

NAD83: Curse Or Blessing?

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Introduction

In order to locate a position on the earth correctly, a datum must be used. The oil industry uses North American Datum 1927 (NAD27) as its primary datum in western Canada and the NWT; however, all levels of the government of Canada and the regulatory bodies who act on their behalf have expressed their intention to move to North American Datum 1983 (NAD83). Most other industries are also using NAD83 and many have had to convert from NAD27.

Converting from NAD27 to NAD83 is a significant undertaking with considerable costs: for a large organization it may take up to four people two years to convert and cost up to \$1.5MM; for a small organization the conversion may be completed in a short period of time and cost very little.

The benefits to industry in the form of cost savings and risk reduction will give a return on the cost of converting in 1½ - 5 years, the length of time is dependent on the exact changes necessary to convert.

In order to achieve these cost savings the following are the recommendations of the CAPP Geomatics committee

- **The oil industry should convert to the use of NAD83 as the datum for all data interchange in a coordinated manner and the conversion should be complete by Q2 2008**
- **An authoritative master land grid (DLS) that is based on NAD83 is made available to industry and the conversion from NAD27 to NAD83 should be performed at the same time as the conversion to the master land grid**

Adoption of NAD83 as the datum interchange standard does not force any organization to convert their data: an organization may decide to continue to store all their data in NAD27 and use gatekeepers to ensure that all data received or distributed by a company has the correct datum.

This paper discusses the cost/benefit analysis project undertaken by CAPP to address the above issue. The presentation will discuss the project, CAPP's decision regarding the recommendations (currently pending) and the next steps for industry.

Background

Latitude and longitude values are not absolute; they are recorded with reference to a datum¹. In North America, the standard datum was defined in 1927 and is known as NAD27. The oil industry currently uses NAD27 for all its spatial data in western Canada and NWT. In 1983 a new, improved datum was defined: NAD83. Coordinates recorded referenced to NAD27 will be different from those recorded referenced to NAD83 for the same point on the ground by up to 270 meters. The oil industry has continued to use NAD27 and has resisted any conversion to NAD83 in Western Canada.

In 1999 CAPP recommended in its publication "Coordinate Integrity in the Third Millennium":

"NAD83 implementation in western Canada is undesirable due to it providing insufficient benefit in relation to its implementation cost, and CAPP recommends all members to continue to operate in NAD27"
http://www.capp.ca/default.asp?V_DOC_ID=763&PubID=64756

Since 1999 the following changes have occurred

- The Alberta government attempted to disseminate their data in a NAD83 referenced format only, effective March 2004 (<http://www.eub.gov.ab.ca/BBS/requirements/ils/gbs/gb2003-30.htm>). CAPP vigorously objected to this time frame and the AEUB agreed to continue to supply their geospatial datasets to the public, third party industry suppliers and data vendors in both NAD27 and NAD83 formats until December 31, 2005.
- Saskatchewan has issued a memorandum stating that it intended to transition to NAD83 for all data by November 2004 (<http://www.isc.ca/default.aspx?DN=719.651.14.1.Documents>). On January 1 2005, Saskatchewan announced that all data distributed would be in NAD83. However, Saskatchewan Industry and Resources will continue to do business with the oil industry in both NAD27 & NAD83 until December 31, 2006, at which point all business must be conducted in NAD83.

¹ A datum may also be referred to as a Spatial Reference System (SRS) and a datum that is used in Canada may be abbreviated to CSRS

Project Initiation

As a result of the changes in the Regulators positions, CAPP initiated a project to determine if the costs and risks to industry associated with converting from NAD27 to NAD83 outweigh the costs and risks associated with maintaining spatial data in NAD27.

The deliverables from the project are

- An outline of the processes required to convert data from NAD27 to NAD83 and an estimate of the likely rate of conversion
- A description of the risks associated with not converting and a guideline for risk management
- A recommendation on the timeline if a conversion process is the preferred approach

Given the above information the CAPP Executive Policy Group (EPG) will need to make a decision as to whether or not to support the recommendations of the Geomatics committee concerning an industry conversion from NAD27 to NAD83 or continued use of NAD27 for all spatial data in western Canada.

Approach

The CAPP Committee distributed a number of surveys to CAPP members, data providers and application vendors. The results of those surveys were used to develop a series of detailed site tests at CAPP member offices to validate the processes and determine the cost of the various options that can solve the problem.

CAPP Member Survey

Questionnaires were distributed to all CAPP members. Approximately 12% of total members replied to the survey. However, the 12% that replied represent 47.8% of the total production in Canada. It is felt, therefore, that although the total number of replies was not high, the replies that were received are representative of the total oil and gas production in western Canada.

