FINDING ANSWERS AND SOLUTIONS: CAUSES AND EFFECTS OF INFORMATION TECHNOLOGY SKILLS SHORTAGES IN RURAL COMMUNITIES

by

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Abstract

This qualitative analysis examines the causes and effects of Information Technology (IT) labour shortages in rural environments and relate them to the labour market in Terrace, British Columbia (BC).

In rural communities with fewer IT job prospects, it can be difficult to attract and retain skilled IT workers, forming a skills shortage. Some of the effects of this skills shortage can be found in IT workers being underemployed or undertrained for positions they hold, leading to waste, inefficiency and lack of productivity. Underemployed IT technicians are a waste of talent which could otherwise be used to increase productivity and efficiency, while undertrained IT technicians are prone to costly mistakes. It is important to note that skills shortages are not restricted solely to rural communities, although they are more pronounced in them.

Some of the effects of a rural IT skill shortage include slower economic growth and technical disparity over urban counterparts, which can contribute to a less diverse workforce.

This paper will explain if and why there are IT skill shortages in Terrace and rural BC, using careful study of data in rural communities and it will present realistic solutions to address these challenges from a management perspective. Growth trends in IT will be explored to project which skills will require training investment in the future.

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Chapter 1: Introduction

1.1 Preamble

For the purpose of this paper, the meaning that will be used when referring to IT is the Information Technology Association of America (ITAA) definition: "The study, design, development, application, implementation, support or management of computer-based information systems." Thus, IT spans a very broad area such as software, hardware, applications, networking, e-commerce, advanced mathematics and much more.

IT contributes 572,000 jobs, $140.5 billion in revenue, $6.0 billion in Research and Development investment, $31.4 billion in exports and $11.4 billion in capital to the Canadian economy (ITAC, 2012). Despite these figures Industry Canada has persisted with its definition of Information and Communications Technologies sectors as an intangible service, (April, 1999).

Global demand for IT services has widely been predicted to expand with the arrival of cloud computing, which is the practice of using a network of remote servers hosted on the internet to store, manage and process data and services. Increasing requirements in business analytics to make sense of the massive amount of data that rapidly accumulates will require deft ability in order to distill it into meaningful information. IT skilled professionals are required in every business both for development and technical support. The chief IT employers in Terrace support healthcare, education and telecommunications due to increasing automation and their reliance on data. Other employers include consulting firms and retail support for small and medium businesses as well as home users.

In general, IT skills shortages negatively affect all areas, but they are more severe in rural communities and are a contributing factor to overall economic inequality with urban counterparts. Past failure to address this disparity has contributed to what is known as the digital divide. Part of what constitutes the digital divide is a difference in high speed internet which places rural communities at a competitive disadvantage over urban centers for IT. The digital divide itself encompasses more than just inequality in urban and rural network access; it is an overall disparity involving utilization and knowledge of information and communication technologies among economic, geographic, ethnicity, age and gender factors. George Sciadas of Statistics Canada defines the digital divide as: "It is commonly understood as the gap between ICT 'haves' and 'have-nots'" (Sciadas, 2002). The digital divide between urban and rural BC occurs for more than geographic reasons. There has already been considerable investment to address and it will require much more investment to solve. Some other IT trends currently include mobile computing, increasing customer support, and consumerization, which is technology growth in consumer markets before spreading to business and government organizations. A key factor in defining consumerization is dual-use of technology in both home and business markets (Moschella, Neal, Opperman, & Taylor, 2004). These trends will be explored to understand what skill sets are necessary in the present and in the future and the resulting implications if existing workers do not retrain to meet market demand.

The research methodology in this paper consists of literature review of rural communities primarily in North America and also contains data from other parts of the world where applicable. There were personal interviews conducted with selected representatives of IT business in rural communities across Northern BC; these interviews were conducted as per

UNBC ethics board guidelines. Further to this, Terrace's market is examined to determine if IT's lack of growth here is interrelated with the decline of overall economy in Terrace, possibly limiting its scope to being value added, only bringing extra features to an existing value chain rather than operating as a separate value chain.

1.2 Contributions

The Canadian government's December 10, 2012 announcement for a skilled trades people program concentrates on shortages in construction, oil and gas labour while overlooking high technology industries that may directly or indirectly support these workers now and in the future (Cohen, 2012). By recognizing the unintended consequences of IT skills shortages, a framework for possible solutions to these limitations can be determined. Some of these consequences include reduced efficiency, decreased productivity and overall economic loss. An analysis of the skills needed today and projected into the future will save time and effort for workers seeking a career in IT and those businesses who must utilize IT. The recommended solutions which result from this analysis can form a starting point for both workers and business in immediate and long term planning.

The results of this research will explain what constitutes an IT skills shortage, identify the constraints that cause them, and propose solutions which will target rural areas with focus on attracting qualified workers and implementing IT in small business.

It was discovered in writing this paper that there is an overall gap in IT training, services and opportunities not just in Terrace, but in many rural communities. Remote cities that take steps to

improve on this situation will gain from greater diversity in their local economies, and will be better positioned to embrace new and divergent technology as these advances are discovered.

