

Business Intelligence

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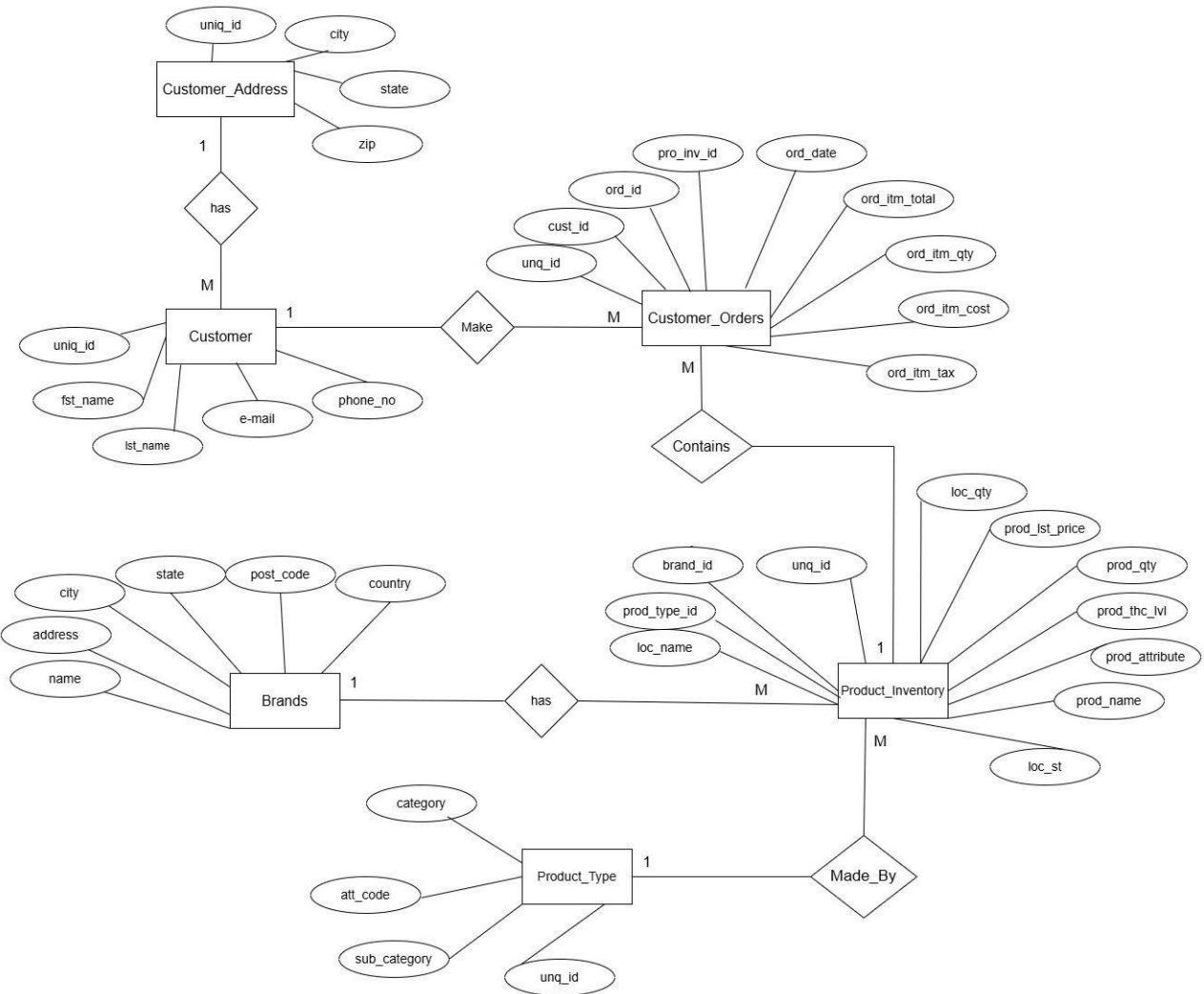
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1. DATA SOURCE

- Data Warehouse implemented in the previous assignment was used as the source to complete Assignment 2. As described in the Assignment 1, the selected data set consisted of transactional data. Customer Order specific details involved with customers, brands, product Types, and product inventory details.

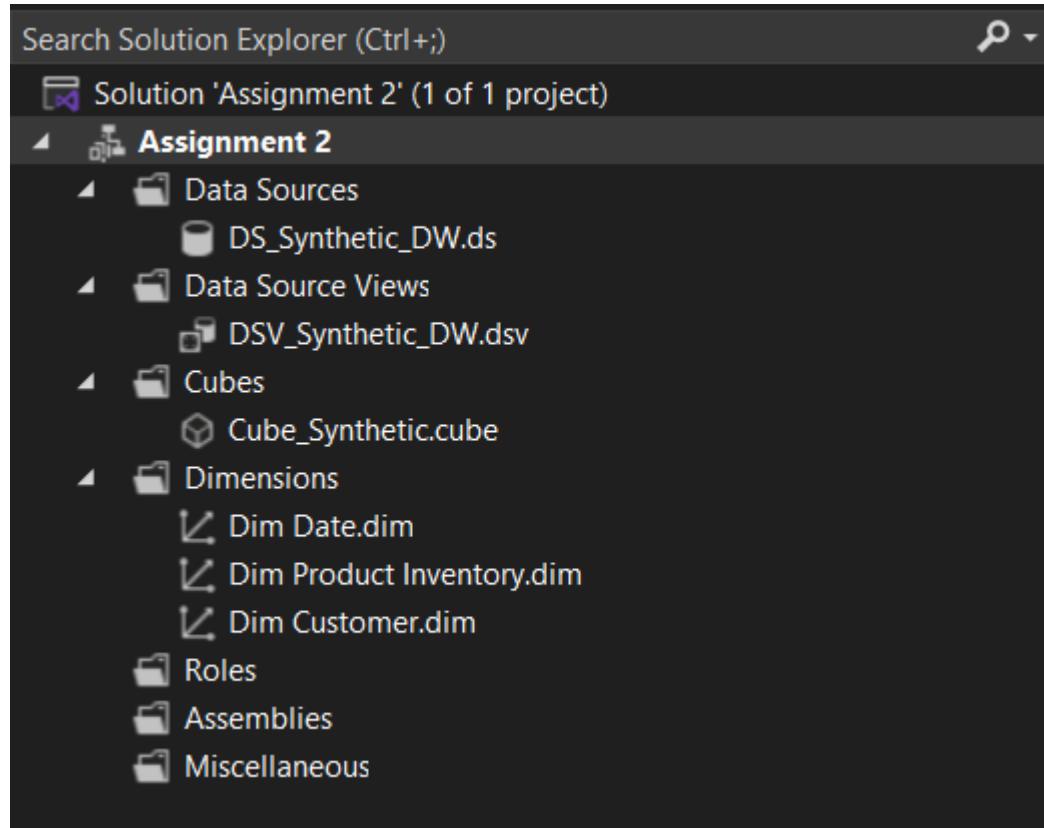
ER-Diagram

The below ER-diagram shows the connection between the entities in the data set and the attributes.

