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Challenges for Video Communications in Remote and Rural Communities

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Abstract

For Canada's remote and rural communities, video communications provide a vital lifeline. This study explores the challenges for video communications in remote and rural First Nation (Indigenous) communities. Central to our analysis are social and technical issues as well as the ICT experiences of community-based organizations and community members. We use an analytical framework to identify challenges in four categories: technical infrastructure, the interactions of the users with the technical infrastructure, the production and reception of audio-visual content, and the organizational and social relations. Our findings underline the need for community capacity building to address these challenges and use video communications to its full potential.

1. Introduction

The expansion of broadband networks has created new opportunities for video communications in rural and remote communities in Canada. Video communications refers to exchanging audio-visual data over broadband networks - applications such as videoconferencing, multi-site videoconferencing, and sharing videos online. This paper explores the social and technical challenges constraining the use and growth of video communications in remote and rural First Nation (Indigenous) communities in Canada.

For remote and rural communities, video communications provide a vital lifeline with each other and for others to access their resources and services. Video communications also supports these communities to access the resources and services they require that are available only in urban communities. Canada has one of the lowest population densities of any country. Canada's North and its most rural areas are rich in wildlife and natural resources, with vast areas of boreal forest and tundra, large lakes, mighty rivers, and few human habitants. The communities in these areas are small, generally with populations ranging from a few hundred to a few thousand residents. Many are First Nation communities or have a large Aboriginal population. The more remote communities have no permanent roads and

are accessible only by air. Videoconferencing networks were originally set up in these communities to provide essential health and education services. Videoconferencing for telehealth allows services such as remote diagnosis of patients and sending medical images from small community health centres to urban hospitals. Videoconferencing for distance education provides opportunities for students in remote and rural communities to complete secondary, college and university courses as well as professional development training.

Our research to date [1] found that First Nations use videoconferencing to conserve and share financial and human resources and to allow participation in events that may not otherwise be possible due to time and travel constraints. Videoconferencing provides more access to region-wide activities and promotes interaction between communities and groups that may not have connected previously. Aside from telehealth and distance education activities, videoconferencing is used by the communities primarily for interactive learning related to personal, professional or community development, for meetings and for community get-togethers. Most of the videoconferences connect more than 10 participants, and women are actively using videoconferencing. The communities are using online video to share their stories with each other, with other First Nation communities, and with the wider outside world. Similar to the videoconferences, online video sharing is mainly a resource for learning related to personal, professional or community development.

2. Research framework

The current study explores the challenges for video communications in remote and rural First Nation communities. When introduced into a community, video communications - similar to all other information and communication technologies - will create both new opportunities to communicate and also new challenges that can lead to inequalities and ineffective communications [2]. This concept of inequality is implicit in influential theories such as Rogers' diffusion of innovations [3] in communications and media research

and the technology acceptance model (TAM) in management information systems research [4].

Our study is guided by community informatics approaches [5], in which the experiences of the community-based organizations and community members with using ICT are central to the analysis. We are also guided by the social informatics concepts of actor network theory and the social actor. Standpoint theory also influences our work. Actor network theory and the social actor concept both assume that the technical and the social are inseparable. People with their technologies comprise social networks. Social actors are both enabled and constrained by socio-technical environments [6][7][8]. In the social informatics approach of Rob Kling, the relationship between the social and the technical is mediated by a complex web of context, structure and agency, history, culture and meaning systems, political and social processes and symbolic and material interests and resources [9][10][11]. Standpoint theory [12] suggests that the experiences and struggles of oppressed groups should be central to the analysis and that although there are commonalities and differences between different members in a group, there can also be solidarity among diverse group members. Drawing on these assumptions leads to valuing the experiential knowledge and perspectives of the actual users of the technology. We believe the best way to value experiential knowledge in our research is to use a participatory-action research approach, working closely with the research partners, using their knowledge and experience to inform our assessments, interventions, and analyses.

In previous research, we developed a framework for analyzing video communications [13]. This framework, which includes four categories or ways of analyzing video communications, guides the current study. The four categories are: technical infrastructure, the interactions of the users with the technical infrastructure, the production and reception of audio-visual content, and the organizational and social relations.

Technical infrastructure includes purely technical elements. Primarily it refers to the bandwidth and network diffusion and architecture, and the quality of service in the network. Video communications requires adequate and symmetrical upload and download speeds on the network. Some kinds of video communications require support for quality of service (QoS). The systems, hardware and software must be flexible and technically compatible. Other technical infrastructure elements include the capacity for video capture, storage and playback, and the flexibility of the technology to support different group setups, locations, and time constraints. These elements of technical infrastructure can also be challenges that determine which communities, groups and

individuals can participate in video communications and the quality of their communication experience.

