GIS/GPS Labour and Educational Needs for Northern Alberta

Opportunity Report

Prepared for the Northern Labour Market Information Clearinghouse

By

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Introduction:

The economy of northern Alberta is based solidly on resource industries. In response to strong global competition and more rigorous environmental policies, many of these industries must increase their reliance upon advanced technology to manage the production and distribution of their product as well as monitor land use and the environment. Geographic Information Systems (GIS) and Global Positioning Systems (GPS) are tools which can effectively help resource industries and regional planners in these endeavours.

There is a great divergence of opinion, however, on the precise definition of GIS/GPS and how they are used. Many people think that a GIS/GPS provides automatic solutions at the push of a button. This is not the case. GIS/GPS users must have a firm understanding of spatial and geographic concepts.

This report briefly defines GIS/GPS, outlines trends of GIS/GPS use within specific sectors, and provides overall summaries and recommendations of GIS/GPS educational needs for northern Alberta. It seeks to answer two main questions: (1) what is the perception of industry leaders towards future labour needs within GIS/GPS and (2) what are effective ways to educate or train northern Albertans in GIS/GPS.

Methodology:

Information presented in this report was derived from the personal expertise of the authors plus personal or telephone interviews with 23 industry leaders. In addition, several articles, conference proceedings, and industry profiles were consulted for background information. Opinions of industry leaders derived from previous consultations by the authors were incorporated into the summaries although these people are not listed as interviewees because information they gave was not solicited specifically for this study.

Definitions and concepts of GIS/GPS:

GIS/GPS cannot be precisely defined without outlining basic key concepts of the technologies. Indeed, all interviewees for this survey stressed the importance of understanding the concepts of GIS/GPS before they can be effectively applied.

Taken in its broadest sense, a GIS is any manual or computer-based set of procedures used to store and manipulate geographically referenced data. Georeferenced data are any data that pertain to a location on the earth's surface, and they are the building blocks of any GIS. The function of a GIS is, in essence, to create information by integrating georeferenced data layers to show information visually from a variety of perspectives. This is done by asking questions, called queries, of the data bases to examine different relationships, usually on a map or image of the land.

Within a GIS, georeferenced data can be *spatial* or *attribute*. Spatial data are actual geographic representations of the world. Attribute data are information about the specific spatial features. Within a GIS, attribute data must be referenced to spatial data. For example, a spatial representation of a tree could show its location on a map and linked to this representation could be information such as tree species, age, and scheduled date of harvest. A GIS allows this type of information to be graphically or visually represented on a map. For example, the integrated analysis of soil type, slope, forestry practices, and cover type can be used to predict soil erosion so that erosion control programs can target the highest risk areas (Figure 1).

