Assessing the Value of an Integrated GIS Seismic Management System
Abstract

- TGS’ seismic order entry system is an enterprise-level database and application that plays a foundational role in the company’s business. Millions of seismic lines, associated products and client entitlements are managed down to the nearest shot point. The detailed user interface combines ASP.NET forms with customized access to ArcIMS. A web service containing various SDE API calls is used to create and manipulate spatial features throughout the data order process. Intricate and specific application of spatial analysis has led to significant productivity gains for many internal user groups.

- This is a multi-faceted application linking many business processes. An invoicing module bridges the spatial and financial domain of each order. Detailed order information is integrated with the order fulfillment system for delivery to the customer. Access to data based on spatial query and analysis is ultimately delivered through automated reporting mechanisms creating a responsive, integrated approach to seismic data management.
Who is TGS?

- A leading global provider of non-exclusive (multi-client) seismic data, well log data, and derivatives to the oil & gas industry.
- Led by an experienced team of geoscience professionals. Approximately 350 employees.
- A solid financial performer with a strong balance sheet and an excellent track record of profitability. Traded on Oslo Stock Exchange (OSLO:TGS).
- Market cap of ~2.1 billion NOK (~$317 million USD) as of December 9, 2003.
Meeting the challenge

The goal

- Migrate a series of legacy applications and databases into a single, seamless software and database system that allows users to enter and track seismic orders in a more cohesive and rapid manner while leveraging updated technology.

The challenge

- There is approximately 1 petabyte (1 million gigabytes) of seismic data for which we must enter and track orders
- There are up to 131 products that can be ordered
- Our entitlement lines SDE layer alone contains about 5 million features and is constantly growing
Order Entry Process
Select geographical location
Order Entry Process

Select client

Order Information:
- Client Name: [Input]
- Display Name: [Input]
- Client #: 2298
- Mstr. License: [Input]
- Supplement: [Input]
- Marketing Rep: [Input]
- Customer Rep: [Input]
- Order by: TGSN Invoicing
- Client/Prospect: [Input]
- Client Ref#: [Input]
- Client AFE: [Input]
- Credit Amt: [Input]

Invoice Attention:
- Individual: TGSN Invoicing
- Address: 13155 Noel Road
- Address2: [Input]
- Email: [Input]
- Phone: [Input]

Companies with Same Parent

Partners

Client Specific Comment:

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<th>Number</th>
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<th>Sub</th>
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</tr>
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Order Entry Process

Define order polygon
Spatial Methods of Order Entry

- Entering and editing order polygon (mostly 3D orders)
  - Advanced freehand draw tool
  - Define based on selecting culture features
  - Merge, clip or buffer order polygon
  - Directly input or edit x/y or lat/long coordinates representing each polygon vertex
  - Directly input or edit track/bin coordinates representing each polygon vertex (3D only) - based on a bin grid.
Order Entry Process

Define individual line/shot point ranges
Spatial Methods of Order Entry

- Entering and editing line/shot point ranges (mostly 2D orders)

  - Type in/edit line numbers and shot point ranges directly.
  - Input a text file containing a pre-formatted list of line/shot point ranges.
  - Trim or extend lines based on ownership.
  - Trim or extend lines to match the project’s boundaries.
  - Trim or extend line to match a product’s availability.
Order Entry Process

Run entitlement and display new vs. pre-owned mileages
Order Entry Process

Save order and define certain order metadata

[Image of an order entry process interface with fields for Order Number, Type, Sub-Type, Office, Order Numbers, Parent Order, Order Entry Dates, Order Confirm Dates, and related options for Entitlement Only Order, Save, and Print.]
Order Entry Process

Define products for the order (optional)
Order Entry Process

Invoicing

[Image of TGS software interface showing invoice details]
System Architecture

Overview

- SDE API web service - most spatial functions
- MAX - Seismic Data Management Software
- Arc IMS web service – allows for more customized AXL sends and receives
- SQL Server Database – including stored procedures, nightly jobs, etc.
- ESM (EarthSpring Map) – Software that browses seismic, well, and cultural data
System Architecture