Chapter 2: Methodology

2.1 Methodology

The methodology for understanding causes and effects of IT skill shortages was to use a combination of both primary and secondary data on IT skills shortages in rural communities in order to gain a better understanding of contributing factors. Primary data was collected because very little secondary data could be found on IT skill shortages outside of urban areas in both BC and Canada, making it difficult to come up with a locale specific analysis. A limiting factor in primary data was a combination of time constraints and a lack of access to subjects. Despite this limitation, participants included experts from the health, government, education and private sector vantage points. The recurring themes found in both primary and secondary data serve to provide a more complete picture of rural IT. General labour force data available on employment and education levels up to 2006 from Statistics Canada was accessed and used to compare findings in Terrace's labour market. Newer Statistics Canada information had not yet been released, and may not have been as encompassing due to changes in long-form census form completion; long-form census completion became both optional and abbreviated. Local post-secondary institutions were contacted in order to determine avenues of training available to the general public. The intent in pursuing this course of action was to learn of outcomes from program completion in terms of employment and local retention. At this time there were no other post-secondary IT training opportunities beyond Northwest Community College (NWCC) in Terrace making them the only local resource. The author's experiences supporting and implementing IT across Northern BC was drawn upon extensively to aid in making competent decisions on IT shortages. The author has worked in both public and private sectors, union and

non-union IT environments and has supported extremely diverse operating environments, often finding unique solutions to mitigate scarcity of labour, equipment and information. Information on market leading publicly traded company acquisitions were analyzed to determine the knowledge, skills and abilities which would be in demand in the future with the rationale that publicly traded companies will seldom reveal their future business plans, but the companies they seek ownership of will reveal the knowledge capital they need. Finally, journal articles from industry analysts were used to determine which IT skills are expected to be in demand going forward.

To summarize, the research methods used to achieve this paper's goal of explaining IT skills shortages, their constraints and to project future skill requirements are listed below:

- Literature review of IT skills shortages, IT labour shortages, rural IT through the UNBC Library and online resources.
- Personal interviews with IT professional participants who operate in a capacity to employ IT workers
- Researching available statistical information from post-secondary institutions and Statistics Canada
- The author's personal experience as an IT professional with 15 years of experience in the Cariboo, Kitimat – Stikine, Skeena - Queen Charlotte, and Peace River regions of BC.
- Future projections on IT skills that are expected to be in demand

2.1.1 Literature Review

The UNBC Library was used to research articles, and an exhaustive online web search for research information. In addition, the Information Technology Association of Canada (ITAC)

were emailed requesting information on rural information technology and graciously provided a paper related to ICT Industry in Canada. Authors in ComputerWorld.com were similarly emailed but replies were not received. An article submission was made to Slashdot (http://ask.slashdot.org), a well-known webpage IT professionals frequent who tout themselves as "News for Nerds, stuff that matters," requesting stories on rural IT, but it was not approved by website moderators for posting.

2.1.2 Interviews

Four IT managers were interviewed from Terrace, Nisga'a Lisims, and Dawson Creek and their input solicited on questions relating to IT hiring and projecting future skills demand. These four were chosen because of their diverse experience from four major areas of IT employment in rural settings; education, health, government and private sector in a rural setting. This provides broad coverage and is representative of the problem because it includes rural areas of the province which are experiencing both economic downturn and economic growth, while providing vantage points of IT from different social aspects.

2.1.3 Labour Market Information

Statistics Canada was searched for information on labour markets including occupation, number and employment rates in Terrace, BC and Canada. NWCC's current IT program coordinator was contacted requesting information on enrollment numbers, completion rates and employment outcomes of their Information & Communications Technology Program since this information is not available elsewhere. BC Student Outcomes (http://outcomes.bcstats.gov.bc.ca) was accessed to try and establish a baseline of rural IT outcomes, but information at the time of access was limited to urban post-secondary institution results.

2.1.4 Training Review

Prometric (Prometric, 2013) and Pearson Vue (Vue, 2013) test sites across BC were collected and plotted on a map to graphically illustrate the geographic complications for IT professionals interested in achieving industry recognized certifications. Both were chosen because they provide test services for the vast majority of recognized certifications for IT professionals (Montante & Khan, 2001). NWCC's website was accessed to understand the scope of local post-secondary institution IT training offered in Terrace.

2.1.5 IT Skill Projections

Four market leading IT company's acquisitions were researched to determine technologies that are sought by these companies, and will therefore require skills advancement to support or utilize. These companies are Microsoft (Microsoft, 2013b), Google (Google, 2013), Apple (Apple, 2013) and Redhat (RedHat, 2013) and were chosen because they encompass most modern aspects of IT that people use: mobile telephony, internet and operating systems.

Chapter 3: Research

3.1 Literature Review

The literature review examines existing research to provide answers for the following questions: What are the implications of an IT skills shortage in rural locations for students wanting to pursue IT as a career and for existing stakeholders? What skills are expected to be in demand for IT workers going forward?

Throughout this literature search, there was a common theme that an IT skills shortage is a gap between what employers want or need and what is able to be delivered from the labour market. When companies with existing IT departments find themselves facing these skill shortages, they often choose to outsource needed services rather than invest in training for employees. The ramifications of these shortages are in knowledge, skills and ability and not necessarily in labour supply.

There is high cost and lack of economies of scale in providing IT services in rural areas (Schafft, Alter, & Bridger, 2006). This situation is compounded by reduced internet and telecommunications service outside of urban centers. As some observers argue, "people without access to Internet telecommunications are less likely to demand these services because they have not experienced the benefits firsthand" (Schafft et al., 2006). In BC, reduced service is somewhat less pronounced as currently 93 percent of the population have access to high-speed internet service, with the remaining 7 percent residing on the outskirts of connected communities and remote areas (Government, 2012).

