EXECUTABLE INFO DOCUMENT

DATA WAREHOUSING INTEGRATION

1. INTRODUCTION

This document provides execution evidence and project results for the **Data Warehousing Integration** solution built using Azure Data Factory (ADF), Azure Databricks, Azure Data Lake Storage (ADLS), and Azure Synapse Analytics.

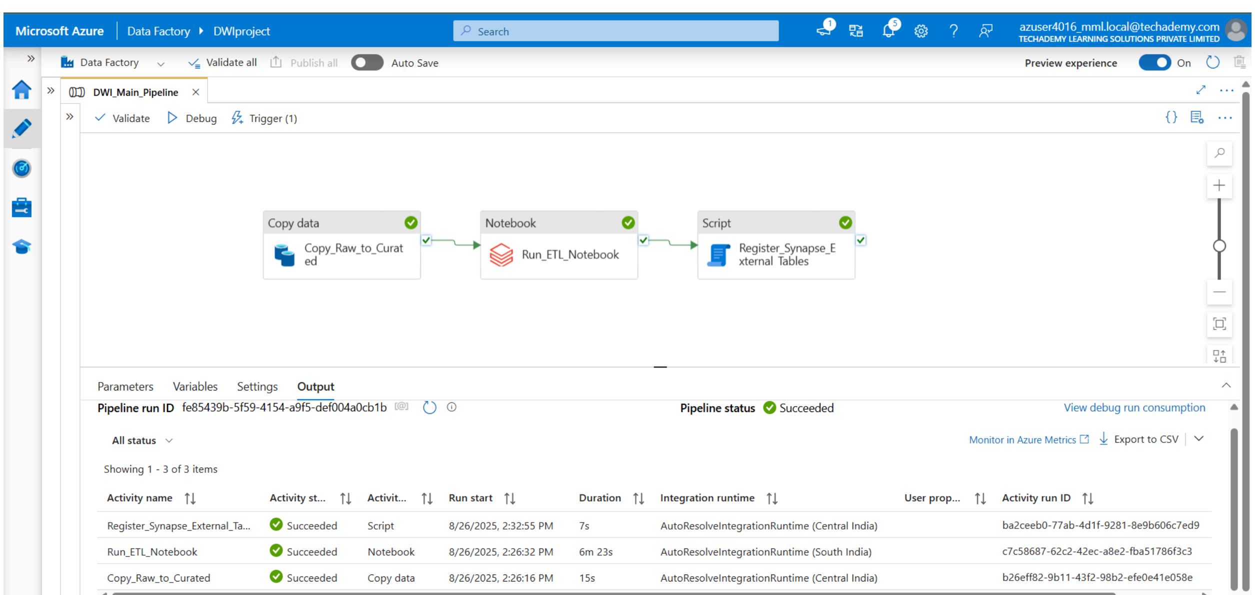
The purpose of this document is to:

- Demonstrate the successful end-to-end execution of the ETL pipeline.
- Showcase validation outputs and query results proving schema consistency and data correctness.
- Present analytical insights derived from curated warehouse tables.