Large companies are facing an integration problem: they receive data from a number of sources, but that data is distributed via twice as many interfaces as the number of sources. This means that simply ensuring that all data vendors convert to NAD83 will not address the whole problem: for large companies the internal data volume is more significant. In addition, the majority of data (75%) is in project stores that do not have a straightforward process to convert from one datum to another.

Small companies are facing a data-loading problem: they receive data from more sources than they have to distribute it to internally. Therefore, if it is possible to ensure that all vendors correctly convert their data to NAD83 then small companies will be able to migrate more easily than large companies. However, the small companies have more “complex” projects than large companies and at least 66% of their data is in project stores that do not have a straightforward migration process. In addition, because the small companies have 32% of their data in project stores that were classified as “Other” it is possible to use answers provided from the vendor survey which indicate that 50% of application stores will allow easy conversion from one datum to another. Therefore, the actual percentage of project stores that will require considerable effort to convert is significantly greater than 66% and probably approximately 80%.

Medium sized companies, as one might expect, have a mix of the problems facing the large companies and those facing the small companies. Although the integration aspect is not as significant as that for large companies, the effort required to undertake any conversion is higher as 95% of data is held in project stores that will be difficult to convert.

In addition, medium companies have the highest percentage of complex projects (100%), but they also have the highest percentage of archived projects, thereby minimizing the total number of projects that need conversion (23%).

Data Vendor/Software Supplier Survey

Questionnaires were distributed to 26 data vendors/ software application suppliers. Approximately 45% of the questionnaires were returned. However, the committee feels that the respondents represent the majority of data and software used by CAPP members.

The data vendors are aware of the issues surrounding datum conversions but they are generally not supplying data in NAD83 simply because there is little demand for it. When demand increases, the data vendors will perform the complete conversion.

The availability of a master land grid is critical to allow the data vendors to convert the data to NAD83.

For most data vendors, the cost of any conversion will be insignificant or a one-off charge and 10% of vendors will actually make an additional charge to continue to use NAD27.

The software that is used to perform analysis is evenly split between applications that will allow an easy datum conversion and those that require significant work. For those that require significant effort, additional functionality to ease any datum conversion issues is generally already planned and is expected to be delivered within 12 months.

Cost estimates of conversion of corporate and project databases

Corporate databases are, by their very nature, unique to each organization. Many corporate databases are based upon a standard data model but there is sufficient difference between them that a custom application will need to be developed by each CAPP member to perform the datum conversion. Cost savings will occur if many members have outsourced their database to a third party and all members agree to the conversion; however, the site testing indicated that this is not currently the situation.

The site testing identified that there are seven data-types stored in corporate databases that may need conversion: wells, seismic, land, facilities, gravity and magnetics, remote sensing, and culture/GIS.

There are a large number of project databases in use today and every application that uses these databases will have a different process to perform a datum conversion. Combined, Landmark Graphics and Paradigm Geophysical represent the majority (58%) of all project databases in use. Therefore, additional interviews were conducted at these organizations to determine the processes necessary to convert from NAD27 to NAD83.

The cost estimate for Schlumberger Geoframe is also included as it represents an example of a project store that does not require any update to then underlying data: instead it is possible to implement a piece of functionality that automatically converts the coordinate value to any datum.

For all project databases, the largest issue is not the technical conversion of the data; instead, it is the project management. It is recommended that a full time project manager be used at all large organizations to oversee any datum conversion. Medium and small organizations will not need a full time resource; however, they should also expect a significant effort to manage any datum conversion project.

The breakdown of costs can be used to determine the likely cost and length of time of a project to convert to NAD83. However, there is the potential for reuse of technology, technical skills and parallel activities to reduce the cost and duration of any project. Interviews at large organizations indicated that a project to convert all data within in a large organization is expected to require up to 1 year for preparation but then all the conversion activities should be able to be completed in 1 year. Finally, the QC and support period is also expected to take approximately 1 year.

The overall cost for an organization to convert all its spatial data, both corporate and project, is highly dependent on the technology that an organization uses. For an organization that has outsourced the majority of its data management and uses Geoframe the cost may be as low as \$250,000 and the entire project can be completed in 4 months. For an organization using a project store such as OpenWorks with several hundred project stores and with very little outsourced data management the cost is expected to be \$1MM - \$1.5MM and take 2 years (one year for preparation and one year for the technical conversion).

Technical Approach

The volume, age and source of data stored in corporate databases means that it is impossible to use the original survey data to recalculate coordinate values in NAD83. The only feasible technical approach is to use a computation method to convert from NAD27 to NAD83.

Many computation methods can be used to convert from one datum to another. However, in Canada the only method that is recommended by the CAPP Geomatics committee is to use the National Transform (version 2) grid shift (http://www.geod.nrcan.gc.ca/index_e/products_e/software_e/ntv2_e.html). There are a number of software applications that use NTV2 to convert from NAD27 to NAD83. Different organizations will be able to use any software application that offers this functionality.

