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POWER BI MASTER CLASS

by Soumya Awasthi

Overview of the course

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Introduction to Business Intelligence	Understand the basics of Business Intelligence and its importance in today's data-driven world.
Getting Started with Power BI	Overview of Power BI, including Installation and navigation of Power BI Desktop.
Data Transformation and Modeling	Learn to clean and transform raw data using Power Query Editor. Introduction to data modeling and relationships in Power BI. Basics of DAX for data analysis.
Creating Reports and Visualizations	Explore creating interactive reports and dashboards. Practice with different visualizations to tell compelling data stories.
Publishing and Sharing Reports	How to publish reports from Power BI Desktop to Power BI Service. Share insights with dashboards and collaborate with your team.
Advanced Data Analysis and DAX	Dive deeper into DAX for complex data analysis. Learn advanced techniques for more dynamic reports and analysis.
Power BI in Practice	Integration of Power BI with other tools like Excel. Real-world case study to apply what you've learned.

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Introduction to Business Intelligence

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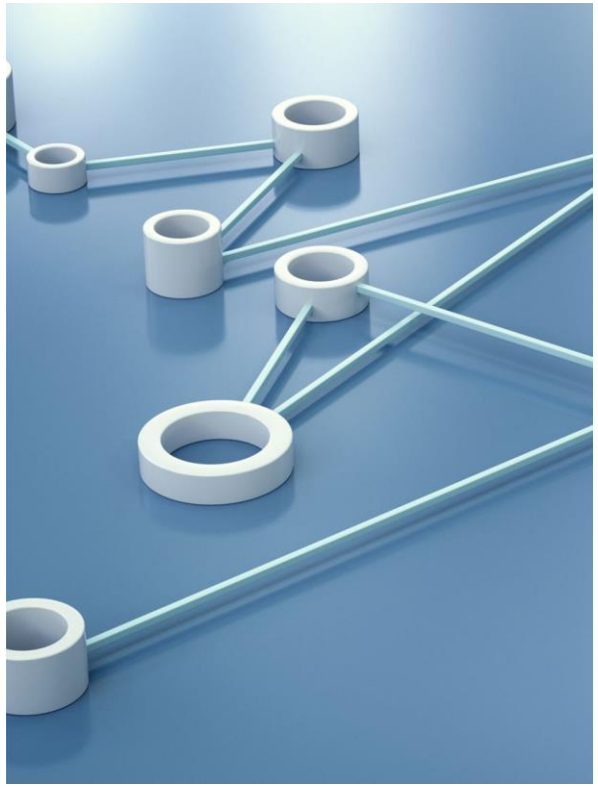
What is Power BI?

•Power BI is a collection of software services, apps, and connectors that work together to turn your unrelated sources of data into coherent, visually immersive, and interactive insights.



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Why Power BI ?

SEARCH VOLUME IN GOOGLE

MAXIMUM NUMBERS OF FEATURES

COST OF POWER BI

DATA CONNECTIVITY

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Components Business Intelligence

- **The Essence of Business Intelligence (BI):**
  - Simplified: BI is the transformation of data into actionable insights for better decision-making in the present and future.
- **Role of BI Solutions:**
  - Aids in understanding business activities.
  - Helps answer key questions: Who? What? When? How much?
  - Predicts future trends and outcomes for strategic planning.
- **BI's Evolution with Big Data:**
  - Modern BI leverages cloud computing for cost-efficiency.
  - Real-time data processing is integral for up-to-date insights.
  - BI tools are expanding to include components like real-time and predictive analytics.
- **The Power of BI Analysis:**
  - Beyond traditional data - Capable of analyzing text, sentiment, and more.
  - Helps understand public opinion of products and services.

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Traditional BI Approach

1. Business Identify the requirement
2. Business User submit the requirement to IT
3. IT extract, transform and load into DW/ Build Models
4. IT creates reports and dashboards based on the requirement
5. Business user approve reports or request for changes

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Getting Started with PowerBI

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Power BI Ecosystem

POWER BI DESKTOP

POWER BI SERVICE

POWER BI MOBILE

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Installing Power BI Desktop

System Requirements:

Check if your system meets the minimum requirements: Windows 7 / Windows Server 2008 R2, or later.

Internet Explorer 9 or above.

Download:

Visit the official Power BI Desktop download page.

Choose the correct version (32-bit or 64-bit) based on your system.

Installation:

Run the downloaded installer file.

Follow the on-screen instructions to complete the installation process.

Sign In:

Once installed, open Power BI Desktop.

Sign in with your Microsoft account or work/school account.

First Launch:

Familiarize yourself with the welcome screen.

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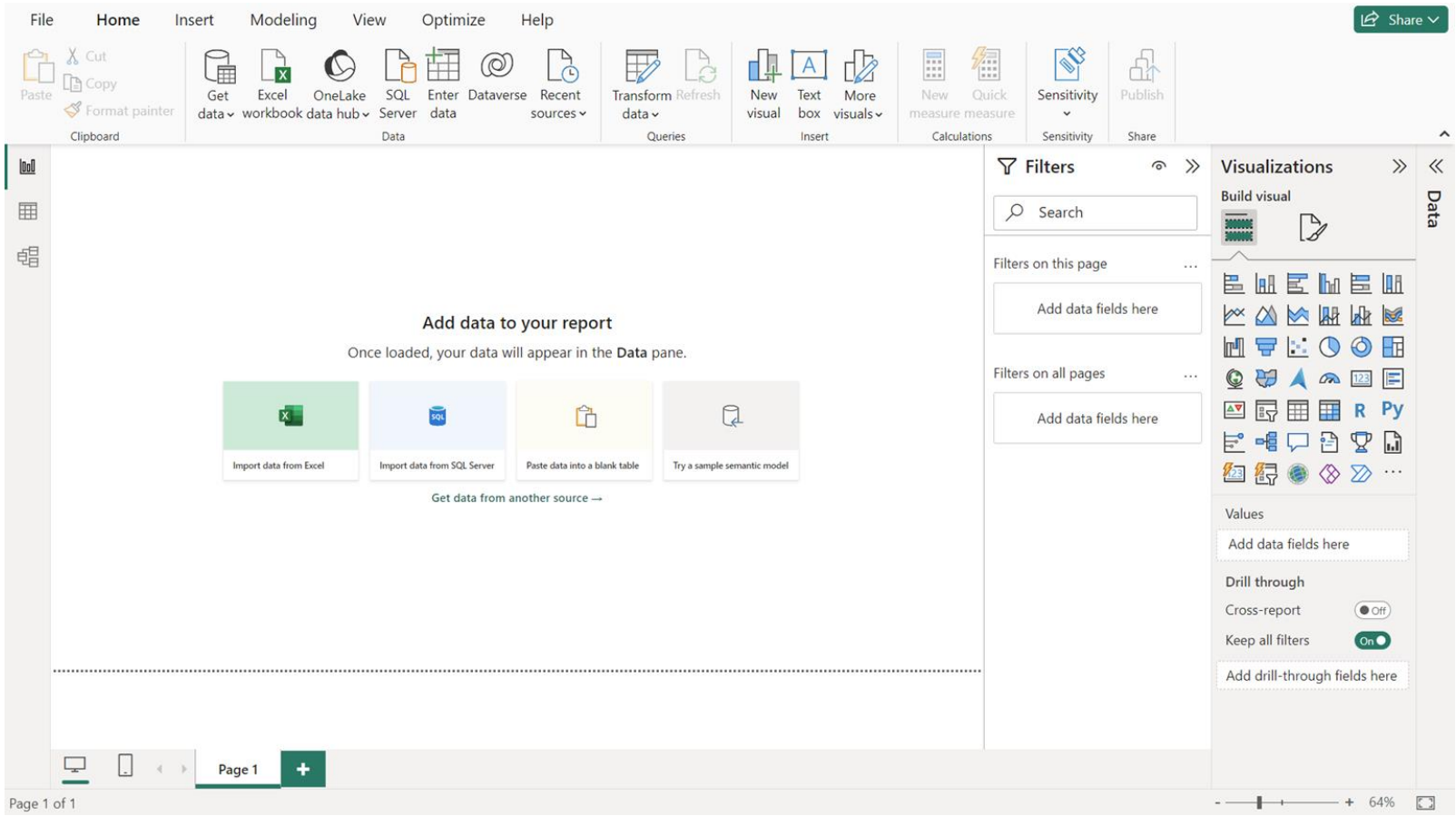

Power BI Interface Tour

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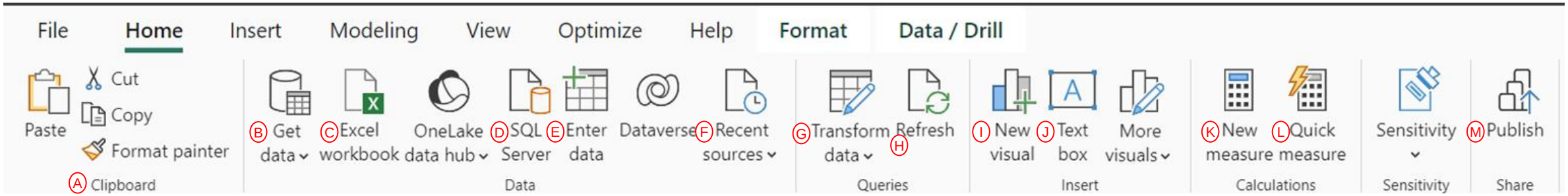
PowerBI Desktop Home Tab



A. Clipboard : In this option, you can find similar other Microsoft office products.

B. Get Data : Where you can ingest data into a Power BI file by connecting different sources.

C. Excel workbook : You can upload excel workbook in Power BI.

D. SQL Server : You can connect Power BI to SQL server through a data gateway.

E. Enter Data : This will open a new window to enter data manually and create a table.

F. Recents Sources : Link to open the most recent data sources you have been working on.

G. Transform data : To access Power Query Editor in Power BI Desktop.

H. Refresh : You can refresh all the tables in the model with the latest data from the source.

I. New Visual : By clicking, you can add a new visual to the Report page.

J. Text Box : You also can add text elements.

K. New Measure : Using DAX queries, you can create new (pre – calculate) measures in your model. This type of calculation is useful when you need to create aggregations that do not require to evaluate row-by-row. Calculate measures are evaluated during the query execution.

L. Quick Measure : Allows quickly creating a measure based on the measures and numerical columns in the table

M. Publish : You can publish your report on Power BI service using this icon

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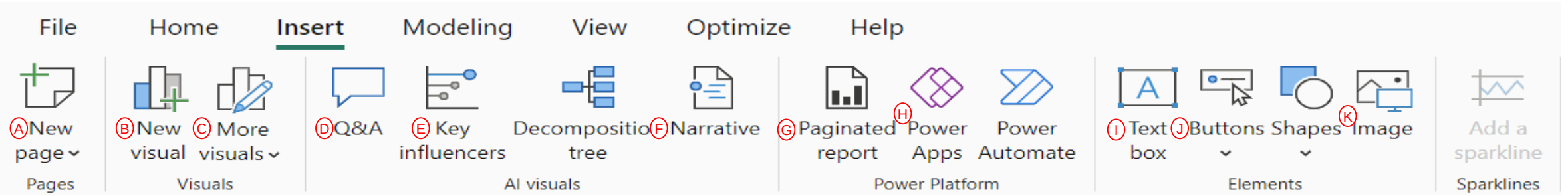
PowerBI Desktop Insert Tab



A. New Page : From this button, you can add a new report page to your Power BI workspace.

B. New visual : By clicking, you can add a new visual to the Report page.

C. More visuals : You can download new visuals from the AppSource.

D. Q&A: Using this feature, you can ask question against the data in the model in natural language. Answers will be generated in the visual manner.