The second framework category includes both technical and social elements: the interaction of users and groups with the technical infrastructure. Awareness is a primary element. Access to bandwidth, networks, hardware and software, and technical support is another element. People may be aware of the technology and its possibilities but not have access to or know how to access it. Additionally, in some rural and remote communities there may be a high number of potential users compared to the available equipment, bandwidth, networks, hardware, software, and technical support. The potential users may have a low capacity to use the technology effectively. Other challenges include the relative ease of using and viewing the video and videoconferencing, the software and hardware user interface, transportation to and support services (such as child care) at the videoconferencing facilities and the physical space available considering furniture (position, quality), room (size, obstructions), lighting and room configuration.

The third category - production and reception of audio-visual content - includes both social and technical elements involved in actually making a video and putting it online or conducting a videoconference. This aspect includes how people, groups and organizations participate to produce the content (of a videoconference or video), and interests of participants to engage in producing the content, the responses of individuals and groups to viewing the content, and the skills and interest of users and groups to produce (and appear in) audio-visual content. It includes the extent to which the content engages the producers and viewers, and to which the production and reception encourages participation and engagement by users and groups. Again, access to adequate bandwidth and equipment to watch and utilize the video productions are essential for a positive experience for the users of these resources.

Finally, social and organizational relations, also an essential aspect of video communications, includes only "social" elements. This last category includes everything from structural social relations such as power and economic relations to the social relationships between participants and the stakeholder organizations, including funding and resource needs, and the governance model of the video communications.

The four categories overlap to some extent: it is not possible to neatly separate the social and technical. We believe this framework manages to capture the range of social and technical elements involved in video communications.

3. Research method

This study was conducted as part of VideoCom, a research project investigating the use of video communications by two First Nations organizations - K-Net in Northern Ontario and the Atlantic Helpdesk in rural Cape Breton, Nova Scotia. Both organizations provide video communications services and support in First Nation communities across their respective regions. VideoCom is studying their use of video communications to support community, social and economic development in these communities. Both K-Net and the Atlantic Helpdesk are somewhat unique IT organizations, operating as not-for-profit second-level support agencies that were established by the communities to provide remote and rural First Nations with IT support and services. This development and support work is possible primarily because of the flexibility provided by First Nations SchoolNet, a federal government program in Indian and Northern Affairs Canada (INAC). Four other Aboriginal organizations supported by First Nations SchoolNet are also delivering similar development and support services for First Nation schools and communities in other regions of Canada.

The current project is a partnership between the researchers and the organizations being researched; developing and maintaining partnerships is an important part of doing research with First Nations [14] [15]. The VideoCom project partners are K-Net in Sioux Lookout and KORI (the Keewaytinook Okimakanak Research Institute) in Thunder Bay, Ontario; and Atlantic Canada's First Nation Help Desk (the Atlantic Help Desk) in Membertou First Nation, Cape Breton, Nova Scotia.

For the current study, the researchers collected data from actual users of video communications in First Nation organizations and communities. The study draws on 18 in-depth interviews (15 in person and three by phone), 43 completed survey questionnaires, and the transcripts of two public meetings held by multi-site videoconference.

The data were collected from April to October 2007. In April, the researchers traveled to Thunder Bay and Sioux Lookout, Ontario and conducted nine in-depth interviews with K-Net and KORI staff members. In the same month, they traveled to Membertou First Nation in Sydney, Cape Breton, Nova Scotia and conducted six in-depth interviews with Atlantic Help Desk staff and associates and Membertou First Nation staff. In July, the researchers conducted supplementary in-depth interviews by telephone about specific technical issues with two of the previous participants and one new participant, all in Northern Ontario. The interview respondents included nine men and seven women in various roles including technical, administrative, support and managerial staff. The 15 semi-structured interviews that took place in person averaged one hour in length, using an interview

guide with 63 mostly open-ended questions. Interview participants received a small honorarium. The three supplemental interviews by telephone were shorter and focused specifically on videoconferencing. The interviews were recorded and transcribed. The interviews were confidential, with the transcripts remaining within the research team. The transcripts were analyzed with N-Vivo software and coded for the elements in the research framework.

In July, the project hosted two open multi-site videoconference meetings. The meetings were advertised on the project online meeting space as well as the websites and mailing lists of both partner organizations. They were held a week apart. K-Net provided the videoconferencing bridge (MCU) that linked the different sites and the live webstream to the project webpage and coordinated the technical aspects of the events. The Helpdesk provided a videoconference bridge to communities in its region. Each meeting lasted 1.5 hours. The first, Advancing the Green Agenda with Videoconferencing, connected 23 sites and more than 40 participants, including 12 First Nations communities. The second, Digital Storytelling, connected 10 sites and more than 20 participants, including four First Nation communities. The transcripts of both sessions were analyzed with N-Vivo and coded using the same themes as the interview transcripts.

