

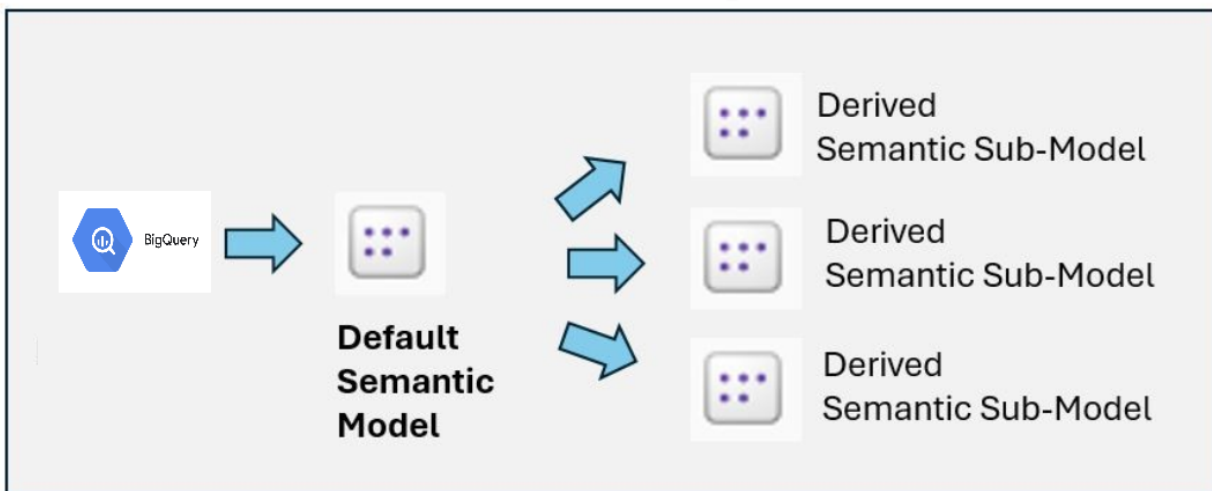
5. Semantic Model

Power BI is a powerful data visualization and business intelligence tool that allows users to create interactive reports and dashboards. Central to its functionality is the concept of **semantic models**, which provide the underlying data structure and relationships to make data analysis intuitive and efficient.

4.1. Understanding Semantic Models

Power BI semantic models define an analytical domain with metrics and business-friendly terminology to enable deeper analysis. These models are typically star schemas, with fact tables representing the domain and dimensions used to analyze, filter, and drill down into data. The semantic model is automatically created, with users selecting tables, relationships, and measures, while inheriting business logic from a parent **Warehouse**. This streamlines downstream analytics for business intelligence in a managed, optimized, and synchronized environment.

These semantic models serve as a ready source for reporting, visualization, and data discovery. Key features include expanding warehouse constructs with hierarchies and relationships, cataloging and searching models in the Data Hub, setting permissions, creating standardized metrics, and integrating with tools like Excel or Tableau for further analysis.



Why Use Semantic Models?

We use Semantic Models to:

- **Ease of Use:** Abstracts technical complexities, enabling non-technical users to interact with data intuitively.
- **Consistency:** Ensures consistent calculations and definitions across reports.
- **Performance:** Optimized queries and efficient data aggregation enhance performance.

4.2. Components of Semantic Models

The Model Explorer in Power BI's Model view allows you to explore and manage complex semantic models, including:

- tables
- relationships
- measures
- roles
- calculation groups
- translations
- perspectives

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Calculation groups

Calculation groups help minimize the need for redundant measures by letting you define DAX expressions as calculation items that can be applied to existing measures in your model.

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Cultures

In the **Cultures** area of Model explorer, you can view all translated versions of the data model. An object can have multiple translations of a name or description, making it possible to support multi-language versions within the model definition.

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Measures

Measures help you by performing calculations on your data as you interact with your reports. You can create or edit a measure and view all the measures in your model together, even when they reside in different tables or folders.

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Perspectives

Perspectives, in tabular models, define viewable subsets of a model that provide focused, business-specific, or application-specific viewpoints of the model.

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Relationships

You can create or edit relationships between tables in **Model explorer**.

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You can establish connections between tables to create a cohesive model:

- One-to-Many
- Many-to-Many
- One-to-One

Roles

You can create or edit security roles (RLS) in **Model explorer**.

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Tables

You can create or edit tables in your model in **Model explorer**. The approach is similar to the **Tables** area in the **Data** pane, but the information here in **Model explorer** includes subsections for each table, organizing your items.

Table partitioning in Delta tables organizes rows into subsets stored in Parquet files, improving query and write performance. For large datasets, such as two years of sales data, partitioning can significantly speed up operations by spreading rows across multiple partitions based on a key like month/year. For Delta tables serving semantic models, it's often better to avoid partitioning and rely on Fabric for file management to enhance query performance through parallelization.

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4.3. Data Modeling

Data modeling is one of the most important aspects of Power BI as it shapes how your data will interact with each other, and it also impacts performance. This is where the core structure of your report is created.