E. Key Influencers : It can help identify important factors in your data by analyzing the relationships between different variables and identifying which variables are more strongly associated with a particular outcome

F. Narrative : Link to open the most recent data sources you have been working on.

G. Paginated Reports : They are designed to be shared or printed. They're called paginated because they're formatted to fit well on a page. They display all the data in a table, even if the table spans multiple pages.

H. Power Apps: Using this , you can pass context – aware data to a canvas app, which updates in real time as you make changes to your report.

I. Text Box : You also can add text elements.

J. Buttons : This is where you can add buttons to your report. Once you add buttons, you can configure different actions for them as desired.

K. Shapes and Images : You also can add text elements, images, and different shapes in order to generate visually rich reports.

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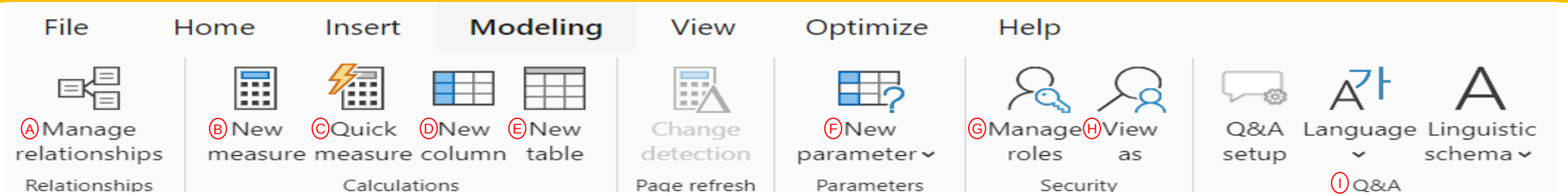
PowerBI Desktop Modelling Tab



A. Manage Relationships :

This opens a window to create and manage relationship build between tables. You can define the cardinality and cross – filter direction type in the relationships you build.

B. New Measure :

Using DAX queries, you can create new (pre – calculate) measures in your model. This type of calculation is useful when you need to create aggregations that do not require to evaluate row-by-row. Calculate measures are evaluated during the query execution.

C. Quick Measure :

Allows quickly creating a measure based on the measures and numerical columns in the table

D. New column :

Create calculated columns using DAX expressions. These columns you create will evaluate during model processing time and save the values in the model. Those are evaluated row by row.

E. New table :

You can create your own table using DAX, which cannot produce from the source.

F. New parameter:

You can perform a what-if analysis and create a parameter from here. Values for the parameter can be set using a slicer.

G. Manage roles:

You can create roles and define the row-level security in your Power BI model.

H. View as:

Once you properly configure the roles, you can check those and view them for validating the logic using this option.

I. Q&A:

Question and answer is an AI feature you will find in the Power BI to convert your data model and allow BI users to through questions in natural language and generate answers. You can configure the language support for Q&A.

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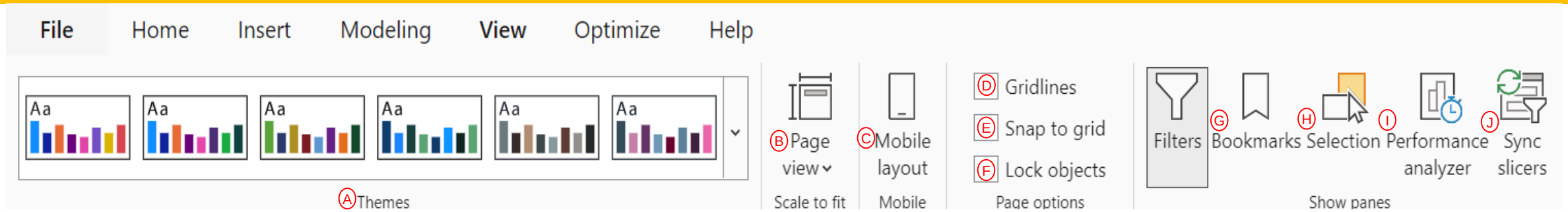
PowerBI Desktop View Tab



A. Themes :
By changing the theme, you can add variety to your Power BI reports. There are pre-built themes you can quickly change.

B. Page view :
This page view helps you to change into different reporting layouts.

C. Mobile Layout :
It will enable mobile view, then you an arrange visual elements the way you want to see in a mobile device.

D. Gridlines :
This is a very helpful tool to show a grid in the report layer. After you create the visuals, this will help you to do the final touch by align the visuals perfectly.

E. Snap to grid :
Once this is enabled, when you move, the visual objects are always aligned with one of the grid points.

F. Lock objects :
Even if you perfectly align you visuals after everything is finished, there is a chance that these objects can move here and there by touching. So, by this option, you can ensure nothing is moved.

G. Bookmarks :
This works like a snapshot; you can bookmark(save) your report objects with different filters and interactions.

H. Selection :
Selection pane feature is also mostly used with bookmarking feature. You will be able to configure the visibility of objects for different bookmarks.

I. Performance analyzer :
This enables you to trace time information for DAX queries and visual loading. Further, this allows you to identify the DAX query behind each visual, which you can use further performance tuning.

J. Sync slicers :
This allows you to select one of many slicers in your report page and start to work those slices across multiple pages.

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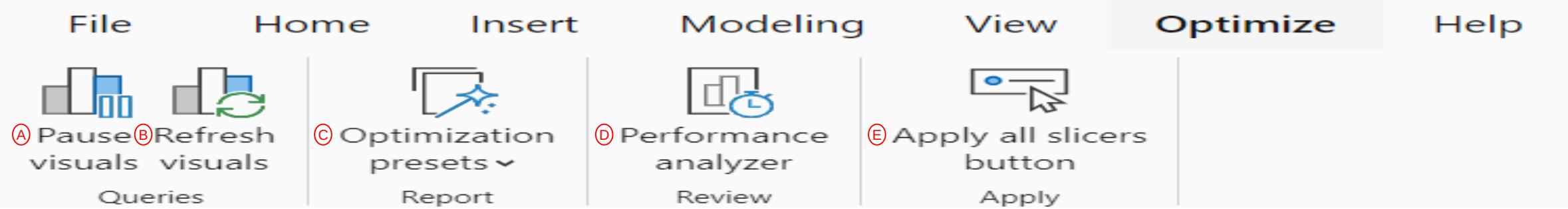
PowerBI Desktop Optimize Tab



A. Pause visuals :

It allows you to add or remove field list items to a visual without the visual updating until you are ready.

B. Refresh visuals :

It allows you to update all visuals in a report page based on a constant interval such as one second or five minutes.

C. Optimization presets :

With this you can quickly choose and apply predefined combinations of settings tailored to your reporting scenario.

D. Performance analyzer :

This enables you to trace time information for DAX queries and visual loading. Further, this allows you to identify the DAX query behind each visual, which you can use further performance tuning.

E. Apply all slicers button :

When on the report page, will keep track of all the slicer selections and then apply them at once when you click the Apply all slicers button!

PowerBI Desktop Help Tab

A. About : This will open small windows containing the version, user ID, session ID.

B. Guided Learning : You will be redirected to the guided learning video tutorials section in Power BI.

C. Training videos : You will redirect to the Power BI YouTube channel from this link.

D. Documentation : This redirects you to the Getting started article series. If you are good at learning this is for you.

E. Support : This will bring you to the Power BI support page. This is the place you can ask for support.

F. Power BI blog : Like in the start-up screen, you can access the Power BI blog for the latest products and feature updates.

G. Community : You can connect with a very large community base where all the peers and experts are live in. That is the place you can raise concerns and ask questions.

H. Power BI for developers : This will bring you to the Power BI developer page, where you can start to build custom visuals, embedding, and automate tasks like duplicate Power BI workspace automatically.

I. Submit an idea : It does not matter you are an expert or a newbie. There is always a place where you can submit your own idea, which is possible to become a reality.

J. External tools : It provides easy access to external tools that are installed locally and registered with Power BI Desktop.

K. Examples : Another good way to start to learn is by looking at existing work done by others. You can find download Power BI sample work files.

L. Consulting services : You will be redirected to paid and free consulting/ workshop for Power BI.

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PowerBI Desktop

Report Tab :

In Report view you can create any number of report pages with visualizations. Report view in Power BI Desktop provides a similar design experience to the report's editing view in the Power BI service. You can move visualizations around, copy and paste, merge, and so on.

Data Tab :

You can come to Data tab by clicking the table icon in the left vertical menu bar. This view is similar to the view we can see in Microsoft Excel. You can click the dropdown button in each field in order to do the data set, such as sorting, filtering, and so on.

Model Tab :

The model tab is where you can view your Star schema or snowflake structure of the model. Further, this view helps you to build relationships, especially when you have many tables. This is also the ideal place to do advanced configurations like aggregations.

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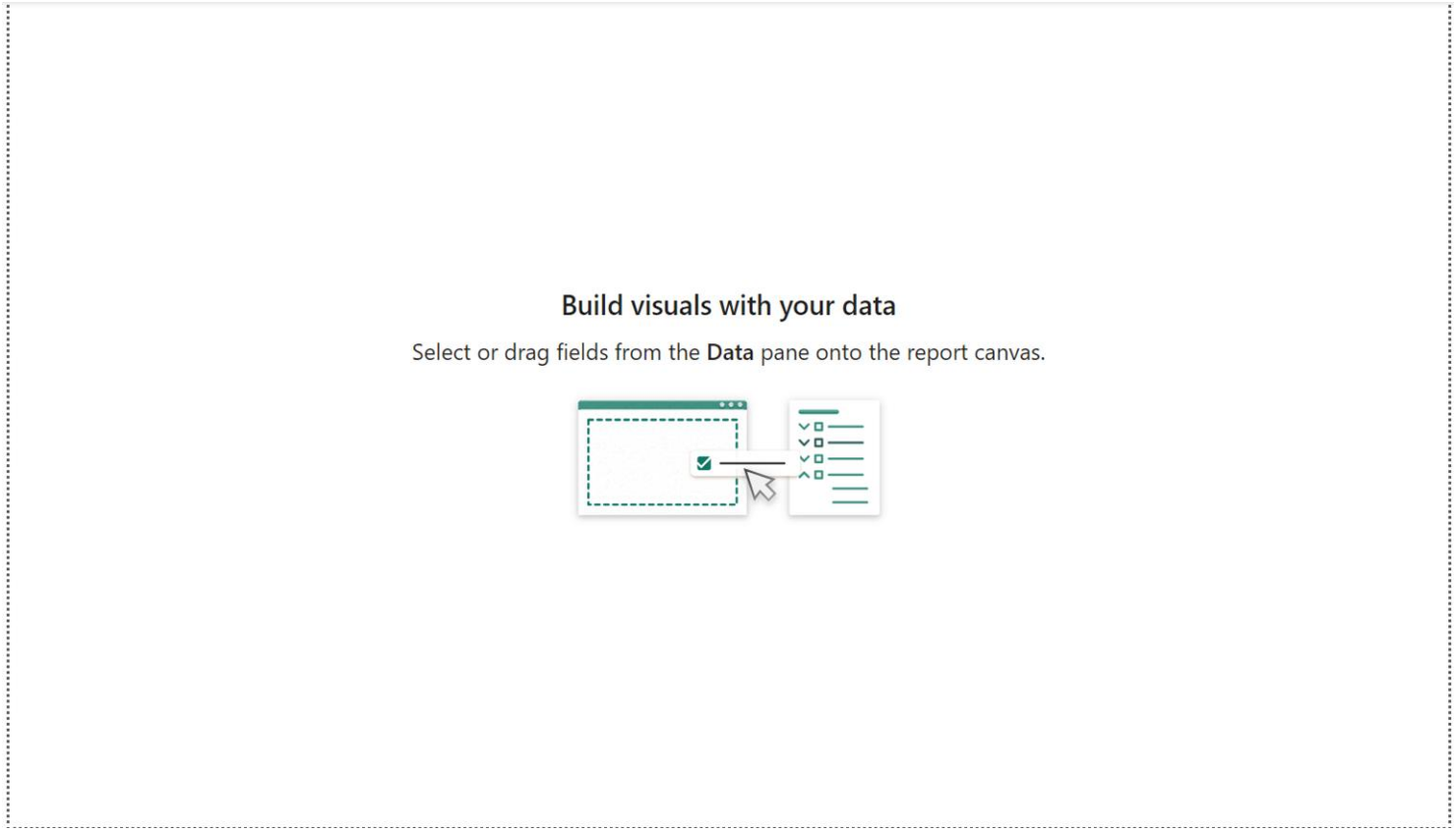
PowerBI Desktop Report View