In October, 43 questionnaires were completed by educators from First Nations schools in Atlantic Canada attending the ICT Symposium organized by the Atlantic Helpdesk. The day-long event was held in two locations connected by videoconference: Burnt Church First Nation in New Brunswick and Membertou First Nation in Nova Scotia. Before completing the questionnaire, participants experienced presentations and demonstrations of online video and videoconferencing as part of the ICT Symposium event. Questionnaires were completed by 43 of the approximately 50 participants at the event, including 15 in Burnt Church and 28 in Membertou. There were 30 mostly closed questions with space for respondents to explain their responses. Questions covered background demographics, current use of a range of video communications technologies, and perceptions and ideas about sharing videos online and using multi-site videoconferencing. Completing the questionnaire took about 10 minutes. The questionnaire was anonymous - respondents were not required to put their names on the survey. The background data indicate the respondents were 22 women and 21 men; 70% spoke English as a first language and 26% spoke an Aboriginal language as a first language; 98% reported they liked working with computers. The questionnaire data were analyzed using SPSS. We used advanced statistical procedures to examine differences in frequency of use of various

technologies (e.g., digital cameras, video chat, videoconferencing) as a function of gender and first language.

The methodology also included a mechanism to check research findings and researcher perspectives: the First Nation research partners provided feedback on an earlier version of this paper.

4. Research findings

4.1 Technical infrastructure challenges

4.1.1 Network and bandwidth constraints Successful video communications requires proper infrastructure at an affordable cost. Videoconferencing and uploading and viewing videos online requires more network bandwidth than exchanging text data. In Canada the bandwidth available in urban communities is significantly greater than that in rural and remote communities. Some of the remote communities serviced by satellite have enough bandwidth for only one videoconference at a time while larger northern communities like Sioux Lookout can handle six or seven simultaneously. The First Nation communities in Atlantic Canada and Northern Ontario are serviced by T1 connections, cable, fibre, and microwave or, in Northern Ontario, satellite connections managed by K-Net through the Northern Indigenous Community Satellite Network. According to one interview respondent: *"The T-1 is a legacy solution; it's based on a twisted pair of telephone cables. It's more adequate than the alternative, certainly [better than] dial-up and DSL, but it's not adequate for burgeoning needs in the future where fibre would be required... we all know that when they have to go from 2 megs, to 5 megs to 10 megs to 100 megs, then the way you have to do it is with fibre."*

In many remote communities there is no commercial competition to provide broadband networks - because of the low population base, the commercial telecom providers are not very interested in providing this service. For many communities, the network is expensive and can take considerable time to acquire. In many Atlantic Canada First Nation communities, the health centres are serviced by costly ISDN lines. In Northern Ontario, the one provider Bell Aliant charges \$1,400 per month for a T1 connection or about \$2,000 per month including the common add-on services to a community, a considerable sum for a small community with several hundred residents. The need for more bandwidth was highlighted by an interview participant who said: *"We have these service industries knocking on our door that they want to have these [videoconference] sessions in communities, but we need to book the quality of bandwidth, but all the bandwidth is taken up in the community, so we're running into that problem now. That's why we're working with*

Bell to plan to increase the T1s to 10 megs, which means a \$6-million infrastructure build to Red Lake and Pickle Lake, or something like that. So you know, it won't happen overnight; it'll take a couple of years. Right now, they plan to finish a plan by next month, but it probably won't be built until 2009, or something like that. That doesn't help us right now."

4.1.2 Need for network management and Quality of Service (QoS) for videoconferencing in remote communities

The limited bandwidth has to be managed to ensure that videoconferencing sessions are not degraded by other uses of the network, such as downloading and sharing large music and video files. A K-Net staff member explained: *"In our regions, in our communities and in our organizations, we have to carefully manage a limited resource. There is no such thing as unlimited bandwidth, so it has to be carefully managed, just like the highway has to be carefully managed and taken care of."*

Managing the network involves providing quality of service (QoS) for videoconferencing, requiring human and technical resources to be maintained and sustained. The K-Net region uses a videoconference booking system working on a first-come-first-serve basis. K-Net's web-based videoconference booking software checks every 15 minutes for any videoconferences scheduled to be starting; if there is one, the software will open a path through all the routers and configure the routers for the QoS for the videoconferencing equipment required for that meeting.