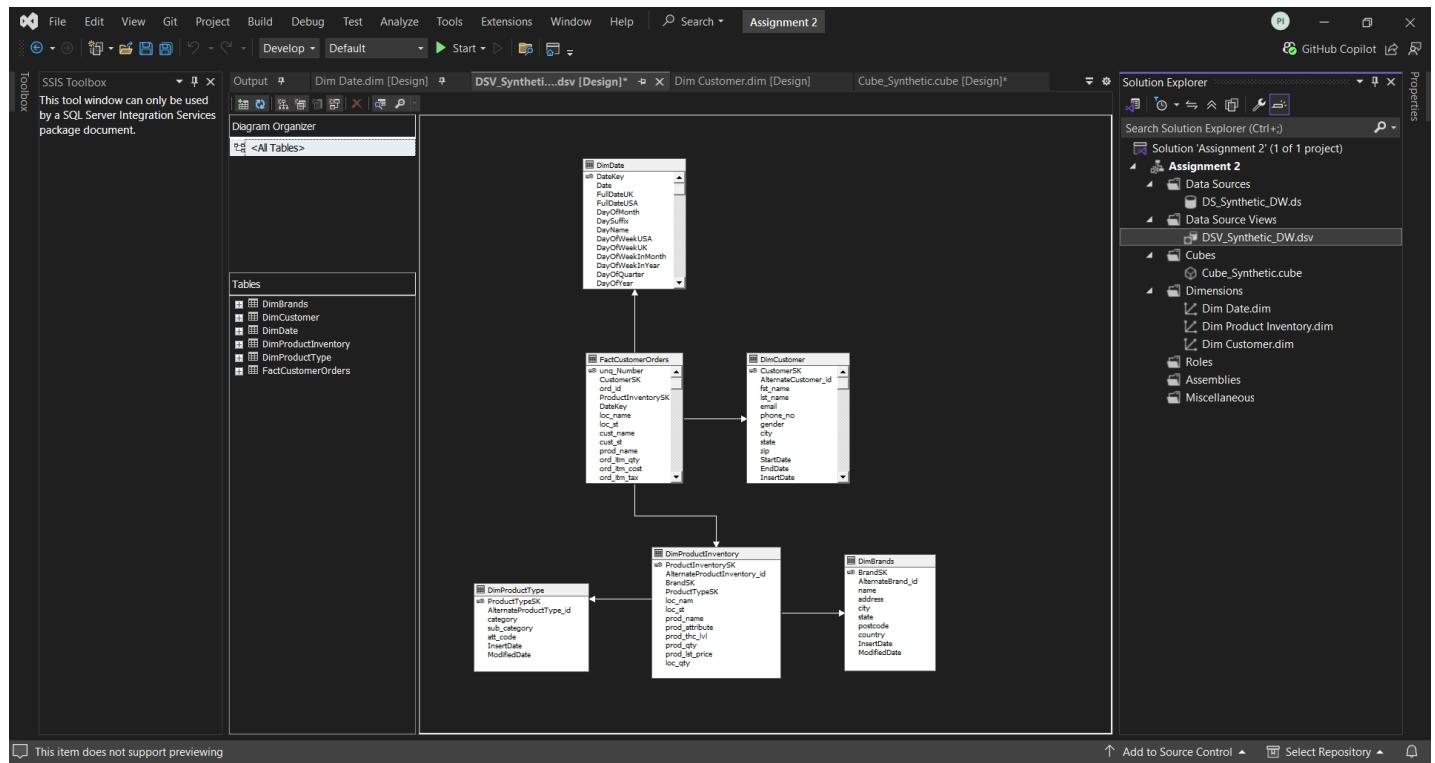


2.SSAS CUBE IMPLEMENTATION

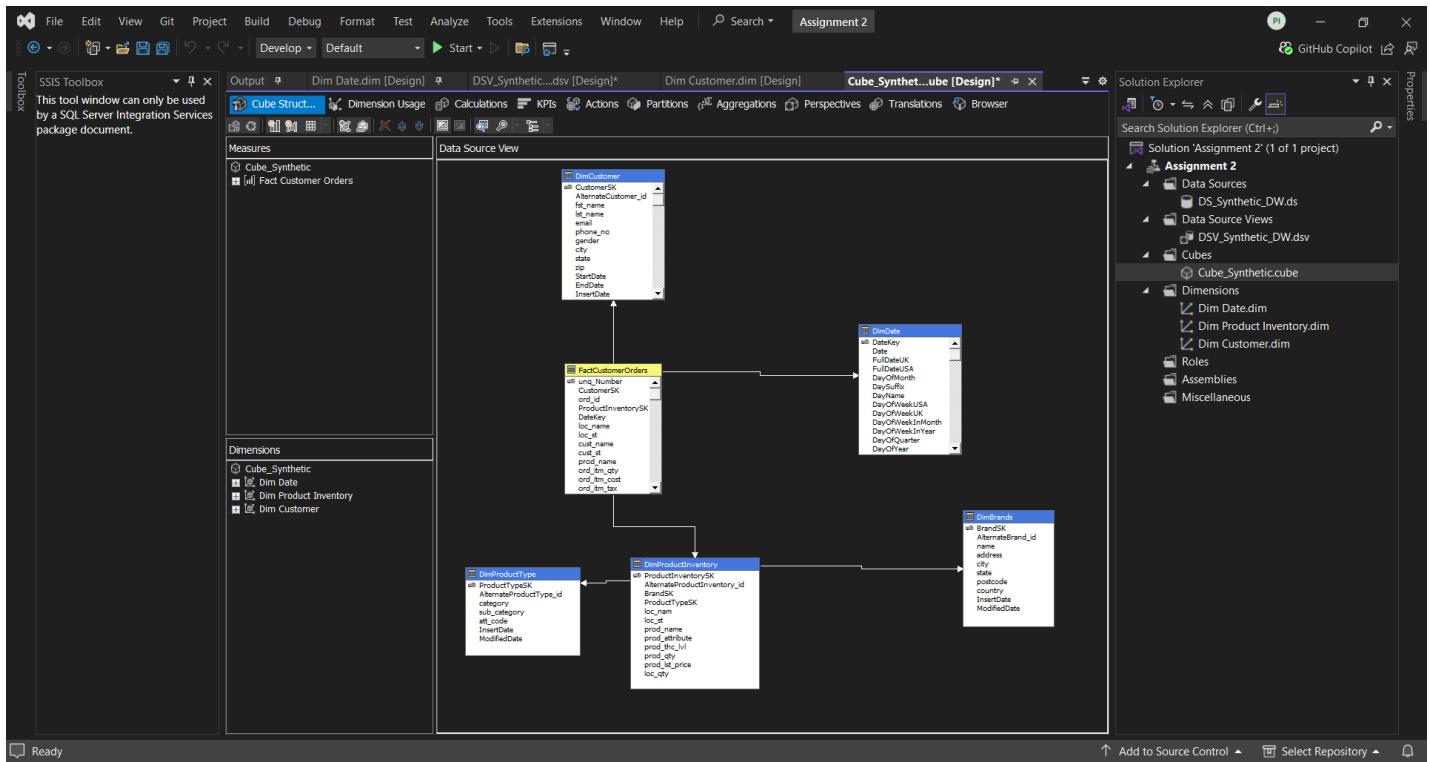
- 1) A new SSAS project was created and named as ‘DWBI_SSAS’, to begin the SSAS cube implementation. First the created Data warehouse was added as a new Data source and configured.



- 2) Next a new Data Source view was added after adding the same warehouse. The created data source view is attached below.



- 3) Next a cube was created by adding a new cube and selecting the fact table, measures, dimensions appropriately. The created cube is demonstrated below.



4) Next attributes were added to the relevant dimensions.

- a. **Customer dimension** – When creating Customer dimension, not only the attributes were added but also a hierarchy was created to ease the process of analyzing data. Customer Hierarchy includes Zipcode, State and City.

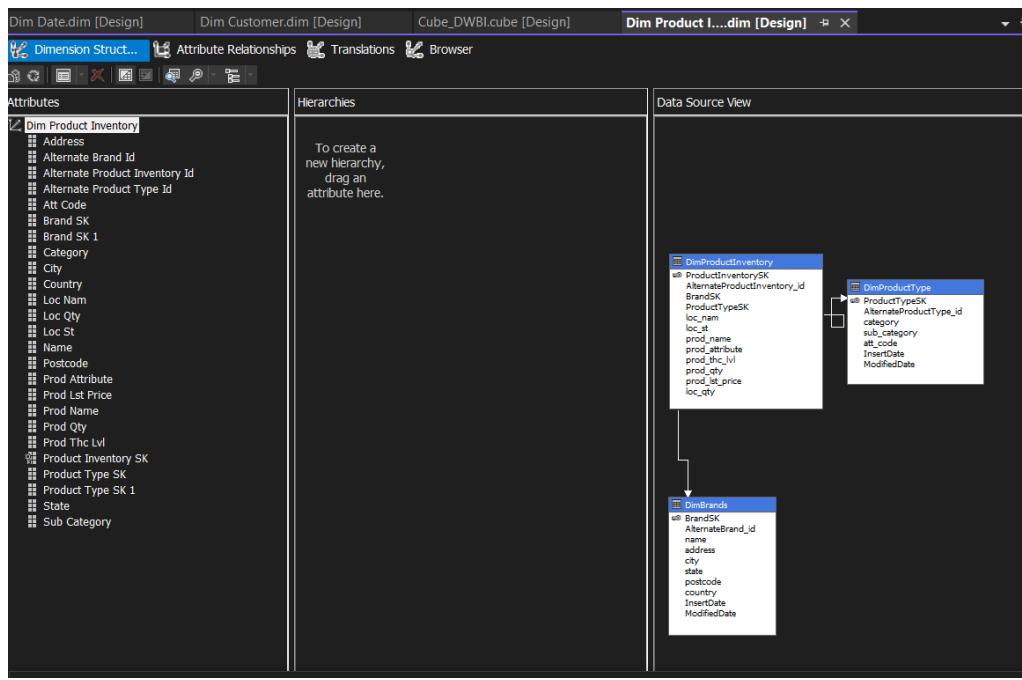
The screenshot shows the Microsoft Analysis Services Dimension Designer for the 'Dim Customer.dim' dimension. The interface is divided into several panes:

- Attributes** pane: Lists all attributes defined for the dimension, including Customer SK, Email, End Date, Fst Name, Gender, Insert Date, Lst Name, Modified Date, Phone No, Start Date, State, and Zip.
- Hierarchies** pane: Displays a hierarchy structure. It shows a 'Hierarchy' node with three levels: Zip, State, and City. A tooltip provides instructions: "To create a new hierarchy, drag an attribute here."
- Data Source View** pane: Shows the physical table structure named 'DimCustomer' with columns: CustomerSK, AlternateCustomer_id, fst_name, lst_name, email, phone_no, gender, city, state, zip, StartDate, EndDate, and InsertDate.
- Output** pane: Located at the bottom left of the designer window.