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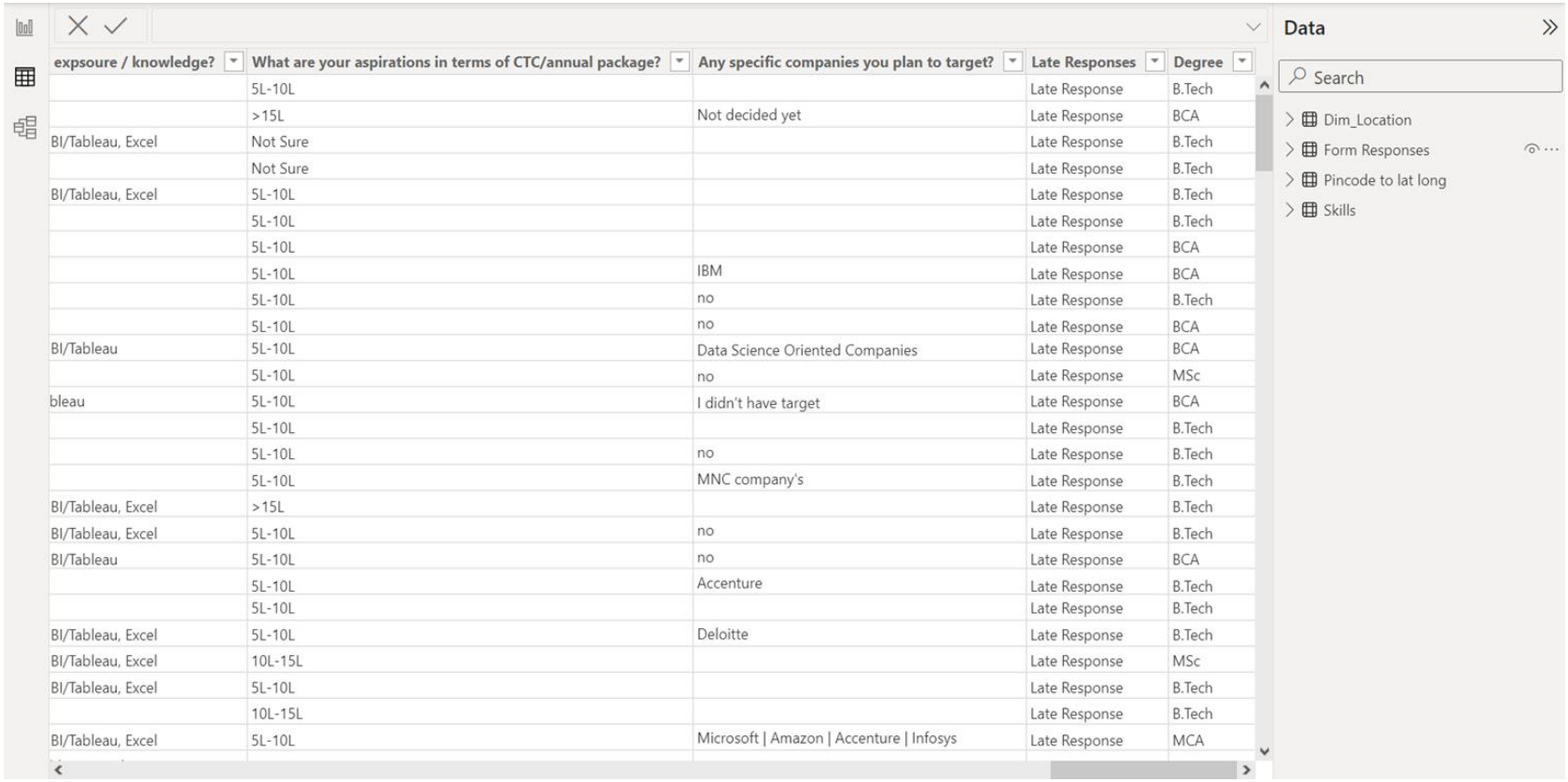
PowerBI Desktop Data View



expsoure / knowledge?	What are your aspirations in terms of CTC/annual package?	Any specific companies you plan to target?	Late Responses	Degree
	5L-10L		Late Response	B.Tech
	>15L	Not decided yet	Late Response	BCA
BI/Tableau, Excel	Not Sure		Late Response	B.Tech
	Not Sure		Late Response	B.Tech
BI/Tableau, Excel	5L-10L		Late Response	B.Tech
	5L-10L		Late Response	B.Tech
	5L-10L		Late Response	BCA
	5L-10L	IBM	Late Response	BCA
	5L-10L	no	Late Response	B.Tech
	5L-10L	no	Late Response	BCA
BI/Tableau	5L-10L	Data Science Oriented Companies	Late Response	BCA
	5L-10L	no	Late Response	MSc
bleau	5L-10L	I didn't have target	Late Response	BCA
	5L-10L		Late Response	B.Tech
	5L-10L	no	Late Response	B.Tech
	5L-10L	MNC company's	Late Response	B.Tech
BI/Tableau, Excel	>15L		Late Response	B.Tech
BI/Tableau, Excel	5L-10L	no	Late Response	B.Tech
BI/Tableau	5L-10L	no	Late Response	BCA
	5L-10L	Accenture	Late Response	B.Tech
	5L-10L		Late Response	B.Tech
BI/Tableau, Excel	5L-10L	Deloitte	Late Response	B.Tech
BI/Tableau, Excel	10L-15L		Late Response	MSc
BI/Tableau, Excel	5L-10L		Late Response	B.Tech
	10L-15L		Late Response	B.Tech
BI/Tableau, Excel	5L-10L	Microsoft | Amazon | Accenture | Infosys	Late Response	MCA

Data

Search

- Dim_Location
- Form Responses
- Pincode to lat long
- Skills

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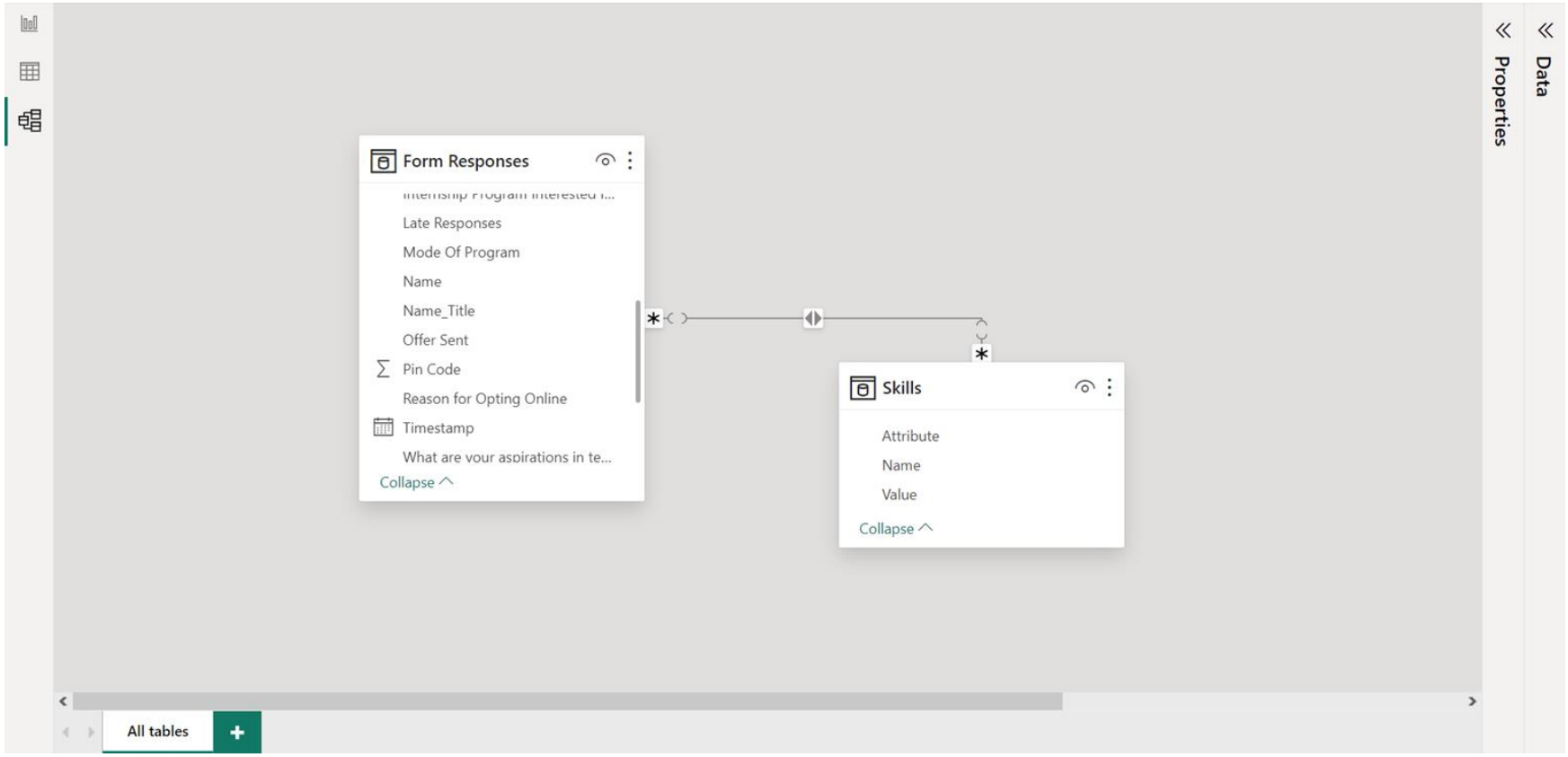
PowerBI Desktop Model View



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Data Transformation and Modelling

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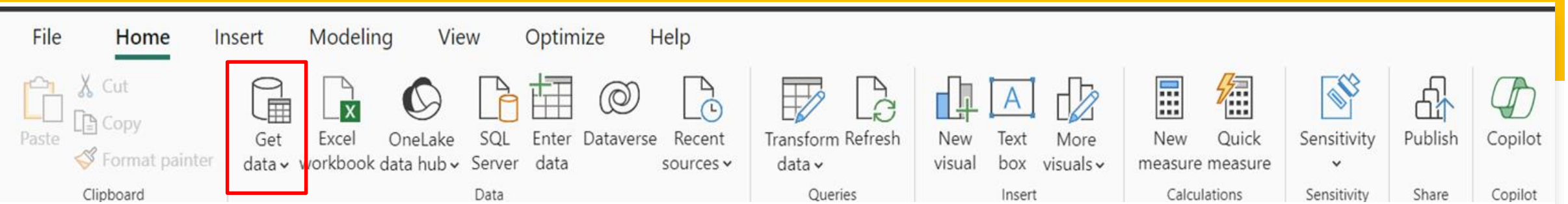
Getting Data - Basic Import from Excel



In order to connect with any data source, first, you need to click the **Get Data** in the **Home** tab in the top menu bar in the Power BI desktop.

