure has been implemented and community development activities enjoy the focus of modest research and government support at the moment. As suggested in some papers, the role of literacy is highly complicated when it comes to Asia. It is understood that the internet and its tools are highly oriented toward the English language. While local keyboards have been developed, the pervasiveness of the English language and commerce structures indicate that literacy initiatives should be emphasized and intensified. It follows from these studies and otherwise that literacy improvement initiatives can be a precursor for many nations to improve the progress towards bridging the digital divide.

Consideration for subsidization of internet access is a worthwhile objective. However this comes with the challenge of maintaining the subsidy over the long term and reinvesting appropriately as technological requirements advance (i.e. T1/DS1 to DS2 to DS3, etc.). Appropriate initial seed-capital investments can overcome these limitations by requiring intermittent subsidies, with perhaps indigenous communities managing these resources, as raised in the “First Mile” discussion, and then collecting the ongoing costs from their system subscribers.

Much was said in this essay about the benefit of community centres as a gathering place and a location from which to conduct internet related activity. These activities could be expanded in rural and remote regions to include Wi-Fi services, thereby enabling the current smart devices. Education via internet becomes an opportunity with the availability of such services,

so that the student no longer has to travel great distances to build certain knowledge that is still being taught via traditional methods.

The role of the non-governmental organizations (NGOs) had very little coverage in the papers surveyed. However, the benefit of these organizations is that they can stay on-task for long periods of time, such that they can transcend both local and national political events while negotiating with the public, government, businesses and others, to advance certain causes. The digital divide is indicated to be one such challenge. NGO's can be created and maintained by indigenous groups to build ICT knowledge and support community development activities in the education realm, GIS mapping, and technology planning. The tracking of these NGO's and using a lessons-learned approach would do much to transfer knowledge between such NGO's and their indigenous communities.

As a last point, much of the research provided was aimed at rural indigenous communities. The urban indigenous communities are also struggling with the digital divide, except that their circumstances are not as well understood, given their likely minority status. Research to establish the urban digital divide respecting indigenous people would serve as a ready comparator to the state of the rural/remote digital divide

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