Simply having high speed internet in rural areas does not automatically place these communities on equal footing with their urban counterparts. There are different definitions of what constitutes high speed. In the United States, the FCC has mandated that 4 Megabit per second (Mbps) be the minimum speed to be considered high speed (Commission, 2010), while Industry Canada has set a recommendation of 1.5Mbps for high speed internet. The Canadian Radio-television Telecommunications Commission (CRTC) has set a target in 2015 to achieve a minimum 5Mbps in order to be considered high speed (Hudson, 2011). Under current standards, 1.5Mbps "high speed" ADSL internet in Terrace is simply not comparable to 100Mbps high speed cable internet in Vancouver. This difference in connection speed and level of service between urban and rural centers has come to be a well known part of the digital divide (Government, 2012). Canada had boasted an aggressive information infrastructure policy seeking to become the most connected country by 2000 which was hampered because at the time market liberalization was a goal, yet so was universal access (Ramírez, 2001).

A large part of what constitutes an IT skills shortage is timing and training of the labour force. As technologies mature, existing labour markets tend to grow and meet saturation points while new and emerging IT roles end up with shortages. These shortages form a knowledge barrier that serve as a major obstacle in maximizing the potential values of any ICT initiatives (Kuk, 2003). A recurring theme of IT skills shortages is that companies often concentrate on recruitment instead of retraining and retention of existing employees to meet these needs (Dillion & Cole-Gomolski, 1999). It is often easier to simply outsource needed skills when there is a lack of internal expertise and worry about training afterward, as Benefit Management Systems (BMS) of the UK found when migrating to a new IT system (Donovan, 2002). This could in turn have a negative effect on existing staff who may wonder about their own long term employment

prospects in a company when faced with contractors being brought in to do work which had been assigned to them. Despite these concerns, employees overall treat outsourcing as a benign decision provided it does not affect their own job, although they may question the company's performance or motives. Layoffs are strongly suggested to be much more negatively regarded and costly in terms of increased turnover propensity (MAERTZ, Wiley, LeRouge, & Campion, 2010). International Business Machines (IBM) is a notable global leader in outsourcing IT support services around the world. For the first time in 2012 IBM's global IT outsourcing workforce was estimated to exceed their entire USA workforce (Thibodeau, 2012). The implications of this are clear in that IT employment growth appears to be concentrating away from in-house support.

Outsourcing has become a major part of IT strategy, yet the motivations have been changing from one of cost reduction to improving business performance by closing the gap in their in-house capabilities (DiRomauldo & Gurbaxani, 1998). In rural settings there may not be anyone to actually outsource these capabilities to, and if there is an option to outsource there is no guarantee of improved performance or reduced cost (Young, 2007) (Young, 2005) .

A specific case of IT skills shortages in the USA found rural hospitals to be less efficient than hospitals in larger centers (Serb, 2006). It was explained that the often volatile nature of technology sometimes causes large investments to lose much of their value through lack of standardization or lack of industry adoption. These risks and the smaller budgets of rural American hospitals make IT investments considerably smaller than urban counterparts. With their remote locations and often lack of specialization, rural hospitals have seen an increased focus on telemedicine consultations (Serb, 2006), essentially outsourcing expertise in medicine to urban areas.

For labour-force workers at the high school level, IT training is probably better spent on vendor-neutral programs that focus on industry standard technologies, fundamentals and encourages life long career development (Thompson, 2004). Some argue that technical credentials may be a more important source of IT skills than higher education in that they convey more about the practical skills that employers care about than do academic degrees (Hadfield, 2005). A downfall to building a portfolio of certifications to boost an IT career is the cost and requirement to continually recertify. In one study, 50% of 100 IT professionals chose not to update their skills because of costs, with 36% expecting they would have to pay the costs out of their own pockets (Hadfield, 2005).

Many IT workers use what is informally known as an "IT buddy system," (Stoller, 2011) partly because it is extremely hard to get people to admit they do not know how to do something (Stoller, 2011). Not all of the responsibility of meeting training requirements should rest with workers. Businesses also need to take some initiative to connect with and take advantage of their community and educational facilities to attain the type of skilled worker they need, looking beyond the bottom line by providing some internal training (Preston, 2012). A possible source of internal training in rural communities is e-learning, which is essentially recorded training modules delivered electronically. A negative aspect of this medium is that it has a very high participant dropout rate possibly due to its self-directed nature (Laine, 2003).

Technology rather than business requirements tend to drive most IT departments, with Canadian training budgets trailing their U.S. counterparts by as much as 70 percent (Stoller, 2011). Skill requirements in this industry are reasonably unique in that they change quickly and often do not build on each other. Skills obsolescence and the lack of retraining explain a large part of the employee turnover in the industry. A focus on recent graduates to fill jobs exacerbates the

labour market imbalances, and the difficulties that older workers often experience (Cappelli, 2000). When employers are considering IT employee retention problems, they should look at the work-life balance, future career prospects and appropriate training for their existing employees (Banks, 2010).

At the forefront of technology is mobile broadband, which has enabled innovation in new digital services and makes next generation technologies and applications such as cloud computing possible. Green ICT industries and sensor technologies are an area to expect future growth (D. A. Wolfe & Bramwell, 2010). With growth in these areas come challenges for training in new technologies such as distributed computing, parallel programming and virtualization. Computerworld, a respected IT magazine in both print and online form has predicted that Programming and Application Development are expected to be the number one IT skill in demand for 2013. This is followed by Project Management, Help Desk/Technical Support and Security (Pratt, 2012). IBM's 2012 Tech Trends report which is based on a survey of over 1,200 IT professionals has placed strong emphasis on four skill areas expected to grow globally. They are: business analytics, mobile technology, cloud computing and social business. It was noted in this report that globally only one in ten IT workers has all the skills needed in these areas to be successful. The report also noted that three out of four students and educators report a moderate to major gap in their ability to meet workforce demands (Lo, Wyble, & Hupfer, 2012). This report was covered across Canada in print media and received many comments from Canadian IT workers. The Financial Post had 48 comments which were overwhelmingly critical, with the highest voted comment writing:

> "There is no shortage of skilled IT workers. There is a shortage of employers who are willing to train and compensate employees fairly. There is a massive shortage of HR

employees who understand IT. They look at hiring IT as a checklist of skills, but since they don't understand what the terms in the checklist actually mean all they can do is scan resumes for keywords. Employers want someone with a decade of experience and willing to work for minimum wage. People saw how quickly pay disappeared after the dot com boom. People see IT as boring, low pay, long hours. No one notices you when you keep things running smoothly. Train people, pay them fairly, you will have no problem and you will see no shortage (Ovsey, 2012)."