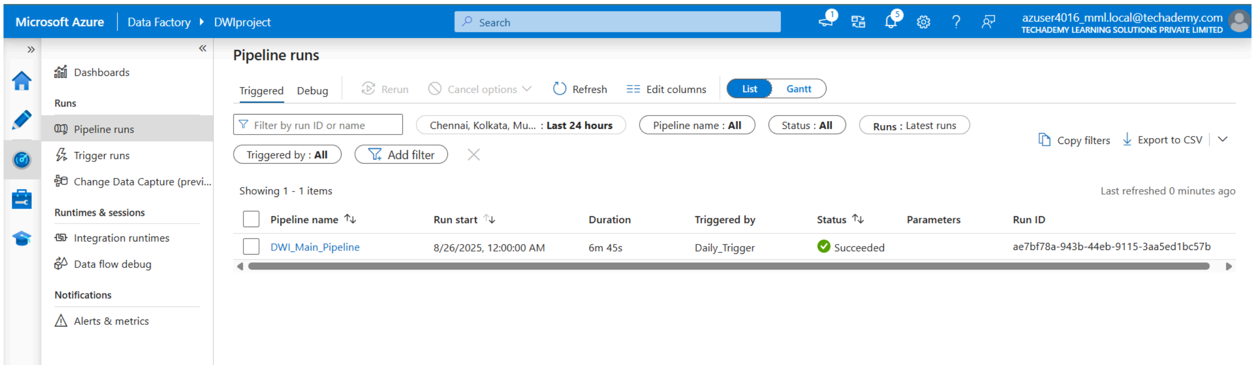
2. PIPELINE EXECUTION PROOF

2.1 AZURE DATA FACTORY (ADF)

- **Pipeline Design View**



- **Pipeline Monitoring**



2.2 AZURE DATABRICKS

- **Databricks Notebook Transformation Output**

```
Yesterday (<1s)                                                    8

# Clean column names (replace spaces with underscores)
df = df.toDF(*[c.replace(" ", "_") for c in df.columns])

df.printSchema()

df: pyspark.sql.dataframe.DataFrame = [Transaction_ID: string, Date: string ... 7 more fields]

root
 |-- Transaction_ID: string (nullable = true)
 |-- Date: string (nullable = true)
 |-- Customer_ID: string (nullable = true)
 |-- Gender: string (nullable = true)
 |-- Age: string (nullable = true)
 |-- Product_Category: string (nullable = true)
 |-- Quantity: string (nullable = true)
 |-- Price_per_Unit: string (nullable = true)
 |-- Total_Amount: string (nullable = true)
```

```
Yesterday (3s)                                                     10

print("Total rows:", df.count())

(2) Spark Jobs

Total rows: 1000
```

3. Transform – Create Dimension Tables

3.1 Customer Dimension

Yesterday (<1s) 13

```python
# Dim Customer
dim_customer = df.select(
    "Customer_ID", "Gender", "Age"
).dropDuplicates(["Customer_ID"])
```

dim_customer: pyspark.sql.dataframe.DataFrame = [Customer_ID: string, Gender: string ... 1 more field]

3.2 Product Dimension

Yesterday (<1s) 15

```python
# Dim Product
from pyspark.sql.functions import monotonically_increasing_id

# Proper Dim_Product with surrogate key
dim_product = df.select("Product_Category").dropDuplicates() \
                .withColumn("Product_ID", monotonically_increasing_id())
```

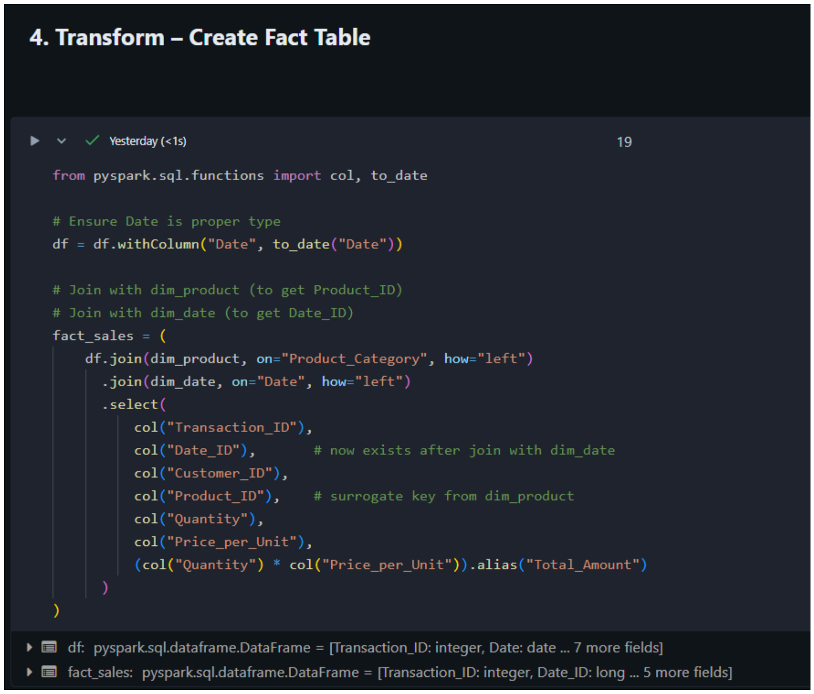
dim_product: pyspark.sql.dataframe.DataFrame = [Product_Category: string, Product_ID: long]