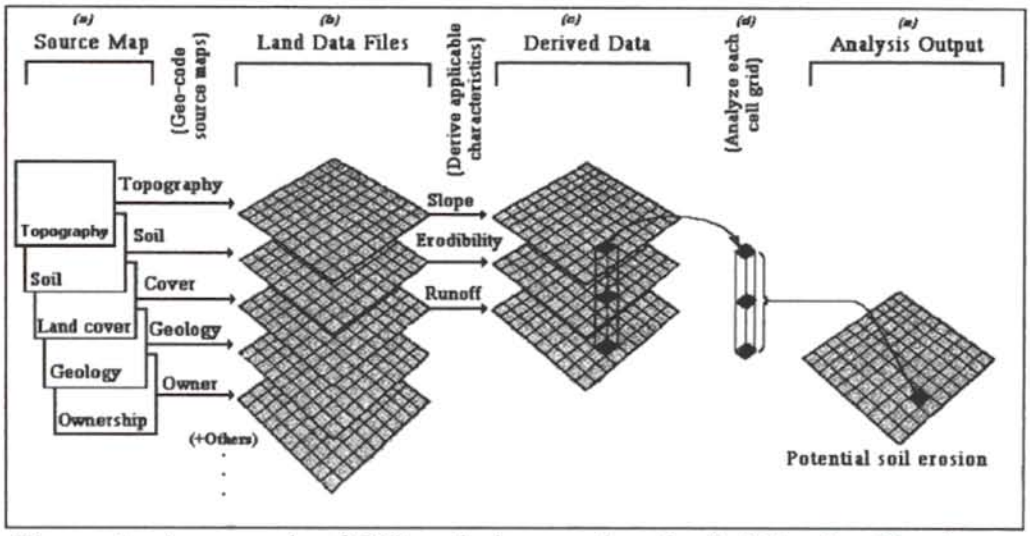

Figure 1: An example of GIS analysis procedure for Soil Erosion Planning.

GIS, in essence, consists of geographical information management systems. The underpinnings of a GIS require a holistic view of systems management: hardware and software systems; data and management systems (DBMS); networking systems; and application systems (Figure 2). Within these systems, the key to their successful use is to most effectively extract appropriate information from the data.

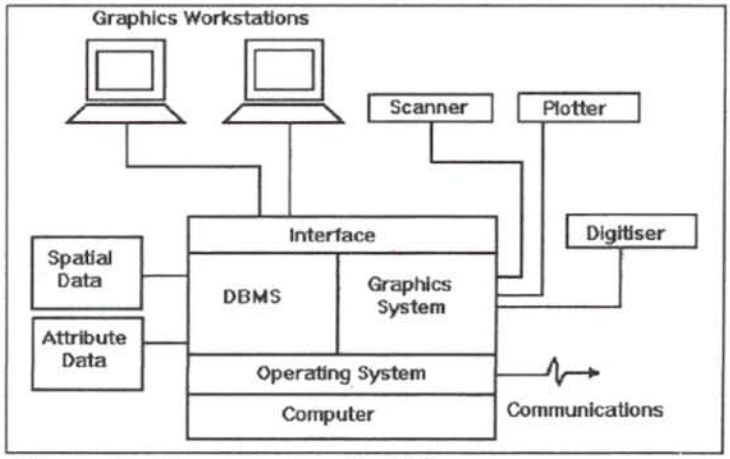

Figure 2: Components of a GIS.

Increasingly, GIS applications are being hailed as integral parts of many industries. As technology increases, so too does our ability to deal with more comprehensive data sets and thus tackle more complex problems which, from a management perspective, are computationally intensive. Other technological advances have increased our ability to collect more powerful data which can be incorporated into a GIS. Although distinct from GIS, Global Positioning Systems (GPS), Remote Sensing (RS) and are indispensable as tools of data collection in GIS.

Global Positioning Systems (GPS) are georeferencing devices designed to precisely identify a geographical location, which works through satellite triangulation. This technology is becoming widely used to accurately locate (often within several centimetres) cutlines, pipelines, utility poles, etc. GPS can also be used as a management tool to show precise locations to apply fertilizer, to precisely map cut block and other vegetated stand boundaries, and for transportation routing to wood lots and mills, etc. This information, when incorporated into a GIS, can then be analyzed and displayed. GPS can also be used as a compass tool for fieldwork and navigation.

Remote Sensing is also an essential form of data collection. Satellite imagery is based on sensing the reflectance of different land types. From a forestry perspective this information can be used to identify vegetation type, stand density and stand health, to name a few applications. Aerial photography is also a type of remote sensing.

SECTOR SUMMARIES:

Sectors covered as potential employers or users of GIS/GPS technology in northern Alberta were resource industries (forestry, energy), GIS consulting and survey/ mapping companies, municipal/ regional planning, and agriculture. The greatest use of GIS/GPS, outside of actual GIS/GPS consulting companies, is within the forestry industries with energy (oil, gas, mining, and utilities) a close second. Two generalizations about all sectors can be made based on interviews and the background knowledge of the authors:

- No one can accurately predict the numbers of GIS/GPS people that will be hired within industry in the next 3 years. The consensus, though, is that there definitely will be a need for more people knowledgeable in GIS/GPS for specific sectors. There was no consensus about whether these would come from upgrading current personnel or hiring new graduates from GIS/GPS programs.

