

Running Head: SuperNet Applications, Benefits, and Barriers

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Exploring Principals' Perceptions of Applications, Benefits, and Barriers of
Alberta's SuperNet

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Abstract

The Alberta SuperNet, a very high speed, broadband network, was built to bring high-speed connectivity to every school, library, and municipal office in Alberta. This CDN \$294 million dollar investment was made based on the perceived need for high-speed connectivity to stimulate economic and community development and to enhance government services, especially education and health. A survey of Alberta school principals was conducted in the spring of 2005. This survey investigated principals' perceptions of 14 potential teaching and learning, administrative, and professional development applications of broadband networking. Results of this survey revealed that while school principals voiced some apprehension, they nonetheless perceive value in broadband applications for educational purposes. Results of the survey can be used to provide rationale for broadband expenditures and both 'supply' and 'demand' side interventions designed to increase effective and enthusiastic use by local schools.

Access to broadband and high-speed networking is seen by many as a key component of economic and social development. The Canadian National Broadband Task Force report enthusiastically claims that “broadband will transform the way we learn, the way we work, the way we use our leisure, the way we govern ourselves, the way we communicate, the way we express ourselves and the way we care for each other” (Johnson, 2001, p. 3). Broadband has also been identified as having particular capability to enhance and add value to public education systems by enhancing the teaching and learning experience, improving cooperation between educational institutions, delivering new potentialities, improving efficiencies, and widening access (Broadband Stakeholders Group, 2003). Trattner, Wang and Carter (2000) argue that “information technology in education is an incredible resource and will, without question, continue to be the single most important component of 21st century education” (p. 34). Despite the rhetoric of government commissions and ardent proponents, there is little evidence that this expectation of ‘broadband nirvana’ is shared by practitioners in the field. In many cases, adoption of a new technology requires systemic change in operations, organization, attitude, and individual activity (Dennings, 2004). Understanding the perceptions of potential adopters is therefore essential for educational planners and policy makers seeking to devise and support broadband educational applications.

Background and Literature Review

In 2001, the Government of Alberta announced funding for an ambitious, province-wide broadband network called the Alberta SuperNet (see www.albertasupernet.ca). The Alberta SuperNet is a CDN \$294 million, government-sponsored broadband networking initiative. Upon completion of the SuperNet in late 2005, high-speed broadband connectivity was made available to approximately 4,700 public institutions including every school, library, hospital, and provincial government office in Alberta. The SuperNet also connects 429 communities and provides competitively priced, high-speed networking connectivity not only for public and government operations, but also for rural and small town business operators and private citizens.

Interventions by government and other institutions in technological innovations has been the subject of considerable study from sociological, political science, and economic perspectives. King, Gurbaxani, Kraemer, McFarlan, Raman, and Yap (1994) argue that for such institutional

interventions to be effective, they must be a “dynamic, contingent, path-dependent process in which the expectations among and interactions between producers and users are highly dynamic” (p. 147). It is essential that network builders and potential users engage each other directly to maximize strategic goals of the intervention. The subjects of this study, school principals, are clearly key actors on the local scene, therefore measuring and understanding their perceptions is essential to guide public policy planners and developers.

Large scale institutional interventions are often accompanied by planned stimulations either on the supply side, or the demand side, or both. King and colleagues (1994) argue that institutional intervention proceeds “through the interaction of influence and regulation along the dimensions of supply-push and demand push forces for innovation” (p. 147). To date, the SuperNet intervention can be seen as primarily a supply-side driven innovation, with some minor effort paid to stimulating the demand-side. Typically supply-side interventions focus on creating, promoting, building prototypes, and funding production of the intervention. Supply-side interventions often operate under an unstated ‘build it and they shall come’ assumption. Supply-side interventions are often rationalized with a believe that when end users see the advantage of the interventions, demand will be stimulated, resulting in the effective adoption and use of the intervention. In a companion piece to this study (Anderson and Christianson, 2006), we measured principals’ awareness and perception of value of seven interventions by Alberta Education, which went beyond construction of the SuperNet to stimulate demand-side. As that study and this current study reveal, however, a significant gap remains between the amount of funding, support, and energy provided by the government to build the network (supply-side) compared to the resources allocated to stimulating potential users (demand-side).