3.3 Other Dimensions (Date, Store, etc.)

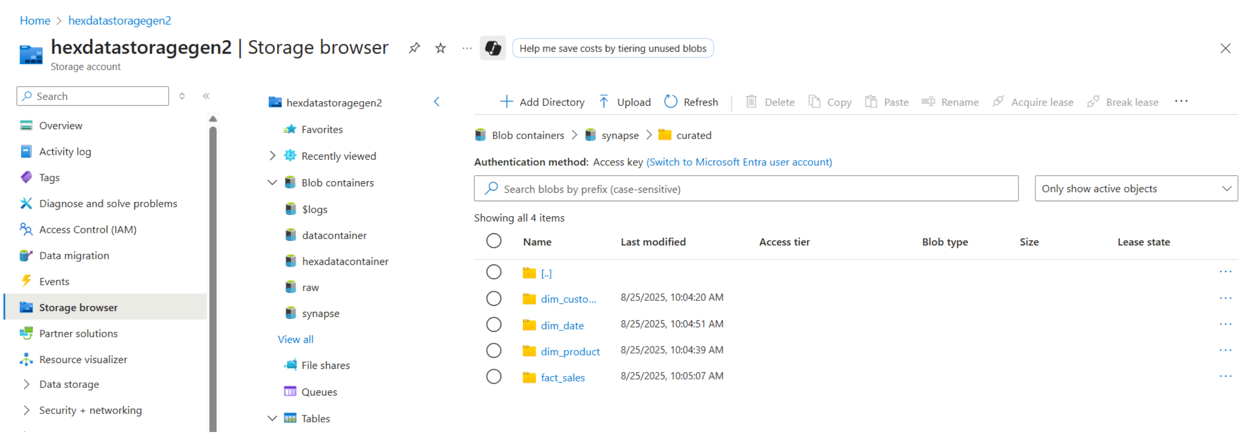
Yesterday (<1s) 17

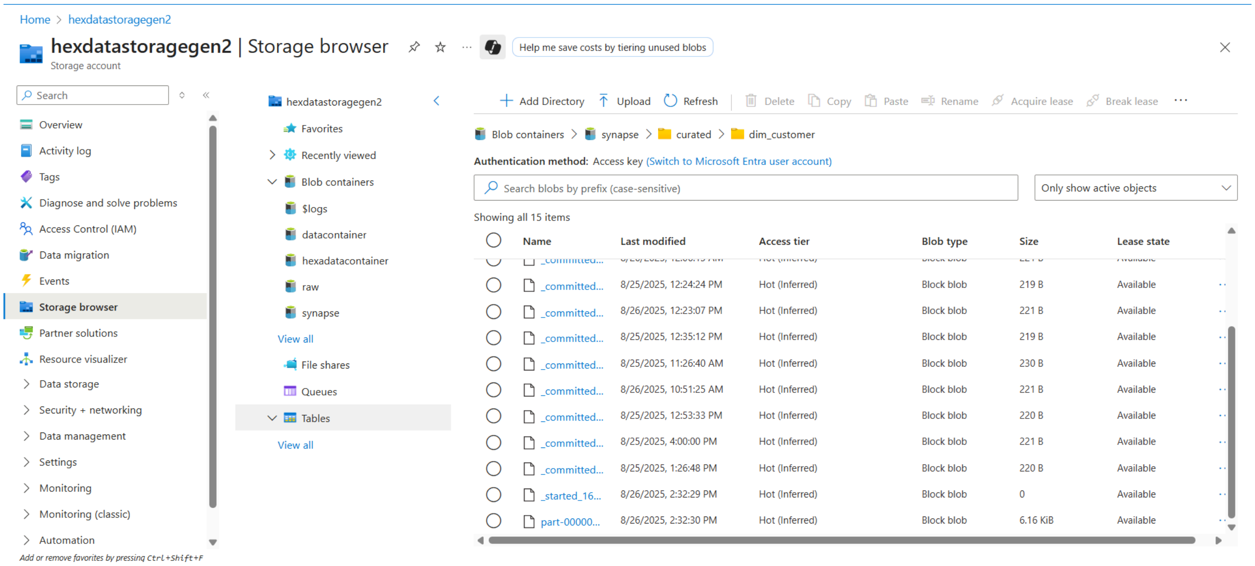
```python
from pyspark.sql.functions import col, to_date, year, month, dayofmonth,
weekofyear, quarter, date_format, monotonically_increasing_id

dim_date = df.withColumn("Date", to_date("Date")) \
             .select(
                 col("Date"),
                 year("Date").alias("Year"),
                 month("Date").alias("Month"),
                 dayofmonth("Date").alias("Day"),
                 weekofyear("Date").alias("Week"),
                 quarter("Date").alias("Quarter"),
                 date_format("Date", "EEEE").alias("DayName"),
                 date_format("Date", "MMMM").alias("MonthName")
             ) \
             .dropDuplicates() \
             .withColumn("Date_ID", monotonically_increasing_id())
```