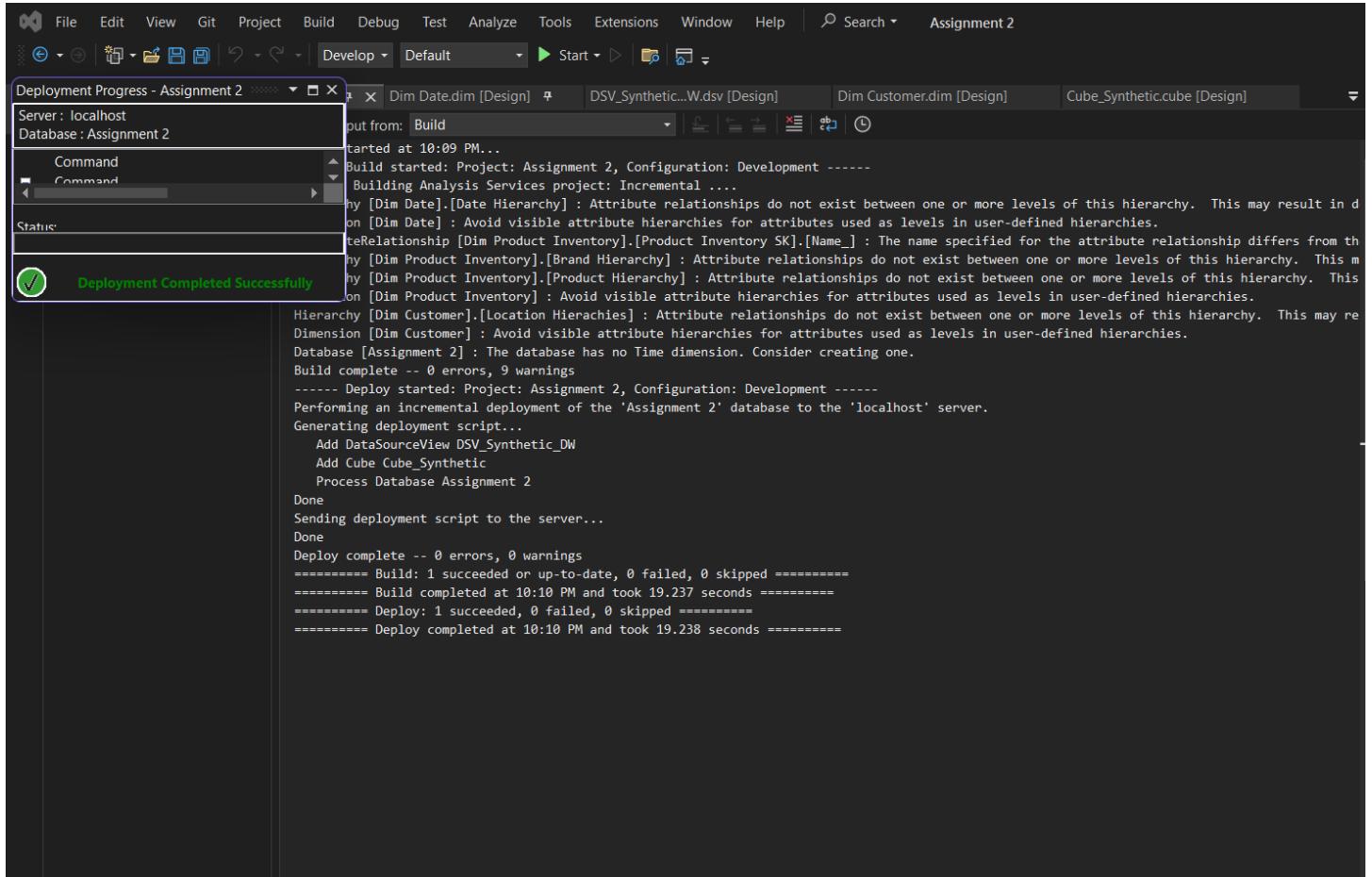
b. Date dimension -In the Date dimension, not only the attributes were added but also a hierarchy was created to ease the process of analyzing data. Date Hierarchy includes Year, Quarter name, Month name and Day of month.

The screenshot shows the Microsoft Analysis Services (SSAS) Dimension Designer interface. The top menu bar includes tabs for "Dim Date.dim [Design]", "Dim Customer.dim [Design]", "Cube_DWBI.cube [Design]", and "Dim Product I...y.dim [Design]". Below the menu, there are several toolbars and buttons. The main workspace is divided into three sections: "Attributes" on the left, "Hierarchies" in the center, and "Data Source View" on the right. In the "Hierarchies" section, a dropdown menu titled "DateHierarchy" is open, showing levels: "Year", "Quarter Name", "Month Name", "Day Of Month", and "<new level>". A tooltip says "To create a new hierarchy, drag an attribute here." To the right of the "Hierarchies" section, a "Data Source View" window is open, showing a list of attributes for the "DimDate" table, including "DateKey", "Date", "FullDateUK", "FullDateUSA", "DayOfMonth", "DaySuffix", "DayName", "DayOfWeekUSA", "DayOfWeekUK", "DayOfWeekInMonth", "DayOfWeekInYear", "DayOfQuarter", "DayOfYear", and "MMYYYY".

c. ProductInventory dimension – Product Inventory dimension is connected with DimBrands and DimProductType through surrogate keys.



5). As the last step of cube implementation, the cube was deployed.



The screenshot shows the SSMS interface with the title bar "Assignment 2". The main window displays the "Deployment Progress - Assignment 2" pane. The pane shows the deployment process started at 10:09 PM, building an Analysis Services project incrementally. It lists several warnings related to attribute relationships and hierarchy levels. The deployment completed successfully at 10:10 PM, taking 19.237 seconds.

```
Deployment Progress - Assignment 2
Server: localhost
Database: Assignment 2
Status: Deployment Completed Successfully

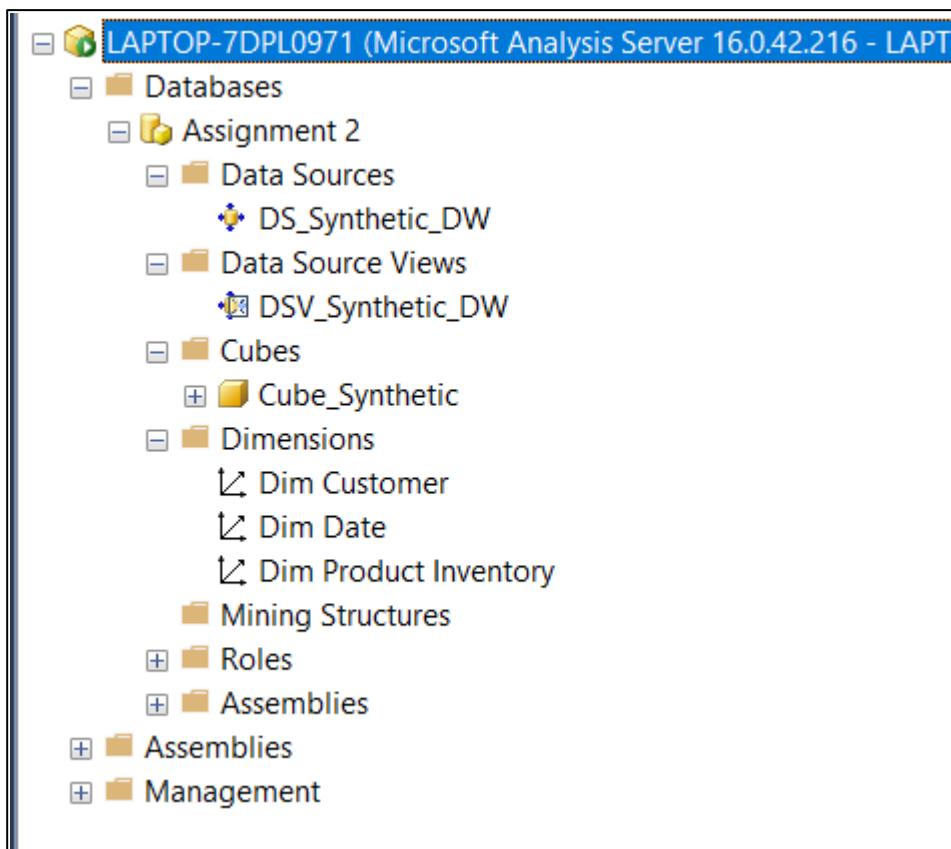
Build started at 10:09 PM...
Building Analysis Services project: Incremental ...
Warning [Dim Date].[Date Hierarchy] : Attribute relationships do not exist between one or more levels of this hierarchy. This may result in dimension anomalies.
Warning [Dim Date] : Avoid visible attribute hierarchies for attributes used as levels in user-defined hierarchies.
Warning [Dim Product Inventory].[Product Inventory SK].[Name] : The name specified for the attribute relationship differs from the relationship name.
Warning [Dim Product Inventory].[Brand Hierarchy] : Attribute relationships do not exist between one or more levels of this hierarchy. This may result in dimension anomalies.
Warning [Dim Product Inventory].[Product Hierarchy] : Attribute relationships do not exist between one or more levels of this hierarchy. This may result in dimension anomalies.
Warning [Dim Product Inventory] : Avoid visible attribute hierarchies for attributes used as levels in user-defined hierarchies.

Hierarchy [Dim Customer].[Location Hierarchies] : Attribute relationships do not exist between one or more levels of this hierarchy. This may result in dimension anomalies.
Dimension [Dim Customer] : Avoid visible attribute hierarchies for attributes used as levels in user-defined hierarchies.
Database [Assignment 2] : The database has no Time dimension. Consider creating one.

Build complete -- 0 errors, 9 warnings
Deploy started: Project: Assignment 2, Configuration: Development -----
Performing an incremental deployment of the 'Assignment 2' database to the 'localhost' server.
Generating deployment script...
  Add DataSourceView DSV_Synthetic_DW
  Add Cube Cube_Synthetic
  Process Database Assignment 2
Done
Sending deployment script to the server...
Done
Deploy complete -- 0 errors, 0 warnings
=====
Build: 1 succeeded or up-to-date, 0 failed, 0 skipped ======
Build completed at 10:10 PM and took 19.237 seconds ======
Deploy: 1 succeeded, 0 failed, 0 skipped ======
Deploy completed at 10:10 PM and took 19.238 seconds ======
```