- There is a tremendous need for personnel in all sectors to have an awareness of how their particular speciality relates, in a spatial context, to other components within their company or industry. The term 'integrative skills' was frequently used to describe this need.

Resource Industries (Forestry, Energy):

There is great demand for people familiar with GIS/GPS in all aspects of resource industries. Examples of information contained in a GIS for resource industries include terrain data, vegetation indexes, timber plots, timber harvest history, land types, land ownership, administrative

districts, precipitation, drainage networks, oil pipeline monitoring, utility pole location, etc. Each of these aspects requires people with specific skills. Increased knowledge of how each aspect affects another leads to greater efficiency in resource planning and increases co-operation amongst workers within a company.

In general, all natural resource workers, no matter what their speciality, are seen to need spatial concepts which will allow them to transfer data from their speciality to a GIS and, thereby, be represented on a map. To do this the specialist should have basic cartographic knowledge and an appreciation for the amount of information that can be conveyed by maps. From another angle, any GIS needs a computer specialist who has a background in GIS/GPS theory and concepts as well as highly developed computer skills. The concern within industry is that it is difficult to find resource specialists who understand spatial concepts but it is also difficult to find GIS/GPS specialists who understand resource specialities.

GIS Consultants; Survey/Mapping Companies:

There is ongoing work for GIS/GPS consultant companies to analyze and produce spatial information on a GIS by highly technical applications. These include digitizing (transferring data into digital form by outlining items from a hardcopy map or photograph), high order queries within a GIS software package, and production of high resolution maps. A market also exists for survey/mapping companies to transfer aerial photographs or satellite images to digital format and to correct these data to conform to the earth's surface.

Except for basic technological work such as digitizing, GIS/GPS companies generally employ university graduates who have resource and GIS/GPS skills. Several companies are finding that large companies, especially in forestry, often have the capability for data collection through GPS. Therefore, the function of GIS and survey/mapping companies is increasingly geared to manipulating, analyzing, and producing data collected by the industry rather than having to hire surveyors to collect data directly in the field.

Municipal/ Regional Planning:

There are many useful applications of GIS in municipal and regional planning. Most municipalities are aware and first think of GIS when needing a way to spatially represent and keep track of tax data linked to properties. Other uses are to inventory and monitor road networks and other infrastructure. Fire, ambulance, and police can use GIS/GPS to locate emergency routes. Analytic capabilities include simulations of zoning changes or mapping how a city would look with new subdivisions, etc.

Unfortunately, only larger cities can afford to implement a full GIS. Small scale GIS could be practical for smaller centres but by and large, GIS/GPS people have been unsuccessful in persuading municipal councils to invest in these technologies. GIS/GPS consultants and municipal staff knowledgeable about the situation suggest that it would be possible for several municipalities or regions to pool resources and share GIS/GPS consultants to help them

implement systems. Overall, there does not, however, seem to be a high demand for GIS/GPS municipal personnel in northern Alberta.

Agriculture:

A primary need for GIS/GPS in agriculture is for the monitoring of crops and fertilizer/pesticide use and for land use management. Precision Farming is a current term used to describe the use of GPS and GIS to determine the precise location of inputs such as seed or type of fertilizer based upon detailed information about soil characteristics, slope, field crop type, weather data, and any other pieces of information that can be recorded and monitored.

The consensus is that there is a need for GIS/GPS in agriculture. However, before farmers will invest in the technology, GIS/GPS uses must be more clearly defined and farmers themselves must have objective demonstrations of why GIS/GPS would be useful for them. One area which may require GIS/GPS agriculturists is with fertilizer distributors or consultant companies who can monitor many farms in a region, and then distribute costs among their farmer clients.