dim_date: pyspark.sql.dataframe.DataFrame = [Date: date, Year: integer ... 7 more fields]



- **Curated Data Stored in ADLS**




Home > hexdatastoragegen2
hexdatastoragegen2 | Storage browser
Storage account
Help me save costs by tiering unused blobs
Search
Overview
Activity log
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Diagnose and solve problems
Access Control (IAM)
Data migration
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Settings
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Monitoring (classic)
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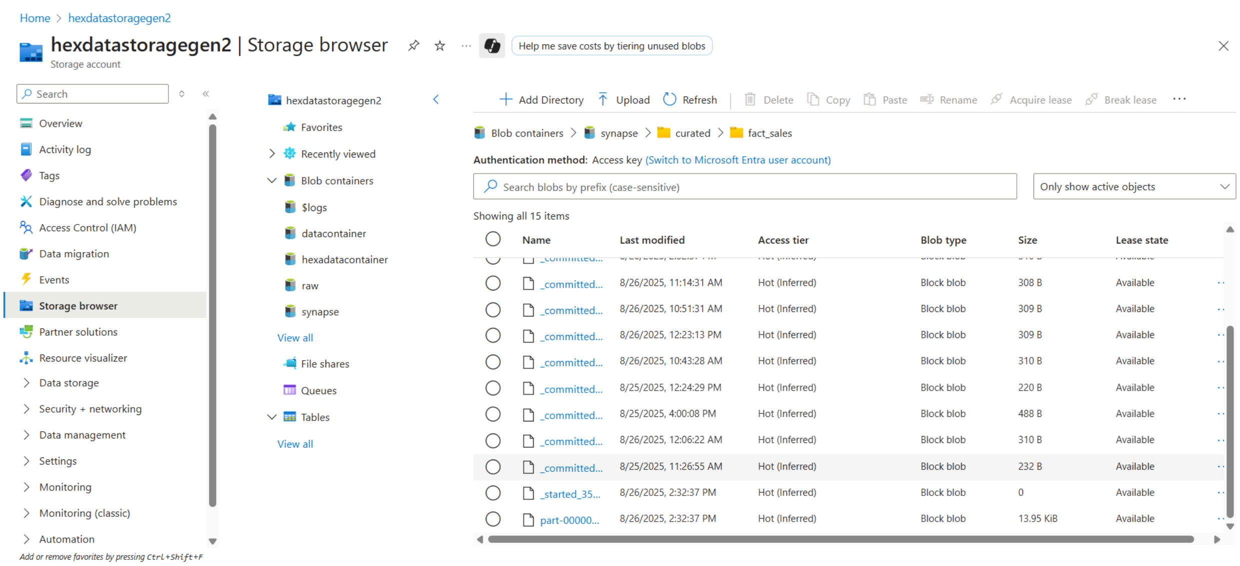
hexdatastoragegen2
Favorites
Recently viewed
Blob containers
$logs
datacontainer
hexadatacontainer
raw
synapse
View all
File shares
Queues
Tables
View all
Add Directory
Upload
Refresh
Delete
Copy
Paste
Rename
Acquire lease
Break lease
Blob containers > synapse > curated > dim_customer
Authentication method: Access key (Switch to Microsoft Entra user account)
Search blobs by prefix (case-sensitive)
Only show active objects
Showing all 15 items
Name
Last modified
Access tier
Blob type
Size
Lease state
_committed... 8/25/2025, 12:24:24 PM Hot (Inferred) Block blob 219 B Available
_committed... 8/26/2025, 12:23:07 PM Hot (Inferred) Block blob 221 B Available
_committed... 8/25/2025, 12:35:12 PM Hot (Inferred) Block blob 219 B Available
_committed... 8/25/2025, 11:26:40 AM Hot (Inferred) Block blob 230 B Available
_committed... 8/26/2025, 10:51:25 AM Hot (Inferred) Block blob 221 B Available
_committed... 8/25/2025, 12:53:33 PM Hot (Inferred) Block blob 220 B Available
_committed... 8/25/2025, 4:00:00 PM Hot (Inferred) Block blob 221 B Available