The QoS online booking process for all videoconferencing equipment on the K-Net Network requires videoconferencing to be booked at least 15 minutes in advance. Trained local operators are provided with access to the video booking software so sessions can be booked from the communities.

4.1.3 Telecommunication providers and institutional, corporate and government technical support

Being able to manage the videoconferencing traffic across all the connections in a videoconferencing session requires that everyone is able to ensure their networks are able to send television-quality traffic to all the other participants. This quality of service (QoS) is possible on a private network where all the routers are set up to manage the videoconferencing traffic in a similar manner.

The First Nations organizations have found that many technicians and network managers in urban-based organizations are unable or reluctant to properly manage their videoconferencing traffic within their own internal networks. This may be due to a lack of experience with

videoconferencing on the part of urban network managers.

When videoconferencing traffic from one site is not managed effectively, it creates problems for the network managers using QoS for the other sites on the same videoconference. Trying to conduct a meeting or a training session by videoconference with a site that is connected over a shared, unmanaged Internet environment, no matter how big the bandwidth is, creates network and technical problems for everyone else involved in the session. Dropped connections, screen freezing and data spikes are only a few of the frustrations experienced by the session participants. Establishing a good connection with these types of "supported" videoconferencing sites on the bridge is often a major challenge, creating delays in the start and the continuing flow of the session.

4.1.4 Critical mass of quality videoconferencing units in communities Videoconferencing will only become widespread in and among remote and rural First Nations when there is a critical mass of videoconferencing units in the communities. Many remote and rural First Nation communities in Northern Ontario have only three videoconferencing units: in the school, health centre and band office. Rural First Nation communities in the Atlantic region usually only have one, in the school; more Atlantic First Nation health centres are acquiring videoconferencing units, and in a few communities the band office has one. One interview respondent described the importance of having more units in communities: *"Easy access to videoconferencing is critical... it's like a fax machine, how far are you going to walk to send a fax? The early days of faxing is not a bad analogy - the first fax didn't make a lot of sense, who are you sending it to? And so it takes that critical mass and it takes that ease of use to really make it very commonplace, like the telephone or like the fax machine... Videoconferencing has to be commonplace. It has to be on people's desks. It's got to be in people's offices. It's got to be easy to use, easy to access, and people have to have that good quality, two-way symmetrical [bandwidth] with quality of service."*

Ensuring QoS also implies the need for good quality set-top videoconferencing systems. Although the cost of these systems is dropping, they are still expensive compared to desktop videoconferencing systems using software and webcams. However desktop systems do not consistently provide the quality necessary for successful community videoconferencing sessions. In a multi-point videoconference session, desktop systems are difficult to manage and can create a lower quality session for all the participants. An interview participant believes the higher-end units are a better value: *"The higher-end video units*

are by far preferential, because when you're dealing with software videoconferencing, you're at the mercy of a webcam. There's such a variation out there of quality of those cameras. You can go to Wal-Mart and buy a camera for \$19, or you can go to wherever and buy one for \$300 or \$400. If you're going to buy one for \$300 or \$400, just to do videoconferencing with it, then maybe I should go the last mile and buy the Sony PCS-1 or the Polycom 6000; buy the better unit that you're going to get quality audio out of, and a more quality product with ease of operation. The higher-end codec is better than the software, which takes some doing to make it work properly."

A related challenge is that many partners and suppliers of the remote First Nation communities do not have videoconferencing units at all and so they cannot use the technology to communicate with the communities.

4.1.5 Technical challenges for sharing videos online The network bandwidth constraints, particularly in satellite-served communities, can lead to slow download speeds and frustrating waits or the inability to view large video files online. Uploading videos will also take longer but for videos, the download speeds are critical for viewing.

The capacity for making videos and putting them online is growing rapidly in rural and remote First Nations communities but technical challenges inhibit more video production and sharing. Editing large and professional quality videos requires a newer computer with FireWire, a DVD burner and editing software, as well as someone who knows how to FTP the file.

Institutions such as government departments are creating firewalls that prohibit individuals working in these institutions from downloading video codecs to their work computer. Without a codec, many of the archived webcast videoconference sessions on the K-Net server cannot be viewed. This means that video stories from the communities cannot be shared with government partners or with civil servants more broadly.

K-Net's server for sharing the videos of archived videoconferences, the Starbak server, is now five old and requires careful management to avoid running out of storage space. It is difficult to find videos on the server and there is no search function. Today, the video codec cannot be used for the MS Vista O/S or Macintosh computers. Replacement archiving hardware and software is being considered but most proprietary solutions still require the use of their own codecs to view the material.

