The strategic advantage of OLAP and multidimensional analysis

Overview

Online analytical processing (OLAP) helps organizations extract the maximum value from their corporate data by transforming it into a format that is useful for multidimensional analysis.

Multidimensional analysis enables users to explore information in a business context. They can compare such things as product or channel performance in light of important factors such as region, customer and time period. With a multidimensional view, users can quickly gain insight into business performance and trends.

Multidimensional analysis helps companies improve their performance by:

- Presenting complex data in business terms that are easy to understand
- Helping people stay on top of changing business conditions, such as market shifts, mergers and acquisitions, and providing trending analysis
- Reducing IT workload by providing self-service access to corporate information

By providing information in a dimensional framework that users can readily understand, they can conduct their own analysis quickly and easily. Organizations can also extend the reach of their analysis and share findings throughout the company with effective reporting that helps them know sooner, understand faster and react more quickly than the competition.

To get more value from large stores of corporate business information, many organizations use OLAP for multidimensional analysis. OLAP is a key part of the underlying infrastructure of IBM Cognos® Enterprise.

What is multidimensional analysis?

Multidimensional analysis takes data and formats it into structures that can be explored. The structures provide a view of data that shows, for example, not only what product sold best, but what product sold best in a specific region, during a particular time period, through a specific sales channel. This expanded view provides you with more specific information so you can make more informed decisions.

With multidimensional analysis, you can explore these data structures by:

- *Drilling down.* You can navigate from lesser to greater detail. For example, when you see a data value for revenue for first quarter sales in your company, you can drill down into that data to see a breakdown of monthly sales in the quarter. Depending on how the data is structured, you can then further drill into weeks and even into daily sales.
- *Slicing and dicing.* You can change active dimensions to get other views of the data. For example, a report of quarterly revenue by location can be easily changed into a report of quarterly revenue by product line.
- *Changing displays.* You can view data in different formats including tables, charts and graphs. Regardless of format, you can interact with and change the display.

Providing quick answers to commonly asked business questions is the primary function of multidimensional analysis. Because it is designed around key business factors, the quality of answers obtained from this type of analysis is very high.

The key concepts of multidimensional analysis

Multidimensional analysis has three key concepts: dimension, member and measure (or fact).

Dimension

A dimension is some distinguishing characteristic of an activity and represents one of several ways in which people measure results in an organization. For example, you might have a sales cube with the following dimensions: time, products, locations and customers. These dimensions help you answer specific questions.

For *time*, the questions include:

- How did we do this month compared to last month?
- How did we do this month compared to the same month last year?
- How did we do this year compared to last year?

For *products*, analysts need to know things like:

- What percentage of overall revenue comes from product line A?
- Has the revenue mix changed between product lines?
- Which product is most profitable?

Large organizations have *locations*: sales territories, branch offices and individual sales representatives. Sales managers are likely to want to know:

- How does sales growth in Europe compare to North America?
- What are the top 10 branch offices in terms of revenue generation?
- What regions have the most pipeline and do we have enough sales people to pursue all of our leads?

Everyone needs to track their *customers* in a variety of categories:

- Which customers are the most profitable?
- Who are our most frequent repeat customers?
- What percentage of customers buys a specific product or combination of products?

Figure 1: Sales analysis makes it easier to determine what is driving the business. It can dramatically improve sales force productivity and enable fact-based selling

Figure 2: Customer and product profitability is an important area of analysis for users who wish to transform their sales force from a revenue-centric to a profit-centric department.

Member
Members are the individual data points in the dimensions. For example, members in the time dimension could be "2012" or "2013." In the location dimension, members might include "Singapore," "Paris," or "Chicago." Note that some members are subsets of others: the member "Chicago" could be a subset of "US Midwest." This hierarchical organization makes it possible to roll up or aggregate values for groups of members into higher levels.

Measure or fact
Measure or fact represents the quantities that are used to build reports and for analysis. For sales, typical measures could be revenue, cost, discounts and returns. Multidimensional analysis can also handle complex models that require allocations of measures such as revenue or costs. Because of the way multidimensional analysis measures values, users do not have to worry about the math behind things such as allocations. They can simply slice and dice to examine the trends and values important to them.

Multidimensional analysis technologies
The technologies most frequently used for multidimensional analysis are dimensionally aware relational schemas and online analytical processing (OLAP). These technologies help provide lower total cost of ownership (TCO) and higher return on your business intelligence (BI) investment than other analysis methods or tools.

Dimensionally modeled relational data
Dimensionally modeled relational schemas have been used for multidimensional analysis for some time. However, problems with the use of structured query language (SQL) and aggregate functions have resulted in slower query response times. Newer products on the market are using automatic summary tables and other features to improve processing efficiency and gain faster results, achieving dimensional analysis that is comparable to OLAP.