_committed... 8/25/2025, 1:26:48 PM Hot (Inferred) Block blob 220 B Available
_started_16... 8/26/2025, 2:32:29 PM Hot (Inferred) Block blob 0 Available
part-00000... 8/26/2025, 2:32:30 PM Hot (Inferred) Block blob 6.16 KiB Available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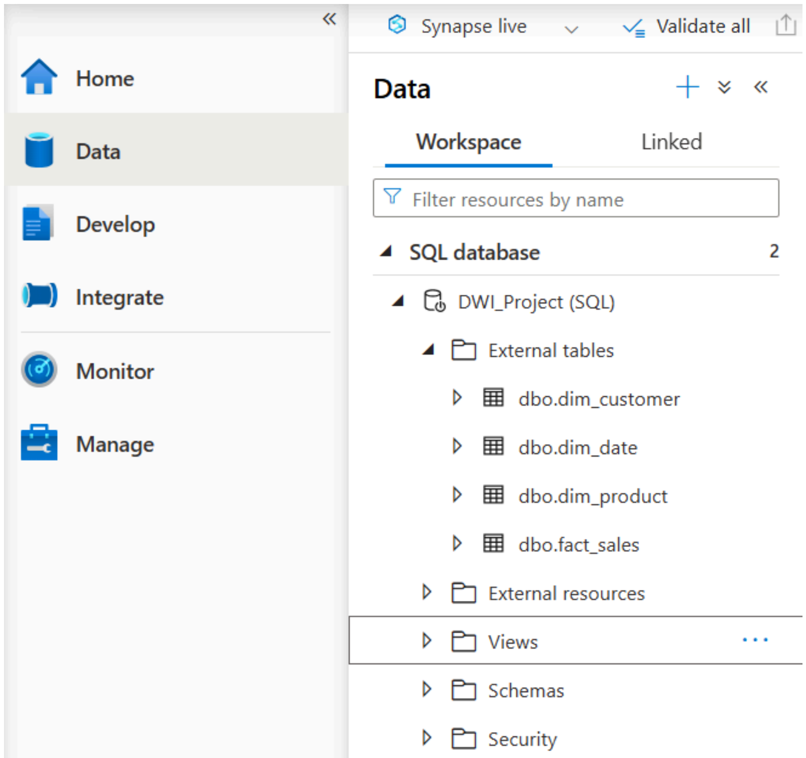
hexdatastoragegen2
Favorites
Recently viewed
Blob containers
$logs
datacontainer
hexadatacontainer
raw
synapse
View all
File shares
Queues
Tables
View all
Add Directory
Upload
Refresh
Delete
Copy
Paste
Rename
Acquire lease
Break lease
Blob containers > synapse > curated > fact_sales
Authentication method: Access key (Switch to Microsoft Entra user account)
Search blobs by prefix (case-sensitive)
Only show active objects
Showing all 15 items
Name
Last modified
Access tier
Blob type
Size
Lease state
_committed... 8/26/2025, 11:14:31 AM Hot (Inferred) Block blob 308 B Available
_committed... 8/26/2025, 10:51:31 AM Hot (Inferred) Block blob 309 B Available
_committed... 8/26/2025, 12:23:13 PM Hot (Inferred) Block blob 309 B Available
_committed... 8/26/2025, 10:43:28 AM Hot (Inferred) Block blob 310 B Available
_committed... 8/25/2025, 12:24:29 PM Hot (Inferred) Block blob 220 B Available
_committed... 8/25/2025, 4:00:08 PM Hot (Inferred) Block blob 488 B Available
_committed... 8/26/2025, 12:06:22 AM Hot (Inferred) Block blob 310 B Available
_committed... 8/25/2025, 11:26:55 AM Hot (Inferred) Block blob 232 B Available
_started_35... 8/26/2025, 2:32:37 PM Hot (Inferred) Block blob 0 Available
part-00000... 8/26/2025, 2:32:37 PM Hot (Inferred) Block blob 13.95 KiB Available