3.2 Statistics Canada Information

The most current census figures for Terrace at the time of writing this paper estimate a total population of 12,044. The three cities closest to Terrace's size in BC are Williams Lake (11,066), Dawson Creek (12,257) and Prince Rupert (12,935). These three other communities will serve as a basis for comparison to Terrace in terms of labour market information. (Ip, 2012)

Terrace had the 4th fastest population decline of mid-sized centres across Canada from 2001-2006 (Canada, 2010). This dubious distinction was shared with 4 other BC communities outside of BC's lower mainland, the area colloquially known as "Northern BC." This drop is directly related to the city's largest employer Skeena Cellulose mill closing in 2001 and the city's inability to find a new primary industry to replace it (Force, 2009).

The last available census information from Statistics Canada that breaks down labour markets according to education level was in 2006, which was well into the mountain pine beetle epidemic that negatively impacted forest based economies (Patriquin, Wellstead, & White, 2007). At this time Terrace had 9,805 in the labour force, of these 1,695 or 17.28% did not have a high school

diploma or further schooling. This is statistically positive in comparison to Williams Lake at 19.82%, Dawson Creek at 21.88%, and Prince Rupert at 21.57%, but higher than the province of BC where 287,200 of 2,226,380 (12.9%) did not have a high school diploma or further schooling. BC itself has a lower than national levels in this statistics, Canada had 2,613,385 of 17,146,135, or 15.24% of the labour force without a high school diploma or further schooling.

From Terrace's 9,810 total labour force, 35 workers were classified as Communications technologies/technicians and support services (CTTSS) with an unemployment rate of 42.9%, while 40 people were classified as computer and information sciences and support services (CISSS) with an unemployment rate of 22.2% (Canada, 2006a). This is considerably higher unemployment than Williams Lake which had an unemployment rate of 0% in this classification, but only had 25 people listed as participants, yet had 90 CISSS with only 11.1% unemployment, Dawson Creek had 35 people classified as CTTSS with 28.6% unemployment, 35 as CISSS with 0% unemployment and Prince Rupert at 15 employees in CTTSS with 0% unemployment and 115 CISSS 8.7% for these same respective classifications (Canada, 2006a). The significance of these numbers is that Terrace has managed to retain IT workers, but have not been able to employ them in as great of numbers to comparable cities.

The Province of BC fared much better in these classifications than Terrace at 5.9% and 6.3% unemployment, while Canada as a whole had 6.4% and 6.2% unemployment in these classifications respectively (Canada, 2006b). This reveals that Terrace either has a lack of demand, or possibly a lack of qualifications in persons who identify themselves in these classifications. The result of this high rate of unemployment and the low numbers in Terrace is a less developed IT market than rural peers, the province or the country.

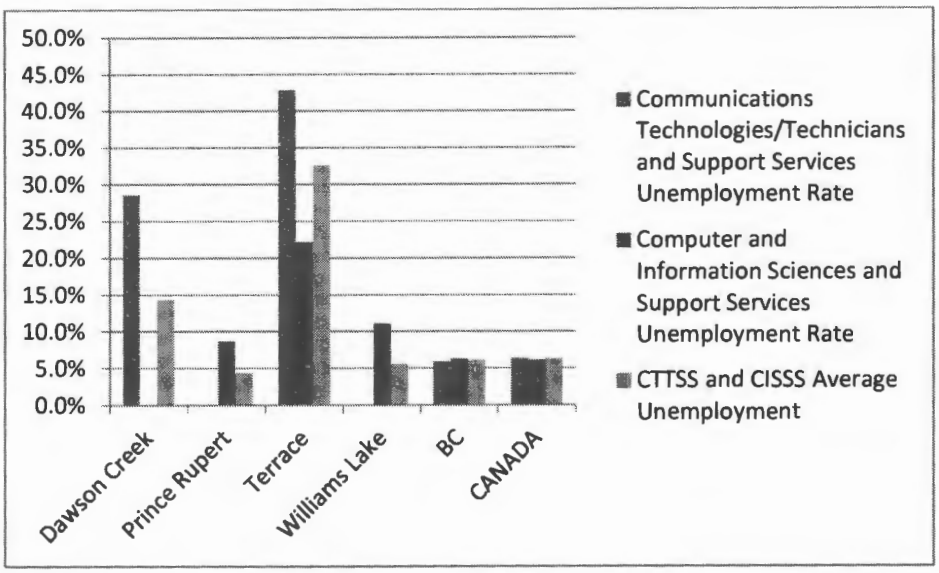

Figure 1 (Statistics Canada 2006)

The implications of the employment statistics and education levels are that lower overall education levels in rural communities have created an economy supporting unskilled workers, leaving qualified skilled labour underemployed or unemployed (Bewley, 1995). Without a supporting market for IT to expand into, Terrace and cities like it will be at a disadvantage against their urban counterparts in current technology. In all likelihood as newer technology builds on or replaces existing technology this disadvantage will continue to grow from a gap into a chasm.

3.3 Interviews

Four IT managers from Northern BC were interviewed and asked the following four questions:

#1) Have you observed any difficulty in filling IT positions?

