Final Report

Connecting Communities:

A web-based mapping application to enhance consultation practices between Treaty 8 First Nations, Government and Industry

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Background

The Treaty 8 Tribal Association (T8TA) acts as a central coordinator, facilitator and technical support provider on a variety of issues as mandated by the Council of Treaty 8 Chiefs. T8TA represents six First Nations communities in north-eastern British Columbia: Doig River First Nation; Fort Nelson First Nation; Halfway River First Nation; Prophet River First Nation; Saulteau First Nations; and West Moberly First Nations. All of the communities have identified the need to incorporate geographic information technologies into their daily practice for reviewing and responding to crown land referrals.

A user needs assessment revealed that each of the six communities lacks the technical expertise in using or implementing geographic information system (GIS) technologies. Community advancement is limited by lack of access to current and relevant data. Lack of information and the capacity to analyse it constrains the ability of the communities to respond to requests from industry and government for input on proposed development.

Since the Oil and Gas Commission (OGC) was established in 1999, the number of applications for oil and gas development has increased dramatically. In 1999, there were 776 well applications, 102 geophysical applications, and 333 pipeline applications, totalling ***1,211*** applications. Over the past 10 years, the number of oil and gas well applications has increased substantially to more than 10,000 applications during this period of time. These referrals do not include applications from the forestry and mining industries, B.C. Hydro, wind, and many other proposals for development requiring First Nation review.

In 2004, the six Treaty 8 communities represented by the T8TA received 2889 applications from the Oil and Gas Commission, as part of the consultation review process. With only a 10-day decision turn-around to provide recommendations to mitigate any infringement to culturally or environmentally significant sites, there were 1535 applications (53% of referrals received) requiring more than 10 days for the necessary review. In most cases, these communities received incomplete application packages and lacked the necessary information and tools to make informed decisions.

Instrumental court cases such as the *Haida* and *Mikisew* decisions have directed government to meaningfully engage with First Nations on development activities that would infringe upon Aboriginal and Treaty rights. Recognizing community challenges, industry and government support our initiative to streamline the consultation process, increase local capacity, and to develop new decision support tools. We believe that this project would serve as an important example for other First Nation communities on how to manage information to support effective consultation with government and industry.

Objectives

T8TA is undertaking this project to streamline and enhance the existing consultation process between all stakeholders in our territory, including government, industry and First Nations. T8TA has developed a central data repository and web portal that will allow each of the six community land use offices to share information using a web-based distribution system. The proposed referral management system ("the application") delivers customized geographic data analysis and mapping tools through the web portal. These tools facilitate land and resource management decision-making. They will reduce duplication, increase efficiency, and support a more meaningful and transparent consultation process. Additionally, they will be used by each community to support ongoing decision-making activities, including local community planning and land use planning.

The project proceeded using an incremental, phased approach that included tangible milestones and a formal software design methodology. This ensures success for all communities in the long-term. In the initial phases, the needs assessment was refined into activity diagrams and use cases, and a detailed software design prepared. Then, a test bed application was developed for the Doig River First Nation. This allowed users, who have limited knowledge of geographic information technologies, to load data, create maps and print them out. The test bed application allows the application to be tested and refined before it is implemented in the other five communities. Once this stage is complete, the application will be implemented for all communities.

Outcomes/Benefits

Access to geographic data through a web-based portal and integrating streamlined mapping tools into the referrals process will enhance the current consultation process by reducing duplication, creating efficiency and building capacity. Community capacity to deal with government and industry on issues related to land management will be enhanced. At the same time, the T8TA coordinating lands office will be able to use the application's ability to integrate geospatial data from the Canadian Geospatial Data Infrastructure (CGDI) and local sources to focus on strategic land use planning for the entire Treaty 8 territory in B.C., and aid consultation with communities when developing land management.

Methods

Our data management and distribution model builds on previous work by the Doig River First Nation supported by the Sustainable Communities Initiative that developed an oil and gas impact review capacity. This is enhanced using information provided by the National Forest Information System (NFIS) and British Columbia web map services (WMS) developed with support from GeoConnections as part of the Canadian Geospatial Data Infrastructure (CGDI). T8TA will maintain a central repository of local information on information themes such as cultural use and occupancy activities. This will create a standardized base of information for all

communities, while keeping updating and maintenance functions in the hands of T8TA. T8TA will work with the Province of British Columbia to test and use cascading WMS technologies to integrate T8TA information with geospatial information from provincial data repositories. Data will be accessed by communities using calls to the cascading WMS, with symbology and content customized where required using Styled Layer Descriptor (SLD) calls. Additionally, use of Data Access Control System (DACS) to provide data security will be investigated.