2.3 AZURE SYNAPSE ANALYTICS

- **External Tables Registered**



- **Data Source & Credential Setup**

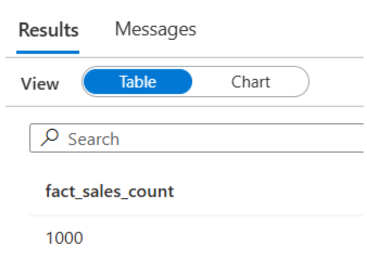
```
---------------------------------------------------
-- STEP 3: Create External Data Source
---------------------------------------------------
IF EXISTS (SELECT * FROM sys.external_data_sources WHERE name = 'dwi_curated')
    DROP EXTERNAL DATA SOURCE dwi_curated;

CREATE EXTERNAL DATA SOURCE dwi_curated
WITH (
    LOCATION = 'https://hexdatastoragegen2.blob.core.windows.net/synapse',
    CREDENTIAL = BlobSAS
);
```

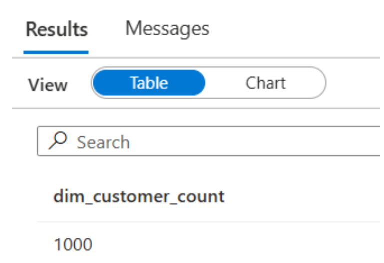
3. VALIDATION OUTPUTS

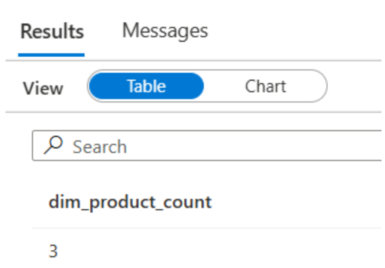
Validation was carried out in Synapse Studio using SQL queries to confirm row counts, schema correctness, and referential integrity.

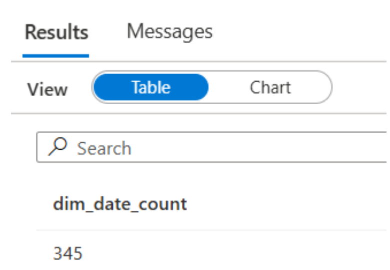
- **Row Count Validation**

```sql
-- 1. Row counts in each table
SELECT COUNT(*) AS fact_sales_count FROM dbo.fact_sales;
SELECT COUNT(*) AS dim_customer_count FROM dbo.dim_customer;
SELECT COUNT(*) AS dim_product_count FROM dbo.dim_product;
SELECT COUNT(*) AS dim_date_count FROM dbo.dim_date;
```



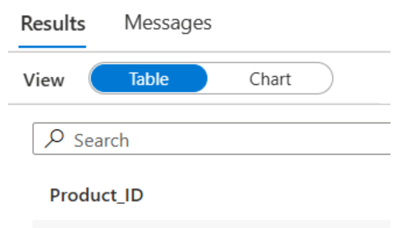




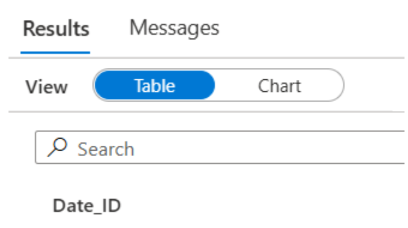


- **Referential Integrity Checks**

```sql
-- 2. Check for orphaned Product_IDs in fact
SELECT DISTINCT f.Product_ID
FROM dbo.fact_sales f
LEFT JOIN dbo.dim_product p ON f.Product_ID = p.Product_ID
WHERE p.Product_ID IS NULL;
```

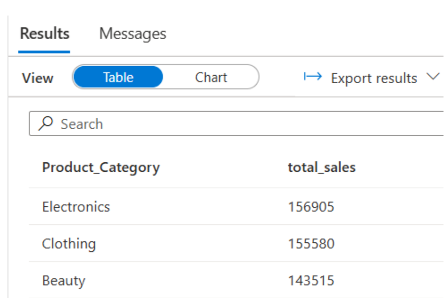



```sql
-- 3. Check for orphaned Date_IDs in fact
SELECT DISTINCT f.Date_ID
FROM dbo.fact_sales f
LEFT JOIN dbo.dim_date d ON f.Date_ID = d.Date_ID
WHERE d.Date_ID IS NULL;
```



