usually there is a fair amount of segregation between business data (represented as one dimension) and spatial data (represented as two and three dimensions), which makes querying spatial data by business attributes more complex. If a middle tier technology such as a spatial data engine (SDE) is used, it goes a part of the way towards solving this problem, but these business attributes still need to be linked in – so there is still no business and spatial data used together in a native, seamless way. Another problem with most current technologies is that it only really caters for either 1D and 2D (business data and two dimensions) or just 2D, and there are not a lot of central systems that take 3D into account.

What is business intelligence?

Business intelligence, per the DataWarehouse Institute can be defined as the processes, technologies and tools needed to turn data into information, information into knowledge, knowledge into plans that drive profitable business action.

Gartner defines BI as an interactive process for exploring and analysing structured, domain specific information (often stored in a data warehouse) to discern business trends or patterns, thereby deriving insights and drawing conclusions. The heart of BI is the ability of an organisation to access and analyse information and then exploit it to competitive advantage.

There have been some graphic elements visible in business intelligence already, such as business graphics, typically charts, which are now common components to reports.

Service-oriented architecture (SOA) as a platform gives an added advantage to BI in that reporting and decision making are based on a common operational picture, or “single version of the truth.”

The whole idea of full business intelligence is to have lots of data in a central repository, or warehouse, so that this data can be used effectively to drive profit and better systems. Proprietary systems, used by both private and public organisations, had become a hindrance in a business environment that demanded agility to operate effectively.

**3D centric systems, GIS (2D) and business intelligence integration**

To address the integration issues between GIS and BI, standards and common ways of interacting with data were provided by various organisations and IT providers. Due to common technology foundations, some of these standards were easier to adopt, than others.

A benefit of the adoption of standards was that GIS and BI application providers were concentrating on working with the data that was most important to core users. Operational units that were not necessarily using both BI and/or GIS could with the adoption of some standards, and better integration between BI and GIS, use both of these respective technologies, with the resultant business benefits.

ESRI’s vision of the integration of GIS and BI goes a long way with regards to seeing an integrated, full BI possibility between spatial and business data, but falls short of full integration as the entire middle tier technology supported by ESRI, remains still just
that; a middle tier, still separate to the database or data warehouse, and still not fully integrated.

Spatial databases such as Oracle Spatial, PostGIS and others similar to these, have also displayed the industry trend towards a spatial warehouse, but similarly fall short, as does ESRI, as there is no full integration (or any real integration to speak of) of 3D data, not in the sense of being able to do full volumetric operations on 3D data within the spatial warehouse.

With regards to integration of 3D centric systems such as mine technical systems, GIS and BI, the 3D area is the area that is left lagging behind in the new industry movements, and there is a need to get these areas consolidated to drive more effective and more profitable actions in any mining company.

Current scene

To further amplify the situation outlined above, the current scene in both the GIS world and the 3D worlds (such as mining) looks like the diagram in Fig. 1.

Industry wide emerging trends

From this current scene with data storage and different formats, an industry wide requirement has evolved with regards to the following:

- Standardised format of various data types.
- Centralised storage of a variety of data.
- Reporting of data from different systems in the same medium.
- Full business intelligence with regards to all data.
- Open formats of data that is "open" to other systems.
- Web enabled systems, with smart client architecture, accessible through the intranet or Internet.
- Standard operations like intersections done in a centralised, tested platform.

Reporting

Business data, GIS data, 3D data such as mine technical data – these all influence each other yet, there is no central standard reporting medium that can incorporate this data.

The challenge is to be able to report off all of this data, as if they are of the same kind and why not? Data is after all just... data! (See Fig. 2.)

Fig. 2: Data is just data.

There have been industry movements towards getting integration and warehousing out of data of various types. Many industries have realised this need including the mining sector. This article will mostly dwell on the mining needs in terms of GIS, CAD, MTS and business intelligence, and how their integration will help to improve operations.

Making a choice: the spatial database route

What is a spatial database?