3.DEMONSTRATION OF OLAP OPERATIONS

After deployment of the created cube is shown in the SQL Server Management Studio the cube was loaded to Excel by following the necessary process. After connecting to the Excel Workbook, the reports and graphs were generated via the available features.



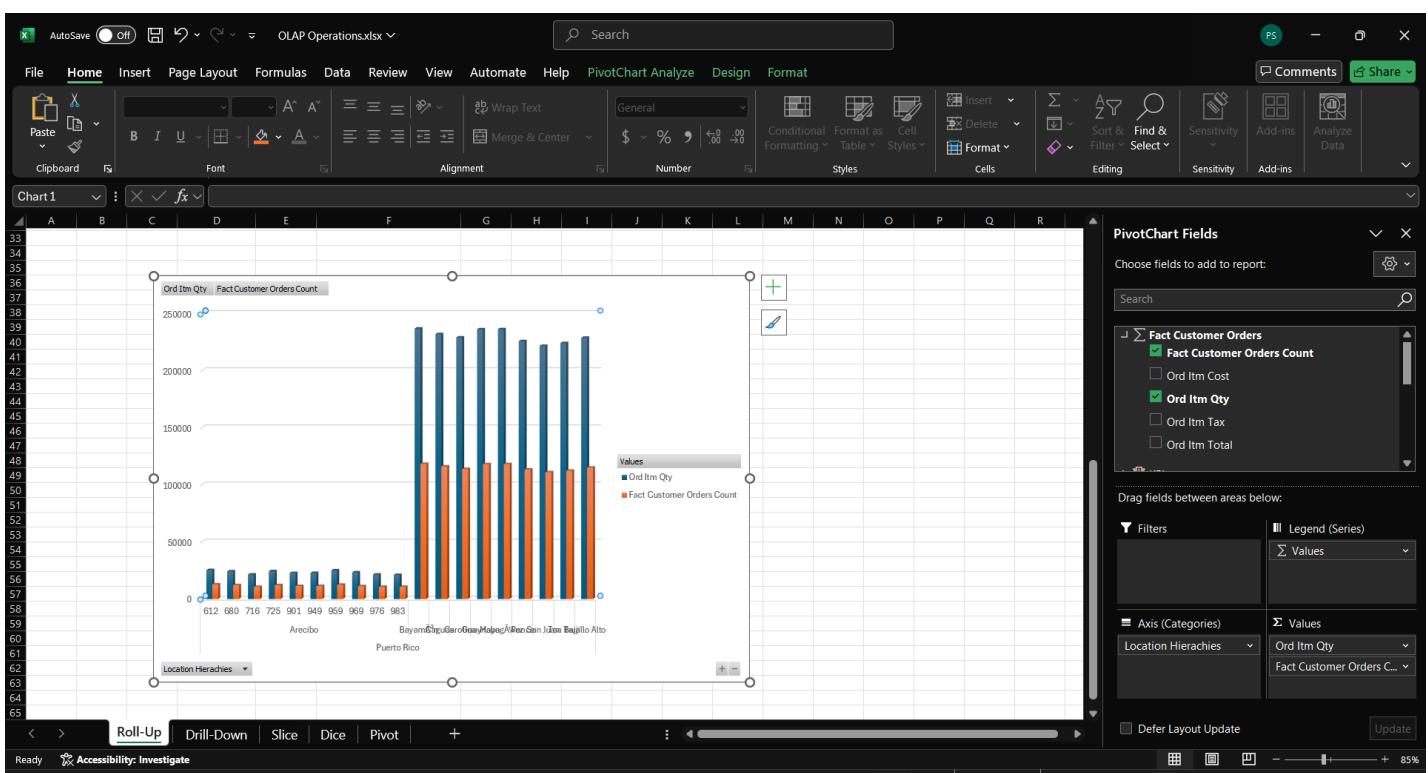
Roll-Up

- In here, climbing up the hierarchy of the dimension to aggregate the data. For that, Location hierarchy has been used. Order_item_Qty and customer_order_count has been taken as values. This analysis shows how the item quantity and customer order count is distributed among different locations of customers.
- The following figures show the rows, column and the fact table measure values that have been used to demonstrate this operation.

The screenshot shows a Microsoft Excel spreadsheet titled "OLAP Operations.xlsx". A PivotTable is displayed in the center of the screen, showing data for "Fact Customer Orders". The PivotTable Fields pane on the right indicates that "Fact Customer Orders" is the primary field, with "Fact Customer Orders Count" selected. The Rows section of the PivotTable Fields pane shows "Location Hierarchies" with "Ord Itm Qty" selected. The Data pane at the bottom shows the following data:

Location	Ord Itm Qty	Fact Customer Orders Count
Puerto Rico	2299535	1150000
Arecibo	231471	115047
612	25277	12762
680	24192	12113
716	21423	10575
725	24312	12097
901	22746	11311
949	22790	11341
959	25095	12435
969	23288	11198
976	21304	10606
983	21044	10609
Bayamón	236530	118212
612	22747	11422
680	24395	12228
716	20982	10655
725	23342	11452
901	23562	11704
949	23710	11881
959	23049	11454
969	23218	11724
976	25151	12269
983	26374	13423
Caguas	231689	115906
Carolina	228754	113720
Guayanabo	235901	117917
Mayagüez	235974	117983
Ponce	225540	113223
San Juan	221366	110893
Toa Baja	223803	112198
Trujillo Alto	228507	114901
Grand Total	2299535	1150000

The ribbon at the top shows various tabs like File, Home, Insert, Page Layout, Formulas, Data, Review, View, Automate, Help, PivotTable, Analyze, and Design. The status bar at the bottom indicates "Ready" and "Accessibility: Investigate".