4.2 Challenges of community members interacting with the technology

4.2.1 Levels of awareness of and comfort with technology in communities The biggest challenge for video communications identified in the interviews is the lack of awareness in communities and by community organizations that the technology is available and that it could be useful. This situation exists after more than five years of introducing videoconferencing equipment in these remote and rural communities. Often staff working in community organizations with the necessary equipment and connections are not aware this capacity exists and that they can use it. Many staff members are “blinded” by traditional ways of doing things and actively resist changing their delivery processes and methods.

Some interview participants said groups and organizations need to change their work processes so that videoconferencing fits. However, others said videoconferencing does fit the current work processes of many groups and organizations but they do not know this: *"People hold this mindset that, oh no, we can't deliver a session or we can't have a meeting by video because we just can't, it doesn't fit into our methods. But when you say to them, well, okay, what do you do, and you actually start pulling what they do at these meetings out, or what they require, then they start to learn that there's tools, like a document camera to show different things. You can hook a PowerPoint presentation up to the video. You can run a VCR and record stuff. You can show a tape. I think people don't see [the opportunities]. Even for focus groups and when people are writing notes, you know, you just move the camera and you show it. There's different ways of doing things."*

Many people in rural and remote First Nation communities are not comfortable with videoconferencing. Interview respondents believe that as people use it more, they will get more comfortable with it. Several mentioned that some older workers in the health and education systems are not comfortable with it but younger ones in training are keen on videoconferencing.

When people are not comfortable with the technology they will not leave the equipment turned on; this in turn makes it difficult for others to visit by videoconference without booking the unit.

4.2.2 Levels of community training and skills training and few champions Following the low levels of awareness, the next biggest challenge for video communications identified in the interviews and survey is the low level of training in communities. Staff at community organizations and other key community personnel need training to use the equipment; in some organizations, staff turnover is high, compounding the challenge. Training is also needed in partner organizations that support community development activities in the rural and remote communities.

Community champions are needed to organize videoconference sessions and support the users of these communication tools, especially special events when invitations need to be sent out to remote participants and rooms need to be booked. One of the interview participants identified the need for more community champions: *"Finding and identifying local champions within the community would be a step in community development. Just locating them and finding the resources. Or being able to give them the knowledge, and the resources, and the support that they need in order to go out and bring community awareness to some of the technologies that are available. I think there's quite a few issues that everybody faces. Money is always a big issue because it's never available, and I don't think people want to work for free."*

There are people in many communities with the skills for making a video. In the survey of Atlantic teachers in First Nation schools, 64% said that making a video and sharing it online would be easy for them to do. In the interviews, several respondents said that many young people in the rural and remote communities are using small cameras and cell phones to record videos and put them online. For these skills to become more widespread in the communities they will need to be shared.

4.2.3 Capacity for technical support in many communities Following on from the low levels of training is the low capacity for technical support. In most government, institutional and corporate offices across the country, there is always at least one trained technical contact person who assists staff in the use of computer and videoconferencing equipment, and the need for technical support staff is rarely questioned. But in remote and rural communities, funding for such a position is always in short supply.

The lack or low level of technical support for video communications was identified as a significant challenge in the interviews, the public videoconference and the survey. There is a need to have technical people in the communities but not every community has this. One participant in the public videoconference described the need for that support: *"There's a fear of using the equipment. People want to have that comfort level of having somebody there in case there's a technical issue that happens. So lots of times I will go there and make sure they get connected and stay there until they are comfortable, and then eventually, they become aware of how the equipment works and they gain a comfort level and they're able to, you know, move forward on their own."* An interview respondent described the need for technical expertise to provide videoconferencing set up and maintenance: *"If the video system gets disassembled somewhere, and there's nobody that knows how it's all*

put back together, well, then there's no video happening anymore with that community until somebody goes there or somebody local is found that can do it."

For organizations that have the resources for technical support staff, keeping trained staff is difficult, especially when they can be better paid in urban centres. One interview respondent said that: *"Staffing is a major issue. It's tough to keep good staff especially whenever other people are pulling them elsewhere with dollars or whatever; especially government pulling people and paying them unreasonable rates, and institutions, and corporations, like you know in those urban centres... And so it is a challenge... to be able to pay adequately."*

Both K-Net and the Atlantic Helpdesk provide videoconference bridging services for multi-site videoconferences. This service requires trained bridge coordinators. The communities would be considerably challenged to use multi-site videoconferencing without that skilled technical support person on staff.