If yes, go to #2. If no, skip to #3

#2) In your opinion, what are/were the difficulties?

#3) Which skills do you seek in prospective IT employees today?

#4) What IT skills do you believe will be in demand over the next 10 years?

The first person interviewed was Mr. Trevor Smith, Technology Systems Manager with School District #59, a largely Apple Macintosh based school district in Dawson Creek, BC. He had observed difficulties in filling IT positions; the last hire took six months to fill due to applicants having a lack of soft skills or job motivation, over qualification or wanting higher wages than the school district were prepared to offer. There were further difficulties in that the school district were competing against oil and gas jobs which pay more than the district were prepared to offer. Trevor felt IT wages in their own district positions had become inflated because of the oil and gas sector's wage competition. Trevor believes the most important skills in his IT environment are soft (interpersonal) skills in communicating with users, as well as experience with Apple Macintosh computers. The school district does provide in house training in Apple Macintosh support skills. Software programming and networking are also important, but not usually found in applicants. Finally, predicting future IT skills, Trevor believes soft skills, cloud computing and networking are the skills he believed will be in demand.

The second person interviewed was Mr. Benjamin Davidson, IT Manager with Nisga'a Lisims Government, a First Nation in the Nass River Valley of Northwest BC (approximately 97km North West of Terrace). He also observed difficulties, mostly from the administrative side wanting to hire locally when the local talent pool didn't exist due to the low population density. There isn't high speed internet readily available or computer stores where he operates, making the IT job market very small. Benjamin explained that local residents who leave the area to gain

necessary IT skills tend not to return. The skills Benjamin looks for in prospective IT workers are security based, since this is an IT area they are lacking at the moment; applicants with security based certification or courses in network security are desirable. Projecting into the future, Benjamin expects cloud computing, collaboration, data synchronization and small custom application development (for Apple IOS/Google Android devices) skills to be in demand. In addition, he believes IT staples such as backup cycling, firewall configuration, email/mail server administration, active directory, and security for mobile devices including laptops. Benjamin did express that, "ten years is a long time to predict."

The third interview was with Mr. Douglas Lancaster, a former 11 year (2000-2011) veteran with Northern Health Authority ITS who was based out of Terrace and had direct involvement in staffing decisions for his department. Douglas also taught the IT course for 4 years at NWCC in Terrace and developed the college's local curriculum which was used from 2003-2007. He stated that he "definitely," had experienced difficulty filling IT positions, due to a lack of qualified people. Northern Health was not able to fill a vacant Northern Health Client Support position in Prince Rupert, BC, while the same position in Fort St John, BC took over a year to fill. The skills he looks for are troubleshooting ability, soft skills, and the ability to be trained. Douglas felt that IT certifications are nice to have, but are not necessary. The IT skills he expected to be in demand going forward are information security, cloud computing, desktop and networking operating systems.

The fourth interview with Mr. Tom Burbee, co-owner of TCSI Consulting, a firm that service northwest BC specializing in small and medium business IT support; everything from advice and planning to sales and support. His company has been in operation for fifteen years. Tom had experienced difficulties in filling IT positions due to fewer people that reside in northwest BC

having hands on experience. There wasn't a shortage of such people from larger centers, but it was difficult to convince them to relocate to Terrace due to its remote geography. The skills Tom seeks in IT workers are customer service skills, customer service experience, and work experience. Certifications are not required, but they are an asset; in Tom's opinion technical service skills can be taught easier than customer service skills. Tom expects small business IT skills will be most in demand in rural areas. In particular, skills relating to workstations, small networks, small server environments and potentially niche areas such as remote networks, wireless or other communications for remote areas. He believes IT is a customer service industry, and in order for it to prevail and be successful, customer service skills will an asset most companies will start focusing on.

In summary, all interviewees experienced difficulty filling positions in their organizations due to a lack of qualified applications. In northeast BC, there was an additional factor beyond a lack of qualified applicants due to competition for wages in other jobs. Nearly all interviewees placed an emphasis on customer service soft skills and cloud computing, and most made a point of saying certifications are nice to have, but not required.

Chapter 4: IT as A Profession

4.1 Preamble

Pursuing IT as a profession in both rural and urban settings has had its own industry specific challenges. Part of this is due to the lack of standardization in qualifications and an overall perception of IT often being semi-skilled labour rather than an actual profession (Howell, 1996). Other issues particular to rural employment are a lack of training, lack of training opportunities and a lack of available jobs for new workers to enter and existing workers to advance into. This has a two-fold effect; persons interested in IT often leave the area to find specific training and possibly not return, while others leave the area to find opportunities not available locally. Finally, those who choose to stay and find employment may find themselves under employed, without a career path and underpaid.

4.2 IT Training

Some of the challenges in attracting and retaining IT talent in rural markets may include:

- Difficulty in accessing relevant vendor certificate training, with unequal access to test centers in comparison to urban centers
- Uncertainty of what skills are required in rural communities
- IT covers very disparate skill sets, including but not limited to mathematical logic, electrical engineering, customer service, troubleshooting, design and organization
- The changing face of IT, which observes increased consumerization, mobility and decentralization with the advent of cloud computing

Most IT professional certification exams are written through companies that provide industry test center services. The major companies who provide this service for IT professionals are Prometric and Pearson Vue. Prometric is notably responsible for major vendor tests from Microsoft, Apple, and many other corporations. Pearson Vue notably provides tests for Oracle, Cisco and many other corporations. It is important to note that although both testing companies provide the same service, their exam portfolios are often mutually exclusive of one another. For example, Microsoft and Apple certification exams are only available through Prometric Test Centers, while Cisco certifications are only available through Pearson Vue test centers.