TRAINING NEEDS AND RECOMMENDATIONS:

The need to investigate development of GIS training in colleges has been addressed by several agencies. In Canada, the most detailed and formal GIS technical training programs reside at British Columbia Institute of Technology (BCIT), Sir Sandford Fleming College in Ontario, and Nova Scotia Community College. The Northern Alberta Institute of Technology (NAIT) in Edmonton has GIS and GPS courses within their Forest Technology and Geomatics Engineering Technology Certification programs. These are not, however, specific GIS/GPS programs.

A project is being conducted by the National Center for Geographic Information and Analysis (NCGIA) at the University of California, Santa Barbara in the United States to develop resources for GIS curriculum design and course building for two-year colleges. A GIS Core Curriculum for Technical Programs (CCTP) is also being developed by NCGIA as a World-Wide Web (INTERNET) based resource that will support GIS technician courses at community colleges. Before any plans are developed for northern Alberta colleges, it is recommended that these NCGIA projects be investigated at http://www.ncgia.usbc.edu/.

Amongst interviewees for this study, there was a consensus that upgrading or certification in GIS/GPS is absolutely necessary for northern resource personnel. There were varying suggestions about the best method for these continuing education programs.

In general, perceptions towards GIS/GPS education are:

- For specialized and/or managerial personnel, intense 1-3 week professional upgrading courses are effective and appropriate.
- For field and technical workers, intensive short courses in spatial concepts and integrative skills or an eight month to one year certification program would be very helpful.

- The costs of setting up a full GIS/GPS laboratory is very expensive, although co-operative arrangements between colleges and industries to lessen the cost are possible.

Currently, the University of Alberta Faculty of Extension and the Micro-computer Institute at NAIT offer professional upgrading courses in GIS/GPS, which include introductory concept courses. These are usually over one weekend and demand is great. A complete GIS laboratory is in place at the Environmental Training Centre in Hinton. Future use of this facility is dependent upon approval by the Alberta Environmental Protection Department. Grande Prairie Regional College is planning to expand their course offerings in GIS. Other colleges have related courses in land use and geographic concepts although these are in conjunction with other programs.

Recommendations:

Core spatial and geographic concepts could effectively be implemented into current northern college curricula. The key is to link these courses in a practical and applied way directly with industry in the college's region (i.e. forestry in Peace River, oil and gas in Fort McMurray). Basic data management and database software use, such as Microsoft Access could be a part of any resource-based program and would provide students with applied skills. Because of the expense of a full GIS/GPS, it is impractical to create laboratories in every college. A co-operative arrangement could be made, however, which could combine technical instruction in the form of short courses from an institute like NAIT in conjunction with INTERNET resources like those being developed by NCGIA.

Professional upgrading programs are available from a variety of sources including NAIT and U of A, individual consultants, and software vendors. A concerted effort should be made to have all managers in resource industries obtain the core concepts of GIS/GPS enabling them to see applications within their companies. Programs should be more sector-specific and suited to the needs of industry. These would be facilitated by increasing the discussion, co-ordination, and co-operation between training centres and industry.

In summary, GIS/GPS technology in northern Alberta requires: CONCEPTS, CO-OPERATION, and CO-ORDINATION.

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Interviewees:

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4. Alberta Forest Product Assoc.	Bob Demulder	(403) 452-2841
5. Brydun Image-Quest	Jack Henry	(403) 778-5856
6. Challenger Surveys	Richard Schachter	(403) 424-5511
7. Daishowa	Kirk Linley	(403) 624-7226
8. Ellehoj Consultants	Erik Ellehoj	(403) 434-1943
9. ESRI (Arc Info)	Lorilie Barteski	(403) 437-9510
10. Forestry Corp.	Brian Maier	(403) 452-5878
11. Geographic Dynamics Corp.	John D. Beckingham	(403) 436-1217
12. Grand Prairie Regional Col.	George Narcession	(403) 539-2061
13. INTERGRAPH	Terry Grant	(403) 424-7431
14. Keyano College	Harvey Williams	(403) 791-4925
15. Lakeland College	Stew Heard	(403) 853-8593
16. Land Data Technologies	Andrew Christopher	(403) 451-6477
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