4.2.4 Difficulty accessing equipment in communities A major challenge for videoconferencing in remote and rural communities is the difficulty of accessing the videoconferencing equipment. It can be a lot of work for a community person to find out where and how they can access the unit in their community. In many organizations it is complicated or hard to get into the rooms with videoconferencing units. In band offices, the units are often in meeting rooms that are heavily booked. The equipment in schools and health centres are usually not set up for community uses of videoconferencing. The rooms with videoconference units are often not available after 4pm and on weekends, and there is nobody to supervise or provide support at these times. When there is a community-type centre in the community, it will not often have videoconferencing equipment. With limited facilities and funding limitations, it is a challenge to find a way to make videoconferencing equipment available on demand. The e-Centre or Telecentre model - where appropriate meeting and training facilities exist with technical support and required equipment - is in place in only a few communities.

A related challenge is that sometimes the videoconferencing equipment is being used for educational events that may attract wider community interest but typically are not open to the wider community. One interview respondent described the situation: *"We're in the process of trying to get the telehealth folks to get some of their events and educational events off their network video units and out into more of a public domain, whether it be the band office board room, or the public health room of the clinic, or the library of the school, or wherever, away from the behind-closed-doors of the clinical equipment and*

mystique of the nursing station. Away from that examining room, or wherever their video unit or their network unit is located. We'd like to see them get off those and into a more public domain where people can be comfortable, and have video being an everyday thing. So that when you walk by you will see a videoconferences going on and you'll think: 'Hey, that's cool, how can I do that?' Rather than have it hidden away in the telehealth suite."

Many of the schools in the communities have high-end video production equipment. One interview respondent said: *"The majority of the First Nations schools in Ontario are equipped, or have been equipped over the years, with camcorders. We've always encouraged the schools to obtain ICT equipment, and preferably it was camcorders, cameras, and projectors, to apply the technique, to use the equipment to capture whatever the topic the community or the school may want to do that particular year. So I would say the majority of schools have the capacity to produce videos - that would be 180 First Nations schools in Ontario. All the KO communities have the higher end equipment, or had at one time, through several different programs like the Smart [Communities] Project. So they have the ability to capture a lot of video."* However people may not know the equipment exists, or they may not know how to access it, or they don't have training in how to use it.

4.3 Challenges for making audio-visual content and events

4.3.1 Levels of time, interest and motivation to produce audio-visual content and events A major challenge identified for producing videos in the communities is that it is hard for skilled people who can make videos to find the time to make them, with so many other demands on their time. To make a good video can take days or even weeks or months, and making videos and putting them online is not a priority, given the time constraints. In community-based organizations, the staff has little time to make videos because of time pressures to be doing other things. Similarly, organizing videoconference events can take a considerable amount of time, and the people in communities most likely to organize a videoconference are also likely to be very busy with other projects.

Another challenge is motivation. In many communities, there is a perception that people prefer to travel to meetings outside the community rather than use videoconferencing to attend the event.

There needs to be someone interested in the community to organize video communications, and not every community has the resources required to support this work or such a position. At the minimum, there needs

to be people in communities wanting to connect and communicate with outside communities; in some communities there are many internal issues and challenges making it difficult to connect with others outside the community.

Both K-Net and the Helpdesk use a community development model in the use of video communications - they do not want to produce the content of a video or videoconferences for communities but will support and help promote it. It is up to the communities, with support, to produce the content and determine how it should be used and distributed. Several interview respondents identified a cultural issue related to motivation. They believe that some people in communities will have to be actively encouraged to share their videos; they will not do it on their own because of not wanting to draw attention to themselves. Culturally in First Nation communities, people tend not to promote themselves or show off their talents; if they are asked or if it is part of their job they will do it but they will not come forward to do it on their own. But it is also obvious that young people in these communities are using social networks more and more to share their videos and stories.

Related to motivation is the fact that some people are uncomfortable with being on camera and are cautious about appearing on the screen in videoconferencing events or online videos. Also people may be hesitant to produce videos that are not engaging. One interview participant said: *"Me personally, I wouldn't want to make anything that would bore anybody. And another thing is hand-held videos. The older models anyway, you get a shaky video. We were watching a hockey game my nephew had recorded... and after awhile I started getting seasick, because the camera was shaking so much... so that's one thing I wouldn't want to do is make anybody sick."*

4.3.2 Levels of use generally by women and Aboriginal language speakers The advanced statistical analysis of the survey of teachers in First Nation schools in the Atlantic region indicate that men engage in many forms of video communications more often than women: using a digital camera for shooting videos, doing video editing on computer, using a webcam on computer, watching online video, videoconferencing with one other site, and videoconferencing with three or more other sites. Also, men reported posting a text comment to an online video significantly more than women. Further, men were significantly more likely than women to report an intention to make a video and put it online during the current school year.

