THE GEOIDE NETWORK: PARTNERSHIPS IN INNOVATION

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ABSTRACT

It requires deliberate effort to mobilize people from diverse backgrounds to work together. Often institutional barriers can impede or even block collaboration that would be of mutual benefit. The Canadian agency Networks of Centres of Excellence (NCE) has a long track record of developing interdisciplinary networks to mobilize research that responds to important national needs for Canada. The GEOIDE (Geomatics for Informed Decisions) network, one of the fourteen current NCEs, has been in operation since 1998. This network has established a strong record of success in building partnerships, conducting research, and providing solutions to important societal challenges with geomatics technology.

GEOIDE has selected and funded over a hundred projects in its first three phases, over 500 students have graduated with special training in interdisciplinary networking. The current state of GEOIDE research demonstrates the results obtained for Canada and the world geomatics and cartographic community. GEOIDE has played a leadership role in creating a Network for Networks that has convened a number of similar network organizations around the world. Each country has a distinct model, based on its institutional arrangements, but there is substantial willingness to collaborate between the national and regional groups.

The GEOIDE Network has learned some lessons from its eleven years of operations. A network organization can enhance creativity while ensuring useful results. The key is that people are the biggest asset to any organization, and they will find ways to work together when given a chance. This paper will set out important results from GEOIDE's first eleven years that have particular importance to other countries as they work on their innovation strategies.

Introduction

Established in 1998, GEOIDE (GEOmatics for Informed DEcisions) is a research network group assembling over 130 researchers at 32 universities across Canada, in a range of fields including cartography, geodesy, photogrammetry, surveying, GIS and all the aspects of geomatics. GEOIDE delivers world-class management and research service that leads to substantial benefit to society and the economy. In 2008, GEOIDE was renewed for its final three years (2009-2012) by the Networks of Centres of Excellence (NCE, an agency of the Government of Canada).

The NCE model supports research and development that is firmly connected to a user community, in contrast to more traditional science councils that fund 'curiosity-based' research submitted by investigators. The NCE has twenty years of experience in managing innovation in this networked style. Recently NCE has launched new programmes to foster commercialization of research with somewhat different business-driven models as well.

The GEOIDE Network has applied the NCE network model in the geomatics sector with partnerships involving industry, government agencies at each level from municipal up to national (federal), as well as private non-profit associations. The basic membership of GEOIDE is made up of the research universities across Canada, currently 32 of them. In addition, there are six partners and three corporate members. Overall, there are one hundred affiliates associated with specific projects. These projects engage researchers drawn from different disciplines at different universities across Canada.

GEOIDE is all about networking, inside Canada and internationally. Inside the Canadian network, there are various forms of membership with roles and responsibilities (32 member universities, 6 Partners, 3 Corporate Members, 1 Sponsor, and 98 Affiliates). In each case, there is active participation in the work of the Network. In the evaluation of potential research projects, there is an incentive to form partnerships internationally. There are thirty international investigators in thirteen countries formally engaged in GEOIDE research. GEOIDE has also encouraged international participation in the workshops to disseminate results at the end of projects. These workshops have included over four hundred participants over the past three years.

GEOIDE projects

Over the past eleven years, GEOIDE has conducted projects in three phases; over a hundred projects engaging two hundred researchers and seven hundred students. These projects have covered a range of issues including natural resources on land and sea, natural hazards and emergency response, transportation and logistics, social services and health. The researchers have been drawn from a wide range of disciplines including environmental sciences (geology, ecology, biology), engineering (geomatics, civil, electrical, computing), health, social sciences (geography, political science, planning) and many others. It is not possible to list all the projects here, let alone provide sufficient detail to understand how each has contributed scientifically or economically. The four examples selected for this paper cover impacts in science, in supporting informed public decision-making, in industrial application, in commercialization, in ensuring Canada's role in the worldwide geomatics sector, and in training the next generation of highly qualified professionals.