Current CGDI infrastructure makes available important datasets of value to land management activities. The infrastructure, used in combination with local information, has the potential to enhance community capacity to comment on development proposals. Since datasets provided by CGDI are served through web-based open standards and maintained by their custodians, communities such as those represented by Treaty 8 Tribal Association can make use of them without putting into place redundant local capacity to update, maintain and serve the data. Instead, T8TA will focus on maintaining up-to-date local datasets such as use and occupancy information. The datasets, along with proposed development information, will be combined through use of cascading web map service (WMS) technology and delivered to communities through web-based tools. These tools will require commonplace and easily supported web client software and hardware on which to run it.

Previously, combining geospatial information in this manner to aid community consultation has been unfeasible. The need for software and hardware capacity, along with staff expertise, to manage and combine datasets locally, has meant that putting in place such an application has been beyond the reach of T8TA communities. The application is innovative in that it:

1. gives communities the capacity to use geospatial information, both local and CGDI-provided, as an aid for decision-making within realistic staff and technology investments;

2. allows easy upgrading of that capacity by T8TA technical staff as enhancements are developed; and

3. facilitates information sharing between communities and T8TA if communities develop in-house abilities to create or maintain geospatial datasets in the future.

RESULTS

Project outcomes compared with planned objectives

The planned objectives for the Connecting Communities project include building an application that would minimize additional work loads in each of our six Treaty 8 First Nation communities. This application would be one that is: straightforward to use, requires minimal training time and technical maintenance, and maximizes task automation. As well, the application would be built flexible to the needs and data availability in each community. The application must also be resilient to network challenges.

In terms of project outcomes, The Treaty 8 Tribal Association (T8TA) has been working diligently on the testing of the application. T8TA has been working with Doig River First Nation on testing the client side, as well as the server side of the application. A server was purchased that will be set up solely for the purposes of this project. The six T8TA First Nation communities will have access to the server and will receive updates on a nightly basis.

The application will allow Treaty 8 First Nations to develop maps that will provide a broad spectrum of information on Treaty 8 territory. The maps will empower the Treaty 8 First Nation communities and help protect cultural and heritage values. This information will also aid Treaty 8 First Nations to make better and more informed decisions about the potential impacts to Treaty and Aboriginal rights which are protected under the Constitution Act, 1982.

Assess the Project's success in meeting end-users needs

The development of the application is very promising in terms of meeting the needs of the six T8TA First Nation communities. Each of the six T8TA First Nation communities receives thousands of Oil and Gas applications each year, so the application is being built to minimize the amount of work load faced by each community. The Reports assist Lands Manager's decisions to use and send out environmental monitors. There is no need to review the report for incorrect information, as all of the fields have automated responses. This minimizes the amount of time needed for reviewing documentation for spelling errors or errors with proponent information.

Discuss the technical challenges encountered

Technical Challenges

The greatest technical challenges encountered while developing Connecting Communities have related to staying true to core principles for the application confirmed during the design phase. Below, we reiterate some of these principles, and then discuss complexities and challenges introduced by following them to design and implementation.

***Minimizes additional work load*:** The application should require a minimal amount of work for users that results in benefits that reduce previous manual workload and return maximum benefits of increased effectiveness and efficiency. Following four sub-principles will help to achieve this goal:

1. ***Simplicity*:** The application should be straightforward to use.

2. ***Minimizes training time***: The application should require minimal staff training to use.

3. ***Maximizes task automation*:** The application should maximize system automation of tasks and minimize user inputs required.

4. ***Minimizes community technical maintenance*:** Application technical maintenance required from community staff should be minimal.

Paradoxically, following this design principle has required a great deal of design effort and care. To achieve maximal task automation and minimize end user inputs, the application architecture has had to be designed to allow definition of geoprocessing and reporting tasks by administrative users so that end users can benefit from these being performed *by the system* and not *by them*. For instance, Connecting Communities supports automatic creation of administrator defined buffers around proposed activity areas/lines/points, selection of features from other geodatasets falling within these buffers, and generation of tabular reports detailing information on these features. These tasks are automated so the end user is only required to load the proposed activity features. This automation requires that a great deal of intelligence be built into the application instead of just relying on end users to execute operations manually. The challenge is compounded because the system does not hard code operations, but rather implements a framework in which operations can be defined.

***Flexible to needs and information availability*:** The application should be flexible to the needs and data availability in each community.

This was a design principle of critical importance for the Treaty 8 communities. The needs assessment and requirements documenting exercises demonstrated that while the communities have common needs, local datasets used to inform decision making differ from community to community. As well, there are some variations in workflow processing referrals and in needs for recording actions taken.

To accommodate differences among communities, the application was modeled to use generic workflow and reporting functions. These can be customized by each community, with values defined for communities stored in application database tables and retrieved to populate pull down controls and the like. For instance, one community may want to record all communications received about a referral under a single *Communication Received* category while another may want to record each type of communication (*Telephone Call, Email, Fax Communication*, etc.). Implementing this flexibility has required design and programming effort.