A spatial database is a database that is optimised to store and query data related to objects in space, including points, lines and polygons. While typical databases can understand various numeric and character types of data, additional functionality needs to be added for databases to process spatial data types. These are typically called geometry or feature.

- Spatial measurements: Find the distance between points, polygon area, etc.
- Spatial functions: Modify existing features to create new ones, for example by providing a buffer around them, intersecting features, etc.
- Spatial predicates: Allows true/false queries such as ‘is there a residence located within a kilometre of the area we are planning to build the landfill?’
- Constructor functions: Creates new features with an SQL query specifying the vertices (points of nodes), which can make up lines. If the first and last vertices of a line are identical, the feature can also be of the type polygon (a closed line).
- Observer functions: Queries, which return specific information about a feature such as the location of the centre of a circle.

The drive for full integration of BI, GIS and CAD technology could be fulfilled with the use of a spatially enabled database. The special requirements for a spatial database that is used in the 3D centric industries would be:

- The spatial database would have to be aware of 2D and 3D objects with operations such as intersections, volumetrics and more to really be effective in the MRM environment.
- GIS data (2D) and CAD data (3D) would have to be treated in the same manner as any other business data (1D). Data would have to be just... data!

What would the advantages be of a spatial database?
• With spatial data treated in the same way as business data, you could use all the BI tools on this data in seamless conjunction with other data... BI scorecards, dashboards, analytics, cubes, reporting etc.

This technology (full spatial enablement including 3D) has only matured in the last twelve months.

Spatial intelligence

Spatial intelligence, according to us, is attributing true spatial coordination and interpretation to business intelligence. A true 3D enabled spatial database would offer:

• A true data warehouse with BI capabilities: slicing and dicing, drilling down, standard reports, cubes, pivot tables, all with spatial data as well.
• Large data volumes easily handled
• Governance, quality, accuracy and auditability.
• Data integrity assurance.

Why spatial intelligence?

• Exploding data sizes for business data and spatial data.
• Electronic data volume doubles every year.
• Shortage of specialised skills needed to analyse and interpret data, especially in spatial arenas.
• Significant impact on companies that depend on insight.
• Information overload.
• Spatial data not fully utilised for BI purposes.

The revolutionary product is called SpatialDB and it was developed to meet the entire mining sector as well as the spatial and business world’s needs, combing the strategic aspect of business intelligence with spatial intelligence. As a result large data volumes can easily be handled, there is data integrity assurance, governance, quality, accuracy, auditability and common operations are now common to a database, not in a proprietary engine. Basically it is a GIS with full business intelligence or the other way round.

Because of this development the integration of both business and spatial intelligence is now a reality. This opens a lot of possibilities in operational efficiency and strategic decision making at all levels.

The way forward

There are numerous advantages of having a full 2D and 3D enabled spatial database:

• Systems can communicate with each other, and a different system’s data could be an overlaid layer on another system’s data with hotspots, thereby making full use of various data.
• 1D (business data), 2D (GIS data) and 3D data would be indistinguishable from each other and can be integrated into a whole with regards to standard reporting, dynamic spatial reporting, usable data for other systems and business intelligence.
• Production times could potentially come down from a matter of hours to a matter of minutes (depending on the situation) with regards to some of the more standard operations, which would perform better within a database than outside one.

There have been many developments in the spatial database world that try achieve this strategic integration and most of the products have only managed to achieve 2D capability, which does not adequately address the problem as 3D data is not catered for. Recent developments have seen that spatial enablement has been done to Microsoft SQL Server database, but only with the use of an outside component called SpatialDB (not belonging to Microsoft). This SpatialDB component adds full 2D and 3D ability to SQL Server, for the first time in history. With such a development it is now possible to fully integrate both business and spatial intelligence.

Industry now has a true data warehouse with both BI capabilities and full 3D, hence operations like spatial indexing, cubes, pivot tables, standard reporting, drilling down, slicing and dicing are possible with spatial data.

The future is here!

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