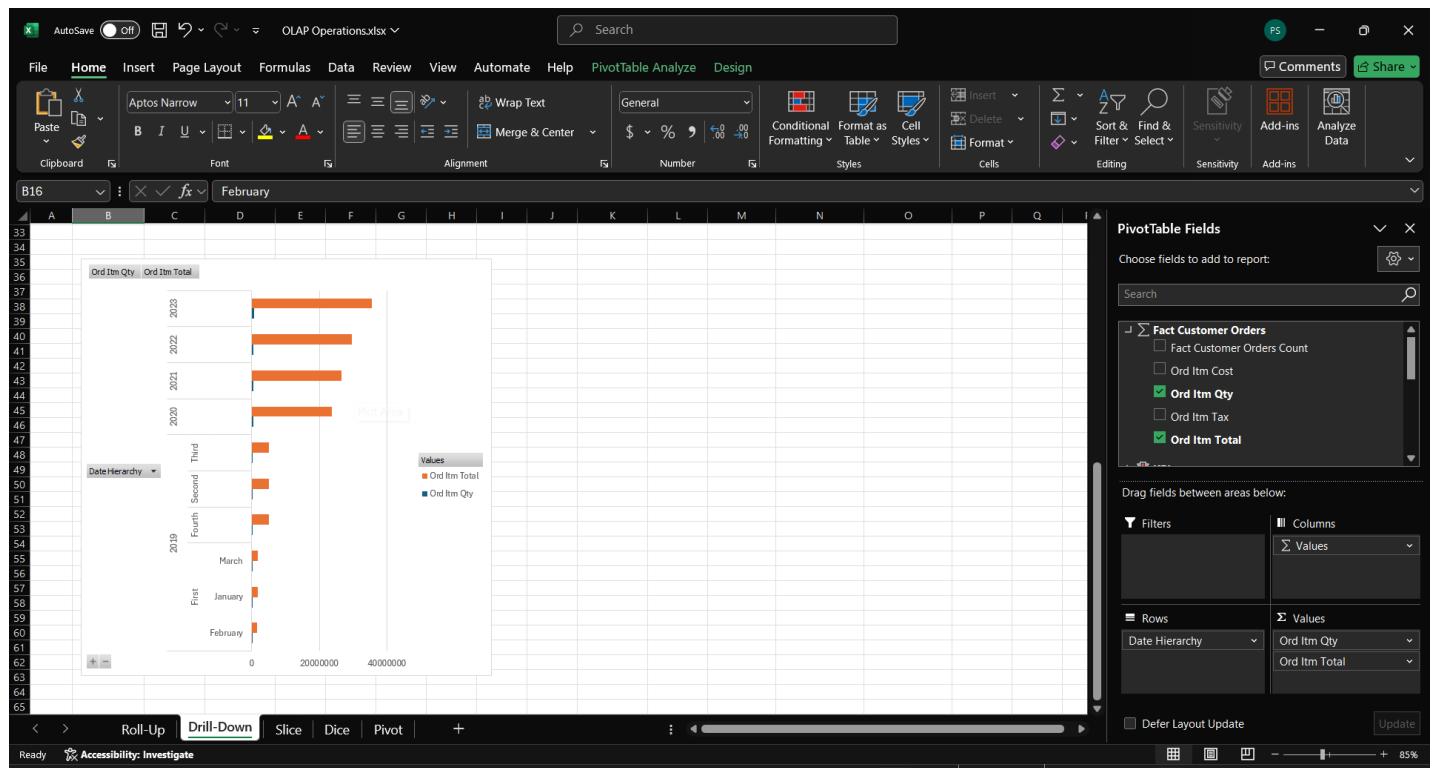


• Drill-Down

- In here, stepping down the date hierarchy of the Date Dimension and it allows the multiple navigation through details in the Dataset and get the data as a small part from it. Date hierarchy consists with year, quarter, name of the month and day of the month attributes in here.
- The following figures show the row, columns and fact table measure values that have been used to demonstrate this operation.

The screenshot shows a Microsoft Excel spreadsheet titled "OLAP Operations.xlsx". A PivotTable is displayed in the center of the screen, showing data for "Fact Customer Orders". The PivotTable has "Date" as the Row Labels, "Ord Itm Qty" and "Ord Itm Total" as the Values, and "Fact Customer Orders" as the Column Labels. The PivotTable Fields pane on the right side of the ribbon shows the fields being used: "Fact Customer Orders" (with "Ord Itm Qty" and "Ord Itm Total" checked), "Filters" (empty), "Rows" (Date Hierarchy), and "Columns" (Ord Itm Qty and Ord Itm Total). The main table data is as follows:

Date	Ord Itm Qty	Ord Itm Total
2019	348741	20692999.66
First	85536	5143254.628
February	26707	1619676.532
January	29430	1750538.043
March	29399	1773040.054
Fourth	88690	5179082.666
Second	86837	5175822.256
Third	87678	5194840.106
2020	400369	23720738.27
2021	451326	26680608.95
2022	499608	29604848.76
2023	599491	35662120.62
Grand Total	2299535	136361316.3

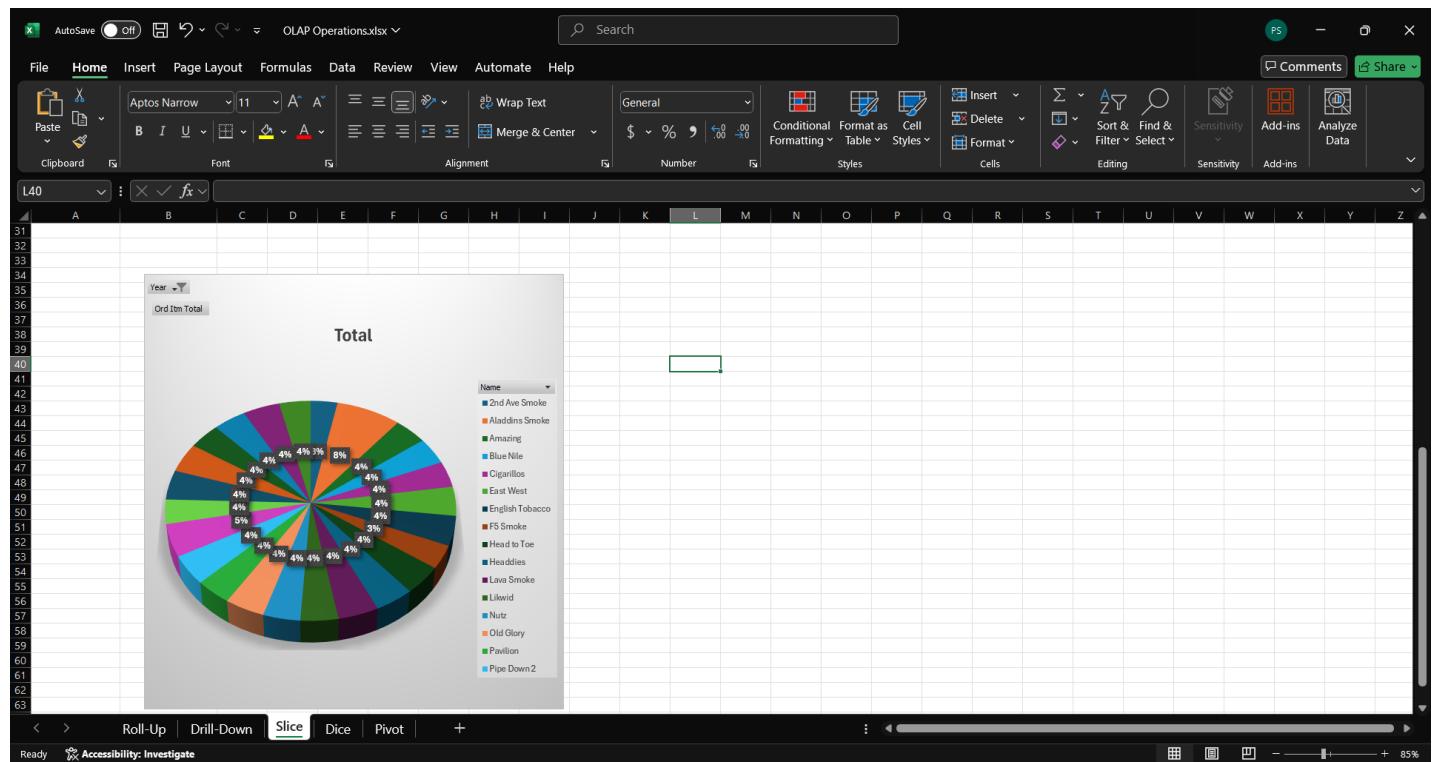


Slice

- In here, Product Inventory Dimension has been selected to demonstrate the Slice operation. By using that dimension, retrieve a new slice by selecting the specific values from the dimension and for that I have used Year as the filter.
- The following figure shows the row, fact table measure value and the filter that have been used to demonstrate this operation.

The screenshot shows a Microsoft Excel spreadsheet titled "OLAP Operations.xlsx". The PivotTable is set up with "Product Name" in the rows and "Ord Itm Total" in the values. A filter is applied to the "Product Name" column, showing only items starting with "Year". The grand total for this filtered slice is 74018586.69. The Excel ribbon is visible at the top, and the status bar at the bottom indicates "Ready" and "Accessibility: Investigate".