Some analysts argue for the necessity of finding or developing a “killer application” that provides such compelling advantage to users, that adoption proceeds rapidly. In a 2002 study of Korea, the country with the world’s highest use (per capita) of broadband networking Lee, O’Keefe and Yun (2003) argue that there must be balanced input on both supply-side and demand-side if complex interventions, such as broadband, are to be effective. Lee and colleagues also note the need for a ‘killer application’ that focuses and stimulates broader demand. Unfortunately, the killer application in South Korea was online gambling, a demand-side push application that is not likely to garner much public support in Alberta. In earlier work (Poscente, Rourke, & Anderson, 2006) we reported on the evidence that IP-based

videoconferencing was the mostly widely cited application for the SuperNet though caution was voiced about the pedagogical value of videoconferencing as a ‘killer application’. Rather, myriad new social software applications such as blogs, Wikis, pod and videocasts, personal and community spaces, portfolios and profiles, etc., where users themselves create content seem to be emerging as the latest ‘killer applications’ for broadband, in both formal and informal learning contexts (Anderson, 2005).

Research Questions

Researchers working with the Alberta SuperNet Research Alliance (see supernet.ucalgary.ca) have recently completed a number of multi-disciplinary studies to explicate the adoption process and to help end-users and government-funders create an informed response to the SuperNet intervention. In this study, we focused on educational users for a number of reasons. First, educational use is perceived by government funders as a major application for the Alberta SuperNet. Second, high-speed educational applications have shown promise to dramatically improve not only the reach of education provision, but also the quality and cost effectiveness of the service (Mason & Rennie, 2004).

The Alberta SuperNet Principal Research Survey was designed to assess school principals’ interest, awareness, and planned use of high-speed networking. The survey also assessed school principals’ perceptions of its potential application and barriers to its adoption and use. Data from this survey can be used to guide educational policy makers and administrators charged with researching, developing, and purchasing broadband applications so as to better meet end users’ needs and overcome perceived barriers to effective adoption.

The study addresses the following research questions:

1. What are the potential applications of the SuperNet that are most valued and what are the greatest perceived barriers to effective use as perceived by school principals?
2. Are there differences among principals of large versus small and rural versus urban contexts in regard to their perceptions of applications and barriers?

Answers to these questions can be used to inform current users, planners, and builders of SuperNet applications, along with users and decision makers in other jurisdictions. The U.S.

Committee on Broadband Last Mile Technology (2002), for example, noted that “the threshold issue is how to determine whether government intervention to accelerate broadband deployment is necessary or desirable” (p. 205). This study, in addition to others carried on by our research group (see supernet.ucalgary.ca), can be used to inform not only policy makers in Alberta, but others grappling with similar questions and concerns.

Method

To maximize effectiveness, reach, and convenience, a self-administered survey was used for this study. Surveys provide capacity to reveal quantitative differences in perceptions among subjects (Anderson & Kanuka, 2003). In addition to a Likert-type scale, the survey instrument included open-ended questions to gather qualitative data using the subjects own words. The instrument was developed based on interviews with Alberta government staff, a review of literature on educationally related broadband applications, and earlier interviews and focus groups with distance education teachers and administrators (Anderson, 2003; Posente, Rourke, & Anderson, 2005). The portion of the survey reported in this paper consists of 14 five point Likert-type scales, plus two open ended questions. To enhance clarity and to reveal vague or hard to understand items, the survey was piloted with two principals.

Invitations to participate in the Alberta SuperNet Research Survey were sent on March 19, 2005 to all 1,960 school principals across the Province of Alberta. A follow-up reminder was sent one month later to those who did not respond to the original invitation. In total, 295 survey responses were received, yielding a response rate of 15%. We were disappointed at the low response rate, and asked a small number of principals to elaborate on possible reasons behind the low rate. They advised that they are inundated with survey type requests; and some respondents indicated that they thought the survey was of little use since the SuperNet had not yet been implemented in their divisions. Finally, we discovered that one of the two very large urban divisions actively discourage research requests (like ours) that were not specifically scheduled by their central office.

In order to fulfill a secondary research goal of determining which survey invitation method worked best, the sample population was split into four groups. Table 1 details the return rates obtained in the Alberta SuperNet Research Survey. Note the much higher response rate

was associated with those principals who received post (as opposed to electronic) invitations, indicating higher responsiveness to paper as opposed to electronic requests for participation.