- **Sales by Product Category**

```sql
-- 4. Sales by product category
SELECT p.Product_Category, SUM(f.Total_Amount) AS total_sales
FROM dbo.fact_sales f
JOIN dbo.dim_product p ON f.Product_ID = p.Product_ID
GROUP BY p.Product_Category
ORDER BY total_sales DESC;
```



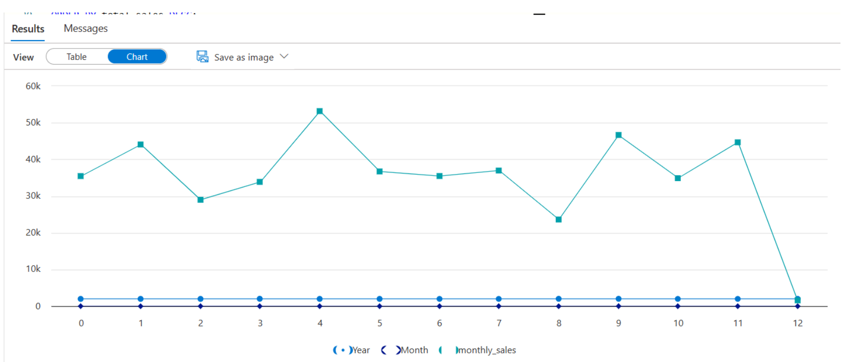
Product_Category	total_sales
Electronics	156905
Clothing	155580
Beauty	143515

- **Monthly Sales Trends**

```sql
-- 6. Sales trend by month (quick time sanity check)
SELECT d.Year, d.Month, SUM(f.Total_Amount) AS monthly_sales
FROM dbo.fact_sales f
JOIN dbo.dim_date d ON f.Date_ID = d.Date_ID
GROUP BY d.Year, d.Month
ORDER BY d.Year, d.Month;
```

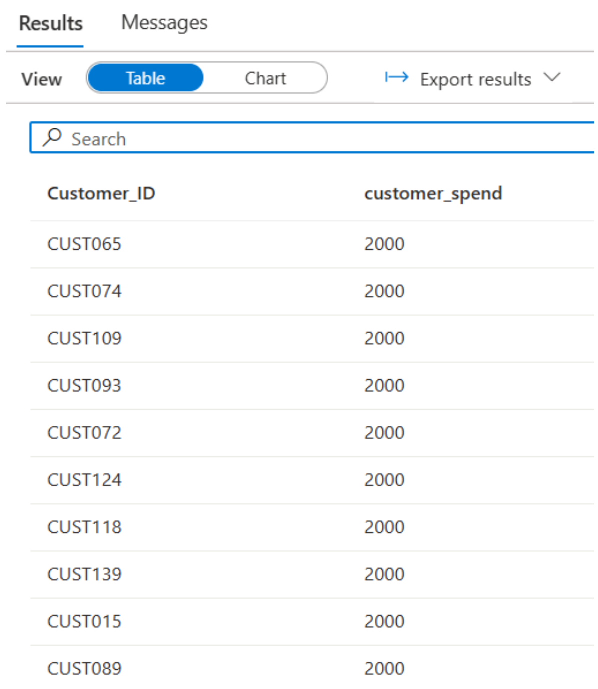
Search

Year	Month	monthly_sales
2023	1	35450
2023	2	44060
2023	3	28990
2023	4	33870
2023	5	53150



- **Top 10 Customers by Spend**

```sql
-- 8. Top 10 customers by spend
SELECT TOP 10 f.Customer_ID, SUM(f.Total_Amount) AS customer_spend
FROM dbo.fact_sales f
GROUP BY f.Customer_ID
ORDER BY customer_spend DESC;
```



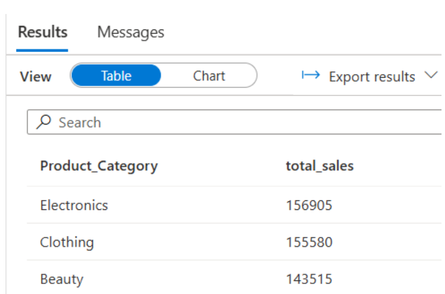
Customer_ID	customer_spend
CUST065	2000
CUST074	2000
CUST109	2000
CUST093	2000
CUST072	2000
CUST124	2000
CUST118	2000
CUST139	2000
CUST015	2000
CUST089	2000