Year	Ord Itm Total
2nd Ave Smoke	2363186.755
Aladdins Smoke	5722207.207
Amazing	2919028.432
Blue Nile	2900580.155
Cigarillos	2823942.301
East West	3171833.855
English Tobacco	3216078.685
F5 Smoke	2545999.406
Head to Toe	3074590.162
Headdles	3006249.594
Lava Smoke	3137767.373
Likwid	2907455.342
Nutz	2862697.064
Old Glory	3083660.151
Pavilion	2766442.524
Pipe Down 2	3195480.052
Pipe Dream	3531869.275
Remedy	2649006.444
Rutgers Smoke	3216325.134
Smokers Choice	3182742.005
Smokers Expo	2808456.532
Songbirds	2920396.392
Utopia	3239416.831
Village Cadeau	2773175.022
Grand Total	74018586.69

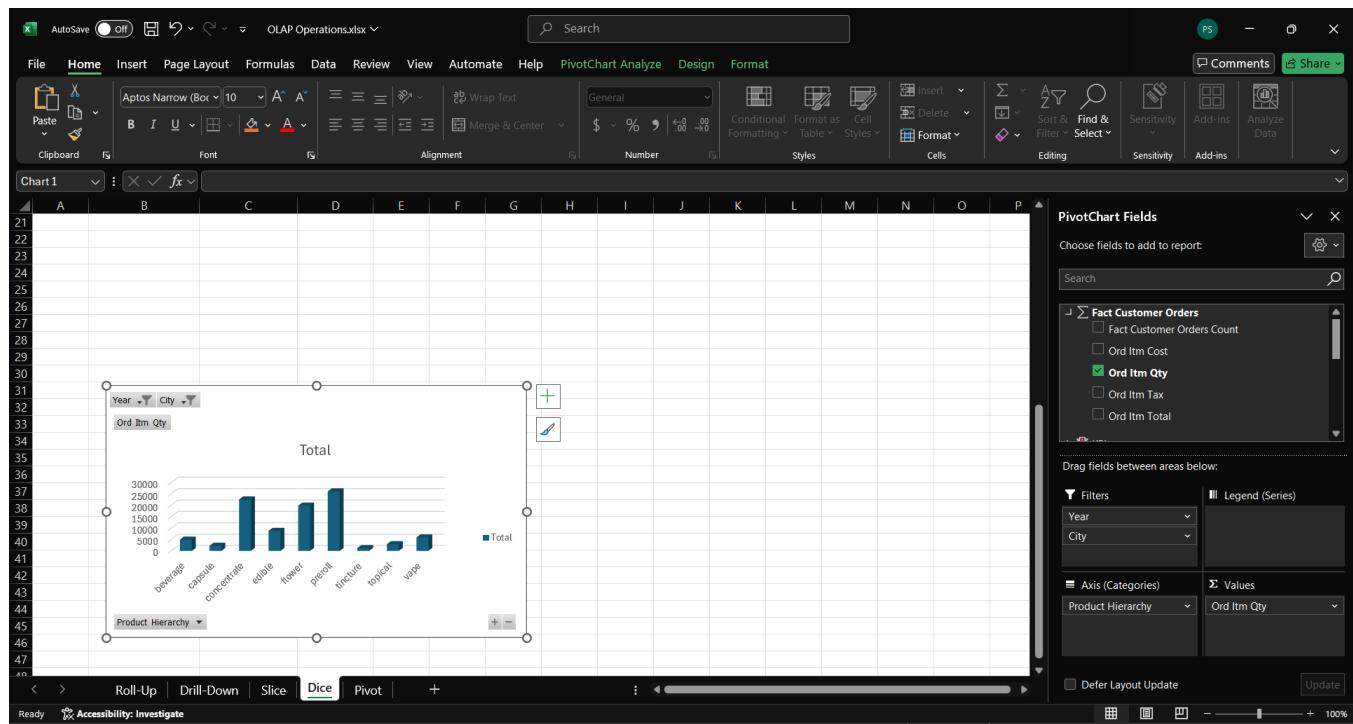


Dice

- In here, Product Inventory Dimension and Date Dimension have been selected to demonstrate the Dice operation. By using those two dimensions, retrieve a new sub-cube by selecting the specific values from the dimension and for that I have used two filters which are from Product Inventory and Date Dimensions.
- The following figure shows the rows, fact table measure value and the filters that have been used to demonstrate this operation.

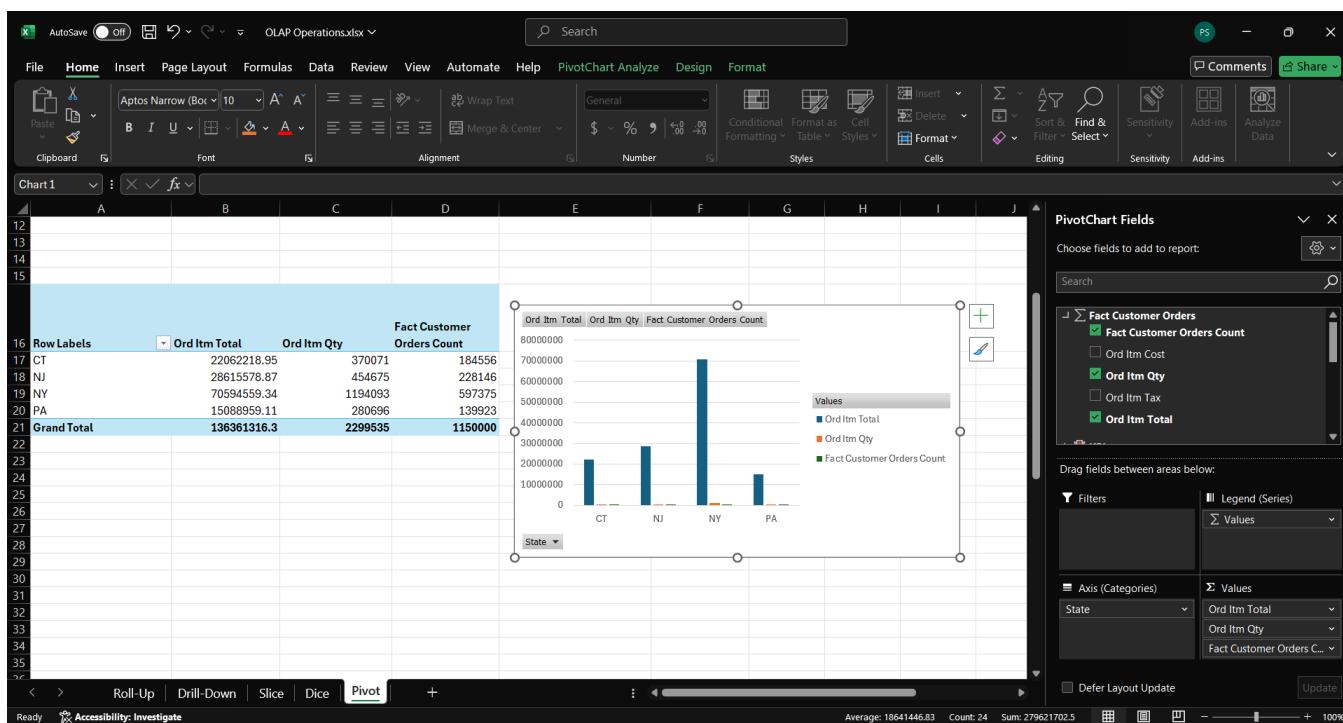
The screenshot shows a Microsoft Excel spreadsheet titled "OLAP Operations.xlsx". The PivotTable is named "Chart 1" and is currently displaying data for "Year" and "City". The data includes various product categories and their quantities. The PivotChart Fields pane on the right shows the "Fact Customer Orders" table with "Ord Itm Qty" selected as the value. Filters for "Year" and "City" are applied, and the axis is set to "Product Hierarchy".