Method of Survey Invitation and Submission	Return Rate (% of surveys by delivery method)	Return Rate (% of total 1,960 surveys sent)	Return Rate (% of total 295 surveys returned)
Postal service invitation and postal (print format) submission	33%	8%	54% (n=160)
Email invitation and online web-based submission	14%	4%	23% (n=69)
Postal service invitation with online web-based submission	8%	2%	14% (n=40)
Email invitation and email submission	5%	1%	9% (n=26)
Total/Average	15%	15%	100%

Table 1. Return rates obtained in the Alberta SuperNet research survey

In the following sections, we detail the perceived interest in three types of potential SuperNet applications:

1. Those relating to teaching and learning,
2. Those utilized for administrative purposes, and
3. Those designed for professional development.

Results

Value of Potential SuperNet Applications

In Tables 2, 3 and 4, we list the mean survey score and standard deviation of the respondents. The Likert-type scales were converted to numbers for calculation of the means and standard deviations as displayed in the tables ‘*Not at all important*’ was scored as 1; ‘*Not very*

important’ was scored as 2; *Neutral*’ was scored as 3; *Important*’ was scored as 4; and *very important*’ was scored as 5.

The teaching and learning applications in Table 2 scored highest in the perception of importance to school principals. These high scores are likely related to the increased emphasis placed on student achievement (as revealed by system-wide testing) by government and school board decision-makers and increased awareness of the role of individual schools in student achievement (Henchey, 2001). It is interesting that the highest rating was obtained for the enhanced capacity for students to do ‘research work’ using the SuperNet. This finding indicates a need for direct student access to Internet resources and speaks positively to the principals’ stated desire to let students use this technology for personal learning as opposed to using it solely as a teaching device. The capacity for individual students or teachers to download and use learning objects, including videos, received the next highest rating. This high rating is probably related to exposure by school leaders to the three publicly funded learning object repositories supported by the Alberta government (see LearnAlberta.ca; Tools4Teachers at <http://www.tools4teachers.ca> ; and the TELUS Learning Connection at <http://www.2learn.ca>). The next highest valued application was the capacity for students to engage in video-conference delivery of distance education programming and the perceived need for video-conference use for curriculum enhancement in regular classroom settings. This data indicating slightly lower interest in video-conferencing (as compared to research and downloading of learning objects) contrasts with the Alberta Ministry's unilateral decision in 2005 to provide free video-conferencing equipment for every school district.

Teaching and Learning Applications	Mean	S.D.
The capacity to increase the speed and capacity for students to engage in research work using the Internet.	4.27	1.09
The capacity to download multimedia learning objects.	4.17	0.99
The capacity to download videos for classroom and individual instruction.	3.92	1.10

The capacity to video-conference with other learners or experts to enhance curriculum.	3.56	1.21
The capacity to use web-based applications to deliver or receive distance education programming.	3.46	1.33
The capacity for students to interact by video-conference with experts such as speech therapists, specialized counselors, etc.	3.38	1.19
The capacity for students to access online courses.	3.32	1.42

Table 2. Teaching and learning applications

Administrative applications detailed in Table 3 were shown to have medium to high perceptions of importance by school principals. Given the administrative responsibilities of the sample frame, it is not surprising that they place significant value on the capacity of the SuperNet intervention to improve secure and timely access to administrative applications. Once again, video-conference applications score lower than those that permit high speed and, hopefully, more efficient administration services with the Ministry and within the local school division.

Application	Mean	S.D.
The capacity to create and transmit secure electronic data such as student records, report cards, and information required by Alberta Education.	4.11	1.08
The capacity to securely access and manage the jurisdiction's administrative applications, such as personnel files, school budget data, etc.	3.92	1.19
The capacity to hold division-level meetings by video-conference to avoid travel time and expense.	3.24	1.32
The capacity to engage in individual video-conference consultations with the board's administrative or technical staff.	3.05	1.30