GEOIDE covers many disciplines, but a single example offers a glimpse into its scientific results. Atlantic salmon hold great value to ecosystems and to humans. The economic value of wild atlantic salmon stems largely from the sport fishery, worth tens of millions of dollars annually. The species is, however, in decline across its natural range, prompting a call to action for resource managers and the science community. A GEOIDE team adopted an integrated approach to salmon habitat from headwaters to estuaries; mobilizing fluvial geomorphology, biology, and geomatics technology. One key element investigates mortality of salmon smolt in their perilous journey from fresh water to the ocean. By using various geomatics techniques, including the innovative use of passive sensor tags on the smolt, they have been able to resolve open scientific questions about a smolt's navigation capacity and its ability to sense salinity and the location of the ocean. Arrays of antennae in the stream bed have enhanced spatial and temporal resolution by orders of magnitude. A previously unknown “commuter” behavior of salmonid juveniles has been observed, to be verified in this field season. The researchers contend that they would not have detected this behavior without the interdisciplinary breadth of their network project. The project’s affiliates (government resource managers, sport fishermen, first nations and the hydro-electric utility) are directly interested in the scientific results since new knowledge of how salmon interact

with their environment will influence land management decisions and public policy on rivers and estuaries.

Several GEOIDE projects heed our Network's motto: *Geomatics for Informed Decisions.* One demonstrated "local visioning" of climate change using an integrated geomatics/ visualization system for improved community planning and engagement on climate change. The goal was to develop ways to spatialize, localize, and visualize the effects of climate change based on climate models "downscaled" to local settings. The work addresses questions such as "what would your neighbourhood look like if everyone met carbon-reduction targets?" The project demonstrated that such a process is workable and effective through testing in two communities in British Columbia (BC). This project has engaged local residents, municipal officials and government researchers; as many as a hundred local citizens attended some of their workshops. Media coverage on radio, television and newspapers increased the reach into the community. The team shared its innovations in participatory visualization methods with colleagues in UK, USA and Switzerland. In the next phase, this team will expand to study four critical regions across Canada and help more citizens and governments to grapple with the tough questions of adapting to climate change. In a parallel effort, another project has assessed the impact of a hypothetical tsunami on the District of Ucluelet, Vancouver Island, BC. The project has considered how to develop credible estimates of losses to properly inform the communities at risk and how to help emergency planners to develop strategies that will reduce consequences of flooding. Using geophysical information about Ucluelet, the project team built a model of a potential tsunami event that details potential damage to types of structures in different landscape positions (wave damage versus flooding). The model was then visualized using advanced augmented reality methods and presented at public meetings. As a result, the District government modified emergency plans to evacuate people more quickly and efficiently to a broader set of safe havens. This presentation was filmed by a documentary crew for the Canadian Broadcasting Corporation (CBC) and will be aired later this year. Through the partnership with the BC government, this model and visualization tool can be replicated for other municipalities.

Conducted in close association with an industrial affiliate, many GEOIDE projects have resulted in advances that have direct application for industry. One of these projects deals with digital photogrammetry. In the consumer realm, digital cameras have revolutionized photography. In the domain of metric cameras for air photography, change has to be backed by careful study of calibration. Adopting new technology requires standards on which the industry can rely. In close collaboration with Terrapoint, a company heavily involved in laser surveys, this effort led to a draft standard for small and medium format digital cameras, and another for LiDAR surveys, issued by the Government of BC. This development will permit the use of lower cost digital cameras for air surveys, position the Canadian industry as a leader in a market valued at around $150 million per year and growing at 15%/year, and may lead to North American standards. In addition, this project explored methods of generating orthophotos from a single image (with supporting laser measurements) that can also reduce costs and improve productivity.

Another project combined video cameras, inertial navigation sensors, and satellite GPS receivers into a prototype mapping van called VISAT. By integrating the inertial sensors with the GPS, the van can operate in urban settings where underpasses, "canyons" caused by tall buildings and other interference limit GPS reception. Similarly, objects detected by the video sensors provide triangulation to enhance positioning. The video imagery can be controlled to

georeference street furniture, needed repairs, or passing traffic to an accuracy of 0.3 m root mean square error, even when the van is travelling at 110 km/h. GEOIDE supported a marketing study for this van to become a commercial venture. A substantial industry has sprung up to capture cities in oblique view, particularly for the major web mapping services. Expenditure on urban infrastructure surveys run at least $50 million per year, growing at 35% annually. This is a small but growing part of the $1 billion spent annually on GIS data in Canada, and much more around the world. GEOIDE is giving Canadian innovation a chance to compete for a share of this global market.