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Year	(Multiple Items)														
2	City	(Multiple Items)														
3	Product Category	Ord Itm Qty														
4	beverage	4975														
5	capsule	2279														
6	concentrate	22588														
7	edible	8822														
8	flower	19882														
9	preroll	26138														
10	tincture	1278														
11	topical	2973														
12	vape	5930														
13	Grand Total	94865														
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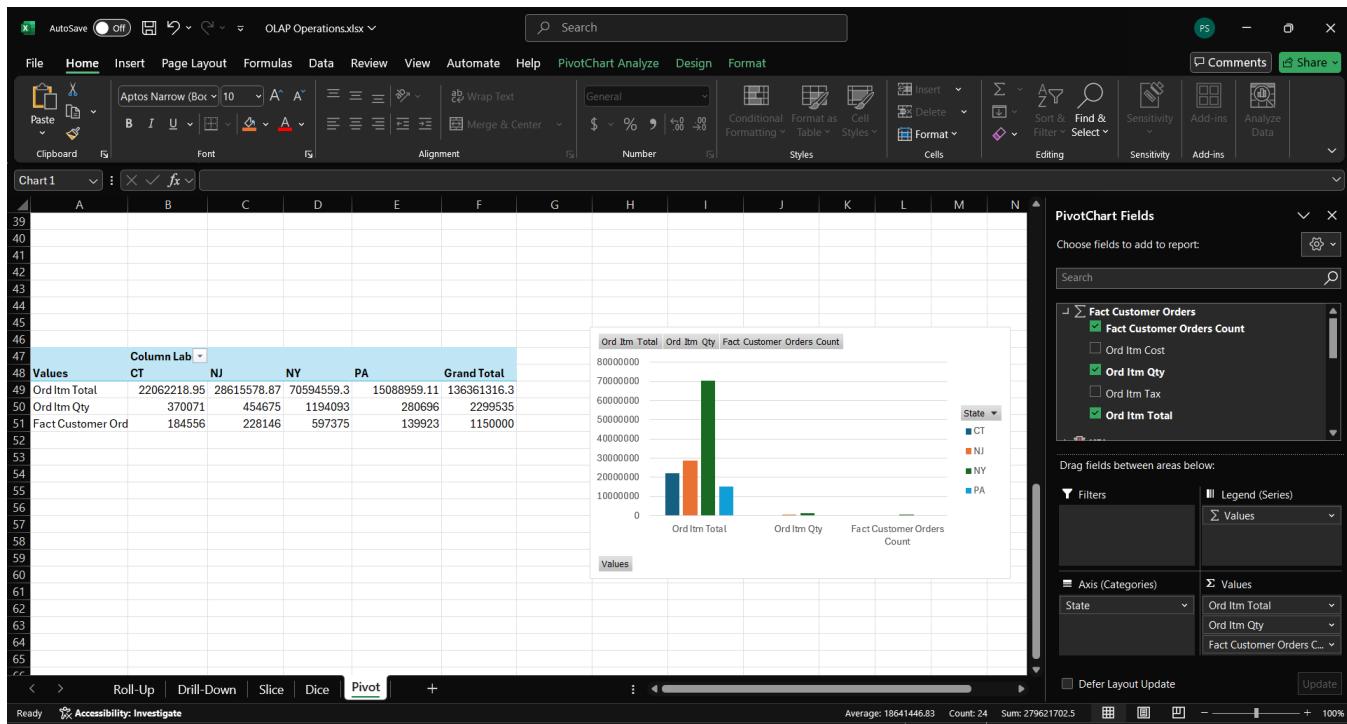


Pivot

- To represent the pivot, Product Inventory Dimension and the Fact Table measure values have been used. In here visualize the State with Fact table measure values, using those values rotate those two axes to provide an alternative presentation of the data. I used that two dimensions and get various visualization for Dataset.
- The following figures show the row/columns with fact tables measures that have been used to demonstrate this operation.



- These two figures also display the same operation after the rotation of row and column data.



4. PowerBI REPORTS

Report 1- Report With Matrix

- This report features a Matrix visual that displays tabular data with both row and column groupings. It's ideal for showing multi-level categorized data, such as city and category. Users can expand or collapse groups to view aggregated or detailed

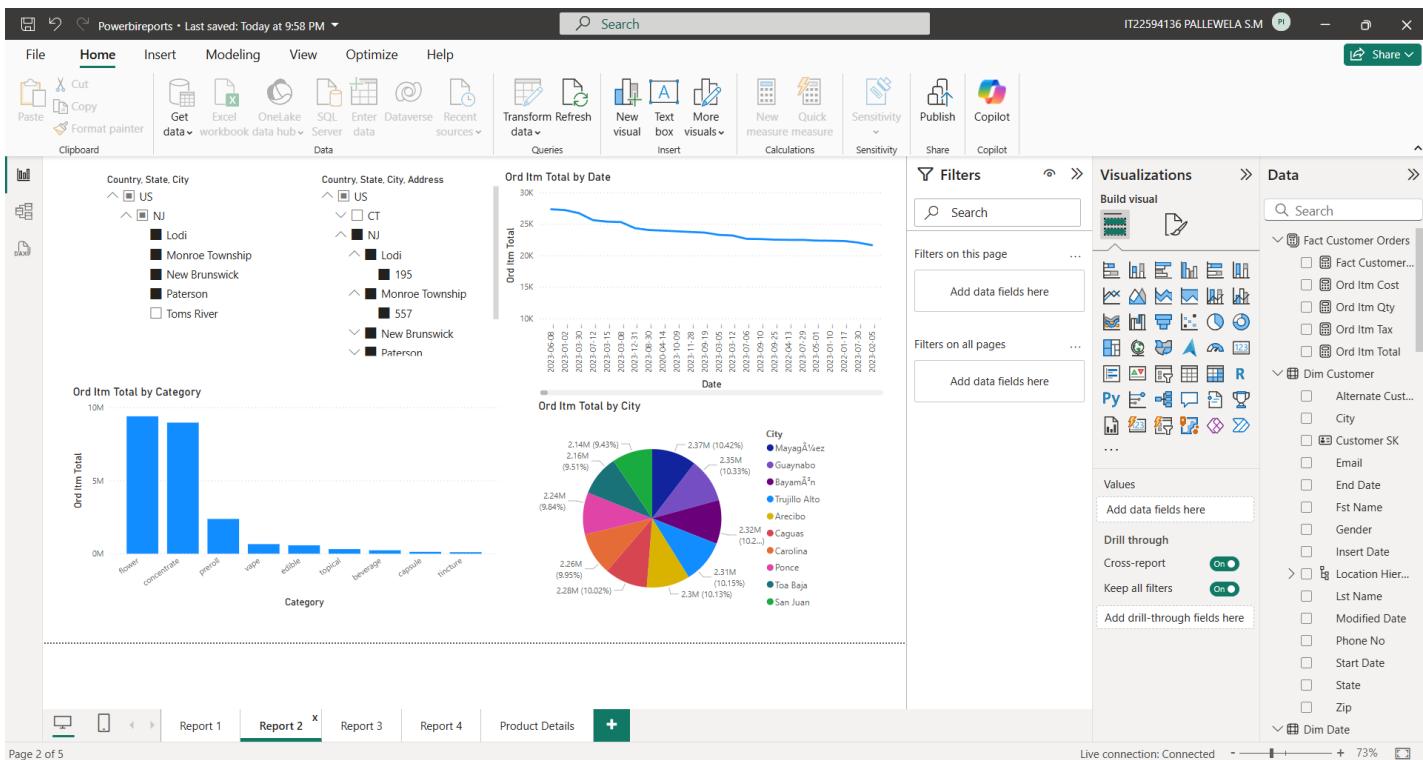
The screenshot shows the Power BI desktop interface with the following details:

- Top Bar:** Powerbireports - Last saved: Today at 9:58 PM. Includes File, Home, Insert, Modeling, View, Optimize, Help, and various ribbon icons.
- Clipboard:** Shows a table with columns: City, beverage, capsule, concentrate, edible, flower, preroll, tincture, topical, vase, and Total.
- Table Data Preview:** A preview of the data table with rows for various cities like Arecibo, Bayamon, Caguas, Carolina, Guayanilla, Mayaguez, Ponce, San Juan, Toa Baja, and Trujillo Alto, along with their respective values for different product categories.
- Filters Panel:** Contains sections for Filters on this page and Filters on all pages, each with a "Add data fields here" button.
- Visualizations Panel:** Shows a grid of visualization icons.
- Data Panel:** Shows a list of data fields:
 - Fact Customer Orders
 - Fact Customer...
 - Ord Itm Cost
 - Ord Itm Qty
 - Ord Itm Tax
 - Ord Itm Total
 - Dim Customer
 - Alternate Cust...
 - City
 - Customer SK
 - Email
 - End Date
 - Fst Name
 - Gender
 - Insert Date
 - Location Hier...
 - Lst Name
 - Modified Date
 - Phone No
 - Start Date
 - State
 - Zip
 - Dim Date
- Bottom Navigation:** Report 1, Report 2, Report 3, Report 4, Product Details, and a plus sign icon.
- Page Footer:** Page 1 of 5, Live connection: Connected, and a zoom level indicator.

data.