Table 3. Administrative applications

As detailed in Table 4, principals attach lower value on use of the proposed system for professional development applications. It would seem that exposing teachers to the network as participants in professional development activities would be advantageous and valued. Hands-on exposure to the technology would raise teachers' and administrators' skill levels using the technology and increase self-efficacy as network users. The results also indicate principals place higher value on learning with groups outside of their own jurisdiction. This highlights a problem currently unresolved in Alberta: specifically the capacity to video-conference across different virtual private networks (VPNs) to create the type of ubiquitous calling capacity enjoyed on telephone systems. Such seamless connectivity is currently not supported due to firewalls that surround most school-based information systems coupled with the lack of central network address directory. A secondary concern is a lack of distributed professional development providers. Currently, the two largest providers of degree programming for teachers do not offer video or other broadband enabled programming. The Alberta Teachers' Association (ATA) and Alberta Regional Consortia are also not currently involved in delivering programming that takes advantage of high-speed networking. This illustrates the need to develop demand-side applications in conjunction with supply-side infrastructure.

Application	Mean	S.D.
The capacity to engage in professional development activities, such as those sponsored by the Alberta Teacher's Association (ATA), Alberta Education, or Alberta Regional Consortia.	2.90	0.96
The capacity for staff to participate in formal university-level programming to enhance their teaching or administrative credentials.	2.69	1.09
The capacity to engage with other teachers or administrators in your division in individual meetings to reduce travel time and expense.	2.60	1.19

Table 4. Professional development applications

Contextual Differences in Survey Results - School Location

Adoption and use of a complex innovation like the SuperNet is directly related to the local context in which it is introduced (Bijker, 1999). Of the many contextual variables that distinguish Alberta schools, we have chosen to investigate the variable of *school location* (i.e., the differences between urban and rural schools).

In a study of Canadian rural school use of ICT, (2003) note the largest technical discrepancy between rural and urban schools relates not to access to machines, but to access to networking capacity. Although rural students report roughly the same use of information and communication technology (ICT) in schools as their urban counterparts, they report lower access at home. This finding underscores the higher importance of access from schools for rural students. Looker and Thiessen argue that "as more and more resources become available via the Internet, these discrepancies, if not countered, will have serious implications for the divisions among youth in terms of their access to the presumed benefits of the information society" (p. 20). Rural locality in Canada has also been shown to be related to lower provision of formal professional computer coordinator time and expertise, less opportunity for technical training for teachers, and lower availability of curriculum related software (Looker & Thiessen, 2003). Thus, we were interested in determining if rural school principals had different understandings of the value of SuperNet-enabled applications.

The location (urban versus rural) of the schools in this research study were dispersed fairly evenly across three size-based categories. 36.6% of the schools are located in a rural community with a population of less than 5,000 people. 26.1% of the schools are located in a small urban community with a population between 5,000 and 25,000 people. 37.3% of the schools are located in a large urban community with a population over 25,000 people. Based on Alberta's population distribution, these figures are skewed towards smaller communities than would be likely expected elsewhere, indicating that slightly more of the rural school administrators responded to the survey. It is recognized that this potentially may set a rural bias in the survey results.

To determine differences between respondents from rural and urban schools, a General Linear multivariate model was calculated, which revealed a significant difference between the

sample means (Wilks' Lambda =.77, $F=2.61$ $p<.001$). We then calculated post hoc ANOVA's to reveal those variables that produced significant differences. The results are reported in Table 6. Principals from schools in rural communities placed significantly higher value than their urban counterparts in relation to the following capacities: to video-conference with other learners or experts to enhance curriculum; to use web-based applications to deliver or receive distance education programming; for students to access online courses; for students to interact by video-conference with experts; to hold division-level meetings by video-conference; to engage in individual video-conference consultations with the board's administrative or technical staff; and to engage with other teachers or administrators. The data collected show that the SuperNet's capacity to support video-conferencing, online engagement, and rich online curriculum, is pertinent and valued by school principals in rural locales to a greater extent than their urban counterparts. The travel time and expense involved for school principals to attend meetings makes video-conferencing particularly useful and valued in rural schools.