OLAP
OLAP enables users to analyze multidimensional data interactively from multiple perspectives. OLAP consists of two of the multidimensional analysis operations, drill-down and slicing and dicing, and adds a third, aggregation. Aggregation involves data that can be accumulated and computed in one or more dimensions. For example, all sales offices are aggregated up to the sales department or sales division to anticipate sales trends. Or, financial data is aggregated for planning and budgeting.

Because it summarizes corporate information from diverse, heterogeneous data sources and presents this data to users in a meaningful business context, OLAP offers great potential for improving and coordinating decision-making. As such, OLAP is often the preferred choice for multidimensional analysis.

To speed this analysis to meet the demands of users for fast response times, OLAP cubes are used to optimize the performance of multidimensional queries. An OLAP cube is a multidimensional database that is optimized for OLAP applications. Business logic and understanding are the basis of their design. Because they are optimized to enable business users to use advanced analysis techniques, plain English can be used to query cubes and they can report on millions of records at a time.

The challenge many organizations face with OLAP is that they might not have OLAP cube technologies. Or, they might want OLAP benefits with relational databases. For that reason, Cognos Enterprise includes not only OLAP cubes and components, but also components that can provide the benefits of OLAP to relational databases.

Cognos Enterprise components for OLAP and multidimensional analysis

Cognos Enterprise was designed for multidimensional analysis. Extensive features and functions simplify the complex analysis of data. Cognos Enterprise includes Cognos TM1 and also features dynamic query and dynamic cubes, which are capabilities you can use for the multidimensional analysis of different types of data sources. Using these components, you can take advantage of a complete and consistent view of business information, regardless of the data source, along with faster response times than those associated with more conventional solutions.
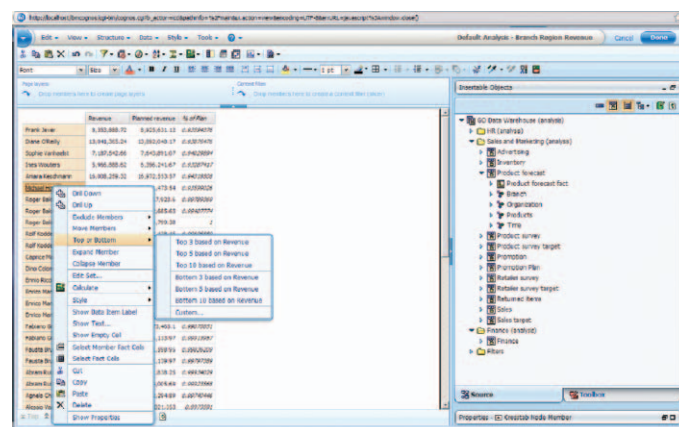

Figure 3: Analysis with Cognos Enterprise helps you recognize business issues and trends more easily

Cognos TM1

IBM Cognos TM1 is enterprise planning software used to implement collaborative planning, budgeting and forecasting solutions, along with analytical and reporting applications. Cognos TM1 is a database in and of itself; it does not rely on an underlying relational database. Data is modeled in cubes that are loaded entirely in RAM when the server starts up. Rule-based or aggregated values are calculated on demand and remain in memory for cached reuse until the underlying data is changed, at which point the engine recalculates the results.

Data in Cognos TM1 is stored and represented as multidimensional OLAP cubes, with data being stored at the "leaf" level. Leaf data computation occurs in real time (for example, to aggregate numbers up a dimensional hierarchy). Cognos TM1 includes a data orchestration environment for accessing external data and systems and capabilities designed for common business planning and budgeting requirements (such as workflow and top-down adjustments).

Cognos TM1 features a contributor client that combines an OLAP engine with the enterprise planning capabilities in a web-based client. Other features include:

- An undo and redo capability for storing a collection of data value changes and walking back through the actions to undo them
- Pick lists for cells that reduce data entry
- Sandboxes for creating personal modeling scenarios
- Data entry shortcuts

A desktop client is also available to facilitate data exploration and collaboration. With a drag-and-drop dashboard interface, users can explore the data from their reports or spreadsheets. Data that is manipulated is translated back into OLAP members automatically.

Dynamic query

The Cognos platform, which is the underlying infrastructure of Cognos Enterprise, includes dynamic query, a true OLAP experience for dimensionally modeled relational (DMR) packages. Dynamic query refers to the execution of BI content with the Java-based extensible query engine in the Cognos platform. Dynamic query retains result sets and metadata captured from optimized queries to relational and OLAP data sources in a 64-bit, in-memory cache. It can reuse these result sets and metadata to minimize the wait times for future requests.