Once you click the **Get Data** button, it will open the **Get Data** window, which gives huge list of sources:

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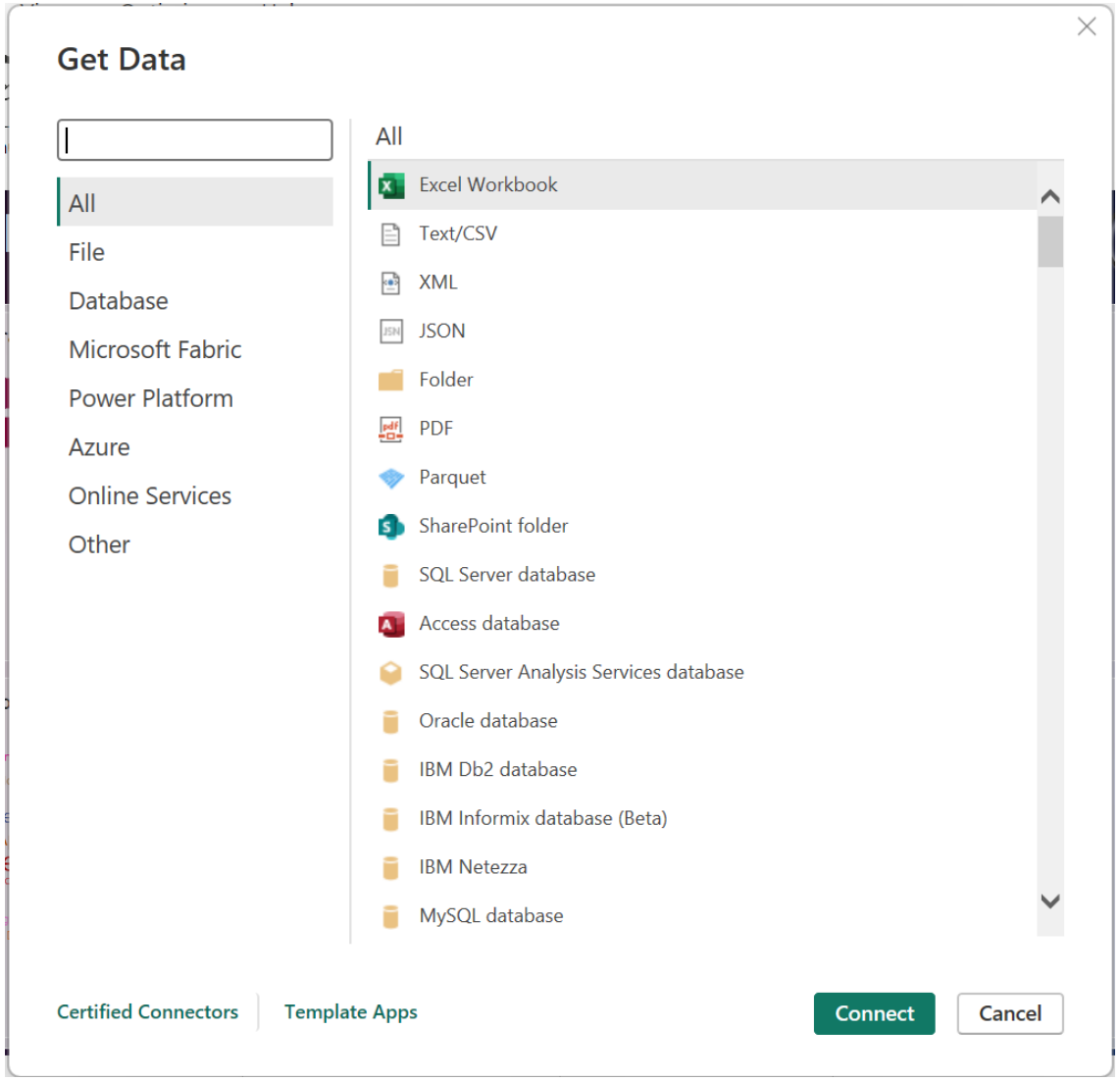

Get Data

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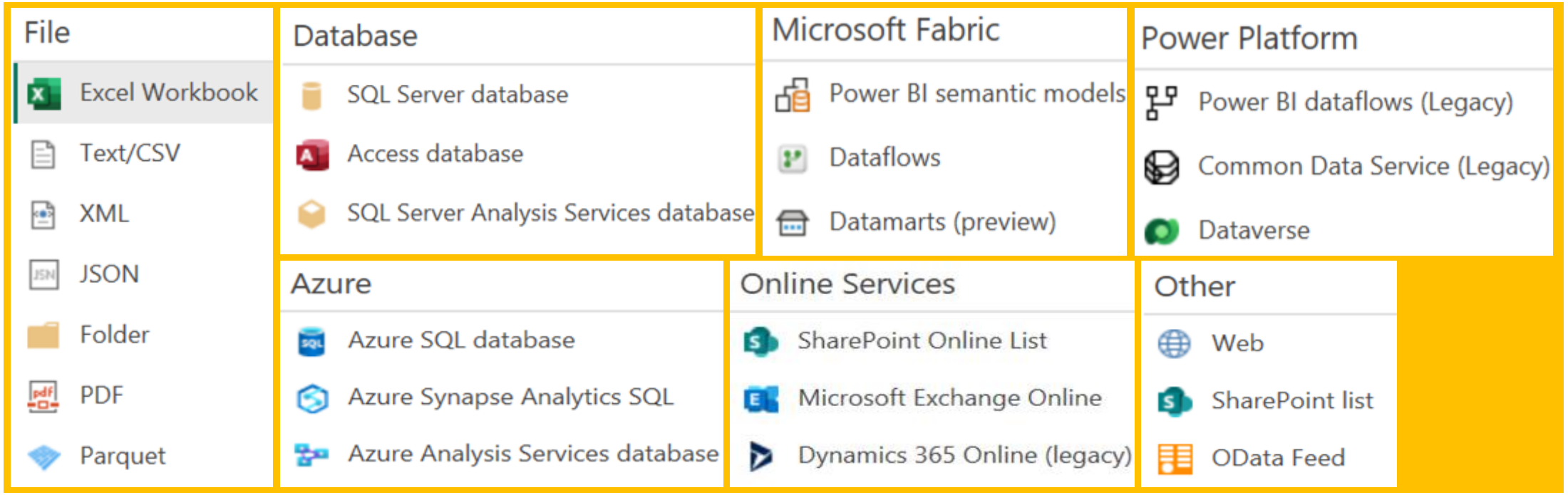
Power BI Connectors

Microsoft Power BI offers a range of connectors, starting from text documents/CSV files to Big Data sources like **Hadoop File Systems (HDFS).** The Power BI team keeps adding new data connectors to the Power BI.

The following diagram demonstrates the list of connectors available in the Power BI. However, this is just few data sources.



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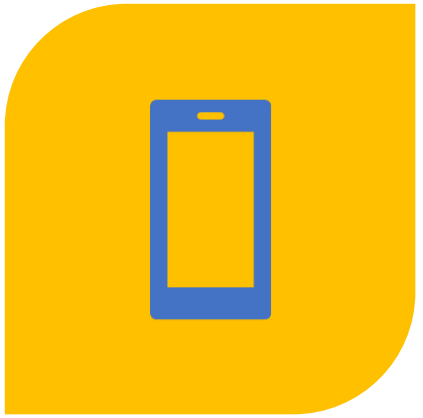
Connection Types

However, the way of connecting data is different from connector to connector. Predominantly, we can group them into three connection types.

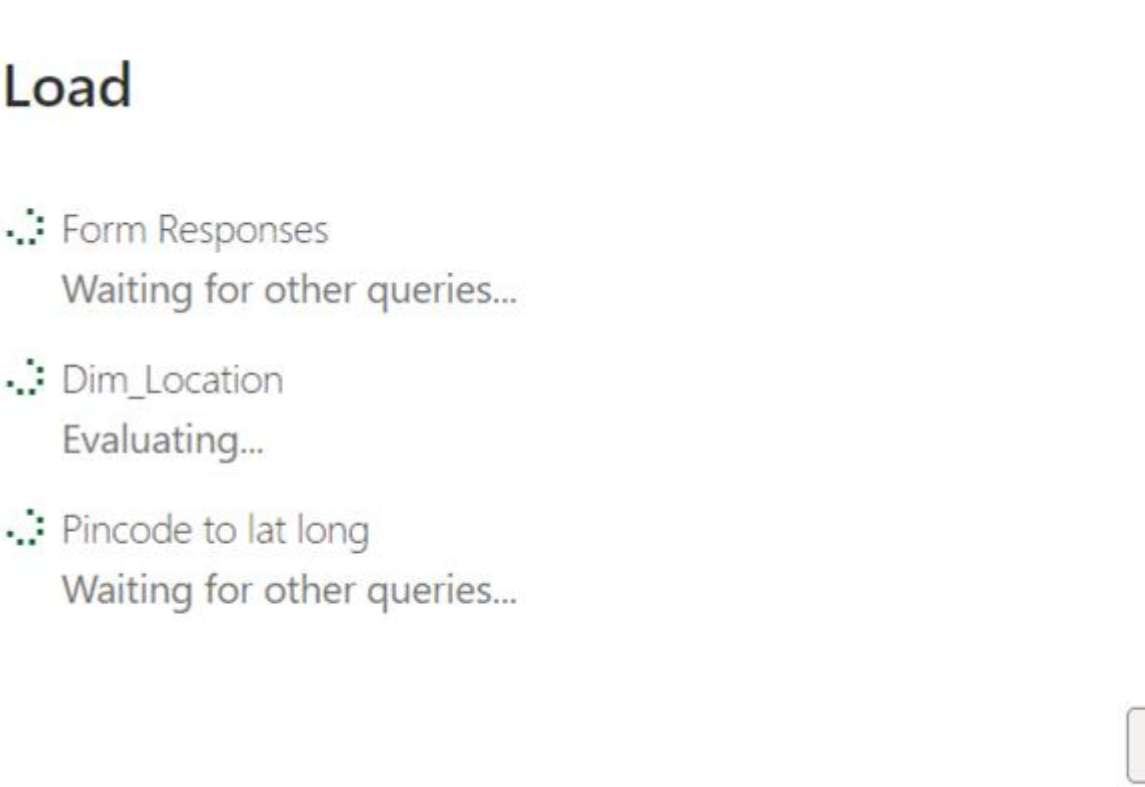
IMPORT

DIRECT QUERY



LIVE CONNECTION

Import



In the **Import** connection type, when you connect any data source, the data will be imported into the Power BI. You can experience this when you try to connect to text/csv or Excel data sources or even in Microsoft SQL Server connector. While you are importing data into Power BI, it will show up a window with the load status along with the list of data sets.