To obtain a list of both Prometric and Pearson Vue sites across BC, both company websites were accessed and scheduled tests with each vendor and perused lists of test centers available in BC. Former test sites in Prince Rupert and Prince George were contacted to verify they are no longer providing exam services. In the northwest there currently no Prometric or Pearson Vue test centers; although Prince Rupert's campus of NWCC had hosted a Pearson Vue test center, it no longer provides this service. The closest test center to Terrace is in Prince George at the College of New Caledonia campus which only provides Pearson Vue testing. Between both test providers there are seventeen test centers across BC, five Pearson Vue and twelve Prometric centers. From both vendors, only three operate outside the southern portion of BC.

Figure 2: Test Centers Across BC (Google Map extrapolated from pearsonvue.com and prometric.com site listings)

Since there are no test centers in Terrace or northwest BC, IT professionals who wish to certify will require taking at least three days off from work in order to write an exam; one day of travel to reach a community with a test center, one day to write the exam and one day to return. If an IT professional pursuing certification is not receiving support from their employer, the cost in lost wages, time bank depletion, travel cost and lodging act as a deterrent for interested rural IT workers, as does the possibility it may not contribute to career advancement. An employer who

agrees to reimburse a rural IT worker on the condition that they successfully complete examination raises the stress level with the risk of failing. This forms a barrier to certification for IT professionals since it does not leave rural residents with an easy way to demonstrate skills beyond work experience and IT courses unless they developed these attributes before moving to the region. It is interesting to note that Fort St John has two Prometric Test Centers and is in fact the closest Canadian Prometric test center to Terrace without traveling internationally to Alaska. The higher concentration in the northeast may be explained by the burgeoning oil and gas industry in this area.

NWCC provides an IT program which is delivered online at (https://ict.onlinecollaborative.ca). At the time this paper was written, NWCC was not able to provide statistical information on student graduation rates or outcomes of program. The only information which could be found on this topic was from BC Student Outcomes who only had results from BC Lower Mainland and Okanagan IT programs. Although these outcomes are interesting in their own right, they are not comparable to rural labour markets and as a result were not included in this paper. With the Statistics Canada recorded high unemployment rate of IT workers in Terrace and other rural communities, it is reasonable to expect the outcome of program completion by Terrace residents was not overwhelmingly positive.

The reason for this disparity in services is not just location, but demographics, 77% of the provincial population live in the southwest corner of BC. This difference in population amounts to an overall difference in infrastructure that presents a hurdle when trying to attract professionals and access services from outside of this area. Some people will not be willing to live in communities which do not offer amenities they seek. Infrastructure requires public

capital investment in order to make private capital investment more productive, which reduces competition for rural investment (Fox & Porca, 2001).

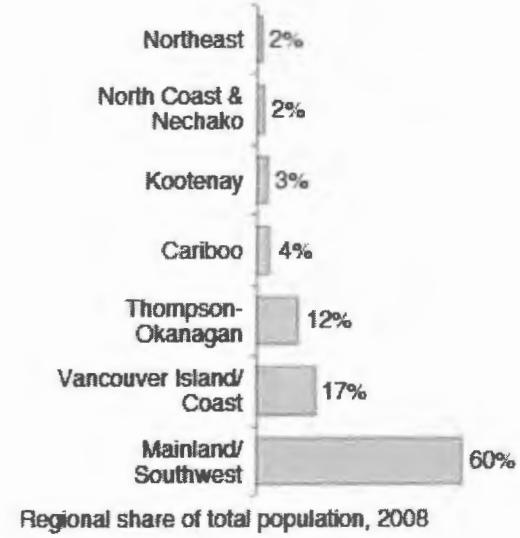

Figure 3: 2008 BC Stats Population (BCStats)

4.3 IT Skill Projections

Microsoft, Apple, Redhat and Google corporation acquisitions were examined in 2012 to extrapolate and project what IT skills will be in demand now and in the near future. Companies typically make acquisitions to either eliminate a competitor or to pick up necessary knowledge capital they anticipate needing but do not already have in house.

Microsoft Acquistions

Date Acquired	Company Name	Business
June 25, 2012	Yammer	Social networking
July 9, 2012	Perceptive Pixel	Multi touch hardware
October 4, 2012	PhoneFactor	Two-factor authentication system
October 16, 2012	StorSimple	Cloud-storage appliance vendor
October 17, 2012	MarketingPilot	Marketing automation firm

Table 1: Microsoft acquisitions in 2012 (adapted from Online sources)

Yammer (Microsoft, 2013e) is a social networking website available worldwide for private corporate use. Since this service is hosted outside of companies that use it, this is a combination of social networking and cloud computing.

Perceptive Pixel (Microsoft, 2013c) make large screen touch sensitive LCD displays, the implications of this acquisition are unclear. PhoneFactor offer a solution that provides an extra level of security for mobile devices such as smartphones, acting as a gatekeeper to online transactions. StorSimple (Microsoft, 2013d) make local computer hardware infrastructure that synchronize offsite using cloud computing, a hybrid local and off-site backup storage solution. MarketingPilot (Microsoft, 2013a) provide software to automate managing marketing activities in both traditional software and cloud computing offerings.

In summary, Microsoft's acquisitions in 2012 have largely focused on cloud computing, social networking, multi touch interfaces, security and marketing.