Results

Over the past eleven years, GEOIDE has conducted projects aimed to produce tangible results. These results take many forms, depending on the community involved and the questions posed. At the heart, this is still university-based research, and it includes a component of student training and of traditional publication. Over the past ten years, GEOIDE has graduated about 550 graduate students with Masters or PhDs in dozens of disciplines. These students have gone on to take up positions across Canada in industry, government and academics. In the academic sector, we figure that GEOIDE-trained PhDs make up approximately half of the recent hires in major departments across Canada.

In the publication field, there are many metrics of performance, all of them of limited utility in understanding how ideas are really shared and developed. Yet, in brute productivity, GEOIDE researchers are doing well. Articles in peer-reviewed journals have risen consistently to about 200 per year. Other forms of peer-reviewed articles (in conferences or edited volumes) amount to over 100, plus over 200 student theses and other unreviewed reports. In terms of impact, it is now possible to see highly cited articles in high impact journals that position Canadian researchers among the world leaders in various fields.

GEOIDE also aims to foster innovation that leads to benefits to the economy and society. With support from the Network, a number of startup companies have been created. Each business plan differs in terms of the market segment and orientation. Yet, each GEOIDE spinoff is still in business, though one was acquired early on. On December 23rd, 2005, GeoTango, a York University-based GEOIDE spin-off company offering 3D modeling and visualization services and products, GeoTango became a subsidiary of Microsoft Corporation. This acquisition sets an important milestone in establishing that Canadian entrepreneurship competes at the top level.

Activities

GEOIDE continues to host an annual Summer School, a Students' Network, an annual scientific conference, workshops and significant knowledge exchange activities. Every year, over 200 delegates from around the world attend our conference. The 2009 Annual Scientific Conference was held in May in Vancouver. In 2010, we will join a group of four other institutions to host the first Canadian Geomatics Conference in June in Calgary, Alberta. GEOIDE also supports mentor exchanges and student travel to events around the world.

Global Network for Networks

Recently, GEOIDE established new links with partner networks in other countries. In 2006, GEOIDE hosted a meeting in Banff, Alberta with twelve leaders from similar organizations around the world. These meetings have continued in 2008 with meetings at ISPRS in Beijing, at Digital Earth Summit in Berlin, and in 2009 at GSDI in Rotterdam. With these discussions, five networks are close to signing an agreement to form a new consortium that will provide a means to collaborate more formally. The initial members of this group are expected to include CRCSI from Australia, KLSG from South Korea, AGILE from the European Union, NCG from Ireland, and CentroGeo from Mexico. There will be five other organizations that will join as associate members. The criteria for full membership involve the use of a network model to engage partnerships, the availability of substantial resources to invest in research, and a commitment to collaboration.

What is new about this consortium is that it allows the research community to break down the barriers to funding that are typically strongly tied to national science councils. This network for networks will seek ways to engage collaboration on an equal footing, and a sharing of results. It will also seek to expand the participation in the network. Once an organization in a given jurisdiction fulfills the membership criteria, it can join as a full member.

Future Directions

The GEOIDE Network faces new challenges as it reaches the end of its NCE funding in 2012. The Network is placing a major effort on developing a plan that will continue operations with different sources of funding. Some of these are internal to Canada, but some are international. Over the new three years, the specific shape will become clear.

Whatever the long term future of network funding, the network style of research has already changed the landscape of Canada. There is a spirit of collaboration that has been tested and found useful. Students have grown up to become researchers in an environment of trust and sharing. Industry and government have been renewed with highly qualified professionals trained in a broader way. This is the main legacy of the Network.

Additional Resources

http://www.geoide.ulaval.ca

http:// www.nce-rce,gc.ca