When you import data from the Power BI storage engine, Vertipaq (Compression Engine of Microsoft Power BI), compresses and store your data in-memory. That memory is machine you are holding the Power BI file. Once you publish the report into

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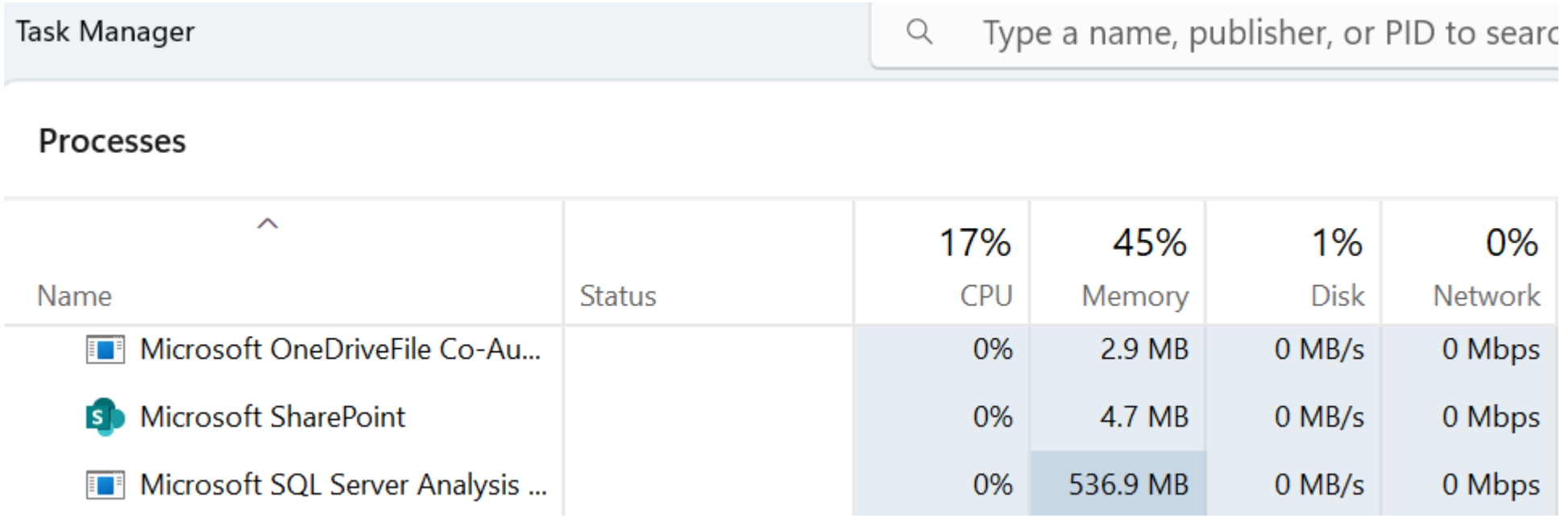
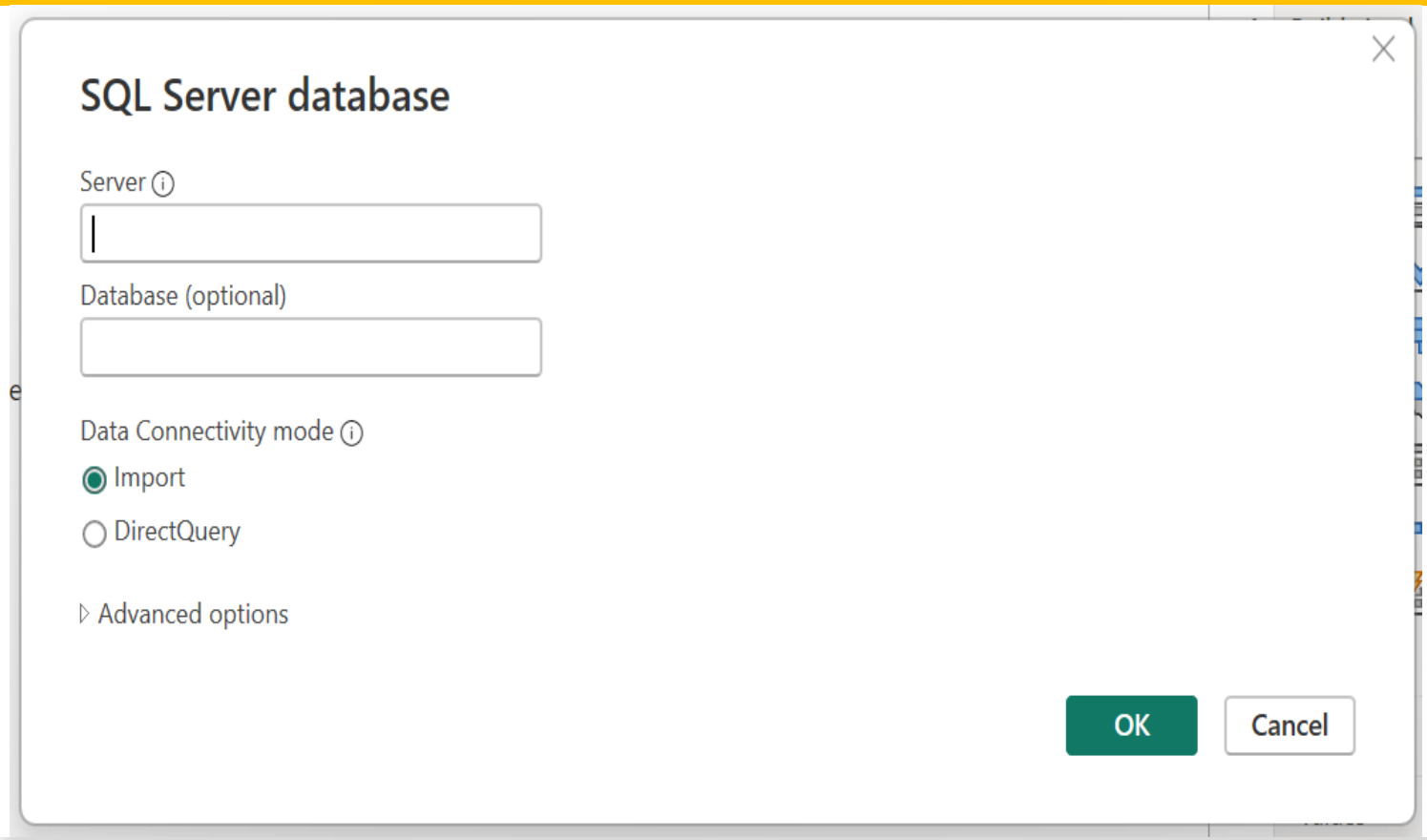


Direct Query



➢ **DirectQuery Definition:**

- DirectQuery is a connection option in Power BI that allows real time data querying from the source without importing the data into Power BI.

➢ **Real – Time Data Visualization :**

- DirectQuery ensures you are always seeing the latest data by live querying the backend source.

➢ Performance Considerations:

- DirectQuery may be slower than Import mode due to factors like data source performance and network latency.
- Import mode compresses and stores data in-memory (e.g., Vertipaq), offering better performance for visualization**.**

➢ Use Cases:

- Choose DirectQuery for scenarios where real-time data is crucial.
- Opt for Import mode when performance and speed are more critical, and the data doesn't need to be real-time.

➢ SQL Server Database Connection:

- Both Import and DirectQuery options are available when connecting to SQL Server databases.
- Select the appropriate option based on your specific needs and performance requirements.

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➢ **Proof of Concept (PoC)**:

- If data quality is unknown and requires transformation, use Import mode to create a data model.
- For data warehouses with pre-cleaned and transformed data, DirectQuery is preferable as importing an entire data warehouse might not be feasible.

➢ **DirectQuery Specifics:**

- **Connection**: Instead of loading data, DirectQuery creates connections to the data source.

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Live Connection

➢ **Import Mode Limitation:**

- In Import mode, there's a limitation on data import, especially when publishing a report to Power BI service with data volume exceeding 1 GB.
- Power BI doesn't limit data analysis; SQL Server Analysis Services (SSAS) Tabular database handles large data volumes.
- Both Microsoft Power BI and SSAS Tabular use the same storage engine technology, Vertipaq.

➢ **Corporate BI Projects:**

- As a BI Engineer, implementing data warehouses for clients is common.
- After loading data into a relational data warehouse, you can:
  Connect Power BI directly for analysis.
  Create a semantic data model using the SSAS database (tabular database).
- Implementing SSAS database improves user experience for Business Intelligence users.
- Similar functionalities are available in both Power BI and SSAS Tabular.

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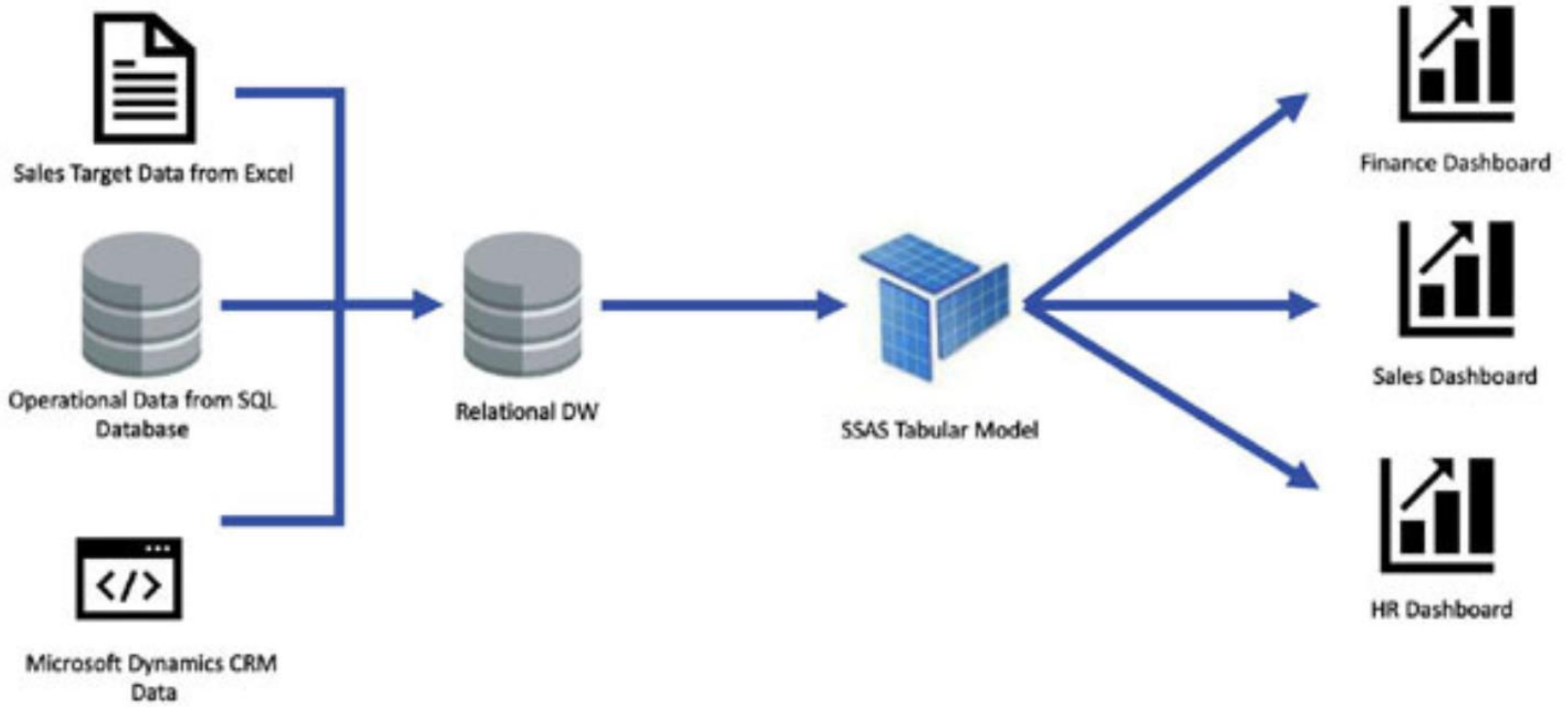
Sales Target Data from Excel
Operational Data from SQL Database
Microsoft Dynamics CRM Data
Relational DW
SSAS Tabular Model
Finance Dashboard
Sales Dashboard
HR Dashboard