Gatekeeping

Gatekeeping is the term used to describe the policies, practices and procedures used by an organization to ensure that all data received and distributed is in a consistent datum.

The current data environment is already a multi-datum world: most data that the oil industry uses is in NAD27; however, there are many data sources that use NAD83 and some data sources that use other datums such as WGS84. Therefore, in order for an organization to be correctly managing its spatial data someone must already be performing a gatekeeper role.

It is expected that over time more and more external data will be in NAD83, for example regardless of whether CAPP members convert all their internal data, eventually they will have to export data in NAD83 in order to submit it to regulatory bodies (see the Saskatchewan Office of Geomatics Coordination letter to CAPP Geomatics Committee).

CAPP members are faced with the choice of converting all their internal data to NAD83 and ensuring that all data vendors convert to NAD83 or continuing to use NAD27. The critical point to note is that whether the oil industry converts or not there will still be a need to exist in a multi datum world; however, the level of gatekeeping will be approximately the same as today as historical data will still be in NAD27.

If the oil industry decides not to convert, the effort involved in gatekeeping will increase and never end. Converting to NAD83 will reverse this trend, resulting in reduced gatekeeping costs over time.

Risk Analysis

Obtaining risk values that are directly attributable to datum conversion issues is a difficult activity. Rarely a single factor contributes to an accident. However, incidents have occurred in the oil industry that are directly attributable to datum issues, in both North America and elsewhere.

Interviews with geomatic professionals revealed that 0.1% of wells are likely to produce sub-optimally or actually have an incident due to a datum issue. There are approximately 20,000 wells drilled each year in the western Canadian basin and it is estimated that datum issues contribute to \$25MM lost revenue each year.

A full conversion of all data both internal and external is expected to reduce the lost revenue due to datum issues by 90% to \$2.5MM.

A large organization that is active in the western Canadian basin may drill 1,000 wells a year; therefore, they can expect to realise a net benefit of a datum conversion of approximately \$500,000 per year. However, in order to realize these benefits the organization will have to pay for the conversion project: this is estimated to cost \$1.5MM meaning that the payback time is approximately 3 years.

Summary and Recommendations

Given the effort that will be required to undertake any datum conversion to NAD83 and the need to coordinate CAPP members, data vendors and application suppliers the following form the recommendations of the CAPP Geomatics Committees

1. An industry wide datum conversion to NAD83 is recommended when the following conditions are met:
 - Data vendors and software application suppliers are delivering data and applications that are datum aware and are capable of displaying all spatial data in NAD83. Information from data and application vendors indicate that this condition will be met by Q1 2006.
 - An authoritative master land grid (DLS) is available in NAD83 as any update to the land grid may require modification to spatial data in interpretation projects. Therefore, if industry converts to NAD83 and the land grid is not stable then the spatial data in projects will need to be converted several times
2. When these conditions are met, the first stage in the datum conversion is to establish NAD83 as the datum standard for all data interchange. Initially, this should apply to data submitted to and distributed by regulatory authorities. The effort involved for CAPP members to comply with NAD83 as the datum standard for all data interchange is significant and so the standard should be implemented by the end of Q2 2008.
3. The CAPP Geomatics Committee has identified two distinctly different approaches to achieving a datum interchange: Mass Conversion and Gatekeeping. All CAPP members who participated in the detailed site testing of a datum conversion will see benefit to a conversion in 5 years or less; however, Gatekeeping will allow a company to be fully compliant with a datum interchange standard without converting all their internal data. Therefore, despite it being the recommendation of the committee that all CAPP members should convert to NAD83 it is recognized that some organizations will continue to store all data in NAD27. This will not affect their ability to conform to the datum interchange standard.

NAD83 is here to stay. Ignoring it is not an option. All Canadian governments have expressed their intentions to drop NAD27 and supply their data only in NAD83. They also plan to require all industry submissions that contain coordinate data to be in NAD83. Other major industries who were at first reticent, have embraced NAD83 and do not regret their changeover. Our industry is already dealing with NAD83 in daily operations but in an ad hoc manner. Most location data is presently collected in NAD83 and forced backwards into NAD27. If we adopt NAD83 we reverse this and over time NAD27 will just disappear. Adopting NAD83 does NOT force any firm to change their data to NAD83: it only sets an industry goal. This in turn gives data suppliers and software suppliers the go ahead to put proper NAD conversion systems in place. Firms may decide to retain their data in NAD27 and set up gatekeeping to insure there is not a datum mixup in the incoming and outgoing data. This is nothing new; it is already in place in many firms and must be done regardless of whether we adopt NAD83 or not. If data/software suppliers have incentive to improve their products datum handling capabilities this will aid the gatekeeper's role. If CAPP adopts NAD83 as a standard, the suppliers will have this incentive.