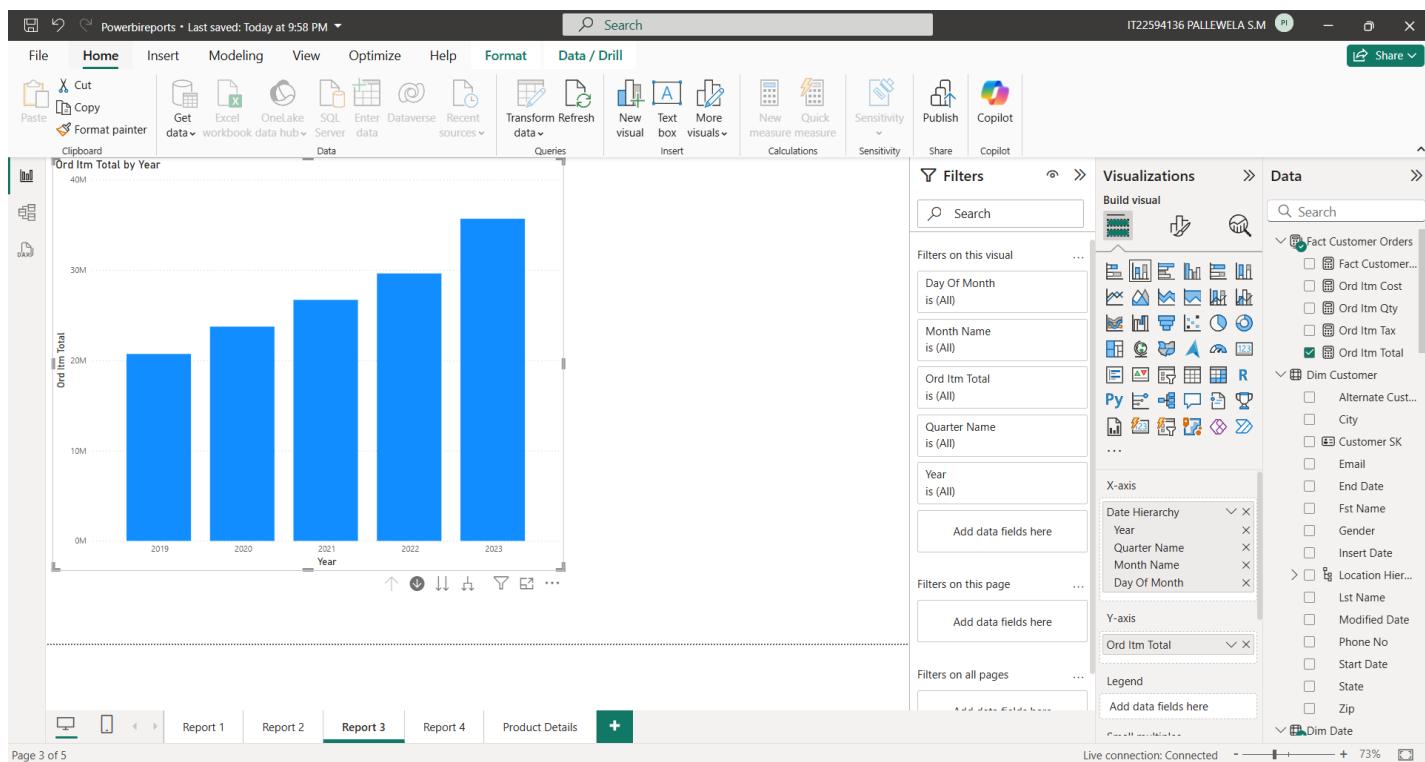
Report 2- Report With Multiple Slicers

- This interactive report includes cascading slicers—selecting a value in the first slicer dynamically filters the options in the second. The report uses multiple visualizations (e.g., bar charts, pie charts) to provide comprehensive insights, helping users drill into segmented data quickly.



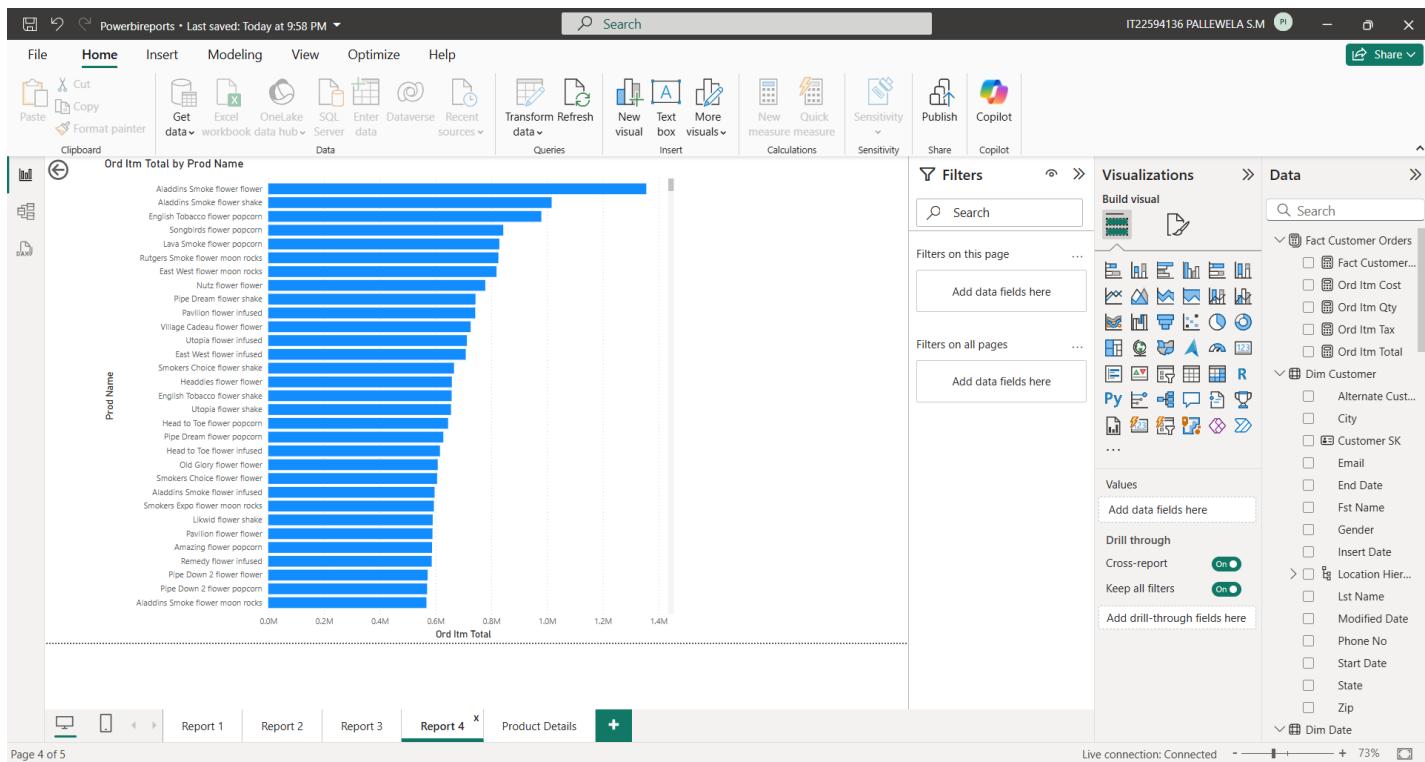
Report 3- Drill-Down Report

- Users can explore data hierarchically in this report. Starting from a high-level view (e.g., Year), they can drill down into finer details like Quarter and Month, providing a clear path through time-based trends and patterns.



Report 4 - Drill-through Report

- This report supports drill-through functionality. By right-clicking a visual (like a summary chart), users can navigate to a detailed page with more granular information related to the selected item.



Powerbiereports • Last saved: Today at 9:58 PM

File Home Insert Modeling View Optimize Help

Cut Copy Format painter Get data Excel OneLake SQL Enter data Datahub Recent sources Transform Refresh data New visual Text box More visuals Insert Quick measure measure Calculations Sensitivity Publish Copilot Share Copilot

Clipboard

Visualizations

Data

Filters

Search

Filters on this page

Add data fields here

Filters on all pages

Add data fields here

Values

Add data fields here

Drill through

Cross-report

Keep all filters

Prod Name is [Dim Product In...]

Fact Customer Orders Count

City Ord Itm Total

Arecibo	64,166.20
Bayamon	77,670.60
Caguas	76,373.50
Carolina	74,430.30
Guaynabo	83,344.10
Mayaguez	80,105.20
Ponce	69,134.10
San Juan	70,553.70
Toa Baja	79,051.00
Trujillo Alto	67,612.30
Total	742,441.00

742.44K

Ord Itm Total

1541

Fact Customer Orders Count

Report 1 Report 2 Report 3 Report 4 Product Details +

Page 5 of 5

Live connection: Connected

73%