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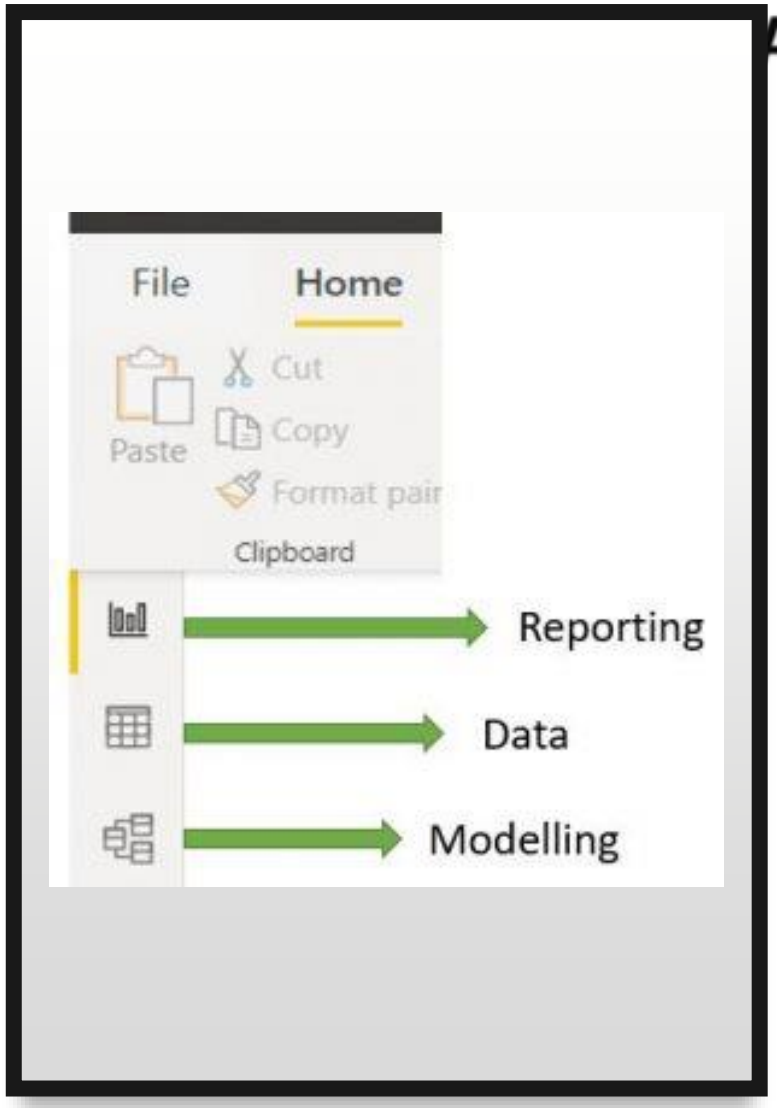
➢ SSAS Tabular Data Model:

- Implemented after setting up the data warehouse using SQL Server.
- SSAS Tabular is an in-memory database consuming deployed server memory.
- No upper limit for memory expansion, surpassing the 1 GB data limit in Import mode.
- In this solution, Power BI functions as a reporting tool, not for data transformation/modeling.
- Steps for data transformation/modeling are handled in the relational data warehouse and SSAS Tabular model.

Guess the connection type ?



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Creating Reports and Visualizations

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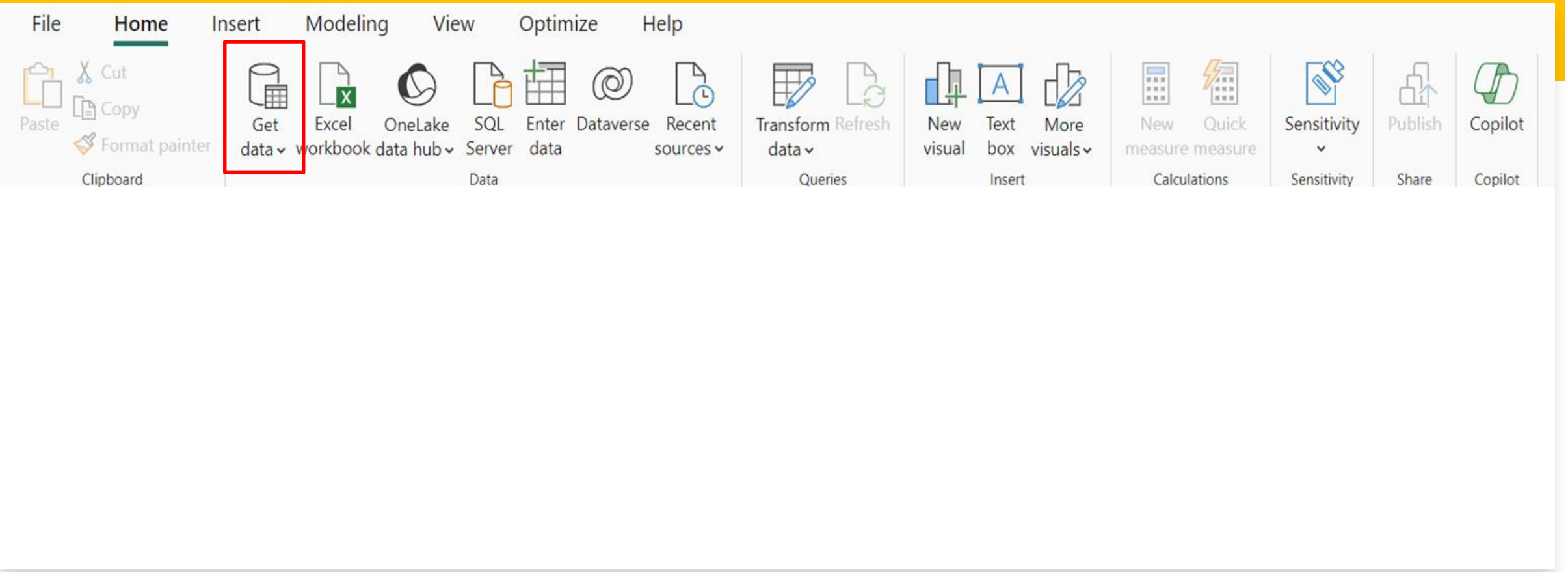
Load data into Power BI



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Data cleansing and blending

➢ **Data Transformation:**

- Data transformation converts data into a required structure through cleansing activities and applying business logic.

➢ **Power Query:**

- Utilizes ETL (Extract, Transform, Load) technology within Power BI for data transformations.
- Accessed via the "Edit Queries" button in the top menu bar, which opens the Power Query Editor window.
- Provides various tools for performing data transformations.

➢ **Power Query Features:**

- Microsoft’s data connectivity and data preparation technology.
- Allows business users to engage with data import and preparation tasks seamlessly.
- Code-free graphical user experience speeds up data preparation.
- Typically, 80% of the time is spent connecting and preparing data, which is streamlined by Power Query.

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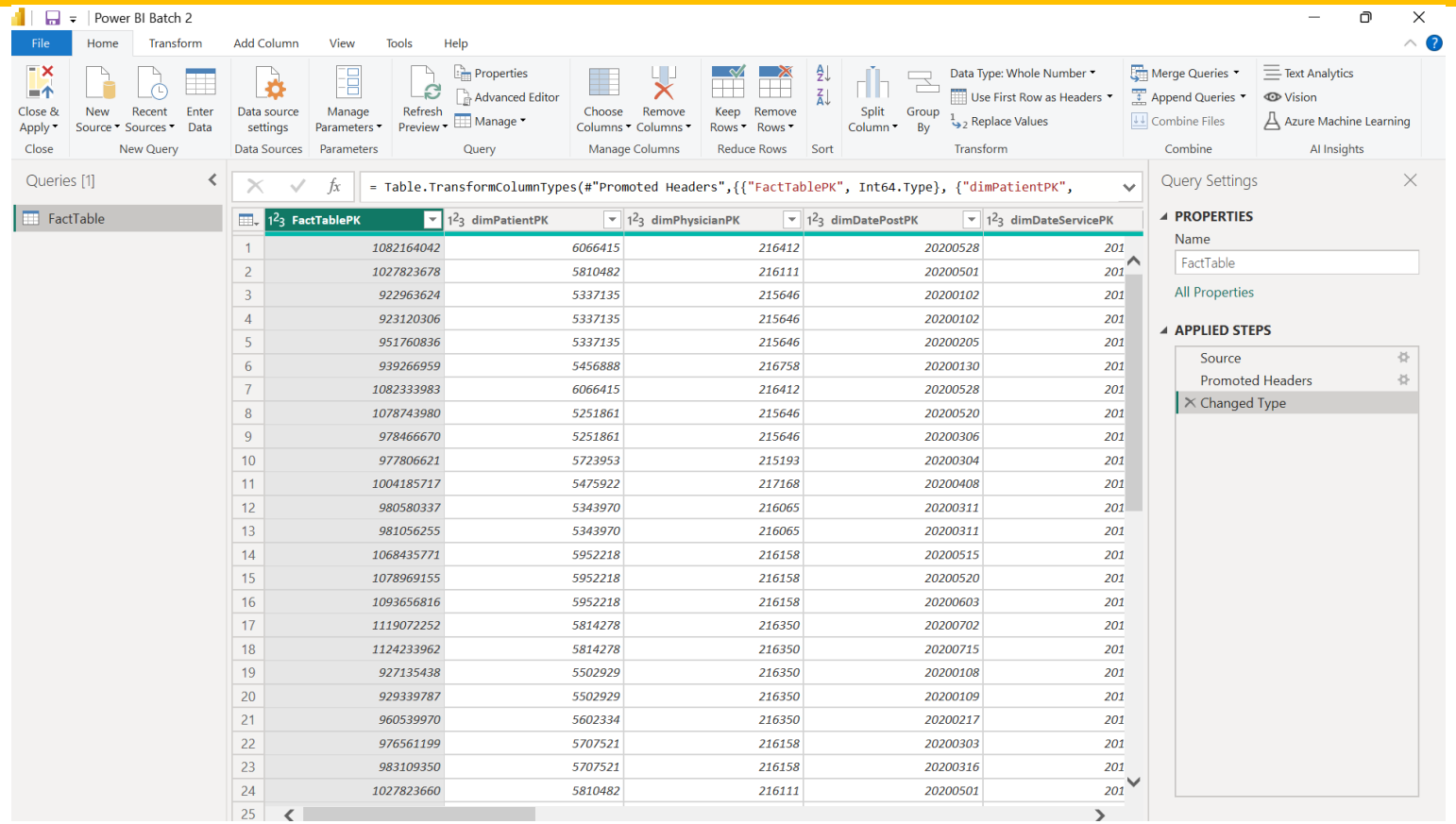
Power Query Editor



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Dimensional Modeling Concepts

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What is Data Modelling and Why?