Survey participants whose first language is English were more likely than those whose first language is an Aboriginal language to report using a webcam on a

computer watching an online video, videoconferencing with one other site, or videoconferencing with three or more other sites.

These results are in marked contrast to the results of our previous study of archived video material online where it was shown that women actually used videoconferencing more than men in the remote First Nations in northern Ontario [1]. Further research could explore this situation in more detail. It is possible that in northern Ontario more communities have videoconference units in health centres, where generally the workers are more often women than men. Another possibility is that in-person contact is possible for women from different communities in Atlantic Canada with road access but not really an option for women living in different remote communities in northern Ontario; given the lack of in-person options, more women in northern Ontario will choose videoconferencing to share and access resources and services.

4.3.3 Knowledge of topics of interest and interested people in communities The survey of teachers in First Nation schools in Atlantic Canada found that many do not know people in other First Nation communities who would be interested in participating in videoconferencing events. Similarly, K-Net and the Atlantic Helpdesk staff are challenged to find the key people in the communities who might be interested in taking part in a particular videoconference event.

There is also a knowledge gap about what topics and issues will interest community members. For a community videoconference, the topic needs to engage people or they will not participate. Similarly, to make engaging videos for sharing online, the topics that will draw viewers need to be known.

4.3.4 Knowledge of videoconference etiquette and good practices For a videoconference event to be successful, participants need to know about videoconference etiquette and good practices. In the public videoconference held as part of the current study, participants noted that some people are not sure of what to do for a videoconference, where they should sit and so on. One participant said: *"The host and the presenters came to us before and said: What's this videoconference like? What should I wear? Where should I stand? So we're excited to talk more about that in the future. I even had to put some masking tape on the ground for some presenters that liked to wander around, and we eventually found good colours that worked on video."*

Participants also said that many people in videoconferences are not aware of lighting and microphone issues, the need to have logos or other identifying information in the videoconference rooms so

that people can recognize the sites and establish trust, and the need to make "presentation" style videoconferences more interactive so that remote participants can actively participate, by limiting the presentation time and so on.

4.3.5 Visibility of existing audio-visual content Many teachers in the survey said they did not know where to view and share videos made by students. Both K-Net and the Helpdesk have many videos on their servers but they are not easy to find and it is not obvious how to share a video on the servers.

K-Net has a dedicated server to store video records of previous videoconference events, including public videoconferences hosted by the Atlantic Helpdesk. However, these video archives are rarely used. Video archives of community videoconferences could be an excellent resource; however, many interview participants said that the archives take too long to sift through. Participants suggested annotating the videoconferences so that relevant content in the archives would be easy to find. However annotating videoconference archives is time-consuming and takes considerable skilled human resources to do properly. Some interview respondents had the perception that archived videoconferences are password protected and hard to view. Another challenge with archived videoconference material is that the content can become quickly outdated; for example, with health sessions the content may become outdated in six months.

4.3.6 Concerns about cultural exploitation by sharing video content A final challenge to the production of audio-visual content in remote and rural First Nation communities is a general concern with sharing content with those outside their community. This can expose the community to potential exploitation of their intellectual property. Unfortunately, there is a long history of outsiders using traditional Indigenous knowledge to make a profit and not sharing the profit with the people who traditionally held the knowledge. Once traditional knowledge is put in the public domain it is difficult to maintain control over it. One interview participant said that in her community it was important to get the permission of community leaders before making a video, to ensure that the video will benefit the community. Sharing of traditional knowledge and First Nation culture become possible using video technologies. Developing innovative strategies to ensure the ownership and information is protected so it can continue to benefit the people and the communities is essential for these developments to be possible within these online environments.

4.4 Challenges for organizational and social relations

4.4.1 Need for a community and social development focus by funding programs Canadian governments recognize the need for public support for broadband infrastructure and networks in rural and remote communities and have made different, but limited, funding sources available for this purpose. Communicating by video requires financial resources for equipment, software, technical support, maintenance, and training. However, an ongoing challenge for community-based ICT in general is that funding is often available for networks and equipment but not to develop the community capacity to maintain and run the equipment, to train people how to use it, or to support its use. Most funding sources do not have a community or social development focus or provide for sustainable development in communities. As a result, funding is generally unavailable for communities themselves to sustain video communications. As well, the K-Net and Atlantic Helpdesk organizations do not have secure, ongoing public funding to support video communications in the communities they serve.

In northern Ontario, K-Net is supporting the development of community-based networks: networks owned by the local communities that can provide services like telehealth to pay for the cost of the network. For these community-based networks to be sustainable, they must be capable of supporting videoconferencing: if services such as telehealth and distance education that use videoconferencing can pay for the infrastructure, the communities will have access to videoconferencing for a wide range of other purposes.