Data Life Cycle

- Project polygon outlines
- Spline around lines
- All possible seismic lines
- All seismic lines that can be ordered
- Clip lines
- Run entitlement
- Temporary order lines
- Save order
- Saved order lines
- Temporary entitlement lines
- Entitlement – feed temp table / save order – feed permanent table
- Saved entitlement lines
- Spline around lines
- Entitlement polygon outlines
- Generate polygon from coordinate list stored in session
- Order polygon outlines
Most of the methods in our primary web service make use of the SDE API to perform spatial functions:

- Clip project lines using order polygon
- Copy lines from temporary to permanent SDE layers
- Extract portions of lines from one SDE layer to another
- Define an exact “spline” polygon around a group of lines
- Clip an order polygon based on another polygon
- Merge an order polygon with another polygon
Arc IMS Web Service

A separate web service is used to send AXL to ArcIMS and retrieve the returned AXL before displaying an updated map image.

This allows for the application to customize the AXL in order to meet various business needs before presenting the image to the user.

Examples:

- Use “SPATIALQUERY” AXL tags to filter what features are visible for certain layers.
- The current map image file name is retrieved from the returned AXL and the image is saved to the database for display in reports.
Defining the Entitlement Problem

- We must extract the new entitlement portions of each order and store this as new lines in the entitlement lines SDE layer, with an accuracy level to the nearest shot point (for 2D) or bin (for 3D).
- We must be able to translate the to and from shot points along each line from an attribute to a spatial level in order to build accurate lines.
- The entitlement lines SDE layer is our largest layer and is always growing. How do we manage this?
- Linear mileages must be summed for each project in an order and used in invoicing to determine how much the client owes.
- Polygons representing entitlement must also be constructed and continually updated for purposes of displaying maps of entitlement.
Solving the Entitlement Problem

Order lines extend across the entire order polygon. We need to extract the portions of lines that appear in green since only this portion represents new entitlement.
Defining the Entitlement Solution

- Initial instinct is to solve this problem spatially. This would involve the use of previous entitlement polygons for the current client and project to clip the current order lines.
- However, this approach has inherent inaccuracies, mostly projection-related.
- The need to obtain a higher level of accuracy requires that this be approached instead on an attribute level…
Steps to Solving the Entitlement Problem

- When entitlement is run during the order process, the records are populated to the entitlement lines layer and the from and to shot point fields are determined and populated based on comparisons against previous entitlement records.

- The actual entitlement line shapes are built later when the order is saved. Each line is built spatially by translating its to and from shot points to measures along a route.

- By storing shot points virtually as measures (as opposed to point features) we are able to much more easily handle the volumes of data required to track and build each client’s entitlement.
Steps to Solving the Entitlement Problem (cont.)

- Mileages are calculated for each entitlement line based on a formula involving to the to and from shot points for that line and various metadata about the project. On the invoicing screen, these mileages are then summed for each project and used to help determine how much a client owes for the ordered data.

- A nightly database job runs to build updated entitlement polygons based on the previous day's activity. This builds polygons around entitlement lines for a given client/project combination, and stores it in a separate layer.
Ex. Entitlement Polygon Built Around a Group of Entitlement Lines
Browsing Entitlement with Mapping Tools

EarthSpring Map
Front-end query builder
Browsing Entitlement with Mapping Tools

EarthSpring Map
Back-end map viewer
(Arc IMS)
Summary

Our seismic order entry and tracking software has been successfully built to handle ongoing orders.

- This accesses and writes to an enterprise SQL Server and SDE database.
- Entitlement is based on an attribute level query of previous entitlement that defines to and from shot points for each line. Related shapes are built later in the process.
- Our system now handles the seismic order entry and tracking process end to end from defining the order lines to invoicing and defining the parameters to be used in data fulfillment.
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