- Data modeling involves designing a logical structure to store data in a database.
- Considers aspects like accessibility and optimization.
- Dimensional modeling is a subset, specifically for report databases or data warehouses.
- Discuss classical approach and data modeling approach in detail and their benefits.

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Classic BI Approach

1

Load Data

2

Create Calculations

3

Visualize

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- Deal with multiple data source systems (e.g., sales, marketing, finance, HR, healthcare, logistics).
- Systems known as Online Transactional Processing (OLTP) systems.
- Highly normalized and optimized for transaction recording.
- Classic BI approach includes:
  Connecting to data source.
  Defining metrics.
  Creating interactive visuals.
- Traditional report development approach: Connect to data source, define metrics, create interactive visuals..

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Classic BI Approach Limitation

- Works fine for simple datasets with few tables and low data volume.
- Difficult to analyze with large datasets (e.g., 50+ tables) or large data volume (approx. 1 GB).
- OLTP systems are optimized for transaction processing, not for reporting.
- Connecting and analyzing multiple tables can become a tedious task.

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Modern Self – Service BI Approach

1

Load Data

2

Create Data Model

3

Create Calculations

4

Visualize

- Overcomes limitations of traditional BI approach.
- Adds an intermediate layer between imported data and defined metrics: Data model or dimension model.
- Data modeling creates a simplified data structure optimized for analytics.
- Steps include: Load Data, Create Data Model, Create Calculations, Visualize.

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End – to – End BI with Microsoft Power BI

- Traditional corporate BI stack replaced with simplified, self-service approach using Power BI.
- Provides tools for data extract/load, data modeling, metric definition, reporting, and collaboration.
- Integration of SSIS, SSAS Tabular, and Power BI services for data warehousing and BI stack.
- Enables end-to-end BI solutions for large data volumes.

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Data Warehouse

- **Typical OLTP Systems:**
- Highly normalized and optimized for transaction recording.
- Challenges in reporting: Slow query execution, difficulty in analytics.

- **Data Warehouse Tables:**
- **Fact Tables:**
  - Store business processes, events, or transactions.
- **Dimension Tables:**
  - Store textual data and entities (e.g., product, category, salesperson, customer, date, time).

- **Dimensional Model:**
- Identified as the data warehouse structure.
- Creates a data warehouse inside Power BI.
- During implementation, map business processes to dimensions in the design phase.

Difference Between Data Warehouse and Databases

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Data Warehouse	Databases
Store large volume of data	Store small volume of data
Designed for read heavy operations	Designed for write heavy operations
High Latency	Low Latency
Denormalized (Data Redundancy High)	Highly Normalized (Data redundancy low)
Columnar Storage	Row based
Parallel Processing of request	Not optimized for parallel processing
OLAP (Online Analytics Processing)	OLTP (Online Transactional Processing)

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Characteristics of Data Warehouse

Integrated

Subject Oriented

Time Variant

Non Volatile

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Fact Table and Dimensional Table

- Fact Table : Measurement
- Dimension Table : Context

Trxn_id	Sales_quantity	Regular_unit_price	Discount_unit_price	Net_unit_price	Sales_amount	Discount_amount
TXN001	5	20	18	15	90	10
TXN002	3	120	96	100	288	72
TXN003	7	85	68	60	476	119
TXN004	1	24	21.6	20	21.6	2.4
TXN005	1	150	135	150	135	15
TXN006	2	200	160	130	320	80
TXN007	6	5	5	4	30	0

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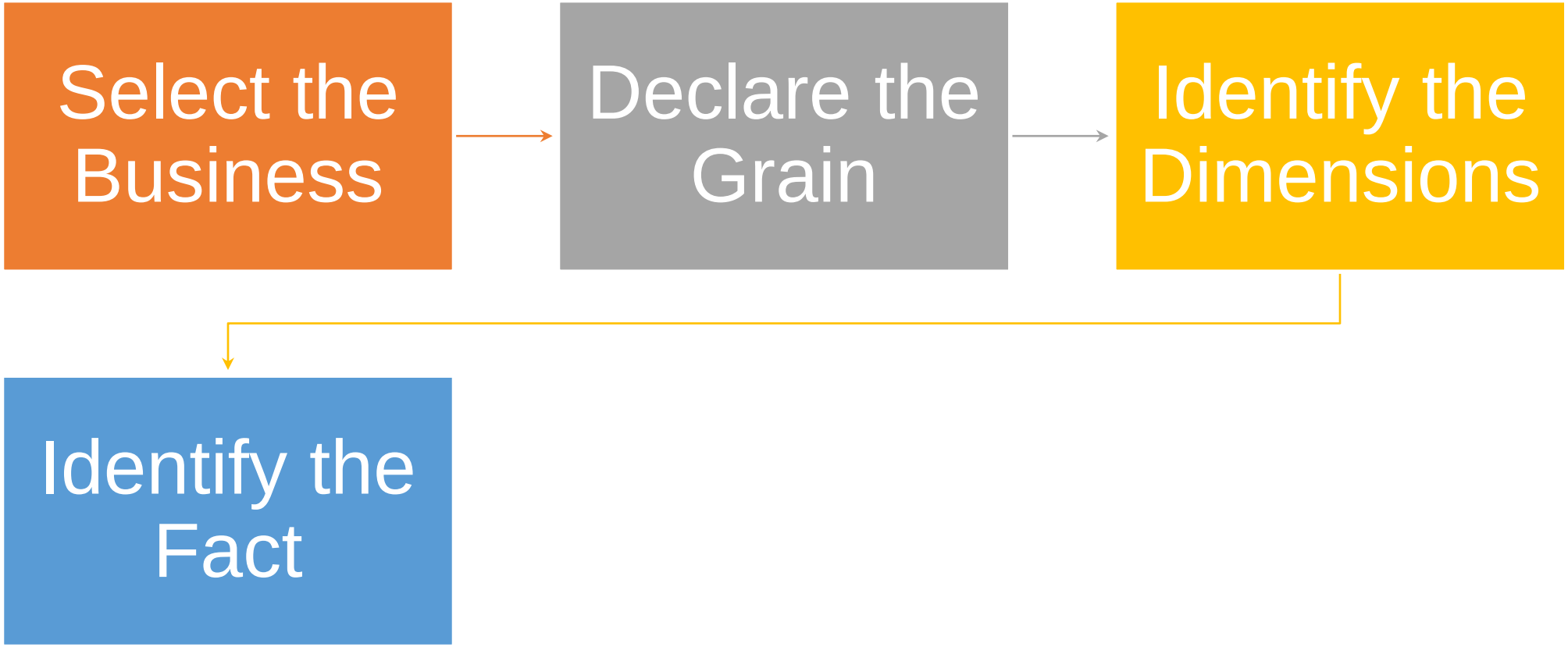
Fact Table and Dimensional Table

Retail_Sales_Fact_Table
Trxn_id
Sales_quantity
Regular_unit_price
Discount_unit_Price
Net_Unit_Price
Sales_amount
Discount_amount

Product_Dim_tbl
product_id
Product_description
Brand_description
Category_description
Package_size
Weight

Fundamental of Dimensional Modelling



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Select the Business

- What does your business do?
- What measurement you want to analyze?
- How does your current Operational dataset look like?

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Declare the grain

- Granularity is the number of dimensions linked to a fact
- Grain is level of details available with the fact table. Basically this means what single record in the fact table shows.

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Identify Dimension and Fact Table

- Who, What, When, Where, How of data in the fact table
- Promotion, Date, store, Product, sales.

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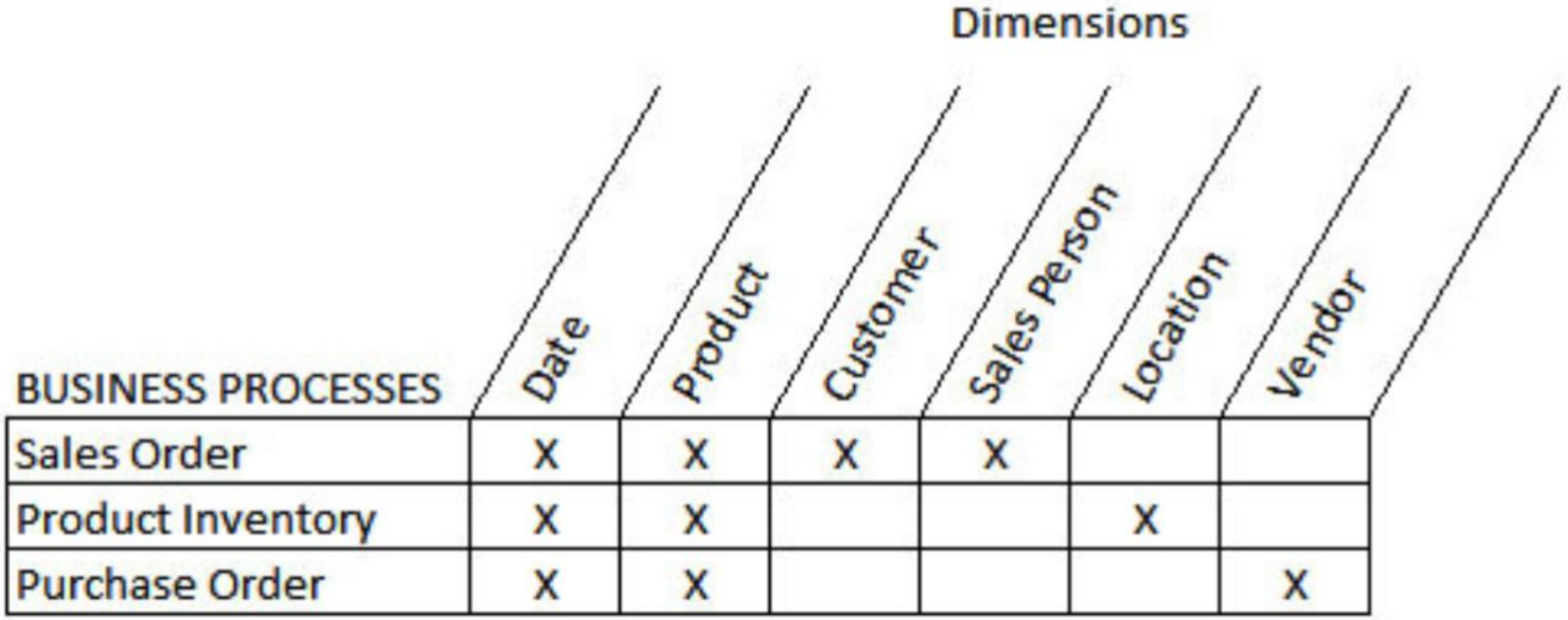
Bus Matrix Architecture



BUSINESS PROCESSES	Dimensions: Date	Product	Customer	Sales Person	Location	Vendor
Sales Order	X	X	X	X		
Product Inventory	X	X			X	
Purchase Order	X	X				X

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Star Schema

- A star schema is a data model that stores information in multiple table types: a single fact table and multiple dimensional tables.
- In contrast to the classical database design of normalizing tables, star schemas connect dimensional data with fact data in a shape resembling a star (hence the name)