K-Net has started to invoice outsiders for videoconferencing bridge and network use, in order to support community ICT activities: *"We've begun invoicing for our bridge and coordination of video calls. We've begun to build in the community support component for these services. Another thing that we've also been adding is compensation for local technicians to help out. Because too often in the communities, there's such a small pool of people that are comfortable enough and trained to use the equipment, and if we can support those persons and if we make sure they're compensated, then they're going to take a lot better interest in keeping the equipment and therefore be more willing to use it. So it's not only supporting the community network, but supporting the community people as well."*

4.4.2 Level of video communications activity by urban organizations The interview respondents identified a general lack of awareness, by professionals and institutions in urban centres, of the communication needs of rural and remote communities. People working in urban organizations have ready access to communication

links and many do not understand the importance of videoconferencing as a tool for connecting rural and remote communities. In some cases, government and other outside partner organizations in urban areas do not have adequate support for videoconferencing in their own organizations and need K-Net and the Atlantic Helpdesk to support their use of video. As well, some large urban institutions have IT departments that do not want to change their mode of operating so that they can connect with IP networks in remote and rural First Nation communities.

At the public videoconference held for this study, several government participants said that many bureaucrats in Ottawa and other urban centres are not aware of videoconferencing and the government lacks champions to promote videoconferencing to reach out to First Nations: *"I think what is missing in Ottawa is maybe champions at the federal government departments to promote the videoconference capacity in reaching out for policy development, not to miss out the First Nations that are in remote communities that often can't come in to Winnipeg or Ottawa to provide their views on future policies. So for consultation purposes, videoconferencing is most important, to make sure that we get the views of all those concerned by the policy and the programs that will be developed."*

Similarly, an interview respondent identified the need for more openness by government bureaucrats: *"Whenever you come down to deliberative policy-making, it really requires two-way communication, and the people at the end know what they need. If they're going to be heard, then they need to be listened to and their opinions need to be respected. The solutions aren't going to come from the centre. The centre can develop solutions for their own environment, for their own communities, but whenever it comes to the rural and remote, there's a real challenge to that. That's what our struggle has always been, is getting people beyond that closed way of thinking."*

4.4.3 Demand for and marketing of local services and information Videoconferencing is an effective two-way or multiple site communication tool that provides local entrepreneurs, businesses and organizations the means to deliver quality programs and services from the remote and rural communities in a cost-effective manner. Telework is possible where the infrastructure and the corporate culture exist to support this non-traditional means of employment. With these communication tools, the possibilities for economic and social development and sharing of expertise are potentially endless. However mitigating these possibilities are traditional attitudes of program and management styles within institutions, businesses, government and corporate environments. A

major shift in thinking and approaches is required to enable demand for videoconferencing to grow.

5. Conclusions

We used an analytical framework with four categories to identify challenges for video communications in remote and rural First Nations communities in Canada.

The challenges are many and varied; the findings highlight at least two common themes. First is the need for capacity building in the communities to use video communications technology effectively to meet community needs. The obvious elements here are building community awareness, community skills training, and community-based technology support; many of the other elements identified by the study also involve community capacity-building. The second and related theme is the need for urban organizations and institutions, and especially funding organizations, to understand and validate the need for video communications in these communities. This would imply developing policies and funding programs to support the more widespread diffusion of broadband networks capable of supporting video communications, and programs that include resources for community capacity building to use these technologies effectively. It also implies that these urban institutions should review their own organizational processes to prioritize using video communications so that they are engaging more frequently with rural and remote First Nations communities using these technologies.

The introduction to this paper discussed the findings of our earlier study that remote and rural First Nations communities are currently using video communications for a wide range of purposes aimed at community, social and economic development. It is useful to remember this point in light of the many significant challenges impeding the use of video communications for these purposes.

We note also that the videoconferencing technologies discussed in this paper are evolving. The use of desktop-computer based videoconferencing is increasing and will create additional challenges for managing limited bandwidth as well as new opportunities for increasing the use of videoconferencing in communities.

As researchers, we should also point out that K-Net, the Atlantic Helpdesk, and the other community-based organizations across Canada supporting the use of video communications, are international leaders in using these technologies for the development of rural and remote First Nation / Indigenous communities. What we are observing is a process, unique in the world, of marginalized communities struggling and mostly succeeding to use advanced communications technologies in the face of some very significant challenges.

Clearly, video communications will continue to be used by remote and rural First Nations. Perhaps the biggest question raised by this study is the extent to which the partners in this process - K-Net, the Atlantic Helpdesk, their funders and government partners, and researchers - will be able to work together to develop strategies to address these challenges.

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