4. ANALYSIS & INSIGHTS

The validated star schema enables rich analytical queries. Some business insights observed:

- **Product Category Contribution**: Certain categories dominate sales.

```sql
-- 4. Sales by product category
SELECT p.Product_Category, SUM(f.Total_Amount) AS total_sales
FROM dbo.fact_sales f
JOIN dbo.dim_product p ON f.Product_ID = p.Product_ID
GROUP BY p.Product_Category
ORDER BY total_sales DESC;
```



Product_Category	total_sales
Electronics	156905
Clothing	155580
Beauty	143515

- **Customer Segmentation**: Spending patterns vary across gender and age groups.

```sql
-- 5. Sales by gender
SELECT c.Gender, SUM(f.Total_Amount) AS total_sales
FROM dbo.fact_sales f
JOIN dbo.dim_customer c ON f.Customer_ID = c.Customer_ID
GROUP BY c.Gender;
```

Results Messages

View Table Chart Export results

Search

Gender	total_sales
Female	232840
Male	223160

```sql
-- 7. Age group sales contribution
SELECT
    CASE
        WHEN c.Age BETWEEN 18 AND 25 THEN '18-25'
        WHEN c.Age BETWEEN 26 AND 35 THEN '26-35'
        WHEN c.Age BETWEEN 36 AND 50 THEN '36-50'
        ELSE '50+'
    END AS Age_Group,
    SUM(f.Total_Amount) AS total_sales
FROM dbo.fact_sales f
JOIN dbo.dim_customer c ON f.Customer_ID = c.Customer_ID
GROUP BY CASE
        WHEN c.Age BETWEEN 18 AND 25 THEN '18-25'
        WHEN c.Age BETWEEN 26 AND 35 THEN '26-35'
        WHEN c.Age BETWEEN 36 AND 50 THEN '36-50'
        ELSE '50+'
    END
ORDER BY total_sales DESC;
```

Results Messages

View Table Chart Export results

Search

Age_Group	total_sales
36-50	139660
50+	133310
26-35	98480
18-25	84550

- **Revenue Trends Over Time**: Sales volume shows monthly variations, enabling time-series analysis.

```sql
-- 6. Sales trend by month (quick time sanity check)
SELECT d.Year, d.Month, SUM(f.Total_Amount) AS monthly_sales
FROM dbo.fact_sales f
JOIN dbo.dim_date d ON f.Date_ID = d.Date_ID
GROUP BY d.Year, d.Month
ORDER BY d.Year, d.Month;
```

Results Messages

View Table Chart Export results

Search

Year	Month	monthly_sales
2023	1	35450
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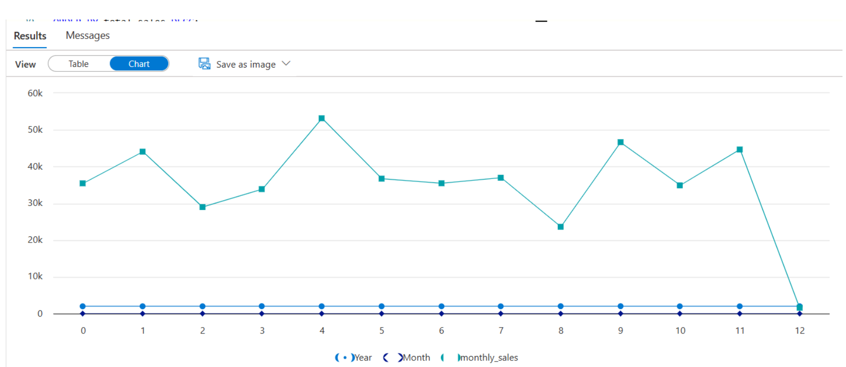

5. CONCLUSION

The project successfully delivered:

- Automated ETL pipelines (ADF orchestrated).
- Scalable data transformations (Databricks PySpark).
- Optimized loading into a **Synapse star schema** (fact + dimensions).
- Validation queries confirming data integrity and usability for analytics.

This system is now **analytics-ready**, with potential for Power BI integration to deliver dashboards and business reporting.