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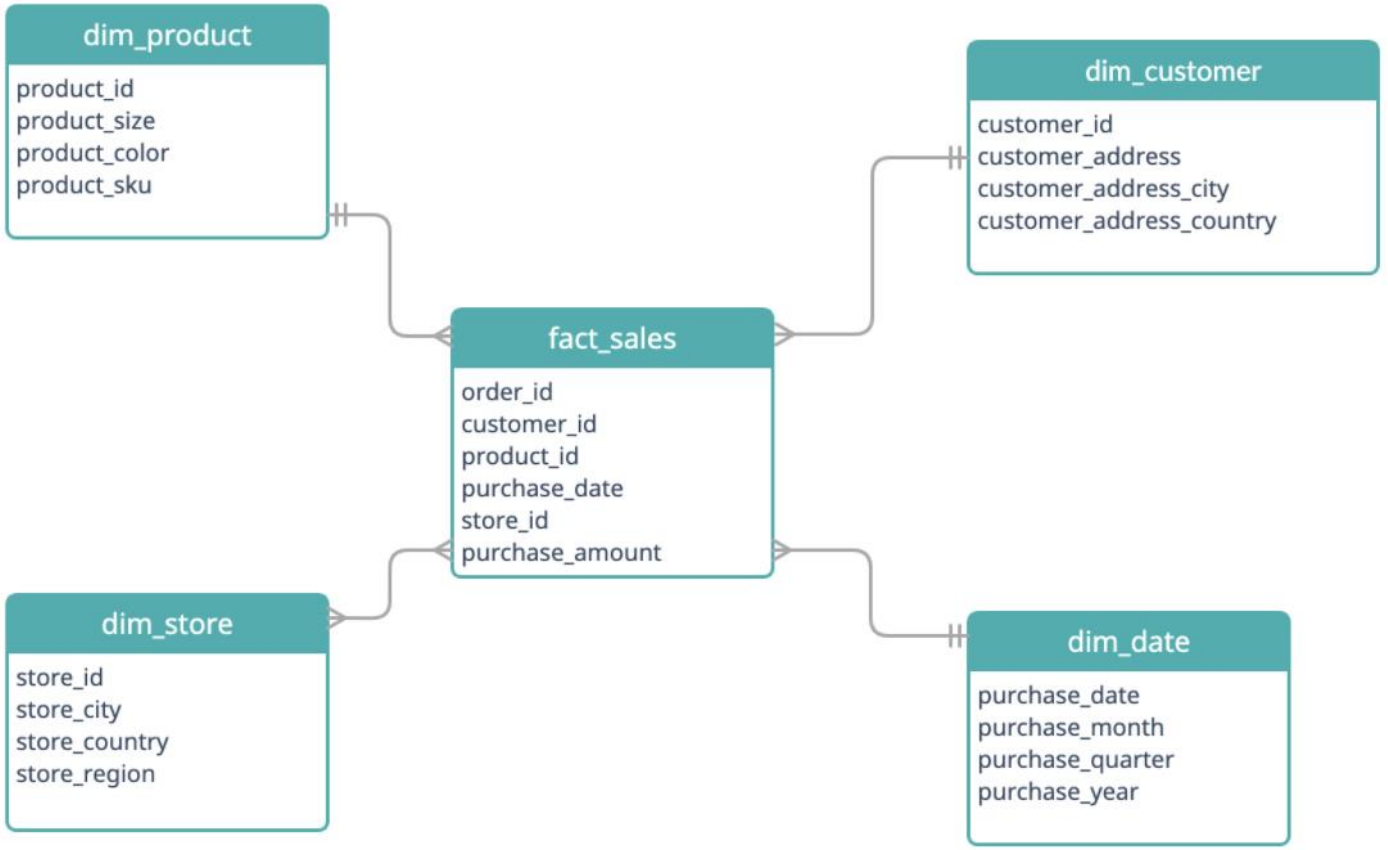
Star Schema



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Snowfake Schema

- A snowflake schema is very similar to the simple star schema above. The main difference is that snowflake schemas split dimensional tables into further dimensional tables (also called lookup tables).

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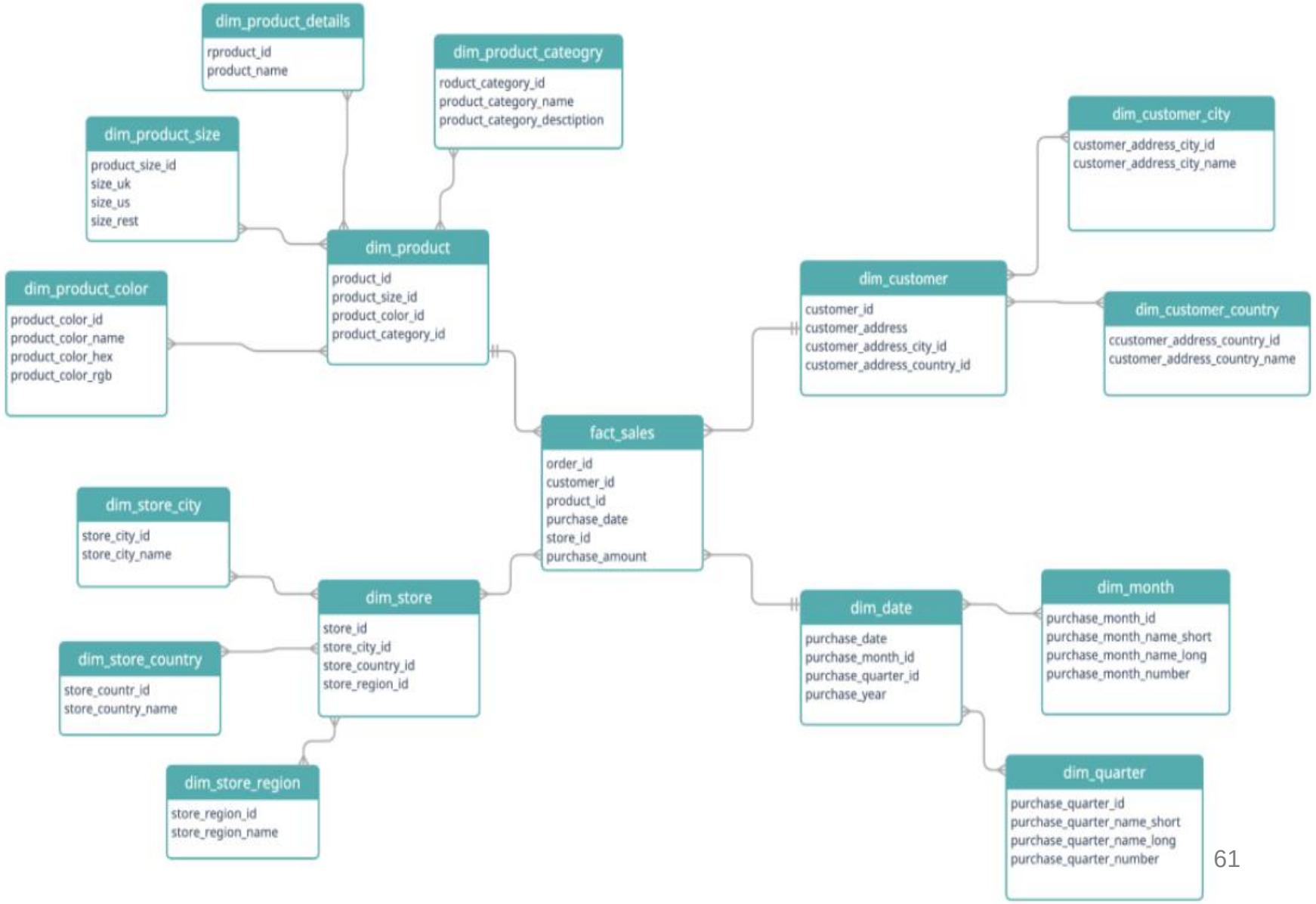
Snowflake Schema



Differences in Star Schema and Snowflake Schema

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	Star schema	Snowflake schema
Normalization of dimension tables	normalized	denormalized
Data redundancy	stores it	avoids it
Query complexity	simple	complex
Query performance	faster	slower
Disk space	more	less
Data integrity	higher risk	lower risk
Set up and maintenance	easier to set up / harder to maintain	harder to set up / easier to maintain

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Cardinality

One-to-One (1:1)

One-to-Many (1:N)

Many-to-Many (N:N)

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One-to-One (1:1)

This cardinality indicates that each value in the column of one table is related to a unique value in the column of another table. It implies a direct and singular relationship between the two tables.

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One-to-Many (1:N)

This cardinality indicates that each value in the column of one table can be related to multiple values in the column of another table. It represents a hierarchical or parent-child relationship, where one record in the parent table can have multiple related records in the child table.

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Many-to-Many (N:N)

This cardinality indicates that multiple values in the column of one table can be related to multiple values in the column of another table. It implies a complex relationship where multiple records in one table can have associations with multiple records in another table.

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Joins

LEFT OUTER		All rows from the left table, matching rows from the right table
RIGHT OUTER		All rows from the right table, matching rows from the left table
FULL OUTER		All rows from both tables
INNER		Only matching rows from both tables
LEFT ANTI		Only rows from the left table
RIGHT ANTI		Only rows from the right table

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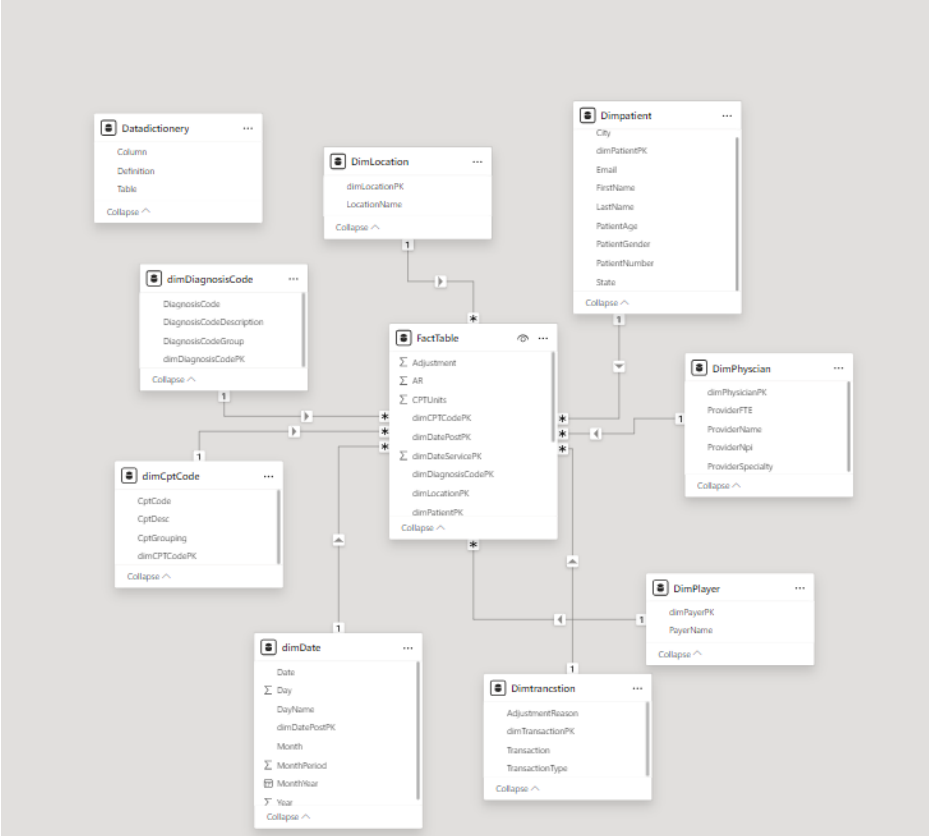
Dimensional Modelling in Project



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Let’s Create a Dashboard

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Drill - Through

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RLS (Row Level Security)

Row-level security (RLS) with Power BI can be used to restrict data access for given users. Filters restrict data access at the row level, and you can define filters within roles.

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Types of RLS

- Static RLS
- Dynamic RLS

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