	Mean	S.D.	Sig p.
The capacity to hold division-level meetings by video-conference to avoid travel time and expense.	3.24	1.321	.000
Rural school (a town of less than 5,000 people)	3.63	1.308	
Mid-size town school (5,000 to 25,000 people)	3.27	1.263	
Urban school (greater than 25,000 people)	2.83	1.261	
The capacity for students to interact by video-conference with experts such as speech therapists, specialized counselors, etc.	3.38	1.189	.001
Rural school (a town of less than 5,000 people)	3.71	1.219	
Mid-size town school (5,000 to 25,000 people)	3.30	1.065	
Urban school (greater than 25,000 people)	3.12	1.176	
The capacity for students to access online courses.	3.32	1.420	.001
Rural school (a town of less than 5,000 people)	3.72	1.352	
Mid-size town school (5,000 to 25,000 people)	3.04	1.473	
Urban school (greater than 25,000 people)	3.13	1.369	
The capacity to engage in individual video-conference consultations with the board's administrative or technical staff.	3.06	1.304	.001

	Mean	S.D.	Sig p.
Rural school (a town of less than 5,000 people)	3.39	1.277	
Mid-size town school (5,000 to 25,000 people)	3.03	1.337	
Urban school (greater than 25,000 people)	2.74	1.235	
The capacity to video-conference with other learners or experts to enhance curriculum.	3.56	1.209	.002
Rural school (a town of less than 5,000 people)	3.88	1.289	
Mid-size town school (5,000 to 25,000 people)	3.45	1.063	
Urban school (greater than 25,000 people)	3.33	1.163	
The capacity to engage with other teachers or administrators in your division in individual meetings to reduce travel time and expense.	3.60	1.193	.01
Rural school (a town of less than 5,000 people)	3.84	1.172	
Mid-size town school (5,000 to 25,000 people)	3.58	1.146	
Urban school (greater than 25,000 people)	3.36	1.206	
The capacity to use web-based applications to deliver or receive distance education programming.	3.46	1.334	.005
Rural school (a town of less than 5,000 people)	3.72	1.304	
Mid-size town school (5,000 to 25,000 people)	3.31	1.290	
Urban school (greater than 25,000 people)	3.31	1.363	

Table 5. ANOVA between Respondents from Urban, Mid-size and Rural School locations

The difference between reactions to the SuperNet between rural and urban principals is probably best reflected in the two polarized views revealed in the survey. As one urban principal notes:

As a member of a large urban board, we see very little benefit to us from the SuperNet. We get great highspeed service from cable at this time, and wouldn't be making any changes if they were not 'directed' at us.

While a rural principal writes:

I cannot stress enough the dire need for online access to a host of services, particularly distance instruction, for rural areas such as 'my

town'...proximity to 'nearest large city' does not serve the regional school district when school size restrictions severely limit a school's ability to offer access to necessary courses of instruction.

To summarize the results (Table 5) reveal that principals of rural schools have greater sense of perceived value in all of the SuperNet capabilities and significantly so in 7 of the 14 capacities.

Qualitative Results: Perceived SuperNet Benefits

Survey participants were provided with open-ended space to reply to the question of “What do you anticipate the greatest benefit will be to your school from the implementation and activation of the SuperNet?” The 258 responses were coded into five major themes.

The first we called ‘increasing functionality’ because it relates to respondents' expected increase in access and functionality of various learning, administrative, and professional development activities. Many of the expected benefits to both students and teachers focus on are access to external resources. The single greatest technical capacity of this increased functionality was the use, or proposed use, of video-conferencing for both distance education and administrative application. Other popular themes related to increased capacity to access streaming video resources for teaching and learning, and professional development opportunities.

The second largest group of comments related to technical affordances of increased speed anticipated through the use of the SuperNet. Often, principals related speed improvements to enhanced applications such as streaming video and voice over the Internet. Some principals noted the increased security made possible by virtual private networks. The following bulleted response by one principal is typical and express most of the perceived benefits voiced by the respondents:

- *Having the capacity to transmit large data files, video titles, etc. with a minimum of delay.*
- *Having the ability to conference with others in "real-time."*
- *Secure and fast pipeline to Alberta Education.*
- *Being ready for new developments in technology that require greater bandwidth.*

Access issues were also mentioned by many respondents and focused on access to resources, courses, and professional development activities.

Our school will benefit from accessing other classrooms in Alberta and Poland. Polish programs throughout Canada and the USA will also be easier and accessible for learning opportunities for our entire community.