***Resilient to network challenges*:** Potential network bandwidth and reliability problems in the communities should be considered in the application design, and alternatives provided whenever possible.

This critical application design principle has led to some of the most challenging aspects of the Connecting Communities architecture. After, it became clear that in the Treaty 8 communities Internet bandwidth was variable, and network connections were of varying reliability. At the

same time, the time critical nature of oil & gas referrals and the volume of referrals both required that the application be highly available and responsive.

Taken together, it was concluded that Connecting Communities must be set up as a network application but one that can be run on a local network without a continuous Internet connection. Technically, this has been achieved through an architecture in which each community has a local server that communicates with a central server to share, provision, and back up data. This has required programming effort and introduced additional complexities during implementation.

***Platform independent*:** Software used should, if possible, be independent of the underlying platform and operating system.

***Open source*:** Well-established open source software components will be favoured over proprietary software as long as required functionality is available.

***OpenGIS Consortium compliant*:** OpenGIS Consortium approved standards will be used as geospatial data transmission and data representation standards whenever reasonably possible.

These three design principles, taken together, represent both strengths to Connecting Communities and significant challenges for designing and implementing the software.

Platform independence is a laudable goal, as it increases flexibility and scalability for an application. Open source software frees the application developers from ongoing reliance on particular software vendors. However, these benefits are not obtained without cost. Though as computer software continues to evolve and mature platform independence is becoming increasingly common, achieving this goal restricts the choice of software environments that can be used. Fortunately, most of the open source software packages we evaluated for Connecting Communities are built using platform independent environments.

Similarly, finding software packages that support the CGDI-promoted OpenGIS Consortium standards well restricted those we could consider. A particular challenge was that existing datasets in the communities and those that we anticipate industry will provide most frequently use ESRI proprietary data formats. It was necessary to find environments that support a wide variety of data standards.

Using open source software has proven to be challenging. For Connecting Communities, we have used a number of open source packages, including: Java/Eclipse; Apache HTTP Server; Apache Tomcat; Apache Axis2; PostgreSQL/PostGIS; uDig. Using open source software has presented several basic challenges.

- Documentation for open source products is unevenly produced, and technical support when problems are encountered or questions require answers is provided by the community using the software. While sometimes information needed to solve a problem can be obtained very quickly, at other times there can be very long lags. Unlike proprietary software, a developer using open source has no recourse on the basis of a

contractual obligation for software support. This can lead to frustrating delays in development. In some cases, to resolve these it has been necessary to hire consultants with specialized expertise.

- Proprietary software environments are usually unitary, i.e. all development work is done in a single environment. To the contrary, we found it necessary to use several different open source environments to handle various tasks. Each of these environments has its own particular set of standards and ways of doing things. Thus, using open source has required climbing multiple learning curves to become conversant in how the software operates.

- When using multiple software environments, not only is it necessary to learn how each operates, but it is also necessary to learn how they interact and collaborate. This also requires dedicated effort and experimentation. For instance, one element of the Connecting Communities application development was putting in place server to client communication. The server code was written using Java, and then plugged into the Axis2 SOAP/Spring framework. While this should have been straightforward, it took several weeks to learn how the server Java objects should be written so they would be transmitted properly by Axis2.

- Open source software often is under active development. It is a challenge to develop applications using software that is being modified, fixed and enhanced on a daily basis. It would be more straightforward to choose a particular release of an environment and develop an application using that, but if significant program errors are encountered that are fixed in a later version a developer may feel compelled to change to that version, at the risk that other environment elements may be altered and require reprogramming of the application. We have encountered this problem repeatedly during development of Connecting Communities. For instance, we encountered issues using Axis2 version 1.3 that were only resolved when version 1.4 was released. As well, when we began development uDig version 1.1 was available in a pre-release version. Over the course of the next nine months, five subsequent pre-release versions were made available, and finally a release version. It was only in the final version before release that a number of previously mystifying problems for the Connecting Communities client were resolved. Furthermore, while the release version of uDig 1.1 has proven quite stable, there is additional functionality available in version 1.2, currently under development, that we would like to incorporate into Connecting Communities. However, we lack confidence in the stability of version 1.2 and thus have not been able to take advantage of new developments in it.

Discuss CGDI content, standards, and technology that were utilized

Current network capabilities in the T8 communities make it unfeasible to use web-based CGDI data delivered using WMS or WFS as a primary resource. However, it was desired that the application architecture be designed to allow use of web-based information alongside local datasets, and to allow evolution to increased use of such information as networking improves.