- **Relationships:**
The relationships between tables define how data can be joined. Power BI uses **cardinality** to define the relationship types:
 - **One-to-Many:** The most common relationship, where one record in a table relates to many records in another.
 - **Many-to-Many:** More complex, allowing for multiple relationships between tables.
 - **One-to-One:** When one record in a table relates to one record in another.
- **Star Schema vs. Snowflake Schema:**
A **star schema** is an ideal design for data models where you have one central fact table (e.g., sales) and multiple dimension tables (e.g., date, product, geography). This model improves reporting performance. The **snowflake schema** is a more normalized version, where dimension tables may be further broken down into sub-dimensions.
- **Data Granularity:**
The level of detail in your data (e.g., hourly, daily, monthly). It's essential to ensure the granularity of the data in your model matches your reporting requirements.
- **DAX (Data Analysis Expressions):**
DAX is Power BI's formula language that enables the creation of custom calculations. DAX allows for:
 - **Measures:** Calculations based on the data (e.g., sum, average, etc.).
 - **Calculated Columns:** New columns created through expressions.
 - **Time Intelligence:** Calculations like Year-to-Date (YTD), Month-to-Date (MTD), and comparisons between time periods.

DAX can become quite advanced, supporting complex business logic and aggregations.

4.4. Building a Semantic Model in Power BI

Clean Data:

Use Power Query Editor to transform and shape data.

- **Design Relationships** - Use the Model view to define and visualize table relationships.
- **Add Measures and Calculations** - Use DAX to create dynamic measures.
- **Define Hierarchies** - Create drill-down paths for better navigation.
- **Test the Model** - Validate relationships and calculations.

Best Practices for Semantic Models

Model Simplicity

- Avoid overloading the model with unnecessary tables and columns.
- Use views or summarized data where possible.

Naming Conventions

- Use meaningful, business-friendly names for tables and fields.

Optimized Relationships

- Ensure proper cardinality and filter direction.
- Minimize the use of bi-directional relationships unless necessary.

Efficient DAX

- Use measures instead of calculated columns where feasible for better performance.
- Avoid complex row-level calculations in large datasets.

4.5. Scheduled Refresh and Data Management

Power BI allows you to schedule automatic data refreshes, ensuring that the data in your reports is always up to date. Depending on your Power BI license, you can schedule data refreshes multiple times a day.

DirectQuery allows real-time data access in Power BI without importing data, but it has limitations such as slower performance, fewer transformation options, and restricted data modeling features. Not all data sources support it, and query complexity may be limited

For **Import mode**, once the report is published, Power BI will refresh the data periodically based on the refresh schedule you define. We recommend setting the refresh to occur once per day.

4.6. Use Cases and Advanced Techniques

Use Cases

- **Financial Analysis** - Create a semantic model for P&L reports, balance sheets, and trend analysis.
- **Sales Insights** - Analyze sales performance by region, product, or customer segment.
- **Supply Chain** - Track inventory levels, logistics performance, and supplier efficiency.

Advanced Techniques

- **Role-Based Security** - Implement row-level security to control access.
- **Aggregations** - Use aggregations to handle large datasets efficiently.
- **Dataflows** - Leverage Power BI dataflows for centralized and reusable models.

4.7. Troubleshooting and Optimization

Common Issues

- **Incorrect Relationships** - Fix relationship cardinality and direction.
- **Performance Lags** - Optimize DAX queries and limit data loads.

Tools for Optimization

- **Performance Analyzer**: Monitor query performance.

4.8. Best Practices

For **reporting purposes**, when constructing semantic models, it's crucial to adopt best practices that not only align with traditional methods like those used in Power BI but also take advantage of the unique capabilities Microsoft Fabric offers. Here's a set of recommendations and comparisons with traditional Power BI approaches:

Use Star Schemas and take care of relationships and cardinality

Star schemas are ideal for semantic model design in Power BI. It separates fact tables from dimension tables, improving query performance and clarity.

Avoid many-to-many and bi-directional relationship and resolve Relationship dependencies

Many-to-many relationships should be avoided at any cost. It multiplies the value of measures and shows wrong values for them. It also does not support the **DAX** related `CALCULATE` function. Although technically it can work with applying correct filters, it creates confusion for the end users, which might be difficult for maintenance. Typically, when we join **2 fact tables**, which ideally should never be joined directly, many-to-many relationships occur. Below, we have a section covering how to join 2 fact tables.

Create Measure for KPIs

Use measures over calculated columns to reduce data redundancy and enhance performance with DAX.

Store the measures inside a "Measures folder" with proper naming convention

Create a common Calendar Table

A common business requirement is to make calculations based on date and time. Organizations want to know how their business is doing over months, quarters, fiscal years, and so on. For this reason, it is crucial that these time-oriented values are formatted correctly.

To use the DAX (Data Analysis Expressions) Time Intelligence functions, there's one prerequisite: your model must include at least one date table.

The date table must be marked as a date table, and be linked to other tables using date (or datetime) columns

Semantic models are the backbone of effective Power BI reports and dashboards. By mastering the principles and techniques outlined in this booklet, you can unlock the full potential of Power BI to deliver insightful and impactful analytics.