Apple Acquisitions

Date Acquired	Company Name	Business
February 23, 2012	Chomp	App search engine
July 27, 2012	AuthenTec	Security hardware and software for PCs and mobile devices
September 27, 2012	Particle	HTML5 web app firm

Table 2: Apple acquisitions in 2012 (adapted from online sources)

Apple's acquisitions in 2012 have not been as numerous as others. Chomp produced mobile application (app) search engine software that examines apps based on their heuristics and not just their name. The features inherent in Chomp were incorporated into Apple's mobile operating

system IOS (Campbell, 2012). This acquisition is in line with Apple's existing strategy of growing software distribution through channels known as "App Stores," which would be purchased online and therefore through cloud computing. AuthenTec provide data encryption and overall computer security software revealing an interest in advancing this part of Apple's business. Particle was a start-up who produced web applications using the newest web browser language known as Hyper Text Markup Language 5 (HTML5). Apple is thought to have bought this company not for their products but the talent in the company (Slivka, 2012)

In summary, Apple's acquisitions for 2012 have been centered on applications distributed via cloud computing, web application development and security.

Redhat Acquisitions

Date Acquired	Company Name	Business
June 27, 2012	FuseSource	Enterprise software
August 28, 2012	Polymita	Enterprise software

Table 3: Redhat acquisitions in 2012 (adapted from Online sources)

FuseSource were acquired by Redhat with the intent to incorporate them into an existing Redhat product called JBoss Enterprise Middleware. In layman terms, Middleware is the software "glue" that some computer software developers use to ease building more complicated software products. Redhat bought both FuseSource (RedHat, 2012b) and Polymita (RedHat, 2012a) with intent to expand their middleware's Business Process Management (BPM) offerings, which is designed for business users and IT to collaborate. In the bigger picture, Redhat stated this is part of their cloud strategy (RedHat, 2012a).

In summary, Redhat's acquisitions for 2012 have been both cloud computing and enterprise business related.

Google Acquistions

Date Acquired	Company Name	Business
March 16, 2012	Milk, Inc	Social Network
April 2, 2012	TxVia	Online Payment
June 4, 2012	Meebo	Instant Messaging
June 5, 2012	Quickoffice	Productivity Suite
July 20, 2012	Sparrow	Mobile apps
August 1, 2012	Wildfire Interactive	Social media marketing
August 13, 2012	Frommer's	Travel Guides
September 7, 2012	VirusTotal.com	Security
September 17, 2012	Nik Software, Inc.	Photography
October 1, 2012	Viewdle	Facial recognition
November 28, 2012	Incentive Targeting Inc.	Digital coupons
November 30, 2012	BufferBox	Package delivery

Table 4: Google acquisitions in 2012 (adapted from Online sources)

Google has been by far the most prolific in acquiring companies in 2012. Milk, Inc. were known for a mobile app named "Oink!" used in rating consumer retail goods (B. M. Wolfe, 2012) . TxVia was an innovator in delivering Platform as a Service (PaaS), a cloud computing technology where the company provided the back end for receiving payment. Meebo was an internet web browser add-in that allowed users to chat with one another using established chat providers. QuickOffice is a competitor to the ubiquitous Microsoft Office productivity suite that is geared toward mobile/tablet use. Sparrow is a utility for reading email client with a strong presence in mobile/tablet markets. Wildfire Interactive acts as a third party that provides marketing services for companies to users of social networking sites. Frommer's produces a

well-known series of books about world travel. Google's interest in buying this company is said to be so they can become a trusted guide for travel and local business data (Trachtenberg, 2012). Google's interest in VirusTotal.com has been rumoured to improve their detection of infected webpages and files in its own search results (Jennings, 2012). Nik Software produces applications for mobile, tablet and personal computers for editing photos and easily sharing them online. Google's purchase is hypothesized to be in response to Facebook buying a competing product (Instagram) and offering their services with social networking (Fingas, 2012). Viewdle was acquired by Google to provide a way for users of their services to automatically recognize and label faces of subjects being photographed (Kerr, 2012). Incentive Targeting Inc. (Targeting, 2013) provides on-the-fly anonymous shopper segmentation to participants. Essentially, consumer price elasticity and preferences are individually estimated for a participant based on usage patterns, coupons are presented based on these patterns to maximize retail profit. Finally, Bufferbox provides anonymous mail drops where customers of online purchases can retrieve merchandise ordered online (Hartley, 2012). It is not clear what can be inferred from this acquisition, perhaps Google anticipates a growing need for anonymous mail service or a future with a greater transient populations who still maintain an internet presence.

In summary, Google's acquisitions over 2012 have largely focussed on cloud computing, social networking and mobile/tablet applications.

All four of these companies acquired companies to further cloud computing goals in 2012. The remaining acquisitions were centered on user security/threat prevention, social networking/collaboration and mobile applications (apps). Based on these findings, it is reasonable to expect that the forefront of IT skills they are focusing on will be heavily reliant on fast internet speed now and in the near future. As a result of this, computer network

infrastructure in design, implementation and troubleshooting local and wide area networks will continue to grow to meet demand. As businesses decide to transition from older network standards to cloud computing, there is a need for competencies in both legacy environments and cloud hosted services. Cloud computing can solve some skill shortage problems in rural communities by eliminating the need to employ workers with specific skills to administer or maintain services such as data storage and email.

Social networking will require IT skills such as database administration, user interface design, data archival/retrieval and data analysis. Security will continue to be important, requiring skills in computing forensics for detecting and addressing intrusion, auditing security practices, cryptology and secure handling of sensitive data. Social networking and office collaboration can also be expected to increase; this will require IT skills in administrating collaboration software and integrating it with other systems as needed. Mobile app development will require skills in software development, integration across platforms and network topologies.