To achieve this, the Connecting Communities architecture supports a heterogeneous data model for mapping and analysis. The primary geospatial data repository for the application is a local PostgreSQL/PostGIS instance. Geodatasets are loaded into this repository primarily from ESRI shapefiles. However, geospatial layers can be defined in the application can consume data from OpenGIS network sources, allowing flexibility to use such data when available and appropriate.

The primary client platform for the application is the Refractions Research uDig product. This open source desktop GIS application framework that was developed with support of GeoConnections. It supports both the WMS and WFS OpenGIS Consortium standards.

Discuss any gaps that were identified in the CGDI

(See Recommendations for CGDI Development and Direction.)

Provide recommendations for CGDI development and direction

- Geomatics capacity in the communities has suffered from a lack of resources necessary to maintain and upgrade computer software and hardware. While GeoConnections provided some support to help deal with this through its Sustainable Communities Initiative program, this concluded in 2005. It would be valuable to establish a similar initiative to aid communities in keeping their technology current.

- While Treaty 8 Tribal Association has endeavoured to address the issue of maintaining community geomatics capacity through supporting community staff with T8TA geomatics experts, it would be valuable for GeoConnections to provide support for ongoing geomatics training through workshops and other means.

- T8TA searches out and downloads geospatial data on an ongoing basis for use by the communities. This is a time-consuming activity. It would be valuable for GeoConnections to promote standards that make finding geospatial data on government websites more straightforward.

- Current development data (for oil & gas activities, mining, and forestry) are not easily obtainable by T8TA or its member communities. These datasets are critical for effective community consultation. GeoConnections should take action to support making these data readily available to all communities involved in consultation.

- It became apparent during the needs assessment and requirements gathering process that one important dataset that could give land officers a clearer sense of community land use and aid fostering community input on development referrals (not to mention for other activities such as land use planning) is use and occupancy mapping (UOM), sometimes also referred to as "cultural inventories." Only one community of six has a recent and thorough UOM dataset. It would be valuable for GeoConnections to provide support to communities for compiling such inventories.

Outline Plans for follow-on activities and Projects

The Connecting Communities is very important to the Treaty 8 Tribal Association and its member communities. Given all of the resource development in Treaty 8 territory, it is important that our member communities are fully equipped with tools that can aid in assessing resource related referrals. Although this application predominantly focuses on the Oil and Gas application process, there is a desire that once the application is working to its fullest potential, the application will then be tailored to meet the needs of the six Treaty 8 First Nation communities for other resource sectors. This will include, but is not limited to: forestry, mining and renewable energy (i.e. wind, run-of-river, and geothermal) sectors. In order for this to occur, the Treaty 8 Tribal Association will continue to seek funding from other organizations.

Of note, the Council of Treaty 8 Chiefs have mandated the set-up of a Coordinating Land Office (CLO). The CLO is currently housed out of the Treaty 8 Tribal Association office and includes the following positions: a Land and Resources Director, a GIS Advisor, a Wildlife Biologist and an Environmental Assessment Coordinator. In addition, a Land Use Planner and Resource Technician will be hired in January 2009. Long term funding for the CLO is through the Treaty 8 Heritage Trust which was set up in March 2008. The Trust receives annual payments from the Province of British Columbia in relation to the change in resource activities from year to year.

Describe Communication activities, including public and internal communications undertaken to date and planned

There are a number of ways that T8TA has been sharing project results. The T8TA has been meeting with Lands Managers from each of the Treaty 8 First Nation communities on a quarterly basis. During these meetings, the T8TA GIS Advisor has been providing updates to all of the Lands Managers on the development of the application. It is envisioned that throughout the deployment of the application to the six Treaty 8 First Nation communities, a running log of notes of lessons learned will be documented. These notes will be crucial for evaluating the success of the project and identifying pitfalls encountered and solutions to overcome potential failures.

The T8TA GIS Advisor has also been presenting at several conferences and/or workshops to share stories about the development of the application. These include:

- The 15th Annual National Claims Research Workshop 2007;
- The Natural Resources Canada AHRDA Holders 2007 Conference;
- The First Nations Lands Referral Forum 091207;
- The 4th Annual First Nations Technology Council Collaboration and Digital Literacy 022108;
- FNSIS Operational Process Documentation; and
- FNTC Community Tools and Cultural Collaboration Conference 2009.

The Treaty 8 GIS Advisor continues to attend several advisory group meetings with the Geo-connections and gives updates with respect to the progress of the software.

Next Steps

T8TA has been working very hard on wrapping up the application and is now testing the application with Doig River First Nation. Once the testing phase with Doig River First Nation is complete, the application will be deployed to the other five T8TA member First Nation communities for use. It is hoped that the application will be fully functional and in use for fall of 2009.

All communications, and promotional and marketing material (e.g. web pages, speeches or papers) related to the project will give recognition to SCEK's contribution, both during and after project completion.