A small number of respondents also noted that access may be problematic in some schools, due to prohibitions for use of the Internet imposed by some schools for religious reasons. This issue was noted in a respondent who stated:

The greatest benefit to us would be access to information for students. However, this is a moot point, as is this survey (for us). We are a Hutterite colony school, and the Hutterite elders have refused SuperNet access for the colony schools in our jurisdiction. It is not permitted even to have a computer in the school. I think SuperNet will be great, but it looks as if it will have to roll on ahead without us. Were we to be involved, I might have answered many of the survey questions in the direction of "important" rather than "neutral."

Finally, some respondents noted technical concerns with improvements in reliability over the existing system. Typically, these users were experiencing problems in maintaining connectivity with existing services.

Two groups of principals saw little advantage of the SuperNet. The first group, mostly from large urban school boards perceived that the high-speed connectivity already provided to them via for-profit providers, made the promise of the SuperNet of little value. Likely, these respondents are not cognizant of the cost benefits or the capacity needed for larger percentages of the student and staff population to access some of the high-end video-streaming and video-conferencing applications that are on the very near horizon..

At this point I do not see any only because I do not know of the SuperNet's long range application. The 'advertisement' of its uses has been very poor.

Secondly, some of the distance education schools serve students and sites outside of Alberta where high-speed networking may not be possible. Access to every student is a typical concern for distance education programmers. Distance education administrators, therefore, tend to focus on the capacity of high-speed technologies to increase student access to basic education courses delivered at a distance, more so than enhancement of classroom courses (Poscente et al., 2006).

Potential adopters usually compare perceived benefits to perceived barriers (Rogers, 2003). Next, we analyze qualitative responses to open-ended questions related to barriers.

Perceived Barriers to SuperNet Use

Participants were asked to identify what they believe are the greatest barriers that need to be overcome to realize the benefits of the SuperNet. Principals' greatest concern related to the cost implications of SuperNet development. Most, but not all, respondents seemed aware of the province's 100% subsidy of the actual connectivity cost. Many respondents, however, noted the need for increased funding for machines for student use, connectivity within the school building, teacher training, and space for distance education and computer labs. As one respondent noted:

We are nervous that dollars for technology will not be available and that we will be looking at a shiny new Cadillac with no means to acquire the gas to use the machine.

The second most frequent barrier identified was time for teacher training, coordinating new applications, installing and maintaining systems, and course development. A number of respondents also noted social barriers: cultural resistance to computer use in schools; teachers' reluctance to use new technologies; students' distraction from the real work of learning by playing on the Internet; and a general sense that technology should not be used to replace face-to-face learning. One respondent expresses this perspective as follows:

Some of the barriers are logistical and these will be overcome. My greater concerns are philosophical. I believe that "education" is relational and I am skeptical that relations of the type I think need to be established between a

teacher and a student is possible at a distance. I think that 3V education has a role to play when more personal possibilities have been exhausted.

Interestingly, only one principal expressed security concerns as a barrier to use of the SuperNet technologies.

General skepticism (largely related to the two-year delay in implementation) is evident in the following comment received from one respondent:

It is unbelievable how badly the ball has been dropped on this new technology. It is extremely overdue, and we've been promised implementation in our school repeatedly over the past few years. In all seriousness, we no longer count on SuperNet being installed ever - we simply don't believe any timelines Alberta Learning gives us anymore.

Limitations

Before discussing these results, some limitations of the study must be explored. The return rates of all but the paper/ mail-based survey was much lower than expected and certainly lower than desired. There are a variety of reasons to which this can be attributed and some were briefly discussed earlier. However, the rate of email and web-based returns was lower than what one would expect for electronic surveys based on other studies using this form of survey (Anderson & Kanuka, 2003). This may be because many of the email addresses used were to the school, rather than being personally addressed to the principal. This may have resulted in a loss of some of these emails or delays in timely arrival at the principals' computers. The low return rate may also indicate that email use is not as prevalent in this population as we had come to believe. In any case, the low return rate makes it impossible to generalize to the whole population of school principals. Nonetheless, we hope that the quantitative data, as well as the qualitative quotations, in this section will still be of use in creating an understanding of the complex issues relating to the adoption of expensive technology-driven interventions.