Chapter 5: Results

5.1 Findings and Recommendations

Throughout researching this project there have been repeated themes; the major ones have been cloud computing, a shortage of training opportunities, a reluctance to invest in retraining existing IT workers and the importance of customer service skills. Terrace and rural BC in general do appear to have IT skills shortages, perhaps more so in Terrace due to the sustained downturn of its primary forestry industry (Halseth, 2010). Since IT has not taken the forefront as a dominant industry in Terrace, it has only been able to grow as a value-added support service.

Some agencies have a mandate to assist in providing training such as BCNET who is committed to provide shared IT services for higher education and research institutions across BC (BCNET, 2013). This is a boon for pure academic environments, but provides little support for business or home users and does not address specific training requirements for IT skill shortages. BCNet also provides a service known as Transit Exchange, which is a high speed network that is available to business, but is not offered in rural areas.

The BC Chamber of Commerce has made recommendations to the BC Provincial Government to address technological and engineering skills shortages by providing funding for related programs at colleges and universities across BC after pointing out talent hired out of the area tend to move back where they came from, while those trained locally statistically stay within 200km of where they trained ("Policy & Positions Manual," 2012 - 2013).

If these recommendations are followed, it will certainly help to increase local opportunities, but will not address disparity in internet capability. To address skills gaps with in-house IT workers,

the choices are limited to providing training opportunities or outsourcing these requirements where it makes sense. With cloud computing on the horizon, network disparity between rural and urban BC will require significant infrastructure investment to overcome limitations. Unfortunately without the population base to offset the expense, there is a stalemate where rural IT cannot grow at the rate of urban counterparts because it lacks the infrastructure. To overcome this, the population in rural areas is required to grow in order to make the capital investment feasible, unless a new and divergent technology can be realized which will overcome this limitation.

The main causes of IT skill shortages in rural communities that were discovered are a lack of overall training and employment opportunities for workers, lack of emphasis for employers to provide training for in-house IT workers and inferior internet access in comparison to urban counterparts. To address training concerns, employers should consider investing in yearly IT training budgets for all staff in order to provide necessary skill upgrades to stay relevant or, to strategically outsource business IT requirements.

The issue of inferior internet access in rural areas will require massive capital investment that would need to be coordinated between both government and business. One may consider that in not having this infrastructure already, it could be a chicken and the egg scenario where it is unclear what should come first, the population or the infrastructure. It could be argued, "If you build it, they will come." A feasibility study involving expansion of BCNet's Transit Exchange network and the Canadian Advanced Research and Innovation Network (CANARIE) into rural areas might answer this question, although this is beyond the scope of this paper.

Throughout the research, cloud computing was almost unanimously found as the primary IT skill area which will require specific training to support going forward, closely followed by business analytics and security. Cloud computing is a compelling form of outsourcing that would have a positive impact on some skill shortages in rural locations. Common cloud computing uses include file storage and sharing, document creation and collaboration, database hosting and maintenance, email and offsite backups. There is some concern in using cloud computing of how to outsource computation without outsourcing control of sensitive data (Chow et al., 2009). To mitigate this, companies can employ high security encryption of their data at the possible risk of irrevocably losing access to this data if access keys are lost. In addition to these skills, electronic collaboration, mobile computing, customer service soft skills and networking knowledge were identified as skill sets that are currently important and poised for growth. Rural business owners would be wise to concentrate their IT strategic plans around these areas to remain competitive, and prospective employees in this field would do well to focus their studies here.

To address short term IT skills shortages, rural business can outsource using cloud computing solutions when feasible. This can only be accomplished within the limitations of network ability, availability and privacy concerns. Partnering and sharing of network resources with educational facilities could help, provided there are clear distinctions made in terms of liability and priority of data

To help address long term IT skills shortages, rural businesses must invest in basic IT literacy for their workforce. These skills allow workers to access e-learning as a means of training, and overall increase a workers employability (Morris, 2009). The digital divide is also likely to

increase if adults who are digitally excluded do not receive help in accessing the benefits that online access brings (Morris, 2009).

5.2 Limitations

Primary data collection was limited due to insufficient lead time to commence research. A wider scope of interviewing similar sets in different rural communities would provide a more complete rural IT employment picture. Projections of future IT skills cannot be completely guaranteed, although every conceivable effort was made for accuracy. Information Technology as an industry strives for efficiency and often evolves in divergent paths. Some constraints such as network disparity between urban and rural areas may be solved in ways which cannot be determined in this paper. Other constraints which contribute to the digital divide may require complex solutions which are more sociological in nature than technical, which is beyond this paper's scope.

5.3 Conclusion

With the present and future of IT seemingly rooted in fast and efficient exchange of information, rural areas on the less capable side of the digital divide will not be able to reach technical parity with urban counterparts without very high investment costs or strategic partnering. Extremely rural locations will only be able to make limited use of cloud computing, if at all, unless a divergent technology is discovered that closes the digital divide. A rural business that focuses on outsourcing physical IT skills will be at a relative disadvantage against urban counterparts who also outsource due to the limited local labour resources of IT workers. Compounding this is the

difficulty of local labour obtaining relevant training, certification and the expense of bringing in consultants from urban areas.

Cloud computing can mitigate this in areas with sufficient connectivity, but has its own limitations in terms of data privacy and availability. Even though the costs associated with this disparity are difficult to quantify, with technology in general being a labour multiplier (Charness, 2008), a competitive disadvantage in IT will make the cost of doing business higher in rural areas due to inefficiency, leading to potentially reduced productivity. The simplest solutions would appear to be rural businesses partnering with institutions that have network capabilities they are lacking, increase investment training of in-house IT staff where possible or carefully managed outsourcing and shared training ventures for staff. In conclusion, not having complete skills or the infrastructure to make full use of technology can at least be partially managed by having local expertise and industry collaboration in addressing these needs.

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