The dynamic query layer was developed to meet requirements for interactive reporting and ad hoc analysis. It employs sophisticated, multiphase query optimization techniques and can dynamically alternate between SQL and MDX processing, depending on what best suits the scenario. Dimensional modeling of relational data enables OLAP presentation of metadata, drill up and drill down functionality and the use of OLAP functions. OLAP data representation enables simple navigation, clear data context and enhanced data visualization.

Dynamic query uses a properly built dimensional layer to provide consistent OLAP-style reporting. For best results, the dimensional layer should be constructed on a relational layer that applies star schema concepts. This dimensional layer provides an abstraction from relational objects and functions, which enable consistent OLAP behavior. Using OLAP over relational with dynamic query enables list and crosstab reports to return identical results.

Dynamic query applies advanced OLAP caching techniques to enhance performance of dimensionally modeled relational packages. The use of caching reduces the frequency of database queries, thus minimizing the database server workload required to service the Cognos Enterprise application.

Dynamic cubes

In a dimensional data warehouse, you model relational database tables with a star or snowflake schema. This type of data warehouse differs from a traditional OLAP model in two ways. First, it stores information about the data in fact and dimension tables rather than in proprietary OLAP data structures. Second, it describes the relationships in the data with joins between the dimension and fact tables, the collection of dimension keys in a fact table and the different attribute columns in a dimension table.

The Cognos platform includes an OLAP component called dynamic cubes. Dynamic cubes adds an in-memory relational OLAP component to the dynamic query server in the Cognos platform to provide a multidimensional view of a relational data warehouse with accelerated performance. Dynamic cubes are built into the query service of dynamic query to load data directly from relational data warehouses.

Each cube definition represents a dimensional view of a fact table in a star or snowflake schema, and you can then use virtual cubes to join multiple cubes or facts. This provides access to a wider area of analysis. Data control is achieved by caching only the data that is required and by moving appropriate calculations and filtering operations to the database.

After dynamic cubes are created, you can conduct OLAP analysis with the dynamic cubes server. Dynamic cubes can be accessed and reported on as if they were traditional OLAP data sources. By using the power and scale of a relational database, dynamic cubes can provide OLAP analytics over terabytes of warehouse data. This allows for a faster performance than a dimensionally modeled relational (DMR) application and enables the explicit management of the member and data caches of a dynamic cube.

The benefits of flexible options for multidimensional analysis

Your organization wants to infuse analysis into each step of the decision-making process so that you can sustain competitiveness. Self-discovery, the ability to manipulate information and data modeling to create scenarios are important capabilities for meeting the needs of analytical reporting, trending, what-if analysis and predictive analytics. The multidimensional analysis options and OLAP components in Cognos Enterprise make it possible to view, assemble and analyze information from different data sources, so you can assess your immediate business situation and make smarter decisions—quickly and almost effortlessly.

Cognos Enterprise OLAP features and components help users access and organize data optimally from almost any source to provide the blueprint for complete analysis. Together, with the ability to transition from a dashboard to complex analysis in the same unified workspace, Cognos TM1, dynamic query and dynamic cubes can help business users find the underlying answer to their business questions to optimize business performance.

Conclusion

Multidimensional analysis can provide your organization with the insight it needs to make more informed decisions and build better business relationships with customers, partners and suppliers.

By aggregating summarized corporate information from volumes of heterogeneous data and presenting this data to users in a meaningful business context, multidimensional analysis offers great potential for improving and coordinating decision-making for your entire enterprise.

Cognos Enterprise helps companies understand and improve business performance by providing corporate data to everyone in the organization who needs it and giving them effective ways to analyze it. Cognos Enterprise supports more than 100 relational and OLAP data sources, and integrates with many enterprise applications from IBM, Oracle and SAP.

Choosing multidimensional analysis is a wise investment for your organization. With Cognos Enterprise, you have the opportunity to reap the highest rewards.

About IBM Business Analytics

IBM Business Analytics software delivers data-driven insights that help organizations work smarter and outperform their peers. This comprehensive portfolio includes solutions for business intelligence, predictive analytics and decision management, performance management, and risk management.

Business Analytics solutions enable companies to identify and visualize trends and patterns in areas, such as customer analytics, that can have a profound effect on business performance. They can compare scenarios, anticipate potential threats and opportunities, better plan, budget and forecast resources, balance risks against expected returns and work to meet regulatory requirements. By making analytics widely available, organizations can align tactical and strategic decision-making to achieve business goals. For further information please visit **ibm.com**/business-analytics.

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