Discussion

As indicated by the respondents, the potential applications of the SuperNet that are most highly valued are the teaching and learning applications. School principals believe the increase in the speed and capacity for students to engage in research work using the Internet is very important. Administrative applications are considered of medium-level importance relative to teaching and learning applications. The most highly valued administrative application is the capacity to create and transmit secure electronic data such as student records, report cards, and other information required by Alberta Education. Professional development applications are considered of lower-level importance relative to administrative and learning applications. The most highly-valued professional development application is the capacity to engage in professional development activities, such as those sponsored by the Alberta Teachers' Association (ATA), Alberta Education, or Alberta Regional Consortia.

The greatest perceived benefit of the SuperNet reported is increased functionality through enhanced access to external resources by both students and teachers. Technical affordances such as increased speed and video-conferencing are recognized as requiring the SuperNet's broadband infrastructure. The greatest perceived barriers to effective use relate to costs associated with the SuperNet. The provincial government is funding the connectivity; however additional costs such as computer lab equipment and teacher training are a concern. The challenge of finding time to invest in learning new applications, such as new system implementation and training, were also reported as barriers to effective use.

This apparently 'hedged' enthusiasm for the SuperNet supports an earlier study on innovation, which noted that: "Those considering innovating know that the innovation's performance is not an absolute, but is relative to other alternatives, and dependent on factors they and other innovators cannot control, such as the rise of competitive substitutes or the presence of essential complements" (King et al., 1994, p. 144)

Survey results also show that rural school principals perceive greater usefulness of SuperNet applications than their urban counterparts. One survey respondent summarized this perspective by stating:

I believe that completing the SuperNet will start to even the playing field between rural schools who are unable to do activities involving Internet access and urban schools who can. Rural schools will have a lot of catching up to do. Rural teachers will have to be retrained to use the Internet.

Many respondents expressed concern with the lack of end-user involvement in the SuperNet development process. This perspective is illustrated in the following quotes:

For me, the SuperNet project has been shrouded in mystery. As principal of a forward-thinking school community, I can tell you we want to be at the cutting edge so have been proceeding on trust that this is a great opportunity for schools in Alberta. Communication regarding SuperNet must become much better in the future if we are to be aware of its true potential.

We all know it is happening but we have no idea when it will materialize. This project has been very vague from the beginning.

In regard to video-conferencing, teachers were not involved in this decision. We were told at a meeting we were getting some, we had no input. The decision was made by our office tech person. No teachers were consulted and there was no plan for in-service shared. Seems like it could be a waste of money without some support.

Planning, design, and construction of a high-speed network (supply-side interventions) and provision of useful applications to run on it (demand-side), has proved to be challenging for a number of reasons.

First, this innovation and the anticipated benefits are often hard for potential users to identify and contextualize within their own workplace or community. Although most potential users are familiar with Internet-based networking through applications such as email and web

browsers, many have difficulty in clearly understanding how a faster network will do anything more than incrementally increase the speed of their connection.

Second, the decision to fund and build the SuperNet was made without involvement of end-users. Instead, a political decision was made to invest some of the Alberta government's oil revenue in an expensive and possibly 'bleeding edge' implementation. Although provincial governments across Canada have been talking for years about the economic and social benefits of high-speed networking, few provinces (nor the federal government) have been willing to undertake a large-scale implementation designed to meet both public and private needs. Rogers (1999) surveyed 1000 art teachers to identify barriers to technology adoption in computer-based art classes. He found that the needs of the institution and individual teachers need to be determined before educational technologies are chosen. The important first step (where early advocates and change agents investigate and develop the rationale and create an implementation plan) was undertaken not by end-users in collaboration with decision makers, but instead the important first step was taken unilaterally by high-level political decision-makers. In short, end-users were not given the opportunity to become champions. The construction phases of the SuperNet also bypassed most end-users. Instead, the SuperNet, was subcontracted and managed by central government officials.

Third, the important 'observability function' of innovation adoption (Rogers, 2003) was largely missing from this intervention. There was no means by which potential end users could observe the network in action prior to making investment or planning decisions. In the absence of observable functionality, proponents are often forced to adopt what Rogers refers to as a "pro-innovation base" arguing that "the implication that an innovation should be diffused and adopted by all members of a social system and that it should be diffused more rapidly and that the innovation should not be rejected or re-invented" (Rogers, 2003, p.100). This type of attitude can alienate more conservative end-users and negates the need for innovations to be socially reconstructed for effective and contextualized use.

Fourth, due to a variety of technical and organizational challenges, the actual construction of the SuperNet was delayed for nearly two years. This delay increased uncertainty in the deployment schedule and resulted in frustration amongst potential end-users.

Finally, the SuperNet roll-out was fraught with challenges that tend to confront all technological innovations in terms of cost effectiveness and rapid adoption. Socio-technical

analyses of technology adoption or technology rejection show that a technology is rarely (if ever) adopted and used in the ways in which its designers originally planned. Rather, users determine the uses and applications of the technology (and its eventual rejection or wide-scale adoption). These processes of construction of use are social, contextualized, and complicated. Bijker (1999) argues that "technological development should be viewed as a social process, not an autonomous occurrence. In other words, social groups will be the carriers of that process" (p. 48). Integral to the facilitation of social adoption is the opportunity for educators to meet, talk, and collaboratively explore the innovation together. Bijker also argues that change and technological innovation takes place within a seamless web influenced in complex ways by social, technical, scientific, and political influences (Ibid., p. 13). It is only through studying these interacting forces that one can begin to understand, predict, stimulate, and support the adoption of an innovation.

Conclusion

The deployment of the Alberta SuperNet provides the infrastructure needed to realize the benefits of broadband networking. A recent policy forum in the UK, however, identified three categories in which policy towards broadband matters most:

1. *Availability*, which involves infrastructure questions;
2. *Take-up*, revolving largely around questions of costs and competition; and
3. *Usage and outcomes*, where consideration is given to the way content, applications and interactivity impact on broader social and economic issues. (Dutton, Gillett, McKnight, and Peltu, 2003, p. 40)

Investment in the Alberta SuperNet has made considerable strides in resolving the first infrastructure question, despite concerns with access to hardware and connectivity in local schools themselves. However, the second set of necessary policy-related issues associated with costs, effective applications, training and support, have hardly been framed, much less articulated in practice. Thus, it is useful to consider the SuperNet investment as a massive supply-side intervention. Supply-side interventions in public arenas, such as education and health care, are typically funded and often managed by governments to effect necessary change and stimulate the use of a particular technology, technique, or innovation. In this case, the supply-side was not matched by sufficient funding to support demand-side programming that informed, demonstrated, and addressed users' concerns. Put simply, insufficient demand-side planning was

undertaken to create demand for the intervention. Finally, the usage and outcomes policy requires ongoing monitoring and development. In particular, the social results of this intervention must be carefully observed and researched, so that workable policies can be put in place to guide ongoing development aimed at addressing individual, local, provincial, and national needs.

This study revealed significant barriers to the adoption by end-users of high-speed networking. Despite the relatively high level of interest in potential broadband applications, the adoption of the Alberta SuperNet by schools has only just begun. Burkman (1987) argues that successful developers must: 1) identify potential adopters, 2) measure the relevant perceived needs of the adopters, 3) design and develop effective and efficient products, 4) inform potential adopters about their product, and 5) facilitate the implementation of the product with moral, tactical, training, and material support. This snapshot from 2005 reveals that potential users (educators) were identified as high level users of the intervention. However, the study shows users' perceived needs were largely determined by uninformed speculation, thus the design of truly effective products, communication, and professional development strategies, and long-term support policies and practices have yet to materialize. In a related study (Anderson & Christiansen, 2006) we documented the awareness and use of some initial interventions instigated by the government to stimulate effect use. This later study, however, shows much more should be done in the early stages of the SuperNet project to increase the probability of effective use. We conclude that the Alberta government largely adopted a "build it and they shall come" strategy – a strategy that has often failed in educational application (Surry & Farquhar, 1997). Nonetheless, we share with our respondents a sense that broadband technologies, with their capacity to support both the production and consumption of teaching and learning content and multimodal communication across time and distance, offers exciting educational potential.

The potential of SuperNet broadband capabilities are generally valued by practitioners. The long term success of the initiative, however, requires end-users' involvement in a host of related production, communication, research, and education innovations. Even after the expenditure of millions of public dollars, effective use of the Alberta SuperNet remains elusive. We hope that this massive public investment will not be marked by failure, but instead support a

climate of technical innovation that will benefit all Albertans, and especially students and educators.

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